

**THE DEVELOPMENT AND TESTING OF
A PURCHASING POWER PARITY METHOD
FOR COMPARING CONSTRUCTION
COSTS INTERNATIONALLY**

Eric A. (Rick) Best

A thesis submitted in fulfilment of the requirements
for the award of Doctor of Philosophy of the
University of Technology, Sydney

December 2008

CERTIFICATE

I certify that this thesis has not previously been submitted for any degree nor has it been submitted as part of the requirements for a degree.

I also certify that that the thesis was written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged.

I also certify that all information sources and literature used are indicated in the thesis.

Eric A. Best

ACKNOWLEDGEMENTS

This thesis could not have been completed without the inspiration, assistance and patience of the following people:

My principal supervisor, Dr Goran Runeson, Adjunct Professor in the School of the Built Environment at UTS, who provided many hours of constructive comment and discussion, and believed that I could complete the task. Without his guidance and dedication this thesis could not have been completed.

My mentor, Professor Craig Langston, who has provided direction, advice and encouragement over many years not only in this endeavour but throughout my academic career.

Jim Meikle, formerly of Davis Langdon Consultancy (UK), for much helpful advice and access to unpublished information that was germane to the research.

Dennis Lenard, formerly Professor of Building Studies at UTS, for his invaluable advice and support over the years, and the rest of the Construction Economics staff at UTS – Grace Ding, Gerard de Valence, John Twyford and Peter Smith - for their support, encouragement, friendship and unfailing good humour.

Professor Ron Best, of Roehampton University (UK), who has provided much of the inspiration for all my academic pursuits, including the completion of this thesis.

My partner, Cheryl O'Brien, who gives unqualified and unselfish support and encouragement to everything I do.

Rick Best

June 2008

TABLE OF CONTENTS

LIST OF FIGURES	xviii
LIST OF TABLES	xix
ABSTRACT	xxii
1.0 INTRODUCTION	1
1.1 General context	1
1.2 Foundation for the research	3
1.3 Problem definition	5
1.3.1 Time, cost and quality	7
1.4 Research questions	8
1.5 Research aims	8
1.6 Research methodology	9
1.7 Research overview	10
2.0 LITERATURE REVIEW	12
2.1 Introduction	12
2.1.1 Comparative studies	12
2.1.2 Grouping comparative studies	12
2.1.3 Cost comparisons	13
2.1.4 The importance of the cost parameter	13
2.2 Performance, productivity, efficiency or success?	13
2.2.1 Productivity	14
2.2.2 Productivity in construction	15
2.2.3 Efficiency and effectiveness	16
2.2.4 Project success	16
2.2.5 Performance	17
2.2.6 Measuring performance	17
2.2.7 Concluding remarks on productivity	18
2.3 Historical cost comparisons	19
2.4 Comparative construction studies	20
2.4.1 The Anglo-American Council on Productivity study	20
2.4.2 Cost studies	21
2.4.3 Types of comparative studies	22

2.4.4	Difficulties with comparisons	22
2.4.5	Underlying problems.....	22
2.4.6	Comparability and representativeness.....	23
2.4.7	Complicating factors	23
2.4.8	The impact of variable factors.....	24
2.4.9	Example.....	25
2.4.10	Innovation and building complexity	25
2.4.11	Balancing comparability and representativeness	25
2.5	Measurement issues	26
2.5.1	Measuring productivity	27
2.5.2	Measuring construction productivity	28
2.5.3	Methods for productivity measurement	29
2.5.4	Measuring productivity using macroeconomic data	30
2.5.5	The value-added approach	30
2.5.5.1	The Access Economics study.....	30
2.5.5.2	The Croce et al. study.....	31
2.5.6	Pricing studies	32
2.5.7	Standard projects.....	32
2.5.8	Case studies.....	33
2.5.9	Hybrid studies	35
2.5.10	The Xiao and Proverbs study	36
2.6	Currency conversions	37
2.6.1	Selecting an appropriate conversion tool.....	37
2.6.2	Exchange rates	38
2.6.3	Value, cost and price	39
2.7	Purchasing power parity and the Law of One Price	40
2.7.1	Purchasing power parity and exchange rates	42
2.7.2	Calculation of purchasing power parities.....	43
2.7.2.1	The OECD/ICP method	43
2.7.2.2	The UBS method.....	43
2.7.3	The <i>Big Mac</i> TM Index.....	44
2.7.4	Testing the Big Mac Index.....	45
2.7.5	Other commodity-based indices.....	45

