

Values of Travel Time Savings Used in Road Project Evaluation: A Cross-Country/Jurisdiction Comparison

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Abstract:

One of the basic inputs to economic evaluation of highway or transit investments is the value assigned to savings in travel time, for work or non-work travel time. This paper reports on a review of empirical studies of the value of travel time savings (VTTS), along with a review of the values being used for project evaluation in various jurisdictions. Empirical estimates of VTTS show a wide range, with a central tendency between 30 to 60 percent of the average wage. Current practice in highway investment appraisal varies immensely across countries, states and provinces. Some make little or no use of economic criteria in highway investments. The VTTS used for non-work time ranges almost ten to one across countries and jurisdictions; the VTTS for working time is more consistent across countries, the highest work VTTS is about three times the lowest value in the sample.

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Introduction

One of the basic inputs to economic evaluation of highway or transit investments is the value assigned to savings in travel time, both for work or non-work travel time. This paper reports on a review of many empirical studies of the value of travel time, along with a review of the values being used for project evaluation in various countries and government agencies. The review of jurisdictions is not exhaustive; information was more readily obtained for some areas than others.

Some countries have made extensive use of cost-benefit analysis (CBA) for road and other transport projects (e.g., New Zealand, Australia, the U.K. and some European countries). CBA has been less popular in North America. Current practice in highway investment appraisal varies immensely across countries, states and provinces. Some make little or no use of economic criteria. In North America, fiscal constraints combined with aging and deteriorating infrastructure are stimulating new interest in evaluation procedures. There appears to be a rebirth of interest in CBA applied to the evaluation of highway projects in North America.

The paper is divided into two broad sections. The first summarizes the values of travel time savings (VTTS) reported in a variety of empirical studies. It shows a wide range of empirical estimates for VTTS. The second section reports on the VTTS being used for project evaluation purposes in a number of countries and North American jurisdictions. There are substantial differences in the base VTTS being used as well as in the presence or absence of adjustments to VTTS for different trip purposes, travel conditions, income, etc. A concluding section summarizes the findings and comments on trends and research needs in the use of VTTS for highway project evaluation.

Empirical Studies of Values of Travel Time Savings

There is an extensive literature on both the theory and empirical estimates of VTTS. There are also a number of recent surveys and/or commissioned studies to review the literature on VTTS. This paper concentrates on empirical results rather than theoretical discussion (for a review of theoretical issues see Bruzelius, 1979; MVA Consultancy *et al.*, 1987; Bates and Glaister, 1990). This paper draws primarily on one review (Waters, 1992) supplemented by other recent reviews (notably Bates and Glaister, 1990; Bone, 1991; Chui and McFarland, 1990; Lawson, 1989; MVA Consultancy, *et al.*, 1987; Miller, 1989).

Empirical studies of VTTS have been carried out in many countries, for different travel situations, using different methodologies. Values of travel time may be expressed in absolute currency units or, often, as a percentage of the wage. Table 1 summarizes the empirical results from a number of studies (listed in approximate chronological order). They have been converted to 1990\$AUS and also expressed as a percentage of the average wage. The VTTS as a percentage of the wage varies about 100 fold. Restricting studies to the most numerous category, automobile commuting, still shows

a range of values greater than ten to one. Figure 1 combines studies of VTTS for commuters from two reviews (Waters, 1992 and Miller, 1989). There is a wide range of results, but with a central tendency for the VTTS to be between 30 to 60 percent of the average wage. (Looking at Table 1, there appears to be some tendency for the VTTS to be higher in more recent studies).

Table 1
Computation of Estimated Value of Travel Time
Savings from Various Studies (in Annex A)
(in chronological order)

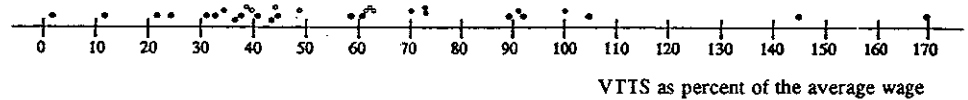
By Percentage of Wage Rate and
by 1990 \$AUS Per Hour

