1996

Australian commodity export pass-through and feedback causality from the exchange rate to Commodity prices

Anthony G. Webber

University of Wollongong

University of Wollongong

DEPARTMENT OF ECONOMICS
WORKING PAPER SERIES
1996

AUSTRALIAN COMMODITY EXPORT PASS-THROUGH AND FEEDBACK CAUSALITY FROM THE EXCHANGE RATE TO COMMODITY PRICES

Anthony G. Webber

WP 96-6

AUSTRALIAN COMMODITY EXPORT PASS-THROUGH AND FEEDBACK CAUSALITY FROM THE EXCHANGE RATE TO COMMODITY PRICES

Anthony G. Webber

Department of Economics
University of Wollongong
Northfields Avenue
WOLLONGONG NSW 2522

IDD: 61 42 297996
Fax: 61 42 213725

Coordinated by Dr. C. Harvie & Associate Professor M.M. Metwally
Working Paper Production & Administration: Robert Hood
Department of Economics, University of Wollongong
Northfields Avenue, Wollongong NSW 2522 Australia

Department of Economics
University of Wollongong
Working Paper Series WP 96-6

ISSN 1321-9774
ISBN 0 86418 423 9

ABSTRACT

Commodity export pass-through is examined for Australia in an attempt to determine whether Australia is a price-taker in its commodity export trade. This is undertaken for seven categories of Australia's main commodity good exports. We also determine if there is feedback causality from particular world commodity prices back to the exchange rate as is often hypothesised for commodity good intensive exporting countries. It is found that Australian commodity good export pass-through is complete for the goods which are relatively less important in its export trade but is incomplete (although high) for the goods which are most important in its export trade. There is significant feedback causality to the exchange rate from the world price of coal and wheat, two of Australia's most important commodity good exports over the 1980s and early 1990s.

I. INTRODUCTION

Due to its relative abundance of natural resources, Australia has always possessed a comparative advantage in commodity goods, particularly wool, wheat, sugar and a variety of minerals such as coal, copper, zinc, and iron ore (amongst many other commodity goods). This comparative advantage is reflected in the significant contribution of the export of such goods to Australia's total merchandise export revenue. Between 1986 and 1992 this contribution was on average 2 per cent for copper, 13 per cent for coking and steaming coal, 7 per cent for wheat, 2 per cent, 3 per cent for Iron Ore, 3 per cent for sugar, 2 per cent for zinc and 12 per cent for wool (Australian Bureau of Agricultural and Resource Economics (ABARE), Commodity Statistical Bulletin, 1993). In total, this implies that just six categories of commodity exports have contributed to over 40 per cent of Australia's total merchandise export revenue on average over this period.

Australia's comparative advantage in these products is also reflected in its relatively significant world market shares. Australia's ranking (in terms of market share) in the world market based on average world market shares are presented in Table I for the abovementioned commodity items. The information contained in Table I is based on the period 1986 to 1992. The table clearly shows Australia's world importance in the various commodity items, with only copper exports outside the top three in the world.

Table 1
World Market Share Ranking

Commodity Export	World Ranking
Raw Wool	1
Wheat	3
Sugar	2
Coal	1
Copper	above 5
Iron Ore	2
Zinc2	

Source: ABARE, Commodity Statistical Bulletin (1993).

One of the key important determinants of commodity export trade is the movement in the prices of such commodities, and, in particular, how these prices respond to movements in the exchange rate. This study will provide estimates of the responsiveness of export prices to the exchange rate for each of the commodity groupings described in Table I, thereby providing information which is directly pertinent to explaining the performance of Australia's most important commodity exports, and thus Australia's exports in total.

The literature is quite vast on the extent to which adjustments in the exchange rate transmit into changes in commodity prices, for instance, more recent contributions include Cote (1986), Jabara and Schwartz (1987), Gilbert (1989), and Reinhart (1991) just to name a few.[1] However, there is no evidence in the literature, to

1 For a more thorough review of the literature consult Webber (1995).

this author's knowledge, of the dual investigation of how adjustments in the exchange rate transmit into changes in commodity prices and how changes in commodity prices simultaneously transmit into changes in the exchange rate.

After considering this fundamental gap in the literature, this paper has two basic aims. Firstly, to determine whether Australia is a price-taker in the trade of its major export commodities. This is an investigation of the extent to which the exchange rate transmits into domestic currency denominated export prices and is measured by determining the extent of exchange rate pass-through.[2] It is envisaged that those commodity exports in which Australia has relatively substantial world influence will exhibit less than complete export pass-through and hence there is unlikely to be a proportionate relationship between the exchange rate and the export price. The motivation for the price-taker investigation stems from the perception that, even though Australia is a small country in its aggregate world trade, it may exhibit price-making behaviour in the trade of individual commodities in which it has some world influence. Based on the data presented in Table I, Australia appears to be in an influential world position in many of its major commodity exports.

Secondly, this paper wishes to evaluate whether there is any feedback causation from commodity prices to the exchange rate. This is undertaken at the same time as the pass-through investigation hence taking into account the possible simultaneity of the commodity price/exchange rate nexus. The examination of feedback causality is a result of the popular belief in commodity good export intensive countries, that world commodity prices are an important determinant of the exchange rate (see Winter and

2 See Webber, (1994), or Menon (1995) for an extensive review of the pass-through literature and the definition of pass-through.

Sapsford, 1990). As we have seen above, the six commodity goods mentioned contribute, in total, to over 40 per cent of Australia's merchandise export revenue. Hence we may expect that since such commodities are an integral part of Australia export revenue earnings they may have some part to play in shaping the behaviour of the Australian dollar.