2.7.5.1	The Braten Index and the “coffee standard”	46
2.7.5.2	The iPod™ Index	46
2.7.6	Applying “burgernomics” to construction	47
2.7.7	Comparing PPP outcomes for construction	47
2.8	Industry specific PPPs	50
2.8.1	General PPPs and construction-specific PPPs	51
2.8.2	Construction data for PPPs – current method	52
2.9	Currency conversion in previous studies	53
2.9.1	Flanagan <i>et al.</i> (1986)	53
2.9.2	Lynton (1993)	56
2.9.2.1	Comparing conversion factors	57
2.9.3	Page Kirkland (1999)	59
2.9.4	Langston and de Valence (1999)	60
2.9.5	Xiao and Proverbs (2002b)	61
2.9.5.1	Converting the cost data to a common base	61
2.9.5.2	Comparing the use of different conversion factors	63
2.9.6	BWA (2006)	65
2.9.7	BCIS (2006)	65
2.9.7.1	The study	65
2.9.7.2	Cost conversions	66
2.10	Concluding Remarks	69
3.0	CONVERSION FACTOR METHODS	70
3.1	Introduction	70
3.2	Industry comparisons	70
3.2.1	Cost v. price	71
3.2.2	What is being compared?	72
3.2.3	Why are conversion factors needed?	72
3.3	Construction output	73
3.3.1	Construction as a service	74
3.3.2	The Law of One Price	75
3.3.2.1	Tradeability	75
3.3.2.2	Labour as a tradeable commodity	76
3.3.2.3	Concluding remarks	76

3.4	Purchasing power parities.....	76
3.4.1	Exchange rate movements over time	77
3.4.2	Alternatives to exchange rate conversions.....	79
3.4.3	Comparing PPPs and exchange rates	80
3.4.4	Analysis of the comparisons	83
3.4.5	Observations.....	83
3.4.6	Concluding remarks	84
3.5	Issues relating to the production of CPPPs.....	84
3.5.1	Comparability and representativeness.....	85
3.5.2	Standard projects.....	86
3.5.3	Dealing with variants	86
3.5.4	Actual costs v. estimates	87
3.5.5	Context	88
3.5.5.1	Scale	88
3.5.5.2	Location.....	88
3.5.5.3	Complexity.....	89
3.5.6	Practical considerations.....	89
3.5.6.1	Implementation	89
3.5.6.2	Program costs	90
3.5.6.3	Data collection	91
3.5.6.4	Variants and specification of priced items.....	92
3.5.6.5	Specifying items in a construction context	93
3.6	Selecting a method.....	93
3.6.1	The standard commodity.....	94
3.6.1.1	Representativeness of the Big Mac	94
3.6.1.2	An index of affordability.....	95
3.6.2	The options.....	95
3.6.3	Expenditure shares	97
3.6.4	Discussion	98
3.6.5	The productivity question	98
3.6.6	Data collection and cost conversion.....	99
3.7	Comparing the options.....	100
3.7.1	Standard project(s)	100

3.7.1.1	The Davis Langdon approach	101
3.7.7.2	The Faithful+Gould/RSMMeans approach	102
3.7.2	Case studies	103
3.7.3	Matched projects	103
3.7.4	Basket of construction components (BOCC).....	104
3.7.5	Basket of goods and services (BOG)	105
3.7.5.1	First attempt	106
3.7.5.2	Results	106
3.7.5.3	Discussion	107
3.7.5.4	Second attempt	108
3.7.5.5	Weighting the basket.....	108
3.7.5.6	Results	110
3.7.5.7	General observations	111
3.7.4.8	Evaluation	112
3.8	Concluding Remarks.....	112
4.0	RESEARCH METHOD AND CONCEPT DEVELOPMENT	114
4.1	Introduction.....	114
4.2	Research method.....	115
4.2.1	Proposed method: Building BLOCs	116
4.2.1.1	Multiple observations.....	117
4.2.1.2	Data validation	117
4.2.2	The BLOC as a PPP tool.....	117
4.2.3	Comparative price levels.....	118
4.2.3.1	Comparing the value of construction work.....	119
4.2.4	The BLOC as a unit of cost measurement	119
4.2.4.1	Example.....	119
4.2.5	The BLOC as a measure of productivity.....	120
4.2.6	Other variables that may affect BLOC costs.....	121
4.3	Research plan.....	121
4.3.1	The concept	122
4.3.2	Deriving the BLOC	123
4.3.3	BLOC method	124
4.3.4	Adjusting the total project cost	125

