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Trade and wages in Australia

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ABSTRACT

The trade and wages debate worldwide, over the last decade has focused attention on the possible relationships between trade liberalisation and the factor distribution of income. In Australia real wages in manufacturing have remained about the same since 1977 while real GDP has doubled. At the same time Australia has reduced import protection. This pattern is observed in a range of developed countries, Slaughter (1998). There is a tendency to attempt to link these two trends causally in the trade and wages debate. Standard trade theory provides a framework to analyse this hypothesis by drawing the links between trade liberalisation and factor returns. This nexus is examined here by examining the factor content of Australian trade in a framework that enables us to draw some conclusions about the changes in factor returns that can be expected from trade liberalisation. In other words, the question posed by this paper is what are the characteristics of workers who benefit and what are the characteristics of the workers who lose from trade liberalisation in Australia given the structure of factor intensities in the tradable sector of the economy. Finally, the paper closes with some discussion of what might be done about the problem of real wage stagnation.

Key words: trade and wages, income distribution, part-time work

JEL Classification: F14, J31

1. THE FACTOR CONTENT OF TRADE

Deardorff and Staiger (1988) have shown that the factor content of trade can be used under certain circumstances to infer the changes in factor prices that are in some sense associated with changes in trade. Leamer (1996) has stressed various limitations of this approach, but Deardorff (1997 and 1999) has extended the model to some extent in response: sufficiently we believe that the factor content of trade remains a useful, if far from perfect, way of getting some information about the factor-market effects of trade. Deardorff and Lattimore (1999) adapted part of Deardorff and Staiger's analysis with a view to making more precise what measures of factor content can tell us.

The question asked is this: At any given time, to what extent did Australia's trade pattern cause the prices of its factors to be different from what they would have been, at that time and under otherwise identical conditions, in autarky. That is, had trade been shut down completely so that Australia had to produce all its needs for itself, prices of factors would have been different, some higher and some lower presumably, in order to satisfy the country's demands for goods. These demands too would have been different than with trade, in response to the different prices of goods that would have followed from the different prices of factors. Taking all of this into account, then, we ask how Australia's actual trade altered factor prices compared to what they would have been in autarky.

We ask this question for the year 1995 because this is the latest year for which a complete data set is available. In that year, Australia's trade pattern was presumably influenced by a wide range of policies: foreign trade policies affecting export access to foreign markets, foreign policies affecting import supply conditions into Australia and Australian trade policy vis a vis imports and exportables. Accordingly, in this analysis we are comparing the trade situation in 1995 in this policy and world market environment, with autarky. To the extent that 1995 is representative of later years in these respects, the conclusions can hold for the present.

Deardorff (1997) has derived the following relationship between factor quantities and factor prices in autarky for a country that produces and consumes an arbitrary number of goods using an arbitrary number of factors in constant elasticity of substitution (CES) production and utility functions with a common elasticity of substitution,

$$\sigma = 1/\varepsilon.$$

$$w_i = C_i^\varepsilon Y^\varepsilon I^{\varepsilon-1} v_i^{-\varepsilon} \quad (1)$$

where w_i is the wage of factor i and v_i is its quantity. C_i is a constant, an index of the distribution parameters in the various CES functions, Y is national income, and I is a CES index of factor prices. Equation (1) says that in autarky the prices of factors are inversely related to

their quantities, with an elasticity ε that is one over the elasticity of substitution. For example, labour economists have estimated the elasticity of factor substitution to be about 1.5.¹ If we take that elasticity to apply also to goods, then (1) suggests a factor price response of about two thirds of the proportional changes in quantities. For simplicity the Cobb-Douglas version of (1) is used for the analysis, leaving it to the reader to scale the changes down by the fraction 2/3 if they wish, or to make any other adjustments that they think appropriate.

