Prices, Exchange Rates and Export Competitiveness of New Zealand: an assessment using Divisia Indices

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ABSTRACT

This paper computes Divisia price and volume indices from quarterly data of New Zealand exchange rates and exports to explore the relationship between New Zealand's domestic inflation and the changes in its exchange rates over the period 1983 – 93. This is a period when the New Zealand economy underwent major reforms with the initial aims of disinflation at home and improved competitiveness in world markets. This paper examines empirically the relationships between these two aims with the help of Divisia indices. It examines, specifically, the international competitiveness of New Zealand's four major export items in five major markets. Divisia indices, their variances, covariances and correlations, are analysed to check whether and to what extent the competitiveness of the selected exports were affected in the markets in question as a result of the domestic price and exchange rate movements. The findings throw some interesting light on the relationships being investigated.

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1. Introduction

To the best of our knowledge, few researchers have investigated the usefulness of the Divisia index for investigating trade competitiveness[1]. The major motivation for this paper is to use such an approach to identify specific features of New Zealand's export competitiveness, for example the extent to which performance in certain sectors has been better (or worse) than the average. We construct a comparative study of export competitiveness, across commodity groups and across markets. The period we study saw significant fluctuations in New Zealand's domestic inflation and in exchange rates of the New Zealand dollar against most other currencies and thus provides an informative basis for investigation. Section 2 below outlines the analytical framework on which the construction of the indices is based. Section 3 explains the nature of the data used, and discusses the results obtained. Section 4 offers our concluding observations.

As the domestic prices of a country's traded goods rise over time, their international competitiveness may be affected unless the exchange rates also alter to offset any adverse effects of the price changes in the international markets. The Law-of-one-Price version of the Purchasing-Power-Parity (PPP) theory asserts that, over the long run, exchange rates between countries adjust to offset international inflation differentials at the level of individual commodities or groups of commodities (Officer 1976, 1986). The behaviour of New Zealand's real effective exchange rate is addressed in MacDonald (2002); an analysis of New Zealand's equilibrium exchange rate along PPP lines is provided in Brook and Hargreaves (2001); the degree of exchange rate pass-through in respect of selected New Zealand exports is reported in Gani and Chatterjee (1994). The present research is an addition to these analytical studies on the behaviour of New Zealand's exchange rate in a policy context.

As an alternative to simply accepting the empirical relevance of the Law-of-one-Price, one could examine whether and to what extent exchange rate movements and domestic prices of specified items of a country's traded goods move in line with one another. Here we do so using the construct known as the Divisia index (Manzur *et al.* 1991). Such indices can be constructed for prices as well as volumes of traded goods. Linking them to the real exchange rates of a country enables tracking of the temporal changes to a country's international competitiveness. The methodology of the Divisia indices has varied applications. Meisner (1979) applied it to analyse price-quantity data to selected U.S. industries; Clements (1982) to Australian consumption data, for example.

We shall compute the Divisia price and volume indices with respect to four major items of New Zealand's exports to five markets over the period 1983–93, and compare them with the changes in the New Zealand dollar vis-à-vis the currencies of the markets in question.

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[1] Manzur et al. (1991) is a noteworthy exception.

Such indices offer first-order moments for overall price and the volume changes. The Divisia variances are the corresponding second-order moments, and measure the extent to which prices and volumes for individual export categories move disproportionately to the aggregate index.

The four export items chosen are: Meat, Food, Forestry Products and Other Exports, the last item being a residual. The first three items constituted, on average, over 60 percent of New Zealand's export trade over the period under study. The five markets are Australia, Japan, the European Union (EU), USA, and the rest of the world. This last-named market, again, is a residual to help complete the total world market. The first four markets made up, on average, over 75 percent of New Zealand's export trade over the period in question. The time period chosen is 1983–93, a period characterised by significant reforms within the New Zealand economy including the floating of the New Zealand dollar in early 1985. The period also saw, first, a sharp increase in New Zealand's domestic inflation rate, which peaked in 1987, and, then, fell steadily as the policies of disinflation began to bite. By 1992, the annual price increase was down to around 2 percent as the policy of disinflation gave way to the objective of maintaining stable prices at between 0% and 2% per annum. The exchange rates against most currencies also exhibited ample volatility, as capital movements became freer since March 1985. It is appropriate therefore to examine whether changes in inflation and exchange rates were in line with each other in general, and also in the different major markets and in respect of the major export items. For a detailed discussion of New Zealand's economic reform over this period see Chatterjee (1996).