Author	Country	VTTS \$ AUS Per Hour	VITS as a % of Wage Rate(a)	Trip Purpose	Mode
Beesley, M. (1965)	UK	4.42 - 6.70	33% - 50%(b)	Commuting	Auto
Quarmby, D. (1967)	UK	2.68 - 3.35	20% - 25%	Commuting	Auto, Transit
Stopher, P. (1968)	UK	2.81 - 4.29	21% - 32%(b)	Commuting	Auto, Transit
Oort, C. (1969)	USA	4.42	33%	Commuting	Auto
Thomas & Thompson (1970)	USA	11.52	86%	Interurban	Auto
Lee & Dalvi (1971)	UK	4.02	30%	Commuting	Bus
		5.36	40%	Commuting	Auto
Wabe, J. (1971)	UK	5.76	43%	Commuting	Subway, Rail
Talvittie, A. (1972)	USA	1.74	12% - 14%	Commuting	Auto, Transit
Hensher & Hotchkiss (1974)	Australia	0.36	2.7%	Commuting	Hydrofoil, Ferry
Kraft & Kraft (1974)	USA	5.09	38%	Interurban	Bus
McDonald, J. (1975)	USA	6.03 - 10.45	45% - 78%(b)	Commuting	Auto, Transit
Ghosh, <i>et al.</i> (1975)	UK	9.78	73%	Interurban	Auto
Guttman, J. (1975)	USA	8.44	63%	Leisure	Auto
		19.43	145%	Commuting	Auto
Hensher, D. (1977)	Australia	5.23	39%	Commuting	Auto
		4.69	35%	Leisure	Auto
Nelson, J. (1977)	USA	4.42	33%	Commuting	Auto
Hauer & Greenough (1982)	Canada	8.98 - 13.53	67% - 101%(f)	Commuting	Subway
Edmonds, R. (1983)	Japan	5.63 - 6.57	42% - 49%(c)	Commuting	Auto, Bus, Rail
Deacon & Sonstelie (1985)	USA	6.97 - 34.04	52% - 254%(b)	Leisure	Auto
Hensher & Truong (1985)	Australia	14.07	105%	Commuting	Auto, Transit
Guttman & Menashe (1986)	Israel	7.91	59%	Commuting	Auto, Bus
Fowkes, T. (1986)	UK	3.62 - 7.91	27% - 59%(d)	Commuting	Rail, Coach
Hau, T. (1986)	USA	6.16	46%(e)	Commuting	Auto, Bus
Chui & McFarland (1987)	USA	10.99	82%	Interurban	Auto
Mohring <i>et al.</i> (1987)	Singapore	8.04 - 16.08	60% - 120%(b)	Commuting	Bus
Cole Sherman (1990)	Canada				
Comparison Model		12.46	93%	Commuting	Auto
		15.54	116%	Leisure	Auto
Logit Model		22.78	170%	Commuting	Auto
		22.11	165%	Leisure	Auto

a - Average wage rate per hour estimated as NSW Nov 1990 average earnings for all employees divided by 38 hours (\$13.40)
 b - Varies with income of the traveller
 c - Estimates are sensitive to data selected.
 d - Varies with income of the traveller and the model used
 e - Paper used 5.71% of daily income in its model (an 8 hour day is assumed)
 f - Inferred values (study actually valued waiting time)

FIGURE 1

Scatter Plot of Values of Commuter Time Savings Involving Auto Travel
(from • Table 1, ○ from Miller (1989) not included in Table 1)



Values of Travel Time Savings for Road Project Evaluation

Travel time savings are a major component of the benefits of nearly all road projects. Because of the importance of this benefit category, a number of countries and/or government agencies have conducted reviews into the values of VTTS used for project evaluation. This paper can only briefly summarize the results of these reviews.

Reviews of VTTS for project evaluation

United Kingdom: Probably the most ambitious review of VTTS was that carried out in the U.K. (MVA Consultancy, *et al.*, 1987; see also Sharp, 1988). They reviewed the theory of travel time valuation, reviewed existing empirical evidence, and conducted a number of additional empirical studies. The most important conclusion was the decision to increase the base non-work VTTS from 25 percent to 40 percent of the wage. The figures adopted officially by the U.K. government for transport project evaluation are as follows (Sharp, 1988):

	pence/hour (1985)	AUS\$/hour (1990)
Standard appraisal value	153.2	4.59
People of working age	180.5	5.42
Retired people	121.0	3.63
All Adults	175.8	5.27
Children less than 16	45.2	1.35

The "standard appraisal value" is the weighted average of the remaining categories. As with their previous practice, the VTTS is adjusted for waiting, walking and riding time. The U.K. government explicitly rejected incorporating an adjustment for income despite evidence of a link between incomes and VTTS.

