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Keywords

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Disciplines

Business | Social and Behavioral Sciences

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Assessing the Impact of Change in Petroleum Prices on Inflation and Household Expenditures in Australia

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Abstract[1]

In this paper we examine three broad issues: (a) the expected impact of the recent petrol price rises on prices throughout the economy, (b) the hypothesis that the economy is now less susceptible to oil price rises than it was in the 1970s when the first major oil prices occurred, and (c) the likely distributional impacts of the petrol price rises? A modified input-output (IO) price model is used to simulate the impact of a two-fold increase in petrol prices on the sectoral and aggregate price indices in Australia. The 1996-97 and 1977-78 IO tables are used. Among the results is an estimated impact on the consumer price index of 1.8 per cent. Also, the same petrol price shock would have consistently larger price effects in the late 1970s than in the late 1990s. Further, using the 1998-99 Household Expenditure Survey, we find that the petrol price rises are regressive.

Keywords: Input-output analysis, Australia's economy, and petroleum prices.

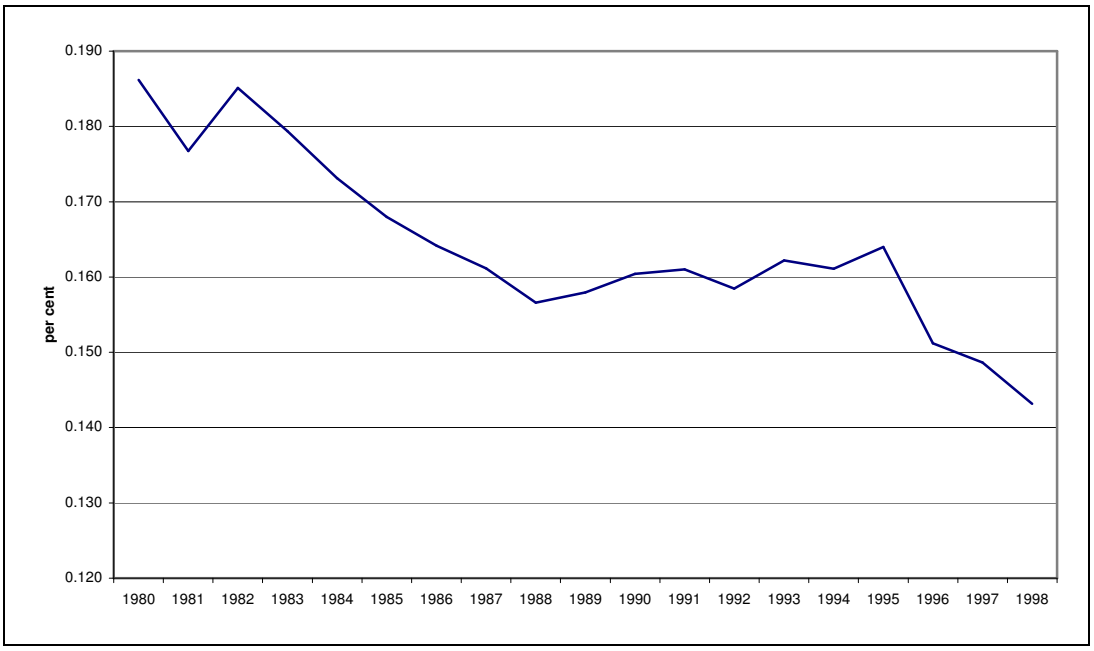
1. Introduction

In this paper we examine three broad questions: First, what will the expected impact of the recent petrol price rises be on prices throughout the economy? Second, is there evidence to support the hypothesis that the economy is now less susceptible to oil price than it was in the 1970s when the first major oil prices occurred? Third, what are the likely distributional impacts of the price rises induced by the petrol price rises?

During the last two years there has been a significant rise in petrol prices in Australia. The rising petrol prices were among the most topical issues in Australia during the last two years, even though they remain relatively low in comparison to other OECD countries and in real terms have actually declined since the 1980s (Webb, 2000). Liberal and Labour State Governments and rural organisations called on the Federal Government to provide offsetting excise tax relief. A major retailer noted some goods passed through several intermediaries before being loaded on store shelves, and petrol costs were levied at each stage of the transfer (Wood, 2000). The impact on Australia's inflation rate, especially given that the Goods and Services Tax introduction had already added several percentage points to the underlying rate in the third quarter of 2000 was thus, a concern. However, other commentators argued that Australia was now less susceptible to rises in crude oil and refined petrol prices than it was in the 1970s when the first OPEC oil price shocks occurred. David Uren (2000) said "Since the Gulf war, there has been a view that the world is no longer susceptible to shocks as serious as in the seventies … Although it is true that energy in general and oil in particular is a much smaller share of the industrialised economies now than it was in the 1970s …"

Figure 1 shows that energy intensity (measured by petroleum used in thousands of barrels per day as a percentage of real GDP) has steadily declined in Australia since 1980. Following the two large oil price rises in the 1970s, the ratio declined substantially. With lower petrol prices in the second half of the 1980s the ratio moved up slowly but the downward trend reasserted itself in the post Gulf War period. This suggests that we should test the hypothesis that the petrol prices rises will have a smaller overall price impact now than an identical petrol price shock in the 1970s.

