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Communications Technologies Working Paper

Adopters and non-adopters of ICT in the Australian Economy: Experimental results based on a linked data file for 1999-2000

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Preface

This working paper is one of a series presenting key results from a joint project of the Productivity Commission, the Australian Bureau of Statistics (ABS), the Department of Industry, Tourism and Resources, and the National Office for the Information Economy. The joint project was set up to investigate the use of information and communications technologies (ICTs) and their impact on business performance. The joint project also provided an Australian contribution to an OECD-led team of researchers and statistical offices from 13 countries to provide new empirical analysis within this field.

The papers draw on the contributions of all members of the study from participating agencies and the guidance and scrutiny of Dr Trevor Breusch from the Australian National University.

This paper reports results of analyses of a linked data set which was constructed by the ABS using three data sources: (1) Business Use of Information Technology (BUIT) survey; (2) Economic Activity Survey (EAS), supplemented by business income tax data (EAS/Tax); and (3) Business Income Tax (BIT) data.

Logit models are estimated to ascertain the association between certain firm characteristics and the following:
*   Use and non-use of computers;
*   Use and non-use of the Internet; and
*   17 specific uses of the Internet that ABS collects data on in its surveys of Australia's business sector.

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Acknowledgments

Contents

1 Introduction

During the late 1990's Australia experienced a surge in productivity growth. The "New Economy" and the greater use of Information Communication Technology (ICT) were hailed as contributors to the surge in productivity growth. Since this time, there has been extensive research into the relationship (at both the aggregate and industry level) to understand how great an affect ICT has had on productivity growth.

There has also been considerable interest in the impact on productivity of the uptake of ICT at the individual firm level. This interest has led to an increased number of statistical collections on the adoption and specific uses of ICT to support analysis and policy development. The Australian Bureau of Statistics (ABS) main collection on individual firms' use of ICT is the Business Use of Information Technology (BUIT). A limitation of this collection is that it does not collect comprehensive financial information needed to undertake analyses of firm level performance.

In late 2002, the ABS began to link the BUIT with other survey and administrative data to create a dataset with information on Australian firms and their use of ICT. This is the first analysis based on the linked dataset. As the dataset is experimental all results should be treated with some caution.

Section 2 of this paper discusses the creation of the linked dataset. Section 3 presents descriptive statistics summarising the main features of Australian firms and their use of ICT in 1999-2000.

Section 4 investigates the attributes of "ICT adopting" and "ICT non-adopting" Australian firms. It also analyses what factors are associated with how firms use the Internet. Section 5 provides some concluding remarks.

2 Data Sources

This paper reports results of analyses of a linked data set that was constructed using three data sources:

> 1. Business Use of Information Technology survey;
> 2. Economic Activity Survey, supplemented by business income tax data; and
> 3. Business Income Tax data.

The linking of different surveys and administrative data is of great interest to both statistical agencies and the user community. Linking data this way reduces provider load (compared with asking additional survey questions) and can provide a more detailed data source for users. Also the costs involved in linking data are far lower than directly collecting the data.

The ABS began with 11,940 firms in the 1999/2000 BUIT data file. That data file was linked to the EAS data file using a unique identifier common to both files. This produced a new file of 3,368 matched firms. The rest of the BUIT file (8,572 records) could not be matched to the EAS file.

For some (6,764) of the unmatched firms, the ABS matched their BUIT records to the Australian Taxation Office (ATO) Business Income Tax (BIT) data. 5,857 (of 6,764 records) could be matched to the ATO BIT data. Thus the linked data file was made up of 9,226 records. Appendix A provides a more detailed overview of the linking process.

Table 2.1: Number of firms by industry and size on the linked dataset for 1999-2000.

Industry	9 or less employees	10-49 employees	50-149 employees	150+ employees	Total firms
Mining	1,834	304	102	108	2,348
Manufacturing	36,738	10,793	1,670	719	49,920
Electricity, gas & water	na	na	na	na	1,076
Construction	66,090	6,913	476	103	73,582
Wholesale trade	20,628	5,658	878	359	27,522
Retail trade	70,264	13,252	727	231	84,474
Accommodation	17,829	5,469	926	205	24,429
Transport and storage	21,273	3,967	411	163	25,815
Communication Services	na	na	na	na	4,640
Finance and Insurance	17,795	2,153	254	204	20,405
Property & Business services	105,502	13,980	1,558	373	121,413
Health & Community Services	25,401	2,281	228	306	28,216
Cultural & Recreation Services	9,361	1,761	111	86	11,318
Personal & other services	24,115	2,379	295	112	26,900
Total	424,440	69,735	7,800	3,040	505,015

na: Cells suppressed to preserve firm confidentiality.

Presented in table 2.1 is the weighted number of firms on the linked dataset by size and industry. Certain cells in the table have been suppressed to ensure the confidentially of the data. The totals have also been slightly altered to preserve confidentiality.

The BUIT survey weights have been used to construct this table. No adjustment has been made to the BUIT survey weights to account for the firms that were not linked.

A comparison is made between the linked dataset and the original BUIT in Appendix A. This helps in understanding the characteristics of the firms 'lost' during the linking process.

3 Descriptive analyses

Firms in Electricity, Gas & Water have been excluded from the analysis due to very small samples. All this analysis is based on the linked dataset rather than the original BUIT dataset.

3.1 Uptake of ICT by industry

Figure 3.1 presents the percentage of firms that use computers, have Internet access and have a web presence in each industry. Wholesale has the highest level (90%) of computer use and the highest percentage of firms with a web presence (46%). Property and Business Services has the highest (79%) penetration of Internet use.

Personal services has the lowest level of computer use at 63% of firms. As a result of this, Personal Services also has the lowest level (40%) of Internet access. Construction has the lowest percentage of firms with a web presence (18%).

Figure 3.1 ICT uptake % by industry (Linked dataset 1999-2000)
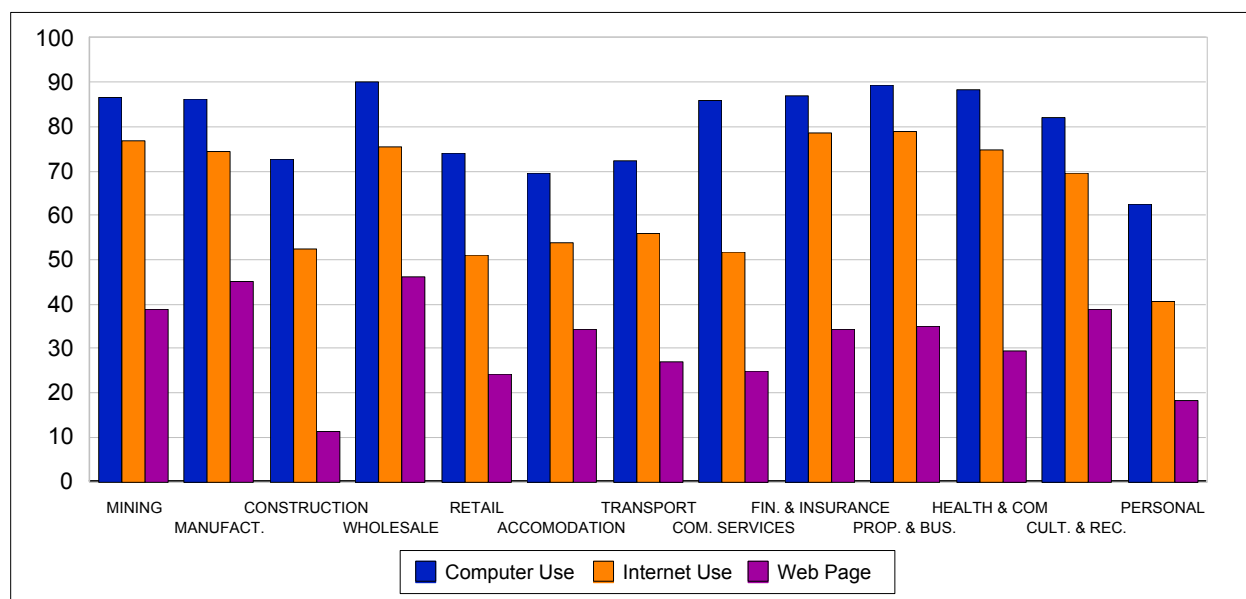
3.1.1 Computer use

Figure 3.2 shows computer use by firm size (where firm size is based on number of employees). Medium sized firms (those with 50 to 149 employees) have 100% computer use in all industries. Small firms (those with between 10 and 49 employees)[1] have over 80% computer use in all industries with the exception of Accommodation that is slightly below 80%. The percentage of small firms using computers varies between industries. In Accommodation 51% of small firms use computers, while in Property and Business Services 88% of small firms use computers.