The remainder of this paper unfolds as follows. The second section describes some simple theoretical ideas, the third section describes the empirical methodology while the fourth presents the results of the econometric analysis. The fifth section analyses the findings as well as offering some important policy ramifications. The final section concludes the paper.

II. A THEORETICAL MODEL

In this section we present a model of export pass-through which is a generalisation and modification of that found in Webber (1995). The modification is that which allows for feedback causality from the world export price back to the exchange rate.

Consider the market for some commodity good, c, which is produced for export only in domestic country D, and consumed in foreign country F where it is not produced. The price in which good c is negotiated is denominated in the currency of country F. The market demand and supply curves for good c (suppressing other exogenous determinants of supply and demand) are:

$$Q^d = Q^d(P^c) \quad (1)$$

$$Q^S = Q^S(P^c.E) \quad (2)$$

where P^c is the world price of commodity good c denominated in country F's currency unit, and E is the domestic currency price of a unit of F's currency.

Suppose that country D is commodity good export intensive, that is, the majority of D's total export revenue is generated by the sale of commodity items, especially commodity good c. It follows that one of the driving forces behind country D's exchange rate is the world commodity price (as explained in Winter and Sapsford Ibid, for example). The function which describes the relationship between the world commodity price and D's exchange rate is:

$$E = E(P^c, V) \tag{3}$$

where V is a vector of arguments which determine the exchange rate but which are exogenous to the market for good c (for example, V may include shocks to domestic or foreign interest rates, fundamentals such as movements in the current account or the general performance of the domestic economy, or 'announcement effects' for instance in the case of the public broadcasting of inflation or growth).

Combining (1), (2) and (3) and assuming market clearing we obtain the simplified implicit system:

$$Q^d(P^c) - Q^S(E.P^c) = 0 \tag{4}$$

$$E - E(P^c, V) = 0 \tag{5}$$

Let us suppose now that there is a shock to one of the components of the vector V, for instance, there is an increase in foreign interest rates placing pressure on the domestic currency to depreciate. Assume that the component of V which changes is some scalar v (with all other components of V unchanged). Assuming that all functions are continuously differentiable in each of their arguments, the total differential of the system is:

$$\frac{\partial Q^d}{\partial P^c} dP^c - \frac{\partial Q^S}{\partial P^D} dP^D = 0 \tag{6}$$

$$dE - \frac{\partial E}{\partial P^C} dP^C - \frac{\partial E}{\partial v} dv = 0 \tag{7}$$

where P^D X $E{\cdot}P^C$. Substituting the total differential dP^D into (6) yields:

$$\frac{\partial Q^d}{\partial P^C} dP^C - \frac{\partial Q^S}{\partial P^D} [E dP^C + P^C dE] = 0 \tag{8}$$

Substituting (7) into (8) gives:

$$\frac{\partial Q^d}{\partial P^c} dP^c - \frac{\partial Q^S}{\partial P^D} E dP^c - \frac{\partial Q^S}{\partial P^D} P^c \frac{\partial E}{\partial P^c} dP^c - \frac{\partial Q^S}{\partial P^D} P^c \frac{\partial E}{\partial v} dv = 0 \tag{9}$$

Rearranging we obtain the elasticity of the world currency commodity price with respect to the exogenous shock to the exchange rate as a function of the direct response by supply and demand, and the feedback response from the commodity price back to the exchange rate and hence market supply:

$$\frac{dP^c}{dv}\frac{v}{P^c}=\frac{\frac{\partial Q^S}{\partial P^D}\frac{\partial E}{\partial v}.v}{\left[\frac{\partial Q^d}{\partial P^c}-\frac{\partial Q^S}{\partial P^D}E-\frac{\partial Q^S}{\partial P^D}.P^c\frac{\partial E}{\partial P^c}\right]} \qquad (10)$$

Note that the degree of exchange rate pass-through between D and F is defined as $\delta^D=1+\frac{dP^c}{dv}\frac{v}{P^c}$ X $\frac{dP^D}{dE}\frac{E}{P^D}$ (See Webber (1995)) which can be clearly seen from the logarithm of the domestic currency export price, (where lower case letters represent variables in logarithms) $p^D = e + p^c$, and the fact that the elasticity of P^D with respect to E is the coefficient on e plus the derivative of p^c with respect to e. It follows that the degree of export pass-through, using (10) is given by:

$$\delta^D=\frac{\frac{\partial Q^d}{\partial P^c}-\frac{\partial Q^S}{\partial P^D}E-\frac{\partial Q^S}{\partial P^D}P^c\frac{\partial E}{\partial P^c}+\frac{\partial Q^S}{\partial P^D}\frac{\partial E}{\partial v}}{\left[\frac{\partial Q^d}{\partial P^c}-\frac{\partial Q^S}{\partial P^D}E-\frac{\partial Q^S}{\partial P^D}P^c\frac{\partial E}{\partial P^c}\right]} \qquad (11)$$

