

**Barriers to Electronic Commerce in Canada:  
A Size of Firm and Industry Analysis (III-C)**

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## **Abstract**

Electronic commerce in Canada has grown from \$5.7 billion in 2000 to over \$28 billion in 2004. Despite this growth, barriers remain to e-commerce's effective integration into the economy. The authors compare responses to Statistic Canada's Survey of Electronic Commerce and Technology for the years 2001 and 2003. This Canada-wide business survey lists ten barriers to e-commerce adoption and asks firms to identify those that apply. The authors identify statistically significant changes over time and show that barriers are changing, but are not consistent across firm size or industry sector. The authors conclude that policies aimed at encouraging e-commerce adoption must be specific to *both* firm size *and* industry sector.

**Key words:** Electronic commerce, barriers, adoption, firms, industry sector, Internet

## INTRODUCTION

Electronic commerce<sup>2</sup> grew in value from \$6 billion in 2000 to over \$28 billion in 2004. While it still represents only a small portion of total economic activity in Canada, the trend continues upward as more firms begin to realise the economic benefits e-commerce has to offer. This growth of e-commerce, however, has not been easy. More work is needed to better understand the obstacles to growth and how firms can capture the benefits of e-commerce. With this information, governments, business associations and individual companies can put into place the appropriate strategies and policies to help Canada ensure its strength and leadership in the global e-economy.

Using the results from Statistics Canada's Survey of Electronic Commerce and Technology (SECT),<sup>3</sup> a clearer picture of the state and development of e-commerce in Canada comes into view. The survey has now been run for several years, allowing for significant time-series analysis of the firms that adopt e-commerce and how they use the technologies.

Canada has a high rate of connectivity and in 2004, 82 percent of all firms connected to the Internet. It appears that only the smallest firms do not use the Internet as those that are connected account for 97 percent of all economic activity. Despite this high level of connectivity and Internet use, however, Canadian firms do not make use of more advanced Internet applications. While most firms use email, as shown in Table 1, only 34 percent have a web site. Of these web sites, very few, only 26 percent, have interactive capabilities.

The use of extranets – secure extensions of the Internet designed to give external users access to some parts of an organisation's internal communications network – is also quite low. In Canada, only 6 percent of all private sector

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<sup>2</sup> Electronic commerce is defined as sales conducted over the Internet with or without an online payment. Included are the value of orders received over the Internet, Extranets, and electronic data interchange (EDI) on the Internet. Excluded are sales using EDI over proprietary networks. Automatic teller machines are excluded, as is the volume of financial transactions conducted over the Internet. Included are the service charges received for conducting the transactions over the Internet.

<sup>3</sup> The annual Survey of Electronic Commerce and Technology (SECT) collects information on the use of information and communications technologies (ICTs) and e-commerce among the private and public sectors. The findings are based on a sample of approximately 21,000 enterprises, which cover all industries with the exception of agriculture. The survey excludes businesses with very low revenues. Depending on the industry, the exclusion threshold typically ranges from \$150,000 to \$250,000.

firms have extranets. Canadian firms are either reluctant or unable to integrate e-commerce technologies and practices into their businesses.

As trends in connectivity and e-commerce usage begin to emerge, differences according to the size of firm become more pronounced. Whether in Internet use, email, web sites or extranet use, small enterprises consistently lag behind their larger counterparts. These lower adoption rates may indicate that small firms face unique challenges compared to their larger counterparts. These differences mean that any analysis of the state of e-commerce in Canada should, where possible, separate out firms according to their size.<sup>4</sup>

**Table 1. Personal Computers and Internet Activities, by size of firm, 2003, private sector, percent**

<b>Size of Firm</b>	<b>Personal Computers</b>	<b>Internet Use</b>	<b>Email</b>	<b>Web Sites</b>	<b>Extranet</b>
<b>Small</b>	86	76	71	29	4
<b>Medium</b>	98	94	93	66	16
<b>Large</b>	99	97	96	77	33
<i>All private sector firms</i>	<i>87</i>	<i>78</i>	<i>74</i>	<i>34</i>	<i>6</i>

## **1. BARRIERS TO E-COMMERCE**

To understand why e-commerce isn't more widely spread, the SECT identifies ten potential barriers and asks firms to indicate all that apply. For the period 2000-2003, the overall responses for all firms not engaged in e-commerce (whether they use the Internet or not) are shown in Table 2.

This chart provides information on the relative importance of the various barriers, as well as showing how these have changed over time. While many of the barriers have remained relatively constant over time, several have experienced statistically significant changes at the 5 percent level, as determined through a difference in proportions test. These include security concerns and development and maintenance costs, which increased, and goods and services do not lend themselves to the Internet, which decreased.

<sup>4</sup> For this analysis, small firms are those with fewer than 20 employees. Medium-sized firms have between 20 and 99 employees, except those in the manufacturing sector which are firms with 20 to 499 employees. Larger firms have over 100 employees or over 500 for those in manufacturing.

For all four time periods, two barriers stand out as significant obstacles to e-commerce growth. These are: 1) goods and services produced do not lend themselves to Internet transactions; and 2) the firm prefers to maintain current business model. The other barriers are a second tier of obstacles. For many firms, these are the obstacles they face when they are willing to adopt e-commerce but have difficulty making the transition. For firms blocked by the first two barriers, these eight other obstacles are often secondary and as a result, are given lower rankings. Some could be expected to increase, and some have already begun to do so, as more firms explore adopting e-commerce.

**Table 2. Barriers to E-Commerce Adoption, all firms, 2000-2003, percent**

<b>Barrier</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
<b>Goods and services do not lend themselves to Internet transactions</b>	56	52	48	44
<b>Prefer to maintain current business model</b>	36	36	37	36
<b>Security concerns</b>	14	13	18	17
<b>Development and maintenance costs too high</b>	12	11	14	14
<b>Customers not ready</b>	10	9	11	11
<b>Lack of skilled employees</b>	10	9	11	10
<b>Concerns about competitors analysing company</b>	6	6	7	7
<b>Uncertain about the benefits</b>	10	8	9	7
<b>Internet available to us is too slow</b>	4	5	5	5
<b>Suppliers not ready</b>	6	5	6	5

Table 2, however, does not provide any information as to whether the growth, decline or stagnation in each of the barriers applies to all three firm sizes or if they are unique to one or more of them. It also does not distinguish among the different industry sectors. In the analysis that follows, each of these barriers is examined in turn to identify trends or linkages to other survey results, to highlight differences according to firm size and industry sector and see how the results have changed over time. When the survey results are broken down by both size of firm and industry sector, distinct variations are seen, suggesting that the barriers to e-commerce adoption change over time and that the drivers for change do not affect all firms in Canada in a similar fashion.