3.1.2 Internet use

In Figure 3.2, Internet use by very small firms (with 9 or less employees) varies between industries. In Property & Business Services 74% of firms use the Internet compared to 30% of firms in Accommodation. In all industries the percentage of firms with Internet access increases as the size of the firm increases. However, the rate of increase is different between industries. For example, in Transport & Storage, 40% of very small firms have Internet access compared to 81% of small firms. Yet in Property & Business Services 74% of very small firms have Internet access compared to 84% of small firms.

3.1.3 Website presence

The percentage of firms with a website also varies between industries and firm sizes. 96% of firms with 150+ employees in Cultural and Recreational Services have a website compared to 45% in Property and Business Services. 31% of firms with between 50 and 149 employees in Construction have a website presence while 81% in Property and Business services have a website presence.

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[1]The definition of firm size adopted in this paper is slightly different from the standard ABS definition. This definition was adopted for use by all the papers from the Joint project on use of Information and Communications Technologies.

Figure 3.2 ICT uptake by firm size (based on number of employees), Linked dataset 1999-2000.

MANUFACTURING

Legend:
- Very Small (1-9)
- Small (10-49)
- Medium (50-149)
- Large (150+)

WHOLESALE TRADE

ACCOMODATION, CAFES, ETC

PROPERTY AND BUSINESS SERVICES

CONSTRUCTION

RETAIL TRADE

TRANSPORT & STORAGE

CULTURE & RECREATION

COMMUNICATION

MINING

PERSONAL SERVICES

FINANCE & INSURANCE
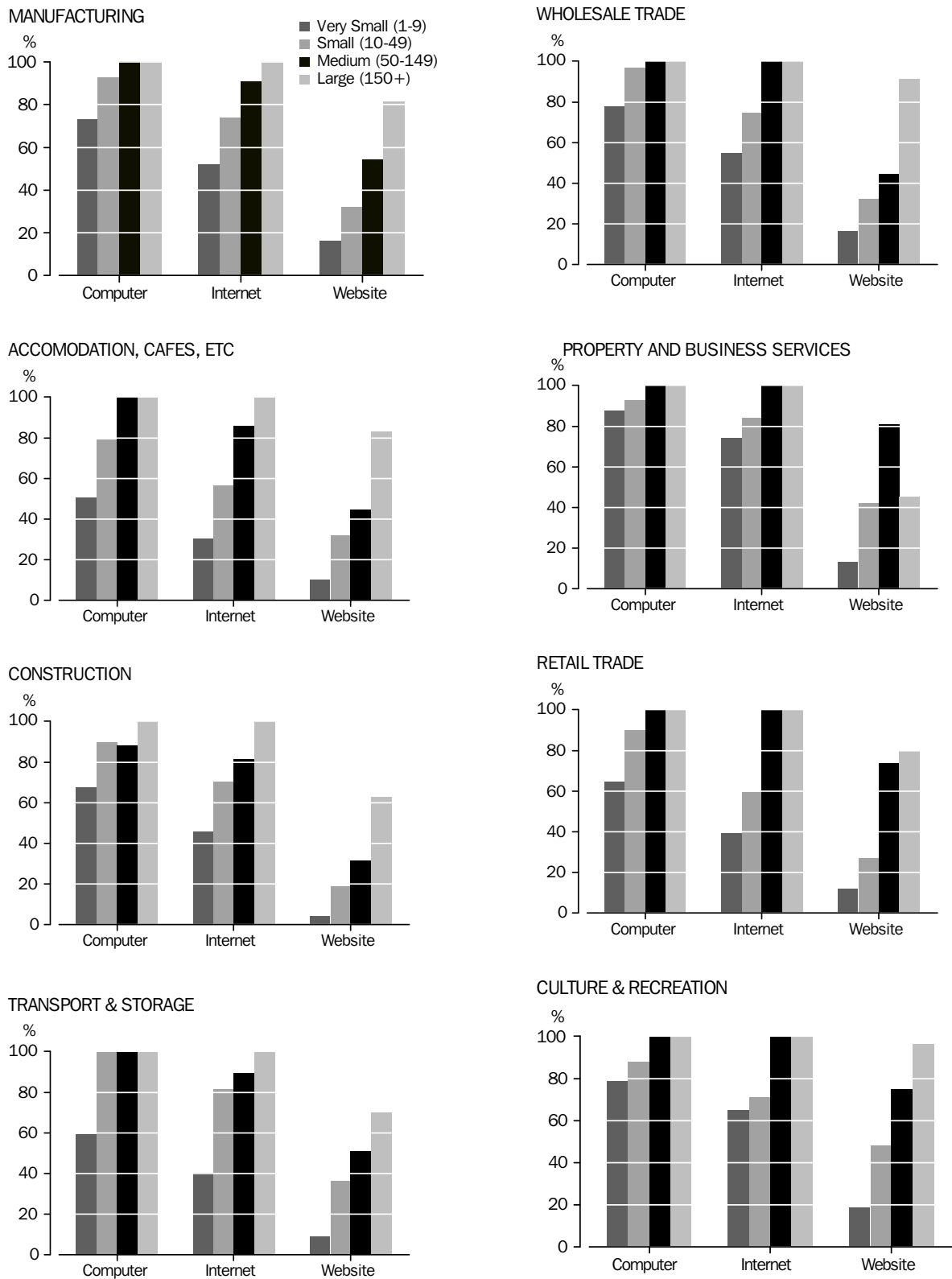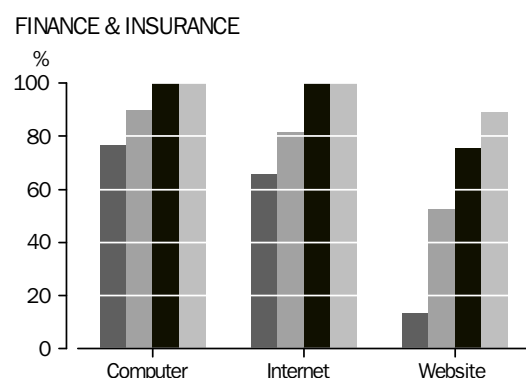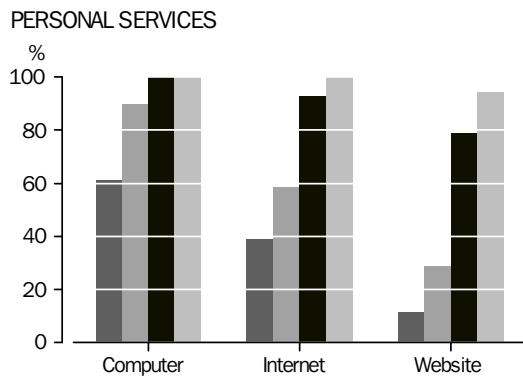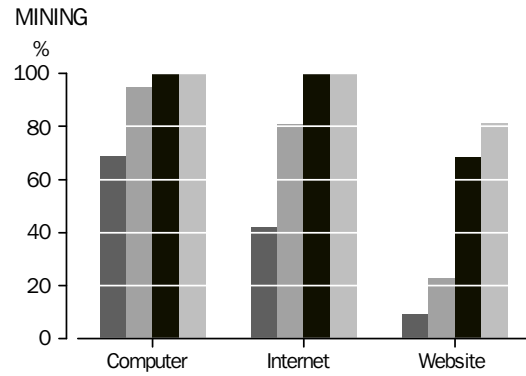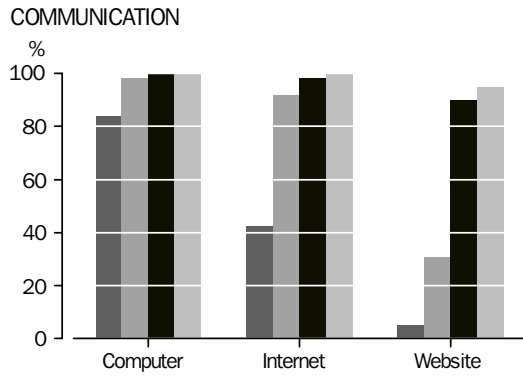
3.1.4 ICT use by labour productivity quartiles

Labour productivity (defined as value added per employee) was estimated for each firm. Firms were then divided into quartiles. In figure 3.3 the percentage of firms using computers in each productivity quartile is graphed. In Wholesale Trade over 90% of firms in the top quartile used computers. This compared with 75% of firms in the bottom quartile are using computers.