The denominator of this expression is the Jacobian determinant associated with the satisfaction of the condition underlying the implicit function theorem. The Jacobian must be non-zero in order for there to be a set of implicit function solutions for the endogenous comparative static variables. Satisfaction of this condition in turn implies that the expression for long run pass-through is defined. This can be written in elasticity form as follows:

$$\delta^{D} = \frac{\varepsilon_{SD}\left(\varepsilon_{Ev} - \varepsilon_{EP^c} - 1\right) + \varepsilon_{DF}}{\varepsilon_{DF} - \varepsilon_{SD}\left(1 + \varepsilon_{EP^c}\right)} \tag{12}$$

where $\varepsilon_{SD} \equiv \frac{\partial Q^S}{\partial P^D}\frac{P^D}{Q}$, $\varepsilon_{Ev} \equiv \frac{\partial E}{\partial v}\frac{v}{E}$, $\varepsilon_{EP^c} \equiv \frac{\partial E}{\partial P^c}\frac{P^c}{E}$, and $\varepsilon_{DF} \equiv \frac{\partial Q^D}{\partial P^c}\frac{P^c}{Q}$. This simple theoretical result, to this author's knowledge, has not yet been witnessed in the literature, although there have been many simple analyses of export pass-through in small and large economies (see Webber (1994), Menon (1995) for comprehensive reviews of the literature). The reason that (12) differs from the standard case, which examines export price response to E rather than a component of v (to be described in detail below), follows from the fact that the exchange rate in this model is endogenous. As a consequence, the shock to the commodity market originates from the exogenous component of the function which describes E. The exogenous component of the E function is described by the vector V, so that to produce the desired shock requires some element of V to change, which we have called v (and may be interpreted, for instance, as a change in foreign interest rates or an 'announcement effect' such as news on domestic inflation or growth).

The intuition associated with pass-through result (12) is as follows. Suppose there is a shock to one of the components of the exogenous vector V, ($dv \neq 0$) which in turn results in a depreciation in the exchange rate of country D ($dE>0$). This causes an increase in the D currency price of commodity good c for a given world price. This in turn induces D to expand its output ($\varepsilon_{SD} > 0$), causing an increase in world supply of c, hence causing a reduction in the world price (if $\varepsilon_{DF} < 0$). The reduction in the world price in turn causes D's currency to depreciate once more, causing a further round of expansion in commodity good supply and reduction in world price. This process continues until a general equilibrium is reached which then defines the extent of long run commodity pass-through.

The degree of pass-through depends on the relationship between the downward forces exerted on P^C and the upward forces on E. If the (accumulated) downward force on P^C dominates the upward pressure on E, then pass-through is partial ($\delta^D \varepsilon (0, 1)$). The partial pass-through result is the standard outcome for a large exporting economy since increases in the economy's export supply cause a downward adjustment in the world price (but to a lesser extent than the upward movement in the exchange rate). In the case where the exporting economy is small, that is $\varepsilon_{SD} \rightarrow 0$, the limiting expression for the degree of long run pass-through is unity, which is the standard complete pass-through result. This implies that in response to a (10 per cent) depreciation in D's currency, the world commodity price remains unchanged since a change in D's supply of c has no significant impact on the market. This causes the D-currency price received by D suppliers to increase in the same proportion (by 10 per cent) as the exchange rate.

It is interesting to see how the long run pass-through result differs if the feedback effects are omitted (that is, if we examine the standard case which is well recognised in the literature). In this case the long run degree of pass-through is:

$$\boxed{\delta^D = \frac{\varepsilon_{DF}}{\varepsilon_{DF} - \varepsilon_{SD}}} \qquad (12')$$

since $e_{EV} = 1$ and $\varepsilon_{EP^c} = 0$. Pass-through (12′) may be more or less than (12) depending on how sensitive the exchange rate is to the change in the commodity price. The more (less) sensitive is the exchange rate to the commodity price, that is, the larger (smaller) is ε_{EP^c}, the more upward pressure on P^D since the deeper the exchange rate depreciation, implying (12) is more likely to exceed (12′).

III. THE JML ESTIMATOR OF THE LONG RUN RESPONSES

In order to estimate the long run response by commodity export prices to exchange rate changes we employ the Johansen (1988) Maximum Likelihood time-series systems framework. The price specifications take the following (general) unrestricted form in n variables (assuming no exogenous/deterministic components):

$$Z_t = \sum_{i=1}^{k} A_i Z_{t-i} + v_t \qquad (13)$$

where Z_t is a vector of all n variables of the model and v_t is a vector of random errors. This VAR representation can also be re-parameterised, that is, we perform a *cointegrating transformation* as follows:

$$\Delta Z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-k} + u_t \qquad (14)$$

where Q_i X -I + A_1 + ... + A_i (I is an identity matrix), and Π X -(I - A_1 - ... - A_k). Based on the ***Granger Representation Theorem,*** (Engle and Granger (1987)), under some general conditions it can be shown that: (i) if the rank of (nxn) matrix P is equal to n the vector process Z_t is stationary, (that is, all variables in Z_t are I(0)), or equivalently there is a unique equilibrium solution, $Z_t = 0$, (ii) if the rank, r, of matrix P is such that rε(0, n), and the series in Z_t are I(1), there exists a representation of P such that:

$$\Pi = \alpha . \beta' \qquad (15)$$

where α and β are both n x r matrices, and the series Z_t are cointegrated. Equivalently, this implies that (14) is a Vector Error Correction (VEC) model. Thus, by examining the rank conditions associated with matrix Π after first determining the time series properties of the variables which comprise Z_t, we are able to determine the number of long run relationships which exist between the variables in Z_t. For instance, if we have three variables which are stationary in first differences, that is, n = 3 and all are I(1), and we find that r=2, that is our rank condition is 2, then this implies that two out of three variables are endogenous, and hence there are two long run relationships between our 3 variables.

