

WORKING PAPERS IN ECONOMICS

PEAK LOAD PRICING AND THE CHANNEL TUNNEL:

A RE-EXAMINATION

by

GORDON MILLS and WILLIAM COLEMAN

No. 59

March 1982

DEPARTMENT OF ECONOMICS



The University of Sydney
Australia 2006

PEAK LOAD PRICING AND THE CHANNEL TUNNEL:

A RE-EXAMINATION

by

GORDON MILLS and WILLIAM COLEMAN

No. 59

March 1982

National Library of Australia Card Number and ISBN

0 86837 038 X

The authors are, respectively, Professor
of Economics, University of Sydney and
Research Graduate, Reserve Bank of Australia.
At the time this work was undertaken,
Mr Coleman was an undergraduate student in
the University of Sydney. The authors are
grateful to Maurice Peat for computational
assistance.

PEAK-LOAD PRICING AND THE CHANNEL TUNNEL: A RE-EXAMINATION

1 Introduction

In his 1976 paper, Glaister argues that the Channel tunnel scheme (abandoned in 1975) would have created far too much terminal capacity, as a result of the intention to charge road vehicles being carried through the (rail) tunnel a price of £19, uniform throughout the year notwithstanding the large seasonal and weekly fluctuations in demand levels. Glaister goes on to calculate profit-maximising prices for each of 17 periods into which he divides the year: he claims that with such peak-load pricing, optimal terminal capacity may be reduced by about 70%, leading to a significant improvement in profits.

Unfortunately one of Glaister's models (that for dependent demands) is improperly formulated; this leads to prices which are unacceptably high, and exaggerates the difference between optimal capacities for peak-load pricing and uniform pricing. Furthermore, it may be argued that the calculations for uniform pricing take the uniformity principle to an unrealistic extreme, further exaggerating the difference between optimal capacities.

In this paper, we present a revised model for the case of dependent demands, compare the peak-load pricing results for it with those obtained from a more accurate calculation of Glaister's other model, and suggest how the principle of 'uniform' prices might be implemented in practice, thus giving a fresh comparison between uniform and peak-load pricing. We also explore the links between optimal prices and (short-run) marginal costs, and consider the implications of the various pricing policies for total (annual) traffic flow and for capacity utilisation.

2 The data on demand

From the official (Governmental) study of the Channel tunnel proposal, Glaister extracts initial demand data for each of the 17 periods (as he explains on p.101). For the projected charge of $\bar{p} = \text{£}19$ (the same in all periods), the demand levels \bar{q}_i were forecast to be those shown in the final column of his Table 1. To these data, Glaister fits a linear demand system:

$$q_i = \xi_0^i + \sum_{j=1}^{17} \xi_j^i p_j \quad (i = 1, 2, \dots, 17) \quad \dots (1)$$

where p_i is the price in period i , and q_i is the demand rate measured in vehicle units per hour.

At the initial demand points (\bar{p}, \bar{q}_i) , each own-price elasticity is denoted e_{ii} , while e_{ij} denotes the cross-price elasticity which reflects the impact of p_j on q_i . These determines the coefficients:

$$\xi_j^i = \bar{q}_i e_{ij} / \bar{p} \quad (\text{for all } i, j) \quad \dots (2)$$

$$\text{Also, from (1), } \xi_0^i = \bar{q}_i - \bar{p} \sum_j \xi_j^i \quad (\text{all } i) \quad \dots (3)$$

Glaister develops a pair of alternative models, each of which rests on distinct assumptions about the values taken by these elasticities at the initial demand points.

