Bank of Canada
Technical Reports

Rapports techniques
Banque du Canada

October 1979

Technical Report 17

THE CANADIAN NEWSPRINT INDUSTRY: ECONOMETRIC MODELS OF DIFFERENT MARKET STRUCTURES

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* The views expressed in this paper are those of the author; no responsibility for them should be attributed to the Bank.

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ABSTRACT

The primary purpose of this report is to determine the type of market structure that best describes the Canadian newsprint industry. Accordingly, a set of models corresponding to a perfectly-competitive, dominant-firm and an "equal-partner cartel" industry structure are simulated. The procedure involves the estimation of a set of equations explaining various economic aspects of the industry. Different subsets of the equations are then employed as analogues for each market structure considered. These subgroups of equations are evaluated and compared by analyzing both intra- and extra-sample simulations. Exchange rate and GNP shocks are then used to compare the dynamics of some of the models. Unfortunately, the analysis does not reveal a universally superior model. While the competitive model seems to perform best over the estimation period, its forecasts are inferior to those of some of the imperfectly-competitive models. It would appear therefore, that further refinements in the model and equation specifications are required in order to resolve the market structure issue.

RESUME

Le but principal de cette étude est de déterminer le type de structure qui correspond le mieux à celle de l'industrie du papier journal. A cet effect, on a testé un ensemble de modèles, qui correspondent respectivement à une industrie où s'exerce une concurrence parfaite, à une industrie dominée par une firme et à une industrie régie par un cartel d'entreprises d'égale importance. La méthode employée a consisté à estimer un système d'équations permettant d'expliquer différentes caractéristiques de l'industrie. Puis on a construit plusieurs sous-systèmes d'équations correspondant à chacune des structures de marché étudiées. L'analyse des propriétés de prévision de chaque modèle tant à l'intérieur qu'à l'extérieur de la période d'échantillonnage a permis d'évaluer et de comparer entre eux ces sous-systèmes d'équations. Ensuite, on a simulé des chocs du taux de change et du PNB pour comparer les unes aux autres les dynamiques inhérentes à quelques-uns des modèles. Malheureusement, aucun modèle ne s'est révélé en tous points supérieur aux autres. Même si le modèle simulant une industrie à concurrence parfaite semble être le meilleur pendant la période d'estimation, les projections qu'il effectue sont moins bonnes que celles de certains modèles correspondant à un régime de concurrence imparfaite. Il semblerait, toutefois, que l'on doive

apporter certaines améliorations au modèle et spécifier davantage les équations avant que l'on puisse résoudre le problème posé par la structure du marché du papier journal.

INTRODUCTION

Most macro models of the economy are demand-determined and are of limited use in analyzing the effect of supply changes. One medium-term solution to the omission of supply factors is the linkage of individual industry models to existing macro models, as in Ueno and Tsurumi (1969) and Wilton (1976). The long-term answer would require a fairly extensive respecification of any existing demand-oriented macro model. However, within this general framework, the investigation of supply responses using industry models is a useful preliminary step, especially if the interest is long-term and structural. With this in mind a set of models of the Canadian newsprint industry is presented in this paper.

An industry model can also be used to consider different market structures. The dynamics of an imperfectly-competitive industry will differ from those of a competitive industry, as will its econometric specification; for instance, the imperfectly-competitive industry will not have a supply curve. Often, enough *a priori* information is available to allow the selection of the appropriate market structure, but for the newsprint industry, the market structure issue is moot. Furthermore, the estimated equations that correspond to different market structures do not clarify the issue. One possible resolution of this problem, which is adopted here, involves the simulation of the various models both within and without an estimation period and a comparison of the results. Of course, this requires the estimation of more equations than may be needed for any one model, though some will be common to all the models.

The general structure of the system consists of demand and supply (or price) equations for production and shipments to three markets (Canada, the United States, and the Rest of the World). The major omissions are factor-demand equations and a financial sector explaining profits and dividends. In addition, capacity equations are estimated in lieu of investment equations. Sub-groupings of these equations can then be used to model different market structures. In this paper, models corresponding to a perfectly-competitive, dominant-firm, and an "equal-partner cartel" industry structure are simulated. The essential difference is that the first uses demand and supply equations while the latter two suppress all or some of the supply functions and determine price via a price equation. While the competitive model performs better for intra-sample simulations it does not forecast as well as the imperfectly-competitive models. Consequently, definitive statements about the market structure of the newsprint industry cannot be made.

From the viewpoint of Canadian policy-makers, the model is limited in that the only policy variable affecting the model directly is the exchange rate. Other exogenous variables are various U.S. demand and price variables. Additional structure relating, for example, to wage and capital costs (and therefore to supply) would be required if one wished to consider other policy variables, such as the impact of tax or interest rate changes.

In the first section of this paper, the historical development of the industry is outlined. One purpose of this overview is an attempt to demonstrate that the North American newsprint market could possibly be described as competitive - at least within the 1947-76 sample period. The second section contains a description of each equation, all the estimations, and a discussion of modelling choices. The simulation properties of the different models of the industry are discussed in Section 3. A final summary and conclusion are given in Section 4.

1 HISTORY AND MARKET STRUCTURE

1.1 History

Since World War II the Canadian newsprint industry's share of both world production and the U.S. market has declined almost continuously (Tables 1 and 2). As over 90% of Canada's newsprint production is exported, with the United States taking about 80% of these exports, this decline is of some concern. The decline of the Canadian market share in the United States is due to the expansion of U.S. capacity, especially in the southern states. The rapid growth of U.S. capacity since World War II was made possible by technological advances in the 1930s which made it feasible to use southern pine in the manufacture of newsprint. The relatively rapid rise of Canadian costs has also been cited as a contributing factor. Moreover, growth in demand and high transportation costs have permitted foreign producers to enter off-shore markets at an efficient scale and to expand rapidly.

The Canadian newsprint industry has been and is, heavily

Table 1

NEWSPRINT PRODUCTION
(thousands of tons)

Year	Canada	United States	Europe	Total	Canadian share
1950	5,279	1,015	1,602	7,896	66.9
1955	6,191	1,552	1,867	9,610	64.4
1960	6,739	2,038	2,464	11,241	60.0
1965	7,720	2,245	3,145	13,110	58.9
1970	8,719	3,464	3,772	15,955	54.6
1974*	9,548	3,481	3,649	16,678	57.2

Table 2

CANADIAN NEWSPRINT TRENDS
(thousands of tons)

	Capacity	Production	Operating rate	Total shipments	Total exports
1950	5,227	5,279	101.0	5,311	4,956
1955	6,064	6,191	102.1	6,236	5,805
1960	7,611	6,739	88.5	6,752	6,265
1965	8,421	7,720	91.7	7,470	7,157
1970	9,637	8,719	90.5	8,704	7,988
1974*	9,810	9,548	97.3	9,596	8,711

	Exports/ total shipments	Exports to the United States	Exports to the United States/ total exports	Exports to the United States/ total shipments	Share of U.S. market
1950	93.3	4,748	95.8	89.4	82.0
1955	93.1	5,070	87.3	81.3	76.9
1960	93.8	5,279	84.3	78.2	71.5
1965	95.8	6,093	85.1	86.1	71.4
1970	91.8	6,163	77.2	70.8	62.9
1974*	90.8	6,949	79.8	72.8	65.9

* Data are quoted for 1974 because of the major strike in Canada in 1975-76.
Source: Canadian Pulp and Paper Association, Reference Tables 1978.

dependent on U.S. markets and hence is extremely sensitive to fluctuations in U.S. economic activity. During the period 1945-55, the industry experienced an annual growth of production (demand) of 5.1% and operating rates were at historic highs. However, after 1955, as new capacity came on stream, the rate of growth of demand for newsprint decreased. The Canadian industry was also affected by additional capacity in the southern states which was and is cost-competitive with Canadian producers. The result has been to segment the market, with producers in Quebec and Ontario supplying the Northeast and Midwest states, U.S. producers in the South dominating that region and producers in British Columbia competing with producers in the U.S. Northwest for markets along the West Coast and in Asia.

The favourable economic situation from 1960 to 1965 promoted a rapid growth of the Canadian industry, although this expansion was moderated by strikes at large U.S. newspapers in 1962 and 1963. In addition, the devaluation of the Canadian dollar in 1962 improved the industry's position from 1962 to 1970. In this period, operating rates peaked at 94.8% in 1966 while the slowdowns in the United States in 1963 and 1968 lowered operating rates to 82% and 83%. The industry then seemed to enter a new period as rated capacity declined in 1970 - the first such occurrence since 1946. A U.S. recession and the appreciation of the Canadian dollar resulted in a profit squeeze, and from 1970 to 1974 expansion plans were delayed or cancelled. This situation was aggravated by prolonged strikes in the Canadian newsprint industry in 1973 and 1975. Although the 1973 strike only lowered the operating rate to 91.1%, the longer strike in 1975 reduced it to 77.6%. The recovery in 1976, which raised operating rates to 89.9%, was due mostly to the rebuilding of newsprint inventories by newspapers. During this period newsprint demand was also reduced by the implementation of new techniques by the publishing industry which saved substantial quantities of paper. Most of these savings were achieved by 1975.

This brief history indicates that foreign demand (especially in the United States) is a crucial determinant of Canadian output and must be incorporated into the model. Variables for strikes and technical changes must also be included. The general decline in the Canadian share of the U.S. market raises the question of the reaction, if any, of Canadian suppliers to the entry of new U.S. producers and the expansion of U.S. capacity, and suggests that the market is becoming more competitive.

1.2 Market Structure[1]

Most authors, including Dagenais (1976), Muller (1978), Lētourneau (1977), Guthrie (1950; 1972), and Eastman and Stykolt (1967), adopt an oligopolistic model with dominant-firm price leadership. Lētourneau and Guthrie, while recognizing that publishers also have market power, do not place much emphasis on this fact in their discussions. It will be argued here that the newsprint industry today may more closely approximate a competitive industry than an oligopolistic one. Indeed, oligopsonistic elements may also be significant.

As indicated in Appendix C, a dominant-firm model may have been appropriate from the 1930s to 1950, but there was also considerable countervailing power on the side of newspaper publishers. The political influence of newspapers, for example, in obtaining anti-trust investigations of newsprint producers, was supported by the backward integration of publishers. In 1958, U.S. publishers controlled 8.7% of Canadian capacity and 28.8% of U.S. capacity for a total of 13.3% of North American capacity.[2] While ownership lines are hard to trace, it would appear that this ratio has increased. If one also considers the buying power of individual newspapers, of newspaper chains, and of the American Newspaper Publishers Association (whose share of total U.S. consumption was 76.5% in 1950 and 70% in 1975), the case for weak oligopsony becomes plausible.

The low rates of return to both investment and stockholders' equity in the newsprint industry also weaken the case for oligopoly. In the United States, according to Guthrie (1972), the rate of return to stockholders' equity in pulp and paper fell steadily from 20% in 1947 to 8.7% in 1967. Returns to equity in newsprint are even lower and have presumably followed a similar pattern. Estimates of returns in 1957 to various mills ranged from 1% to 6%.[3] This is certainly not suggestive of producer market power. Further, the demand for newsprint is generally conceded to be very inelastic; if a cartel is effective, however, it should not operate in the inelastic region of the industry's demand curve. Since equation (6) estimated in Section 2.4(c), indicates a price elasticity of demand between -.25 and -.5 it appears doubtful that an effective cartel exists. In addition, the newsprint market has moved from a zonal pricing system based on the New York price to a system of three regional base prices - a change which indicates an increase in competition. This price history is discussed further below.

In terms of concentration ratios, the four largest firms in North America held 38.9% of capacity in 1958 and the eight-firm ratio rises to about 50%. These numbers make the question of oligopoly debatable. The issue is no clearer today as the Abitibi-Price merger presumably has offset some of the reduction in concentration that had resulted from the additions of new capacity. The situation may be clarified by Table 3 which lists the firm initiating a price change, the first price announced, the final price and the different prices prevailing at one time. Prior to the 1950s, according to both Guthrie (1972) and Mathias (1976), International Paper was the price leader. This no longer seems to be the case. Indeed the industry appears to be a classic example of barometric price leadership[4] - which is only one step removed from a competitive industry. In addition, price shading is known to have occurred in 1971, 1972, and 1977. Thus, it would seem that the newsprint industry is more competitive than oligopolistic, though there are also oligopsonistic aspects. One of the problems with this analysis is that market power is to some extent a function of demand and supply conditions. During the

Table 3 PRICE LEADERS - NEWSPRINT INDUSTRY*

Year		Price leader	Initial price ($U.S.)	Other announced prices ($U.S.)	Final price ($U.S.)	Firm whose price prevailed
1950		Powell**	$110	$106; 105	$106	International
1951		Abitibi	116	115; 114	116	Abitibi
1952		Abitibi	126	123; 122	All five prices	-
		Consolidated		121; 125.50		
1953		Dispersion of prices reduced to	123-126			-
1955		St. Lawrence	131	130; 129	All three prices	-
1956	Jan. 1	Order Restored	-	-	130	International
1957		Abitibi	134	134.50	134	Abitibi
1964		MacMillan-Bloedel	124 †	134 in East		MacMillan-Bloedel
1966		Crown Zellerbach	134 †	145; 141	139	Great Northern
		Bowater	144	139		Kimberly-Clark
		Crown Zellerbach	138 †	137 †	137 †	MacMillan-Bloedel
1967		Consolidated	142	-	142	Consolidated
1969		International	147	146	Both prices	International; Southland***
		Bowater	152	151	Both prices	Bowater; Southland
1970		Anglo-Canadian	162	160; 158	All prices	Anglo; Boise, Southland
1971		International	165	-	165	International
1972		Kimberly-Clark	163 ††	-	163	Kimberly-Clark
		Great Northern	170	-	170	Great Northern

* Initial Price in 1950 = $100 (U.S.); price changes after 1972 became too complex for this Table and are discussed in Footnote 5.

** Powell later merged with MacMillan-Bloedel.

*** With Southland's appearance as a price-setter the market was segmented into three regions, the South, the West Coast, and the Northeast-Midwest markets.

† West Coast price only.

†† Southern price only.

Source: Guthrie (1972), various issues of ANPA's Newsprint Bulletin, and newspaper reports.

early 1950s and mid-1960s, capacity utilization was high and producers were relatively more powerful. This hypothesis is supported by the frequency of price increases in these periods. On the other hand, new capacity, technical change and a slower growth of demand in other periods gave purchasers an advantage. This was particularly true during the early 1970s when operating rates fell sharply (82.6% in 1971). Indeed, in some cases publishers were able to force producers to assume part of the storage costs usually borne by the purchaser. The net effect may have exaggerated the degree of competitiveness in the industry.