The least squares estimate of Π is inefficient in the presence of rank restrictions. The JML estimator, however, is able to overcome this efficiency problem by virtue of the fact that it is able to directly incorporate information about the desired value for r. In the context of our previous example, this means that the JML estimator would restrict the number of endogenous variables to two as opposed to three. The JML estimator has been found to be symmetrically distributed, median unbiased and asymptotically efficient (Bewley and Orden, 1992).

In order to estimate the rank of matrix Π and test its significance, thus obtaining the number of significant long run vectors, we use two tests proposed by Johansen, namely maximal eigenvalue (λ_{max}) and trace statistic tests. The lag length for the VAR, k, is found by using a sequence of adjusted likelihood ratio tests (Sims, 1980). In order to further test the validity of the VAR ordering the sensitivity of the maximal eigenvalue, trace statistics, and long run coefficient estimates to marginally alternative VAR orderings are examined. Augmented Dickey-Fuller (ADF) and Phillips-Perron tests (PP) are employed to determine the order of integration of the variables in Z_t prior to applying the Johansen estimator.

If tests reveal only one cointegrating vector in each of the commodity price specifications the normalisation are hypothesised, based on economic theory, to be on Australian dollar export prices from which we can obtain our long run pass-through estimates. The long run specification assuming such a normalisation is given below:

$$EP_t = \beta_0 + \beta_1 WP_t + \beta_2 E_t + u_t \qquad (16)$$

where EP is the export price, WP is the world price, E is the currency which is used to denominate commodity trade contracts, t is a subscript for time, and u is the disturbance term which satisfies the classical assumptions.[3] All variables are in natural logarithms. This specification is consistent with the definition of country D's domestic currency export price, P^D given in section 2.

If tests reveal two cointegrating vectors then, using the

3 Data sources and construction are given in the Appendix.

information given in section 2, we suppose that the normalisation is associated with both the export price and the exchange rate variable, the latter long run specification being:

$$E_t = \alpha_0 + \alpha_1 WP_t + \alpha_2 EP_t + w_t \qquad (17)$$

where w is a disturbance term satisfying the classical assumptions.

IV. TEST RESULTS AND EXPORT PASS-THROUGH ESTIMATES

In this section we perform unit root and cointegration tests, in addition to estimating the degree of long run pass-through. The pass-through estimate will inform us about whether Australia is a price-taker in the international trade of the commodity in question. Specifically, if we find that pass-through is complete, there is sufficient evidence to conclude that we cannot reject the price-taker hypothesis. This is undertaken for seven of Australia's main commodity exports; coal, copper, iron ore, sugar, wheat, wool, zinc, in addition to an aggregate commodity group which uses as a price the weighted sum of the seven categories. The sample timeframe used in the investigation is the third quarter 1973 to the second quarter 1993 (80 observations), which is the timeframe over which the data is available.

Unit Root Tests

ADF and PP tests for the existence of unit roots are presented in Table II. The optimal lag length in the ADF tests are found by consulting t-values and the Durbin-h or Durbin-Watson statistic (to determine whether the specification from which the unit root statistic is obtained is acceptable). The truncation lag length in the PP test is found by using the highest significant lag order from the autocorrelation function or the partial autocorrelation function for the first difference series. The results indicate that all variables are I(1), implying stationarity in first differences. It follows that since all variables have the same order of integration then we are in a position to determine whether long run relationships exist.

Cointegration Tests

The cointegration test results are given in Table III where it is shown that three categories only reveal two cointegrating vectors, coal, wheat and the aggregate group, while the remaining have just one cointegrating vector. Since coal and wheat were easily the main export revenue earners out of all of the commodity categories for the majority of the 1973 to 1993 sample timeframe, earning 44 per cent and 16 per cent of the total revenue earned by the seven main categories in 1991 respectively, then this feedback causality result for coal and wheat is not surprising.

Table II
Unit Root Tests

	Dickey-Fuller		Phillips-Perron	
Variable	Levels[a]	First-Difference	Levels	First Difference
EPCOAL	DF = -2.004	ADF = -4.982	-1.992	-9.488
E	DF = -2.328	ADF = -4.694	-2.428	-8.086
WPCOAL	ADF = -2.392	ADF = -5.954	-2.392	-7.358
EPWHEAT	DF = -2.987	ADF = -5.313	-3.116	-7.270
WPWHEAT	DF = -3.138	ADF = -7.358	-3.309	-7.400
WPCOPP	ADF = =2.554	ADF = -4.653	-2.623	-7.284
EPCOPP	ADF = -2.604	ADF = -4.425	-1.560	-10.413
EPIO	ADF = -2.444	ADF = -4.932	-1.832	-13.690
WPIO	ADF = -2.848	ADF = -4.74	-3.610	-8.854
EPSUG	ADF = -2.420	ADF = -4.957	-3.716	-12.562
WPSUG	DF = -2.595	ADF = -4.079	-2.732	-8.137
WPWOOL	ADF = -3.036	ADF = -4.187	-2.522	-6.250
EPWOOL	ADF = -2.532	ADF = -4.930	-3.391	-4.188
WPZINC	ADF = -2.747	ADF = -6.180	-2.977	-5.925
EPZINC	ADF = -2.449	ADF = -5.448	-3.803	-15.070
EPCOMM	ADF = -3.490	ADF = -6.702	-2.729	-11.239
WPCOMM	ADF = -3.119	ADF = -4.551	-3.427	-5.191

Notes: [a]The critical values are those associated with the unit root regression with constant and trend, approximately equal to -3.47, -4.08, -3.16 (based on linear extrapolation) at the 5 per cent, 1 per cent and 10 per cent levels (T=80) (Fuller 1976, p. 373). [b]The abbreviations used are COPP = copper, IO = iron ore, SUG = sugar, COMM = the aggregate commodity group.