2. The Analytical Framework

Let q_{ij} be the amount in physical units of commodity i exported to country j and let p_{ij} be the unit value in New Zealand dollars. The value in New Zealand dollars of all New Zealand exports to all countries is then

$$X = \sum_{i=1}^{i=n} \sum_{j=1}^{j=m} p_{ij} q_{ij} \qquad 1.$$

Let s_j be the exchange rate of country j, defined as the amount of foreign currency purchased by one New Zealand dollar, and define p_{ij}^* as the price of commodity i in the own currency of country j, i.e. $p_{ij} = (p_{ij}^* / s_j)$. The Law-of-one-price predicts the long-run outcome $p_{ij} = p_i$, $j=1, \ldots m,$ but we are allowing that this may not be the case empirically.

The value of exports of commodity i to country j within New Zealand's total export trade provides a natural weighting scheme to be used in the construction of index numbers:

$$w_{ij}^* = p_{ij} q_{ij} / X \qquad 2.$$

Divisia indices use such weights to form average values of price movements or quantity movements, with the individual movements measured as differences in logarithms: $\delta x_t = \log_e(x_t) - \log_e(x_{t-1})$. Implementation of Divisia indices in discrete time requires a decision on the dating of the budget shares that are to be used as weights. We can resolve this decision[2] by computing, for each time period *t*,

$$w_{ij,t} = \left(w^*_{ij,t} + w^*_{ij,t-1}\right)/2 \qquad 3.$$

With these weights the Divisia price and volume indices for New Zealand exports are defined as

$$DP_t = \sum_{i=1}^{i=n}\sum_{j=1}^{j=m} w_{ijt}\delta p_{ijt} \quad \text{and} \quad DQ_t = \sum_{i=1}^{i=n}\sum_{j=1}^{j=m} w_{ijt}\delta q_{ijt} \qquad 4.$$

The indices DP_t and DQ_t represent the average growth in New Zealand export prices and volumes from time (t–1) to time t.

By changing the ranges of summation used to construct the indices, we can obtain the average growth rates of prices and volumes for specific commodities or specific countries or over specific time periods. For example, $DP_j = \sum_{i=1}^{i=n}\sum_{t=1}^{t=T} w_{ijt}\delta p_{ijt}$ will measure the average growth over the whole sample period of the prices of New Zealand's exports to country j.

Corresponding to the first-order Divisia moments defined in equation 4 are the second order moments that are the Divisia variances for price and volume movements:

$$VP_t = \sum_{i=1}^{i=n}\sum_{j=1}^{j=m} w_{ijt}\left(\delta p_{ijt} - DP_t\right)^2 \text{ and } VQ_t = \sum_{i=1}^{i=n}\sum_{j=1}^{j=m} w_{ijt}\left(\delta q_{ijt} - DQ_t\right)^2 \qquad 5.$$

At each time period these measure the heterogeneity present amongst the price and volume movements of individual export categories. We can also define Divisia price-volume covariance and correlation at each time period to assess whether the relative magnitude of price and volume movements at that time is common across the categories of exports:

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[2] The weights defined here are in common use. Their advantages, most notably that they satisfy the time-reversal requirement for index numbers, are assessed in Theil (1973).

$$\Gamma_t = \sum_{i=1}^{i=n} \sum_{j=1}^{j=m} w_{ijt} \left(\delta p_{ijt} - DP_t \right) \left(\delta q_{ijt} - DQ_t \right) \text{ and } \rho_t = \frac{\Gamma_t}{\sqrt{VP_t . VQ_t}} \qquad 6.$$

Finally, under conditions of homotheticity and preference independence, the price elasticities of exports, inclusive of real exchange rate effects, can be obtained as follows (see Manzur et al, 1991, p. 79):

$$E_t = \Gamma_t / VP_t \qquad 7.$$

The importers of similar goods from New Zealand are assumed to have similar taste patterns although they are in different countries.

These (own-price) price elasticities of demand for exports combine the effects of changes in the price in New Zealand as well as those in the nominal exchange rates that translate those price changes to foreign currencies. Because the changes in the prices and quantities are measured in (finite) log units, the ratio in equation 7 above measures the price elasticity as it is defined (see Clements and Theil 1978, pp 135-36).

3. Data and Results

The data, provided by Statistics New Zealand, are quarterly time series, from September 1982 to December 1993. We examine the export price indices for four broad commodity groups[3]: "Meat, Wool and By-Products", "Food and Beverages"[4], "Forestry Products" and "Other Exports", together with the volume indices for exports of these commodity groups to five markets: Australia, Japan, United States, European Union and the Rest of the

[3] The list of the Harmonized System codes of the items included in each of the four aggregate commodities considered here is available on request.

