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Trade Liberalisation and Factor Returns In New Zealand

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Abstract

This paper analyses the effects of New Zealand's trade liberalisation on its factor markets. Although the consensus among most existing empirical studies is that there is little contribution of trade in increasing wage inequality, disagreement remains regarding the appropriate methodology. Recognising the importance of taking account of general equilibrium considerations, this paper follows the factor content of trade formulation proposed by Deardorff and Staiger (1988) and Deardorff and Lattimore (1999a, b). It is found that, in contrast to the income distribution widening effect, New Zealand's trade reforms have reduced skill premiums when the comparison is made between 1986 and 1996. This result is consistent with Deardorff and Lattimore (1999a, b). Furthermore Data of personal income distribution by qualifications are investigated. From 1986 to 1996, a tendency of income distribution widening is found. If the relative factor returns and personal income distribution by qualifications are highly correlated, it suggests that trade liberalisation has helped reduce income inequality while some other factors have led to the widening of the income distribution.

Keywords: Trade and wages; Factor content of trade; New Zealand.

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1. INTRODUCTION

Much empirical research shows that real wage differentials between unskilled and skilled workers in the United States have widened since about 1980 until very recently. In Western Europe, the pressure is believed to instead take the form of high unemployment because the labour markets are less flexible (OECD, 1997). In New Zealand, Hills (1995) argues that between 1980 and 1994, New Zealand had the largest increase in income inequality among the OECD countries.

To explain this phenomenon, globalisation and technological progress are the two most frequently proposed candidates. The technology explanation asserts that it is skill-based technical progress that increases the relative demand for skilled workers and consequently drives up their wages. The globalisation argument works through the Stolper-Samuelson theorem or the stronger Factor Price Equalisation theorem, which suggest that increasing trade with developing countries is responsible for the labour market outcomes in developed countries.

The literature about globalisation and labour markets has been growing rapidly since the 1980s. Most empirical studies find only moderate support for the argument that trade causes decreasing wages of less-skilled labour in developed countries. Most of the studies focus on the United States. This paper addresses the issue of the possible trade explanation for rising wage differentials in New Zealand.

Beginning around 1984, New Zealand carried out a sequence of economic reforms including an extensive programme of trade liberalisation.[1] While the focus of this

[1] For a comprehensive review of the reforms, see Evans *et al.* (1996).

paper is the role of trade reforms, other policy reforms, including changes in monetary and fiscal policy, exchange rate management, and so forth can also have effects on factor returns. Also historically, many other factors, such as the United Kingdom joining the EU and Asian countries' rapid growth in this decade, have contributed to New Zealand's increasing engagement of trade with developing countries, especially those in Asia. It is difficult to separate the effects of all these factors. However, given the significant trade reforms and the time period this paper studies, it is plausible to argue that trade reforms would be the dominant force to impact on New Zealand's trade patterns.

In the general equilibrium framework of the Heckscher-Ohlin (HO) model of international trade, trade impacts on factor returns. The relationship between the changes of relative factor returns and trade liberalisation in New Zealand is therefore analysed. The question to be asked is by how much the trade reforms have changed the relative factor returns compared to what they would have been without the reforms. In this paper, the factors of production are defined to be labour, capital, and land. Labour is categorised further into four groups according to educational qualifications obtained to proxy skill levels. The concept of factor returns does not coincide with that of personal income. The data of personal income distribution is also investigated to see if the income distribution is indeed widening and if trade reforms have contributed to this widening.

The format of the rest of this paper is as follows. Section two briefly reviews the debate of the theoretical and empirical studies on trade and the factor markets. Section three outlines the methodology. Section four presents some empirical evidence. Finally, section five gives conclusions.

2. TRADE AND INCOME DISTRIBUTION

To analyse the role of trade and globalisation on income distribution, there are two most common lines of arguments. One is the direct application of the Stolper-Samuelson (SS) theorem[2] through the link between goods prices and factor prices. The other is the factor content of trade theory, through the link between trade volumes and factor prices.

The basic intuition of the SS theorem is that international trade affects product prices, and this in turn affects factor prices by influencing relative factor demands. The SS theorem thus talks about the relative income distribution between factors. However, since the economy as a whole can gain from trade, it is possible for all factors to have an increase in their total income, both in nominal and real terms. Due to the availability of data, this paper employs the factor content of trade methodology, in particular, following and modifying the set up of Deardorff and Staiger (1988) and Deardorff and Lattimore (1999a, b), discussed below.

2.1 The Factor Content of Trade

This approach views trade as effectively shipping the factor services embodied in traded goods between countries, that is, the factor content of trade. *Ceteris paribus*, imports add to a country's effective factor endowments while exports reduce them. Factor content studies have triggered a substantial methodological debate[3] about the conditions under which trade volumes can correctly identify the effect of trade on

[2] Rigorous statements of the HO model and the SS theorem can be found in chapters 2 and 3 of Mikić (1998).

[3] Some examples include Krugman (1995), Krugman (2000), Leamer (2000), Deardorff (2000), Deardorff and Lattimore (1999a, b).

relative factor prices. Some trade economists insist on the price mechanism of the SS theorem and argue that trade volumes depend on tastes, technology, and resource endowments. Even a small volume of imports can influence wages if this leads to large changes in domestic prices. Others argue that under certain conditions, factor content studies do relate the volume of imports to changes in product prices and thus contain information on the effect of trade. Although disagreement remains regarding the empirical value of the factor-content studies, most studies reach the same conclusion as those following the SS theorem that trade liberalisation accounts for a positive yet relatively small share of rising income inequality.

2.2 Deardorff and Staiger's and Deardorff and Lattimore's Contribution

Deardorff and Staiger (1988) show that under the standard assumptions of the HO model, it is possible to construct a hypothetical autarky equilibrium from any trading equilibrium by altering its factor endowments by the amount of the factor contents of trade, deducting net factor exports and adding net factor imports. It follows that any comparison between two trading equilibria can also be made between their equivalent autarky equilibria. The factor content of trade thus can be interpreted as indicating the nature of the factor price adjustments that can, in some specific sense, be attributed to that trade. Since factor prices in autarky are related to factor endowments, it follows that factor prices in trading equilibria are related to effective endowments, that is, factor endowments minus the factor content of trade.