4.3.5	Identifying and weighting items in the basket	125
4.3.6	Materials.....	125
4.3.6.1	Formwork.....	126
4.3.6.2	Other materials.....	127
4.3.6.3	Deriving materials quantities	127
4.3.7	Labour	128
4.4	Adjusting for local factors	130
4.4.1	Industrial disputes	131
4.4.2	Site conditions.....	131
4.4.3	Regulatory standards.....	132
4.4.4	Government controls.....	132
4.4.5	Imported resources	132
4.4.6	Market conditions (building cycle)	133
4.4.7	The validity of adjustment for market conditions.....	134
4.4.8	Taxation.....	135
4.4.9	Quality.....	135
4.4.9.1	Code compliance.....	136
4.4.9.2	Workmanship, defects and rework.....	136
4.4.9.3	Grading quality.....	137
4.4.9.4	Quality in the BLOC method.....	138
4.5	Pilot study	139
4.6	Compiling the pilot study	140
4.6.1	Materials weights	141
4.6.2	Materials quantities	141
4.6.3	Labour weights.....	142
4.6.4	Assembling the basket.....	142
4.6.5	Using the mini BLOC to collect cost data	143
4.6.6	Data normalisation issues.....	144
4.7	Results from the pilot study	145
4.7.1	Market conditions.....	146
4.8	Analysis of the pilot study data	147
4.8.1	Exchange rates and the Big Mac Index.....	147
4.8.2	Other PPPs	148

4.8.3	Differences in labour and materials costs	149
4.8.4	Contractors' margins	149
4.9	Data quality issues	150
4.10	Concluding remarks	151
5.0	DATA COLLECTION AND ANALYSIS	153
5.1	Introduction.....	153
5.2	Using the BLOC	153
5.2.1	General information	154
5.2.2	Refining the questionnaire	155
5.2.3	Survey instructions.....	156
5.2.3.1	Materials.....	156
5.2.3.2	Labour	157
5.2.3.3	Variants	157
5.2.4	Distributing the questionnaire	157
5.2.5	Responses to the survey	158
5.2	Data checking and validation.....	159
5.3.1	Data quality and associated issues	159
5.3.1.1	Sources of cost data in Sydney.....	160
5.3.1.2	Cost checking outside Australia.....	161
5.3.2	Data validation	161
5.3.3	The nature of the BLOC data.....	162
5.3.3.1	The raw data.....	162
5.3.3.2	Overpricing and underpricing	163
5.3.3.3	Distribution of unit rates in the survey.....	168
5.3.3.4	Effects of sample size.....	170
5.4	Central Limit Theorem	171
5.4.1	Application of the Central Limit Theorem.....	172
5.5	Verifying materials data.....	173
5.5.1	The verification process	173
5.5.2	First analysis	174
5.5.3	Second analysis	174
5.5.3.1	Concrete	175
5.5.3.2	Plywood for formwork (formply)	176

5.5.3.3	Bar reinforcement.....	177
5.5.3.4	Precast concrete.....	178
5.5.3.5	Stressing steel.....	179
5.5.3.6	Structural steel.....	180
5.5.3.7	Concrete blocks.....	181
5.5.3.8	Toughened glass.....	181
5.5.3.9	Windows	182
5.5.3.10	Sawn stone	183
5.5.3.11	Fire rated door.....	183
5.5.3.12	Non- fire rated door.....	183
5.5.3.13	Plasterboard (sheetrock).....	184
5.5.3.14	Ceramic tiles.....	185
5.5.3.15	Carpet	185
5.5.3.16	Paint	186
5.5.3.17	Timber joinery.....	186
5.5.3.18	Low voltage electrical cable.....	187
5.5.3.19	Low voltage downlight	188
5.5.3.20	Vanity basin	189
5.5.3.21	Cast iron pipe	189
5.5.3.22	Copper pipe	190
5.5.3.23	Rigid duct.....	190
5.5.3.24	Flexible duct.....	191
5.5.3.25	Labour rates.....	191
5.5.3.26	Margins	192
5.5.3.27	Preliminaries	193
5.6	Final dataset	194
5.7	Data normalisation.....	200
5.7.1	Taxation.....	200
5.7.2	Market conditions.....	201
5.8	Concluding remarks.....	202
6.0	DATA ANALYSIS AND RESULTS.....	204
6.1	Introduction.....	204
6.2	Calculating BLOC costs for Australia.....	204