The last item to be considered in this section is the effect of the Abitibi-Price merger. In 1975, the year of the merger, the Canadian four-firm concentration ratio with respect to capacity was .45. Abitibi was the third largest firm with 10.7% of capacity and Price was fourth with 10.0%. In 1977 the four-firm ratio was .54 with Abitibi-Price owning 19.6% of Canadian capacity. The concentration ratios for North America will be lower but the presence of international firms keeps the concentration ratio above 40% (about .42). Abitibi-Price owns 15.5% of North American capacity. Whatever the effects of the merger on market structure, continued capacity growth in the United States through the 1980s will probably reduce its impact. Finally, the outcome of recent takeover attempts within the industry could significantly alter one's view of the industry's market structure.

2 THE MODEL

2.1 Introduction

As has been indicated, this study diverges from previous work on the newsprint industry in that it considers models of several market structures, including a competitive one. However, the equation systems for these model structures do not permit a definite conclusion as to which is the superior model. Accordingly, in this section a set of equations is estimated which can be used in various combinations to represent the different market structures discussed in Section 3. A competitive market can be modelled so that prices adjust to clear the market; an oligopolistic structure (with all firms included) does not have a supply equation so that output or inventory changes become the residual market-clearing variable; and finally, a model of a "dominant-firm" type of market would have, say, a U.S. fringe supply function with Canadian output clearing the market.

The empirical results of this study are not easily compared with those of other analysts because of different data bases, estimation periods and model structures. Dagenais' (1976) study is limited to oligopolistic pricing behaviour in newsprint and the only point of comparability is the implied break-even operating rate of about 70% obtained in both studies. This is discussed further in Appendix E. Muller (1978) and Lētourneau (1977) also begin with an assumption that the industry is oligopolistic, but again comparisons are difficult - except with respect to the price elasticity of demand. Lĕtourneau was unable to obtain a meaningful elasticity and Muller's, while negative, was small (-.05) and insignificant. This is substantially different from the results obtained in this study and the difference is independent of the use of the list price or the more meaningful unit price derived from shipments data.

For expository purposes a brief description of the U.S. demand for newsprint function will be given first, followed by a discussion of the equations for prices and other variables that influence the demand for newsprint. A more rigorous examination of the demand equation itself follows, and the remaining supply and demand relationships for Canadian newsprint are then discussed.

In all reported results the t-statistics are given in brackets and all equations are estimated in double-log form, except for equations (7), (11), and (12) which are linear. The selection of functional form was based on a comparison of equations using explanatory power and agreement with *a priori* theory as choice criteria. As it happened, all the alternative structural models considered proved to be recursive (except for the competitive model) and all the equations are estimated by ordinary least squares. Adjustments for autocorrelation are reported only if the standard error of the equation is reduced. Finally, the data are annual and the equations are estimated over the period 1947-76. A list of mnemonics is given in Appendix F.

2.2 The Demand for Newsprint

The demand for newsprint is a derived demand and is affected by those variables that influence the demand for newspapers by consumers and the demand for newspaper linage by advertisers. Thus two final product prices are required: a newspaper price and an advertising price. Actual circulation and advertising levels then serve as demand-shift variables reflecting income and taste changes. The price of newsprint enters as an input price and another price for substitute inputs is also required. In this study the U.S. industrial wholesale price index is used as the substitute input price.

2.3 The Price Equations

Price equations are required for newsprint (XP), the consumer price of newspapers (JP), and the price of newspaper advertising (ADRT). The U.S. CPI and WPI (industrial) are also used but are exogenous. The price producers charge publishers for newsprint is assumed to be a function of demand and capacity (operating rates), the exchange rate, inventories and other factors such as technical change and strikes. The actual price series (XP) is obtained from shipments data and then converted into U.S. dollars. [An alternative price is the landed New York price (NPP) but this is primarily a reference price and discounts are frequent. In general, XP is the better theoretical variable and also yields superior empirical results.] Operating rates (OR) indicate potential excess supply and should be positively associated with prices. Generally, prices should be negatively associated with the exchange rate (PFX) since an increase in PFX (a devaluation) will increase the Canadian dollar price and prompt a Canadian export supply response which would imply a reduction in XP. Finally, inventories (INV) should be negatively, and strikes (ST) and technical change (TE) positively, associated with XP.[6] The general equation is

$$XP = f_1(\underset{(+)}{XP_{-1}}, \underset{(+)}{OR}, \underset{(+)}{TE}, \underset{(+)}{ST}, \underset{(-)}{PFX}, \underset{(-)}{INV}) \qquad (1)$$

where

XP_{-1} is added to capture an adjustment mechanism.

The estimated equation is

$$XP = \underset{(-.16)}{-.249} + \underset{(12.50)}{.8894}\ XP_{-1} + \underset{(1.31)}{.1912}\ NOR_{-1} + \underset{(6.10)}{.1295}\ TE$$

$$+ \underset{(2.08)}{.0375}\ ST - \underset{(-.50)}{.0996}\ PFX$$

see = .0377 RB2 = .9777 dw = 1.09

Experimentation with different lags, inventory definitions (total, U.S. and Canadian), and operating rates (Canadian and North American), resulted in the deletion of the INV variables from the equation (insignificant with incorrect signs) and the selection of the North American operating rate (NOR) rather than the Canadian or U.S. rate. This last result supports the hypothesis that the relevant market for newsprint is North American and that producers recognize this fact. The role of PFX remains moot: it enters with a negative sign, but has a low t-statistic (-.50). Despite this latter result, theoretical considerations dictated that PFX be retained in the equation. An equation representing mark-up-over-cost pricing, which has a significant PFX effect, is described in Appendix E, although it is not used in the simulations since a cost equation has yet to be estimated. The XP equation determines the price in all the imperfectly-competitive models but is not used in the competitive model.

Under normal circumstances JP and ADRT would be treated as exogenous but it is useful to close the system by estimating equations for them. Some additional aspects of JP are presented in Appendix D and the construction of ADRT is discussed in Appendix A. A simple autoregressive model is chosen for each and they are also tied to the U.S. consumer and wholesale price indices, i.e.,

$$JP = f_2(\underset{(+)}{JP_{-1}}, \underset{(+)}{CPI}, \underset{(?)}{TE}, \underset{(+)}{T}) \qquad (2)$$

$$ADRT = f_3(\underset{(+)}{ADRT_{-1}}, \underset{(+)}{WPI}, \underset{(?)}{TE}, \underset{(+)}{T}) \qquad (3)$$

where

T is time.

The effect of TE is not clear since the new production methods may affect demand via quality changes and supply via the cost curve. The estimated equations are

$$JP = \underset{(1.29)}{.4881} + \underset{(2.24)}{.3832}\ JP_{-1} + \underset{(2.89)}{.4479}\ CPI + \underset{(3.28)}{.01442}\ T + \underset{(1.07)}{.01993}\ TE$$

see = .02550 RB2 = .9952 dw = 1.25

$$ADRT = \underset{(1.19)}{.3486} + \underset{(4.55)}{.4625}\ ADRT_{-1} + \underset{(5.15)}{.4114}\ WPI + \underset{(4.38)}{.007816}\ T + \underset{(1.64)}{.02002}\ TE$$

see = .01373 RB2 = .9975 dw = 2.09

2.4 Volume Equations

2.4(a) <u>Newspaper Circulation (CIRC)</u>

It is obvious that circulation levels will influence the demand for newsprint. Owing to the existence of both daily and Sunday papers, their relative sizes (number of pages), and the secular increase in the number of pages per issue, a circulation variable must be created. The construction of this variable is discussed in Appendix A.

In principle both supply and demand equations for newspapers are required. It is likely, however, that some market power exists at the local level. The problem is how to approximate the market structure of the aggregated national industry. Such an aggregate is probably best represented by a competitive structure.

However, to keep the model simple, the reduced form is estimated instead of the structural system.[7] The derivation of one such reduced form is given in Appendix D.

The structural system is:

$$CIRC^d = r_1(RYD, JP, CIRC_{-1}, ADV, CPI) \quad (R1)$$

$$CIRC^s = r_2(WPI, XP, JP) \quad (R2)$$

$$CIRC^d = CIRC^s \quad (R3)$$

In this analysis the circulation of newspapers is used as a proxy variable for the consumption of a certain type of entertainment and information. The demand for such a consumer good will be a function of real disposable income (RYD) and the price of the good (JP).[8] The circulation variable is included with a lag to capture the inertia of subscribers. Finally, the inclusion of ADV, real advertising expenditure in newspapers, reflects the hypothesis that advertising in print media has a high information content and can therefore serve as a proxy for that good. In the supply equation WPI and XP represent prices of inputs and JP represents the price of output.[9] The resulting reduced-form equation is

$$CIRC = f_4(\underset{(+)}{RYD}, \underset{(+)}{GNP}, \underset{(?)}{WPI}, \underset{(?)}{CPI}, \underset{(-)}{ADRT_{-1}}, \underset{(-)}{XP}, \underset{(+)}{CIRC_{-1}}) \quad (4)$$

The estimated equation provides an excellent fit; however, because XP and $CIRC_{-1}$ had low t-statistics they were deleted from the equation.

$$\begin{aligned} CIRC = {} & \underset{(2.21)}{4.348} + \underset{(2.13)}{.7095}\ RYD - \underset{(-4.44)}{1.089}\ CPI - \underset{(-2.13)}{.4031}\ ADRT_{-1} \\ & + \underset{(3.84)}{.8740}\ WPI + \underset{(1.80)}{.6112}\ GNP \end{aligned}$$

see = .03504   RB2 = .9777   dw = 1.99

2.4(b) Advertising (ADV)

Advertising expenditures are an important determinant of the demand for newsprint. Accordingly, an equation describing the demand for newspaper advertising is required. The prospective advertiser will base his decision on the cost of advertising (milline rate),[10] the number of readers the advertisement will reach (circulation), and the cost of "other" inputs (industrial wholesale price index).[11] In addition, if advertising is profitable for the firm, an upward shift in its product's demand curve will raise the price of the product or the marginal product of advertising or both and thus raise the firm's level of advertising.[12] Another variable (GNP) is required to control for such demand curve shifts. The general equation is

$$ADV = f_5(\underset{(+)}{GNP}, \underset{(-)}{ADRT}, \underset{(?)}{WPI}, \underset{(+)}{CIRC}) \tag{5}$$

Finally, a time-trend (T) is included in the hope that it will pick up the impact of substitute media such as television and specialty magazines since an appropriate price variable is not available. The construction of ADV is discussed in Appendix A.

The sign on WPI, if WPI is the price of production inputs, depends on the elasticity of demand, the shape of the cost curves, and the sensitivity of demand to advertising. If WPI is a proxy for non-advertising selling expenses, a positive coefficient would be expected. Of course, the specification of equation (5) implies that WPI measures both types of inputs, and the sign remains unclear.[13] Equation (5) also postulates a one-input production function for the economy and non-zero ADV implies that the economy is not perfectly competitive.

The estimated equation is

$$\underset{}{ADV} = -\underset{(4.40)}{4.514} + \underset{(4.00)}{.8711}\, GNP - \underset{(-2.46)}{.7388}\, ADRT + \underset{(1.65)}{.4089}\, WPI + \underset{(1.21)}{.1934}\, CIRC$$

$$see = .03417 \qquad RB2 = .9764 \qquad dw = 1.43 \qquad rho = \underset{(4.06)}{.5576}$$

This equation is adjusted for first-order autocorrelation. It should be noted that while an increase in ADRT should increase the demand for newsprint (see Section 2.4(c)), the resulting reduction in ADV may offset this.

2.4(c) <u>The U.S. Demand for Newsprint (USNPC)</u>

The price elasticity of demand is the most important parameter to be estimated. Guthrie (1972) argues that the demand for newsprint is inelastic (0. to -.5) since there are no cheap or suitable substitutes available.[14] Further, he argues that a rise in the price of newsprint will probably affect all publishers equally and the response will be to increase prices at the newsstand and to raise advertising rates. The obvious omission of consequent effects on circulation and advertising would seem to weaken the argument considerably.

Muller (1978) estimates a demand equation for newsprint using newspaper circulation, U.S. GNP, and a relative price term as explanatory variables. The implied price elasticity was -.05 but was insignificant. Of course, circulation and the relative price term are not independent and hence the coefficients are biased. A more serious question is whether Muller's circulation variable is adjusted for daily and Sunday circulation and for the increase over the last 30 years in the number of pages per issue. As the results presented below show, his specification is unsatisfactory. Because newsprint is an intermediate product, specific consideration of circulation and advertising is required.

Before the estimated equations are discussed, a brief digression on the measurement of newsprint consumption is essential.[15] In 1974 newspaper publishers adopted a number of new production techniques which generally reduced paper usage. One of the resulting changes was a lowering of the basis weight to

30 lb from 32 lb for 500 sheets measuring 24" x 36". A given tonnage of newsprint can now produce more newspapers. Rather than adjust the reported values to tonnage equivalents of the former or new weights, actual tonnages are used. This shift in basis weight represents a reaction to price changes or to new technology and the adjustment of the reported tonnages would obscure the economic response. Accordingly, a dummy variable is introduced in the demand equation (6) and the newsprint price equation (1).

Again, newsprint is an intermediate product, and publishers' demand for it is determined by the demand and production functions for newspapers. A profit-maximizing publisher's demand for inputs will be a function of input prices and final-product prices. These variables should explain movements along given demand curves. However, with all prices constant, changes in circulation and advertising levels will change newsprint consumption. Accordingly, they are the shift variables.[16] Finally, since newspapers earn revenue from both circulation and advertising two final product prices are required. The general equation is

$$USNPC = f_6 \underset{(+)}{(CIRC}, \underset{(+)}{ADV}, \underset{(-)}{XP}, \underset{(-)}{WPI}, \underset{(+)}{JP}, \underset{(+)}{ADRT)} \qquad (6)$$

In the estimated equation WPI is deleted because of an incorrect sign and a very low t-statistic.

$$USNPC = \underset{(9.83)}{6.091} + \underset{(1.07)}{.07973}\ CIRC + \underset{(9.22)}{.6583}\ ADV - \underset{(-5.87)}{.3271}\ XP + \underset{(1.28)}{.1116}\ JP + \underset{(2.28)}{.3404}\ ADRT$$

see = .0181 RB2 = .9938 dw = 1.39

The price elasticity of demand is -.33 and is significant. If the New York list price (NPP) is used, the elasticity is -.49 with a t-statistic of 6.7. Similar results are obtained with a linear function. The inelastic demand suggests that the "cartel" is not very effective. It should be noted that an autocorrelation adjustment does not improve the equation. Finally, the point estimate of the net impact of a one percent increase in ADRT is a 0.146% decline in newsprint consumption.

Total U.S. demand for newsprint can now be obtained by adding inventory changes. The inventory adjustment equation is specified in a fairly standard way as[17]

$$DUSINV = f_7(USNPC, USINV_{-1}, ST, TE) \qquad (7)$$

$$\text{with } TUSD = USNPC + DUSINV \qquad (8)$$

where

$$USINV = DUSINV + USINV_{-1} \qquad (9)$$

and TUSD is total U.S. demand for newsprint.