Deardorff and Staiger study the effects of trade on relative factor prices at a given point in time. Deardorff and Lattimore (1999a, b) use a slightly different version of the factor content of trade methodology to study the changes of relative factor prices in New Zealand over time. They construct a two period study, for 1986 and 1996. In

The methodology used in this paper, drawn and modified from Deardorff and Staiger and Deardorff and Lattimore, is briefly discussed in the next section.

3. THE METHODOLOGY

Consider an open economy producing n goods, $X_1,\ldots, X_n$, using m factors of production, $L_1,\ldots, L_m$, and a vector of goods C^0 is demanded.[6] The difference between production and demand, $T^0 = X^0 - C^0$, is the net trade vector. Define the factor content of trade, S^0, as the vector of factors needed to produce what is exported, less the factors needed to produce replacements for what is imported. That is

$$S^0 = A^0 T^0 \qquad (1)$$

Equation (1) calculates the economy's factor content of trade according to its own matrix of techniques, A^0. In addition to the raw inputs, A_{ij}, production of good j also requires intermediate inputs of other goods and itself. Let $B = \{b_{kj}\}$ be the matrix of intermediate input requirements, where b_{kj} is the amount of good k used in production of a unit of good j. Taking into account the intermediate inputs, the net output is $(I - B)$ times gross output, with I being an identity matrix of dimension n (the number of goods).[7] The total raw factors needed to produce a unit of net output is therefore $A\,(I - B)^{-1}$, where $(I - B)^{-1}$ is the Leontief inverse matrix. Define this to be the adjusted factor content of trade, $\tilde{S}$, that is

$$\tilde{S} = A(I - B)^{-1} \cdot T \qquad (2)$$

[6] For details of the assumptions and the derivation of the competitive production equilibrium, see Deardorff and Staiger (1988).

[7] The intermediate input matrix will be modified to take account of the import dependence in the next section for the empirical analysis.

Deardorff and Staiger show that a strong relationship between the factor content of trade and changes in relative factor prices exists in an economy where all the preferences and production functions are Cobb-Douglas. Leamer (2000) argues that their conclusion can only survive in a Cobb-Douglas world since the earning shares in such an economy are fixed. Deardorff (2000) extends the notion to CES functions and argues that the equilibrium factor prices must depend in some conventional way on factor quantities, and therefore be related to the factor content of trade even though the assumptions of either Cobb-Douglas or CES functions may be too strong. In this paper, for simplicity, only the Cobb-Douglas version is explored.

Cobb-Douglas production functions imply that each factor earns a constant share of the revenue in each industry, and Cobb-Douglas preferences imply that consumers spend a constant fraction of their total expenditure, E, on each good. In autarky, consumer expenditure on a good equals the revenue of the industry producing that good. These assumptions together ensure that each factor's total income is a constant fraction of total consumer expenditure. Letting the constant for factor i be c_i, it follows that in a closed economy,

$$w_i L_i = c_i E. \tag{3}$$

Now define an equivalent autarky equilibrium as the equilibrium that would arise if the original economy's factor endowments were changed by the amounts of the factor content of trade. Deadorff and Staiger show that an equivalent autarky equilibrium exists in which outputs equal C^0 and prices of both goods and factors are the same as those that prevaile in the original trading equilibrium.[8]

[8] For proof, see Deardorff and Staiger (1988), p. 96, proof of proposition 1.

Consider this economy at two trading equilibria, h, numbered 1 and 2. With trade, equation (3) may not hold. We can compare instead the autarky equivalents of the two trading equilibria. Denote the actual factor endowments to be L^h. Assuming that the two trading equilibria have the same endowments, the price of factor i can be expressed as

$$w_i^h = \frac{c_j E^h}{\left(L_i^0 - \widetilde{S}_i^h\right)}, \qquad \text{where } h = 1, 2. \tag{4}$$

We can now compare factor prices in the two equilibria

$$\frac{w_i^2}{w_i^1} = \frac{E^2\left(L_i^0 - \widetilde{S}_i^1\right)}{E^1\left(L_i^0 - \widetilde{S}_i^2\right)}. \tag{5}$$

After some rearrangement

$$\frac{\frac{w_i^2}{E^2}}{\frac{w_i^1}{E^1}} = \frac{\left(L_i^0 - \widetilde{S}_i^1\right)}{\left(L_i^0 - \widetilde{S}_i^2\right)}. \tag{6}$$

After normalising the prices in both equilibria so that the expenditure ratio drops out, we have the following relationship

$$\frac{\widetilde{w}_i^2}{\widetilde{w}_i^1} = \frac{\left(L_i^0 - \widetilde{S}_i^1\right)}{\left(L_i^0 - \widetilde{S}_i^2\right)}. \tag{7}$$

Note that $\widetilde{w}_i^h$ is the relative[9] factor return to factor i in equilibrium h. It can also be express in terms of the change of the relative factor returns between two equilibria,

$$\frac{\widetilde{w}_i^2 - \widetilde{w}_i^1}{\widetilde{w}_i^1} = \frac{\left(\widetilde{S}_i^2 - \widetilde{S}_i^1\right)}{\left(L_i^0 - \widetilde{S}_i^2\right)}. \tag{8}$$

Since prices are now normalised to equate total expenditure to unity in both equilibria, each $\widetilde{w}_i$ is the wage of factor i as a fraction of the economy's total expenditure. Therefore, equation (8) does not indicate in an absolute or real sense the

[9] Relative to the total expenditure.

effects of trade on factor prices. It indicates only the effects on factor prices relative to total expenditure. Implicitly this also tells us the effects on factor prices relative to one another since wages to all factors have to sum up to unity. A rise of the earnings of one factor must imply a decline of some other factor.