## 2. ANALYSIS OF SURVEY RESULTS

To determine if there has been a statistically significant change at the 5 percent level for each of the barriers from 2001 to 2003 for each size of firm, the authors examined the coefficients of variation (CVs) along with the actual percentages recorded. In addition, the authors constructed 95 percent confidence intervals (CI) for each year and compared them. The use of CVs indicates the proportion the standard deviation is of the mean for each barrier, assuming that the standard deviation increases proportionately to the mean.<sup>5</sup> Using this methodology of analysis, the authors were able to determine which changes were statistically significant over time and may represent a trend.

### 2.1 Main Barriers to E-Commerce Adoption

#### *2.1.1 Goods and services do not lend themselves to Internet transactions*

The largest barrier to e-commerce adoption is that businesses believe their goods and services do not lend themselves to Internet transactions. It is interesting to note, however, that this barrier has declined 12 percentage points over the past three years, a substantial and statistically significant change at the 5 percent level. In the year 2000, 56 percent of all private sector firms not engaged in e-commerce indicated that this was a barrier.

By 2003, this number had dropped to 44 percent. This drop may indicate that awareness-building activities have had some effect.

A slightly different picture emerges when the results are divided according to the size of firm. As shown in Table 3 below, the strength of this barrier is not consistent across all firm sizes. Among small firms, 44 percent in 2003 found this to be a barrier worth noting. This was a statistically significant drop from 52 percent two years prior. In 2003, 48 percent of medium-sized firms found their products to be a barrier, down from 55 percent in 2001. While it decreased slightly over the years examined, over half of the large firms surveyed reported that the goods or services produced do not lend themselves to Internet transactions. This drop for large firms, however, was not statistically significant at the 5 percent level. There is, however, a slightly larger variation with respect to the mean for this barrier for the small and medium sized firms. This may indicate that the exact nature of this barrier differs according to firm size. It may also indicate the success of e-commerce outreach activities targeted to small business.

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<sup>5</sup> References to the *mean* in the text are not references to the binomial mean. Instead, the percentages presented in the tables are treated as the mean as they can be referred to being the probability of a success of a single trial from a series of independent repeated Bernoulli trials. Similarly, this paper refers to the number of trials as the sample size.

**Table 3. Main Barriers to E-Commerce Adoption, by firm size, 2001-2003, percent**

Barrier	Small			Medium			Large		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
<b>Goods and services do not lend themselves to Internet transactions</b>	52	47	44	55	51	48	56	54	53
<b>Prefer to maintain current business model</b>	36	37	36	32	34	33	20	26	23

Small firms show the largest percentage point decrease for this barrier, but when broken down into broad industry groups, as classified by the North American Industry Classification System (NAICS), different patterns emerge.<sup>6</sup> Not all sectors have a statistically significant change over time. The sectors listed below in Table 4 are those which have a significant decrease for this barrier to e-commerce adoption. The other sectors, while they still experienced declines, did not appear statistically significant. Most had a large variance about their mean in either or both time periods which made it impossible to detect a statistically significant change.

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<sup>6</sup> An industry sector is defined by the NAICS. Due to data limitations, the sectoral analysis was restricted to a selection of industry sectors at the top two-digit classification level.

**Table 4. Barrier: Goods and Services do not lend themselves to Internet Transactions, by Firm Size and Industry Sector, 2001-2003, percent**

Industry sector <sup>1</sup>	Small firms		Medium firms		Large firms	
	2001	2003	2001	2003	2001	2003
<i>All private sector firms</i>	51.9	43.8* <sup>3</sup>	54.6	48.0*	55.5	53.2
Forestry Logging & Support Activities	62.3	44.0	N/A <sup>2</sup>	N/A	N/A	N/A
Mining and Oil & Gas Extraction	31.1	54.2	N/A	N/A	84.9	N/A
Utilities	69.9	49.6	63.3	N/A	53.8	37.5
Construction	56.9	41.2*	65.0	59.6	N/A	N/A
Manufacturing	51.8	45.9	52.7	53.9	51.3	59.3
Wholesale Trade	41.0	36.4	38.9	31.0	N/A	N/A
Retail Trade	40.5	38.4	37.2	33.4	38.5	N/A
Transportation & Warehousing	50.7	41.6	48.0	50.9	62.3	N/A
Information & Cultural Industries	66.0	42.3*	N/A	N/A	64.6	30.8
Finance & Insurance	55.3	34.8*	N/A	N/A	N/A	N/A
Real Estate & Rental and Leasing	49.3	39.3*	18.2	N/A	84.9	N/A
Prof., Scientific & Technical Services	58.0	51.7*	66.9	59.4	N/A	N/A
Mgmt of Companies & Enterprises	43.6	29.7	N/A	N/A	N/A	N/A
Admin. & Support, Waste Mgmt & Remediation	54.1	45.7	78.3	40.2	N/A	N/A
Educational Services (private sector)	44.6	32.8	72.5	N/A	N/A	N/A
Health Care & Social Assist. (private)	52.1	47.7*	57.8	49.4	N/A	13.6
Arts, Entertainment & Recreation	40.9	44.1	N/A	N/A	38.0	43.7
Accommodation & Food Services	54.2	50.0	61.0	52.9	N/A	N/A
Other services (except Public Administration)	53.8	42.8	58.8	57.3	30.7	N/A
<i>All public sectors</i>	45.4	46.6	56.1	47.9	56.7	44.8*
Educational Services (public sector)	N/A	N/A	41.7	38.5	44.0	35.4
Health Care & Social Assist. (public)	54.9	N/A	53.0	52.0	68.6	53.4
Public Administration	0.0	0.0	N/A	N/A	41.0	45.7

<sup>1</sup> Industry Sector is defined using the North American Industrial Classification System at the two-digit level.