Equation (7) is estimated in linear form as

$$DUSINV = \underset{(2.12)}{256.7} + \underset{(1.29)}{.01914}\ USNPC - \underset{(-2.73)}{.4709}\ USINV_{-1} - \underset{(-1.19)}{44.78}\ ST + \underset{(3.71)}{183.3}\ TE$$

see = 98.9   RB2 = .4131   dw = 1.83

This equation is heavily damped and stabilizes in two periods.[18]

2.4(d) <u>The Demand for Canadian Newsprint</u>

The equation set (1) - (9) produces estimates of U.S. newsprint demand. With an estimate of the Canadian producers' share of this demand it is then possible to predict Canadian newsprint shipments to the United States. Total Canadian shipments are then obtained by adding this result to sales in Canada and to the rest of the world. Sales to Canada (CNPD) and to the Rest of the World (ROWD) account for 10% and 20%, respectively, of Canadian shipments. Unfortunately the amount of economic content in the equations is low, though the explanatory power is high:

$$CNPD = f_{10}(CNPD_{-1}, T) \tag{10}$$

$$ROWD = f_{11}(ROWD_{-1}, T, ST, TE) \tag{11}$$

Canadian demand is completed with the addition of an equation describing the change in Canadian producers' inventories.

$$DCINV = f_{12}(USNPC, CINV_{-1}, ST, TE) \tag{12}$$

While equation (10) is estimated with a double-log specification, equations (11) and (12) are estimated as linear equations.

$$\underset{}{CNPD} = \underset{(3.46)}{2.787} + \underset{(3.61)}{.5159}\ CNPD_{-1} + \underset{(3.19)}{.01729}\ T$$

see = .03426 RB2 = .9882 dw = 1.62

$$ROWD = \underset{(1.41)}{84.43} + \underset{(3.05)}{.4293}\ ROWD_{-1} + \underset{(4.38)}{33.10}\ T - \underset{(-3.70)}{167.2}\ ST + \underset{(.99)}{63.00}\ TE$$

see = 121.00 RB2 = .9285 dw = 2.00

$$DCINV = \underset{(-2.10)}{-101.1} + \underset{(3.95)}{.03979}\ USNPC - \underset{(-4.78)}{1.220}\ CINV_{-1} - \underset{(-1.73)}{27.84}\ ST - \underset{(-1.65)}{39.33}\ TE$$

see = 43.22 RB2 = .4060 dw = 1.47

Unlike DUSINV, DCINV overshoots but the simulations indicate that it stabilizes within two time periods.[19]

In some models a critical equation is the one that explains the "Canadian share of the U.S. market" (CMS). Such an equation can also be viewed as a reduced form that summarizes general trends in competitiveness - especially when one of the explanatory variables measures international cost competitiveness.

The major determinants of this market share (CMS) will be relative costs (RELC) and, as suggested by Muller (1978), the share of capacity. Use of the latter variable, however, is questionable since it has the characteristics of an identity at high operating rates. The recent diversification by Canadian producers into other markets presumably mollifies this objection. The economic content of a capacity share variable is that the "cartel" divides the U.S. market on that basis. This proposition is not, however, consistent with an increasingly competitive market structure. Moreover, its tautological nature in the 1950s when U.S. capacity was small and operating rates were high argues against the use of a capacity-share variable. A market-share strategy seems more appropriate since it will reflect (a) the existence of long-term contracts (with minimum and maximum purchase requirements) that place a limit on market-share losses in any one year and (b) market diversification. Accordingly, a lagged market share is used as an independent variable. Canadian - U.S. relative costs are also important[20] since firms with plants in both countries can meet demand by reallocating production and because of general cost-competitive effects. This cost term is affected directly by changes in PFX. The resulting equation is

$$CMS = f_{13A}(\underset{(+)}{CMS_{-1}}, \underset{(?)}{TE}, \underset{(-)}{ST}, \underset{(-)}{RELC}, \underset{(-)}{T}) \qquad (13A)$$

Data limitations restrict this equation's estimation period to 1958-75. The construction of RELC is discussed in Appendix A.

$$\underset{}{CMS} = \underset{(2.10)}{3.045} + \underset{(2.51)}{.5413}\ CMS_{-1} - \underset{(-1.40)}{.00369}\ T - \underset{(-1.17)}{.1169}\ RELC + \underset{(1.53)}{.01802}\ TE$$

$$- \underset{(-2.26)}{.01858}\ ST$$

$$see = .01954 \qquad RB2 = .8902 \qquad dw = 1.36$$

A different equation is used in the simulations as RELC is available only from 1958 to 1975 and a satisfactory equation explaining RELC could not be obtained. Moreover, in order to keep the model small, equations for each country's unit cost were not estimated. The simulation equation is

$$CMS = \underset{(2.88)}{3.071} + \underset{(3.42)}{.5425}\ CMS_{-1} + \underset{(2.72)}{.02704}\ TE - \underset{(-2.41)}{.1791}\ ST - \underset{(-2.68)}{.004646}\ T$$

$$see = .01940 \qquad RB2 = .9516 \qquad dw = 1.40 \qquad (13B)$$

The demand system is completed with an equilibrium condition and an inventory identity:

$$CPRO = CMS*TUSD+ROWD+CNPD+DCINV \quad \text{(Canadian production)} \quad (14)$$

$$CINV = CINV_{-1} + DCINV \quad \text{(Canadian inventories)} \quad (15)$$

2.4(e) North American Newsprint Capacity and Supply

The above equations are sufficient to model an oligopolistic industry. A competitive model, however, requires supply functions for U.S. and Canadian producers. The different technologies and cost structures necessitate two supply curves. As well, a dominant-firm model (which treats Canada as the dominant firm) requires a supply function for the competitive fringe (U.S. producers). Following Fisher et al. (1972), the Canadian and the U.S. supply functions are

$$CPRO = f_{16}(\underset{(+)}{CPRO_{-1}},\ \underset{(+)}{AP_{-1}},\ \underset{(-)}{USINV_{-1}},\ \underset{(?)}{T},\ \underset{(-)}{ST}) \qquad (16)$$

$$USPR = f_{17}\ (\underset{(+)}{USPR_{-1}},\ \underset{(+)}{XP_{-1}},\ \underset{(-)}{USINV_{-1}},\ \underset{(-)}{TE}) \qquad (17)$$

where

AP is the Canadian dollar price of newsprint.

The estimated equations are

$$CPRO = \underset{(2.30)}{3.595} + \underset{(3.95)}{.5400}\ CPRO_{-1} + \underset{(2.46)}{.2013}\ AP_{-1} - \underset{(-4.28)}{.2351}\ USINV_{-1} + \underset{(2.93)}{.01153}\ T - \underset{(-6.84)}{.0833}\ ST$$

see = .02847 RB2 = .9779 dw = 2.01

$$USPR = -\underset{(-.28)}{.1894} + \underset{(23.52)}{.9761}\ USPR_{-1} + \underset{(1.39)}{.1537}\ XP_{-1} - \underset{(1.27)}{.1510}\ USINV_{-1} - \underset{(-1.83)}{.0651}\ TE$$

see = .05996 RB2 = .9830 dw = 1.69

These results are consistent with the existence of competitive supply curves. Changes in the exchange rate affect Canadian production by changing AP, the Canadian dollar price received by producers. While the low t-statistic for XP in the USPR equation makes conclusions tenuous, the implications of the point estimates are interesting. The statistical equality of the short-run price elasticities suggests similar technologies and operating costs in Canada and the United States. However, the sharp divergence of the long-run elasticities, 6.43 for U.S. producers versus .44 for Canadian producers, reinforces the conventional wisdom about relative costs. Price rises promote large increases in new capacity in the United States and, ultimately, higher sales and production. The Canadian supply response, on the other hand, often takes the form of more intensive use of existing equipment. If the coefficients of AP and XP are changed by one standard error so as to minimize the elasticity difference, the U.S. elasticity declines to 1.8 and the Canadian rises to .62. It must also be remembered that U.S. expansion over the sample period proceeds from a very small base and the long-run supply elasticity will probably decline over time.

The set of estimated equations, identities, and equilibrium conditions is now sufficient to model different market structures. For example, demand equations (6), (7), (10), (11), and (12) can be equated to supply equations (16) and (17) to solve for the equilibrium price. This would be a perfectly-competitive model. Note that CMS is also determined by this process. An imperfectly-competitive market structure in which prices are set and output is adjusted to clear the market, uses the equation for XP (1), the demand equations (6), (7), (10), (11), and (12), and the market-share equation (14) to determine the market-clearing CPRO. Various types of imperfect markets can be examined by including one or both of the supply equations for CPRO (16) and USPR (17). If both are included, then inventories become the market-clearing variable. This is the procedure followed in Section 3.

First, a few words on USPR are required. The output of U.S. producers could be closely approximated by equating it with that part of the U.S. market not served by Canadian producers, i.e., USPR = USNPC - CMS*USNPC. This procedure would be equivalent to making U.S. producers junior members of the oligopoly. It will be inaccurate to the extent that U.S. producers export to other countries. While a postwar high of 11.4% of U.S. output was exported in 1955, exports usually run at less than 3% (1.6% in 1976). Accordingly, two exogenous variables will be included in the simulations - U.S. exports and U.S. imports from non-Canadian sources. Finally, using equations (14) and (17) corresponds to the dominant-firm model with U.S. producers as fringe suppliers.

For short-run forecasting, the above equations are sufficient since the lead-time necessary for building new capacity is substantial. However, long-run simulations do require capacity equations. A comprehensive capacity equation would comprise final product prices, capital equipment prices, labour prices, and some inventory variables. While such a system is discussed in Appendix E, the additional requirement of setting up equations for prices of capital and labour seems to make the system more complex than necessary at this stage of the research. Accordingly, "forecasting" (reduced-form) equations were estimated for Canada and the United States. The equations are

$$CCAP = f_{18}(CCAP_{-1}, CCAP_{-2}, TCS_{-2}, USC_{-2}, TE), \quad (18)$$

$$USC = f_{19}(USC_{-1}, USC_{-2}, USNPC_{-2}, PFX_{-2}, TE), \quad (19)$$

$$NOR = (CPRO + USPR)/(CCAP + USC), \text{ and} \quad (20)$$

$$TCS = CMS*TUSD + ROWD + CNPD \quad (21)$$

U.S. capacity is used in equation (18) since the relevant market is North American and capacity decisions will thus be influenced by the level of Canadian and U.S. capacity. Furthermore, U.S. capacity changes will be influenced by PFX since changes in that variable affect U.S. competitiveness and profitability. Thus, PFX has an indirect influence on Canadian capacity. The estimated equations are

$$CCAP = \underset{(.91)}{.3519} + \underset{(7.71)}{1.180}\, CCAP_{-1} - \underset{(-2.92)}{.4798}\, CCAP_{-2} + \underset{(3.45)}{.2096}\, TCS_{-2}$$

$$+ \underset{(1.62)}{.06478}\, USC_{-2} - \underset{(-3.56)}{.0288}\, TE$$

see = .01441 RB2 = .9963 dw = 1.73

$$USC = -3.172 + \underset{(6.08)}{.999}\, USC_{-1} - \underset{(-1.92)}{.2763}\, USC_{-2} + \underset{(3.78)}{.6005}\, USNPC_{-2}$$
$$\qquad \underset{(-3.44)}{} - \underset{(-2.61)}{.5836}\, PFX_{-2} - \underset{(-3.00)}{.07367}\, TE$$

see = .0395 RB2 = .9929 dw = 2.01

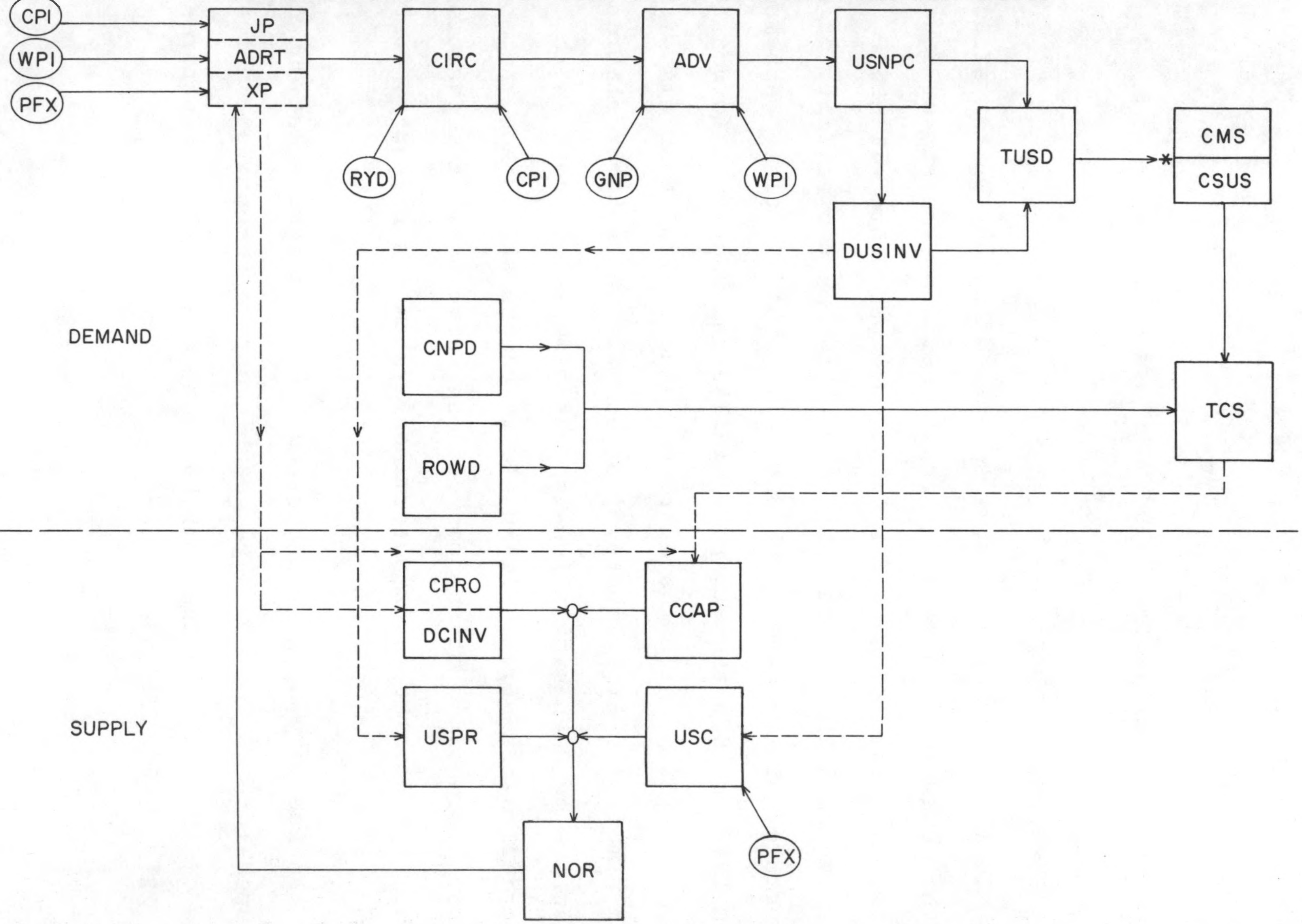
3 SIMULATION RESULTS

In this section models of several different market structures of the newsprint industry will be formed from the set of equations estimated above. A set of simulation experiments will be performed and the results used to comment on the validity of each structure. The general procedure will be to simulate each model from 1949 to 1976 then to reinitialize and use it to forecast for 1977 and 1978. While there are some theoretical problems with such simulation experiments,[21] especially the autocorrelation of errors between simulation and actual values, there is no practical alternative. As an aid to understanding how the model works, a schematic of the connections between all the equations (i.e., the complete over-determined system) is presented in Figure 1-A.