There does not appear to be a clear increase across all industries in the percentage of firms with computers, Internet or a website as the labour productivity quartile increases. For example, in Construction as the productivity quartile increases so does the percentage of firms using the Internet. While in Retail the uptake of the Internet is fairly constant across all productivity quartiles.

Figure 3.3 - ICT uptake by labour productivity quartiles, Linked dataset 1999-2000.

MANUFACTURING

CONSTRUCTION

WHOLESALE TRADE

RETAIL TRADE

ACCOMODATION, CAFES, ETC

TRANSPORT & STORAGE

PROPERTY & BUSINESS SERVICES

CULTURE & RECREATION
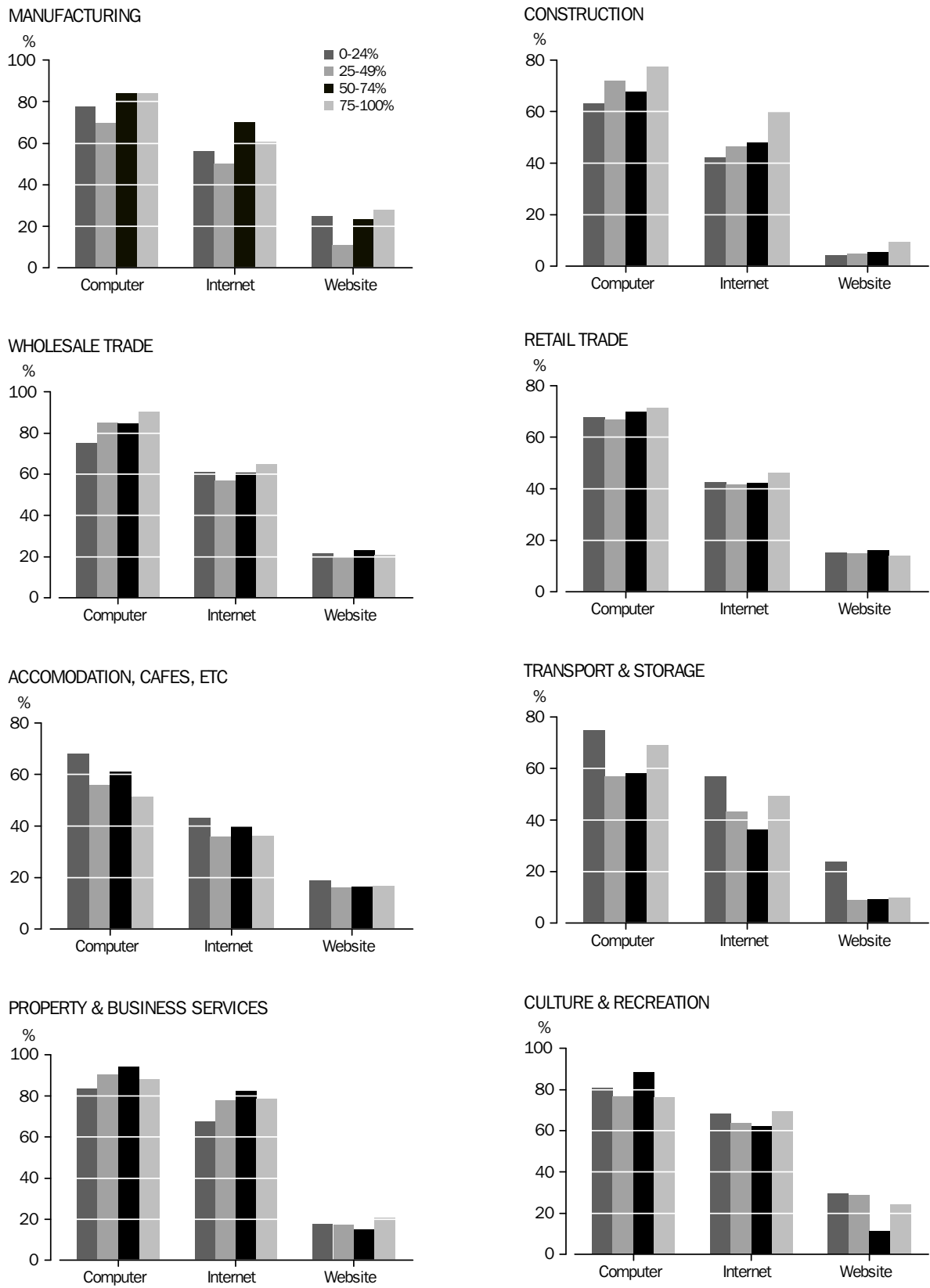
COMMUNICATION
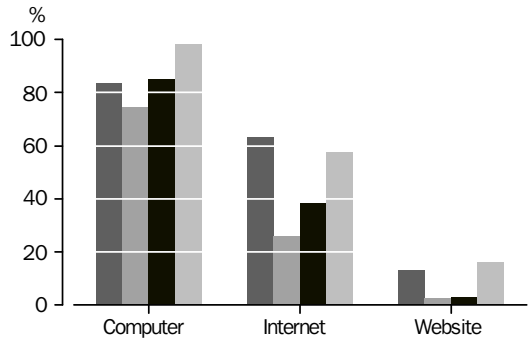
MINING
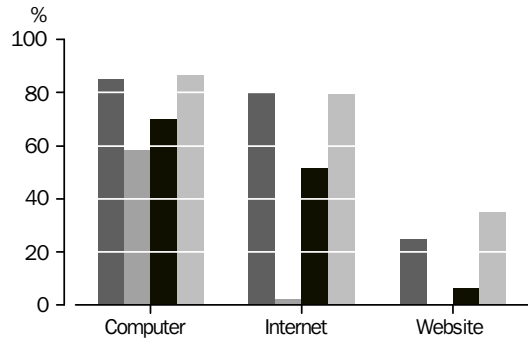
PERSONAL SERVICES
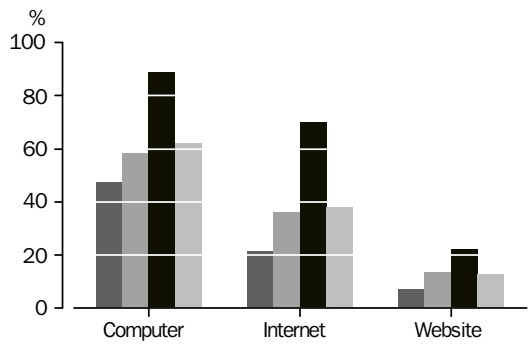
FINANCE AND INSURANCE
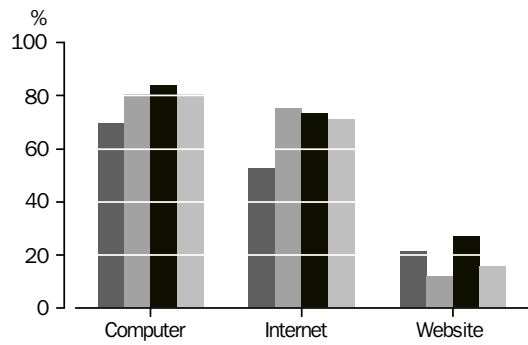
4 - Attributes of ICT adopters and non-adopters

4.1 Methodology

In this section the factors that are associated with firms that have adopted ICT will be explored. Logit models are estimated to ascertain the association between certain firm characteristics and the use of ICT.

An odds ratio of less than one indicates that the parameter estimate in the probability model is negative. An odds ratio more than one indicates that the parameter estimate in the probability model is positive. The following box explains the relationship between the Odds Ratio and the Logit equation.

Let the probability that a firm uses ICT be given by P_i where P_i is described by a logistic function:

$$P_i = 1/(1+e^{-Z_i})$$
$$Z_i = b_1 + b_2 X_i$$

$1-P_i$ is the probability of not using ICT, where:

$$1-P_i = 1/(1+e^{Z_i})$$

The odds ratio in favour of using ICT is then given by the following ratio:

$$P_i/(1-P_i) = e^{Z_i}$$

.