<sup>2</sup> Data that are either unavailable or statistically unreliable are indicated by N/A.

<sup>3</sup> The asterisk (\*) indicates that the change between the two periods examined is statistically significant at the five percent level.

Although variability about the mean was higher for medium firms, again making it difficult to determine statistically significance, several industry sectors did record large statistically significant decreases, such as Administrative and Support, Waste Management and Remediation, dropping to 40 percent in 2003 from 78 percent in 2001.

As mentioned above, large firms, in general, showed no change for this barrier. In addition, industry sectors with large firms exhibited large CVs making statistically significant calculations inappropriate and no definitive conclusions may be made with respect to large firms for this barrier.



### ***2.1.2 Prefer to Maintain Current Business Model***

There are also significant size-of-firm differences for the next largest barrier, the preference to maintain current business models. As shown in Table 3 above, the overall size of this barrier has remained stable, with no statistically significant change in any size of firm between 2001 and 2003. Small firms, however, show a higher preference to maintain their current business model and not adopt e-commerce practices. These results indicate that although more companies realise that e-commerce may apply to them, they are unwilling or unable to make the transition. As small firms are more reluctant than larger firms to change their business model, other barriers need to be examined in more detail to determine other possible sources of this preference for the status quo.

Small businesses, however, are not consistently behind larger firms for all barriers. These results indicate that their lower willingness to change the current business model may have a different explanation than for medium and large firms. As we shall see below, these barriers include customers and suppliers are not ready, the lack of skilled employees and the available speed of the Internet is too slow, as well as growing concerns over security and development costs.

## **2.2 Secondary Barriers to E-Commerce Adoption**

The remaining barriers listed on the SECT can be considered as secondary. These are considered secondary because a firm may encounter them only after it begins exploring e-commerce possibilities (i.e., once it has dealt with the first two barriers). Thus, once a firm recognises that e-commerce applies to its activities and is willing to change the current business model, it may still face other barriers to adoption. These barriers are listed in Table 5.

While a few of the barriers show a decrease in value over time, none of these is statistically significant. In contrast, four barriers – customers not ready, lack of skilled employees, development and maintenance costs too high and security concerns – have grown over time for at least two of the three firm sizes. Each of these eight secondary barriers will be discussed in turn below.

**Table 5. Secondary Barriers to E-Commerce, by size of firm, 2001-2003, percent**

Barrier	Small			Medium			Large		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
<b>Customers not ready</b>	9	10	9	12	16	16	10	19	20
<b>Suppliers not ready</b>	5	6	4	7	9	8	6	12	14
<b>Lack of skilled employees</b>	9	11	11	8	12	8	5	13	8
<b>Concerns about competitors analysing information</b>	5	7	7	9	12	10	5	9	11
<b>Available Internet is too slow</b>	4	5	5	7	7	6	4	3	2
<b>Uncertain about the benefits</b>	8	9	8	7	7	6	3	5	2
<b>Security concerns</b>	13	17	17	13	20	19	11	18	22
<b>Development and maintenance costs too high</b>	11	14	13	10	15	16	6	13	17

**2.2.1 Customers and suppliers not ready for e-commerce**

This is more of a concern for large firms. Customers not ready increased 100 percent for large firms over the three years examined, but only by a third for medium-sized firms. As well, large firms saw a 136 percent increase in the number of firms that view suppliers not ready as a barrier to e-commerce adoption between 2001 and 2003. Medium firms, however, had only a small statistically significant increase for the barrier customers not ready. Small firms showed no statistically significant change for either barrier between the two time periods.

These responses may indicate that although many large firms would like to do e-commerce, they find that their supply chains are not ready to handle these transactions. This may indicate a possible market coordination problem where individual participants are not able to sufficiently influence e-commerce practices. This may be due to market structure issues, including the number of small firms in different parts of the supply chain, the extent to which the market is domestic versus international, etc.

**Table 6. Barrier: Suppliers not ready, by Firm Size and Industry Sector, 2001-2003, percent**

Industry sector <sup>1</sup>	Small firms		Medium firms		Large firms	
	2001	2003	2001	2003	2001	2003
<i>All private sector firms</i>	4.8	4.2	7.0	8.0	5.9	13.9* <sup>3</sup>
Forestry Logging & Support Activities	3.7	0.02*	2.4	0.2	4.5	N/A <sup>2</sup>
Mining and Oil & Gas Extraction	2.1	3.0	0.9	16.0*	5.7	13.9*
Utilities	0.8	6.7*	3.1	4.1	14.1	5.4*
Construction	7.6	5.3	13.3	8.4*	1.4	2.5
Manufacturing	9.1	8.5	6.8	9.1	6.0	14.9
Wholesale Trade	10.5	9.3	16.1	23.9	13.8	11.6
Retail Trade	7.2	7.2	8.1	7.5	5.4	16.1
Transportation & Warehousing	5.2	3.0	8.1	8.7	9.7	19.3*
Information & Cultural Industries	N/A	N/A	0.6	0.4	1.3	4.4
Finance & Insurance	3.8	3.8	4.3	4.9	4.2	N/A
Real Estate & Rental and Leasing	3.4	2.1	1.0	9.6*	N7.6	N/A
Prof., Scientific & Technical Services	2.6	2.4	1.0	2.6	0.7	1.5
Mgmt of Companies & Enterprises	1.6	1.7	12.8	0.0	N/A	N/A
Admin. & Support, Waste Mgmt & Remediation	3.7	3.9	9.2	7.3	5.8	1.3*
Educational Services (private sector)	N/A	6.0	2.1	10.1*	N/A	N/A
Health Care & Social Assist. (private)	2.3	2.7*	1.4	4.0	3.1	1.3
Arts, Entertainment & Recreation	1.3	6.1*	2.8	17.7*	7.7	5.2
Accommodation & Food Services	4.0	3.7*	8.9	1.9	N/A	N/A
Other services (except Public Administration)	5.0	4.5	5.0	0.1*	1.9	0.9
<i>All public sectors</i>	N/A	N/A	N/A	N/A	7.6	5.7*
Educational Services (public sector)	N/A	N/A	0.0	6.4	6.0	7.3
Health Care & Social Assist. (public)	N/A	N/A	5.7	12.7	9.7	7.1
Public Administration	0.0	0.0	N/A	N/A	4.4	1.0

<sup>1</sup> Industry Sector is defined using the North American Industrial Classification System at the two-digit level.