6.2.1	BLOC costs in Australian cities.....	204
6.2.2	Comparing Australian BLOC costs to superficial costs	205
6.2.3	Differences in costs in three Australian cities.....	207
6.2.3.1	Labour costs	209
6.2.3.2	Services costs	209
6.2.3.3	Materials costs.....	210
6.2.3.4	Summary	211
6.2.4	Recalculating BLOC costs using median prices	211
6.3	BLOC costs in all locations	212
6.3.1	BLOC costs – input costs for materials and labour only	212
6.3.2	BLOC costs including preliminaries.....	213
6.3.3	BLOC costs including contractors’ margins.....	214
6.3.4	BLOC costs including contractors’ margins and taxes.....	214
6.3.4.1	Dispersion of BLOC costs in different locations.....	215
6.3.5	Adjustment for market conditions.....	217
6.3.6	Separating labour and materials costs	218
6.3.7	BLOC based CPPPs and 10 year average exchange rates	218
6.4	Comparing results from the pilot study and main study.....	219
6.5	Modifying the BLOC.....	220
6.6	The impact of services costs	221
6.6.1	BLOC costs minus services	222
6.6.2	Dealing with the services issue	223
6.6.2.1	Sanitary fittings	224
6.6.2.2	Drain pipes	224
6.6.2.3	Water pipes.....	225
6.6.2.4	Electrical cable	225
6.6.3	Possible solutions to the services problem.....	225
6.6.3.1	Hydraulics	226
6.6.3.2	Mechanical	226
6.6.3.3	Electrical	226
6.6.3.4	Concluding remarks	227
6.7	Comparing derived CPPPs to other conversion factors.....	227
6.7.1	Notes on data and sources	228

6.7.2	Observations.....	229
6.7.3	Comparing construction dollars	230
6.8	Evaluating the CPPPs	231
6.8.1	International superficial rates	231
6.8.2	Implied CPPPs derived from published superficial rates.....	232
6.8.3	Ranking cost levels	234
6.9	Comparing construction costs using CPPPs	234
6.9.1	In-country comparisons.....	234
6.9.2	Current exchange rates	235
6.9.3	Construction specific PPPs	236
6.9.4	Building costs that reflect different price levels	237
6.9.5	Comparing PPP adjusted costs and published superficial rates	238
6.9.6	Comparing BLOC CPPPs and OECD CPPPs.....	239
6.9.7	Comparing BLOC CPPPs and Faithful+Gould parities.....	240
6.9.8	Market adjusted CPPPs.....	241
6.10	The BLOC as a metric of international construction costs.....	242
6.10.1	Relative productivity.....	243
6.11	Sensitivity analysis – varying superficial rates.....	244
6.11.1	Scenario 1 – Phoenix cost 10% lower, Sydney cost unchanged	245
6.11.2	Scenario 2 – Phoenix cost unchanged, Sydney cost 20% higher.....	245
6.11.3	Scenario 3 – Phoenix cost 10% lower, Sydney cost 10% higher.....	246
6.11.4	Scenario 4 – Phoenix cost 15% lower, Sydney cost 15% higher.....	246
6.11.5	Discussion of sensitivity analysis results	247
6.12	Sensitivity analysis – varying materials costs.....	247
6.12.1	Scenario 1 – Materials cost: Phoenix unchanged, Sydney 10% higher	247
6.12.2	Scenario 2 – Materials cost: Phoenix 10% higher, Sydney 10% higher	248
6.12.3	Scenario 3 – Materials cost: Phoenix 10% higher, Sydney unchanged	248
6.12.4	Discussion of Sydney/Phoenix sensitivity analysis results.....	249
6.12.5	Phoenix/Singapore comparison.....	249
6.12.6	Scenario 1 – Materials cost: Phoenix unchanged, Singapore +10%	249