[4] Excluding meat.

World. For these same markets we have the respective exchange rates[5] vis-à-vis the New Zealand dollar. It would obviously have been useful to bring the time period more up-to-date, but considerations of costs involved in accessing the required additional data precluded that possibility. Nevertheless, we consider the findings to be useful enough, if only as an indicator of the way New Zealand's real exchange rate behaved over a period when both inflation and the nominal exchange rate saw some substantial, policy-induced, movements. For an analysis of New Zealand's trade patterns and policies how they have changed in recent years, see Chatterjee (2001).

In Table 1 we report the Divisia price indices, measuring the percentage change in the prices of the four export commodities in the five markets considered. In part A the change is measured over the whole sample period of eleven years; in part B over the six years from 1983 to 1988; and in part C over the five years from 1989 to 1993.

In Table 2 we report the yearly changes in the prices and the volumes of the four commodities for all countries together. At the foot of the tables we report the mean yearly changes in the indices and their standard deviations; the sums of the indices over the whole sample period (which measure the total change over the whole sample period); the price elasticities of exports (Table 2A), and finally the correlation coefficient between prices and volumes (Table 2B).

In Table 3 we report the yearly changes in the prices and the volumes of the New Zealand total exports (i.e. the sum of the four aggregate commodities) into the five countries considered. The indices' means, standard deviations and totals over the sample period are reported at the foot of the tables together with the price-volumes correlations and elasticities.

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[5] For the European Union we used the ecu exchange rate (obtained as the cross-rate with the British pound) and for the Rest of the World we used the Trade Weighted Exchange Rate Index (TWI).

Table 1A reports that the prices of all four items rose in Australia and USA, and fell in Japan, while in EU and the rest of the world markets the price movements were mixed – some rising and others falling. While the magnitudes of the price movement were "moderate" in most cases, in respect of some items in some of the markets, the changes have been substantial.

Looking at the figures market by market, Australia and Japan stand out as the markets in which the price changes were asymmetric – all prices rising in the former and falling in the latter – and "large" in respect of two products in Australia and three in Japan. New Zealand's export competitiveness in Japan, thus, improved uniformly, while in Australia and the USA, it worsened uniformly. In the other two markets, the results were mixed.

Tables 1B and 1C break the period down into two subperiods viz. 1983–88 and 1989 –93. It is interesting that this reveals the earlier period 1983–88 to be the one in which the price movements were much sharper. Once again, export price changes to Australia and USA were all positive, the EU, which also experienced increased export prices from New Zealand, now joins them. All prices fell in Japan – the magnitudes being somewhat smaller than over the whole period. In the rest of the world too all prices rose with the exception of Food whose price declined somewhat.

In the latter subperiod, the price changes are uniformly more modest, and the direction of their change in markets other than Australia and Japan is mixed – some positive while others negative. All export prices to Australia rose and to Japan fell again. By the end of the period, both prices and exchange rates had stabilised a great deal. This is reflected in the more modest price changes over the latter sub period. The pattern of the observed changes in the different markets is not easy to explain except perhaps to point out that trade with Australia is virtually free whilst Japan imposes many restrictions. Japan's own currency too underwent significant changes following the Plaza Accord of 1985 and the

Louvre Accord of 1987. The US dollar also fluctuated a great deal in the 1980s and early 1990s. The observed export price changes therefore are a mixture of the changes taking place in New Zealand and elsewhere in the world.

Turning to Table 2A, the average price changes of the four commodities confirm that the changes were modest in respect of all of them. Meat and Food prices fell, on averages, over the period while the prices of Forestry and other goods rose, on average. The changes in the volume indices, reported in Table 2B, show an increase in all four items over the period as a whole, with the highest increase in Food (20%), followed by Meat (17%), and Other Products (16%) while Forestry shows a modest increase of only 6%.

The elasticities, reported in Table 2A, are all negative, as one would expect; but low, as one would also expect for primary products such as Meat, Food and Forestry. The negative signs and low magnitudes of the elasticities of the Other Products category perhaps also reflects the fact that much of New Zealand's non-primary products are, essentially, processed primary products and, as such, face inelastic international demand. The few non-primary manufactured exports are too small a part of the total to alter substantially the overall response of demand to price changes.

