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SIMULATING THE IMPACT OF THE PRICE CONTROLS WITH A CORPORATE MODEL

Introduction

A large number of computer-based and other financial models have been developed in recent years. The growth in the use of computer models over the last three years had been of the order of "50-100 per year in Britain"[1].

In a survey in September, 1974, Social System Inc.[2], found that 73% of 346 U.S. Corporations were either using or developing a corporate planning model. Most (76%) of the corporate planning models in use today were "What if" models, i.e. models which simulate the effects of alternative managerial policies and assumptions about the firm's external environment. With few exceptions (4% in the Naylor survey), the models which were then widely used in all sizes of companies were straightforward case study deterministic models. Naylor commented that top management had become increasingly aware that the old ways of 'muddling through' were not adequate to meet the complex problems facing corporations in the future. Conceptually, the use of such models in predicting the impact of a changing environment on a business firm involves representing the essential elements of the firm and the environment and their interaction. Through the use of such models, various changes in the environment could be simulated in order to determine their impact on a company's performance[3].

It has been suggested that corporate simulation models are a logical extension of the theory of the firm[4]. Their contribution

is directed towards the decision making process in a firm, in conformity with the models of a firm developed by Cyert and March[5]. This model assumes that price and output decision are made independently via a set of specific decision rules in the light of a sales objective and a mark-up objective. Given this kind of approach to decision making, corporate simulation models could be used to generate the price-output path over time under various alternative "scenario" assumptions. So far as the external environment is concerned the basis for forming scenarios is usually derived from macro-economic forecasts regarding inflation, demand, growth in output, etc. Indeed, one of the important objectives of macro-economic forecasts is to change the expectations of business.

Therefore, it is expected that macro-economic models should take into consideration corporate planning models if such forecasts are to make any positive contribution to the corporate planning process. As described below high levels of inflation necessitated considerable shifts of emphasis on financial variables in the whole process, particularly on the interconnections between accounting and cash flow models so far as it relates to the corporate industry sectors.

There was little doubt that the high levels of world inflation that had been experienced in the six or seven years beginning 1970 had brought total corporate models into their own; inflation had also forced financial managers to include previously ignored variables in company models and to examine more carefully interfaces between cash flows and accounting flows[6]. As an example, the Chief Executive Officer of the Republic Steel Corporation, U.S.A., described what he called the FIN PLAN. "This is a carefully constructed computer model into which we can feed any number of variables with respect to price, costs, volume, productivity, and many other factors, and in short order be looking at print-outs which indicate bottom-line results"[7].

From our discussions in previous chapters on the relationship between accounting flows and cash flows, the price-output decision framework subject to price control and the nature of financial modelling just described, indicate the necessity of a total model

for investigating the impact of price control policies. Financial modelling at practical levels must take into consideration the interface between cash flows and accounting flows and capture the impact of varying rates of input price changes and volume changes in a dynamic manner. Specifically, we need a multi-period financial model as described below.

A Multi-Period Financial Model

The model described hereafter is a deterministic simulation model which has been developed over a number of years at the Manchester Business School[8]. Figure 1 gives some indication of the input data (profit and loss account and balance sheet) and outputs (profit and loss account and balance sheet) linked by a total cash flow statement.

In addition to input data in the form of the profit and loss account and balance sheet, this model could, as indicated by the caption to Figure 1, handle six different rates of relative price changes by the user. The user was, as also indicated, required to choose an output growth rate. Other necessary input data include two rates of interest, details of the company's corporation tax position, including losses and/or capital allowances brought forward, tax rates, and an asset replacement rate based upon the existing asset stock. The model also had a procedure which determined a level of growth investment in relation to the (physical) sales growth rate.

The impact of accounting policy variables on the model's outputs could be handled by *historic cost* and *current cost* variants of the model. Figure 1 illustrates the former. The latter was based upon the recommendations, contained in the Report of the Inflation Accounting (Sandilands) Committee which, subject to certain modifications, were to be embodied in an accounting standard to be promulgated by the Consultative Committee of Accountancy Bodies. The tax routine for the historic cost version incorporated the stock appreciation allowance granted by the Chancellor of the Exchequer in November, 1974, as amended in April, 1976. The Sandilands version incorporated the (current) cost of sales adjustment for tax purposes as recommended in its Report.