As has already been indicated, the estimated equations can be grouped in a variety of ways, each group representing a different view of the market. The four basic models (market structures) are:[22]

Figure 1 - A

DEMAND AND SUPPLY STRUCTURE OF THE COMPLETE NEWSPRINT MODEL



I. IMP1 — This represents an "equal-partner oligopoly" model. The demand and price equations produce an estimate of the total demand for North American newsprint (U.S. exports are exogenous). Production is then whatever is required to clear the market at the prevailing price. Canadian exports to the United States are determined by the Canadian producers' market share and U.S. producers supply the residual. In all the other models the Canadian market share is determined residually. The supply equations for both CPRO and USPR are suppressed.

II. DOM1 — This structure corresponds to a dominant-firm oligopoly with the U.S. producers treated as the dominant firm. Thus, the price equation feeds into demand and Canadian production is determined by its supply function while U.S. production is whatever is necessary to clear the market.

III. DOM2 — In this model Canadian producers are treated as the dominant firm. U.S. production is determined by its supply function and Canadian production clears the market.

IV. COMP1 — This competitive model collects all the demand and supply relations and solves them to determine what price will equate supply and demand. This is the only structure which is not completely recursive as XP and USNPC are determined simultaneously. An equation for USNPC is therefore estimated by Two Stage Least Squares and used in the simulations. (Model COMP1 uses the OLS demand equation, while COMP1A uses the TSLS equation). The XP equation is not used.

The TSLS equation for USNPC is slightly better than the OLS version, i.e.,

$$\underset{(8.11)}{\text{USNPC} = 5.796} + \underset{(1.55)}{.1378\ \text{CIRC}} + \underset{(7.17)}{.6016\ \text{ADV}} - \underset{(-4.20)}{.2725\ \text{XP}}$$

$$+ \underset{(1.87)}{.1991\ \text{JP}} + \underset{(0.97)}{.1705\ \text{ADRT}}$$

see = .0187 RB2 = .9934 dw = 1.44

A truncated schematic for each of these models is presented in Figure 1-B. The set of estimated equations is such that each structure can be simulated with or without the capacity equations. As the endogenizing of capacity affects all the models in the same way the discussion will be confined to simulations without the capacity equations. Finally, the simulations of JP, ADRT, CIRC, ADV, CNPD, and ROWD are invariant with respect to model structure and are not discussed explicitly. The five models all produced reasonable results for the intra-sample simulations. These are summarized in Table 4.

A comparison of the RMSEs indicates,[23] not surprisingly, that DOM2 is at least as good as DOM1 for all but the relatively unimportant inventory variables. Moreover, DOM2 performs generally better than IMP1, though the variables TCS and CPRO are notable and important exceptions. The two competitive models, COMP1 and COMP1A, are roughly comparable, and outperform IMP1 and DOM2 except for the critical variables XP and USNPC. On the whole, these results suggest the following ranking: COMP1A, COMP1, DOM2, IMP1, DOM1. The only major problem lies with XP. In the imperfectly-competitive structures, the simulated values generate autocorrelated residuals when compared to the actual values, but they do follow the generally rising pattern of the actuals and do turn down from 1958 to 1967 when XP declined or was flat. The path of XP in the competitive models is much more volatile with increases and decreases in all periods. This is what produces the higher RMSE. This does not, however, seem

Figure 1 - B

DEMAND AND SUPPLY RELATIONSHIPS FOR FOUR MARKET STRUCTURES

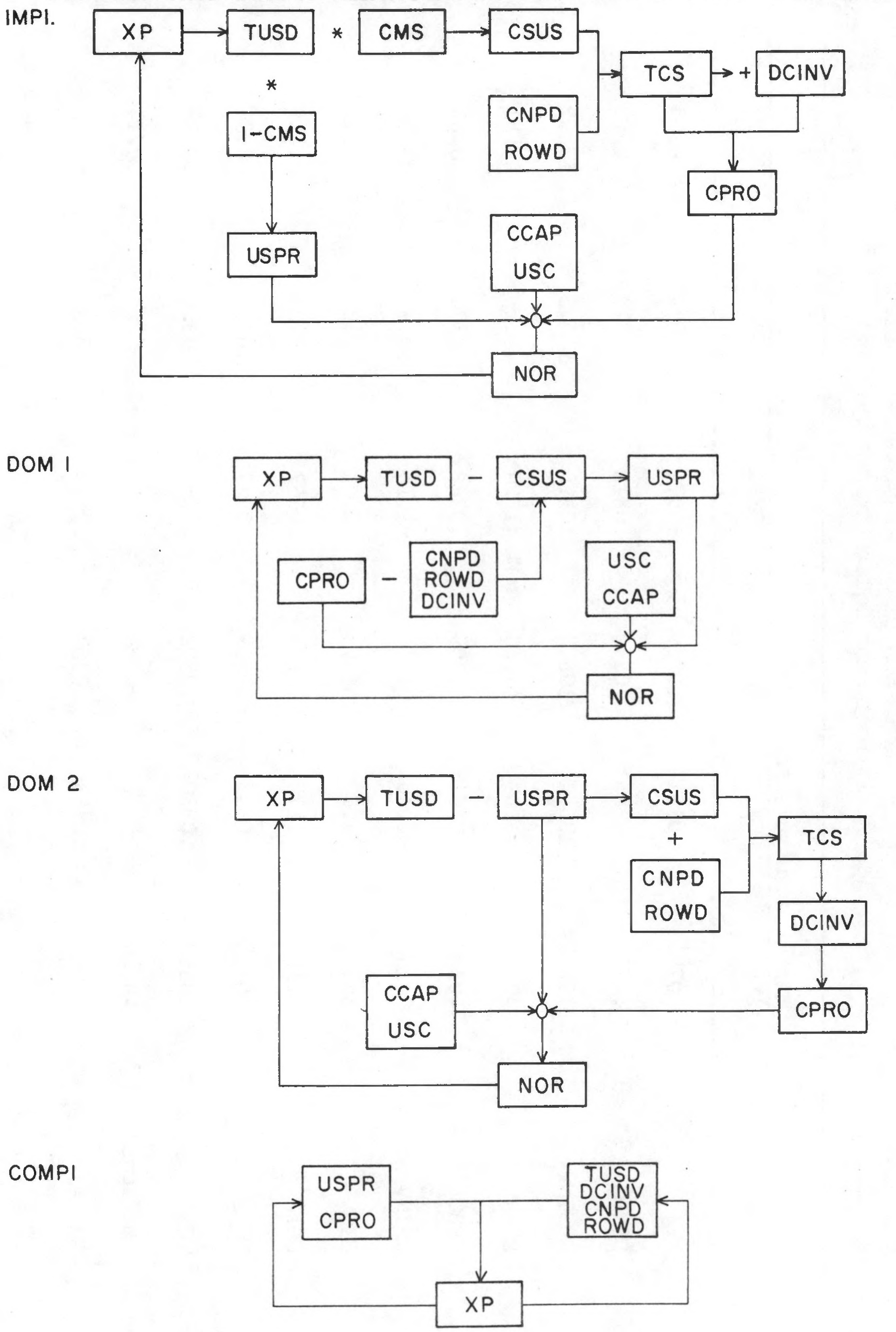


Table 4

INTRA-SAMPLE SIMULATION STATISTICS
(Root Mean Square Errors:1949-76)

	Market structure model					
	IMP1 (RMSE)	DOM1 (RMSE)	DOM2 (RMSE)	COMP1 (RMSE)	COMP1A (RMSE)	IMP2* (RMSE)
XP	.0791	.0791	.0759	.0870	.1054	.0954
USNPC	.0285	.0285	.0279	.0316	.0323	.0308
DUSINV	106.4	106.4	106.4	105.0	104.8	108.2
DCINV	47.59	47.59	47.60	41.20	41.24	48.81
CPRO	.0358	.0541	.0399	.0346	.0330	.0365
USINV	94.40	94.40	94.44	91.16	90.86	95.36
CINV	36.77	36.77	36.73	32.71	32.81	37.72
USPR	.122	.172	.118	.0667	.0724	.119
NOR	.0343	.0343	.0339	.0327	.0323	.0581
TCS	.0352	.0539	.0392	.0360	.0356	.0356
CMS(logs)	.0214	-	-	-	-	.0214
CMS(%)	-	.0453	.0357	.0178	.0189	-
CCAP	-	-	-	-	-	.0396
USC	-	-	-	-	-	.0831

* IMP2 is identical with IMP1 except that CCAP and USC are endogenous.

sufficient cause to reverse the above ranking, although the superiority of one competitive model over the other is quite small.

The picture changes dramatically when the forecasts for 1977 and 1978 are compared. The competitive models produce prices that are too low, a declining U.S. production, and a Canadian market share that rises substantially. (The increase in CMS to 65.6% in 1978 was partly due to strikes at U.S. plants). These results cast some doubt upon the validity of these structures, especially since both IMP1 and DOM2 do well. DOM2 has a slight edge in 1977 but IMP1 seems better in 1978. DOM1 again performs poorly. The results are summarized in Table 5. As the graphs of the four acceptable models are all quite similar, only the results for IMP1 (Figures 2 to 15) and IMP2, i.e., IMP1 with capacity endogenous (Figures 16-24), are presented. The variables that are unaffected by model structure are charted only for IMP1. The differences between IMP1 and IMP2 are concealed by the short period of the forecast.

The failure of the competitive model to forecast reasonably is worrisome. One possible explanation is that the Abitibi-Price merger changed the market structure so as to invalidate the competitive model. Another, probably more informative approach is based on the observation that recent changes in the exchange rate far exceed any experienced in the estimation period. In this context the important relations are the imperfect-market equation (1) for XP and the competitive-market equation (16) for CPRO.

Table 5 FORECASTS 1977-78*

Model	Year	XP	USNPC	DUSINV	DCINV	CPRO	USINV	CINV	USPR	NOR	TCS	CMS	CCAP	USC
IMP1	1977	10.218	9.221	- 8	-103	9.111	1354	196	8.253	6.825	9.122	63.3	-	-
	1978	10.260	9.234	- 2	28	9.154	1352	224	8.270	6.852	9.151	63.1	-	-
DOM1	1977	10.218	9.221	- 8	-103	9.210	1354	196	7.969	6.825	9.221	72.6	-	-
	1978	10.260	9.234	- 2	28	9.311	1352	224	7.737	6.852	9.309	78.9	-	-
DOM2	1977	10.218	9.221	- 8	-103	9.099	1354	196	8.247	6.815	9.110	63.5	-	-
	1978	10.258	9.235	- 2	28	9.137	1352	224	8.277	6.843	9.134	62.9	-	-
COMP1	1977	9.851	9.341	17	- 52	9.210	1379	247	8.247	6.899	9.209	67.7	-	-
	1978	9.966	9.331	7	7	9.233	1385	254	8.218	6.895	9.218	68.3	-	-
COMP1A	1977	9.861	9.315	11	- 63	9.210	1373	236	8.247	6.894	9.190	66.8	-	-
	1978	9.973	9.306	4	10	9.236	1374	246	8.220	6.895	9.201	67.4	-	-
IMP2	1977	10.218	9.221	- 8	-103	9.111	1354	196	8.253	6.844	9.122	63.3	9.180	8.304
	1978	10.264	9.233	- 2	28	9.153	1352	224	8.269	6.866	9.150	63.1	9.179	8.347
ACTUAL	1977	10.205	9.233	-148	- 17	9.104	1214	282	8.261	6.822	9.106	62.9	9.200	8.319
	1978	n.a.	9.295	-111	- 79	9.181	1103	203	8.244	6.871	9.189	65.6	9.196	8.334

n.a. - not available.

\- exogenous to model.

* All variables are measured in natural logarithms except for DUSINV, DCINV, USINV, CINV, and CMS.

SIMULATION AND FORECAST RESULTS

MODEL IMP1

(Canadian and U.S. Capacity Exogenous)