Figure 1 Petroleum Use (Thousand Barrels per Day)/Real GDP, Australia, 1980-1998



Source: Energy Information Administration, Washington, http://www.eia.doe.gov

In this paper we do not seek to explain the reasons underlying the increase in petrol prices over the last two years. Our focus is on the consequences of the price rises on the production costs of various industries. We aim to measure the impact of a two-fold increase in the price of the petroleum and coal products industry (as an important

intermediate input provider) on the sectoral and aggregate price indices in Australia, employing a modified version of the Leontief IO price model. The 1996-97 IO table is used to quantify the impacts of the recent exogenous petrol price rises on the prices of the other 34 endogenous sectors. Within this framework, we also examine the way in which structural changes through time can affect the determination of prices. For this purpose, the 1977-78 IO table is used to generate the sectoral price responses to the same price shock in the petroleum and coal products industry. We show that the economy is now less susceptible to petrol price rises than in the 1970s. Finally, we marry the price rise estimates obtained from the IO analysis with household spending patterns described in the Australian Bureau of Statistics, *Household Expenditure Survey*, to assess the distributional impacts of the estimated sectoral price rises. We find that the petrol-price induced rises impact relatively more on the lowest income group (first quintile of the income distribution) than on the top income group (fifth quintile).

This paper is structured as follows. Section 2 outlines the theoretical and analytical framework of the modified version of an IO price model that we use. Section 3 discusses the data and sectoral coverage as well as the specific data problems associated with the study. Section 4 presents the empirical findings of the simulations in terms of the three aims stated above. Concluding remarks follow.

2. Theoretical Framework

The IO price model (Leontief, 1951) has been widely used both in developed and developing countries to analyse the nature of cost-price inter-relationships within a sectoral framework. For example, the PRISMOD analysis developed by the Commonwealth Treasury is a recent Australian application that allows one to measure the

price effects of the Goods and Services Tax introduced in July 2000 (see Dixon and Rimmer, 2000).

An IO system is a simplified representation of the production side of an economy, where the set of producers of analogous goods and services form a homogeneous industry. Each industry requires different inputs to produce its output, with these inputs procured from other domestic industries or from suppliers of non-domestically produced inputs (intermediate imports). IO systems are based on the following assumptions: (1) homogeneity of output; (2) zero rates of substitution between inputs; (3) fixed proportions between inputs and outputs; (4) absence of economies of scale; (5) linearity of coefficients; and (6) exogeneity of primary inputs and final demand components. In this paper, we employ a modified version of the IO price model, which we outline after initially introducing the standard Leontief price model. In the following price system it is assumed that the price in a particular sector P_i depends on: (1) the domestic input coefficients (a_{ij}), (2) the prices of the required intermediate domestic inputs, (3) the domestic primary input components (such as wages, operating surplus, indirect taxes, subsidies) or value-added per unit of output, and (4) the value (price times quantity) of intermediate imports per unit of output.

This price system can be written as:

$$\begin{cases} P_1 = a_{11}P_1 + a_{21}P_2 + ... + a_{n1}P_n + v_1 + m_1 \\ P_2 = a_{12}P_1 + a_{22}P_2 + ... + a_{n2}P_n + v_2 + m_2 \\ ..... \\ P_n = a_{1n}P_1 + a_{2n}P_2 + ... + a_{nn}P_n + v_n + m_n \end{cases} \quad (1)$$

where:

P_i = the price index for the ith sector (i = 1, 2,…, n),

a_{ij} = domestic direct coefficients,
v_i = the ratio of value added at market prices to output in the ith sector (V_i/X_i), and
m_i = the ratio of imported inputs to output in the ith sector (M_i/X_i).