FIGURE 1

Non-allowable cost for this run = ·20
Delay factor in passing cost increase = ·02
% Sales growth rate for this run = ·10
Inflation rates in % for this run :

Sales	Mat'ls	Labour	VBL EXP	FXD EXPS	FXD ASTS
24.34*	29.65	18.32	18.00	18.00	20.00

FINANCIAL STATEMENTS

Profit & Loss Account (In Multiples of 10000 units) For Periods Ended	1	2	3	..	..	8
Sales	3413	4201	5220	..	..	15968
Materials	1492	1953	2558	..	..	9849
Labour	756	904	1080	..	..	2632
Cost of Sales	2248	2857	3638	..	..	12482
Gross Margin	1164	1343	1582	..	..	3486
Fixed Expenses	354	417	493	..	..	1127
Depreciation	122	150	184	..	..	486
Variable Expenses	350	418	498	..	..	1198
Profit Before Tax	337	357	407	..	..	674
Interest Expense	81	87	126	..	..	614
Pre-Tax Income	256	270	280	..	..	59
Taxation	133	140	146	..	..	31
Profit After Tax	123	129	134	..	..	28
Dividends : Pref	2	2	2	..	..	2
Ord	57	60	63	..	..	13
Retained Earnings	62	66	68	..	..	12

CASHFLOWS IN MULTIPLES OF 10000 UNITS

Cash Flow Statement For Periods Ended	1	2	3	..	..	8
Sales Income	3250	4002	4963	..	..	15146
Material Purchases	1549	2025	2648	..	..	10136
Wages	756	904	1080	..	..	2632
Expenses Paid	692	821	973	..	..	2283
Gross op Cash Flow	252	251	261	..	..	93
Interest Paid	81	87	126	..	..	614
Tax Payments	112	0	0	..	..	0
Dividend Payments	73	60	63	..	..	41
Cap Spend Buildings	0	0	0	..	..	0
Cap Spend Plant	412	495	595	..	..	1492
Net OP Cash Flow	—426	—391	—523	..	..	—2054

*Period 8 only

(*Contd.*)

Balance Sheet for Periods Ended*	1	2	3	..	..	8
Fixed Assets	1448	1793	2205	..	..	5829
Total Current Assets	1858	2338	2958	..	..	9886
Total Assets	3307	4132	5163	..	..	15716
Current Liabilities	1187	1805	2621	..	..	12402
Working Capital	671	533	336	..	..	—2515
Net Assets Employed	2119	2326	2541	..	..	3314
Funds Employed	2119	2326	2541	..	..	3314

Structure of the Model

The specification of accounting relationships in a total financial model is little more than a simple exercise in double-entry book-keeping on a multi-period basis. Much more problematical is the behaviour of costs and revenue as a function of both output and time. If the output of a total model is to be used as a basis for determining the direction of corporate strategy, or whatever, cost and revenues must be related to both output and time. The model described here copes with this problem, in the manner illustrated in Figure 2, which shows five main categories from the profit and loss account.

FIGURE 2 : REVENUE AND COST RELATED TO OUTPUT AND TIME

	(i)	(ii)	(iii)	(iv)
	(base-period) value	volume increase factor in period j	price increase factor in period j	value in period in j (i) (ii) (iii)
Sales	S_{j-1}	$1+v_j$	$1+p_j(s)$	S_j
Materials	RM_{j-1}	$1+v_j$	$1+_{pj}(m)$	RM_j
Labour	W_{j-1}	$1+_{vj}$	$1+p_j(w)$	W_j
Variable Exp.	VE_{j-1}	$1+v_j$	$1+_{pj}(ve)$	VE_j
Fixed expenses	FE_{i-1}	—	$1+p_j(fe)$	FE_j

*Details of the Balance are omitted.

In Figure 2, S_{j-1}, RM_{j-1}, VE_{j-1}, and FE_{j-1} represent base-period data from which corresponding magnitudes for subsequent periods are to be estimated. The estimated rate of volume change (positive or negative) for the first period is denoted by v_j and the rates at which the five categories are expected to increase in money terms in that same period are denoted by $p_j^{(s)}$, $p_j^{(m)}$, $p_j^{(v)}$, $p_j^{(f)}$. The user may choose a set of volume and relative price changes allowing them to remain constant over all future periods or he may select a different combination of relative price changes for each period.

Precisely where the line of demarcation between fixed and variable costs actually lies is essentially a question concerning the facts of production, technology, etc. Its location ought to be well appreciated by all financial managers and is equally pertinent to both computer-based and non-computer based financial modelling exercises. Such divisions in costs should not be difficult.