In this paper, the above methodology is modified by incorporating endowment changes since the amount of the factor content of trade obviously depends on the endowments. A shortcoming of this approach is that it is now not possible to separate the effects of trade and factor accumulation on relative factor returns. This is not necessarily undesirable since trade may have contributed to the endowment changes and only looking at the changes of trade volumes may be misleading. The reasons for endowment changes are beyond the scope of this paper and the endowments are taken as exogenously given.

Consider the open economy at two different points in time, t_1 and t_2, with endowments, $(L_1^{t_1},...,L_m^{t_1})$ and $(L_1^{t_2},...,L_m^{t_2})$. From the previous result, an equivalent autarky equilibrium can be defined for times t_1 and t_2 by altering the endowments by the amount of the respective factor contents of trade. The changes in relative factor returns caused by changes in the factor content of trade and endowments can then be derived by comparing instead the two equivalent autarky equilibria. Assuming that consumer preferences and production technologies remain the same over time, it follows that the income share of each factor, c_i, is constant over time, regardless of the changes in endowments. Therefore,

$$w_i^t = \frac{c_i E^t}{\left(L_i^t - \tilde{S}_i^t\right)} \qquad \text{for } t = 1, 2. \tag{9}$$

Carrying out the same procedure as in equations (5) to (7),

$$\frac{\widetilde{w}_i^2 - \widetilde{w}_i^1}{\widetilde{w}_i^1} = \frac{\left(L_i^1 - L_i^2\right) - \left(\widetilde{S}_i^1 - \widetilde{S}_i^2\right)}{\left(L_i^2 - \widetilde{S}_i^2\right)}. \tag{10}$$

In the empirical analysis, both equations (8) and (10) are used, and it is found that the empirical results from the latter are more plausible. It suggests that the endowment changes in New Zealand for the past ten years may be too significant to be overlooked when analysing factor returns.

4. EMPIRICAL ANALYSIS

In this section, the methodology in the previous section is applied to estimate the effects of New Zealand's trade liberalisation on its factor markets. The analysis is carried out by comparing the relative factor returns in 1986, 1991, and 1996. With regard to the trade and wage issue, two questions can be considered. First, did New Zealand's trade liberalisation change the relative factor returns compared to how they would have been without this liberalisation? Second, can the observed changes in relative factor returns be explained by changes in trade caused by the liberalisation?

To answer the first question, as stated previously, given the radical trade reforms, the effects of trade reforms on relative factor returns can be inferred by the factor contents embodied in the net trade flows prior to and after the trade liberalisation. For the second question, some further data investigation is needed. The actual changes in relative factor returns over time and the results from the factor content of trade analysis need to be compared. If they are not consistent with each other, one may say that other factors, rather than trade liberalisation, have impacted New Zealand's factor markets more heavily. However, data for the income distribution among factors are not available. The changes in the New Zealand economy's factor

intensities over time are therefore examined to see if the tendency is consistent with the results. The argument is that, for a given factor, if its relative return increases, its factor intensity should decrease as industries switch to other factors of production that are now relatively cheaper.

Furthermore, data on personal income are reported. The relationship between personal income and factor returns depends on the individuals' ownership matrix over the factors of production. Since such a matrix is not available, one cannot make conclusions about changes of factor returns from the changes in personal income or vice versa. However, it may be plausible to assume that personal income by qualifications and factor returns by qualifications are highly correlated.[10]

Another reason for reporting the changes in personal income is that what really matters for an individual's standard of living is their personal income. Whatever effects trade liberalisation may have over the factor returns, if the personal income distribution is not widening, trade should not be of great concern. For example, if trade reforms have increased the wage premium for skills, but the distribution of personal income is not widening, it may be the case that tax and welfare policies have offset the effects brought about by trade. It then suggests that, as Bhagwati (1999) argues, we are using free trade as an income generating instrument and welfare policies to take care of the social agenda.

4.1 Net Trade Vectors

The main equations used for the empirical analysis are equations (2), (8), and (10) from section three. Data from New Zealand *Input-Output Tables* are used to calculate

[10] Maani (1997) has a similar opinion.

the net trade vector, T, and the intermediate input matrices, B.[11] The New Zealand *Input-Output Tables* are produced at different aggregation levels in different years with 25 industries (NZSNA production groups) being the most commonly available one. However, since capital and employment data are not easily separated between some of the groups, the empirical analysis is performed in 23 NZSNA production groups.[12]

Table 1 reports the imports and exports by 23 NZSNA production groups. In the 1987 table, imports are defined by the New Zealand Harmonised System Classification (HSC). The data has been regrouped into the NZSNA groups according to HSC chapters and NZSIC codes. This mapping is admittedly unsatisfactory since the data by HSC are by commodity, and one commodity is often produced by more than one industry, whereas the NZSIC codes are by industry. A more favourable method would be to take the Production of Commodities by Industry Table (called the MAKE matrices), which shows the production of a commodity according to the industries that produce it and calculate the proportions of the commodity produced in each industry. The data in the 1987 Imports Table can then be split into industries according to these proportions. Unfortunately, the 1987 MAKE Table employs different definitions of commodities from those used in the Imports Table, and such a transformation is not possible.

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[11] The particular tables used here are Inter-Industry Transaction Tables and Imports into Industry Tables. In the Imports Tables, imports are classified according to the industries they would be produced in if they were produced locally, which is the definition we need for calculating the factor content of trade. The Imports into Industry Tables are not available for 1986 and 1991, therefore, the tables for 1987, 1993, and 1995, are used to carry out the three-point analysis.

[12] Putting Central and Local Government Services together as Government Services and Community, Social and Personal Services and Domestic Services of Household together as Social Services.