The IO price system of Equation (1) can be written in matrix notation as:

$$\begin{bmatrix} P_1 \\ P_2 \\ .. \\ P_n \end{bmatrix} = \begin{bmatrix} a_{11} & a_{21} & \dots & a_{n1} \\ a_{12} & a_{22} & \dots & a_{n2} \\ .. & .. & \dots & .. \\ a_{1n} & a_{2n} & \dots & a_{nn} \end{bmatrix} . \begin{bmatrix} P_1 \\ P_2 \\ .. \\ P_n \end{bmatrix} + \begin{bmatrix} v_1 \\ v_2 \\ .. \\ v_n \end{bmatrix} + \begin{bmatrix} m_1 \\ m_2 \\ .. \\ m_n \end{bmatrix} \tag{2}$$

Thus:

$$\mathbf{P} = \mathbf{A}'\mathbf{P} + \mathbf{v} + \mathbf{m} \tag{3}$$

And rearranging gives:

$$\left(\mathbf{I} - \mathbf{A}'\right)\mathbf{P} = \mathbf{v} + \mathbf{m} \Rightarrow \mathbf{P} = \left(\mathbf{I} - \mathbf{A}'\right)^{-1}(\mathbf{v} + \mathbf{m}) \tag{4}$$

Equation (4) is the Leontief IO price model (Miller and Blair, 1985, p.354). Given the constancy of the direct coefficients (a_{ij}) and intermediate import requirements (**m**), Equation (4) implies that **P** is a function of **m** as well as **v** and can be "used to assess the impact on prices throughout the economy of an increase in value-added costs in one or more sectors" (Miller and Blair, 1985, p. 356). If $\mathbf{A}'$, **m** and **v** are substituted into Equation (4) from a base year IO table, one obtains an *n*-element vector of sectoral prices of unity, which are referred to as the basic or benchmark price levels.

Equation (4) is used to measure the sectoral price impacts of changes in indirect taxes, subsidies, wages, the operating surplus (or any elements in the third quadrant of the IO table). However, Equation (4) shows that when the primary input shocks are imposed on the model, prices (**P**) in all sectors of the IO table are treated as endogenous variables. A shock to the IO price model can be imposed in two ways: (a) A price shock to one sector through an increase in, say, indirect taxes, wages, value added, imports; or (b) The

price of a commodity can be rendered exogenous by dropping it from the system. We adopt the second approach in this study. This is because we assume that the price in the petroleum and coal products (P_X) is entirely exogenous whereas the prices in the other *n-1* sectors are endogenous ($\mathbf{P_E}$). There are a number of internal and external factors affecting P_X via the items in the third quadrant of an IO table such as: indirect taxes, wages, profit margin and operational surplus, import prices and exchange rate (see Webb, 2000). To facilitate the simulation, we assume the internal factors are unchanged and that the remaining prices in the petroleum and coal products industry are exogenously set. By assuming P_X to be totally exogenous we are negating any feedbacks onto coal products and accepting this assumption that the major price components in the petroleum and coal products industry are established in world markets (dominated by OPEC in the case of petroleum and Japan in the case of coal). To model this exogeneity, we drop the P_X-equation from the system.

Equation (3) is thus partitioned into exogenous and endogenous components:

$$\begin{bmatrix} P_X \\ \mathbf{P_E} \end{bmatrix} = \begin{bmatrix} a_{XX} & \mathbf{A'_{EX}} \\ \mathbf{A'_{XE}} & \mathbf{A'_{EE}} \end{bmatrix} \cdot \begin{bmatrix} P_X \\ \mathbf{P_E} \end{bmatrix} + \begin{bmatrix} v_X \\ \mathbf{v_E} \end{bmatrix} + \begin{bmatrix} m_X \\ \mathbf{m_E} \end{bmatrix} \tag{5}$$

where:

P_x = the price index for the petroleum and coal products as an exogenous variable,
$\mathbf{P_E}$ = the (*n-1* x 1) column vector of basic prices in the endogenous sectors,
a_{xx} = the input requirement of the petroleum and coal products from its own output,
$\mathbf{A'_{EX}}$ = the (1 x *n-1*) row vector of the input requirements from the *n-1* endogenous sectors for the production of one unit of the petroleum and coal products,
$\mathbf{A'_{XE}}$ = the (*n-1* x 1) column vector of the input requirements from the petroleum and coal products sector for the production of one unit of output in each *n-1* endogenous sectors,
$\mathbf{A'_{EE}}$ = the (*n-1* x *n-1*) square matrix of the Leontief domestic direct coefficients of the *n-1* endogenous sectors,
v_X = the ratio of value added to the output in the petroleum and coal products sector,
$\mathbf{v_E}$ = the (*n-1* x 1) column vector of the ratio of value-added to output in the endogenous sectors,

m_X = the ratio of imported inputs to output in the petroleum and coal products sector,
$\mathbf{m_E}$ = the (n-1 x 1) column vector of ratio of imported inputs to output in the endogenous sectors, and,
n = the number of endogenous sectors (in this study 35 sectors).