Equation (1) becomes useful when we draw on the result of Deardorff and Staiger (1988) that any trading equilibrium (with again arbitrary numbers of goods and factors and now also with arbitrary constant-returns-to-scale technologies and arbitrary barriers to trade) will have the same factor prices as what they call an “equivalent autarky equilibrium,” in which factor endowments are changed by the amounts of the factor content of trade and trade is then prohibited.² Thus equation (1) can be used to compare not just two actual autarky equilibria, but also two equilibria with or without trade by constructing what the factor endowments in their equivalent autarky equilibria would have been.

Consider then an economy with a vector of actual factor endowments $\bar{v} = \{\bar{v}_i\}$. Were that economy not to trade, its factor prices, $\bar{w} = \{\bar{w}_i\}$, would be given from (1) in the Cobb-Douglas case ($\varepsilon = 1$) by

$$\bar{w}_i = C_i \bar{Y} \bar{v}_i^{-1} \quad (2)$$

where

$$\bar{Y} = \sum_i \bar{w}_i \bar{v}_i = \bar{w} \bar{v}. \quad (3)$$

With trade, let $s = \{s_i\} = AT$ be the factor content of trade, a vector of positive and negative factor quantities derived from the vector of net trade (exports minus imports) in goods, T, by multiplying by the matrix A of factors employed in each industry per unit of output. Then following Deardorff and Staiger (1988), the factor prices, \tilde{w} , that prevail in that trading equilibrium will be the same as those that the same economy would have in autarky if factor endowments were altered by the factor content of trade, becoming $\tilde{v} = \bar{v} - s$. Thus, from (1), again with $\varepsilon = 1$,

$$\tilde{w}_i = C_i \tilde{Y} \tilde{v}_i^{-1} \quad (4)$$

where

¹ See Johnson and Stafford (1997)

² This result also requires several other assumptions, such as perfect competition and the absence of domestic distortions, and perhaps most importantly that all goods be produced in the domestic economy. Leamer (1996) has rightly criticised this last assumption, and while Deardorff (1997) has made some progress in adapting the model to drop this assumption, we do not attempt to incorporate that extension here. Suffice it to say that he shows that assumption to be unnecessary for the Cobb-Douglas case that we apply here.

$$\tilde{Y} = \sum_i \tilde{w}_i \tilde{v}_i = \tilde{w} \tilde{v} = \tilde{w}(\bar{v} - s) = \tilde{w} \bar{v} - S \quad (5)$$

and S is the trade (current account) surplus.³

In order to compare factor prices in the trade equilibrium, \tilde{w} , with what they would have been in autarky, we take the ratio of (2) and (4). So as to compare relative factor prices rather than ones in some arbitrary numeraire, we normalise on the value of the factor endowments, setting $\bar{Y} = \bar{w} \bar{v} = \tilde{w} \bar{v} = \tilde{Y} + S$. The result is

$$\frac{\tilde{w}_i}{\bar{w}_i} = \frac{\tilde{Y} \bar{v}_i}{\bar{Y} \tilde{v}_i} = \frac{\bar{Y} - S}{\bar{Y}} \frac{\bar{v}_i}{\bar{v}_i - s_i} \quad (6)$$

or

$$\frac{\tilde{w}_i}{\bar{w}_i} = \frac{1 - \frac{S}{\bar{Y}}}{1 - \frac{s_i}{\bar{v}_i}} \quad (7)$$

That is, if trade is balanced ($S = 0$), then whether trade has raised or lowered a particular relative factor price compared to autarky depends simply on whether that factor's content of trade is positive or negative. If a factor is net-exported in content terms ($s_i > 0$), then the denominator on the right of (7) is less than one and $\tilde{w}_i > \bar{w}_i$. If trade is not balanced, then net trade in the factor must be compared to net trade overall in order to infer effects on relative factor prices. For example, only if the net export of a factor relative to its endowment is greater than the country's trade surplus relative to national income will the factor's relative price be raised by trade.

2. MEASURING THE FACTOR CONTENT OF TRADE

Once the factor content of trade has been measured, equation (7) can be implemented straightforwardly with easily accessible data on the trade balance and national income, plus data on factor endowments. Note however that the equation holds for each factor separately, so that it is not necessary to apply it for all factors if data for only some are available.