<sup>2</sup> Data that are either unavailable or statistically unreliable are indicated by N/A.

<sup>3</sup> The asterisk (\*) indicates that the change between the two periods examined is statistically significant at the five percent level.

When these barriers are examined at the industry sector level, more details become apparent. Not all industry sectors report that the lack of readiness in suppliers is growing as a barrier to e-commerce adoption. Increases were more prominent in magnitude and with greater frequency within sectors of medium and large firms. Table 6 above identifies the industry sectors for each firm size that saw a statistically significant change for *suppliers* not ready as a barrier.

For the barrier *customers not ready*, a different pattern emerges. *There was a larger increase in the number of firms that regard customers not ready as an obstacle to e-commerce adoption than there was for suppliers not ready.*

More viewed this as an increasing barrier and fewer sectors that viewed it as a decreasing barrier. Table 7 below illustrates the industry sectors for each firm size that have seen a statistically significant change for customers not ready as a barrier.

**Table 7. Barrier: Customers not ready, by Firm Size and Industry Sector, 2001-2003, percent**

Industry sector <sup>1</sup>	Small firms		Medium firms		Large firms	
	2001	2003	2001	2003	2001	2003
<i>All private sector firms</i>	8.7	9.2	12.1	16.2* <sup>3</sup>	10.2	19.8*
Forestry Logging & Support Activities	8.6	10.0	26.0	N/A <sup>2</sup>	15.1	N/A
Mining and Oil & Gas Extraction	1.7	5.7	13.4	21.8	6.4	13.8
Utilities	11.0	11.7	9.7	4.1	12.4	9.3
Construction	11.6	6.1	4.1	6.7	1.4	N/A
Manufacturing	15.5	11.1	18.5	20.5	9.6	34.0*
Wholesale Trade	19.9	25.5*	25.8	45.3*	19.9	21.1
Retail Trade	13.5	15.2	17.0	18.3	17.3	5.7
Transportation & Warehousing	7.7	8.1	14.3	19.3	14.5	N/A
Information & Cultural Industries	1.4	7.3	13.1	6.7	6.2	4.5
Finance & Insurance	9.9	8.6	13.3	14.2	6.5	N/A
Real Estate & Rental and Leasing	5.6	6.0	1.2	16.7*	7.5	N/A
Prof., Scientific & Technical Services	5.7	7.9	3.3	9.9	1.3	N/A
Mgmt of Companies & Enterprises	4.9	3.3	N/A	N/A	N/A	N/A
Admin. & Support, Waste Mgmt & Remediation	6.5	7.8	6.6	11.5	8.6	5.7
Educational Services (private sector)	3.0	8.95*	2.4	N/A	N/A	N/A
Health Care & Social Assist. (private)	2.7	5.97*	4.4	9.3*	N/A	N/A
Arts, Entertainment & Recreation	4.8	2.3	14.3	N/A	N/A	7.6
Accommodation & Food Services	6.7	6.06*	4.9	1.9*	N/A	N/A
Other services (except Public Administration)	8.3	8.0	8.8	14.0*	N/A	N/A
<i>All public sectors</i>	0.0	0.0	N/A	N/A	6.9	7.0
Educational Services (public sector)	0.0	0.0	N/A	N/A	4.9	2.4
Health Care & Social Assist. (public)	N/A	N/A	N/A	N/A	8.2	7.7
Public Administration	0.0	0.0	N/A	N/A	5.7	12.6*

<sup>1</sup> Industry Sector is defined using the North American Industrial Classification System at the two-digit level.

<sup>2</sup> Data that are either unavailable or statistically unreliable are indicated by N/A.

<sup>3</sup> The asterisk (\*) indicates that the change between the two periods examined is statistically significant at the five percent level.

### 2.2.2 Lack of skilled employees

In 2001, approximately 9 percent of all firms held that lack of skilled employees was a barrier to adopting e-commerce. This barrier has slightly increased over time, up to 11 percent in 2003.

When examined at the industry level (Table 8), some interesting details emerge. For small firms, it is only when they are aggregated that a statistically significant growth in this barrier is detected. For medium firms, two sectors show a significant increase – Manufacturing (from 6 percent in 2001 to 13 percent in 2003) and Real Estate and Rental and Leasing (from 2 percent in 2001 to 23 percent in 2003).

**Table 8. Barrier: Lack of skilled workers, by Firm Size and Industry Sector, 2001-2003, percent**

Industry sector <sup>1</sup>	Small firms		Medium firms		Large firms	
	2001	2003	2001	2003	2001	2003
<i>All private sector firms</i>	8.9	10.8* <sup>3</sup>	7.9	11.8*	4.7	8.2
Forestry Logging & Support Activities	12.4	6.4	N/A <sup>2</sup>	N/A	N/A	N/A
Mining and Oil & Gas Extraction	1.6	3.1	4.1	N/A	N/A	N/A
Utilities	12.4	9.2	4.8	N/A	10.0	2.6*
Construction	12.2	13.4	6.6	2.4	N/A	N/A
Manufacturing	13.4	12.2	6.0	12.7*	2.6	3.1
Wholesale Trade	15.1	18.6	11.4	16.9	4.2	4.8
Retail Trade	15.7	17.9	13.2	14.5	N/A	N/A
Transportation & Warehousing	6.7	12.4	10.9	25.0	1.9	19.9
Information & Cultural Industries	3.3	4.8	1.4	4.2	3.1	1.1
Finance & Insurance	4.5	9.4	0.0	9.2	2.8	5.5
Real Estate & Rental and Leasing	5.2	8.3	1.8	23.0*	N/A	1.1
Prof., Scientific & Technical Services	5.9	8.0	1.8	2.0	1.0	0.8
Mgmt of Companies & Enterprises	0.0	1.7	N/A	N/A	N/A	N/A
Admin. & Support, Waste Mgmt & Remediation	9.9	14.5	3.8	8.1	13.4	0.9*
Educational Services (private sector)	0.3	3.0	6.8	29.8	6.8	N/A
Health Care & Social Assist. (private)	4.0	7.0	5.8	9.1	7.8	2.6
Arts, Entertainment & Recreation	12.7	7.4	N/A	N/A	8.7	20.7*
Accommodation & Food Services	7.9	8.8	10.4	12.3	N/A	N/A
Other services (except Public Administration)	9.0	8.8	11.0	9.2	11.9	N/A
<i>All public sectors</i>	6.4	20.7*	12.5	8.9	9.0	7.0
Educational Services (public sector)	0.0	21.0	34.1	16.2	10.3	9.3
Health Care & Social Assist. (public)	N/A	N/A	5.9	6.0	8.2	10.9
Public Administration	0.0	0.0	8.9	6.3	9.5	12.6

<sup>1</sup> Industry Sector is defined using the North American Industrial Classification System at the two-digit level.