Figure 2

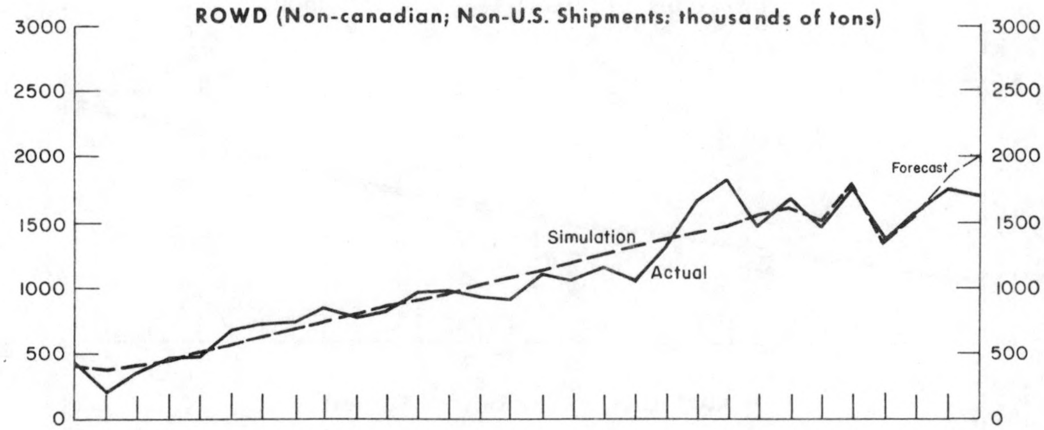


Figure 3

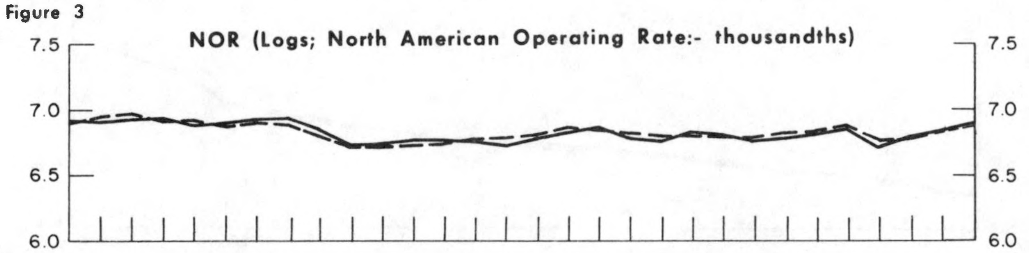


Figure 4

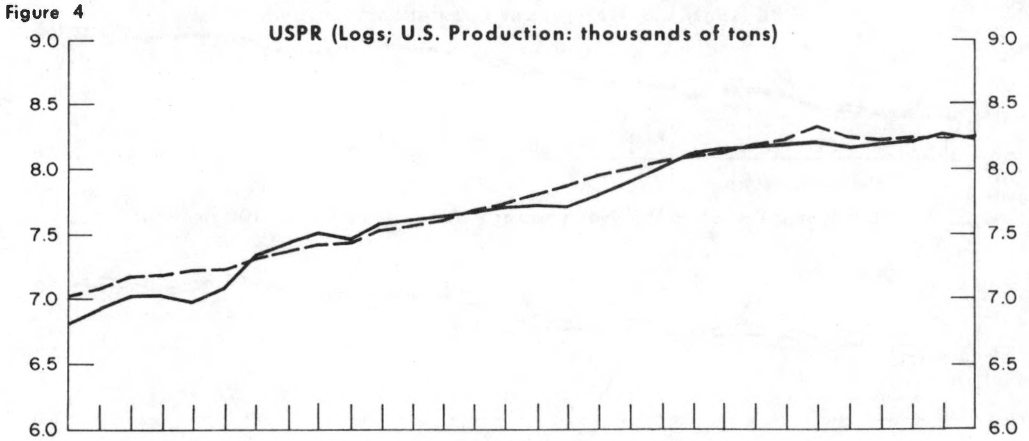
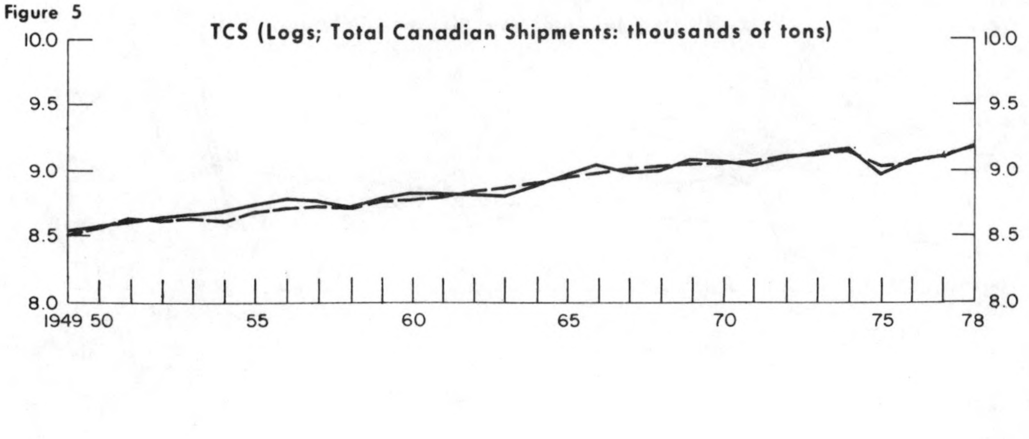


Figure 5



SIMULATION AND FORECAST RESULTS

MODEL IMP1

(Canadian and U.S. Capacity Exogenous)

Figure 6

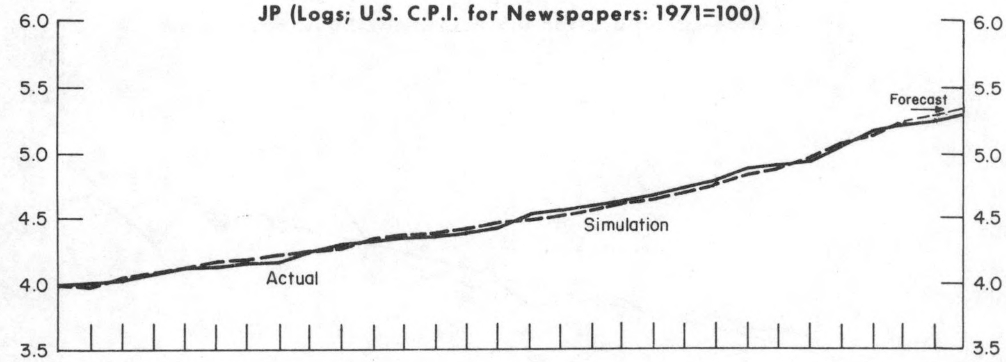


Figure 7

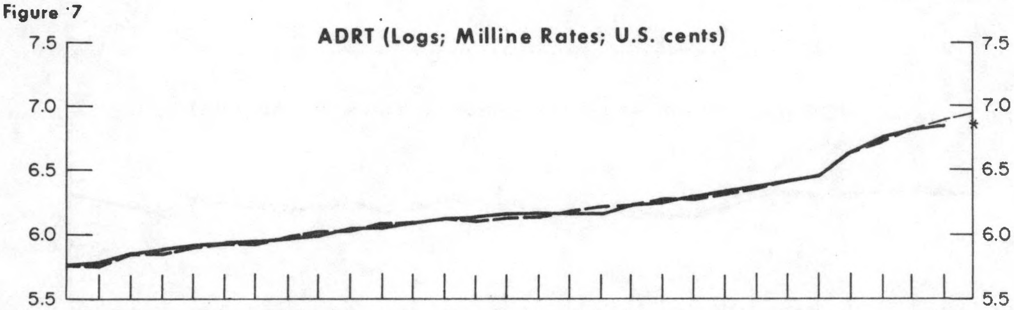


Figure 8

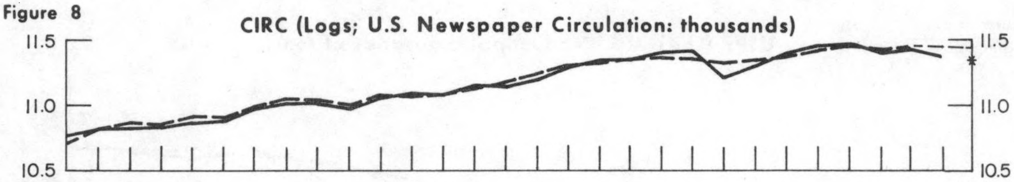


Figure 9

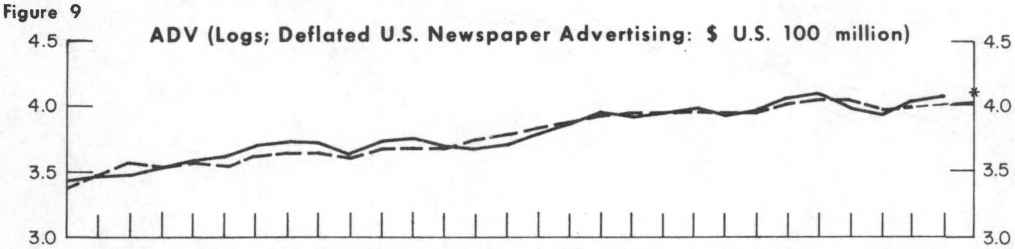
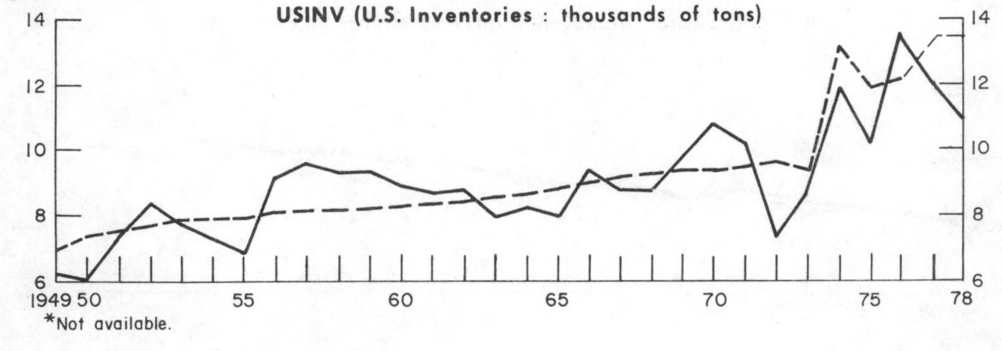


Figure 10



*Not available.

SIMULATION AND FORECAST RESULTS
MODEL IMP1
(Canadian and U.S. Capacity Exogenous)

Figure 11

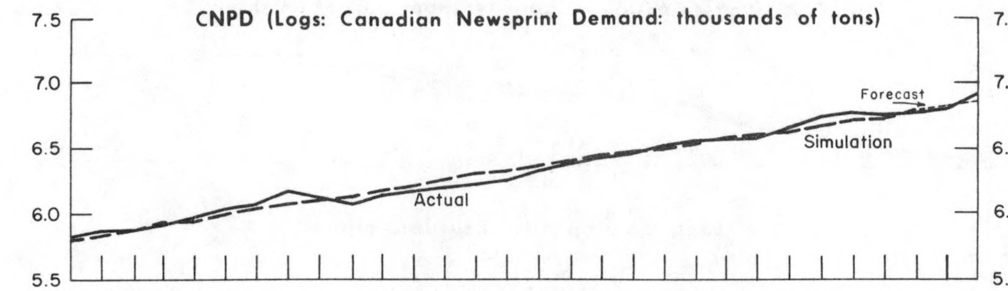


Figure 12

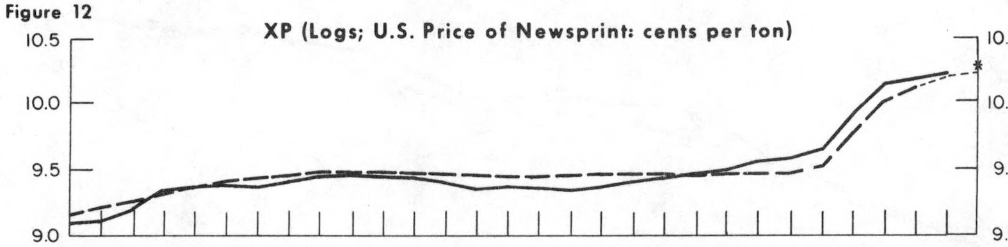


Figure 13

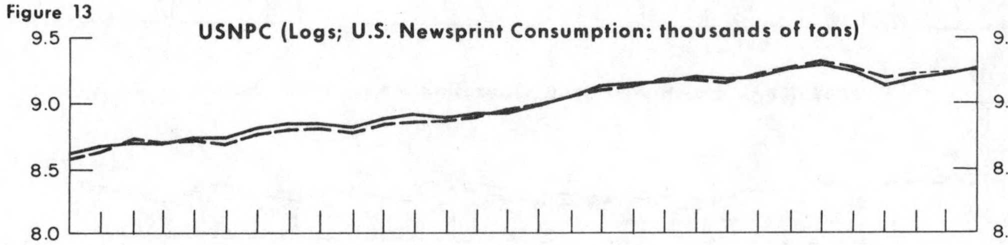


Figure 14

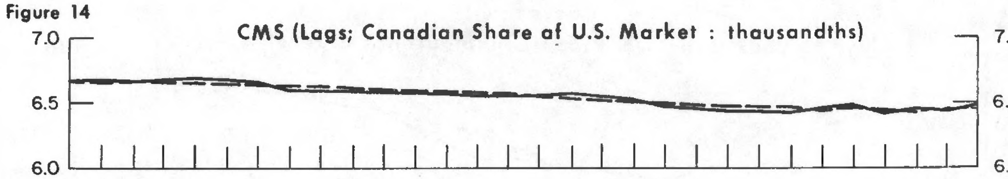
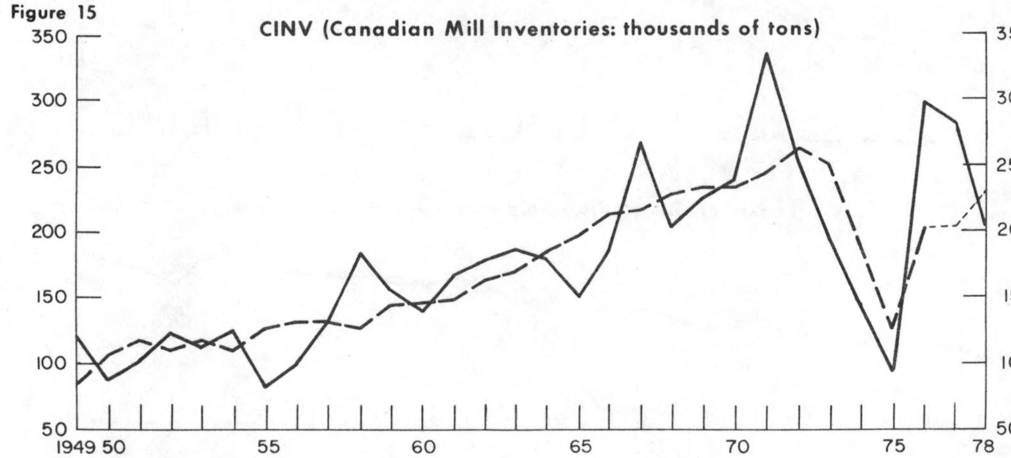


Figure 15



* Not available.