With P_X-equation excluded from the IO price system under the assumption of exogeneity, Equation (5) then is focused on the determination of $\mathbf{P_E}$. Accordingly, Equation (9) can be written as:

$$\mathbf{P_E} = \mathbf{A'_{XE}}P_X + \mathbf{A'_{EE}}\mathbf{P_E} + \mathbf{v_E} + \mathbf{m_E} \tag{6}$$

After some algebraic manipulation we have:

$$\underset{(n\text{x}1)}{\mathbf{P_E}} = \underset{(n\text{x}1)}{\left(\mathbf{I} - \mathbf{A'_{EE}}\right)^{-1}} \underset{(n\text{x}1)(1\text{x}1)}{\mathbf{A'_{XE}}\ P_X} + \underset{(n\text{x}n)}{\left(\mathbf{I} - \mathbf{A'_{EE}}\right)^{-1}} \underset{(n\text{x}1)}{\left(\mathbf{v_E} + \mathbf{m_E}\right)} \tag{7}$$

In Equation (7) $\mathbf{A'_{XE}}$, $\mathbf{A'_{EE}}$ (note that these two matrices are transposed), $\mathbf{v_E}$, and $\mathbf{m_E}$ can be computed from a base year IO table and substituted into the system. It is assumed that these four components remained unchanged, when the impact of P_X on $\mathbf{P_E}$ is being measured. It should be borne in mind that when $P_X = 1$, there is no deviation in the price of the petroleum and coal products sector from its baseline value, and therefore, the solution of the system yields a column vector (n-1 x 1) of unity for $\mathbf{P_E}$. However, when, for example, the price of petroleum and coal products doubles, the shock is introduced to the system as $P_X = 2$. Assuming $P_X = 2$ and solving Equation (7) for $\mathbf{P_E}$, and, expressing the resulting price deviations from unity in percentage form, one can determine the impacts of this price shock on the n-1 endogenous sectors. It is worth noting that Equation (7) provides us with the sum of both direct and indirect impacts of a rise in P_X on $\mathbf{P_E}$. It is clear that the direct impacts can be easily calculated from relation (1) as:

$$\frac{\partial P_i}{\partial P_j} = a_{ji}$$

The direct effect shows the immediate price response of a sector, whereas the total effect determines the price changes after taking into account the sectoral inter-dependencies.

The next issue is to determine how one measures the overall impact of ΔP_X on the consumer price index (CPI) or the implicit price deflator for GDP? The impact of this price change varies from one sector to another, so the overall impact should be a weighted average of the sectoral price changes. Three different weights are applied: (1) the share of each sector in the total private consumption (*C*), (2) the share of each sector in GDP (*VA*), and (3) the share of each sector in total gross output (*Q*). The results will be sensitive to the weights used. Accordingly, if one is interested in measuring the impact of the price shock on the CPI, the first weighting is more appropriate. However, if one is seeking to determine the impact of the shock on the implicit GDP deflator, then the second weighting is more pertinent. Finally, for producers who are interested in the cost of both primary and intermediate inputs, the third weighting would be more applicable.

The IO price model fails to capture any dynamic links dynamic links between the exchange rate and wage rates (real or nominal). As a consequence, our results do not provide a medium to longer-term account of the inflationary path.

3. The Data

The aggregated version of the 1996-97 IO table with 35 sectors is used to simulate the impact of a two-fold increase in the price of petroleum and coal products on the price indices of the other 34 industries as well as the cost of aggregate output in the Australian economy. This table has been compiled on the basis of the System of National Accounts 1993, which is the latest international standard for compiling IO tables and national

accounts statistics (Australian Bureau of Statistics, ABS, 2001, Cat. 5209). All transactions recorded in the table are expressed at basic prices. The original 1996-97 IO table was compiled with 106 industry sectors but for the simplicity the aggregated version of this table is employed in this study. It is worth noting that in the disaggregated version of this table the most specific sector relating to the petroleum sector is "the Petroleum and coal products", and thus in terms of the specificity of our analysis the use of the 35-sector table in lieu of the 106-sector table is inconsequential. Had there been a separate sector for diesel fuel or petrol, we could have produced more accurate results. However, the results we obtain are still useful because the 34 sectors for which price changes are generated by the simulation are still meaningful from a policy perspective.

We also used the 1977-78 IO table (ABS, 1983, Cat 5209.0) to simulate the impact of doubling the price of petroleum and coal products in the late 1970s. If the simulation results obtained from the 1977-78 IO table yield price changes that are significantly above those from the 1996-97 table, then the hypothesis that the economy is now less susceptible to oil price rises than it was in the 1970s has plausibility. Initially the 1977-78 IO table had 108 sectors but to obtain comparable results we aggregated the table into 35 sectors using corresponding ANZSIC codes and definitions.

We are also interested in the distributional consequences of the simulated price changes. Once a price shock is imposed on the IO price model, the model is able to generate the deviation of each sector from the base line price. If one wants to examine how these production cost increases would be distributed across the different income groups**,** then it would be desirable to have private consumption data in the second quadrant of the IO table available by, say, quintiles. Unfortunately, the ABS does not

produce this data. As a result, we confine ourselves to a "rule of thumb comparison" of household expenditure survey figures with the computed sectoral price indices.