United States: The most notable review on VTTS in the United States is in connection with the update and revision to the AASHTO manual (1977). This is the most widely used guidebook for highway and transit project evaluation in North America. This update is not yet completed. The best indication of the likely recommendations are those in Chui and McFarland, 1990. They review a number of

VTTS studies for different valuation approaches. Their recommended VTTS is about 80 percent of the wage. They do not distinguish between work and non-work time. Table 2 lists the 1977 AASHTO figures along with the suggested update, converted to AUS\$.

Miller (1989) has also carried out various reviews of VTTS and made recommendations to the U.S. Federal Highway Administration. His recommendation of 60 percent of the wage for non-work VTTS has been adopted by FHWA.

The individual U.S. states vary immensely in their procedures for highway evaluation. CBA is employed by a few states; many have adopted various ad hoc criteria, normally defined in terms of highway sufficiency ratings or other technical criteria. Most states which do carry out CBA studies rely on updated AASHTO figures. Table 3 is an incomplete sample of VTTS used by various states (N/A means values of time savings not calculated for highway studies).

Canada: Lawson (1989) reviewed the VTTS literature and practices in several countries for Transport Canada. Largely on the basis of Lawson's review, Transport Canada (1990) is recommending 50 percent of the wage for the valuation of non-work time savings. Notable is Transport Canada's adoption of a uniform non-work VTTS for all modes, including air travel. This reflects a rejection of varying time by income level, which is thought to largely explain the differences in VTTS found in different modes. The not yet official figures are shown in Table 4.

Table 2
Recommended VTTS for the New AASHTO Guide
(Source Chui & McFarland, 1990)
(converted to 1990 AUS\$)

Vehicle Type	Value of Time \$ per Vehicle Hour ^a
Passenger Cars	16.23 ^b
Buses	162.72 ^c
Trucks	
Single-unit, 2-axle, 4-tire	20.89
Other Single-unit	24.94
Semi Combinations, 4 or less axles	31.10
All others, 5 or more axles	34.52

Source: Chui and McFarland, 1990

^a All Figures are converted to AUS \$1990 after converted to \$CDN and indexed up.

^b Assuming 1.3 persons per vehicle.

^c Assuming 10 passengers per vehicle.

Table 3

**Summary of Value of Time Figures from Contacted Organizations
(U.S. State Highway and Transportation Departments)**

	(1990 AUS\$)
Alaska	N/A
California	\$ 9.22/hour (Autos) \$24.57/hour (Trucks) (in 1991 AUS\$)
Colorado	N/A
Connecticut	AASHTO Figures + CPI
Florida	\$20.34/hour (Autos) \$23.89/hour (Light Trucks) \$28.49 - \$39.47/hour (Various size Trucks)
Georgia	N/A
Idaho	AASHTO Figures + CPI
Kansas	N/A
Kentucky	AASHTO Figures + CPI (PPI for Trucks)
Louisiana	N/A
Mississippi	N/A
Montana	AASHTO Figures + CPI
Nevada	AASHTO Figures + CPI
New York	\$ 5.75/hour (Autos, Light trucks) \$23.56/hour (Trucks)
Pennsylvania	AASHTO Figures + CPI

Source: Waters (1992).

CPI - Consumer Price Index; PPI - Producer Price Index.

N/A - Not Applicable, The State contacted does not have any figures for value of time.

Figures have been converted to AUS\$ 1990 unless otherwise noted.

Table 4
TRANSPORT CANADA'S PROPOSED VALUE OF PASSENGER TIME
 \$/Hour
 1986 Base Year - Converted to 1990 AUS\$ Dollars

<u>Mode</u>	<u>Business Travel</u>	<u>Non-Business Travel</u>	<u>All Travel</u>
Air	34.45	6.59	23.11
Auto	22.03	6.59	9.39
Bus	22.03	6.59	8.64
Highway	22.03	6.59	9.29
Rail	22.03	6.59	10.69
All non-Air	<u>22.03</u>	<u>6.59</u>	<u>9.39</u>
All Modes	25.38	6.59	10.04

Source: Transport Canada (1990) p.iii.