6.12.7	Scenario 2 – Materials cost: Phoenix +10%, Singapore +10%.....	250
6.12.8	Scenario 3 – Materials cost: Phoenix +10%, Singapore unchanged	250
6.12.9	Discussion of Phoenix/Singapore sensitivity analysis results.....	250
6.13	Using CPPPs and the BLOC Index	251
6.13.1	Time issues.....	251
6.14	Concluding remarks.....	252
7.0	CONCLUSION	254
7.1	Introduction.....	254
7.2	Summary of the research	254
7.2.1	The need for a cost conversion mechanism	254
7.2.2	Purchasing power parity.....	255
7.2.3	Testing the BLOC concept.....	255
7.2.3.1	Pilot study	255
7.2.3.2	Main study.....	255
7.2.4	Using the data.....	256
7.3	A review of the research questions.....	256
7.3.1	Research question Q1.....	256
7.3.2	Research question Q2.....	257
7.3.3	Research question Q3.....	258
7.3.4	Research question Q4.....	258
7.4	Outcomes	259
7.4.1	The BLOC as a comparative tool.....	259
7.4.2	Results of the empirical study.....	260
7.5	Further research	261
7.5.1	Refining the BLOC	261
7.5.2	Testing the BLOC for other building types.....	262
7.5.3	Testing the BLOC in other locations	263
7.5.4	Testing the impact of different labour profiles	263
7.5.5	Testing the reliability of cost data.....	264
7.5.6	Investigating the Singapore anomalies.....	265
7.5.7	Testing the BLOC in developing countries.....	266
7.5.8	Verifying BLOC outcomes for Melbourne	266
7.5.9	Using the BLOC as an alternative to superficial rates in estimating	266

7.5.10	Testing the Law of One Price in an integrated market.....	267
7.5.11	Bilateral comparisons using project pairs	267
7.5.12	Verifying data regarding contractors' margins	268
7.5.13	The influence of market conditions	269
7.5.14	The influence of taxation on apparent cost relativities	269
7.5.15	Comparing the BLOC and the BOCC.....	270
7.6	Final remarks	270
APPENDIX A1 BQ ANALYSIS		272
A1.1	Introduction.....	272
A1.2	Reference projects.....	272
A1.3	Calculation of weights for the BLOC	273
A1.3.1	Ready-mixed concrete.....	273
A1.3.2	Bar reinforcement.....	274
A1.3.3	Precast concrete.....	274
A1.3.4	Stressing steel.....	275
A1.3.5	Structural steel.....	275
A1.3.6	Glass.....	276
A1.3.7	Windows	276
A1.3.8	Stonework	277
A1.3.9	Doors	277
A1.3.9.1	Fire rated doors.....	277
A1.3.9.2	Non fire rated doors.....	277
A1.3.10	Plasterboard.....	278
A1.3.11	Ceramic tiles.....	278
A1.3.12	Carpet	279
A1.3.13	Paint	279
A1.3.14	Timber joinery.....	280
A.1.3.15	Electrical cable.....	281
A1.3.16	Luminaires.....	282
A1.3.17	Sanitary fittings	282
A1.3.18	Drain pipe.....	283
A1.3.19	Water reticulation.....	284
A1.3.20	Air conditioning ductwork – rigid and flexible	284

APPENDIX A2 LABOUR ANALYSIS	286
A2.1 Labour breakdown for each material	286
APPENDIX A3 – DERIVING THE BLOC QUANTITIES	288
A3.1 Introduction.....	288
APPENDIX A4 – PILOT STUDY.....	291
A4.1 Introduction.....	291
APPENDIX A5 – THE MAIN SURVEY	297
A5.1 Introduction.....	297
APPENDIX A6 – ANALYSIS OF PUBLISHED UNIT RATES	308
A6.1 Introduction.....	308
A6.2 Selected unit rates	308
A6.2.1 Ready-mixed concrete.....	308
A6.2.2 Formwork.....	309
A6.2.3 Bar reinforcement.....	309
A6.2.4 Precast concrete.....	309
A6.2.5 Structural steel.....	310
A6.2.6 Concrete blocks.....	310
A6.2.7 Sandstone facing	310
A6.2.8 Doors	311
A6.2.8.1 Fire rated doors	311
A6.2.8.2 Non fire rated doors	311
A6.2.9 Plasterboard.....	311
A6.2.10 Ceramic tiles.....	312
A6.2.11 Paint	312
A6.2.12 Drainage	312
A6.2.13 Water reticulation.....	313
A6.2.14 Sanitary fittings	313
A6.2.15 Electrical work	313
A6.2.16 Air conditioning.....	314
APPENDIX A7 – UPDATING THE BIG MAC INDEX.....	315
A7.1 Introduction.....	315
A7.2 Current Big Mac prices.....	315
A7.3 Big Mac Index	315