SIMULATION AND FORECAST RESULTS
MODEL IMP2
(Canadian and U.S. Capacity Endogenous)

Figure 16

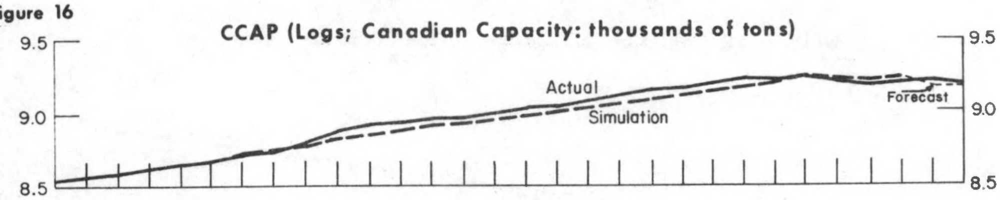


Figure 17

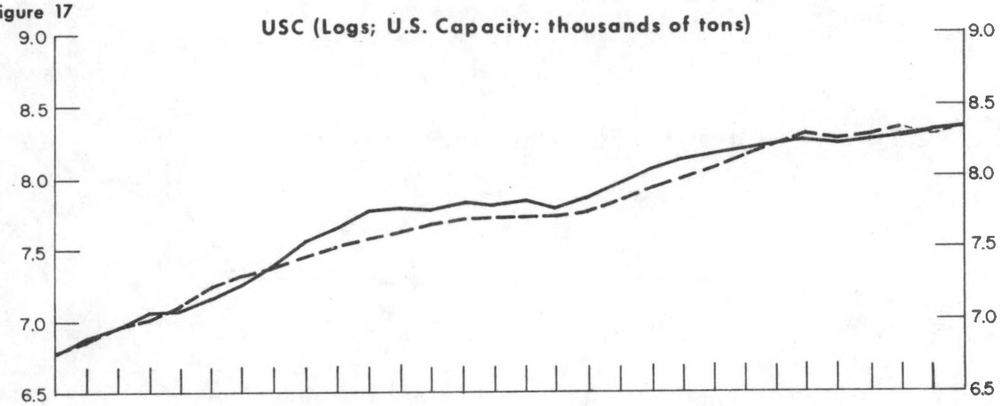


Figure 18

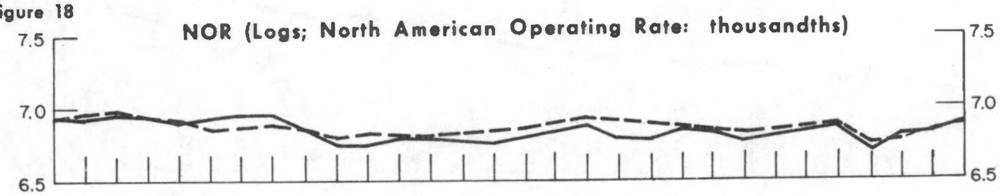


Figure 19

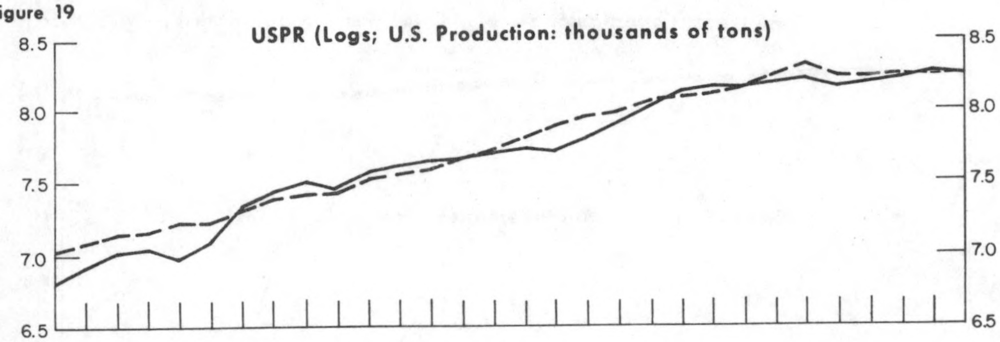
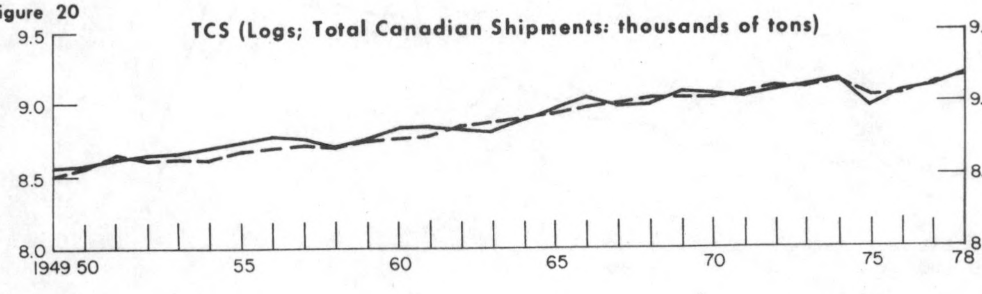


Figure 20



SIMULATION AND FORECAST RESULTS
MODEL IMP2
(Canadian and U.S. Capacity Endogenous)

Figure 21

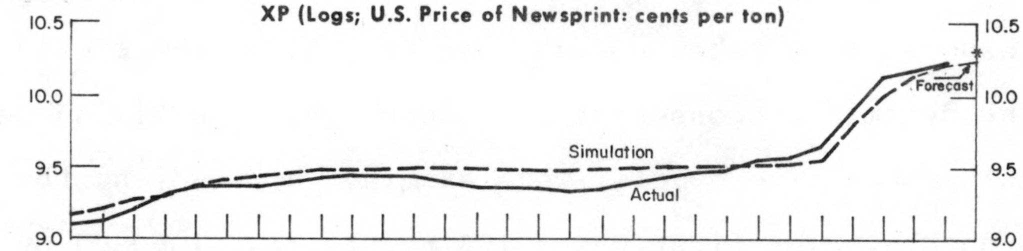


Figure 22

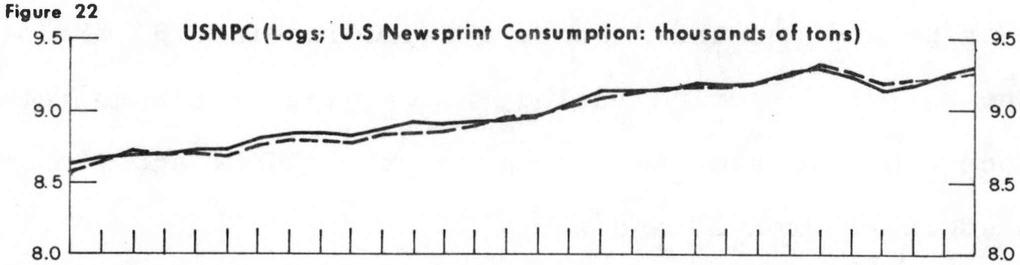


Figure 23

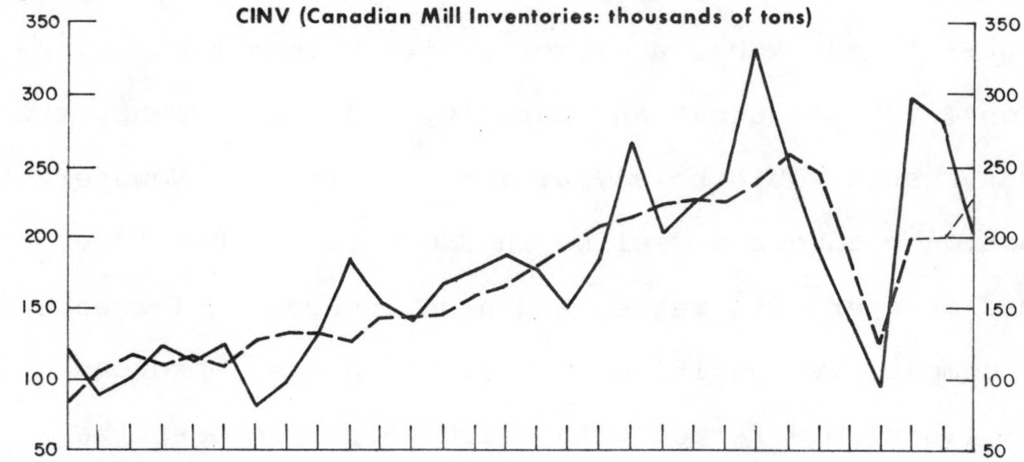
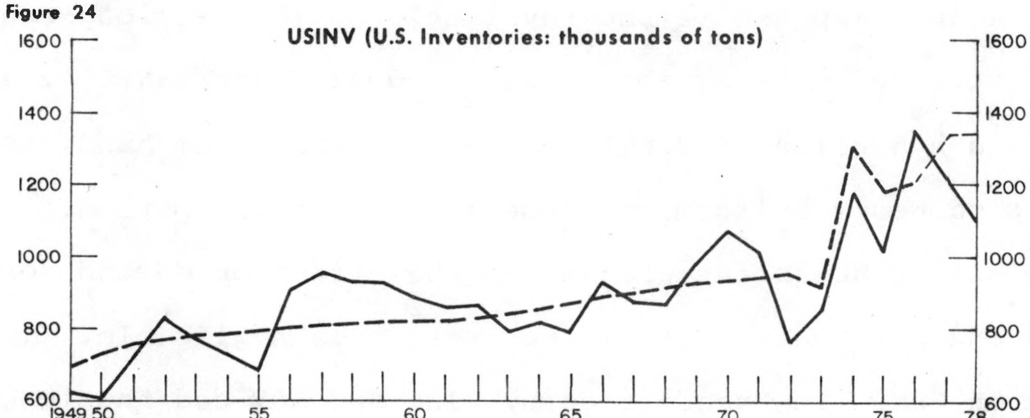


Figure 24



*Not available.

These equations indicate that the impact response of XP to a PFX change is about five times greater in the competitive model and it is this sensitivity that produces the forecasting divergence. This issue will be taken up again at the end of the section.

The dynamic responses of the imperfectly (IMP2) and perfectly (COMP1A) competitive models, were examined by studying the effects of two shocks. The first was a 10% revaluation imposed over a nine-year period and the second, a reduction in U.S. GNP of 1% over the same time period (using the original exchange rates). The shock-minus-control solutions for XP, USNPC, and TCS are presented in Figures 25 and 26.

In the imperfectly-competitive model (IMP2), the exchange-rate shock has a direct positive impact on prices via equation (1). If output and capacity did not respond, the long-run result would be a 9.0% increase in XP. However, the revaluation produces a decline in USNPC (and, therefore, a decline in Canadian operating rates) and also induces an increase in USC as the competitive position of U.S. producers improves. Canadian capacity is also affected with a lag which produces the humped-shape response to the revaluation. The net long-run result is an increase in XP of about 3.2%, a decline in USNPC of about 1.06% and a decline of 0.67% in TCS. On the other hand, the GNP shock produces a uniform response throughout the period. Changes in GNP affect newsprint prices via the effect on demand, operating rates, and shipments, but the net result is negligible. The impact on USNPC is transmitted by CIRC and ADV and the long-run

NEWSPRINT
MODEL IMP2 AND COMPIA*
Shock Minus Control as a Percent of Control

Figure 25

PFX Shock

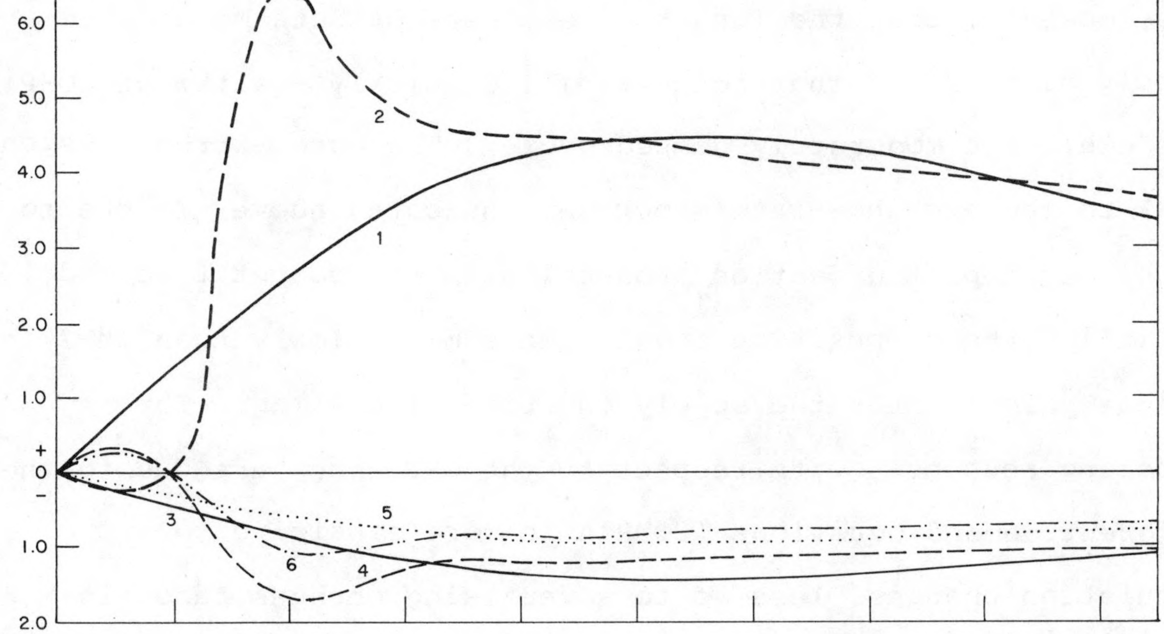
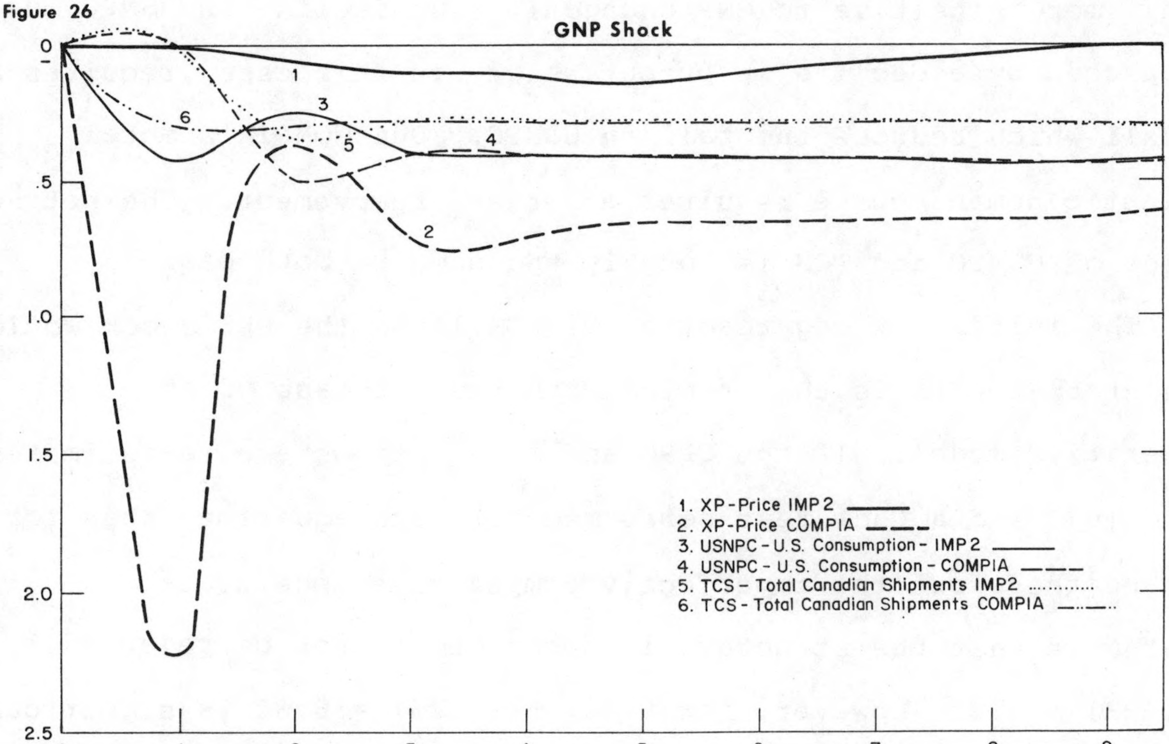


Figure 26

GNP Shock



* Including Capacity Equations.

result is a decline of 0.43%, while TCS declines by about 0.3%.