Table 1. Trade by 23 NZSNA production groups (millions of New Zealand dollars)

	1986			1993			1995		
	Export	Import	Net Trade	Export	Import	Net Trade	Export	Import	Net Trade
Agriculture	1234.6	343	**891.55**	1393	334	**1059**	1494	322	**1172**
Fishing and Hunting	164.9	4	**160.92**	176	1	**175**	199	2	**197**
Forestry & Logging	33.6	0	**33.58**	492	6	**486**	626	7	**619**
Mining & Quarrying	64.3	335	-270.7	293	1074	-781	330	962	-632
Food, Beverages & Tobacco	4868.2	590	**4278.2**	8128	1092	**7036**	8094	1331	**6763**
Textiles, Apparel & Leather	1452.6	912	**540.56**	1527	1280	**247**	1775	1509	**266**
Wood & Wood Products	217.0	126	**91.04**	672	134	**538**	941	172	**769**
Paper, Products & Printing	518.2	569	-50.85	742	947	-205	811	934	-123
Chemicals, Petrol, Rubber etc.	389.0	2465	-2076	695	3462	-2767	1128	4100	-2972
Non-metallic Mineral Products	41.9	151	-109.1	78	251	-173	84	309	-225
Basic Metals	544.7	892	-347.3	1034	720	**314**	650	884	-234
Fabricated Metal Products	457.0	4921	-4464	1428	7094	-5666	1857	9323	-7466
Other Manufacturing	108.7	346	-237.3	280	429	-149	235	460	-225
Electricity, Gas & Water	3.0	0	**2.95**	7	5	**2**	8	4	**4**
Construction	21.7	0	**21.68**	50	5	**45**	37	4	**33**
Trade, Restaurants & Hotels	1780.7	413	**1367.7**	3055	615.2	**2439.8**	4248	725	**3523**
Transport & Storage	1931.9	2290	-358.2	2444	2805.8	-361.8	3078	2896	**182**
Communication	224.6	40	**184.58**	274	235	**39**	299	240	**59**
Finance, Insurance, Real Estate & Business Services etc.	293.9	432	-138.1	398	1225	-827	452	842	-390
Owner-occupied Dwellings	0	0	0	0	0	0	0	0	0
Social Services	197.7	138	**59.74**	223	97	**126**	280	88	**192**
Government Services	59.2	0	**59.24**	68	0	**68**	101	0	**101**
Private Non-Profit Services	47.6	0	**47.58**	27	0	**27**	29	0	**29**
Re-export		310	- 310						
Sum	14655	15277	-622.2	23484	21812	***1672***	26756	25114	***1642***

Note: Figures in bold (positive numbers) indicate net exports.

Source: New Zealand Input-Output Tables, Statistics New Zealand

The HSC classification is used for merchandise trade data (goods) only and does not cover services. Data from 1987 Provisional Imports into Industry Table are used for

the services sector.[13] For the 1993 and 1995 imports of travel services, following Deardorff and Lattimore, the data are divided between transport and storage and trade, hotel, and restaurant in the percentage of 80% and 20%.

4.2 The Input Matrices

To calculate the primary input matrix, A, for New Zealand, the data come from various sources. Land data for agriculture and forestry sectors are taken from the *New Zealand Official Yearbooks*. For all the sectors, the data are taken from Bicknell *et al.* (1997). Estimated capital stock by industry cannot be found in official publications and are taken from Philpott (1992, 1995).[14]

Employment data by qualification and by industry are taken from Census data. Labour is divided into four groups: university degree, other tertiary qualifications, school qualifications, and no qualification according to the highest qualification

[13] The total imports for the service sector are the same in the provisional table and the final table in 1987. Another reason for using the provisional table is that the items for the service industries in the table use the same definitions as in the New Zealand national accounts. After checking the definitions of these items in the national accounts, it is found that each entry usually needs to be divided among several production groups. Since the proportions according to which the data can be split are not known, it may be more proper to use the provisional table.

[14] Both gross and net capital stock data are reported in his work. He suggests that for use in analyses of production and productivity, gross capital measures are more appropriate. However, the gross capital estimates are quite sensitive to assumptions of depreciation. Therefore, like most of the empirical literature, this paper takes the average of these two for the analysis.

obtained.[15] The data are not disaggregated by sex because social norms, rather than skill differentials, may be the main reason for generating different payment to workers of different genders in the same educational group.

For the production of final goods, both domestic and imported intermediate inputs may be used. When calculating the intermediate input matrix, the import dependence (the elements in the Imports into Industry Table) is also considered. Define the elements in the modified intermediate input matrix, $\widetilde{B}$, as

$$\widetilde{b}_{kj} = \frac{c_{kj} + m_{kj}}{X_j} \tag{11}$$

where c_{kj} is the amount of the intermediate inputs produced in (domestic) industry k and used in industry j, and m_{kj} is the amount of intermediate inputs imported from (foreign) industry k into industry j, and X_j is the total production of industry j.

4.3 Factor Content of Trade Calculations

The adjusted factor contents of trade, $\widetilde{S}_i$, is calculated according to equation (2) after incorporating the modified Leontief inverse matrices, $\left(I - \widetilde{B}\right)^{-1}$. The calculated factor content of trade is reported in table 2.

[15] For the 1986 Census, university degrees include postgraduate and bachelors degree; other tertiary qualifications include undergraduate, technicians certificate, teaching or nurses certificate/diploma, trade or advanced trade certificate, and other tertiary qualifications; school qualifications include higher school or leaving certificate/bursary, university entrance/sixth form certificate, school certificate, and other school qualifications; no qualifications count workers without formal qualifications. Deardorff and Lattimore (1999a, b) use employment data disaggregated by sex into seven categories by highest qualifications.

In Table 2, New Zealand seems to be a net exporter for all the six factors of production for all the three years. This is puzzling since if all factors of production are considered, and the domestic and foreign technology of production is identical, net trade in the factors weighted by their factor prices should be of the size of the current account surplus. This is not the case here especially when New Zealand had a current account deficit in 1986.[16] Some possible explanations may be that some of the factors New Zealand imports are missing in the discussion or that the assumption of identical domestic and foreign technology is too unrealistic. Note that since equations (8) and (10) hold for every factor and this theory considers only the changes of the relative returns of the considered factors in two equilibria, this factor content of trade methodology can be employed even when some factors of production are missing in the calculation.