A further feature of the model's mechanics effectively facilitates financial forecasting both within and outside the familiar yardsticks and ratios of conventional accounting. This is, namely, the manner in which the cash flow statement is derived by the model from the input data and chosen scenario assumptions. That part of the input data represented by the balance sheet and profit and loss account can be characterised by such ratios as, for example :

Sales : finished goods
Sales : trade debtors
Purchases : trade creditors

Having picked up these ratios from the input data for, say, end-year j-1, the model will, unless instructed to the contrary, reproduce them in every subsequent balance sheet. Thus, making use of S_j, RM_j, W_j, VE_j and FE_j, a balance sheet at end-year j and profit and loss account for the year j are computed. Making further use of the (opening) end-year j-1 balance sheet, the cash flows for period j are then calculated as a set of dependent variables.

Financial Modelling and Price Control

The work of the present researcher involved adjustment in the model described in the previous section, so as to reflect the ope-

ration of the two price control factors which were designed to produce a "squeeze" on the pre-tax income figures in Figure 1, under conditions of rising input prices. It should be mentioned here that in order to reflect the essence of the Price Code mechanism, increase in sales and sales prices were computed as endogenous variables, while rates of input price inflation, growth in volume and the price control constraints, were introduced as exogenous inputs to the model. Price control factors were :

(a) non-allowable cost increase ;
(b) delay factor in passing increased costs.

Given the base period inputs and other exogenous variables, excepting rate of increase in sales price, the model as per its structure computed the increases in the costs of material, labour and interest for the next period. A fraction of the labour cost increase over the previous period was then taken out as non-allowable cost increase. Another fraction of the increase in total cost, i.e. the sum of all cost elements prior to pre-tax income in Figure 1, was also taken out for delays in passing*. In other words, the total extracted fraction of the increased cost was not available to be passed on to higher sales prices. This would produce the "squeeze" on the base period pre-tax (Profit) margin which was $M_{j-1} = \frac{1-\Sigma bij_{-1}}{S_{j-1}}$

Where Σbij_{-1} = sum of pre-tax costs in base period
S_{j-1} = sales revenue in base period

Sales revenue, S_j, for the period j was then computed as a dependent variable as

$$S_j = \frac{\hat{\Sigma bij}}{1-M_{j-1}}$$ where $\hat{\Sigma bij}$ = sum of allowable cost (after deducting non-allowable portions)

or $S_j = \hat{\Sigma bij} \left(\frac{S_{j-1}}{bij-1}\right)$

Rate of incaease in sales price in period j was then computed as a dependent variable as $SI_j = \frac{S_j}{S_{j-1} \quad (1+R_j)} - 1$

* The factor was estimated from the questionnaire survey mentioned in Chapter 4.

where SI=Rate of sales price increase over previous period
R=Rate of growth (volume) in Sales.

After completing the financial reports for period j the model computed the pre-tax (Profit) margin, M_j, which, as expected, would be lower than M_{j-1}.

Like other exogenous variables the two price control factors could be put in with base period input and allowed to remain constant or changed from period to period.

As a result of these adjustments into the structure of the model, it became suitable for simulating price increases under price controls, rising factor input prices and/or growth for companies with different cost and capital structures. Characteristically, this adjusted version of the FINAPLAN resembled the Harvard Business School model PRISM (Price Inflation Simulation Model)[9]. This model could be used to investigate the impact of pric econtrol in a "What if" manner. Specifically one could observe outcome of the question : What happened to company selling prices, company profits and company finances, if a constraint was placed on the profit and loss account in the form of an official price control policy?

The Results of Simulation Experiments

The model described in the previous section was used to simulate the operation of the price controls on two companies, one from the food sector and the other from building materials to reflect differing cost structures. The 1972 position of these companies sectors and the manufacturing industry had been used as the base period input. The following chart presents the results of 9 runs on the year ending 31st August, 1972, of Ranks Hovis McDougall under alternative assumption of cost inflation and real growth subject to a constant level of cost absorption due to price controls. The chart (on page 97) shows the relationship between pre-tax conventional profit which the Price Commission used to measure the level of erosion and corresponding earnings measured on a cash flow basis. This chart was prepared from the output of computer runs. Based on the results presented in the chart certain conclusions were arrived at as follows :—