Table 5
British Columbia's Value of Travel Time Savings (AUS\$1990)

<u>Category</u>	<u>Work</u>	<u>Non-Work</u>
Passenger cars & Light Trucks		
Driver (Adult)	\$19.02	\$6.34
Driver (Retired)		\$4.44
Passenger (Adult)	\$19.02	\$4.44
Passenger (Retired)		\$3.20
Passenger (under 16)		\$2.69
Bus		
Driver	\$32.61	
Passenger (Adult)		\$4.44
Passenger (Retired)		\$3.20
Passenger (under 16)		\$2.69
2-Axle Trucks		
Driver	\$29.45	\$8.16
5-Axle Trucks		
Driver	\$32.43	\$9.18

The VTTS is higher for waiting time as well as travel time in highly congested conditions. The non-work VTTS is factored up as follows: (Note: There is a lesser congestion adjustment for work VTTS)

Level of Service D	Multiply by 1.33
Level of Service E	Multiply by 1.67
Level of Service F	Multiply by 2.00
Stoppages of any kind	Multiply by 2.00

British Columbia recently completed a review of VTTS (Waters, 1992). The recommendation from the study was a VTTS of 50 percent of the wage, plus various adjustments for age and travel conditions (degree of congestion). British Columbia has adopted 40 percent as the base VTTS and is incorporating various adjustments (not income), as indicated in Table 5.

A few other provinces have conducted CBA studies, although none of them rely on CBA on a consistent basis. British Columbia is the most active in reviewing the applicability of CBA to highway evaluation. (CBA had not been used for highway evaluations in B. C. until recently.) Table 6 reports on the VTTS figures for five other provinces.

New Zealand: New Zealand has used CBA for road projects since 1973. They undertook a review of values of time from 1989-1991 (Miller, 1989, Bone 1991). They adopted 40 percent of the wage as a base value of time, but with adjustments for auto and bus passengers (the latter valued differently for standing or seated). The recommendations from Bone (1991) for commuting and recreation time are in Table 7; figures from the New Zealand Road Project Evaluation Manual (1991) are in Table 8.

Table 6
Summary of Value of Time Figures from Contacted Organizations
(Canadian Provincial Highway and Transportation Departments)
(1990 AUS\$)

Alberta	\$ 6.48/hour (Non-Work trips) \$14.04/hour (Commuting) \$25.38/hour (Trucks)
Manitoba	\$ 6.48/hour (Autos)
Ontario*	\$11.96/hour (Work Trips) \$ 3.19/hour (Commuting) \$49.95/hour (Trucks)
Quebec	\$10.69/hour (Auto - Work Related) \$ 2.24/hour (Auto - Non-Work Related) \$15.24/hour (Truck - 2 Axle) \$16.45/hour (Truck - 5 Axle)
Saskatchewan	N/A

Source: Waters (1992).

N/A - Not Applicable: The Province contacted does not have any figures for value of time.

Figures have been converted to AUS\$ 1990 unless otherwise noted.

*Ontario figures for 1983, converted to \$AUS and indexed to 1990.

Table 7
Recommended VTTS for New Zealand

(source: Bone, 1991, p.29)

Commuting to/from work:	
Base value of time	40% of the wage rate
Car, van passenger	factor of 0.75 that of car drivers, or 30% of wage rate.
Stage bus passenger	25% of wage rate
Walking to/from bus	40% of the wage rate, i.e., a factor of 1.6 on in-vehicle time
Walking to/from car	60% of the wage rate, i.e., a factor of 1.5 on in-vehicle time
Waiting for bus	50% of the wage rate, i.e., a factor of 2.0 on the in-vehicle time
Cycle and motorcycle	as for car driver
Social and Recreational Trip Purpose:	75% of commuting values

Table 8

Base Value for Vehicle Occupant Time Costs in NZ\$/Hour (1991)

Vehicle Occupant	Work Travel Purpose NZ\$/hr	Non-Work Travel Purpose NZ\$/hr
Car, Motorcycle Driver	14.52	4.66
Car, Motorcycle Passenger	14.52	3.51
Light Commercial Driver	13.14	4.66
Light Commercial Passenger	13.14	3.51
Medium Commercial Driver	10.77	4.66
Medium Commercial Passenger	10.77	3.51
Heavy Commercial Driver	10.77	4.66
Heavy Commercial Passenger	10.77	3.51
Seated Bus Passengers	14.52	2.90
Standing Bus Passengers	14.52	5.88
Pedestrian and Cyclist	14.52	7.03

Source: Transit New Zealand, *Project Evaluation Manual* (1991)

Australia: Australia also makes use of CBA studies in road project evaluation. Tables 9 and 10 report the VTTS for New South Wales and South Australia (these were the only figures we had in Canada). The VTTS differ for rural and urban road projects. Note that NSW figures are per vehicle hour for urban areas but per person hour for rural VTTS.