Table 2. The factor contents of trade over time

	1986	1991	1996
Land	6718.33	8318.55	7412.48
Capital	3132.25	5925.83	4723.27
University Degree	1079.42	4045.2	6799.90
Other Tertiary Qualifications	337.34	19186.14	16575.36
School Qualifications	13579.71	27136.60	38842.51
No Qualifications	26090.44	36590.08	33365.09

4.4 Relative Factor Returns

The calculated changes of relative factor returns with identical endowments (equation 8) are reported in Table 3. The figures suggest that when comparing factor returns in 1991 and 1986 and in 1996 and 1986, the returns to all the factors have increased.

[16] As an alternative, different intermediate input matrices were used for imports and goods produced domestically. The coefficients in the Imports into Industry Table was used to calculate the Leontief inverse matrix for imports and the Inter-Industry Transaction Table was used for the domestic production. However, New Zealand is still a net exporter of all the six factors in this exercise.

Some negative effects only appear when comparing 1991 and 1996. During this period, returns to labour with a university degree and labour with school qualifications increased and the returns to other factors decreased.

Table 3. Changes in relative factor returns due to the factor contents of trade

	$\frac{\widetilde{w}^{91}-\widetilde{w}^{86}}{\widetilde{w}^{86}}$	$\frac{\widetilde{w}^{96}-\widetilde{w}^{91}}{\widetilde{w}^{91}}$	$\frac{\widetilde{w}^{96}-\widetilde{w}^{86}}{\widetilde{w}^{86}}$
Land	0.1710	-0.0776	0.0676
Capital	0.0177	-0.0072	0.0100
University Degree	0.0302	0.0239	0.0599
Other Tertiary Qualifications	0.0437	-0.0053	0.0375
School Qualifications	0.0392	0.0386	0.0755
No Qualifications	0.0233	-0.0101	0.0160

Since the total expenditure is normalised to unity, if some factors' relative earning shares have increased, some other factors' relative shares must have declined. This is not the case in Table 3. It suggests that the assumption of identical endowments may be too radical. The factor content of trade and endowments are interactive. The causation is difficult to define and the effects are difficult to isolate. Table 4 reports the relative factor price changes after adjusting for endowment[17] growth according to equation (10).

After adjusting for the difference of endowments at different points of time, for those factors whose endowments decreased, the relative returns increased compared to the figures in Table 3, and vice versa for the factors that experienced an endowment increase. Consequently, an increase of relative return to land is partly offset and three groups, capital, university degree, and other tertiary qualifications, had negative changes in their relative returns when comparing 1996 and 1986. The relative return to labour without qualifications increased after this modification.

[17] Here, the endowments of labour only include those who are actually employed.

The figures suggest that from 1986 to 1996, changes in trade patterns have increased the relative returns to land, labour with other tertiary qualifications, and labour without qualifications. Notice that the skill premiums between workers with a university degree and those with other tertiary qualifications and between workers with school qualifications and those with no qualifications declined. After decomposing the period into two sub-periods, 1986 to 1991 and 1991 to 1996, changes in trade flows had favourable effects for land, school qualifications, and no qualifications in the first sub-period but only favour other tertiary qualifications in the second sub-period.

Table 4. Changes in relative factor returns due to the factor content of trade (adjusted for the changes in endowments)

	$\frac{\widetilde{w}^{91}-\widetilde{w}^{86}}{\widetilde{w}^{86}}$	$\frac{\widetilde{w}^{96}-\widetilde{w}^{91}}{\widetilde{w}^{91}}$	$\frac{\widetilde{w}^{96}-\widetilde{w}^{86}}{\widetilde{w}^{86}}$
Land	0.0171	-0.0083	0.0087
Capital	-0.0363	-0.0764	-0.1100
University Degree	-0.1426	-0.2966	-0.3969
Other Tertiary Qualifications	-0.0832	0.1078	0.0157
School Qualifications	0.1428	-0.3376	-0.2430
No Qualifications	0.4559	-0.0755	0.3460

Table 4 suggests that the relative earnings of workers with a university degree decreased while those of unqualified workers increased over the ten years. This is consistent with Deardorff and Lattimore who conclude that the trade reforms did not contribute to the widening of the income distribution among factors comparing 1986 and 1996.

4.5 Factor Intensity

Data of changes in factor returns are not available. Theoretically when the return to one factor rises relative to others, firms will switch to the use of other factors of

production and the factor intensity of that factor should decrease. Since there are six factors of production in this paper, the choice of the numeraire factor for defining the factor intensity is somewhat arbitrary. Factor intensities defined by other tertiary qualifications are reported in Table 5. Since we cannot have much information about the numeraire factor, factor intensities defined by another group, land, are also reported (Table 6) for comparison and completeness.

Table 5. Weighted average factor intensities over time

(defined by other tertiary qualifications)

		Land	Capital	UD	SQ	NQ
1986	Endowment	0.0393	0.3639	0.2274	0.8297	1.0814
	Production	0.0401	0.4037	0.1968	0.9347	1.2461
	Exports	0.0438	0.3521	0.1326	1.0091	1.9327
	Imports	0.0140	0.3428	0.1366	0.8071	1.3987
1991	Endowment	0.0375	0.3386	0.2396	0.6710	0.6925
	Production	0.0462	0.4033	0.1912	0.7172	0.8125
	Exports	0.0516	0.3574	0.1241	0.7928	1.2555
	Imports	0.0121	0.3874	0.1436	0.6465	0.9104
1996	Endowment	0.0398	0.4032	0.3803	1.1194	0.8176
	Production	0.0439	0.5205	0.3237	1.1834	0.9469
	Exports	0.0512	0.4150	0.2298	1.3593	1.4214
	Imports	0.0108	0.4461	0.2254	1.0685	1.0948

Note: Weights assigned by the share of the industry's output in total production, exports, and imports.