1. Only under a situation of zero inflation and growth would pre-tax conventional profit be equal (approximately) to cash flow earnings.
2. In conditions of rising input-output prices and/or growth in sales, cash flow earnings fell short of the conventionally measured profits. Therefore, higher rates of inflation and/or growth increased the shortfall and vice versa.
3. As was well known, the major cause of this shortfall in cash flow earnings or the overstatement of conventional profit, was the omission of cost of periodic increase in working capital which increased as a linear function of rising relative prices and/or growth ; the other factor being the undercharging of replacement capital expenditure relative to historic cost depreciation.
4. It was observed that, as expected, the price control factors produced a cumulative erosion in the conventional margin over time for a given level of inflation and growth. On the other hand, for any level of inflation in a year, a similar effect was produced by higher rates of growth and vice versa. This indicates that the impact of price control factors which eroded pre-tax margins, had exacerbated the shortfall in cash flow earnings. It has been discussed that there were significant variations in the rates of increase in input and output prices and growth among the various sectors of the manufacturing industry. Therefore, it might be inferred that the distribution of the price control burden had not been equitable, especially when there were significant variations in working capital investment among companies.
5. In view of the large increases in the number of corporat e models of the type used for financial planning, a strong presumption that appeared to be gaining increasing acceptance among macro-economic planners (post hoc) was that prospective cash flow shortages might have had encouraged recessionary activities. That is, given the scenario assumptions, based either on historic time-series data or expectations formed by utilising macro-economic or company forecasts, optimal policy selection by corporate financial planners could have been influenced

RELATIONSHIP BETWEEN PRE-TAX CONVENTIONAL PROFIT AND CASHFLOW EARNINGS*

Sales Growth Rate \ Rate of Inflation	1973: 0	1973: LOW	1973: HIGH	1974: 0	1974: LOW	1974: HIGH	1975: 0	1975: LOW	1975: HIGH
0	£m 22.7 [5.1 %] (22.2)	£m 23.1 [4.75 %] (12.9)	£m 23.7 [4.45 %] (-19.3)	£m 22.6 [5.1 %] (22.7)	£m 23.7 [4.39 %] (12.9)	£m 24.2 [3.80 %] (-19.8)	£m 22.6 [5.1 %] (22.7)	£m 23.4 [4.04 %] (12.0)	£m 24.2 [3.16 %] (-22.2)
LOW 2.5%	22.8 [5.0] (21.9)	23.2 [4.65] (8.0)	23.8 [4.36] (-27.5)	22.8 [4.9] (22.1)	23.3 [4.20] (7.6)	24.3 [3.65] (-29.8)	22.8 [4.8] (21.6)	23.3 [3.75] (6.2)	23.9 [2.91] (-34.3)
HIGH 5%	22.8 [4.9] (18.5)	23.2 [4.56] (3.0)	23.9 [4.28] (-35.8)	22.9 [4.7] (18.5)	23.4 [4.02] (2.1)	24.3 [3.47] (-40.0)	22.9 [4.5] (18.0)	23.2 [3.48] (-0.18)	23.6 [2.67] (-47.7)

* Figures within brackets are corresponding cash flows

** Figures in the boxed corner are pre-tax margins. (Percentage of Sales) 5.1% being the base period margin.

Assumptions

1. 20 percent of the increase in labour cost was non-allowable for price increase
2. 1.0 percent of the total increase in labour and material cost was to be absorbed due to delay factors.
3. Rates of Cost increase :

	Materials	Labour	VBL EXP	FXD EXP	FXD ASST
Low (%)	10	9	6	6	8
High (%)	21	18	15	15	20

4. Average Loan Interest, 10% ; Average overdraft interest 12%
5. Average life of depreciable assets : 10 years.

by the bottom line of the cash flow statements. The current shifting of emphasis on financial forecasting at macro level, as well as at the levels of firms, indicated that a cleavage between theory and practice might have co-existed in recent years of high inflation and price control[10].

For the manufacturing industry an attempt was made to estimate the impact of the programme in terms of comparative scenarios of no-price controls. In this exercise the actual magnitude of the rates of increase in the price of materials and fuels and average earnings and output of manufacturing industry during 1973-76 was used. The 1972 financial position[11] of the industry was used as the base period input after suitable adjustments to produce a pre-tax margin of 6.5%. Although the established reference level for the industry was 8.5% this was pegged higher by about 25%, according to Price Commission estimates.[12] The Stage IV productivity deduction of 20% was used, though during Stages II and III the percentage deduction was 50%, and it was assumed that 2% of the increase in total cost had to be absorbed due to delays and lags, on an annual basis. (Actually, various alternative scenarios were tried ; results were similar to the one already presented with one company. The effect of the Price Code on Sandilands CCA was also presented to the CBI's Economic Committee[13] in a short seminar.) The following were observed for the manufacturing industry as a whole :