<sup>2</sup> Data that are either unavailable or statistically unreliable are indicated by N/A.

<sup>3</sup> The asterisk (\*) indicates that the change between the two periods examined is statistically significant at the five percent level.

For larger firms, a few industry sectors, such as Utilities, Administration and Support and Waste Management and Remediation experienced statistically significant decreases in this barrier. In contrast, the Arts, Entertainment and Recreation sector had a significant increase from 9 percent in 2001 to 21 percent in 2003.

### 2.2.3 Competitors gaining access to company information

The concern about competitors having access to company information is not consistent across all sizes of firm. As shown in Table 5, in 2003, 7 percent of small firms indicated this was a barrier, compared to 10 percent of medium and 11 percent of large. It is more important to large firms which, given their larger size may have more information to protect and a greater need to control access to information. This barrier, however, did not have a statistically significant change between the two time periods. It has not declined over time, indicating that more awareness-building on the possibilities of e-commerce needs to continue.

#### 2.2.4 Available Internet speed too slow

Insufficient Internet speed received the lowest response for all the barriers for all three sizes of firm. In 2003, 5 percent of small firms, statistically unchanged from 2001, said that the available Internet speed was insufficient. This compares to 6 percent of medium-sized firms and 2 percent of large firms in 2003. In addition, this barrier does not appear to significantly explain the comparative lack of small business take-up of e-commerce.

**Table 9. Internet Connection Speeds by size of firm, private sector, 2002-2003, percent<sup>6</sup>**

Size of Firm	Dial-Up		High Speed <sup>7</sup>	
	2002	2003	2002	2003
Small	39	30	56	64
Medium	26	16	71	77
Large	11	3	84	94
All	37	28	58	66

While the barrier of access to higher Internet speeds is rated similarly across all sizes of firm, there are size-of-firm differences in the use of broadband. Small firms are less likely to use high speed Internet connections than their larger counterparts. As shown in Table 9, only 64 percent of small firms use broadband, compared to 77 percent of medium firms and 94 percent of large. There is still room for growth in broadband usage, which is increasingly seen as a necessary condition for advanced e-commerce.

#### 2.2.5 Uncertain about the Benefits

One barrier that has a stronger relative rating for small firms is the uncertainty surrounding the benefits of e-commerce, as shown in Table 5. In 2003, 8 percent of small firms and 6 percent of medium firms indicated this uncertainty to be an obstacle. This compares to only 2 percent of large firms. Large firms may be better able to assess how e-commerce applies to their organisation and assess its overall impact. There may also be economies of scale at work where the impact of e-commerce on a small firm is not immediately as evident or significant as for larger firms.

<sup>6</sup> The percentages do not add up to 100 percent as many firms will have more than one type of connection and because not all survey respondents were able to provide information on connection speeds.

<sup>7</sup> The high speed Internet access category includes cable, DSL, ISDN, T1 line and greater speeds of access.

When firms who do e-commerce were asked to assess the benefits, overall, as shown in Table 10, there were no statistically significant changes in the percent of e-commerce firms reporting any benefits between 2001 and 2003. Approximately a third of all firms experienced an increased ability to reach new customers and a quarter had lower costs. In 2003, 21 percent had better co-ordination with their suppliers and 17 percent had reduced time to market, again, not significantly different from the year before.

Many firms overcame the barriers to e-commerce adoption and now do buy and/or sell online. The majority of these firms in 2003, some 89 percent, were able to identify one or more real benefit to their e-commerce activities. The e-commerce firms were able to point to real cost savings, expanded markets and efficiency gains through better co-ordination with suppliers and a reduced time to market. It is not possible to determine the value of the benefits from the available data but a positive response indicates that there must be a noticeable impact on the firm's profitability or productivity.

**Table 10. Benefits of e-Commerce, all private sector firms doing e-commerce, 2001- 2003 (percent)**

<b>Year</b>	<b>Lower Costs</b>	<b>Reach New Customers</b>	<b>Better Co-ordination with Suppliers</b>	<b>Reduced Time to Market</b>	<b>No Benefits</b>
<b>2001</b>	24	34	20	17	7
<b>2002</b>	25	32	21	16	15
<b>2003</b>	26	33	21	17	11

It is when the data is examined according to the size of firm that differences begin to emerge, as shown in Table 11. In general, small firms are less likely to perceive benefits to e-commerce activities when compared to both medium and large firms. The data show that 16 percent of small firms reported no benefits from e-commerce. This reported lack of benefits declined to 11 percent for medium firms and 7 percent for large. These results may reflect the specific difficulties smaller firms face in implementing appropriate e-commerce solutions, identifying or measuring the benefits of e-commerce or from other specific regional or sectoral factors.

Almost half of all large e-commerce firms found that they were better able to reach new customers as a direct result of their e-commerce activities while only 30 percent of small firms were able to do so. In addition, approximately 40

percent of the large firms associated lower costs with their e-commerce practices. Comparatively, less than one quarter of small firms claimed this benefit.

**Table 11. Benefits of e-Commerce by size of firm, all private sector firms, 2002, percent**

<b>Size of Firm</b>	<b>Lower Costs</b>	<b>Reach New Customers</b>	<b>Better Co-ordination with Suppliers</b>	<b>Reduced Time to Market</b>	<b>No Benefits</b>
<b>Small</b>	23	30	20	15	16
<b>Medium</b>	30	44	24	17	11
<b>Large</b>	41	45	34	20	7

Of interest is that large firms are less likely to report a failure to identify any benefits associated with e-commerce. While 16 percent of small e-commerce firms found no real benefits with this activity, only 7 percent of large firms were in a similar situation. The perceived lack of benefits, however, has increased over time. Overall, in 2002, 15 percent of active e-commerce firms associated no real benefits as listed in the survey directly with their e-commerce activities. This is double from the previous year when only 7 percent of all active e-commerce firms found no benefits. It is important to track whether firms that saw no benefits to their e-commerce activities continued to buy or sell online in the future. If they continue, it may be that the real savings are not realised immediately upon implementing an e-commerce strategy or the firms may be reluctant participants, drawn into e-commerce by other participants in the supply chain.