3 The model for independent demands

In the first of these models (which we call Case A), each demand is supposed to be independent of the other prices i.e. all the cross-price elasticities are taken to be zero. Further, Glaister quotes some evidence on overall price elasticities and then chooses

$e = e_{ii} = -1.5$ for all i . On these assumptions, from (2),

$$\xi_j^i = 0 \quad (\text{for all } i \neq j)$$

$$\xi_i^i = -\frac{3}{38} \bar{q}_i \quad (\text{for all } i) \quad \dots (4)$$

and, from (3),

$$\xi_0^i = \bar{q}_i - \xi_i^i \bar{p} = 2.5 \bar{q}_i \quad \dots (5)$$

Together with Glaister's linear cost function (for the capital cost of capacity and for the various types of operating cost), this gives a quadratic profit function, to be maximised by appropriate choice of the 18 variables (viz. prices p_i and capacity q), subject to a capacity constraint for each of the 17 periods. Using a quadratic programming algorithm, Glaister obtained the results shown in the first two columns of our Table 1. Our own calculations yield the results in the next two columns. Our optimal capacity of 768 vuph is almost identical with his value of 770 vuph; however, there are small but disturbing discrepancies in several of the off-peak prices. These discrepancies are now explored.

The dual values, associated with the capacity constraints, measure the rate of change of the objective function. Each dual relates to a relaxation of a single capacity constraint, and not to a general increase in capacity (which would be available in all periods). Thus each dual measures the rate of change of the revenue function if (somehow) more vehicles could be carried in the period in question; and it relates to revenue after netting out operating costs (but not capacity costs). As shown in Table 1, capacity is not fully used in period 7 nor in periods 10 to 17. For each of these periods, a

necessary condition for profit maximisation is that marginal (gross) revenue must equal marginal (operating) cost, and in any one period marginal operating cost per vehicle is a constant (here called c), because of the linearity of the cost function. Now gross revenue in period i is $R_i = t_i p_i q_i$ where t_i hours is the duration of period i . Thus marginal (gross) revenue is

$$\begin{aligned} \frac{dR_i}{dq_i} &= t_i \left(p_i + q_i \frac{dp_i}{dq_i} \right) = t_i \left(2p_i + \xi_0^i / \xi_i^i \right) \\ &= t_i \left(2p_i - \frac{95}{3} \right) \end{aligned} \quad \dots (6)$$

by virtue of (1), (4) and (5). When marginal revenue equals the per-period marginal operating cost $t_i c$,

$$p_i = \frac{1}{2} \left(c + \frac{95}{3} \right) \quad \dots (7)$$

Now marginal cost in periods 7, 10 and 12 to 17 is simply Glaister's direct operating cost $\gamma = 0.37$, giving $p_i = 16.018$. For period 11, output also attracts the permanent labour force cost, which (when prorated per vehicle) is $573 \div 173.2 = 3.3083$; thus here $c = 3.6783$ and (7) then yields $p_{11} = 17.672$. This analysis confirms the relevant price results from our programming calculations, and shows that in periods when capacity is not fully used, it is optimal to charge a relatively low price, which is related to marginal operating cost.

4 A reformulation of the model for dependent demands

For his second model, Glaister allows for dependent demands, and the system now takes the general form (1). He uses hypothetical (but plausible) data for the cross-elasticities, with values designed to

give symmetry in the substitution effects (p.106). But he supposes that all the own-price elasticities are still -1.5 , apparently not realising the significance of this assumption. The effect is to portray demands as being more inelastic (overall) and to lead to 'optimal' prices which are much too high.

In order to explore this point, consider variations around the initial prices $p_i = \{1\}$, variations which are such that the prices remain equal to each other i.e. all $p_i = p$. Now the overall price elasticity is

$$e_i = \frac{p}{q_i} \frac{dq_i}{dp} \quad \dots (8)$$

while, from (1),

$$\frac{dq_i}{dp} = \sum_j \xi_j^i \frac{dp_j}{dp} = \sum_j \xi_j^i \quad \dots (9)$$

since all $p_j = p$. Thus at the initial demand point

$$e_i = \frac{\bar{p}}{\bar{q}_i} \sum_j \xi_j^i \quad \dots (10)$$

In Case A, substituting from (4), the overall elasticity is $e_i = -1.5$ (for all i) as intended. But in the construction of Glaister's second model (here called Case B), some positive terms are added on the right hand side of (10) while the own-price term remains as before; thus the absolute values of the overall elasticities are greatly reduced, most of them falling in the range -0.1 to -0.5 .