APPENDIX A8 – EXPLANATION OF ACRONYMS	316
A8.1 Introduction.....	316
A8.2 Currencies	316
A8.3 General terms.....	316
REFERENCES AND BIBLIOGRAPHY	319

LIST OF FIGURES

Figure 2.1 Price of Big Mac in comparable terms	49
Figure 2.2 Percentage difference between general and construction-specific PPPs .	52
Figure 2.3 General PPPs (OECD, 2002) and 10 year average money market exchange rates	58
Figure 2.4 Cost data from Xiao and Proverbs (2002b) converted to GBP using six different conversion factors	64
Figure. 2.5 Comparison benchmark building costs in five countries: USD/m ² of gross internal floor area.....	67
Figure 2.6 Comparison of BCIS results using different conversion factors	68
Figure 3.1 Historical exchange rates: AUD to JPY	78
Figure 3.2 Historical exchange rates: AUD to USD	79
Figure 3.3 Historical exchange rates: AUD to GBP	79
Figure 3.4 General PPPs, C PPPs and 10YA rates.	80
Figure 3.5 Conversion factors: JPY to AUD	81
Figure 3.6 Conversion factors: USD to AUD	81
Figure 3.7 Conversion factors: GBP to AUD.....	82
Figure 3.8 Basic comparison methodology.....	101
Figure 3.9 Office building price comparison – project prices in ECUs (base date September 1997)	102
Figure 3.10 Bilateral comparison (after Meikle).....	110
Figure 5.1 Data distribution for concrete prices from Sydney showing a positive skew	168
Figure 5.2 Data distribution for reinforcing steel prices from Phoenix	169
Figure 5.3 Data distribution for concrete block data from Sydney. Prices are evenly distributed except for two outliers well to the right.....	169

LIST OF TABLES

Table 1.1 GDP, contribution of construction to GDP and capital formation, and ratio of industry sectors in Australia for 2005-6.....	2
Table 2.1 Statistical interpretations for international hotel costs per m ²	48
Table 2.2 Use of PPPs.....	50
Table 2.3 Weightings of basic categories of construction in five European countries for 1996	52
Table 2.4 Weightings of basic categories for Australia over the period 2001-2005..	53
Table 2.5 Project construction costs – based on data from Flanagan <i>et al.</i> (1986)....	55
Table 2.6 Office project costs - based on data from Page Kirkland (1999	60
Table 2.7 Unit price for the hypothetical project	62
Table 2.8 Unit price for the hypothetical project converted by PPPs	62
Table 2.9 Original cost data in national currencies calculated from GBP equivalents	63
Table 2.10 Comparison benchmark building costs in five countries	67
Table 3.1 Weighted basket of goods for construction work	106
Table 3.2 Quantity weightings for the basket of goods	110
Table 4.1 Mini BLOC - calculation of materials quantities.....	141
Table 4.2 Mini BLOC – calculation of labour costs	142
Table 4.3 Calculation of labour quantities for the pilot study.....	143
Table 4.4 Mini basket of goods (mini BLOC) – rounded quantities	144
Table 4.5 Frequency of opinions of market conditions obtained from pilot study..	144
Table 4.6 Costs for the mini basket in local currencies using average rates from each city.....	144
Table 4.7 Conversion factors relative to 1 AUD.....	146
Table 4.8 Working time required to buy typical food items	148
Table 4.9 Analysis of data from the pilot study showing the mean, standard deviation, coefficient of variation and median value for each mini BLOC item in each location	150
Table 5.1 BLOC items and quantities	154
Table 5.2 General information questions from the main survey	155
Table 5.3 Survey responses: number and source for each location	159
Table 5.4 Sydney cost data sources – suppliers	160
Table 5.5 Analysis of the raw BLOC data showing mean, standard deviation, coefficient of variation (CoV) and median values for the item data obtained from the main survey	164
Table 5.6 Cost of electrical cable per foot (USD)	188
Table 5.7 Proportion of unit rates discarded in the validation process.....	194
Table 5.8 Dispersion of validated data.....	195
Table 5.9 Tax applied to construction in target locations	200
Table 5.10 Deflators to adjust for prevailing market conditions	202
Table 6.1 Basic BLOC costs in AUD in Sydney, Melbourne and Brisbane.....	205
Table 6.2 Hotels – average cost (AUD) per m ² of GFA for 4-6 level medium quality hotels	206
Table 6.3 BLOC costs including preliminaries and contractors’ margins estimated from Cordell rates (14 materials and 4 labour items).....	206