Long Run Parameter Estimates

The long run parameter estimates and chi-square test statistics for the significance of the independent variables are reproduced in Table IV (excluding the intercept term for expositional simplicity). The results show that export pass-through in all of the categories is high, (equal to or in excess of 85 per cent) in addition to indicating that all regressors are statistically

Table III

Cointegration Test Results

Regression	Null Hypothesis	Var Lag	Maximal Eigenvalue	95% Critical Value	Trace	95% Critical Value	Rank
COAL	r=0	4	29.425	22.002	54.858	34.910	r=2
	r≤1		19.962	15.672	25.433	19.964	
	r≤2		5.470	9.243	5.470	9.243	
WHEAT	r=0	4	20.895	22.002	44.088	34.910	r=2
	r≤1		16.604	15.672	23.192	19.964	
	r≤2		6.589	9.243	6.589	9.243	
COPPER	r=0	1	30.970	22.002	40.727	34.910	r=1
	r≤1		7.6022	15.672	9.7567	19.964	
	r≤2		2.155	9.243	2.155	9.243	
IRON ORE	r=1	3	28.717	20.967	43.705	29.680	r=1
	r≤1		10.201	14.069	14.988	15.410	
	r≤2		2.687	3.762	2.687	3.762	

Table III

Cointegration Test Results (continued)

Regression	Null Hypothesis	Var Lag	Maximal Eigenvalue	95% Critical Value	Trace	95% Critical Value	Rank
SUGAR	r=1	2	49.660	22.002	62.561	34.910	r=1
	r≤1		10.193	15.672	12.901	19.964	
	r≤2		2.708	9.243	2.708	9.243	
WOOL	r=1	4	26.645	22.002	42.807	34.910	r=1
	r≤1		10.760	15.672	16.161	19.964	
	r≤2		5.402	9.243	5.402	9.243	
ZINC	r=1	1	48.007	22.002	41.702	34.910	r=1
	r≤1		8.634	15.672	12.651	19.964	
	r≤2		4.238	9.243	4.238	9.243	
EPCOMM	r=1	3	34.000	22.002	58.795	34.910	r=2
			16.261	15.672	24.795	19.964	
			8.535	9.243	8.535	9.243	

a Critical values come from Osterwald-Lenum (1990).

Table IV
Parameter Estimates and Significance

	PARAMETER ESTIMATE		
REGRESSAND	World Price Variable	Exchange Rate Variable	Export Price Variabe
EPCOAL	0.9941	1.0248	
EX	-0.7978		1.3141
x^2 for significance	(23.820)	(23.4049)	(23.545)
EPCOPP	1.0428	0.9510	
x^2 for significance	(13.9315)	(16.4318)	
EPWHEAT	0.9155	0.8785	
EX	-0.3425		0.9907
x^2 for significance	(9.8309)	(12.0444)	(8.0161)
EPIO	1.4462	0.84639	
x^2 for significance	(17.5115)	(10.7922)	
EPSUG	0.83801	0.91119	
x^2 for significance	(37.2468)	(37.1302)	
EPWOOL	0.83109	1.0510	
x^2 for significance	(13.5543)	(15.3262)	
EPZINC	1.1305	0.9634	
x^2 for significance	(13.2520)	(7.179)	
EPCOMM	1.1055	0.91603	
EX	-0.6855	-0.41732	
x^2 for significance	(23.4428)	(20.6277)	(21.324)

Note:* The 10 per cent critical value is 2.71, the 5 per cent critical value is 3.84, and the 1 per cent critical value is 6.63. Clearly all variables are statistically significant at all of the significant levels.

significant. With the exception of wheat, iron ore, sugar and the aggregate commodity group, export pass-through is complete. In the exceptional cases export pass-through is approximately 10 or more per centage points below the complete case. However, tests for the hypothesis of complete pass-through, given in Table V, reveal that in all cases at the 5 per cent level of significance pass-through is complete, although at the 10 per cent level wheat, iron ore, sugar and the aggregate commodity group do reveal a departure from complete pass-through. This evidence suggests two possibilities which are not necessarily mutually exclusive. Firstly, Australia is likely to be a price-taker in the international trade of some commodity goods but not others. In the case of wheat, sugar and iron ore, the evidence of incomplete pass-through is vindicated by the significant shares that Australia has in the world market in the export of such commodities. As was mentioned in the introduction, Australia ranks fourth in the world in the export of wheat, and second in the export of both iron ore and sugar. Secondly, evidence suggests that for at least wheat (Grennes *et al* (1978) and Thursby *et al.* (1986)) and sugar (Fry (1985)) the Australian product is an imperfect substitute for the overseas competition by virtue of differences in the degree of variety and quality. This is further supported generally by the evidence presented by Lord (1989) who found significant commodity good differentiability across regional sources. In the case of imperfect substitutes, we would expect that there exists (at least partial) customer loyalty even in the context of higher foreign currency prices, thereby giving rise to a disproportionate relationship between the Australian dollar price and adjustments in the exchange rate.