Taking natural logs of the odd ratio gives:

$$Ln(P_i/(1-P_i))) = Z_i = b_1 + b_2 X_i$$

This equation is the logit regression

Source: Modified from Gujarati (1995)

For example, an odds ratio of 1.05 indicates that the presence of that characteristic increases the probability of a certain event by 5%.

The dependent variable in the logit models (estimated in this section) is a dichotomous variable taking on the value of 1 if a business on the linked data set uses computers (or the Internet) and zero if it does not. The following are used as explanatory variables:

i. Type of legal organisation

This variable takes on the value of '0' if a business on the linked data set is unincorporated (sole trader) and a value of '1' if it is incorporated (a company). The expected sign of this variable in model is expected to be positive. If positive (negative), then the odds ratio for this variable is expected to be greater (less) than one, meaning that an incorporated company is more (less) likely to adopt ICT than an unincorporated business.

ii. The capital labour ratio

This variable is a continuous variable taking non-negative values. The variable in the probability model is expected to have a positive sign. Thus the odds ratio for this variable is expected to be greater than one i.e. for every unit increase in the capital - labour ratio for the business the odds or probability of having adopted ICT increases.

iii. Wage rate

This variable is a continuous variable taking non-negative values. The variable in the probability model is expected to have a positive sign. Thus the odds ratio for this variable is expected to be greater than one i.e. for every unit increase in the wage rate for the business the odds or probability of adopting computers increases.

iv. Low profit

This variable is a dichotomous variable computed following Gretton, Gali and Parham (2002). It takes on the value of 'one' if the business earnings before interest and tax on the value of fixed tangible assets is less than 5%, and is zero otherwise. The variable in the probability model is expected to have a negative sign. Thus the odds ratio for this variable is expected to be less than one, meaning that a low profit business is less likely to adopt ICT than a high profit business.

v. Firm size

Firm size is based on the total number of employees. We would expect to see large firms being more likely to use ICT.

Ideally one would like to have more detailed information on organisational characteristics of the firm – for example, educational qualifications of staff, number of part-time and full-time staff or does the firm use business planning practices. It is suggested in the literature that these factors may be important in understanding the uptake and use of ICT. However, these types of variables are not on the linked dataset.

The regression models specified in this paper have not been weighted. Controlling for industry and size (these are the two variables by which the BUIT is stratified) in the models should make the inclusion of the weights non-informative.

The specified models are also estimated including weights. The results of the weighted and unweighted are in most cases broadly consistent. This helps confirm that the weights are non-informative to the specified models.

For further discussion of the role of weights in regression analyses see Skinner, Holt, and Smith (1996) Pferrermann (1993), Mage, Robb. and Burbidge (1998), Porter (1973), and DuMouchel and Duncan (1983).

4.2 ICT adopters

Tables 4.1a and 4.1b summarise the associations for computer use for 12 industries in Australia. Type of legal organisation (incorporated or unincorporated) is positively and significantly associated with computer use in two of the industries. That is, incorporated firms are more likely to use computers than unincorporated firms.

In most cases the type of legal organisation is statistically insignificant. Gretton (2002) found that type of legal organisation was statistically significant in half the industries they examined. As their period of analysis was between 1996-97 and 1997-98, this may indicate that incorporated firms were the first to adopt computers. Over the late 1990's computer use became more widespread with unincorporated firms also adopting computer use. So by 1999-2000, there was no significant difference between computer use by incorporated and unincorporated firms. The exception was the Finance & Insurance and Personal Services industries.

Table 4.1a Factors associated with computer use, based on a linked data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size	Correct predictions
			Odds ratio			(%)
Mining	0.59	1.13#	1.29#	**1.47**	1.01#	78
Manufacturing	1.47	1.01	0.91	1.4	1.2*	88
Construct	1.17	1.06#	0.99	0.86	1.19*	71
Wholesale Trade	1.35	1.23	1.09*	1.39	1.43*	88
Retail Trade	0.98	0.95	1.21	1.05	1.15*	76
Accommodation	0.98	1.11#	1.24#	1.21	1.15*	83
Transport & Storage	1.02	0.99	1.07	1.05	1.25*	80
Communication Services	0.47	0.84	1.59	1.9	1.02	77
Finance	1.07+	0.98	1.16	0.67	1.5*	80
Property & Business	0.9	0.95	1.08	0.87	1.15*	75
Cult & rec services	1.12	0.98	1.27#	0.68	1.10*	73
Personal Services	1.77+	1.12*	1.11	1.36	1.23*	75

* Statistically significant at the 1% level.

+ Statistically significant at the 5% level.

Statistically significant at the 10% level.

Table 4.1b Summary over the 12 sectors – Number of factors associated with computer use, based on a linked data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size
Number sectors where variable is statistically significant and positive	2	4	4	0	11
Number sectors where variable is statistically significant and negative	0	0	0	0	0
Expected sign	+	+	+	-	+

Table 4.1b shows that four industries have a positive significant association between the capital labour ratio and computer use. That is, in these industries more capital-intensive firms are more likely to be using computers.

Four industries have a positive significant association between the capital labour ratio and computer use. That is, in these industries more capital intensive firms are more likely to be using computers.

The wage rate in a firm is positively associated and statistically significant in four industries. So those firms with higher average wage rates are more likely to be using computers. This may indicate that these firms have a higher skilled workforce or the firm is undertaking more technical or complex work that requires computers.

Low profitability of a firm is not significantly associated with firm use of computers in any industry.

Firm size is an important and significant explanatory variable associated with use of computers in all industries. This may indicate that as firms grow in size (in terms of the number of employees) computers become an important management tool.

The column headed "correct predictions" gives the percentage of firms that the different models can correctly predict as having computers. All models for computer use have good prediction rates of at least 71%.

The results from the logit models for Internet use are presented in table 4.2a and table 4.2b. The type of legal organisation is statistically significant with Internet use in three industries. In Communication and Personal Services incorporated firms are more likely to use the Internet than unincorporated firms. In the Mining industry the situation is reversed. In the remaining industries type of legal organisation is not statistically significant.

Table 4.2b shows that the capital labour ratio is positively and significantly associated with Internet use in three industries (Mining, Construction and Personal Services). In these industries as the amount of capital per employee increases so does the probability of using a computer. In the Retail Trade industry the situation is reversed. That is, less capital-intensive firms are using the Internet. This may reflect that in the Retail industry most firms are involved in the provision of services that may be more labour intensive.

The wage rate is significantly associated with Internet use in 6 of the industries. In all cases the relationship is positive. That is, the higher the average wage rates the higher the probability of the firm using the Internet. As with computer use the higher wage rates associated with Internet use may reflect the type of more complex work being done by these firms.

Profitability of a firm is only statistically significantly in the Property and Business Services. In this industry low profit firms were 44% (1-0.56) less likely to use the Internet than other firms. These firms may not have sufficient funds to invest in access to the Internet. Alternatively, the lack of Internet access may be leading to their poor performance.

Firm size is an important and significant explanatory variable associated with use of the Internet. The larger the firm the more likely it will have access to the Internet.

In table 4.2a, the column headed "correct predictions" gives the percentage of firms that the different models can correctly predict as using the Internet. The Internet use models prediction rates ranged between 66% for Retail Trade and 81% for Mining.

Table 4.2a Factors associated with Internet Use, based on a link data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size	Correct predictions
	Odds ratio					(%)
Mining	0.37*	1.09#	1.28#	1.27	1.01	81
Manufacturing	1.2	0.94	1.16	0.97	1.01*	80
Construct	0.99	1.05#	1.07	0.99	1.07*	69
Wholesale Trade	1.35	0.95	1.34+	0.85	1.01*	75
Retail Trade	1.14	0.90*	1.15#	1.01	1.00*	66
Accommodation	0.88	0.96	1.5*	1.08	1.01*	78
Transport & Storage	1.38	0.96	1.02	1.06	1.14*	81
Communication Services	2.48*	0.97	1.23	1.42	1.08*	81
Finance	0.9	1.01	1.07	0.56*	1.16*	73
Property & Business	0.77	0.95	1.2+	0.82	1.01*	70
Cult & Rec services	1.6	0.95	1.17	1.2	1.01*	70
Personal Services	1.71+'	1.13*	1.31+'	1.11	1.07*	

* Statistically significant at the 1% level.

+ Statistically significant at the 5% level.

Statistically significant at the 10% level.