Table 6.4 Comparing relative costs with Sydney as a base (index=1.000), based on values from tables 6.1 – 6.3.....	207
Table 6.5 Average labour rates and BLOC costs (labour only) obtained from survey responses (AUD).....	209
Table 6.6 Comparative rates – electrical installation.....	210
Table 6.7 BLOC costs based on mean and median unit rates	212
Table 6.8 Basic BLOC costs (B) (local currencies, no adjustments), the derived CPPPs and the official exchange rates relative to the USD for the six locations.....	212
Table 6.9 BLOC costs (local currencies) and derived CPPPs. BLOC Cost (P) includes preliminaries percentages. Exchange rates are relative to the USD.....	214
Table 6.10 BLOC costs (local currencies, including margins) and derived CPPPs. BLOC cost (PM) includes preliminaries and margins	214
Table 6.11 BLOC costs in local currencies and derived CPPPs. BLOC cost (PMT) includes preliminaries, margins and tax.....	214
Table 6.12 Dispersion of total BLOC costs based on raw and validated data from the survey	216
Table 6.13 Deflated BLOC costs (local currencies, including preliminaries, margins and tax) and derived CPPPs	217
Table 6.14 BLOC costs and CPPPs based on materials and labour only	218
Table 6.15 Comparison between three CPPPs and 10 year average exchange rates	219
Table 6.16 CPPPs derived from the mini BLOC and full BLOC studies.....	220
Table 6.17 CPPPs based on costs of full BLOC and reduced BLOC with four items removed. The CPPP(PMT) values are based on costs that include preliminaries, margins and tax.....	221
Table 6.18 CPPPs based on costs of the complete BLOC (all materials and labour) items and the reduced BLOC (no services items or related labour).....	222
Table 6.19 Comparisons of BLOC(PMT) based CPPPs and other conversion factors.....	232
Table 6.20 Three star hotels: average cost in local currencies per m ² of GFA	232
Table 6.21 Implied CPPPs based on published \$/m ² rates	232
Table 6.22 Comparative cost levels – rankings are based on CPPPs from Table 6.21	234
Table 6.23 Some regional cost indices for New South Wales	235
Table 6.24 Hypothetical project cost – local currencies, based on current exchange rates.....	235
Table 6.25 Hypothetical project cost – local currencies, based on CPPPs	236
Table 6.26 Comparative costs based on nominal exchange rates, CPPPs based on BLOC costs and real exchange rates derived from current nominal exchange rates and CPPPs.....	238
Table 6.27 Comparison of general PPPs and construction-specific PPPs (OECD, 2005; 2008) and BLOC-based CPPPs	239
Table 6.28 Comparison of BLOC CPPPs and parities from by Faithful+Gould/ RSMMeans (2008).....	240