Table 9
New South Wales
Values for Travel Time Savings
1991 \$AUS
Urban Areas

<u>Period</u>	<u>Time Value</u> <u>\$/vehicle hour</u>
Off Peak	\$13.51
Medium Off-Peak	\$13.51
Medium Business hours	\$17.43
Business Hours	\$17.43
AM Peak	\$10.58
PM Peak	\$10.58
VTTS for Rural Areas^a	
<u>Vehicle Type</u>	<u>AUSS/person</u>
Private Car	\$ 7.12
Business Car	\$26.89
Light Commercial Vehicle	\$12.99
Heavy Vehicles	\$13.23

a - Per person hour

Source: "Economic Analysis Manual", New South Wales Roads and Traffic Authority, November, 1990, Tables 2 and 7.

Table 10
South Australia
Estimated Values of Travel Time

<u>Vehicle Type</u>	<u>Rural Value</u> <u>(\$AUS person/hour)</u>	<u>Urban Value</u> <u>(\$AUS person/hour)</u>
Private Car	\$3.51	\$2.58
Business Car	\$13.29	\$17.96
2-Axle Truck	\$9.88	\$9.88
3-Axle Truck	\$12.95	\$12.95
4-Axle Truck	\$13.06	\$13.06
5-Axle Truck	\$13.29	\$13.29
6-Axle Truck	\$13.29	\$13.29
Road Train	\$20.21	--

Source: Government of South Australia, Transport Portfolio, *Economic and Financial Evaluation Guidelines*.

South Australia also has recently compiled a guide for economic evaluations. This guide, called the "Transport Project Evaluation Guidelines Manual" has figures for

both urban and rural areas (In 1990 Australian Dollars). They are summarized in Table 10. VTTS values are further disaggregated by trip purpose, type of time valued (e.g., waiting time, walking time, etc.) and mode type. The manual discusses differences between small and large time savings, yet chooses not to value them differently.

Other Countries: Reviews of VTTS have been conducted in other countries too. Citing personal communication, Lawson reports 1985 values of time for evaluating infrastructure investments for the Federal Republic of Germany as:

	DM/hr (1985)	AUS\$/hr (1990)
working time	12.67	9.00
non-work time	2.11	1.49

Lawson (1989) also reports the values of time for road investment appraisal in Finland. The value for work trips is a gross wage including 57 percent markup to reflect "social security costs." For commuting and personal business, the value of time is 35 percent of the gross wage, and the value of time for leisure travel is assumed to be 20 percent of the wage. The following figures are reported:

	FIM/hr (1988)	AUS\$/hr (1990)
work trips	64.40	21.72
commuting	14.40	4.86
leisure	8.20	2.77
weighted average*	16.10	5.43

(* Weights are proportion of vehicle kilometres, .17, .39 & .44, respectively)

Source: Lawson, 1989, p. 30

Bates and Glaister (1990) summarize the studies for Holland. The Netherlands Government sponsored a major study on value of time, carried out by the Hague Consulting Group (1990). The Netherlands study includes breakdowns of time values by trip purpose, income level and a number of other characteristics including travel conditions, age, and amount of free time. The VTTS while working ranges from \$5.09 to \$11.09; the highest income class has more than double the value of time than the next highest class. Values for commuting time and other trip purposes are about 70 to 80 percent of the work time value (except for highest income class). The base and average values are as follows (AUS\$1990):

	commuting time	business time	other
base value (low income)	3.92	5.09	4.14
avg. value across sample*	7.11	11.09	4.53

*adjustments include for income, household composition, occupation, age, sex, amount of personal free time, trip purpose, travel mode and journey conditions.

Although the value of time study was carried out for the Netherlands government, we

do not know if the results have been officially adopted for transport project appraisal.

Lawson (1989) reports via personal communication that Norway assumes a value of time of 50Kr per hour in 1988, or AUS\$11.30/hr in 1990. No further breakdown was reported.