With demand now represented as being more inelastic (overall), it is hardly surprising that the model yields much higher optimal prices and lower optimal capacity. Glaister's results are reproduced

in Table 1 (in the columns headed 'Case B'). (We have performed calculations for this case, and obtain prices which are relatively close to Glaister's; however our result for optimal capacity is 450 vuph, whereas Glaister quotes 520 vuph.)

Now the empirical evidence quoted by Glaister suggests an overall elasticity of -1.5 , and it is this situation which Glaister intends to analyse. Thus Glaister's formulation (Case B) does not seem to be a very useful representation. Accordingly we have analysed a Case C, in which the cross-price elasticities are those specified by Glaister, but in which the own-price elasticities are adjusted so as to give in each period an overall elasticity of -1.5 . For Case C, then, (10) is adapted to yield

$$\xi_i^i = -\sum_{j \neq i} \xi_j^i + e_i \bar{q}_i / \bar{p} = -\sum_{j \neq i} \xi_j^i - 3\bar{q}_i / 38 \quad \dots (11)$$

and

$$e_{ii} = \bar{p} \xi_{i/q_i}^i = -1.5 - (19/\bar{q}_i) \sum_{j \neq i} \xi_j^i \quad \dots (12)$$

Most of the e_{ii} then fall in the range -2.5 to -2.9 . In other words, the possibility of transfer to "adjacent" periods makes the demand a good deal more sensitive to own-price than in Case A.

For Case C, the quadratic programming calculations yield the results shown in the last two columns of Table 1. Marginal revenue insights are again of interest. As shown in the Appendix, for Case C marginal revenue in any period is

$$\frac{dR}{dq_i} = t_i \{2p_i + \xi_0^i / \sum_j \xi_j^i\} \quad \dots (13)$$

In each period in which capacity is not fully used, optimisation again requires that marginal revenue should equal marginal cost. For Case C, as for Case A, this yields $p_i = 16.018$, except in period 11 for which $p_{11} = 17.672$. This confirms some of the Case C results in Table 1.

5 Discussion of the new results for peak load pricing

Given that the same overall elasticity is used in Cases A and C, it is not surprising that the results are broadly similar. However there are some instructive differences. With dependent demands, it is possible to use prices to transfer demand from the busiest periods to adjacent periods which are not quite so busy. In contrast, in Case A with independent demands, traffic not accommodated in the period in which it offers is lost entirely. In consequence, period 4 capacity in Case A is only just used up, whereas in Case C the price in that period is somewhat higher, as a result of some demand transferring from the busier periods 1, 2 and 3, for which prices are now a little lower. Overall, there is somewhat better use of capacity in Case C, optimal capacity is a little smaller, and profit a little larger, as shown by some calculations which are summarised in the first two columns of Table 2.

As Glaister mentions, it is desirable to avoid undue tariff complexity. It is now seen that seven periods in Case C (eight in Case A) have a uniform optimal price of £16. In these periods, capacity is not fully used; optimal price is related to marginal operating cost, and is significantly less than the uniform price £19 proposed in the Governmental study. For the other periods, it would not be difficult to devise groupings of periods, if desired in the interests of tariff simplicity. For example, the tariff might comprise

just five distinct prices, say £25, £22, £20, £18 and £16 (in Case C).

In Glaister's formulation of dependent demands (Case B), most of the optimal prices are in the range from £44 to £56, disturbingly higher than the uniform price initially considered. In contrast, in our formulation (Case C), all optimal prices are relatively close to that initial price of £19 for which the demand system has been calibrated. This outcome is fortunate, for two reasons: the linearisation of the demand system is likely to be a very poor approximation when prices are as high as £50; and these very high prices of Case B would be much more likely to yield political opposition to the idea of peak/off-peak price differentials. In contrast, the price differentials (and the absolute price levels) of Cases A and C are modest enough to make such political opposition unlikely.

6 A re-examination of the base case of uniform pricing

Although the price differentials introduced by peak-load pricing are relatively modest, that policy does significantly reduce the required level of capacity. Before pursuing that contrast, however, we take a closer look at the uniform-pricing policy which Glaister uses as a starting point for his comparisons.