Table 4.2b Summary over the 12 sectors – Number of factors associated with Internet Use, based on a link data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size
Number sectors where variable is statistically significant and positive	2	3	5	0	11
Number sectors where variable is statistically significant and negative	1	1	0	1	0
Expected sign	+	+	+	-	+

4.3 Factors associated with how businesses use the Internet

The BUIT collects information on how firms use the Internet. The survey form provides 18 different activities that a firm can use the Internet for. Figure 4.1 summaries the responses for those business in the linked dataset. The responses are arranged in descending order starting with the use selected by most firms. Figure 4.1 refers only to 17 uses, the 18th use - "other uses" is excluded from Figure 6 and from the rest of the analysis. The three most common uses of the Internet are general uses (Email, Information searches, Accessing government services and Internet banking) that appear at the top of figure 4.1.

Figure 4.1 How firms use the internet.
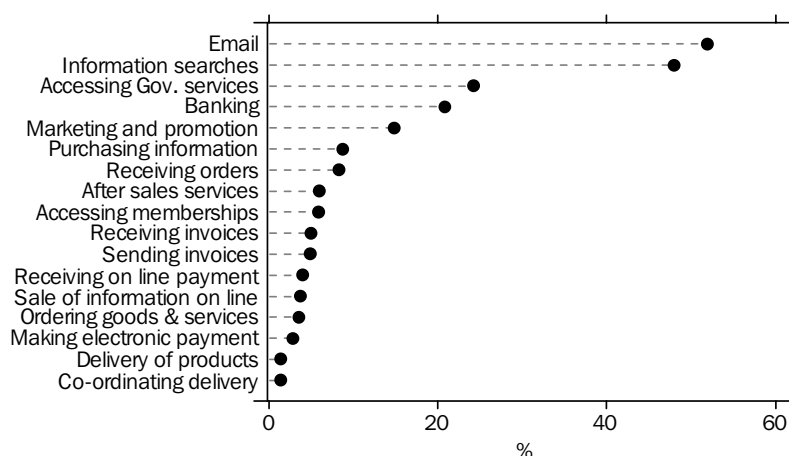
To help understand the factors associated with using the Internet for certain activities use is again made of the logistic regression method. To explain the estimates we use Email an example in Table 4.3a and 4.3b. Appendix B provides estimates on an industry-by-industry basis and shows how the strength of association varies across the industries. Due to sample sizes in some of the activities results are only presented for eight industries (Manufacturing, Construction, Wholesale, Retail Trade, Accommodation, Cafe & Restaurants, Transport and Storage, Property and Business Services and Cultural and Recreation Services).

Of most interest here is the negative relationship between wage rates and e-mail use. In six of the industries the lower the average wage rate the more likely the firm will use the Internet for e-mail. The factors behind this phenomena still require further research.

Table 4.3a Factors associated with email use, based on a link data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size	Correct predictions
			Odds ratio			(%)
Manufacturing	1.3	0.97	0.93+	0.95	2.03+	81
Construction	1.17	0.99	1.02	0.96+	1.92+	66
Wholesale Trade	1.32	1.02	0.92+	0.81	1.96+	77
Retail Trade	1.56+	0.96+	0.89*	0.98	1.83*	70
Accommodation	1.00	0.99	0.85*	0.66#	2.13*	72
Transport & Storage	1.3	0.97	0.88*	0.93	2.23*	76
Property & Business	1.2	1.01	1.03	0.67#	1.5*	65
Cult & Rec Services	2.59*	1.01	0.94*	0.96	1.64*	75

* Statistically significant at the 1% level.
+ Statistically significant at the 5% level.
# Statistically significant at the 10% level.

Table 4.3b Summary over the 12 sectors – Number of factors associated with Email Use, based on a link data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size
Number sectors where variable is statistically significant and positive	2	1	0	0	8
Number sectors where variable is statistically significant and negative	0	0	6	3	0
Expected sign	+	+	+	-	+

The low profit flag was statistically significant in three of the industries (Construction, Accommodation, Property and Business Services). In all cases low profit firms were less likely to use e-mail. The capital to labour ratio does not appear to be a major factor associated with the use of e-mail.

The firm size is more in line with what was seen with computer and Internet use. The larger the firm the more likely it is to use e-mail. This may indicate that as firms grow in size the use of e-mail helps information management and exchange by the firm.

4.4 Barriers to adoption and use of ICT by Australian businesses

This section investigates the characteristics of firms that have not adopted computers or the Internet. The BUIT collects the reasons why firms did not use computers (see table 4.4) and why they did not use the Internet (see table 4.5).

For those firms that did not use a computer, the most prevalent barrier to computer use was that computers were not suited to the nature of the business, with 32% of firms reporting this reason. Firms in the Wholesale industry recorded the highest rate, with 39% reporting this as a barrier to computer use. This was followed by firms in the Cultural and Recreational Services and Property and Business Services industries, with rates of 38% and 34% respectively.

Lack of skills or appropriate training was the second highest reason and accounted for 26% of all firms. Firms in the Construction and Manufacturing industries reported the largest incidence of this barrier with rates of 31% and 30% respectively.

Table 4.4   Reason for an industry not using computers, based on a linked data set for 1999-2000

Reason	High Cost (%)	Lack of Interest (%)	Not suited (%)	Lack of Skills (%)	Other reason (%)
Manufacturing	15	15	28	31	11
Construction	13	17	29	31	11
Wholesale trade	15	12	39	21	14
Retail trade	19	13	33	24	11
Accommodation	21	13	34	22	10
Transport and Storage	16	15	31	29	10
Finance and Insurance	7	10	53	14	16
Property & Business Services	15	17	34	22	12
Cultural & Recreational	4	15	38	24	9
Total	16	15	32	26	11

Computer costs being too high was a factor for 16% of all firms, with firms in the Accommodation, Cafes and Restaurants industry reporting the highest rate of 21%.

table 4.5a and table 4.5b report results from estimating a logit equation to explore the factors that may be associated with firms reporting "High Costs" as a barrier to using computers. The results for the other barriers to computer use are reported in Appendix C.

The most noticeable result is that larger firms are far less likely to report High Cost as a barrier to using computers in all eight industries. The relationship between the wage rate variable and High Cost as a barrier is ambiguous. In three industries a firm with a higher wage rate was more likely to reporting High Cost as a barrier to computer use. In the four other industries a firm with a higher wage rate was less likely to report High Cost as a barrier to computer use. This may indicate the heterogeneous nature of firms' activities between the different industries.

Table 4.5a Factors associated with reporting high cost, based on a link data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size	Correct predictions
		Odds ratio				(%)
Manufacturing		1.08	1.05*	1.18	0.75*	82
Construction	0.41	0.92*	1.18*	0.64	0.85*	72
	0.51					
Wholesale Trade	0.34	0.86*	0.63	0.74	0.91+	88
Retail Trade	0.56	1.05	1.1*	0.7	0.82*	72
Accommodation	0.59	0.95	0.69+	0.85	0.91*	71
Transport & Storage	0.4#	1.02	0.8*	0.54	0.88*	72
Property & Business	0.53	0.94	0.98*	1.22	0.75*	70
Cult & Rec Services	1.03	0.96	0.6*	0.57	0.75	76

* Statistically significant at the 1% level.

+ Statistically significant at the 5% level.

Statistically significant at the 10% level.

Table 4.5b Summary over the 12 sectors – Number of factors associated with reporting high cost as a barrier, based on a link data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size
Number sectors where variable is statistically significant and positive	0	0	3	0	0
Number sectors where variable is statistically significant and negative	1	2	4	0	8
Expected sign	-	-	-	+	-

For those firms that did not have access to the Internet, the most prevalent barrier was that the Internet was Not Suited to the nature of the business. This reason was reported by 33% of firms without Internet access. Property and Business services firms recorded the highest rate, with 36% of firms reporting this reason for not accessing the Internet. Firms in the Construction industry recorded a rate of 35%. Lack of Interest was the second highest barrier for accessing the Internet, accounting for 17% of all firms. Firms in the Accommodation, Cafes and Restaurants industry reported the largest incidence of this barrier, with 21% of firms reporting this as a barrier.