Given the rates of increase in factor costs and the rates of real output change, a pricing policy (in the absence of control) to achieve the 1972 pre-tax margin would have resulted in a situation where pre-tax-incomes would have been positive and increasing but net operating cash flows negative and increasing in 1973, 1974 and 1975. This implied that even if there were no controls a fixed mark-up on historic cost pricing would have produced a widening shortfall between conventional pre-tax margins and cash flow earnings. This result, as is known, was caused in times of rising prices by the increased outflows on account of working capital and capital expenditure. Basically, its cause is rooted in the nature of historic cost accounting which, anticipates some element of revenue, understates current operating costs and effectively allocates them forward through time when input and output prices continue to rise. Whereas to reflect rising current costs

in current prices the mark-up on historic cost needed to be higher, resulting in higher output prices, the effect of price control factors was to produce a continuous erosion in the pre-tax margin. It was, therefore, expected that the price restraint resulting from the erosion in margin exacerbated the shortfall in cash flow earnings. In other words, the shortage in cash flow earnings which companies were already faced with from the impact of historic cost pricing in times of high input price inflation, was simply aggravated from the operation of price controls. Differential effects of a reducing margin, as compared with a fixed margin, is presented in the following table.

TABLE A : IMPACT OF PRICE CONTROLS ON THE MANUFACTURING INDUSTRY

Comparative to a "Scenario" of no-control

	1973	1974	1975	Total
1. Reduction in price inflation rates (% points)	1.40	1.30	1.21	
2. Cumulative erosion in pre-tax margin (% points)	1.10	2.18	3.25	
3. (2) as percentage of base period margin of 6.5%	16.92	33.53	50.00	
4. Reduction in pre-tax profit (£m.)	390	950	1760	3100
5. Increase in net cash flow shortfall (£m.)	−290	−730	1360	−2380

Since no estimate of the impact of price controls at such aggregate levels would be perfect, the figures in the table provided some broad but reasonable estimate, because by the third quarter of 1975 pre-tax margins were almost halved as a percentage of reference levels[14].

However, the erosion of margins on account of delays as assumed for simulation might not have been solely caused by price control. As mentioned earlier, industries' inexperience in pricing under conditions of an explosive increase in factor input prices, and the profit illusion, might also have had contributed to some lag in adjusting output prices relative to cost increases. On the other hand, it might

again be pointed out that although productivity deduction at 20% was used for simulation for all three years, in 1973 and 1974, the rate was actually 50%.

As indicated, the objective of the exercise was not to produce a precise assessment of the impact of price controls, but to emphasise the important interconnections between the variables and to provide some idea of the level of erosion in cash flow earnings. The broad message was that from the perspective of a financial planner the magnitude of the deterioration could have been predicted, based on the kind of total model used in this research. On the other hand, in making macro forecasts for growth plus inflation, it ought to have been appreciated that as far as financial resources were concerned they both make similar demands on companies. While price controls shifted resources out of the companies, conflicting objectives possibly did not allow a policy prescription favourable to company finances in terms of both supply and price. Evidence of the consequent shift of resources, may also be obtained in the 'flow of funds' analysis which showed increasingly large surpluses in the personal sector as a counterpart of deficits in the company as well as the public sector[15]. High rates of interest which were offered to attract funds to finance public sector deficits (and also due to the pressure of external accounts on sterling balances), effectively raised the cost of capital much above the rates of return[16]. The company sector, therefore, might have been effectively barred from availing growth opportunities if there were any.

The following chapter presents the analysis of company accounts to obtain empirical evidence of the impact of price control and taxes on profitability and financial viability, some indication of which were provided in this and the preceding two chapters.

Footnotes

1. E. L. Harison, "Computer Modelling in Practice". *The Accountants Magazine*, June, 1976.
2. T. H. Naylor, "A conceptual framework for corporate modelling and the result of a current survey". *Operational Research Qtrly*. Vol. 27, No. 3, 1976.
3. S. C. Wheelwright, "Management by Model During Inflation". *Business Horizon*, June, 1975.

4. T. H. Naylor, "Corporate Simulation Models and the Economic Theory of the Firm" in Corporate Simulation Models, ed. by A. N. Scrieber, University of Washington, Seattle, Washington, 1970.
5. Cyert & March, "A Behavioural Theory of the Firms". Prentice-Hall, Englewood Cliffs, N. J., 1963.
6. G. H. Lawson, "Financial Models, Relative Price Changes and Financial Forecasting". MBS.
7. W. J. Delaney "Management's Expectations of Financial Planners", *Managerial Planning*, Jan.-Feb. 1976.
8. D. G. Bean, A. W. Stark, and G. H. Lawson, "FINAPLAN".
9. S.C. Wheelwright, *op. cit.* The conceptual design of PRISM was created by Professor R. F. Vancil of Harvard University.
10. G.H. Lawson, *op. cit.*
11. M_3—Sixth Issue. H. M. S. O.
12. Price Commission Report.
13. D. R. Glynn, CBI, December, 1976.
14. Price Commission Reports.
15. The Bank of England, Quarterly Bulletin.
16. *Ibid.*