From Glaister's account (pp.100-102), it seems that the official studies proposed a uniform price of £19, but it is not clear what capacity was proposed in those studies. The division of the year into 17 periods is Glaister's own construction, and the stated capacity of 2053 vuph is that required to clear the market in the busiest of these 17 periods (period 1). The first question is whether among all possible choices of a uniform price, the price of £19 is intended to maximise

profits. And if so, does that price maximise profit for the demand system as postulated by Glaister (including the use of 1.7 periods to make up the year)?

This second question may be answered by appropriate optimising calculations (which may be based on the Kuhn-Tucker conditions rather than on quadratic programming, because there are now only two policy variables). With uniform prices, the results will be the same no matter which demand system (Case A or Case C) is supposed. Summary results are shown in the third column of Table 2. The optimal price is £19.4, and this seems to suggest that Glaister's representation of the demand system is fairly close to that used in the official studies, if those studies intended £19 as a profit-maximising price.

In this solution, the percentage utilisation of capacity is so low as to prompt doubts as to whether it is truly optimal to have so much capacity. However equation (6) shows that at the price of £19.4, marginal revenue is about £7.1 per hour per unit, which is well above marginal (operating) cost in all periods. For a unit decrease in capacity (with the concomitant higher price, needed to clear the market in period 1, but used in all periods), the incremental loss of annual gross revenue is about \$6491 while operating cost savings are only \$477. Of course, the net figure (approximately) matches the saving in annual capacity cost (\$6016), and optimality is illuminated and confirmed.

The next question arises from the very brief duration of the two busiest periods, periods 1 and 2, which relate to a two-hour span from 12 noon on Saturdays in July and August respectively; the next busiest time is period 3, which comprises all other daytime hours on Saturdays in those months. As shown in Glaister's Table 1, for a uniform price of £19, it is optimal to install capacity of 2053 vuph;

however only 1533 vuph is needed in period 3, and of the extra capacity of 520 vuph, 444 vuph is used for barely 9 hours in the year, with the remaining 76 vuph used for barely 18 hours. Even within the context of a policy of uniform prices, it seems unlikely that it would be considered wise to provide so much extra capacity to be used for such a short time. Accordingly two alternative policies are now considered, both embodying only small departures from the philosophy of uniform prices.

The first alternative requires aggregation of periods 1, 2 and 3: it is assumed that (at a uniform price of £19) the total flow of vehicles in the new composite period is simply the sum of the flows in the three distinct periods. This presupposes that any demand not accommodated in periods 1 and 2 is willing to divert to period 3 i.e. is willing to queue for later service or to arrive earlier in the day. For the resulting 15-period demand model, the profit-maximising uniform price is then calculated, the results being shown in the fourth column of Table 2. The optimal capacity is greater than the flow of 1533 vuph quoted for period 3 by Glaister, in part because the optimal uniform price turns out to be £18.7, which is below the initial price of £19.¹

The second alternative is to use higher prices in periods 1 and 2, to smooth out demand. Among various ad hoc approaches which might be adopted, the one selected here is to keep the price of £19.4 for all other periods. Working with the assumption of independent demands (Case A), higher prices are then found which will clear the market in periods 1 and 2, if the installed capacity is 1489 vuph (the amount required to match demand in period 3 when the price is £19.4). The results are shown in the last column of Table 2.

While keeping broadly to the philosophy of uniform pricing, both of these alternative policies lop the very top of the peak; the second alternative uses a surcharge, while the first departs from strict market-clearing and hence relies on traffic spilling over into period 3. As the results show, when compared with a strict interpretation of uniform pricing, either of these modest changes leads to a major reduction in capacity and a major increase in profits.