Table 6. Weighted average factor intensities over time

(defined by land)

		Capital	UD	OTQ	SQ	NQ
1986	Endowment	9.2632	5.7886	25.4587	21.1232	27.5316
	Production	814.7550	1097.0160	3111.0800	3697.6750	2634.4540
	Exports	367.2989	300.9618	1439.8563	1671.1065	2346.9495
	Imports	464.1222	404.2397	2002.5435	1823.2348	2360.1299
1991	Endowment	9.0399	6.3966	26.6947	17.9112	18.4861
	Production	1172.3370	1601.9610	4125.2510	3744.3540	2112.8020
	Exports	429.9801	347.9451	1618.6824	1413.9276	1506.8936
	Imports	773.1004	849.2069	2802.9127	2212.1124	1730.0660
1996	Endowment	10.1324	9.5575	25.1319	28.1328	20.5485
	Production	1427.6950	2629.9240	3979.2820	5573.3960	2503.2650
	Exports	456.8216	575.4410	1492.5074	2205.1885	1586.5566
	Imports	658.9301	899.4634	2129.8697	2467.0743	1709.9098

Note: Weights assigned by the share of the industry's output in total production, exports, and imports.

In Table 5, exports are more intensive in land, labour with school qualifications, and labour without qualifications than imports for all three points in time. Exports were more capital-intensive than imports in 1986, but the pattern has changed since 1991. The pattern is not clear in table 6. This is probably due to New Zealand's strong comparative advantage in land-intensive goods.

Table 7. Signs of changes in relative returns and factor intensities over time

	Land	Capital	UD	OTQ	SQ	NQ
1986-1991	+, +	−, −	− , −	−, + ✓	−, −	+ , − ✓
1991-1996	− , −	−, + ✓	−, + ✓	+ , − ✓	−, + ✓	−, + ✓
1986-1996	+, +	−, + ✓	−, + ✓	−, + ✓	−, + ✓	+ , − ✓

Note: Intensities other than that for OTQ are defined by OTQ while OTQ's intensity is defined by land. A ✓ indicates that the correlation between the relative return changes and intensities is negative, which is what is expected from the theory.

The correlation between calculated changes in factor returns and the observed changes in factor intensities are reported in Table 7.[18] For most of the factors and time points, the signs of correlation seem to be consistent with the theory, that is, a negative correlation. The exception is land, with the intensity and returns moving in the same direction for all the three time points. For groups 'Other Tertiary Qualifications' and 'No Qualifications', the signs are negative for all periods. For groups 'School Qualifications' and 'Capital', the correlation is positive for 1986 to 1991. This is possibly due to firms' inability to adjust their factor employment in response to price changes in the shorter run. Note that what is reported here is only a correlation relationship, not causation. Overall, the changes in the factor intensity are quite consistent with what we found in the changes in factor prices driven by trade and endowment changes.

4.6 The Distribution of Personal Income over Time

In this section, the data of changes in personal income by qualification over time are reported (Table 8) to see if they are consistent with changes in factor returns. For comparison, define the relative change in personal income as $\left(\tilde{I}_i^2 - \tilde{I}_i^1\right)/\tilde{I}_i^1$, where $\tilde{I}_i^b = I_i^b / E^b$ and E^b is the total earning/expenditure. The results are in Table 9.

Table 8. Personal income by qualification over time

		UD	OTQ	SQ	NQ
1986	Income	35577	25799	19227	17751
	Sample size	11469	53036	50241	72232
1991	Income	35454	23293	18044	15617
	Sample size	12427	62621	50461	67321
1996	Income	37030	26050	20062	17066
	Sample size	20792	44426	55997	63418

Note: Incomes are in 1991 dollars.

Data source: Maani (1997, 1999).

Table 9. Change in relative personal income by qualification over time.

	$\frac{\tilde{I}_i^{91} - \tilde{I}_i^{86}}{\tilde{I}_i^{86}}$	$\frac{\tilde{I}_i^{96} - \tilde{I}_i^{91}}{\tilde{I}_i^{91}}$	$\frac{\tilde{I}_i^{96} - \tilde{I}_i^{86}}{\tilde{I}_i^{86}}$
University Degree	0.0387	-0.0243 ✓	0.0135
Other Tertiary Qualifications	-0.0589 ✓	0.0448 ✓	-0.0167
School Qualifications	-0.0218	0.0387	0.0160
No Qualifications	-0.0830	0.0209	-0.0638

Note: A ✓ indicates that the sign coincides with that of changes in relative returns.

Figures in Table 9 suggest that there is a tendency for the income distribution to widen comparing 1986 and 1996, with the relative income for labour with a university degree increasing and that for labour without qualifications decreasing. After decomposing this into two sub-periods, although the income distribution is widening

[18] The factor intensities in Table 7 are the intensities in production.

for 1986 to 1991, the opposite has happened for 1991 to 1996. For most of the groups, the changes in relative personal income and relative factor returns are in different directions. It suggests that trade is not the cause of the changes in the income distribution. Furthermore, since the changes in trade flows increase the relative returns of labour without qualifications and decrease that of labour without a university degree when comparing 1991 to 1986 and 1996 to 1986, it actually partly offsets the personal income distribution widening effects from other sources.

4.7 Problems and Limitations

One of the important limitations of the results in this paper relates to the endogeneity of trade flows. It is obvious that net trade flows will be affected by many factors, such as changes in consumer preferences and technological progress over time, other than trade policies. To study the effects of trade in New Zealand's labour market quantitatively, a preferred solution may be to develop a multiple sector computable general equilibrium model.