Table 4.6: Reason for an industry not using the internet, based on a linked data set for 1999-2000

Reason	High cost (%)	Lack of interest (%)	Not suited (%)	Lack of skills (%)	Security (%)	Connection Speed (%)	Other (%)
Manufacturing	15	15	27	16	11	6	9
Construction	9	18	35	15	13	3	8
Wholesale trade	14	14	32	14	11	4	11
Retail trade	9	16	34	14	11	4	11
Accommodation	13	21	32	14	8	3	10
Transport & storage	15	19	25	14	12	5	10
Finance Insurance	7	12	47	14	12	2	6
Property & Business	13	17	36	15	9	6	4
Cultural & Recreational	16	14	33	14	9	5	9
Total	11	17	33	15	11	5	13

A logistic regression was fitted to for barriers to Internet use. The results are presented in Appendix D. To help illustrate the results the "Not Suited to the Business" will be used as an example. The results of this logistic regression are presented in table 4.7.

In all industries the wage rate was statistically significant. Firms with higher wage rates are less likely to report that the Internet was Not Suited to their business. This may indicate that there may be a complementary affect between skilled workers and Internet use.

It is also of interest to note that the firm size is not significant in any of the industries. This indicates that the size of the firm has no affect on firms reporting the Internet is not suitable to their business.

Table 4.7a Factors associated with reporting 'Not Suited to Business', based on a link data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size	Correct predictions
			Odds ratio			(%)
Manufacturing	1.18	0.95	0.85*	0.99	0.83	66
Construction	1.47#	0.99	0.83*	0.80	0.88	57
Wholesale Trade	0.76	1.10	0.76*	0.84	1.00	72
Retail Trade	0.81	0.96+	0.88*	0.87	0.96	53
Accommodation	1.32	0.98	0.83*	0.80	0.88	54
Transport & Storage	0.78	1.07	0.78*	0.76	0.84	68
Property & Business	0.74	0.99	0.80*	1.46	0.92	60
Cult & Rec Services	0.38#	1.01	0.84*	0.75	0.82	68

* Statistically significant at the 1% level.
+ Statistically significant at the 5% level.
# Statistically significant at the 10% level.

Table 4.7b Summary over the 12 sectors – Number of factors associated with reporting 'Not Suited to Business', based on a linked data set for 1999-2000

Variable	Type of legal organisation	Capital to labour ratio	Wage rate	Low profit flag	Firm size
Number sectors where variable is statistically significant and positive	1	0	0	0	0
Number sectors where variable is statistically significant and negative	1	1	8	0	0
Expected sign	-	-	-	+	-

5 Conclusions

This study has linked together data from three different data sources to investigate the factors that are associated with ICT use by Australian firms. The linked dataset contains both ICT use variables and some firm characteristics and performance indicators. The linking of different surveys and administrative data reduces costs and provider load and provides a detailed data source for users.

Throughout the analysis in this paper we have found that the size of the firm and the average wage rate were associated with the use of computers and the Internet. In most industries the larger the firm the more likely it is to use computers and the Internet. This may indicate that computers and the Internet help firms manage activities as they increase in size.

Higher average wage rates also appear to be positively associated with computer and Internet use. Higher wages may be reflecting higher skilled workers. This suggests that ICT and high skilled workers may be complementary to each other.

Appendix A: A Summary of the BUIT/EAS/TAX linking exercise

A linked data set was constructed using three data sources:

>   1. Business Use of Information Technology survey;
>   2. Economic Activity Survey supplemented by business income tax data; and
>   3. Business Income Tax data.

The 1999-2000 BUIT is the core dataset in the linked dataset. The BUIT collected information on businesses and their use of computers and the Internet, including websites and Internet commercial activities. The survey was a stratified random sample of 11,940 private sector businesses. All industries with the exception of Agriculture, General Government, Religious organisations and private households employing people were sampled in the BUIT.

The EAS data is collected directly via an annual ABS survey. These data are supplemented by Business Income Tax (BIT) data provided to the Australian Taxation Office (ATO). The ABS survey component of the collection covers approximately 12,000 businesses in the public trading and private employing sectors in all industries except those coded to Agriculture.

This survey data is then supplemented by a sample of approximately 65,000 ATO BIT records extracted from returns lodged during the same financial year. EAS collects financial information such as total assets, wages and salaries, sale of goods and services and number of employees.

The BIT data file for the financial year ending 30 June 2000 comprised approximately 2.1 million business entities. The BIT data contains total income and total expenses for each firm.

The linking of different surveys and administrative data is of great interest to both statistical agencies and the user community since it reduces provider load (compared with asking additional survey questions) and can provide a more detailed data source for users.

Creating a dataset that contains both data on ICT and other financial performance variables, require 4 steps (see Figure A.1) as follows:

Step 1 - 3,368 firms in the BUIT were matched with EAS/Tax. That is 3,368 firms were in the sample for both the BUIT and the EAS surveys. There were 8,572 firms that could not be matched.

Step 2 - 6,764 records (not matched in Step 1) were then matched with the complete Business Income Tax unit record file. This match resulted in an extra 5,857 units having data available for analysis.

Step 3 - A total of 3,084 records were discarded because they could not be matched with either the EAS/Tax file or the Business Income tax file. These were records for which ABS could not identify either a Tax File Number or a record on the BIT.

Figure A.1: A schematic representation of the BUIT-EAS-BIT linked file
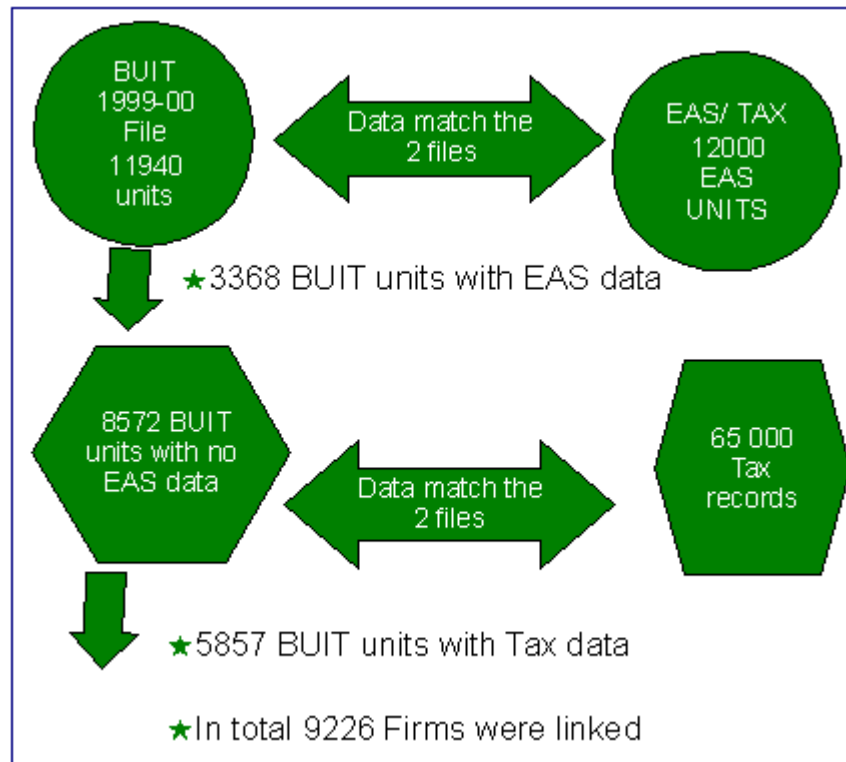
Step 4 - Overall 9,226 records were available for analysis (3,368 + 5,857). To each record from BUIT with a match, various expenditure, income and other economic and financial data were attached. For the 3,368 units that were matched on the EAS/Tax file, the required expenditure and income variables were available directly from the EAS collection. So those details were attached to the BUIT record. For the 5,857 units that were matched using the full BIT file, only limited expenditure and income variables were available from the Business Income Tax file. Consequently estimates of most economic and financial variables were treated as missing and derived using the standard EAS imputation methodology (ABS, 2001b).