### **2.2.6 Security Concerns**

Security is essential to a trustworthy environment for electronic transactions on open networks. This barrier does not appear to have a strong correlation with firm size, as shown in Table 5. In 2003, 17 percent of small firms indicated that security concerns prevented them from doing e-commerce. This was up from 13 percent in 2001. Medium and large sized firms were slightly more likely to find security concerns a barrier, with 19 and 22 percent respectively.

All three firm sizes show a statistically significant increase since 2001. Only one other barrier, development and maintenance costs too high, shares this property. When broken down by industry sector, more information is obtained. Table 12 lists all the sectors that had a statistically significant change between 2001 and 2003. Only one sector, Utilities, at the medium-sized firm level, shows a statistically significant decrease from 2001 to 2003 for this



barrier. All other industry sectors, regardless of firm size, show either no change or a marked increase in their security concerns.

**Table 12. Barrier: Security concerns, by Firm Size and Industry Sector, 2001-2003, percent**

Industry sector <sup>1</sup>	Small firms		Medium firms		Large firms	
	2001	2003	2001	2003	2001	2003
<i>All private sector firms</i>	13.1	17.0* <sup>3</sup>	13.2	19.0*	11.4	21.7*
Forestry Logging & Support Activities	15.8	13.9	7.3	N/A <sup>2</sup>	10.3	5.2
Mining and Oil & Gas Extraction	9.4	15.7	N/A	N/A	3.1	N/A
Utilities	16.9	8.9	27.2	9.6*	19.6	19.9
Construction	11.5	14.5	9.3	12.4	0.7	1.2
Manufacturing	13.7	21.5*	14.7	20.4	N/A	N/A
Wholesale Trade	17.3	24.5*	13.7	28.1*	6.4	16.5
Retail Trade	17.1	19.0	18.5	19.6	8.8	N/A
Transportation & Warehousing	12.1	12.0	13.9	35.7*	N/A	N/A
Information & Cultural Industries	5.3	12.1	21.5	12.2	N/A	9.7
Finance & Insurance	22.6	25.7	22.3	27.4	4.4	18.6
Real Estate & Rental and Leasing	9.5	14.5	2.0	N/A	5.8	N/A
Prof., Scientific & Technical Services	12.3	19.8*	9.0	14.6	9.0	3.4
Mgmt of Companies & Enterprises	8.4	8.2	N/A	N/A	N/A	N/A
Admin. & Support, Waste Mgmt & Remediation	14.9	17.5	11.7	12.8	16.7	13.8
Educational Services (private sector)	5.6	26.9*	9.0	N/A	7.8	17.2*
Health Care & Social Assist. (private)	14.1	18.4	6.1	18.7	N/A	N/A
Arts, Entertainment & Recreation	13.0	14.9	N/A	N/A	N/A	N/A
Accommodation & Food Services	7.6	7.6	8.6	4.0	2.6	N/A
Other services (except Public Administration)	12.8	15.5	17.0	13.6	28.1	N/A
<i>All public sectors</i>	N/A	N/A	13.2	15.9	24.5	24.6
Educational Services (public sector)	N/A	N/A	17.1	19.3	26.0	25.0
Health Care & Social Assist. (public)	N/A	N/A	17.7	15.7	22.1	22.2
Public Administration	0.0	0.0	4.4	12.7	29.0	27.5

<sup>1</sup> Industry Sector is defined using the North American Industrial Classification System at the two-digit level.

<sup>2</sup> Data that are either unavailable or statistically unreliable are indicated by N/A.

<sup>3</sup> The asterisk (\*) indicates that the change between the two periods examined is statistically significant at the five percent level.

While security concerns are growing for firms not doing e-commerce, e-commerce firms, on average, are not changing their security practices by making their web sites more secure, as shown in Table 13. There was a slight statistically significant increase in the percent of secure sites for all firms with web sites between 2001 and 2003, driven substantially by the increase in the percentage of large firms with secure sites. Despite this increase, however, the overall percentage of firms with secure web sites is still low – only about one quarter of firms has a secure site, mostly concentrated among larger firms. Of the private sector firms with web sites in 2003, only 26 percent of these were secure, up from 19 percent in 2001. The magnitude of growth for security concerns as a barrier to e-commerce adoption far outweighs the growth in security precautions taken by industry.

**Table 13. Firms with Secure Web sites, percent of all web sites, by firm size, 2002-2003**

Firms with secure web sites	Small		Medium		Large		All Firms		
	2002	2003	2002	2003	2002	2003	2001	2002	2003
<b>Private Sector</b>	20	23	26	30	34	44	19	22	26
<b>Public Sector</b>	N/A	N/A	N/A	N/A	N/A	N/A	38	45	49

While the public sector has a greater percentage of secure web sites, it does not show clear leadership in this area as they have yet to reach the half way point. More work is needed to see how this indicator changes over time and to understand its implications.

As seen in Table 14, industry sectors that had significant growth in the proportion of secure web sites for small and medium-sized firms were those which had the lowest percentage of secure sites in 2001. Those sectors which had a higher percentage of secure sites in 2001 showed no statistically significant growth for this indicator even though they had not even achieved a 50 percent penetration level. Small firms are, by and large, not adopting secure solutions.

Medium-sized firms within a few sectors put a greater emphasis on secure web sites. This may be because they have greater resources to dedicate towards this issue and have a larger presence online. The Finance and Insurance sector, for example has a high penetration level at 65 percent in 2003. Two other sectors had significant growth. During the period examined, the percent of secure web sites for Professional, Scientific and Technical Services more than doubled and public sector education more than tripled.