The second limitation is the appropriateness and consistency of the data for the empirical analysis. For this paper, a large amount of effort was devoted to data search. Data were obtained from various sources. Even for data from the same source, the definitions often vary over time. Hopefully, despite the data imperfections, this paper can still provide some approximate estimates.

5. CONCLUSIONS

New Zealand's policy reforms have been substantial and much research has been devoted to evaluating their economic consequences. Most of the effort has been directed to studying New Zealand's macroeconomic performance since then. This

paper follows the methodology developed by Deardorff and Staiger (1988) and Deardorff and Lattimore (1999a, b) and studies the effects of trade liberalisation on New Zealand's factor markets.

The empirical analysis suggests that the trade liberalisation has raised the relative returns to workers without qualifications when the comparison is made between 1986 and 1996. This result is consistent with Deardorff and Lattimore (1999a, b). However, after decomposing this interval into two sub-periods, it is found that different trends have occurred for some of the groups. By examining the economy's weighted-average factor intensities over time, it is found that the changes in factor intensities are basically consistent with the changes in relative factor returns caused by trade liberalisation.

Data of personal income by qualification were also investigated. Despite the decline of wage differentials brought about by trade reforms, there is still a tendency for the income distribution to widen when comparing 1986 and 1996. The results confirm the general belief that trade liberalisation has contributed little to New Zealand's rising income inequality.

The results of this paper lie in the same line with most of the other empirical studies in the area of international trade and wages and conclude that increasing globalisation should not be blamed for the widening of the income distribution. Rather, the results suggest a stronger proposition that it might have actually helped to reduce inequality. To get some more accurate quantitative results, some further research could be devoted to constructing a multiple sector CGE model.

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APPENDIX

Table A1. Weighted factor intensities by industry 1986

(defined by the group 'Other Tertiary Qualification').

	Land	Capital	UD	SQ	NSQ	Share in prodn	Share in exports	Share in imports
Agriculture	0.47013	0.58682	0.14368	1.22772	2.05798	0.05947	0.08424	0.02245
Fishing and Hunting	0.00000	0.11102	0.05548	0.38141	0.91401	0.00427	0.01125	0.00026
Forestry & Logging	0.74349	0.28699	0.21437	1.00743	2.32218	0.01279	0.00229	0.00000
Mining & Quarrying	0.05965	1.34174	0.21053	0.59123	1.55088	0.01087	0.00439	0.02193
Food, Beverages & Tobacco	0.00166	0.36574	0.12551	0.99036	2.43898	0.09025	0.33219	0.03862
Textiles, Apparel & Leather	0.00040	0.17303	0.10174	1.33830	3.34574	0.03115	0.09912	0.05970
Wood & Wood Products	0.00170	0.15041	0.05095	0.78749	1.69967	0.01797	0.01481	0.00825
Paper, Products & Printing	0.00048	0.24300	0.14255	0.79081	0.99230	0.03074	0.03536	0.03725
Chemicals, Petrol, Rubber etc.	0.00088	0.61123	0.25248	0.86773	1.49461	0.04535	0.02654	0.16135
Non-metallic Mineral Products	0.00255	0.32606	0.14970	0.90180	1.96766	0.01013	0.00286	0.00988
Basic Metals	0.00111	0.80172	0.15006	0.59395	1.22699	0.01469	0.03717	0.05839
Fabricated Metal Products	0.00033	0.09466	0.07379	0.60738	1.03479	0.06705	0.03118	0.32212
Other Manufacturing	0.00287	0.15322	0.13316	1.17232	1.82245	0.00276	0.00742	0.02265
Electricity, Gas & Water	0.01742	2.03509	0.09080	0.37240	0.55080	0.02941	0.00020	0.00000
Construction	0.00021	0.06099	0.04729	0.42530	0.83457	0.08533	0.00148	0.00000
Trade, Restaurants & Hotels	0.00037	0.15507	0.12876	1.27722	1.51931	0.13507	0.12151	0.02703
Transport & Storage	0.01033	0.45664	0.07619	0.82948	1.36546	0.05487	0.13183	0.14990
Communication	0.00016	0.20841	0.07939	0.98908	0.85214	0.01748	0.01533	0.00262
Finance, Insurance etc.	0.00007	0.33175	0.55713	1.47424	0.48788	0.11525	0.02005	0.02828
Owner-occupied Dwellings	0.00000	0.00000	0.00000	0.00000	0.00000	0.03223	0.00000	0.00000
Social Services	0.00215	0.02482	0.37887	0.37492	0.51975	0.03754	0.01349	0.00903
Government Services	0.00459	1.15014	0.40584	1.21408	0.58141	0.08525	0.00404	0.00000
Private Non-Profit Services	0.00000	0.00000	0.00000	0.00000	0.00000	0.01009	0.00325	0.00000
Exports	0.04377	0.35211	0.13263	1.00914	1.93272			
Imports	0.01397	0.34278	0.13656	0.80705	1.39869			
Endowment	0.03928	0.36385	0.22737	0.82971	1.08142			

Note: Some industries do not have the 'Other Tertiary Qualifications' employment and therefore the factor intensities are not defined.

Table A2. Weighted factor intensities by industry 1991
(defined by the group Other Tertiary Qualifications').