4. Empirical Results and Policy Implications

4.1 Price impacts and a declining susceptibility to petrol price shocks

Prior to undertaking any empirical simulation it is crucial to check the accuracy of various components ($\mathbf{A}'_{\mathbf{XE}}$, $\mathbf{A}'_{\mathbf{EE}}$, $\mathbf{v}_{\mathbf{E}}$, and $\mathbf{m}_{\mathbf{E}}$) of Equation (7). To this end, this system is solved with p_X set at unity and as theoretically expected for the baseline prices, it was observed that Equation (7) generated a (34 x 1) column vector of unity for $\mathbf{P}_{\mathbf{E}}$. The second stage of the simulation assumes that $P_X = 2$ and the sectoral price changes are obtained relative to the original normalized prices (that is, baseline $\mathbf{P}_{\mathbf{E}}$ or the (34 x 1) column vector of unity). We also report the comparisons of the identical simulations of the 1996-97 IO table and the 1977-78 IO table to assess whether the Australian economy is less susceptible to petrol price rises now than in the 1970s?

Table 1 shows the total (direct plus indirect) and direct effects of doubling the price of petroleum and coal products on various industries of the Australian economy using the 1977-78 and 1996-97 IO tables. A cursory look at the simulation results from both the 1977-78 and 1996-97 IO tables reveals that majority of Australia's industries in the mid-1990s are less susceptible to petroleum prices than the late 1970s. The comparison indicates that if the price of petroleum had been doubled in two separate scenarios one in 1977-78 and the other one in 1996-97, prices would increase in 1977 more significantly than those of 1996 in the majority of cases. Exceptions are Communication services; Accommodation, cafes & restaurants; Clothing and footwear; Mining; Property and business services; Wholesale trade; Textiles; Retail trade; Wood

and wood products; Repairs; Miscellaneous manufacturing; Government administration; and Forestry and fishing.

However, value added in these 13 sectors only constituted less than 38 per cent of GDP in both 1977 and 1994. Table 1 allows one to examine the most affected sectors in 1996 and 1977 and the changes (column 5) over the intervening period.

According to Table 1 four sectors experience a direct price (that is $a_{oil,j}$ times the increase in the price of oil) of more than one percent in 1996-97: Forestry and fishing (4.3 per cent); Transport and storage (4.0 per cent); Mining (2.4 per cent); and Agriculture, hunting and trapping (1.6 per cent). These sectors are thus relatively more reliant on Petroleum and coal products and therefore an increase in P_X immediately impacts on their production costs. Further, the indirect effects (total effect minus direct effect) in 1996-97 for the following 9 sectors exceed one per cent: Meat and dairy products (1.84 per cent); Non- metallic mineral products (1.64 per cent); Basic metals and products (1.64 per cent); Other food products (1.33 per cent; Beverages and tobacco products (1.20 per cent)); Textiles (1.20 per cent); Wood and wood products (1.18 per cent); Fabricated metal products (1.06 per cent); and Wholesale trade (1.01). The price increases in these sectors is mainly due to inter-dependencies among industries. These sectors may not use petroleum significantly as an intermediate input, but they need to buy intermediate inputs from those sectors in which petroleum constitutes a higher proportion of total intermediate cost. For example the meat and dairy products industry purchases only a negligible percentage of its intermediate inputs from the petroleum and coal products sector (with direct coefficient of 0.0011). But the transport and storage industry,

which is more directly affected (with a direct coefficient of 0.04), is crucial in the provision of transport services for the meat and dairy products industry.

Under the assumption that increases in petrol prices do not affect value-added or import prices, then they must generate domestic price level effects. The total impact in Table 1 indicates that the petrol price shock would have increased prices in the following 10 industries more than 1.5 per cent: Forestry and fishing (5.3 per cent); Transport and storage (4.82 per cent); Mining (3.8 per cent); Agriculture; hunting and trapping (2.45 per cent); Basic metals and products (2.40 per cent); Non- metallic mineral products (2.12 per cent); Meat and dairy products (1.95 per cent); Chemicals (1.72 per cent); Wholesale trade (1.56 per cent); and Other food products (1.51 per cent). We deduce from the simulation that if P_X increases, motorists, farmers and livestock breeders will mostly bear the costs and this is consistent with the claims of the leading automobile and farming lobby groups noted in the introduction.