The short-run response of the competitive model COMP1A to the same shocks differs mainly with respect to XP. It is important to note, however, that the long-run responses of both models are broadly similar and that both stabilize quickly - although COMP1A does exhibit a moderately damped cycle. The more extreme response of XP to the exchange-rate shock, as indicated above, is due to the higher impact effect on production in the competitive model. Initially, the competitive model reacts more slowly than IMP2 because prices enter the supply equation with a lag. The differing responses with respect to the GNP shock are due to the different demand equations (COMP1A is more sensitive to circulation changes, less so to advertising changes, and, in total, more sensitive to GNP changes). The decline in USNPC must be matched by a decline in output which, in this case, requires XP to fall which reduces the fall in USNPC. But COMP1A's more inelastic demand curve requires a larger XP movement. The net effect on USNPC and TCS is roughly the same in both cases.

The initial strong reaction of COMP1A to the PFX shock would suggest that this is the problem with the forecast of the competitive model. If the CPRO and XP equations are re-estimated up to 1977 and a Chow test performed for each equation, then for XP, and therefore the imperfectly-competitive models, the hypothesis that the structure is unchanged cannot be rejected, $F(1, 23) = 0.8$. However, for CPRO, $F(1, 23) = 6.62$ is significant at the 5% level, though not at the 1% level. While this does not say much more than the forecast results it does seem to strengthen the argument for the non-competitive model. Of course, the possibility of a structural change is also consistent with a competitive model but more data are required to re-estimate the relevant equations.

4 CONCLUSION

In this paper an econometric model of Canada's newsprint industry has been specified and estimated. It was argued that the industry could be more accurately described as competitive rather than oligopolistic. The estimated equations were generally good but the differences were not great enough to define clearly the market structure of the industry. Several different market structures were then simulated to see if one was superior. While the competitive model seemed superior for the intra-sample simulations, the imperfectly-competitive models appeared to provide better forecasts. Accordingly, the market structure issue is still open to question although a forecaster should probably use one of the acceptable non-competitive models. Generally, the tracking, simulation, and forecasting properties of the acceptable non-competitive models were reasonably good.

For further refinement, the basic model could be extended to incorporate equations for profits, dividends, and investment expenditure, which in turn could be linked to price and capacity equations. Additional work on factors affecting supply, such as factor costs, could provide more linkages between the Canadian economy and the performance of the industry, and might also improve the forecasting properties of all models. In addition, estimation of a unit cost equation would permit the use of an equation representing prices as a mark-up over cost. Advertising and circulation variables could also be incorporated into the Canadian demand equation. Furthermore, an equation explaining relative costs between Canada and the United States should be added so that equation (13A) can be used in simulation experiments.

APPENDIXES

APPENDIX A

SOURCES OF DATA AND THE CONSTRUCTION OF VARIABLES

1 Sources of Data

Most of the data for this study are taken from the Canadian Pulp and Paper Association's (CPPA) Reference Tables and from various issues of Statistics Canada's annual publication, Pulp and Paper Mills (Cat. 36-204). The CPPA also publishes an Annual Newsprint Supplement which supplies basic data on circulation and advertising rates. Similar data for the United States are also available in Historical Statistics of the United States, Colonial Times to 1970 and in the annual Statistical Abstract of the United States, which also gives the average number of pages in daily and Sunday newspapers. This information is sufficient to compute the adjusted circulation and advertising data. The American Newspaper Publishers Association's Facts about Newspapers supplies similar data. Relative cost data are from the Statistics Canada publication, Pulp and Paper Mills (Cat. 36-204) and the United States Bureau of the Census publication, Annual Survey of Manufactures.

2 Construction of the Variables

Owing to the length of the sample period (1947-76), both tastes and technology have changed. When such changes are apparent either new variables must be included in the model or old variables modified. While technical change and strike variables are incorporated in the model, a consistent method of adjusting the raw data seems to be more effective.

The first variable to be adjusted is circulation. A problem arises from two sources. First, daily and Sunday papers have different circulations, frequencies and numbers of pages. Second, the size of the average U S newspaper has doubled over the last 30 years. The first problem is resolved by converting Sunday circulation into the equivalent daily circulation. This requires adjustments for frequency of appearance (1 to 6) and for relative size (3 to 1), to produce an adjusted daily circulation. This figure is then scaled by an index of the number of pages in the average daily. Thus,

$$CIRC = ((S/D)/6)*CS + CD)*IC$$

where

S = average number of pages in a Sunday issue.
D = average number of pages in a daily issue (morning and evening).
CS = Sunday circulation.
CD = daily circulation (morning and evening).
IC = size index of papers.

Advertising rates pose a similar problem, with rates differing for morning, evening and Sunday papers. First, an average rate per agate line per million of circulation is constructed for daily papers, this same rate is then applied to Sunday circulation adjusted to an equivalent daily basis

Thus,

$$ADR = \frac{RM*CM+RE*CE}{CM+CE}$$

where

ADR = average daily rate.
RM = morning rate.
RE = evening rate.
CM = morning circulation.
CE = evening circulation.
CT = CM + CE = total daily circulation.

and

$$ADRT = \frac{(CSA/6)*RS+ADR*CT}{(CSA/6)+CT}$$

where

RS = Sunday rate.
CSA = (S/D)*(CS/6).
CS = Sunday circulation.

Fortunately, for ease of forecasting, the key variables S, D, RS, RM and RE either follow a regular trend or their ratios are constant or follow a trend. Thus, these variables could be forecast. But since they seem to represent gradual changes in consumption preferences and production techniques it is simpler to estimate equations for the constructed variables CIRC, ADR, and ADRT. As well, the gradual changes in tastes and technology provide a rationale for the inclusion of a time trend in the ADV and ADRT equations. This, along with price responses, is the most likely explanation for the insignificance of the technical-change variables. Finally, it should be noted that the circulation data do <u>not</u> include non-daily, non-Sunday papers, advertising inserts, supplements and special features, or special issues.

Because cost data are only available for certain aggregates of the pulp and paper industry, the apportioning of costs between various products requires some questionable assumptions. The procedure adopted for Canada involved the allocation of total costs on the basis of newsprint's share of the total value of pulp and paper shipments. A unit cost figure was then obtained by dividing the allocated costs by tons produced. This yielded reasonable numbers, e.g., the 1964 value was $83.95 (U.S.) which is in the range given by Haviland et al (1968) of $78.60 to $87.52 (U.S.). As well, the series has a pattern similar to the cost series used by Dagenais (1976).

A similar procedure was used for the United States. Cost data were available for paper mills excluding paperboard. However, the resulting unit cost figures seem much too high, for example, $94.14 (U.S.) in 1964 versus an estimate of roughly $75 (U.S.) by Haviland et al. Though this disparity varies a great deal, it is apparent that the computed series is not of high quality. As a result, a relative cost series, adjusted by the exchange rate, was constructed. This index does seem to move in a manner consistent with the conventional wisdom on the behaviour of industry-international relative costs.

APPENDIX B

THE TECHNICAL-CHANGE AND STRIKE VARIABLES

From 1973 to 1975 there were several technical innovations in newspaper publishing. One of the resulting cost savings was the shift from a nominal 32 lb basis weight to a nominal 30 lb basis weight. In Canada the change in basis weight began in 1973. While the basis weight averaged 31.7 lb for that year, it declined to 31.3 lb by December. The transition was completed in 1974 with basis weights falling from 30.8 lb in January to 30.2 lb in December, an annual average of 30.4 lb. In 1975 the average weight fell to 30.0 lb and has since stabilized at 29.9 lb.

This lagged change produces problems in using published data. The significant change in basis weight and paper-savings took place in 1974 and capacity and production figures are available for that year for both basis weights. In the capacity and production equations a dummy variable is used to pick up the basis weight change. However, because of lagged terms in these equations the technical change dummy (TE) is transitional. Because the lags are one and two years TE is set equal to two in 1974, one in 1975 and 1976, and zero in all other years. The problem with the list price data is somewhat different. Since the 1974 price is for 32 lb paper, either a new price must be constructed for 1974 or a new technical change variable must be introduced. This is not a problem for the prices derived from the shipments data.

Experimentation with different technical variables and with a constructed 1974 list price suggests that a new 1974 price should be constructed. In September 1974 newsprint was quoted at $235 (U.S.) per ton for 30 lb basis weight, while 32 lb paper was quoted at $210 per ton early in the year and at $220 per ton towards the end of the year. The price adjustment factor used by the industry is that 30 lb paper should have a price 6% greater than 32 lb paper. The list price series used in this study quotes $210 as the 1974 price. Accordingly, the adjusted list price used in this study is:

$$\text{(1974 Price)*(1973 Basis wt)/(1974 Basis wt)} = (\$210)(31.7)/(30.4) = \$218.98$$

Other procedures produce prices up to 67 cents higher but do not significantly affect any of the estimated equations.

A more general problem with the TE and strike (ST) variables is their interpretation. These variables are particularly prominent in the newsprint price equation. Indeed, TE affects newsprint demand primarily via the price equation and does not enter the demand equation directly. However, the significance of this result is not clear. Furthermore, since ST has a one in 1973 and 1976 and a three in 1975 it is quite similar to TE, and slight changes in TE (to 1, 1, 1, or to 1, 2, 1, or to 2, 3, 3) tend to lower the t-values for both variables - often to insignificant levels. As the values of TE are arbitrary its usefulness is not clear. Caution with regard to the use of the strike variable ST in the list price equation is also required. While strikes should raise the prices derived from the shipments data, it can be argued that the list price should not be affected.

A final problem with the acceptance of the significance of TE and ST is that their non-zero values coincide with a period of high inflation. Thus, at least part of their significance may be due to some simultaneous outside event. This conclusion is supported by an examination of the coefficient on TE. It is approximately .1, i.e., equivalent to a 10% price increase. However, the consensus of the industry was that the price of the 30 lb basis weight paper should be 6%-7% higher than that of the 32 lb paper. Accordingly, if one accepts TE as is, one must also accept the additional hypotheses that demand for 30 lb paper was relatively greater than demand for 32 lb paper and that the marginal cost curves were rising at that time. With operating rates of 90% or more, the latter hypothesis is reasonable. In summary, despite the high significance levels and the presence of correct signs, the interpretation of the TE and ST variables is not clear.

APPENDIX C

CARTELS, ANTI-TRUST ACTIONS, AND MARKET STRUCTURE IN THE NORTH AMERICAN NEWSPRINT INDUSTRY[24]

In the 1870s U.S. newspaper publishers began to abandon rag paper for wood-pulp paper. During the economic slump of 1878 newsprint producers attempted to form a cartel but were unable to maintain it. The subsequent boom in 1879 rendered the issue academic. However, in an effort to gain relief from rising newsprint prices, publishers lobbied for lower tariffs to promote Canadian competition. This effort was as short-lived as the boom and the next 15 years saw declining or constant prices. Newsprint producers made another abortive attempt to form a cartel in the mid-1890s. One result was the creation of the International Paper Company from 19 other companies. During the boom in 1899 publishers again lobbied for lower tariffs - this time successfully - and newsprint tariffs were eliminated in 1913. As a result, the Canadian share of the U.S. market grew steadily, reaching a peak of 82% in 1946.

In 1915 producers in both Canada and the United States established the News-Print Manufacturers Association (NPMA) and the first of the anti-trust suits began. In 1916 costs were estimated at $33 per ton while the price was $40 per ton and rose to $65 in 1917. An action under the Sherman Act resulted in a "nolo contendere" plea by the NPMA and a fine of $11,000.

Throughout the 1920s publishers demanded more anti-trust investigations, but as prices declined (the 1920 price of $112.60 was not to be matched until 1952) the cries abated. In the 1930s producers tried unsuccessfully to rationalize, and a 1936 merger attempt by the four largest Canadian producers failed. Despite the depressed state of the industry, publishers fiercely resisted price increases and continued political lobbying in an effort to hold prices down. Their attack on the National Recovery Act of 1934 was apparently motivated in part by the $1 per ton increase in newsprint prices that would have resulted. The Act was subsequently declared unconstitutional. An important development occurred in 1938 when International Paper set a price of $50 per ton which most Canadian producers followed. The previous price leader, Great Northern Paper, responded with a price of $48 per ton and International reacted by maintaining its price and cutting production. The industry had apparently become a dominant-firm oligopoly.

The American Press Association was still pressing for anti-trust investigations. In 1939 manufacturers were indicted for price-fixing in 1935 and 1937. The result was a no-contest plea in 1941 and the firms paid their fines. Investigations continued throughout the 1950s, headed in most cases by Emanuel Celler, chairman of the House Committee on the Judiciary. While the investigations had a certain religious fervour, they did not produce any prosecutions. It does, however, seem reasonable to believe that the constant investigations may have exerted some restraint on industry pricing policies. The continuing absence of monopoly and cartel charges of late could be variously interpreted, but it does suggest that the newsprint industry has become much more competitive since the early 1950s and the dominant-firm model is no longer applicable. There is no reason however, to believe that U.S. publishers have lost any of their market power. In 1950, the members of the American Newspaper Publishers Association consumed 76.5% of U.S. newsprint production and 70.0% in 1975. The net result of such buying power is, presumably, a lower mark-up factor for producers.

APPENDIX D

THE REDUCED FORM OF THE CIRCULATION EQUATION

The derivation of the reduced form of the circulation equation is described in this appendix. The difficulties and added costs of incorporating a demand-supply system for circulation into the newsprint model are probably high compared with the potential benefits. Accordingly, a reduced-form equation was estimated and the tracking record of the equation over the sample seems to indicate that little explanatory power is lost with this approach.

In the following derivations, certain variables which were insignificant and were deleted from the final equation, are eliminated to avoid clutter. The deleted variables are ST, TE, and T. The equation system is as follows:

$$CIRC^d = a_1 + a_2RYD + a_3JP + a_4CIRC_{-1} + a_5ADV + a_6CPI \quad (R1)$$

$$CIRC^s = b_1 + b_2WPI + b_3XP + b_4JP \quad (R2)$$

$$CIRC^s = CIRC^d \quad (R3)$$

$$ADV = d_1 + d_2GNP + d_3ADRT + d_4WPI + d_5CIRC \quad (R4)$$

$$ADRT = f_1 + f_2ADRT_{-1} + f_3WPI + f_4T + f_5TE \quad (R5)$$

where

$a_2, a_4, a_5, b_4, d_2, d_4, d_5, f_2, f_3 > 0$, $a_3, b_2, b_3, d_3 < 0$, a_6 is indeterminate, and $f_4 = f_5 = 0$ for this derivation.