Table 6.29 Comparison of hypothetical project costs (in local currencies), calculated using BLOC(PMT) based CPPPs and market adjusted CPPPs.....	241
Table 6.30 Project costs expressed in BLOC equivalents and BLOC Index values derived from those BLOC equivalent costs.....	243
Table 6.31 Varying cost/m ² rates – Scenario 1	245
Table 6.32 Varying cost/m ² rates – Scenario 2	245
Table 6.33 Varying cost/m ² rates – Scenario 3	246
Table 6.34 Varying cost/m ² rates – Scenario 4	246
Table 6.35 Labour/materials ratios in BLOCs for the six cities surveyed.....	247
Table 6.36 Varying materials costs – Scenario 1	248
Table 6.37 Varying materials costs – Scenario 2	248
Table 6.38 Varying materials costs – Scenario 3	248
Table 6.39 Varying materials costs – Scenario 1	249
Table 6.40 Varying materials costs – Scenario 2	250
Table 6.41 Varying materials costs – Scenario 3	250
Table A1.1 Electrical services – Project B – figures include GST	281
Table A1.2 Hydraulic services – Project B – figures include GST	283
Table A1.2 Hydraulic services – Project B – figures include GST	286
Table A3.1 BLOC development – deriving quantities of materials and labour.....	289
Table A3.2 BLOC development – deriving labour quantities	290
Table A3.2 BLOC development – deriving labour quantities	308
Table A6.2 Rate breakup – formwork.....	309
Table A6.3 Rate breakup – bar reinforcement	309
Table A6.4 Rate breakup – precast concrete	309
Table A6.5 Rate breakup – structural steel	310
Table A6.6 Rate breakup – blockwork	310
Table A6.7 Rate breakup – stone facing	310
Table A6.8 Rate breakup – fire rated doors	311
Table A6.9 Rate breakup – non-fire rated doors.....	311
Table A6.10 Rate breakup – formwork.....	311
Table A6.11 Rate breakup – ceramic floor tiles	312
Table A6.12 Rate breakup – painting	312
Table A6.13 Rate breakup – cast iron pipework.....	312
Table A6.14 Rate breakup – copper water pipe.....	313
Table A6.15 Rate breakup – vanity basin	313
Table A6.16 Rate breakup – power outlet	313
Table A6.17 Rate breakup – light point	314
Table A7.1 Big Mac Index: April 2008	315

ABSTRACT

Over the past fifty to sixty years there have been numerous attempts to compare the performance of the construction industries of different countries. In almost all cases the cost of construction has been an important, sometimes the single parameter Cost performance has sometimes been equated to productivity, and productivity measurement and comparison is attempted by governments and their agencies on a regular basis.

Fundamental to these exercises has been the necessity to bring construction costs in different national currencies to a common base. This is imperative as amounts in different currencies cannot be directly compared.

Money market exchange rates do not provide suitable comparisons as they are too volatile and do not represent true comparisons of the volume or value of construction. Additionally there are real differences in price levels between economies that hamper valid comparisons. Purchasing power parity, however, provides a theoretical basis for cost comparisons without the distortions caused by moving exchange rates and differences in price levels between countries.

Using the option of purchasing power parity and its supporting theory, the Law of One Price, a mechanism for bringing construction costs to a common base currency has been devised. It is based on a basket of construction materials and labour referred to as a BLOC (i.e. Basket of Locally Obtained Commodities) and is applied to a hotel project.. The materials and their respective quantities were derived by the analysis of a completed hotel. Labour hours associated with those materials and quantities were derived using published materials/labour ratios for the various items. In this way the basket or BLOC represented a mix of the most cost significant materials in a typical hotel project.

Input costs for the BLOC were obtained from six cities, three in Australia plus Auckland, Singapore and Phoenix. BLOC costs were then used to derive a set of purchasing power parity factors specific to the construction industry in each location. These factors were then used to assess the relative cost of construction in each location.

The BLOC also provides a straightforward method for comparing productivity between locations. Lower building costs, when expressed in BLOC equivalents, signify higher productivity. While not an absolute measure of productivity this provides a clear indication of relative productivity between locations.

The study described provides some interesting results. For example, while construction costs in Sydney are clearly shown to be higher than those in Phoenix the industry in Sydney is shown to be considerably more productive. Higher costs in Sydney are related largely to higher pay for tradespersons and other resources, however, the higher pay is offset by the improved productivity.

The method devised satisfies many of the requirements for regional and international cost comparisons. It is theoretically correct and relatively inexpensive to administer and thus provides the opportunity for the gathering data from more respondents in each location and at more frequent intervals.

The thesis concludes with suggestions for a number of research projects that would extend this work considerably and greatly expand the body of work devoted to this fundamental construction economics problem.