The factor content of trade was defined above as $s = \{s_i\} = AT$, or

$$s_i = \sum_j a_{ij} T_j \quad (8)$$

³ With competitive prices, $\tilde{p} = \tilde{w}A$, $B = \tilde{w}s = \tilde{w}AT = \tilde{p}T$.

where a_{ij} is the quantity of factor i used per unit of output of good j . Both trade and input requirements are more easily got in terms of values of the goods, not quantities, and these are obtained by transforming (8) as

$$s_i = \sum_j \left(\frac{a_{ij}}{p_j} \right) (p_j T_j) \quad (8')$$

More difficult is the issue of intermediate inputs. Suppose that in addition to requiring the primary inputs a_{ij} , production of good j also requires intermediate inputs of itself and other produced goods, b_{kj} being the amount of good k used in production of a unit of good j . Letting $B = \{b_{kj}\}$ be the (square) matrix of intermediate input requirements, net output is only $(I - B)$ times gross output (with I an identity matrix), and the total primary factors needed to produce a unit of net output, including all intermediate inputs, is $A(I - B)^{-1}$. Thus we have the choice of measuring only the direct factor content of trade, $s = AT$, as in (8), or of allowing also for the indirect use of primary factors in producing inputs. In that case we have $s = A(I - B)^{-1}T$, or

$$s_i = \sum_k a_{ik} \sum_j \left\{ (I - B)^{-1} \right\}_{kj} T_j \quad (9)$$

This too can be transformed into value terms for easier application:

$$s_i = \sum_k \frac{a_{ik}}{p_k} \sum_j \left\{ (I - \beta)^{-1} \right\}_{kj} p_j T_j \quad (9')$$

where $\beta = \{\beta_{kj}\} = \{p_k b_{kj} / p_j\}$ is the value of input k per unit value of output j .

3. EMPIRICAL ANALYSIS

The empirical analysis consists of estimating equation 9 and equation 7 for labour inputs using the 1994-95 (107 sector) input-output table for Australia and a cross tabulation of employment by 107 sectors from the 1996 population census. The labour force is disaggregated by highest educational qualification obtained as a proxy for skill levels. Eight educational levels are distinguished from higher degrees to no formal educational qualification. They are listed in the following Table. This approach to assessing skill levels was suggested by Harrigan (1997) because educational qualifications are more exogenous than some other commonly available statistics on type of work such as the distinction between managers, process workers and the like.

The net trade vector required for equation 9 is adapted from the input-output table to reconcile it with the current account balance of the balance of payments statistics. In particular, the input-

output table does not include all factor payments in financial services. To correct this a sum equal to the difference between the 1995 current account deficit of \$26.515 billion and the trade deficit in the input-output table has been added to imports of banking services. This amended table of net trade by product is given in the Annex.

On this basis, the equations are estimated firstly with respect to the total labour input in full-time job equivalents. The wage with trade (relative to autarky, w^*/w , equation 7) is 0.98. This implies that exports are slightly labour extensive and importables are slightly labour intensive. It is also likely that another production factor or factors are intensive in exports. This might be capital and/or natural resources. Furthermore, a relative wage of 0.98 provides some evidence that trade reduces the real wage by around 2 percent as compared to an autarkic situation.

The next step in the analysis consisted of disaggregating the labour input into male and female workers, full and part-time workers and the eight formal qualification levels referred to earlier. The results are given in Table 1. The relative wages in Table 1 tend to be close to unity with most ranging from 0.98 and 1.03 with just a couple of outliers.

These values do not appear to be large deviations from unity when compared with some other studies. For example, in a similar study for New Zealand, wages with trade relative to autarky for many labour categories were greater than 5 percent, that is, outside the range 0.95-1.05, (Cagatay et al, 1999).

The sex break down of the labour force shows some pattern. Females are more prevalent in export oriented jobs with 11 of the 16 categories of females having relative wages greater than or equal to 1.0, while half of the male categories below unity. There is a much clearer pattern of differences between part and full time workers. For part-time workers, 15 of the 16 categories have relative wages greater than or equal to one indicating that this group is highly export sector oriented. By contrast 12 of the sixteen full-time categories are importable sector oriented with relative wages less than unity.