7 Conclusions

Glaister argued that while uniform pricing leads to an optimal capacity of 2053 vuph, peak-load pricing reduces this to 770 or 520 vuph (according to the demand model used). Our results show that this conclusion is somewhat exaggerated. For the demand pattern postulated by Glaister, strictly uniform pricing leads to optimal capacity of 1993 vuph. This makes something of a fetish out of uniform pricing, however, and in practice it seems unlikely that so much capacity would be installed that about 25% of it would serve for no more than 18 hours per year. A more realistic alternative is peak lopping (involving only small departures from the uniform-pricing principle) and this reduces capacity to about 1500 to 1650 vuph. Compared with this, full application of the peak-load pricing principle does yield a further major capacity reduction, bringing optimal capacity down to about 700 to 750 vuph (depending on the demand model).

The price differentials required to achieve this reduction are relatively modest (unlike those calculated by Glaister for his model of dependent demands). Not discussed by Glaister are the consequences for total annual traffic flow: as seen in Table 2, the policies which bring reduced optimal capacity do not reduce this traffic level.

Indeed full peak-load pricing leads to a slight increase, the reason being that the low marginal operating cost leads to a lower optimal price in periods when capacity is not fully used, and these periods are of great total duration. Consequently the percentage utilisation of capacity is markedly increased.

Finally, profits are increased significantly by peak-logging, and even further increased by full peak-load pricing, though the latter improvements are not as great as those stated by Glaister. Compared with the peak-logging policies, full peak-load pricing reduces optimal capacity by about 50% and increases profit (as defined) by about 15% to 20%.

FOOTNOTE

1. For a case of welfare maximisation and independent demands, Craven (1971) offers a formal approach to the optimal division of the whole cycle into periods.

REFERENCES

- Stephen Glaister (1976), "Peak load pricing and the Channel tunnel: a case study", Journal of Transport Economics and Policy 10, 99-112.
- John Craven (1971), "On the choice of optimal time periods for a surplus-maximizing utility subject to fluctuating demand", Bell Journal of Economics 2, 495-502

Appendix: Marginal revenue in the case of interdependent demands

Suppose that the i^{th} demand quantity q_i increases by a small increment Δq_i , while all other quantities remain unchanged i.e. while $\Delta q_j = 0$ for all $j \neq i$. The set of price changes which induces this set of changes in demand quantities is denoted Δp_j (for all j).

Gross revenue is $R = \sum_j t_j q_j p_j$ and, ignoring the second-order terms in Δp_j , Δq_j , the incremental revenue is

$$\Delta R = \sum_j t_j (p_j \Delta q_j + q_j \Delta p_j)$$

For the particular increment Δq_i (with all other $\Delta q_j = 0$), this becomes

$$\Delta R = t_i p_i \Delta q_i + \sum_j t_j q_j \Delta p_j \quad \dots (A1)$$

Using S to denote the summation term in (A1), and employing the demand system (1), from the main text, to substitute for the q_j ,

$$\begin{aligned} S &= \sum_j t_j q_j \Delta p_j = \sum_j t_j \xi_0^j \Delta p_j + \sum_k \sum_j p_k t_j \xi_k^j \Delta p_j \\ &= \sum_j t_j \xi_0^j \Delta p_j + \sum_k p_k t_k \sum_j \xi_j^k \Delta p_j \quad \dots (A2) \end{aligned}$$

by virtue of the symmetry of the substitution effects (cf. Glaister p.110), which ensures that $t_j \xi_k^j = t_k \xi_j^k$.

Also, taking increments in the demand system (1),

$$\Delta q_j = \sum_k \frac{\partial q_j}{\partial p_k} \Delta p_k = \sum_k \xi_k^j \Delta p_k \quad \dots (A3)$$

and thus (A2) may be written

$$S = \sum_j t_j \xi_0^j \Delta p_j + \sum_k p_k t_k \Delta q_k$$

$$= \sum_j t_j \xi_0^j \Delta p_j + p_i t_i \Delta q_i$$

since $\Delta q_k = 0$ for all $k \neq i$.

Substitution in (A1) of this value for S yields

$$\Delta R = 2p_i t_i \Delta q_i + \sum_j t_j \xi_0^j \Delta p_j \quad \dots (A4)$$

This result holds for all linear demand systems which have symmetry in the substitution effects.