Large firms in certain industry sectors outperformed their smaller counterparts in terms of the percent of secure sites. Due to data limitations, it is not possible to get a full picture of large firms broken down by industry sector. We know, however, as seen in Table 13, that it is more likely for their web sites to be secure. Table 15 shows that for the sectors where information is available, Information and Cultural Industries and Utilities have high rates of secure sites, with 81 and 63 percent respectively. This may due to either higher awareness of security issues or a higher

need to safeguard their businesses and clients.

**Table 14. Barrier: Firms with secure web sites, by Firm Size and Industry Sector, 2001-2003, percent**

Industry sector <sup>1</sup>	Small firms		Medium firms		Large firms	
	2001	2003	2001	2003	2001	2003
<i>All private sector firms</i>	20 <sup>4</sup>	23	26 <sup>4</sup>	30	34 <sup>4</sup>	44* <sup>3</sup>
Forestry Logging & Support Activities	N/A <sup>2</sup>	N/A	24.3	1.0	44.6	36.7
Mining and Oil & Gas Extraction	N/A	N/A	5.0	N/A	N/A	N/A
Utilities	7.1	N/A	24.0	9.5	39.8	62.8*
Construction	15.7	13.5	23.1	NA	44.4	3.0*
Manufacturing	10.9	20.3*	19.0	15.7	N/A	N/A
Wholesale Trade	13.9	19.9	23.1	25.4	39.3	36.1
Retail Trade	21.1	28.4	23.0	31.9	39.2	N/A
Transportation & Warehousing	16.1	41.2*	8.1	18.5	N/A	26.8
Information & Cultural Industries	24.5	34.0	N/A	NA	15.4	81.2*
Finance & Insurance	N/A	N/A	20.9	64.5*	N/A	N/A
Real Estate & Rental and Leasing	17.9	14.3	N/A	NA	N/A	5.6
Prof., Scientific & Technical Services	16.4	27.9*	21.0	44.8*	N/A	N/A
Mgmt of Companies & Enterprises	N/A	N/A	N/A	N/A	58.6	N/A
Admin. & Support, Waste Mgmt & Remediation	N/A	N/A	6.9	N/A	62.8	N/A
Educational Services (private sector)	22.9	17.7	28.0	N/A	N/A	N/A
Health Care & Social Assist. (private)	12.8	20.5	N/A	N/A	53.1	9.8*
Arts, Entertainment & Recreation	5.0	18.7	N/A	11.0	N/A	46.8
Accommodation & Food Services	11.3	12.1	N/A	N/A	N/A	N/A
Other services (except Public Administration)	16.6	12.1	28.2	N/A	N/A	N/A
<i>All public sectors</i>	N/A	N/A	N/A	N/A	N/A	N/A
Educational Services (public sector)	0.0	0.0	7.0	30.9*	20.3	70.7*
Health Care & Social Assist. (public)	N/A	N/A	18.0	25.3	N/A	N/A
Public Administration	N/A	N/A	9.7	37.9*	54.1	59.1

<sup>1</sup> Industry Sector is defined using the North American Industrial Classification System at the two-digit level.

<sup>2</sup> Data that are either unavailable or statistically unreliable are indicated by N/A.

<sup>3</sup> The asterisk (\*) indicates that the change between the two periods examined is statistically significant at the five percent level.

<sup>4</sup> These data are for 2002 not 2001

### 2.2.7 Development and Maintenance Costs too High

The cost of developing and maintaining e-commerce solutions appears to be consistent across firm size. This obstacle to e-commerce adoption had a statistically significant increase from 11 percent in 2001 to 14 percent in 2003 for all sizes of firm. In 2003, 13 percent of small firms felt that the costs were too high, compared to 16 percent for medium firms and 17 percent for large firms. All of these changes were statistically significant. It is interesting to note that in 2001, this barrier was inversely related to size of firm – a higher percentage of smaller firms listed these costs as more of a concern for smaller firms than larger ones. This has now reversed and development and maintenance costs are now a bigger concern for larger companies. This may be due to the fact that large and

medium-sized firms have more complex networks to manage, both internally and with their network of suppliers and customers.

**Table 15. Barrier: Firms indicating development and maintenance costs, by Firm Size and Industry Sector, 2001-2003, percent**

Industry sector <sup>1</sup>	Small firms		Medium firms		Large firms	
	2001	2003	2001	2003	2001	2003
<i>All private sector firms</i>	10.8	13.2* <sup>3</sup>	9.9	16.5*	5.8	17.5*
Forestry Logging & Support Activities	9.5	11.8	12.7	N/A <sup>2</sup>	10.3	10.4
Mining and Oil & Gas Extraction	2.2	2.9	N/A	N/A	N/A	N/A
Utilities	9.3	6.9	6.2	6.6	11.9	20.3
Construction	9.3	9.2	15.9	5.8	0.7	0.0
Manufacturing	15.1	18.9	11.8	20.6*	7.4	26.8*
Wholesale Trade	17.4	22.2	16.8	30.9	N/A	N/A
Retail Trade	21.1	22.2	15.0	15.6	N/A	N/A
Transportation & Warehousing	5.7	8.5	4.3	21.8*	10.6	N/A
Information & Cultural Industries	4.4	9.6	13.9	14.5	N/A	N/A
Finance & Insurance	8.9	12.7	14.5	14.3	N/A	N/A
Real Estate & Rental and Leasing	5.8	6.9	0.9	7.3	N/A	N/A
Prof., Scientific & Technical Services	7.0	14.0*	3.1	8.3	1.1	2.6
Mgmt of Companies & Enterprises	6.5	4.9	N/A	N/A	N/A	N/A
Admin. & Support, Waste Mgmt & Remediation	9.6	14.7	2.4	13.7	9.7	1.2
Educational Services (private sector)	5.0	20.1*	9.2	N/A	5.6	10.3
Health Care & Social Assist. (private)	7.9	7.0	1.1	18.2*	10.4	5.2
Arts, Entertainment & Recreation	12.2	10.5	16.6	N/A	N/A	15.8
Accommodation & Food Services	9.7	8.4	8.9	14.9	N/A	N/A
Other services (except Public Administration)	11.7	14.7	10.8	13.5	17.2	N/A
<i>All public sectors</i>	N/A	N/A	12.6	9.1	9.6	12.3
Educational Services (public sector)	0.0	0.0	17.1	11.3	12.3	14.6
Health Care & Social Assist. (public)	N/A	N/A	16.6	6.0*	7.1	6.9
Public Administration	N/A	N/A	4.4	12.6	12.8	17.0

<sup>1</sup> Industry Sector is defined using the North American Industrial Classification System at the two-digit level.