The value of time for Swedish road investment appraisal is published by the Swedish Road Administration (cited in Lawson, 1989). The value for work trips are relatively high. The categories of time values and corresponding values are:

	SEK/hr (1985)	AUS\$ (1990)
private traffic		
work trips		
state highways	135.	32.78
municipal roads	121.	29.38
non-work trips		
state highways	25	6.07
municipal roads	21.	5.10
commercial trucks		
state highways	95.	23.06
municipal roads	61.	14.81

Comparisons of VTTS Across Countries and Agencies

Both the empirical evidence and values of VTTS used in practice differ considerably among countries and among agencies carrying out road project evaluation. It may not be surprising that VTTS might differ among countries, because of cultural and income differences. On the other hand, all of these studies and practices are from relatively wealthy countries where car travel is a common characteristic of life. Regardless, there appears to be comparable variation in VTTS employed *within* countries as compared *across* countries. Table 11 summarizes the VTTS for work and non-work travel for several countries and jurisdictions. These figures should be regarded as approximate; in some cases they are based on different year base figures which have been updated while exchange rates differ over time. Further, many countries add various adjustments to a base VTTS depending on income, travel conditions, etc. Nonetheless, Table 11 indicates substantial variation in the VTTS being employed for highway project evaluation. Given the importance of VTTS in road (and other transport) project evaluation, it is surprising there has not been more communication across decision-making agencies to exchange information, views, and converge on more consistent practices. Such cooperation is common in other technical matters of road building and maintenance. Under present evaluation frameworks in different regions and departments, a similar project could be rated quite differently because of differences in assumed VTTS.

Conclusions and Directions for Research

The primary purpose of this paper was to draw attention to the diverse estimates of value of travel time savings (VTTS) used in transport project evaluation, especially for roads. There are substantial differences in the VTTS adopted by different countries and agencies in the world. The actual range probably is higher than what is shown here, because many jurisdictions do not explicitly value time savings in connection with road projects. There are implicit weights which result from their decisions. We do not know what these implied values might be but it is likely they imply a wide range of values.

Unfortunately, the empirical evidence does not offer a clear guide to the appropriate value for VTTS. Different studies, using different methodologies at different places and time, for different travel conditions, have produced a wide range of VTTS estimates. These diverse estimates tend converge to a value of 30 to 60 percent of the wage rate as the average VTTS for non-work travel time. Of course, some types of service-sensitive markets could reveal VTTS higher than the average. There are a sufficient number of studies in existence that there is promise in trying to identify characteristics of the sample and/or methods employed which might help explain the variation in VTTS estimates in existing studies. Of course, there is always room for additional studies, but it is increasingly important to record characteristics and idiosyncrasies in any study to facilitate comparison with studies done elsewhere.

Another important research topic not discussed here is the recognized debate over valuing large and small time savings as equivalent. Although there are intuitive reasons for questioning the value for small time savings, there are a number of arguments which suggest that employing a uniform VTTS may be a reasonable approximation (e.g., even if large numbers of people do not value small time savings highly, it may be that a few have very high values which would "average out" with those with zero or low values of time). Very few empirical studies have focused on the value of small time savings. This is a research topic which would be of wide interest.

Table 11
Summary Comparison of Values of Travel Time Used for
Road Project Evaluation in Various Countries and Government Agencies
 (rural area figures where distinguished; in approx. \$1990AUS)

<u>country/jurisdiction</u>	\$/vehicle hr. (non-work time)	\$/person hr. (non-work time)	\$/person hr. (work time)
North America			
United States			
AASHTO (used by several states)	18.93	14.56	14.56
California	9.22	--	--
Florida	20.34	15.65	--
New York		5.75	--
Canada			
Transport Canada		6.59	22.03
Ontario		3.19	11.96
Quebec		2.24	10.69
Alberta		6.48	14.04
British Columbia		6.34	19.02
<u>Europe</u>			
United Kingdom		5.42	--
Germany		1.49	9.00
Finland		4.86	21.72
Holland (base figure)		3.92	5.09
(avg. adjusted)		7.11	11.09
Sweden (rural)		6.07	32.78
<u>Australia</u>			
New South Wales (rural)		7.12	26.89
South Australia (rural)		3.51	13.29
<u>New Zealand</u>			
		4.66	14.52

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