Using the additional properties of the present case, the summation term in (A4) may be further refined. From (3) in the main text,

$$\xi_0^j = \bar{q}_j - \bar{p} \sum_k \xi_k^j \quad \dots (A5)$$

and from (10),

$$\bar{q}_j = \frac{\bar{p}}{e} \sum_k \xi_k^j \quad \dots (A6)$$

where e denotes the overall elasticity of demand, which (by assumption) is the same for all j . Thus, after substituting for \bar{q}_j ,

$$\xi_0^j = \frac{1-e}{e} \bar{p} \sum_k \xi_k^j$$

and on substituting this, the summation term in (A4) becomes

$$\begin{aligned} & \frac{1-e}{e} \bar{p} \sum_j \sum_k t_j \xi_k^j \Delta p_j \\ &= \frac{1-e}{e} \bar{p} \sum_j \sum_k t_k \xi_j^k \Delta p_j \quad \text{from the symmetry} \\ &= \frac{1-e}{e} \bar{p} \sum_k t_k \sum_j \xi_j^k \Delta p_j \end{aligned}$$

$$= \frac{1-e}{e} \bar{p} t_i \Delta q_i$$

from (A3), and since $\Delta q_k = 0$ for $k \neq i$. Using (A5) and (A6) to eliminate \bar{p} and e , this may be written alternatively as

$$t_i \Delta q_i \xi_0^i / \xi_j^i$$

When this result has been substituted in (A4), that equation may be divided by Δq_i , and on taking the limit as $\Delta q_i \rightarrow 0$, the result is marginal revenue

$$\frac{\partial R}{\partial q_i} = t_i \{ 2p_i + \xi_0^i / \xi_j^i \} \dots (A7)$$

Clearly, this result is a generalisation of equation (6) in the main text. Its simplicity is due to the assumption that the overall price elasticity is the same in all periods, when measured at a uniform price \bar{p} .

Table 1: Prices and duals (in £) for independent and dependent demands

period	Case A: independent demands				dependent demands			
	original		revised		Case B		Case C	
	price	dual	price	dual	price	dual	price	dual
1	26.9	188	26.9	189	56.4	170	25.5	164
2	25.6	166	25.6	166	56.0	172	24.9	153
3	25.3	968	25.3	968	54.8	1251	23.7	803
4	16.1	7	16.1	26	41.6	722	18.2	608
5	24.9	616	24.9	616	48.8	593	24.2	568
6	23.6	1586	23.6	1583	50.9	880	22.5	1355
7	16.0	0	16.0	0	42.9	2036	16.1	38
8	22.0	822	22.0	823	44.7	182	21.5	757
9	20.0	1662	20.0	1643	45.1	8	19.8	1569
10	15.7	0	16.0	0	45.0	0	16.0	0
11	19.7	0	17.7	0	51.0	0	17.7	0
12	16.0	0	16.0	0	46.0	0	16.0	0
13	16.1	0	16.0	0	44.5	0	16.0	0
14	16.0	0	16.0	0	43.9	0	16.0	0
15	16.1	0	16.0	0	29.0	0	16.0	0
16	16.8	0	16.0	0	26.9	0	16.0	0
17	15.8	0	16.0	0	15.9	0	16.0	0

Table 2: Summary results for alternative pricing policies

Demand model	Peak-load pricing for profit max.		Uniform pricing for profit maximisation		Peak lopping
	Case A	Case C	17 periods	15 periods	Case A
Prices (£)	(see Table 1)	(see Table 1)	19.4	18.7	p_1 : 22.5 p_2 : 19.9 other : 19.4
Capacity (vuph)	768	692	1993	1653	1489
Annual traffic flow (mvu)	2.01	1.96	1.83	1.94	1.83
Annual capacity utilisation, %	30.0	32.4	10.5	13.4	14.0
Profit* (£ million)	29.4	29.9	22.5	25.2	25.5

* Before netting out capital costs other than those for the terminal facilities.