Table 2 shows the share of each sector in total private consumption (*C*), the share of each sector in GDP (*VA*), and the share of each sector in total gross output (*Q*). A comparison between the 1977 and 1996 figures shows that the Australian economy has experienced sectoral shifts. For example, the share of the following 13 industries in total output, value added and household expenditures increased: Mining; Paper, printing and publishing; Miscellaneous manufacturing; Repairs; Accom. cafes & restaurants; Transport and storage; Communication services; Finance and insurance; Ownership of dwellings; Property and business services; Government administration; and Cultural and recreational services.

Table 1 A Comparison of Sectoral Inflation Rates

Sector	Percentage changes in $\mathbf{P}_E$				(2)/(4) ratio
	1977-78		1996-97		
	(1)	(2)	(3)	(4)	(5)
	Direct impact	Total impact	Direct impact	Total impact	
Agriculture, hunting & trapping	2.05	2.89	1.59	2.45	1.2
Forestry and fishing	4.32	4.95	4.28	5.03	1.0
Mining	1.28	1.93	2.38	3.18	0.6
Meat and dairy products	0.51	2.51	0.11	1.95	1.3
Other food products	0.36	1.75	0.18	1.51	1.2
Beverages and tobacco products	0.42	1.47	0.14	1.35	1.1
Textiles	0.12	0.94	0.07	1.27	0.7
Clothing and footwear	0.02	0.5	0.03	0.84	0.6
Wood and wood products	0.28	1.29	0.26	1.44	0.9
Paper, printing and publishing	0.48	1.13	0.25	0.97	1.2
Petroleum and coal products	-	100	-	100.	1.0
Chemicals	1.38	2.34	0.75	1.72	1.4
Rubber and plastic products	0.19	0.96	0.13	0.89	1.1
Non- metallic mineral products	1.13	2.35	0.49	2.12	1.1
Basic metals and products	1.01	2.49	0.76	2.40	1.0
Fabricated metal products	0.24	1.34	0.20	1.26	1.1
Transport equipment	0.19	0.83	0.04	0.71	1.2
Other machinery and equipment	0.18	0.91	0.06	0.82	1.1
Miscellaneous manufacturing	0.11	0.9	0.08	0.98	0.9
Electricity, gas and water	1.86	2.7	0.69	1.43	1.9
Construction	0.81	1.66	0.28	1.04	1.6
Wholesale trade	0.70	1.02	0.56	1.56	0.7
Retail trade	0.52	0.87	0.41	1.02	0.8
Repairs	0.21	0.57	0.27	0.63	0.9
Accom., cafes & restaurants	0.18	0.56	0.59	1.32	0.4
Transport and storage	5.02	5.58	3.97	4.82	1.2
Communication services	0.19	0.36	0.57	1.15	0.3
Finance and insurance	0.10	0.31	0.01	0.30	1.0
Ownership of dwellings	0.03	0.39	0.02	0.20	1.9
Property and business services	0.35	0.64	0.37	0.99	0.6
Government administration	0.29	0.8	0.27	0.82	1.0
Education	0.01	0.28	0.00	0.19	1.4
Health and community services	0.40	0.75	0.18	0.49	1.5
Cultural & recreational services	0.31	0.81	0.14	0.71	1.1
Personal and other services	0.52	0.93	0.50	0.89	1.0

Source: Authors' calculations.

Table 2 Sectoral shifts within the Australian Economy

Sector	Percentage of total:					
	Household expenditures (C)		Gross output (Q)		Value added (VA)	
	1978	1996	1978	1996	1978	1996
Agriculture; hunting and trapping	1.4	1.2	4.1	3.2	4.4	3.3
Forestry and fishing	0.2	0.4	0.4	0.3	0.4	0.2
Mining	0.0	0.2	3.5	4.3	4.0	4.7
Meat and dairy products	6.3	2.7	3.5	1.8	1.4	0.7
Other food products	4.9	4.2	2.8	2.2	1.5	1.2
Beverages and tobacco products	2.8	1.9	1.1	0.8	0.7	0.5
Textiles	1.6	0.6	1.3	0.6	0.8	0.3
Clothing and footwear	2.5	1.1	1.0	0.6	0.7	0.3
Wood and wood products	1.2	0.0	1.5	0.6	1.1	0.5
Paper, printing and publishing	0.6	1.2	2.1	2.1	1.7	1.7
Petroleum and coal products	1.3	0.8	1.5	1.1	0.7	0.3
Chemicals	1.2	0.7	2.1	1.7	1.3	1.0
Rubber and plastic products	0.5	0.5	1.1	0.8	0.8	0.6
Non- metallic mineral products	0.1	0.0	1.3	0.9	1.0	0.6
Basic metals and products	0.0	0.1	3.5	2.4	1.9	1.3
Fabricated metal products	0.3	0.2	2.2	1.5	1.6	1.1
Transport equipment	2.4	1.4	3.0	2.0	1.9	1.3
Other machinery and equipment	1.9	0.7	3.2	2.2	2.4	1.5
Miscellaneous manufacturing	0.5	0.5	0.3	0.7	0.3	0.5
Electricity, gas and water	2.2	3.1	2.8	2.4	3.0	2.6
Construction	0.0	0.0	8.7	6.5	7.6	6.1
Wholesale trade	5.6	4.9	6.0	6.1	7.9	4.8
Retail trade	15.8	15.6	5.3	4.7	6.0	4.3
Repairs	2.5	3.0	1.4	1.9	1.6	2.5
Accom. cafes & restaurants	4.2	6.2	1.6	3.0	2.1	2.4
Transport and storage	4.5	3.5	5.7	6.5	5.2	6.2
Communication services	1.6	2.4	1.6	2.6	2.5	3.0
Finance and insurance	3.5	6.5	3.9	4.9	5.3	6.4
Ownership of dwellings	18.0	20.6	5.6	5.8	7.3	9.7
Property and business services	0.7	1.4	3.8	11.4	5.1	10.7
Government administration	0.3	0.3	3.7	4.1	4.1	4.5
Education	0.8	2.2	3.3	2.8	4.9	4.8
Health and community services	6.9	5.2	5.2	4.1	6.8	6.1
Cultural and recreational services	2.4	3.6	1.5	1.8	1.5	1.8
Personal and other services	1.3	3.2	0.5	1.8	0.6	2.4
Total	100	100	100	100	100	100