Table V

Estimates of Pass-through and Tests of the Small Country Hypothesis

Export Category	Long run Pass-through Estimate	Chi-Square Statistic for Complete Pass-through
Coal	1.0248	1.922
Copper	0.9510	0.082
Wheat	0.8785	3.244[a]
Iron Ore	0.8464	2.782[a]
Sugar	0.9112	2.734[a]
Wool	1.0510	0.443
Zinc	0.9634	0.012
Aggregate Commodity Group	0.9160	2.865[a]

Note: [a]Significant departure from complete pass-through at the 10 per cent level with critical value 2.71.

The incomplete result for the aggregate group is a reflection of the fact that it comprises the (export share) weighted average of the six commodity groups, including three groups with incomplete pass-through. The only suprising pass-through results are those associated with wool and coal. In both commodity groups Australia has been ranked 1 in the world in terms of market share for at least the last decade yet Australia still has little influence over the world market price given the evidence of complete pass-through obtained.

Purging out Feedback Effects

The long run parameter estimates presented in Table III incorporate the effects of feedback from commodity prices to the exchange rate in the case of wheat, coal and the aggregate group. If such feedback influences are purged from these results the extent of long run pass-through is estimated to be 1.048 for coal, 1.109 for wheat and 1.150 for the aggregate group. This implies the influence of the feedback is approximately 2 per cent for coal, 23 per cent for wheat and 23 per cent for the aggregate group. All feedback effects have reduced the degree of pass-through, more so in the case of wheat and the aggregate group. This is explained by Section II's model via the parameter which describes the elasticity of the exchange rate with respect to the commodity price, ε_{EP^c}. As described in Section II, if this parameter is relatively low in absolute value, that is, the exchange rate is not particularly sensitive to the commodity price, then there is less pressure for the exchange rate to depreciate, for instance, when commodity prices fall, which implies that there is less upward pressure on the domestic currency export price and hence exchange rate pass-through. In the context of the estimates presented in Table III, this suggests that although there exists feedback causality from wheat and coal world prices to the Australian dollar, the magnitude of the change in the Australian dollar which results from the change in the world prices is small. This is verified by the relatively inelastic coefficient estimates given in the estimated long run feedback vectors for coal and wheat, with the sensitivity of the Australian dollar to the world price of coal (inelastically) equal to -0.7978, for wheat = -0.3425, and for the aggregate group equal to -0.6855.

V. CONCLUSION AND POLICY CONSIDERATIONS

This paper has investigated export pass-through in the trade of Australia's main commodity exports in an attempt to determine whether Australia is a price-taker in the trade of those items. The results show that Australia is likely to be a price-taker in the trade of commodity items coal, copper, wool and zinc, but appears to have some (albeit minor) market power and hence price-making behaviour in the trade of its main commodity exports wheat, iron ore and sugar, as well as aggregate commodity prices. This paper has also found that the world price of the important commodities coal and wheat have a significant influence on the direction of the Australian dollar exchange rate.

The estimation/test results contained in this paper have two important ramifications for Australian economic policy. Firstly, the results appear to indicate that Australia has significant market power in some commodity items and not others, although in the cases where some market power is indicated the strength of the market influence is relatively weak. This implies that, in general, exchange rate devaluation strategies which are aimed at improving Australia's commodity export performance will permit the necessary increase in the Australian dollar export price, providing the impetus for exporters to expand production, hence increasing foreign exchange earnings in Australian dollar terms. Secondly, our results show that movements in the Australian dollar appear to be significantly affected by changes in the world price of our two main commodity exports, those exports being wheat and coal. Consequently, in formulating exchange rate policies the Government should take into account expected movements in world commodity prices, particularly those of coal and wheat.

DATA APPENDIX

1. World Prices, WP

World prices of coal, wheat, sugar, iron ore, copper, zinc, wool from the International monetary fund bulletin, *International Monetary Statistics,* various issues. The currency which is used in order to form all of the commodity price indices is indicated by the IMF bulletin to be $US. This implies that the currency which is used in order to denominate trade contracts is either $US, or has been converted to $US.

2. Exchange Rate, E

The Australian dollar price of 1 unit of $US. Australian DX Database, Balance of Payments, section. This is the only relevant exchange rate to employ in this study by virtue of the fact that the currency which is used to construct the world commodity price indices is $US.

3. Export Prices, EP

Australian Bureau of Statistics, Catalogue number 5403.0, Various Issues.

REFERENCES

Bewley, R. and Orden, D. (1991), "Alternative Methods for Estimating Long-Run Responses with Applications to Australian Import Demand", Discussion Paper No.6, School of Economics, UNSW.

Cote, A. (1986), "The Link Between The U.S. Dollar Real Exchange Rate, Real Primary Commodity Prices, And LDC's Terms Of Trade", *The Review of Economics and Statistics*, vol. 69, November, pp. 547-551.

Engle, R.F. and Granger, C.W.J (1987), "Cointegration and Error Correction: Representation, Estimation and Testing", *Econometrica*, vol. 55, no. 2, pp. 251-276.

Fry, J. (1985), "Sugar: Aspects of a Complex Commodity Market", Division Working paper 1985-1, Commodities and Export Projections Division, IBRD.

Fuller, W.A. (1976), *Introduction to Statistical Time Series* (New York: Wiley).

Gilbert, C.L. (1989), "The Impact of Exchange Rates And Developing Country Debt On Commodity Prices", *The Economic Journal*, vol. 99, September, pp. 773-784.

Jabara, C.L. and Schwartz, N.E. (1987), "Flexible Exchange Rates and Commodity Price Changes: The Case of Japan", *American Journal of Agricultural Economics*, vol. 69, August, pp. 581-590.

Johansen, S. (1988), "Statistical Analysis of Cointegrating Vectors", *Journal of Economic Dynamics and Control*, vol. 12, pp. 231-254.