<sup>2</sup> Data that are either unavailable or statistically unreliable are indicated by N/A.

<sup>3</sup> The asterisk (\*) indicates that the change between the two periods examined is statistically significant at the five percent level.

As stated earlier in the paper, once a firm recognizes that the Internet can be used for their business transactions, it will begin to explore ways to implement it. Paradoxically, overcoming this barrier only serves to bring the secondary barriers into sharper relief. Thus firms have to face additional costs (barriers) such as the need to purchase new equipment and software, hiring or retraining employees and implementing secure solutions (to combat another growing concern). All these costs may be further complicated by the lack of interoperability and standards, including the limited electronic trading platforms.

Some sectors appear to face higher development and maintenance costs than others, as seen in Table 15. For small firms, two sectors – Professional, Scientific and Technical Services and private sector Educational Services – had

statistically significant increases. For medium-sized firms, a different list of three industries had a significant change – Manufacturing, Transportation and Warehousing and private sector Health Care and Social Assistance. Among large firms, only the Manufacturing sector, for which the barrier nearly quadrupled, had significant growth.

### **2.3 Conclusion and Future Work**

The barriers to e-commerce adoption are changing over time and various trends are beginning emerge. Most of these trends indicate differences according to the size of firm and, perhaps more importantly, according to the industry sector. Together these barriers are significant enough to prevent most firms from moving their activities online. While the dollar value of sales dramatically increased over the period examined, the total number of firms selling online rose only marginally. In 2003, 7.1 percent of Canadian firms of all sizes sold online, a statistically insignificant increase from 2001 when 6.7 percent did so.

The increase in the value of sales, therefore, is not from the increase in the number of firms doing e-commerce but, instead, from an increase in the activity and sales of existing players. In the past, a driving factor in this growth was the value of sales to consumers, rather than to other businesses. Consumer purchases made up 30 percent of online sales in 2003, up from 21 percent in 2001. This trend, however, may now be reversing as business-to-business sales accounted for 75 percent of all e-commerce sales in 2004.

The size of firm appears to be a determining factor in the rate of e-commerce adoption and the resulting benefits that firms are able to realise. The first two main barriers are stronger for smaller firms, as is uncertainty regarding the benefits of e-commerce.

The main barrier to e-commerce adoption, the applicability of e-commerce to the goods and services produced, remains significant but it is dropping, particularly for small firms. This shows an increasing awareness of e-commerce, but not a corresponding increase in the benefits of e-commerce.

In contrast, many of the secondary barriers, such as customers not ready and security concerns, are given a relatively higher rating for larger firms. Large firms were not as concerned as to whether their activities could accommodate e-commerce. Instead, they were more likely than small firms to report that obstacles within supply chains, concerns over security and the high costs associated with electronic commerce were barriers to them practicing electronic commerce.

When the data was broken down by industries, distinct industry-specific patterns emerged. The aggregate results often masked significant changes within some industry sectors, as seen with the growth of barriers in a firm's supply chain, such as customers or suppliers not being ready. This indicates that efforts to encourage e-commerce adoption in Canada will need to address industry-specific issues. In addition, size-of-firm differences were often magnified within an industry. Additional research and analyses at the industry level is needed to better understand the underlying factors to the barriers that restrict e-commerce growth in Canada. Further research will also support the development of policies and initiatives tailored to an industry sector with the goal to assist all firms to participate fully and effectively in the global e-economy.

## Appendix A

### Methodology

In order to determine statistical significance between percentages provided by Statistics Canada for the years 2001 and 2003, three different methods were employed.

1. In instances where only the percentages for each category were available with unknown variances, a computed z-value for the normal approximation to the difference between two proportions was used.

The computed z-value,

$$z_c = [(p_1 - p_2) - (B_1 - B_2)] / [p_1(1 - p_1) / n_1 + p_2(1 - p_2) / n_2]^{1/2}$$

Where  $p_y$  = proportion for each year and  $n_y$  represents the sample size or number of trials for each year.

Assuming that the sample size remains constant between 2001 and 2003,  $n_1 = n_2 = n$ .

$$\text{Therefore, } z_c = [(p_1 - p_2) - (B_1 - B_2)] / \{[p_1(1 - p_1) + p_2(1 - p_2)] / n\}^{1/2}$$

Our null hypothesis was set at  $B_1 = B_2$  and our alternate hypothesis was set at  $B_1 \neq B_2$ .

A conservative n value was used for each size of firm, such that

$$n = 5000 \text{ (small firms),}$$

$$n = 1000 \text{ (medium firms), and}$$

$$n = 100 \text{ (large firms).}$$

A two-sided test was carried out with  $\alpha/2 = 0.025$ .

2. Where Statistics Canada was able to provide coefficients of variation, CVs, for each corresponding percentage for any given year, then significance testing was carried out using  $CV = (\text{Var}[p])^{1/2} / \hat{u}_p$  where  $(\text{Var}[p])^{1/2}$  is the standard deviation of a given percentage and  $\hat{u}_p$  is the mean of each percentage given. However, as is the case with Statistics Canada, the CVs were modified by using  $\hat{u}_p = 0.5$ . Thus, one avoids getting very small or very large CVs due to  $\hat{u}_p$  being close to 1 or zero.

A 95 percent confidence interval was created, where  $CI = 1.96(0.5)CV$ .

A confidence interval difference, CID, was calculated such that

$$CID = [CI(p_{2001}) + CI(p_{2003})]^{1/2}$$

Finally, upper and lower bounds were established:  $(p_{2001} - p_{2003}) \pm CID$ .

The null and alternate hypotheses followed in the same manner as above.



3. A third method of verification for the results obtained in 1 above was also used.

When the standard deviation was unknown, a  $100(1 - \alpha)\%$  confidence interval for B for each year was constructed and compared using

$$p - z_{\alpha/2} [p(1 - p)/n]^{1/2} \leq B \leq p + z_{\alpha/2} [p(1 - p)/n]^{1/2}$$

Note that a binomial variance,  $nB(1 - B)$ , can be used if one desires to do so.