Source: The 1996-97 and 1977-78 IO tables.

On the other hand, the following 15 sectors have shrunk in terms of all of these three measures: Health and community services; Other food products; Chemicals; Agriculture; hunting and trapping; Rubber and plastic products; Beverages and tobacco products; Fabricated metal products; Transport equipment; Other machinery and equipment; Non- metallic mineral products; Meat and dairy products; Wood and wood products; Petroleum and coal products; Clothing and footwear; and Textiles. The other industries fall somewhere in between. Some industries experienced an expansion in terms of one (or two) of the measures (output, or value added or household expenditure) while shrinkage in terms of another.

In the light of these structural changes we wish to assess whether the overall economy is now less susceptible to oil price rises than it was in the 1970s when the first major oil price rise occurred? This question can be answered by attaching the weights in Table 2 to the price increases in Table 1. Table 3 presents the overall impact of the price perturbation on the CPI (P_C), the cost of output (P_Q) and GDP price deflator (P_{VA}), respectively. The weighted average prices presented in Table 3 indicate that the petrol price shock in 1996-97 generates a 1.8 per cent change in the CPI, a 2.5 per cent change in the cost of output, and a 1.5 per cent change in the GDP price deflator. Likewise, the same exogenous shock in the price of petroleum in 1977-78 could have increased the CPI, the cost of gross output and the GDP deflator by 2.5 percent, 3.0 percent and 2.1 percent, respectively. Irrespective of which weight is used, the results show that a similar petrol price rise in the 1970s would have had a greater price impact on the Australian economy than in the 1990s. Given the differential sectoral price rises in Table 1 (Column 5) and aggregate impacts presented in Table 3, we conclude that the sectoral and overall

price reactions arising from the 1977-78 IO table are significantly higher than those arising from the 1996-97 IO table. This finding is consistent with the view that the Australian economy is less prone to price shocks induced by an exogenous change in the price of oil. But, these results cannot be used to say that the current impacts are insignificant.

Table 3 Impacts of Doubling PX on Aggregate Price Indices in 1977-78 and 1996-97

Percentage changes	1977-78	1996-97
Consumer price index	2.5	1.8
Gross Output	3.0	2.5
GDP deflator	2.1	1.5

Source: Authors' calculations.

4.2 Who bears the costs of the price rises?

In this section, we attempt to assess the distributional impacts of the price rises estimated in Section 4.1. In Section 3 we noted that the data on private consumption in the second quadrant of the IO table are not available by household income quintiles and thus we have to employ another method if we seek to relate the price increases to household expenditure by quintile.

Drawing on the 1998-99 Household Expenditure Survey (ABS, 2000), Table 4 summarises the expenditure on different consumer goods and services by percentage of total spending by household income quintile. A relative measure is needed to identify which expenditure items are relatively more important for the "poor" (first quintile) and for the "rich" (fifth quintile), respectively. In Table 4, our approximate relative measure is the quotient of the percentage share of the first quintile to the percentage share of the

fifth quintile. If the relative measure for an expenditure item exceeds unity, we conclude that the poor spend a higher proportion of their total expenditure on that item than the rich, and vice versa. We ranked the expenditure items according to the magnitude of the computed relative measure. Table 4 also shows that the poor households spend more on diesel fuel, kerosene, heating oil, lubricant and other oil, and meat and dairy products, other food products, LPG and other gas fuels. We have already seen from Table 1 that a rise in P_X increases the cost of producing these items in domestic industries relatively more than that of other items. These industries are domestic suppliers of consumer goods and services. Given the different share of income groups in the consumption of domestically produced goods and services, an increase in the price of petroleum can affect both households and producers. In terms of the impact on petrol prices themselves, the lowest and highest quintiles suffer equi-proportionate losses (see Table 4). Overall, while it is difficult to draw unambiguous conclusions, we would tentatively say that the price rises are regressive in their impact.