The elasticities in each of the selected markets, reported in Table 3A, however show that in two of them, the USA and the Rest of the World, their values are greater than unity. So a real exchange rate depreciation (appreciation) will generate a more-than-proportionate increase (decrease) in New Zealand total exports to these markets. The elasticities for the three remaining markets, Australia, E.U and Japan, are all negative and very small. Table 3A also shows that, over the ten year period considered, the Total Exports price indices increased in three out of the five markets, viz. Australia, EU and the Rest of the World. They fell in Japan and the USA.

Table 3B reports the changes in the Divisia volume indices for all exports to the five markets. The mean of the changes in the indices over the ten-year period in respect of each market is positive, and all moderately large. This indicates that, despite disparate price movements, total export volumes improved everywhere.

The price-volume correlations given in the bottom rows of Tables 2B and 3B are all negative, with mean values of –.405 and –.355 respectively; thus indicating that enhanced (blunted) competitiveness caused by a real depreciation (appreciation) helped to expand (contract) New Zealand exports as a whole in each market.

The results reported above confirm that a change in New Zealand's real exchange rate helps improve export volumes, albeit at, generally, moderate rates. Taken together with the elasticity estimates discussed above, this confirms New Zealand's status as a small, mainly primary exporting, economy and, as such, a price-taker in world markets. These findings are of particular interest when one remembers that New Zealand faces policy-induced trade restrictions, largely of a non-tariff nature, in all her export markets, with the solitary exception of Australia with which it has virtually free trade as part of the two countries' Closer Economic Relations (CER) Agreement.

4. Conclusion

This paper examined, with the help of Divisia indices of prices and volumes of selected New Zealand exports to some of New Zealand's major markets, the relationship between domestic inflation and nominal exchange rate movements with a view to determining whether the *real* exchange rates matter. The results confirm that they do, if only in general terms and usually moderately. The real exchange rate elasticities of the selected exports confirm that New Zealand faces inelastic foreign demand for its exports with a couple of exceptions which show up in respect of the total exports to two of the selected destinations. The fact that, despite the many restrictions New Zealand's primary exports face around the world, the co-movements in their prices and volumes are of the expected

negative sign confirms that real exchange rates can improve their competitiveness. We consider this to be of significant policy implication. Likewise, the observed differential impacts that non-symmetric exchange rate movements had for the selected export items in the different markets is a pointer to the need to adopt a disaggregated approach to studying the consequences of inflation for *real* exchange rate movements against different currencies.

TABLE 1A

Divisia Price Indices by Commodity and Country, 1983 – 1993

	Country				
Commodity	Australia	E.U.	Japan	USA	R of W
Meat	.02463	-.04030	-.10496	.05068	.05815
Food	.06239	.04304	-.22672	.06778	-.0047
Forestry	.16559	.00135	-.03843	.00679	.04865
Other	.35282	-.01526	-.24187	.04568	.00746

TABLE 1B

Divisia Price Indices by Commodity and Country , 1983 - 1988

	Country				
Commodity	Australia	E.U.	Japan	USA	R of W
Meat	.02346	.06251	-.06805	.13750	.06931
Food	.03171	.01506	-.17604	.07282	-.00597
Forestry	.10618	.00099	-.03122	.00462	.02417
Other	.29543	.00495	-.14811	.07919	.02030

TABLE 1C

Divisia Price Indices by Commodity and Country , 1989 - 1993

	Country				
Commodity	Australia	E.U.	Japan	USA	R of W
Meat	.00117	-.10281	-.03691	-.08682	-.01116
Food	.03068	.02798	-.05068	-.00504	.00122
Forestry	.05940	.00036	-.00721	.00217	.02448
Other	.05739	-.02021	-.09376	-.03352	-.01284

TABLE 2A

Yearly Divisia Price Indices by Commodity, 1983 – 1993

	Commodity			
Year	Meat	Food	Forestry	Other
1983	.051826	-.087344	-.002796	.051615
1984	.041107	-.013911	.040260	-.083040
1985	-.052837	-.084228	.014759	.011552
1986	-.239422	-.085183	-.006907	-.128091
1987	.377924	.019080	.054156	.228390
1988	.046142	.189165	.005273	.067367
1989	.090060	.151625	.014997	.042043
1990	-.223114	-.222433	-.032395	.010916
1991	-.160933	.060484	-.047247	-.263899
1992	.012209	.051950	.038448	.046012
1993	.045242	-.037475	.105395	-.036254
Mean [a]	-.00107	-.00528	.01672	.01353
Sum [b]	-.01179	-.05827	.18394	.14883
St. Dev.[c]	.17188	.11758	.04228	.13445
Covariances [d]	-.02758	-.00273	-.00141	-.00666
Elasticities [e]	-.703	-.198	-.790	-.369

[a] Mean change in prices over the period. [b] Total change in prices over the period. [c] Price dispersion around the mean change over the period. [d] Price-volume covariances over the period. [d] Export volume elasticities with respect to own price.