Lord, M.J. (1989), "Product Differentiation in International Commodity Trade", *Oxford Bulletin of Economics and Statistics*, vol. 51, no. 1, pp. 35-54.

Menon, J. (1995), "Exchange Rate Pass-Through", *Journal of Economic Surveys*, vol. 9, no. 2, pp. 197-231.

Osterwald-Lenum, M. (1990), "Recalculated and Extended Tables of the Asymptotic Distribution of Some Important Maximum Likelihood Test Statistics", Unpublished.

Reinhart, C.M. (1991), "Fiscal Policy, the Real Exchange Rate, and Commodity Prices", *IMF Staff Papers*, vol. 38, no. 3, September.

Sims, C.A. (1980), "Macroeconomics and Reality", *Econometrica*, vol. 48, pp. 1-48.

Thursby, M.C., Johnson, P.R. and Grennes, T.J. (1986), "The Law of One Price and the Modelling of Disaggregated Trade Flows", *Economic Modelling*, vol. 10, pp. 293-302.

Webber, A.G. (1994), "Some Popular Misconceptions About Small Country Pass-through", Paper Presented at the New Zealand Association of Economists Annual Conference, August, Massey University.

Webber, A.G. (1995), "Partial Small Country Import Pass-through, Currency Composition and Imported Inputs", *International Economic Journal*, vol. 9, no. 4, Winter.

Winter, L.A. and Sapsford, D. (1990), *Primary Commodity Prices: Economic Models and Policy*, (Cambridge: Cambridge University Press).

PAPERS IN THE SERIES

90-1 C-H. Hanf and D.J. Thampapillai, *Optimal Taxation Policies for a Nonrenewable but Quasi-infinite Energy Resource: a Two-period Framework.*

90-2 C. Nyland, *Sexual Difference and Industrial Relations Research.*

90-3 J. Halevi, *Employment, Investment and Structural Maturity.*

90-4 A. Levy, *Repudiation, Retaliation, and the Secondary Market Price of Sovereign Debts.*

90-5 A. Chaturvedi, V.H. Tran and G. Shukla, *Performance of the Stein-rule Estimators when the Disturbances are Misspecified as Homoscedastic.*

90-6 C. Nyland, *John Locke and the Social Position of Women.*

90-7 E.J. Wilson, *Exchange Rate Variability. A Case of Non-Linear Rational Expectations.*

90-8 E. Pol, *Ray Scale Economies and Multiproduct Cost Functions.*

90-9 V.H. Tran and A. Chaturvedi, *Further Results on the Two-stage Hierarchical Information (2 SHI) Estimators in the Linear Regression Models.*

90-10 A. Levy and T. Romm, *Need Satisfaction Motivated Behaviour: Static and Dynamic Aspects.*

90-11 A.H. Vanags, *A Marshallian Model of Share Tenancy*

90-12 A. Levy, *An Analysis of the Potential Externalities Affecting the Borrowing Behaviour of Developing Countries.*

90-13 Tran Van Hoa, *System Estimation of Generalized Working Models: A Semiparametric Approach.*

90-14 A. Chatuverdi, Tran Van Hoa and R. Lal, *Improved Estimation of the Linear Regression Model with Autocorrelated Errors.*

91-1 C. Nyland, *Adam Smith, Stage Theory and the Status of Women.*

91-2 A. Levy and T. Romm, *Optimal Timing of Migration: Expected Returns Risk Aversion and Assimilation Costs.*

91-3 D.P. Chan and K.Y. Cheung, *Covered Interest Arbitrage Under the Linked Exchange Rate: Does it Exist? An Evidence from the Hong Kong Foreign Exchange Market.*

91-4 M. M. Metwally, *Role of Advertising in Oligopolistic Markets: Theory & Evidence.*

91-5 A. Levy and T. Romm, *The Consequences of Mutually Secured Debts: The Case of Israeli Moshavim.*

91-6 Tran Van Hoa, *Fundamentals of a new Macro-Modelling. Approach: With Application to Explaining and Forecasting Growth.*

91-7 Boon-Chye Lee, *A Sequential Bargaining Model of International Debt Renegotiation.*

91-8 A. Levy, K. Chowdhury, and E. Wilson, *Are the External Debts of Developing Countries A Symptom or a Cause of Economic Slowdown?*

91-9 Amnon Levy, *A Pareto Optimal Condition for Bankruptcy and the Role of Variations in Aggregate Variables.*

91-10 K. Y. Cheung, *On Testing the Joint Hypothesis of Short Term Interest Rate: A Single Extraction Approach.*

91-11 Tran Van Hoa, *How to Forecast Wage and Price Inflation with More Accuracy: The Australian Experience: 1945/50 to 1988/89.*

91-12 Amnon Levy, *Unemployment and Feedback Approach to the Management of Immigration by the Host Country.*

92-1 Ann Hodgkinson, *An Industry Policy Debate for the 1990s—What Lessons from the USA?*

92-2 Lino Briguglio, *Tourism Policies, Environmental Preservation and Sustainable Development on Small Islands: the Case of Malta.*

92-3 Amnon Levy and Khorshed Chowdhury, *An Integrative Analysis of External Debt, Capital Accumulation and Production in Latin America, Asia-Pacific and Sub-Saharan Africa.*

92-4 Tran Van Hoa, *Effects of Oil on Macroeconomic Activity in Developing Countries: A Cointegration Analysis.*