The majority of firms common to both BUIT and EAS are large firms because larger firms have a higher probability of selection in ABS surveys than smaller firms. The inclusion of the BIT data led to a more representative sample of the population of Australian firms because it made it possible to match medium and small firms in the BUIT sample to the BIT data. Table A1 gives the distribution (by industry and firm size) of firms that could not be matched

Table A.1 Percentages of firms (in BUIT) not included in the linked data set unweighted data (weighted data)

Industry	4 or less employees	5-19 employees	20-99 employees	100+ employees	Total (%)	Total firms linked (unweighted)
Mining	22% (21%)	16% (18%)	16% (23%)	4% (3%)	16% (19%)	429
Manufacturing	12% (12%)	19% (14%)	14% (16%)	3% (11%)	11% (13%)	805
Electricity, gas & water	50% (54%)	31% (35%)	46% (44%)	16% (23%)	31% (40%)	103
Construction	16% (17%)	12% (10%)	14% (19%)	6% (8%)	15% (16%)	1,340
Wholesale trade	24% (20%)	15% (13%)	26% (28%)	4% (18%)	17% (19%)	442
Retail trade	21% (21%)	15% (15%)	23% (24%)	4% (23%)	17% (19%)	1,037
Accommodation	34% (27%)	32% (28%)	36% (36%)	8% (38%)	30% (29%)	645
Transport and storage	20% (18%)	14% (13%)	26% (26%)	10% (16%)	18% (18%)	735
Communication services	17% (16%)	12% (17%)	14% (14%)	18% (35%)	16% (16%)	265
Finance and insurance	32% (33%)	28% (34%)	25% (30%)	11% (27%)	28% (33%)	756
Property & business services	20% (19%)	18% (17%)	26% (33%)	8% (32%)	17% (19%)	1,052
Health & community	29% (29%)	47% (46%)	70% (76%)	6% (35%)	31% (37%)	532
Cultural & recreation services	44% (41%)	44% (40%)	49% (51%)	16% (37%)	42% (42%)	402
Personal & other services	32% (31%)	39% (37%)	54% (48%)	21% (33%)	35% (34%)	683
Total	25% (21%)	24% (21%)	30% (31%)	8% (24%)	22% (22%)	9,226
Total firms (unweighted)	5,912	1,398	359	1,591	9,226	

Source: Computed by the authors from a data matching success rate report.

Table A.1 shows that 22% of the BUIT sample could not be matched to either EAS/Tax data or the ATO BIT data. However the "data matching failure rate" varied by industry and firm size. Table A.1 shows that firms with between 20 and 99 employees had the highest "data matching failure rate" with 30% (31% weighted) being unmatched. In contrast only 8% (24%) of large firms (100+ employees) were not able to be matched. The industries that had very high "data matching failure rates" were Cultural & Recreation Services, Personal services, Health Services and Electricity, Gas & Water.

Appendix B: Odds Ratio for factors associated with the use of the internet

	LEGEND	
Industry		Variable
Man: Manufacturing		TOLO: Type of legal organisation
Con: Construction		K/L: Capital- labour ratio
Who: Wholesale		Wage: Wage rate
Ret: Retail		Low: Low profit
Acc: Accommodation		Size: Firm size
Tran: Transport		* Statistically significant at the 1% level.
Prop: Property & Business		+ Statistically significant at the 5% level.
Cult: Cultural & Recreation		# Statistically significant at the 10% level.

General activities

E-mail

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.3	1.17	1.32	1.56+	1	1.3	1.2	2.59*
K/L	0.97	0.99	1.02	0.96+	0.99	0.97	1.01	1.01
Wage	0.93+	0.91+	0.92+	0.89*	0.85*	0.88*	1.03	0.94*
Low	0.95	0.95	0.81	0.98	0.66#	0.93	0.67#	0.96
Size	2.03+	1.92+	1.96+	1.83*	2.13*	2.23*	1.5*	1.64*

Internet searches

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.16	1.04	1.82+	1.53*	1.37	1.15	1.31	2.4+
K/L	0.97	1	0.97	0.96+	0.97	0.98	1.01	0.98
Wage	0.92*	0.9*	0.91*	0.89*	0.82*	0.87*	1.02	0.94+
Low	1.13	1.01	0.87	0.76	0.57+	0.79	0.6	0.97
Size	1.9*	1.85*	1.86*	1.56*	2.15*	2.32*	1.45*	1.47*

Access government services online

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.66*	1.18	1.82+	1.38#	1.19	1.44	1.18	1.1
K/L	0.92*	0.95*	0.94+	0.96+	0.94*	0.94*	0.99	0.95
Wage	0.87*	0.84*	0.85*	0.78*	0.78*	0.84*	0.92*	0.86*
Low	1.31	0.98	0.98	0.71	0.48*	0.9	0.74#	0.8
Size	1.62*	1.76*	1.79*	1.94*	2.19*	1.8*	1.43*	1.7*

Marketing & promotion

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	0.68#	0.79	1.39	1.95*	1.52+	1.34	1.17	1.57
K/L	0.93*	0.95+	0.9*	0.92*	0.91*	0.92*	0.97#	0.97
Wage	0.85*	0.73*	0.89*	0.77*	0.81*	0.78*	0.85*	0.82*
Low	1.21	0.69	0.77	0.86	0.72	0.92	0.84	0.87
Size	1.88*	2.55*	1.74*	1.88*	2.01*	2.2*	1.78*	1.89*

Internet banking

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.44#	1.01	1.71#	1.56+	1.36	1.32	1	1.64
K/L	0.95+	0.96+	0.93+	0.97	0.97#	0.94*	1.01	1
Wage	0.87*	0.84*	0.88*	0.82*	0.74*	0.86*	0.89*	0.83*
Low	1.03	0.64*	0.81	0.78	0.63*	0.91	0.93	0.63
Size	1.3*	1.65*	1.31*	1.46*	2.17*	1.42*	1.3*	1.39*

Access membership services

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.13	0.87	0.64	1.18	2.78*	0.61	0.9	2.25#
K/L	0.92*	0.92*	0.86*	0.94+	0.91*	0.93+	0.98	0.88*
Wage	0.8	0.73*	0.87*	0.7*	0.72*	0.73*	0.8*	0.79*
Low	0.62	1.06	1.46	0.83	0.24*	0.82	0.89	0.52
Size	1.49*	1.86*	1.39*	1.77*	1.83*	1.96*	1.37*	1.63*

Using the internet to sell goods and services

Receiving orders

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.03	1.47	0.72	0.45*	0.52*	1.01	0.67#	0.91
K/L	1.04	1.05#	1.09*	1.09*	1.08*	1.1*	1.03	1.02
Wage	1.21*	1.32*	1.21*	1.32*	1.24*	1.23*	1.25*	1.25*
Low	1.14	1.18	1.59	0.9	2.21*	1	1.36	1.41
Size	0.7*	0.61*	0.63*	0.61*	0.64*	0.61*	0.69*	0.64

Send invoices to customers

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	0.74	1.38	1.15	2.59+	8.93*	1.43	1.92+	1.3
K/L	0.94	0.96	0.85*	0.92+	0.82*	0.91+	0.98	0.97
Wage	0.76*	0.74*	0.79*	0.66*	0.7*	0.69*	0.77*	0.76*
Low	0.47	0.92	0.91	0.57	0.37	1.2	1.02	0.8
Size	1.49*	1.23	1.57*	1.57*	1.18	2.21*	1.18#	1.06

Delivery of products in digital form

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.77	0.16	2.26	1	17.8+	0.26	1.16	0.59
K/L	0.86*	0.95	0.74*	0.93	0.85#	0.96	1	0.86+
Wage	0.72*	0.65*	0.69*	0.57*	0.59*	0.58*	0.69*	0.65*
Low	1.32	1.21	0.21	0.67	0.49	0.01	1.02	0.15
Size	1.57*	0.85	1.92+	2.2*	1.2	2.71*	1.43*	2.68*

After sales service

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	0.93	0.93	1.89#	3.42*	2.28#	1.59	1.61#	1.95
K/L	0.9*	0.94+	0.89*	0.93+	0.89*	0.93#	0.96#	0.93
Wage	0.79*	0.69*	0.84*	0.69*	0.73*	0.66*	0.79*	0.76*
Low	1.33	1.48	1.02	0.53	0.28+	0.59	1.09	0.51
Size	1.55*	1.98*	1.35*	1.55*	1.39#	2.46*	1.35*	1.39+

Receive online payment from customers

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	0.73	1.27	2.08#	1.98+	2.52+	0.7	0.96	1.08
K/L	0.98	0.94*	0.86*	0.93+	0.91*	0.92+	0.92*	0.9+
Wage	0.77*	0.69*	0.78*	0.71*	0.69*	0.73*	0.81*	0.75*
Low	1.45	0.67	1.56	0.67	0.58	0.94	0.7	0.45
Size	1.38*	1.97*	1.65*	1.68*	1.6*	1.92*	1.31*	1.78*