WORKING PAPERS IN ECONOMICS

- | | | |
|-----|------------------------------|--|
| * 1 | I.G. Sharpe | A Framework for Analysis of the Money Supply Process in Australia |
| * 2 | I.G. Sharpe &
R.G. Walker | Asset Revaluation and Stock Market Prices |
| * 3 | N.V. Lam | Incidence and Stabilization Impact of Tin Export Taxation in West Malaysia |
| * 4 | V.B. Hall &
M.L. King | Inflationary Expectations in New Zealand: A Preliminary Study |
| * 5 | A.J. Phipps | Strike Activity and Inflation in Australia |
| 6 | N.V. Lam | Incidence of the Rice Export Premium in Thailand |
| * 7 | I.G. Sharpe | Secondary Reserve Requirements, the Monetary Base and the Money Supply in Australia |
| 8 | P. Saunders | Labour Demand Functions and the Quasi-Fixity Hypothesis: Some Empirical Results for U.K. Manufacturing Industries, 1963-1974 |
| 9 | W.P. Hogan | Economic Strategies for Recovery |
| 10 | T.P. Truong | Asset Revaluation and Share Prices: A Study using the M.S.A.E. Regression Technique |
| 11 | S. Kim | Instability of Primary Exports, Income Stabilization Policies and Welfare |
| *12 | I.G. Sharpe &
P.A. Volker | Institutional Change, Specification Error, Inflation and the Stability of the Demand for Money Function in the United States, 1901-1974 |
| *13 | I.G. Sharpe &
P.A. Volker | The Impact of Institutional Changes on the Australian Short-Run Money Demand Function |
| *14 | W.P. Hogan | The Connections Between Foreign Trade and Economic Development: An Empirical Study |
| *15 | F. Gill | The Case of the Black Exodus from the Southern U.S., 1910-1970: Some Lessons for Theory and Applied Theory |
| *16 | A.J. Phipps | The Impact of Wage Indexation on Wage Inflation and Strike Activity in Australia |
| *17 | V.B. Hall | Pricing Behaviour in Australia: A Data Evaluation Study |
| *18 | I.G. Sharpe | Australian Money Supply Analysis: Direct Controls and the Relationship Between the Monetary Base, Secondary Reserve and the Money Supply |
| *19 | L. Haddad | Economic Systems: Towards a New Classification |
| 20 | G. Lewis | A Strategy for Winning at Roulette |

- 21 R.L. Brown A Test of the Black and Scholes Model of Option Valuation in Australia
- * 22 V.B. Hall Pricing Behaviour in Australian Manufacturing Industry: Hypothesis Testing 1955-1956 to 1967-1968
- *23 I.G. Sharpe & P.A. Volker The Selection of Monetary Policy Instruments: Evidence from Reduced Form Estimates of the Demand and Supply of Money in Australia
- *24 V.B. Hall Excess Demand and Expectations Influences on Price Changes in Australian Manufacturing Industry
- *25 I.G. Sharpe & P.A. Volker The Tradeoff Between Improved Monetary Control and Market Interest Rate Variability in Australia: An Application of Optimal Control Techniques
- *26 Evan Jones with the assistance of Mary MacDonald An Examination of Earnings Differentials in Australian Manufacturing Industry
- 27 W.P. Hogan Questions on Structural Adjustment Policies
- 28 P. Saunders Price and Cost Expectations in Australian Manufacturing Firms
- 29 W.P. Hogan, I.G. Sharpe & P.A. Volker Regulation, Risk and the Pricing of Australian Bank Shares 1957-1976
- 30 W.P. Hogan Quicksands of Policy-Making
- 31 C. Emerson Taxing Natural Resources Projects
- 32 R.W. Bailey, V.B. Hall & P.C.B. Phillips A Small Model of Output, Employment, Capital Formation and Inflation, applied to the New Zealand Economy
- 33 W.P. Hogan Eurofinancing: Currencies, Loans and Bonds
- 34 S. Adei The Growth of Foreign Investment and Economic Nationalism in Post Independence Ghana: 1957-1975
- 35 W.P. Hogan The 40 Per Cent Investment Allowance
- 36 W.P. Hogan Controlling Eurofinance Markets
- 37 R.T. Ross Disaggregate Labour Supply Functions for Married Women: Preliminary Estimates for New Zealand
- 38 U.R. Kohli Beginning- and End-of-Period Specifications of Asset Market Equilibrium in Balance-of-Payments