Differences in relative wages are less obvious for different qualification levels. However, if we look at the top and bottom three categories, some differences emerge. Nine of the twelve top three categories tend to be export sector oriented versus only 50 percent of the bottom three categories. In the middle grouping of workers with undergraduate and associate diplomas, fifty percent are export sector oriented with relative wage ratios greater or equal to one and fifty percent importable sector oriented.

Table 1 Effect of trade on labour force by characteristic

Highest Qualification			Relative Wage
Higher degree	Full time	Male	0.98
		Female	1.01
Higher degree	Part time	Male	1.01
		Female	1.02
Postgraduate diploma	Full time	Male	1.00
		Female	1.03
Postgraduate diploma	Part time	Male	1.03
		Female	1.03
Bachelor degree	Full time	Male	0.96
		Female	0.99
Bachelor degree	Part time	Male	1.00
		Female	1.02
Undergraduate diploma	Full time	Male	0.98
		Female	1.02
Undergraduate diploma	Part time	Male	1.01
		Female	1.03
Associate diploma	Full time	Male	0.95
		Female	0.98
Associate diploma	Part time	Male	0.99
		Female	1.00
Skilled vocational qualification	Full time	Male	0.97
		Female	0.99
Skilled vocational qualification	Part time	Male	1.00
		Female	1.01
Basic vocational qualification	Full time	Male	0.99
		Female	0.98
Basic vocational qualification	Part time	Male	1.01
		Female	1.00
No Qualification ¹	Full time	Male	0.99
		Female	0.97
No Qualification ¹	Part time	Male	1.02
		Female	1.00

Source: Authors calculations

4. CONCLUSIONS AND FURTHER RESEARCH

The factor content based analysis of Australian trade in 1994-95 suggests that exportables are slightly more extensive in the use of total labour inputs than importables. To the extent this is true, trade liberalisation at home and abroad is disadvantaging labour relative to other factors of product in the static sense. This pattern appears to be reversed for certain categories of labour. In particular, exportables appear to be intensive in part-time employees of many qualification levels from higher degrees to those with no formal qualifications. The framework suggests,

therefore, that part-time workers would be relatively advantaged by further trade liberalisation and full-time workers would generally not be. However, the positive and negative effects of trade liberalisation tend to be small, generally around 2-3 percentage points.

This analysis suggests that it is very unlikely that trade liberalisation, globalisation and the international division of labour generally can be used to explain a significant portion of the stagnation in real wages in Australia in recent decades. More likely, the major cause lies elsewhere in technological growth bias perhaps.

A further issue that arises, however, is whether trade policy might be useful in improving real wages. Deardorff (1999) in a recent paper addresses this issue explicitly and argues that no matter what the cause of the real wage stagnation, be it 'trade' or technology, trade policy is not likely to be the answer. This is a familiar argument in trade theory in the case of factor market distortions, for example. Import protection tends to be at most, the second best solution.