	Land	Capital	UD	SQ	NSQ	Share in prodn	Share in exports	Share in imports
Agriculture	0.44498	0.45594	0.12740	1.05652	1.41271	0.065757	0.08424	0.02245
Fishing and Hunting	0.00000	0.16174	0.05357	0.34903	0.76786	0.004348	0.01125	0.00026
Forestry & Logging	1.07127	0.33937	0.13636	0.68182	1.50673	0.013338	0.00229	0.00000
Mining & Quarrying	0.06343	1.49907	0.22015	0.42351	1.04851	0.011266	0.00439	0.02193
Food, Beverages & Tobacco	0.00162	0.38273	0.11799	0.82367	1.68856	0.102715	0.33219	0.03862
Textiles, Apparel & Leather	0.00043	0.17678	0.08419	1.02105	1.99955	0.024197	0.09912	0.05970
Wood & Wood Products	0.00151	0.14355	0.04836	0.57881	0.94352	0.016341	0.01481	0.00825
Paper, Products & Printing	0.00048	0.28481	0.12055	0.61949	0.66144	0.030623	0.03536	0.03725
Chemicals, Petrol, Rubber etc.	0.00099	0.66299	0.22793	0.68186	0.98642	0.042157	0.02654	0.16135
Non-metallic Mineral Products	0.00333	0.41979	0.11719	0.72969	1.40469	0.00802	0.00286	0.00988
Basic Metals	0.00102	0.89523	0.15589	0.46420	0.83141	0.014964	0.03717	0.05839
Fabricated Metal Products	0.00039	0.12150	0.07115	0.43829	0.62965	0.051338	0.03118	0.32212
Other Manufacturing	0.00201	0.07197	0.11679	0.84307	0.97628	0.002367	0.00742	0.02265
Electricity, Gas & Water	0.02107	2.38986	0.10982	0.25689	0.37639	0.029987	0.00020	0.00000
Construction	0.00020	0.05258	0.03462	0.31820	0.51956	0.062354	0.00148	0.00000
Trade, Restaurants & Hotels	0.00029	0.14274	0.11914	1.03849	0.93559	0.134866	0.12151	0.02703
Transport & Storage	0.01040	0.43914	0.08057	0.71822	0.94226	0.051318	0.13183	0.14990
Communication	0.00019	0.36694	0.13771	0.64685	0.59395	0.023908	0.01533	0.00262
Finance, Insurance etc.	0.00004	0.32195	0.52193	1.00388	0.36248	0.117023	0.02005	0.02828
Owner-occupied Dwellings	0.00000	0.00000	0.00000	0.00000	0.00000	0.049266	0.00000	0.00000
Social Services	0.00188	0.02498	0.38732	0.31161	0.35388	0.039102	0.01349	0.00903
Government Services	0.00354	0.86900	0.40232	0.84413	0.40892	0.093554	0.00404	0.00000
Private Non-Profit Services	0.00000	0.00000	0.00000	0.00000	0.00000	0.011193	0.00325	0.00000
Exports	0.05157	0.35740	0.12407	0.79277	1.25554			
Imports	0.01213	0.38744	0.14359	0.64646	0.91039			
Endowment	0.03746	0.33864	0.23962	0.67097	0.69250			

Note: Some industries do not have the 'Other Tertiary Qualifications' employment and therefore the factor intensities are not defined.

Table A3. Weighted factor intensities by industry 1996
(defined by the group 'Other Tertiary Qualifications').

	Land	Capital	UD	SQ	NSQ	Share in prodn	Share in exports	Share in imports
Agriculture	0.41497	0.45619	0.19292	1.49055	1.50874	0.058822	0.08424	0.02245
Fishing and Hunting	0.00000	0.20153	0.13389	0.91632	1.18410	0.003988	0.01125	0.00026
Forestry & Logging	1.05510	0.25010	0.24853	1.07737	1.51583	0.015213	0.00229	0.00000
Mining & Quarrying	0.08153	2.30815	0.29017	0.77938	1.36451	0.009615	0.00439	0.02193
Food, Beverages & Tobacco	0.00217	0.49950	0.23577	1.45924	1.91698	0.093419	0.33219	0.03862
Textiles, Apparel & Leather	0.00058	0.21286	0.18716	1.68146	2.38152	0.024003	0.09912	0.05970
Wood & Wood Products	0.00158	0.14608	0.08426	0.99154	1.15660	0.021033	0.01481	0.00825
Paper, Products & Printing	0.00062	0.35930	0.19482	1.03834	0.81416	0.030461	0.03536	0.03725
Chemicals, Petrol, Rubber etc.	0.00118	0.74331	0.34517	1.16705	1.19907	0.040514	0.02654	0.16135
Non-metallic Mineral Products	0.00391	0.48135	0.19633	1.23119	1.57982	0.00871	0.00286	0.00988
Basic Metals	0.00137	1.20509	0.21495	0.80530	1.03894	0.010104	0.03717	0.05839
Fabricated Metal Products	0.00042	0.12409	0.13443	0.75795	0.75271	0.056375	0.03118	0.32212
Other Manufacturing	0.00234	0.07973	0.15957	1.22766	1.11277	0.002264	0.00742	0.02265
Electricity, Gas & Water	0.03527	4.17962	0.28340	0.52227	0.40810	0.030853	0.00020	0.00000
Construction	0.00022	0.05308	0.05436	0.61452	0.66926	0.072243	0.00148	0.00000
Trade, Restaurants & Hotels	0.00031	0.15685	0.24311	1.80154	1.09876	0.144219	0.12151	0.02703
Transport & Storage	0.01174	0.46121	0.16991	1.20183	1.12303	0.053098	0.13183	0.14990
Communication	0.00035	0.88723	0.35625	1.62133	0.99651	0.022655	0.01533	0.00262
Finance, Insurance etc.	0.00004	0.41619	0.86837	1.46742	0.47077	0.122582	0.02005	0.02828
Owner-occupied Dwellings	0.00000	0.00000	0.00000	0.00000	0.00000	0.045884	0.00000	0.00000
Social Services	0.00200	0.03474	0.52537	0.58137	0.43269	0.040588	0.01349	0.00903
Government Services	0.00460	1.16124	0.64271	1.25964	0.45532	0.081824	0.00404	0.00000
Private Non-Profit Services	0.00000	0.00000	0.00000	0.00000	0.00000	0.011532	0.00325	0.00000
Exports	0.05123	0.41496	0.22977	1.35925	1.42139			
Imports	0.01079	0.44613	0.22542	1.06850	1.09481			
Endowment	0.03979	0.40317	0.38029	1.11940	0.81763			

Note: Some industries do not have the 'Other Tertiary Qualifications' employment and therefore the factor intensities are not defined.