39	G. Mills	Government Incentive Contracts with Private Companies: Some Lessons from the Channel Tunnel
40	C.G.F. Simkin	Closer Economic Relations Between Australia and New Zealand
41	U.R. Kohli	Relative Price Effects and the Demand for Imports
42	W.J. Merrilees	Alternative Models of Apprentice Recruitment: with Special Reference to the British Engineering Industry
43	P. Saunders	Price Determination in Australian Manufacturing Firms: A Cross-Section Study
44	W.P. Hogan	Immigration Policies and Issues
45	W.J. Merrilees	Labour Market Segmentation in Canada: A Translog Approach
46	W.J. Merrilees	Pricing Strategies in the Newspaper Industry
47	J.L. Whiteman	The Micro-Foundations of Layoffs and Labour-Hoarding
48	U.R. Kohli	On the Duality between Fixed and Flexible Exchange Rates.
49	U.R. Kohli	Nonjoint Technologies
50	P. Saunders	Price Determination, Expectations Formation and some Tests of the Rationality of Australian Price Expectations
51	J.L. Whiteman	Rational Choice, Learning-By-Doing and the Personal Distribution of Income.
52	J.L. Whiteman	Firm- Specific Human Capital, Experience and the Differential Incidence of Unemployment.
53	J. Yates	An Analysis of Asset Holdings in Australia By Income Class.
54	J. Yates	An Analysis of the Distributional Impact of Imputed Rent Taxation.
55	G. Mills	Investment in Airport Capacity - A Critical Review of the MANS Study
56	V.B. Hall & P. Saunders	Pricing Models In Australian Manufacturing The Evidence From Survey Data.
57	P. Saunders	How Rational are Australian Price Expectations?
58	F. Gill	The Costs of Adjustment and the Invisible Hand with Special Reference to the Labour Market

Papers marked with an asterisk are out of stock. Copies of the others are available upon request from:

Department of Economics,
The University of Sydney,
N.S.W. 2006.

Working Papers in Economics that have
been accepted for publication elsewhere

2. I.G. Sharpe & R.G. Walker Journal of Accounting Research, Fall, 1975, 293-310.
3. N.V. Lam Journal of the Developing Economies vol. 17, No. 1, March 1979.
4. V.B. Hall & M.L. King New Zealand Economic Papers, 1976, 118-51.
5. A.J. Phipps Economic Record, September 1977, 297-319.
6. N.V. Lam Journal of Development Studies, vol. 14, No. 1, October 1977.
7. I.G. Sharpe Australian Journal of Management, April 1976, 85-106.
9. W.P. Hogan Economic Papers, No. 55, The Economic Society of Australia and New Zealand, 29-57.
12. I.G. Sharpe & P.A. Volker Economics Letters, 2, 1979, pp.45-49.
13. I.G. Sharpe & P.A. Volker Kredit und Kapital, vol.12, No. 1, 1979.
14. W.P. Hogan Some Calculations in Stability and Inflation, A.R. Bergstrom et.al. (eds), John Wiley and Sons, 1978.
15. F. Gill Australian Economic Papers, vol. 19, No. 35, December 1980.
18. I.G. Sharpe Journal of Banking and Finance, 4, 1980, pp. 283-300.
21. R.L. Brown Australian Journal of Management, vol. 3, No. 1, April 1978, 17-36.
23. I.G. Sharpe & P.A. Volker The Australian Monetary System in the 1970s, M. Porter (ed.), Supplement to the Economic Record, 1978.
24. V.B. Hall Economic Record, vol. 56, No. 152, March 1980, 69-81.
25. I.G. Sharpe & P.A. Volker Australian Journal of Management, October 1979, pp. 119-134.
27. W.P. Hogan Malayan Economic Review, vol. 24, No. 1, April 1979.
28. P. Saunders Australian Economic Papers, vol. 19, No. 34, June 1980.