92-5 Amnon Levy, *The Role of Repudiation and Trade and Credit Sanctions in the Accumulation of Sovereign Debt, Production Capital and Reputation.*

92-6 Kui Yin Cheung, *On Testing the Hypothesis that Premium in US$/$A Forward Exchange Rate is Constant: A Signal Extraction Approach*

92-7 Khorshed Chowdhury, *On Trade and Economic Growth: Further Evidence*

92-8 Charlie Harvie, Chris Nyland and Stuart Svensen, *The Effects of Protective Legislation on Occupational Segregation in the United States and Australia.*

92-9 Amnon Levy, *Efficiency and Equity Considerations in Allocating Renumerations Under Uncertainty: The Case of Australian Universities.*

92-10 Amnon Levy, D.P. Chaudhri and Khorshed Chowdhury, *The Effects of Yield Variations, Price Expectations, Risk Aversion and Money Illusion on Farm-land Allocation in Punjab.*

93-1 Kui Yin Cheung and Lillian Cheung, *The Relative Effectiveness of Fiscal and Monetary Policy on Inflation and Unemployment: the Australian Experience.*

93-2 Daniel Po-ming Chan and Kui Yin Cheung, *One-Way Arbitrage with Transaction Costs: an Evidence from the Hong Kong Foreign Exchange Market.*

93-3 Amnon Levy, *Rescheduling a Sovereign Debt: a Theoretical Analysis.*

93-4 Charles Harvie and Tran Van Hoa, *Terms of trade volatility and macroeconomic adjustment in a resource exporting economy: the case of Australia.*

93-5 Amnon Levy and Khorshed Chowdhury, *Intercountry Income Inequality: World Levels And Decomposition Between And Within Developmental Clusters And Regions.*

93-6 Kyle Bruce and Chris Nyland, *Scientific Management and Market Stabilisation, 1914 - 1930.*

93-7 Charles Harvie, *Monetary Policy Effects in the Short and Long Run under Alternative Wealth Assumptions.*

93-8 Amnon Levy, *Rescheduling a Sovereign Debt: Expected Repayment, Risk and Time Preference.*

93-9 Amnon Levy and Khorshed Chowdhury, *Intercountry Income Inequality 1960-1990: World Levels and Decomposition Between and Within Geographical Clusters and Regions.*

93-10 Darren McKay, *An Input/Output Analysis of Overseas Students Studying at Australian Universities.*

93-11 Darren McKay and Donald E. Lewis, *Expenditures by International University Students.*

94-1 Ann Hodgkinson, *Dew on the Wires: the Australian Telecommunications Industry's Response to the Global Market Place—A Case Study in Corporate Organisational Change.*

94-2 Amnon Levy, *Continuation and Liquidation Timing: A Pareto Optimal Approach.*

94-3 Chris Nyland, *Beatrice Webb as Feminist.*

94-4 Tony Webber, *Some Popular Misconceptions about Small Country Pass-Through.*

95-1 Lillian Cheung, Khorshed Chowdhury, Charles Harvie & Amnon Levy, *Interindustry Linkages and Business Bankruptcy Rates: Evidence from Australia, 1973–1991.*

95-2 Frank Neri, *Heroin Prohibition and the Incentive for Collusion.*

95-3 Amnon Levy, *Repudiation, Retaliation and the Secondary Market Price of Sovereign Debts.*

95-4 Michael Organ and Stuart Svensen, *Research Assistants in the Clever Country.*

95-5 Amnon Levy, *Sovereign Debt and the Triple R Problem: Repudiation, Retaliation and Reputation.*

95-6 Amnon Levy, *Trade Union Membership Fees: Some Theoretical Considerations.*

96-1 Charles Harvie and Boon Chye Lee, *Financial Deregulation and Macroeconomic Adjustment: the Case of Australia*

96-2 Charles Harvie and Colm Kearney, *Public Infrastructure Capital and Private Investment*

96-3 Ray Markey, *The Relative Significance of the ACTU and the Labor Council of New South Wales*

96-4 John L. Rodgers and Joan R. Rodgers, *The Impact of Rural-to-Rural Migration on Economic Status*

96-5 Frank Neri, *The Optimal Price of Heroin: More or Less Prohibition?*

96-6 Anthony G. Webber, *Australian Commodity Export Pass-through and Feedback Causality from Commodity Prices to the Exchange Rate*

96-7 Ray Markey, *Colonial Forms of Labour Organisation in Nineteenth Century Australia*

96-8 Charles Harvie, *Economic Reform and Future Prospects of the Vietnamese Economy*

96-9 Amnon Levy and Khorshed Chowdhury, *Trends in Inter-Country Income Differences: World Levels and decomposition Between and Within Regions*

96-10 Charles Harvie, *Economic Transition and Macroeconomic Performance in the Czech Republic, Hungary and Poland: and Prospects for Membership of the European Union*

96-11 Ray Markey, *The Relevance of Labour History to Contemporary Labour Relations in Australia*

96-12 Anthony G. Webber and Warren B. Knight, *Union Density and Industry Output, Dynamic and Long Run Responses: The Case of the Australian Building and Construction Industry*

Coordinated by Associate Professors C. Harvie and M.M. Metwally
Working Paper Production and Administration: Robert Hood
Department of Economics, University of Wollongong
Northfields Avenue, Wollongong NSW 2522 Australia
Phone: + 61 42 213666
Fax: +61 42 213725
Email: robert_hood@uow.edu.au

WORKING PAPER 96-6
ISSN 1321-9774
ISBN 0 86418 423 9