Coordinating delivery arrangements

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	2.38	0.1*	1.15	1.5	12.26+	7.77#	1.51	0.37
K/L	0.85*	0.9#	0.81*	0.95	0.83+	0.94	0.99	0.93
Wage	0.7*	0.59*	0.78*	0.6*	0.7*	0.45*	0.63*	0.59*
Low	0.84	1.39	1.21	0.58	0	0.71	0.64	0.38
Size	1.53*	3.28*	1.43+	1.93*	0.92	3.4*	1.87*	2.46*

Sale of information

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.03	0.72	2.02	1.37	2.48	1.43	1.45	0.2
K/L	0.93	0.97	0.87*	0.93	0.86*	0.91*	1	0.95
Wage	0.75*	0.63*	0.78*	0.7*	0.74*	0.73*	0.7*	0.69*
Low	1.43	1.38	0.19	0.83	0.56	0.95	0.86	1.37
Size	1.53*	2.17*	1.59*	1.51*	1.72*	1.85*	1.63*	1.97

Use the internet to purchase goods and services

Ordering goods and services

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.13	0.48#	1.51	3.19*	2.05	1.95	1.13	0.72
K/L	0.88*	0.94	0.85*	0.94	0.88*	0.87*	0.98	0.94
Wage	0.76*	0.65*	0.81*	0.68*	0.67*	0.65*	0.75*	0.75*
Low	0.38#	0.18#	0.37	0.35*	0.13	0.33	0.75	0.47
Size	1.68*	2.46*	1.4	1.68*	1.77*	2.54*	1.62*	1.75*

Electronic payments for goods & services

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.33	0.73	1.66	2.88*	0.51	2.36	1.87	0.39#
K/L	0.9	1.73	0.86*	0.93	0.9*	0.85	0.98	1.04
Wage	0.7*	0.67*	0.81*	0.68*	0.69*	0.62*	0.71*	0.73*
Low	0.36	0.33	0.41	0.29*	0.39	0.27	0.74	0.34#
Size	1.87*	2.15*	1.27	1.63*	1.91*	2.32*	1.61*	1.74*

Purchase of information online

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.35	0.79	0.97	1.55	1.76*	1.76*	1.76	0.71
K/L	0.88*	1	0.92	0.94	1.76*	1.76#	1.76*	0.98
Wage	0.85*	0.74*	1.92*	0.72*	3.76*	0.75*	0.79*	0.81*
Low	0.92	0.97	0.71	0.59	4.76	0.96	0.78	0.6
Size	1.39*	1.85*	1.35*	1.75*	5.76*	1.88*	1.53*	1.51*

Receive invoices

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
TOLO	1.41	0.84	2.65	0.9	1.32	0.76	1.48	2.52#
K/L	0.89*	0.97	0.8*	1	0.9	0.94#	0.95#	0.92#
Wage	0.77*	0.69*	0.86*	0.66*	0.69*	0.71*	0.77*	0.75*
Low	0.42*	0.83	0.39	0.8	0.14#	1.04	1.12	0.53
Size	1.57*	1.72*	1.14	1.96*	1.59	2.12*	1.49*	1.6*

Appendix C: Odds ratios for factors associated with firms reporting barriers to the use of computers

Computers too costly

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	0.41*	0.51*	0.34#	0.56*	0.59*	0.4*	0.53+	1.03
K/L	1.08	0.92*	0.86#	1.05	0.98	1.02	0.94	0.96
Low	1.05	1.18	0.63	1.1	0.69	0.8	0.98	0.6
TOLO	1.18	0.64	0.74	0.7	0.85	0.54#	1.22	0.57
Wage	0.75*	0.85*	0.91	0.82*	0.91+	0.88*	0.75+	0.75*

Lack of interest in computers

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	0.36*	0.55*	0.36+	0.52+	0.59+	0.47*	0.7	0.58#
K/L	1.03	0.94+	0.88#	1.02	0.96	0.96	1.02	0.91
Low	0.65	0.93	0.49	0.63	0.47	0.79	0.81	0.88
TOLO	1.48	0.96	0.33	1.11	1.03	0.59	0.96	1.75
Wage	0.81*	0.85*	0.97	0.82*	0.86+	0.9*	0.69*	0.82*

Computers aren't suitable to business

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	2.29*	2.31*	4.4*	1.96*	1.8*	2.46*	2.77*	1.83*
K/L	1.06	1.04#	1.13	1.02	1.03	1.09*	0.94#	1.05
Low	1.31	0.72	1.64	1.36	1.16	1.29	0.92	1.36
TOLO	1.89#	1.19	0.61	1.31	1.85*	0.67	1.63	2.54#
Wage	1.04	1.09*	1.07	1.07*	1	1.05	1.21*	1.06

Lack of skills

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	2.1*	1.62*	2.65*	1.61*	1.57*	1.91*	1.63	2.21*
K/L	1.05	1.04#	1.15	0.95#	1.04	1.02	0.98	1.01
Low	1.96	1.12	3.75	1.46	1.67#	0.98	0.7	1.14
TOLO	1.24	1.25	1.47	1.12	0.99	1.22	1.87	0.8
Wage	1.08	1.1*	1.02	1.22*	1.06*	1.09*	1.31*	1.18*

Appendix D: Odds ratio for factors associated with firms reporting barriers to the use of the internet

Internet seen as too costly

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	0.69#	0.55+	1.17	0.97	0.63#	0.82	0.66	0.82
K/L	1.01	1.01	1.03	1	1.13#	0.89+	1.02	1.01
Low	0.84	1	2.94#	1.11	1.37	0.65	1.25	0.17#
TOLO	0.86	0.75	0.59	0.69	0.64	1.1	4.2+	0.49
Wage	0.79*	0.77*	0.72*	0.73*	0.68*	0.81*	0.63*	0.81*

Internet seen as unsuitable to business

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	0.83	0.88	1	0.96	0.88	0.85	0.92	0.82
K/L	0.95	0.98	1.1	0.95	0.98	1.07	0.99	1.01
Low	1	0.8	0.84	0.86	0.8	0.76	1.46	0.75
TOLO	1.18	1.47#	0.76	0.81	1.32	0.78	0.74	0.38*
Wage	0.85*	0.83*	0.76*	0.88*	0.83*	0.78*	0.8*	0.84*

Lack of skills

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	0.75#	0.7	0.8	0.83	1.04	0.84	0.82	0.8
K/L	0.97	1.02	1	0.99	0.96	1.01	1.04	1.04
Low	0.51	0.45	1.83	0.39	0.38#	0.81	1.25	0.01
TOLO	2.9	1.19	0.91	1.84#	2.92	0.87	2.1	0.54
Wage	0.77*	0.77*	0.77*	0.76*	0.74*	0.76*	0.65*	0.79*

Slow connection speed

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	1.02	0.84	0.92	0.82	0.88	1.09	0.52	0.51
K/L	1.04	1.17	1.03	0.98	0.99	0.98	1.03	0.91
Low	1.2	0.01	4.77*	0.41	1.13	4.31#	1.77	0.51#
TOLO	2.73	0.46	0.35	1.21	0.01	0.46	1.05	1.06
Wage	0.6*	0.55*	0.68*	0.7*	0.62*	0.64*	0.64*	0.78*

Lack of interest

	Man	Con	Who	Ret	Acc	Tran	Prop	Cult
Size	0.52*	0.72	0.65#	0.93	0.95	0.85	0.77	0.62
K/L	0.98	0.94+	0.92*	0.99	0.99	0.99	0.99	0.92
Low	0.12+	0.5#	0.3	0.47+	0.82	0.42#	1.15	0.01
TOLO	1.28	1.22	1.97	1.56#	1.47	0.59	1.21	1.98
Wage	0.83*	0.83*	0.85+	0.79*	0.76*	0.82*	0.73*	0.77*

Appendix E: Project on use of information and communications technologies working papers

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Gretton, P. and Gali, J. 2003, The take up of computers in Australia: firm level evidence, Third working paper of the Joint Project on Use of Information and Communications Technologies and Productivity Commission Staff Working Paper, Canberra, (forthcoming).

Gali, J. and Gretton, P. 2003, Effects of Computer Use on Firm Performance - Some Empirical Evidence, Fourth working paper of the Joint Project on Use of Information and Communications Technologies and Productivity Commission Staff Working Paper, Canberra, (forthcoming).

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