5. Conclusion

In this paper we have examined three broad issues: (a) the expected impact of the recent petrol price rises on prices throughout the economy, (b) the hypothesis that the Australian economy is now less susceptible to oil price rises than it was in the 1970s, and (c) the likely distributional impacts of the price rises on various income groups. We employed a modified version of the IO price model to simulate the impact of a two-fold increase in the price of the petroleum and coal products on sectoral inflation in Australia to help us examine these questions.

Using the 1996-97 IO table, our empirical simulations, *ceteris paribus*, indicate that this hypothetical price increase would raise the price of gross output by 2.5 per cent, the GDP price deflator by 1.5 per cent and the CPI by 1.8 per cent. The caveat is that we assumed that the prices in the petroleum and coal products sector were exogenous as a vehicle for introducing the petrol price shock. The 1996-97 IO table aggregates petroleum with coal products. Clearly, if petroleum was separated from coal products we would be more assertive, given that the nature of petrol price determination justifies an assumption of exogeneity (Webb, 2000). The results show that the transport sector and agricultural sub-sectors will mostly bear the cost of this price rise. These results lend support to the concerns of the transport and farming lobby groups expressed in the popular media over the last six months. This study can assist the Government in identifying the industries, which have been hit hardest by the large petrol price rises over last two years.

The paper has also shown that the sectoral price reactions arising from the 1977-78 IO table are significantly higher than those arising from the 1996-97 IO table. Our results are consistent with the view that the Australian economy is now less susceptible to oil price rises than it was in the 1970s when the first major oil prices occurred.

The final concern was to gauge the distributional impacts of the simulated price rises. Overall, while it is difficult to draw unambiguous conclusions, we would tentatively say that the price rises are regressive in their impact.

Table 4 Share of Household Expenditure on Different Goods and services, By Household Income Quintile Groups (Per cent)

Expenditure Item	Quintile					Relative Measure	Rank
	1st	2nd	3rd	4th	5th		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Domestic fuel and power (a)	3.8	3.3	2.7	2.3	1.9	1.90	1
Diesel fuel	0.2	0.1	0.2	0.2	0.1	1.87	2
Meat, and dairy products	5.4	5.4	4.5	3.9	3.4	1.60	3
Household services and operation	7.9	6.7	5.9	5.7	5.2	1.52	4
Other food products	8.6	8.7	7.4	6.7	5.8	1.47	5
LPG and other gas fuels (b)	0.2	0.2	0.3	0.2	0.2	1.46	6
Household appliances	1.9	1.9	1.6	1.2	1.4	1.36	7
Current housing costs (c)	16.1	15.1	15.6	13.8	12.0	1.34	8
Medical care and health expenses	5.2	4.9	4.4	4.7	4.5	1.11	9
Sub-total 1 (Group 1)	**49.0**	**46.2**	**42.7**	**38.8**	**34.5**	**1.40**	
Petrol	3.0	3.6	3.7	3.5	3.1	0.96	10
Beverages and Tobacco	5.9	6.6	6.4	6.2	6.2	0.96	11
Other goods and services	12.5	8.7	11.4	12.9	13.9	0.90	12
Cultural and recreational services	10.9	11.9	12.2	12.4	14.1	0.77	13
Household Furniture (d)	1.5	1.8	1.9	1.8	1.9	0.76	14
Other transport (e)	10.2	10.6	11.7	13.8	13.9	0.74	15
Clothing and footwear	3.7	3.8	3.8	4.7	5.5	0.68	16
Public transport fares	0.4	0.4	0.4	0.5	0.6	0.68	17
Other household furnishing and equipment	2.9	6.2	5.9	5.6	6.3	0.47	18
Sub total 2 (Group 2)	**50.9**	**53.8**	**57.3**	**61.2**	**65.5**	**0.80**	
Total	100.0	100.0	100.0	100.0	100.0		

Source: Authors' calculations from (ABS, 2000)
Totals may not add to 100 due to rounding. Column (6) is derived as (1) divided by (5).

(a) Includes electricity, gas and kerosene and heating oil.
(b) Includes lubricants.
(c) Includes rent, mortgage repayments, repair and maintenance.
(d) Includes kitchen, bedroom, lounge, other furniture.
(e) Includes vehicle registration, insurance, parts, charges and fare and freight charges.

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