TABLE 2B

Yearly Divisia Volume Indices by Commodity, 1983 – 1993

	Commodity			
Year	Meat	Food	Forestry	Other
1983	.198216	.225535	.143687	.256899
1984	.488468	.165917	-.068047	.306030
1985	.270258	.348914	.030146	.129377
1986	.278595	.046464	.058025	.073322
1987	-.113958	.313107	.065162	.235569
1988	.446680	.127645	.053421	-.011840
1989	-.258505	.008604	.063648	.140390
1990	.381770	.213385	.095790	.043912
1991	.208227	.506856	.118361	.339581
1992	-.191179	.127855	.024892	-.019529
1993	.172360	.132848	.019463	.261631
Mean [a]	.17099	.20156	.05496	.15958
Sum [b]	1.88093	2.21713	.60455	1.75534
St. Dev.[c]	.25330	.14361	.05627	.12770
$\rho_{p,v}$ [d]	-.477	-.162	-.594	-.388

[a] Mean change in prices over the period. [b] Total change in prices over the period. [c] Price dispersion around the mean change over the period. [d] Price-volume correlations over the period. [e] The mean correlation over the four commodities is -.405.

TABLE 3A

Yearly Divisia Price Indices by Country, 1983 - 1993

	Country				
Year	Australia	E.U.	Japan	U.S.A.	R. of W.
1983	.059487	.081770	-.110556	-.007523	-.009877
1984	.000234	.073128	-.027104	-.066912	.005079
1985	.226169	-.101373	-.152781	.021244	.000044
1986	.055858	-.225276	-.238345	.005927	-.057767
1987	.148128	.126576	.047034	.234335	.123478
1988	-.033085	.128681	.058329	.107071	.046950
1989	.037545	.048621	.130589	-.004337	.086305
1990	.051214	-0.22366	-.092361	-.017057	.086920
1991	-.129884	-.009330	-.104548	-.106504	-.061329
1992	.126031	-.019466	-.032910	.184427	.056521
1993	.063723	.109157	-.089324	-.013763	.007115
Mean [a]	.05504	-.00102	-.05563	.01554	.00996
Sum [b]	.60542	-.01117	-.61198	.17092	.10950
St. Dev.[c]	.09401	.13054	.10500	.08996	.06568
Covariances [d]	-.00339	-.00222	-.00218	-.00994	-.00452
Elasticities [e]	-.383	-.130	-.198	-1.228	-1.081

[a] Mean change in prices over the period. [b] Total change in prices over the period. [c] Price dispersion around the mean change over the period. [d] Price-volume covariances over the period. [d] Export volume elasticities with respect to own price.

TABLE 3B

Yearly Divisia Volume Indices by Country, 1983 - 1993

	Country				
Year	Australia	E.U.	Japan	U.S.A.	R. of W.
1983	.27838	-.33807	.13263	.49584	-.04870
1984	.14507	.18073	.14413	.38000	.04243
1985	.10759	.29412	.10590	.10893	.16216
1986	-.05694	.03834	.15347	.29219	.02934
1987	.09877	.21526	.27785	-.09842	.00642
1988	.11057	.09100	.07009	.06381	.28043
1989	.13033	.05074	-.03178	-.05287	-.14228
1990	-.03972	.19571	.08793	.23231	.25863
1991	.29930	.29930	.11660	.21672	.29864
1992	.01331	-.01379	-.05318	-.09526	.09096
1993	.10662	.08488	.02194	.18760	.18526
Mean [a]	.10325	.12750	.09323	.15735	.10575
Sum [b]	1.13574	1.40249	1.02557	1.73086	1.16329
St. Dev.[c]	.10326	.11638	.09234	.19414	.14349
$\rho_{p,v}$ [d e]	-.349	-.146	-.225	-.569	-.488

[a] Mean change in prices over the period. [b] Total change in prices over the period. [c] Price dispersion around the mean change over the period. [d] Price-volume correlations over the period. [e] The mean correlation over the five countries is $\tilde{}$.355.

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