Setting $CIRC^s = CIRC^d$, solving for JP, and then substituting into R2 yields:

$$CIRC = (ka_1 - kb_1 + b_1) + b_2(1-k)WPI + b_3(1-k)XP$$
$$+ ka_2\ RYD + ka_4 CIRC_{-1} + ka_5 ADV + ka_6 CPI$$

where

$k = b_4/(b_4 - a_3)$, $0 < k < 1$

Successive substitutions produce the reduced form equation:

$$CIRC = A_1 + A_2{*}RYD + A_3{*}GNP + A_4{*}WPI + A_5{*}CPI + A_6{*}ADRT_{-1}$$
$$+ A_7{*}XP + A_8 CIRC_{-1}$$

where

$A_0 = 1/(1-ka_5d_5) > 0$ if $ka_5d_5 < 1$ (as is probable)

$A_1 = A_0{*}[b_1 - k(a_1 + a_5d_2 + a_5d_3f_1 + b_1)]$

$A_2 = A_0 ka_2 > 0$

$A_3 = A_0 ka_5 d_2 > 0$

$A_4 = A_0{*}[b_2 + k(a_5d_3f_3 + a_5d_4 - b_2)$, indeterminate

$A_5 = A_0 k a_6$, indeterminate[25]

$A_6 = A_0 k a_5 d_3 f_2 < 0$

$A_7 = A_0 b_3 (1-k) < 0$

$A_8 = k a_4 > 0.$

In the estimated equation, equation (4) in the newsprint model, A_2, A_3, and A_4, are positive while A_5 and A_6 are negative. While A_7 had the correct sign it was insignificant (t = -.3) and was deleted, A_8 was insignificant and also had the wrong sign. It should be noted that the above solution takes ADV and ADRT as endogenous to the circulation submodel but treats XP as exogenous. In the context of the complete model however, all the variables are endogenous. If XP is substituted out (using equation (1) in the text), the additional variables XP_{-1} and NOR_{-1} are insignificant.

A final point is that this model for CIRC yields an equation for JP. This equation, when estimated, is reasonable but statistically is no improvement over the simpler equation (2) in the text. Accordingly, the autoregressive equation was retained despite its inconsistency with the structural submodel for circulation.

APPENDIX E

CAPACITY AND PRICE-COST-MARKUP EQUATIONS

Industry capacity equations are estimated in place of investment equations. If the capital stock-capacity ratio is constant, then a capacity equation can yield an investment equation. Unfortunately, real capital stock data are not available for the newsprint industry, however, they are available for the larger Pulp and Paper Mills (SIC 271) aggregate.[26] In 1947 this ratio had a value of $133.99 per rated ton and rose steadily to $354.60 per rated ton in 1976. This would indicate that the assumption of a constant ratio is invalid, especially since rated capacity has been raised by increasing the number of operating days per year. Of course, part of this increase can be attributed to recent expenditures on pollution control measures, but this is a recent phenomenon. This consideration also suggests that a fixed coefficient production function is inappropriate.

In a neoclassical investment equation, an increase in non-capital costs (mostly wages) will promote an increase in the capital stock if output levels are maintained and, with a fixed capital stock-capacity ratio, raise capacity. The increase in this ratio over time means that this positive relationship will be weakened or even reversed. The signs on the price of capital, final product price, and the volume of demand remain unchanged. The analysis also holds for a capacity equation. Since the market is North American, Canadian producers will consider their own capacity and that of U.S. producers as well, when making investment decisions.[27] The estimated equation is

$$\begin{aligned} CCAP = & -1.7145 - .2018\ WCL_{-2} - .05650\ RPK_{-2} + .1768\ AP_{-2} \\ & \ \ (-1.84) \quad (-3.63) \qquad\qquad (-.48) \qquad\qquad (1.74) \\ & +.3843\ TCS_{-2} + .06646\ USC_{-2} + .7944\ CCAP_{-1} - .01356\ TE \\ & \ \ (4.44) \qquad\qquad (1.72) \qquad\qquad (8.53) \qquad\qquad (-1.48) \end{aligned}$$

see = .01329 RB2 = .9969 dw = 1.49

where

WCL is a wage cost term,

RPK is a capital cost variable, and

AP is the producer's realized price of newsprint.

It must be noted that the appearance of the variable TE is related only to the change in the basis weight and its effect on the measurement of capacity, and thus its purpose becomes redundant when the capacity and shipment variables are measured in the new basis weight units. Accordingly, TE is zero after 1976. The estimated equation is satisfactory, although the collinearity of labour and capital costs presents a problem. The deletion of WCL raises the t-statistic on RPK but lowers the Durbin-Watson statistic and other t-statistics. These results suggest that the equation is mis-specified without WCL:

$$CCAP = \underset{(-1.0)}{1.7538} - \underset{(-1.26)}{.1800}\, RPK_{-2} + \underset{(.93)}{.1171}\, AP_{-2} + \underset{(2.49)}{.2402}\, TCS_{-2}$$

$$+ \underset{(.73)}{.03419}\, USC_{-2} + \underset{(7.20)}{.8361}\, CCAP_{-1} - \underset{(-3.04)}{.03026}\, TE$$

see = .01670 RB2 = .9951 dw = 1.19 N = 28

The mark-up equation is straightforward. The export price of newsprint in U.S. dollars (XP) is a function of unit costs in U.S. dollars (UC) and North American operating rates (NOR). Each of these variables is lagged one period and the current value of the exchange rate (PFX) is also included. This embodies the assumption of a one-year planning horizon where current prices are based on the last year's costs with adjustments in the current period reflecting current information and anticipated changes in costs.

$$XP = \underset{(3.59)}{4.896} + \underset{(1.21)}{.1992}\, NOR_{-1} - \underset{(-2.22)}{.4574}\, PFX + \underset{(3.93)}{.07211}\, ST + \underset{(6.35)}{.1467}\, TE$$

$$+ \underset{(10.16)}{.7252}\, UC_{-1}$$

see = .04231 RB2 = .9614 dw = 1.21 N = 28

Although the standard error of this regression is somewhat higher than that of the price equation as presented in equation (1) in the main text, it still appears to be superior. The Durbin-Watson statistic is higher, despite the absence of a lagged dependent variable, and the t-statistics on the theoretically important variables, NOR and PFX, are much higher. Finally, this equation implies a long-run equilibrium break-even operating rate of 68.7% (using 1975 values and assuming that total unit costs are roughly 15% higher than UC). This is close to Dagenais' (1976) estimate.

APPENDIX F

LIST OF MNEMONICS

ENDOGENOUS VARIABLES

ADRT	is the adjusted milline rate of newspaper advertising (Appendix A).
ADV	is advertising spending in newspapers deflated by ADRT.
CCAP	is Canadian newsprint capacity.
CINV	is Canadian manufacturers' holdings of newsprint inventories.
CIRC	is adjusted daily circulation (Appendix A).
CMS	is the Canadian share of the U.S. newsprint market.
CNPD	is Canadian newsprint consumption.
CPRO	is Canadian newsprint production.
CSUS	is Canadian newsprint shipments to the United States.
DCINV	is the change in CINV.
DUSINV	is the change in USINV.
JP	is the U.S. price index for delivered and newsstand newspapers.
NOR	is the North American operating rate of newsprint plants.
NPP	is the landed New York list price of a ton of newsprint (U.S. dollars).
ROWD	is the "Rest of the World" consumption of Canadian newsprint.
TCS	is total Canadian shipments (CPRO - DCINV).
TUSD	is total U.S. demand, - consumption plus inventory changes
USC	is U.S. newsprint capacity.
USINV	is the total newsprint inventory held by U.S. consumers and producers.
USNPC	is U.S. consumption of newsprint.
USPR	is U.S. production of newsprint.
XP	is the U.S. dollar price of newsprint equal to value of shipments divided by tons shipped.

EXOGENOUS VARIABLES

CPI	is the U.S. consumer price index.
GNP	is real U.S. GNP (1972 deflator).
PFX	is the price of foreign exchange (Canadian dollar/U.S. dollar).
RELC	Canadian production cost (in U.S. dollars)/U.S. production cost (U.S. dollars).
RPK	is the rental price of capital defined by PK*(1+i) where PK is a price index of capital goods and i is rate of return on government long-term bonds plus the depreciation rate.

RYD	is the U.S. real personal disposable income.
ST	is a dummy variable for strikes (1973 and 1976 equal 1; 1975 equals 3 and all other years have zero entries).
T	is time, (1947=1).
TE	is a technical change variable (1947-73 = 0; 1974 = 2, and 1975 and 1976 equal one).
UC	is the unit cost of newsprint (see Appendix A).
WCL	is the average annual cost of one unit of labour.
WPI	is the U.S. producer price index, industrial commodities (1967=100.0).

MIXED VARIABLES

AP	is the producers' realized Canadian dollar price of a ton of newsprint (AP = PFX*XP).

FOOTNOTES

1. Background material on developments from the 1870s to the 1950s is presented in Appendix C.

2. Eastman and Stykolt (1967, p. 267).

3. Ibid., p. 270. Quoted as a "return on investment".

4. Scherer (1970) lists three characteristics of barometric price leadership: (i) the identity of the price leader changes; (ii) price leaders are not always followed, and (iii) the new price often just formalizes recent departures from list price. In many ways the price leader acts as a barometer of market conditions.

5. In April 1973 Bowater announced a price increase of $5 per ton to $175 for 32 lb paper effective for July. The increase was generally followed throughout the industry although it was not implemented until September because of a price freeze announced by President Nixon. On the West Coast, MacMillan-Bloedel raised prices by $10 (versus $5 for Bowater) to $178. Later in the year Bowater and Abitibi announced increases of $15 effective January 1, 1974 to be followed by a further increase of $10 on July 1st of that year. International Paper subsequently announced an immediate $25 increase. This $200 list price was substantially higher than the $183 and $178 southern prices announced by Southwest Forest Products and Southland. These price developments were complicated by the changeover to the 30 lb basis weight. However, by mid-1974, 30 lb paper was listed at $213.50 per ton, which is roughly equivalent to $200 per ton for 32 lb paper. In contrast, however, as of March 1 of that year, Boise was still charging $192 for 32 lb paper.

   In May 1974, Consolidated-Bathurst initiated a move to $220 (32 lb), although this price did not become effective immediately. (For example, in August Kimberly-Clark raised its price to $215.) This confusion was superceded in September by Price's announcement of increases to $260 (30 lb) and $243 (32 lb) effective for January 1, 1975. This movement was generally followed, although Bowater announced a price of $270 (30 lb). Southern prices increased more slowly, reaching $256 (30 lb) in July 1975. Further increases to $285 implemented by International and Reed in early 1976 stabilized the market as several producers matched this new price. Crown Zellerbach, however, subsequently announced a price of $305. Announcements of increases to $300 and $302 followed before the $305 price was generally accepted. Finally, in late 1977, Bowater announced a price of $320 to be effective in 1978. The industry seems to have followed this increase.

6. The strike and technical change variables are discussed in Appendix B.

7. It can also be argued that the reduced-form estimates will be less subject to bias due to mis-specification. This is because: (i) a reduced form can be consistent with several structural models; (ii) constraints on the parameters are minimal; and (iii) an omitted variable may appear in more than one structural equation in a manner that lessens or obliterates its impact in the reduced form.

8. Since an appropriate substitute good (and its price) is not available, it is omitted from the equation. This is equivalent to assuming that the utility function is separable. The consumer price index could be included but, since the equation is estimated in double-log form, this will not significantly affect the reduced-form equation. See Appendix D.

9. The list price (NPP) can be used instead of XP but this does not change the empirical results. See Appendix D.

10. The price of advertising in media substitutes, (e.g., television, radio) should also be included but the relevant data do not seem to be available. The omission of this variable could account for the presence of autocorrelation in the advertising equation.

11. "Other" inputs refers to actual production inputs. It is assumed that sales can be increased via the production process, (e.g., new techniques, improvements in quality). The latter is the most likely causative factor. See Dorfman and Steiner (1954).

12. This follows from Dorfman and Steiner (1954).

13. If advertising is viewed as a productive input, then the sign of WPI should be positive. In this case, an increase in advertising increases sales and therefore output, and lowers the marginal product of "other inputs" (if there are diminishing returns to this aggregate input), which is the opposite of the usual case. See the discussion of input and demand functions in Henderson and Quandt, (1971, pp. 69-70).

14. A contrary view is that publishers are quite sensitive to changes in newsprint prices and will curtail circulation in marginal areas and implement paper-saving techniques. This observation may be influenced by the substantial savings of paper that publishers achieved in 1974 and 1975. During

those years several new techniques were implemented but it is not clear whether comparable savings are a continuing possibility. (The trend line for newsprint demand has shifted downward, but its slope has not changed). However, as the empirical results presented in Section 2.3 indicate, the matter is not quite so simple.

15. Most of the newsprint consumed in the United States is used by the newspaper industry. Recently some magazines have been switching to groundwood papers (newsprint) but they are still relatively small consumers and are not discussed in this study.

16. Income is another possibility. However, real U.S. GNP did not prove to be significant when included in the equation.

17. Rowley and Trivedi (1975, ch. 6).

18. It should be noted that the use of stock-shipment (S-S) ratios did not improve the fit and its dynamics were also inferior. The equation in the text is stable and its long-run S-S ratio asymptotically approaches .041 from above (versus .12 in 1976). On the other hand, the equation with the S-S ratio has an unbounded, continuously declining S-S ratio as USNPC approaches infinity.

19. While the equation in the text does have a bounded S-S ratio of .0326 as USNPC approaches infinity (versus .028 in 1977), it approaches this value from below. However, when the equivalent equation using S-S ratios is evaluated, the ratio is unbounded and rising. Finally, the estimated equation is somewhat superior to the one that uses total Canadian shipments and both versions have the same dynamic properties.

20. The construction of the relative-cost variable is discussed in Appendix A.

21. Howrey and Kelejian (1969).

22. Another market structure that used inventory adjustments as a market clearing mechanism was also evaluated. It is not discussed in the text, however, since its simulations and forecast were unstable and very poor. The problem is that the price equation runs consistently high or low and, since inventories are small relative to production, explosive oscillations result.

23. Use of any of the various forms of Thiel's U-statistic will produce the same conclusions.

24. Most of this material is from Mathias (1976).

25. Since consumer expenditures on newspapers are small the income effect of a CPI increase will probably overwhelm the substitution effect, making a_6 negative. This would imply that A_5 is also negative.

26. The capital stock values are from Statistics Canada's _Fixed Capital Flows and Stocks in Manufacturing Industries at the 3-Digit Level (1960 SIC) 1947-1977_. (Mimeo).

27. This is not a contradiction of the previous argument that the newsprint industry is more competitive than oligopolistic. Both elements are present. The issue is how best to model the structure of the industry. Even in an industry which diverges only slightly from perfect competition there may be producers who consider other competitors' decisions.

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ACKNOWLEDGEMENTS

The author would like to thank Danielle Joly, Noella Laforest and Yvonne Rowe who typed various versions of this report as it passed through numerous rewrites. The collection of data was made possible by many people but the aid of Geri Beaumont and the Bank of Canada's Library staff must be mentioned. Many people offered constructive comments on the paper, those of W.E. Alexander, J.W. Crow, and W.R. White requiring special mention. As usual, all remaining errors and omissions are the responsibility of the author.

Printed in Canada Imprimé au Canada