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ANNEX: AUSTRALIAN NET TRADE

Table 2 Australian net trade, 1994-95

000 \$	Exports	Imports	Net Trade (million \$)
Industries			
Sheep	2117853	75125	2043
Grains	1478162	120479	1358
Beef cattle	178536	119994	59
Dairy cattle	0	62375	-62
Pigs	1596	20432	-19
Poultry	3160	4341	-1
Other agriculture	526027	100000	426
Services to agriculture; hunting and trapping	592246	16467	576
Forestry and logging	25950	14760	11
Commercial fishing	467902	53548	414
Coal; oil and gas	9556178	2638429	6918
Iron ores	2152615	125713	2027
Non-ferrous metal ores	6516327	759007	5757
Other mining	590181	120146	470
Services to mining	14971	10000	5
Meat and meat products	4070688	95839	3975
Dairy products	1515657	283828	1232
Fruit and vegetable products	352786	552308	-200
Oils and fats	67173	366494	-299
Flour mill products and cereal foods	449130	146285	303
Bakery products	163793	210092	-46
Confectionery	202474	317343	-115
Other food products	2685722	1155209	1531
Soft drinks, cordials and syrups	93229	270127	-177
Beer and malt	290857	161019	130
Wine and spirits	471119	561417	-90
Tobacco products	154285	524048	-370
Textile fibres, yarns and woven fabrics	965141	1997646	-1033
Textile products	162596	693769	-531
Knitting mill products	49476	409216	-360
Clothing	541131	1736866	-1196
Footwear	45710	605387	-560
Leather and leather products	564673	542046	23
Sawmill products	525642	704409	-179
Other wood products	85908	457181	-371
Pulp, paper and paperboard	70456	1991934	-1921
Paper containers and products	113719	203722	-90
Printing and services to printing	68459	337541	-269
Publishing; recorded media and publishing	230557	1806664	-1576
Petroleum and coal products	728935	1852205	-1123
Basic chemicals	1128097	4537431	-3409
Paints	55267	107462	-52
Medicinal and pharmaceutical products, pesticides	550869	1769126	-1218
Soap and other detergents	78876	194483	-116
Cosmetics and toiletry preparations	64638	366526	-302
Other chemical products	209606	885961	-676
Rubber products	92645	1211346	-1119
Plastic products	237933	1811306	-1573
Glass and glass products	65564	351101	-286
Ceramic products	62496	610412	-548
Cement, lime and concrete slurry	10502	40457	-30
		1994-95	

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000 \$ Industries	Exports	Imports	Net Trade (million \$)
Plaster and other concrete products	24399	9410	15
Other non-metallic mineral products	84284	227255	-143
Iron and steel	1601039	1720566	-120
Basic non-ferrous metal and products	7566569	716790	6850
Structural metal products	166435	44443	122
Sheet metal products	90789	135368	-45
Fabricated metal products	333863	1867582	-1534
Motor vehicles and parts; other transport equipment	1176758	9951242	-8774
Ships and boats	348282	463621	-115
Railway equipment	93218	120788	-28
Aircraft	402044	1506980	-1105
Photographic and scientific equipment	526177	3295500	-2769
Electronic equipment	1219089	10800849	-9582
Household appliances	150413	1366479	-1216
Other electrical equipment	580387	2510296	-1930
Agricultural, mining and c	446173	3272598	-2826
Other machinery and equipment	831487	5600752	-4769
Prefabricated buildings	22410	2773	20
Furniture	76420	499396	-423
Other manufacturing	321191	1577401	-1256
Electricity supply	26767	8026	19
Gas supply	8	2211	-2
Water supply; sewerage and drainage services	6686	9852	-3
Residential building	27869	8500	19
Other construction	92834	35450	57
Wholesale trade	6123068	1186	6122
Retail trade	1287136	287870	999
Mechanical repairs	0	0	0
Other repairs	0	0	0
Accommodation, cafes and restaurants	2008729	1328862	680
Road transport	1544688	305870	1239
Rail, pipeline and other transport	1098883	162509	936
Water transport	1836589	1374905	462
Air and space transport	3261500	3082262	179
Services to transport; storage	1594808	1051268	544
Communication services	844932	1144806	-300
Banking	323858	16025330	-15701
Non-bank finance	16666	56400	-40
Financial asset investors	22	0	0
Insurance	564181	827813	-264
Services to finance, investment and insurance	156536	169200	-13
Ownership of dwellings	0	0	0
Other property services	248168	280203	-32
Scientific research, technical and computer services	728083	823275	-95
Legal, accounting, marketing and business	989477	1111384	-122
Other business services	385316	311069	74
Government administration	39313	0	39
Defence	143313	0	143
Education	1431870	390843	1041
Health services	390019	261596	128
Community services	2076	387	2
Motion picture, radio and television services	149770	489939	-340
Libraries, museums and the arts	102960	240528	-138
Sport, gambling and recreational services	349816	227830	122
Personal services	72825	58512	14
Other services	6873	2581	4
Totals	83364577	109879577	-26515

Source: Adapted from Australian Input-Output Table 1994-95, see text.