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Internet shopping in Canada: An examination of data, trends and patterns

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Internet shopping in Canada: An examination of data, trends and patterns

User information

Symbols

The following standard symbols are used in Statistics Canada publications:

.   not available for any reference period

..   not available for a specific reference period

...   not applicable

0   true zero or a value rounded to zero

0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded

^{p} preliminary

^{r} revised

x   suppressed to meet the confidentiality requirements of the *Statistics Act*

^{E} use with caution

F   too unreliable to be published

Table of contents

Acknowledgements

Abstract

Before the Internet was launched commercially, few people outside the scientific and academic worlds were aware of this new technology. Commerce has since changed in unimaginable ways and it is now possible to search, purchase and sell just about anything over the Internet. Using data from Statistics Canada's Internet use surveys, this research examines the data, trends and patterns in Canadian online shopping from 2001 to 2007. Despite the enormous growth, the value of online orders is still relatively small compared with total retail sales. Although the Internet is having profound impacts on consumer behaviour, it appears that the potential detrimental effect on traditional retail has not come to fruition, at least not yet. Rather, electronic commerce has become an important complement for traditional retail in some product categories, as well as a substitute in others. In 2007, Internet shopping remained concentrated with a small group of Canadians accounting for almost one-half of online orders and over three-quarters of their value. While some factors, such as concerns for online credit card security, may be delaying electronic commerce from the mainstream, demographic and technological factors should continue to encourage online shopping.

Internet shopping in Canada: An examination of data, trends and patterns

by Lawrence McKeown, Statistics Canada and Josie Brocca, Industry Canada

1   Introduction

Before the Internet was launched commercially in 1993, few people outside of the scientific and academic worlds knew anything about this new technology. Commerce has since changed in unimaginable ways and it is now possible to search, purchase and sell just about anything over the Internet (Rowland, 2006). However, some of the expected impacts of electronic commerce (e-commerce), such as the potential detrimental effects on traditional retail, have not yet come to fruition (Sciadas, 2006). It appears that the impact of the Internet on retail shopping depends on the specific product category as well as other factors such as consumer behaviour and concern for online security.

This paper reviews Internet shopping data, trends and patterns in Canada from 2001 to 2007. It begins with a brief description of e-commerce measurement at Statistics Canada, followed by the number and value of Internet orders made from 2001 to 2007. Online purchases by type of product are then examined to illustrate how the Internet has become both a complement to, and a substitute for, traditional retail. The relative concentration of online shopping among certain Canadians is also examined, while the final section identifies the determinants of online shopping during 2007 and the extent to which concern for online credit card security remains an impediment.

2   Measuring e-commerce in Canada

Statistics Canada has been monitoring e-commerce activity in the Canadian economy since 1999, with surveys of both consumer purchases and business sales (see *Note to Readers*). As depicted in Chart 1, when a new technology diffuses over time, the statistical instruments used to measure its adoption and use must also evolve. In the early stages of an innovation, measurement is focused on the readiness of the market to adopt the new technology. The Household Internet Use Survey (HIUS) was launched by Statistics Canada in 1997 to assess the readiness of households to use the Internet and the possible barriers to their use.

As the adoption and applications of a new technology become more widespread, measurement interest shifts to the types and intensity of uses. In 1999, the HIUS added questions on the use of the Internet for household shopping. With more and more households connected to and using the Internet, the HIUS was replaced in 2005 by the Canadian Internet Use Survey (CIUS), which focused more on individual use, including shopping. When technological adoption approaches saturation the focus shifts again, from adoption and use to the outcomes and impacts on society. Measuring impacts is a challenge for any innovation, but perhaps even more so with commercial applications of the Internet since "the rate of development and innovation on the Web is actually getting faster and faster all the time".[1]

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1. Tim Berners-Lee, one of the inventors of the World Wide Web, recently said during a ceremony celebrating its 20th anniversary (The Associated Press, 2009).

Chart 1
The evolution of e-commerce measurement in Canada
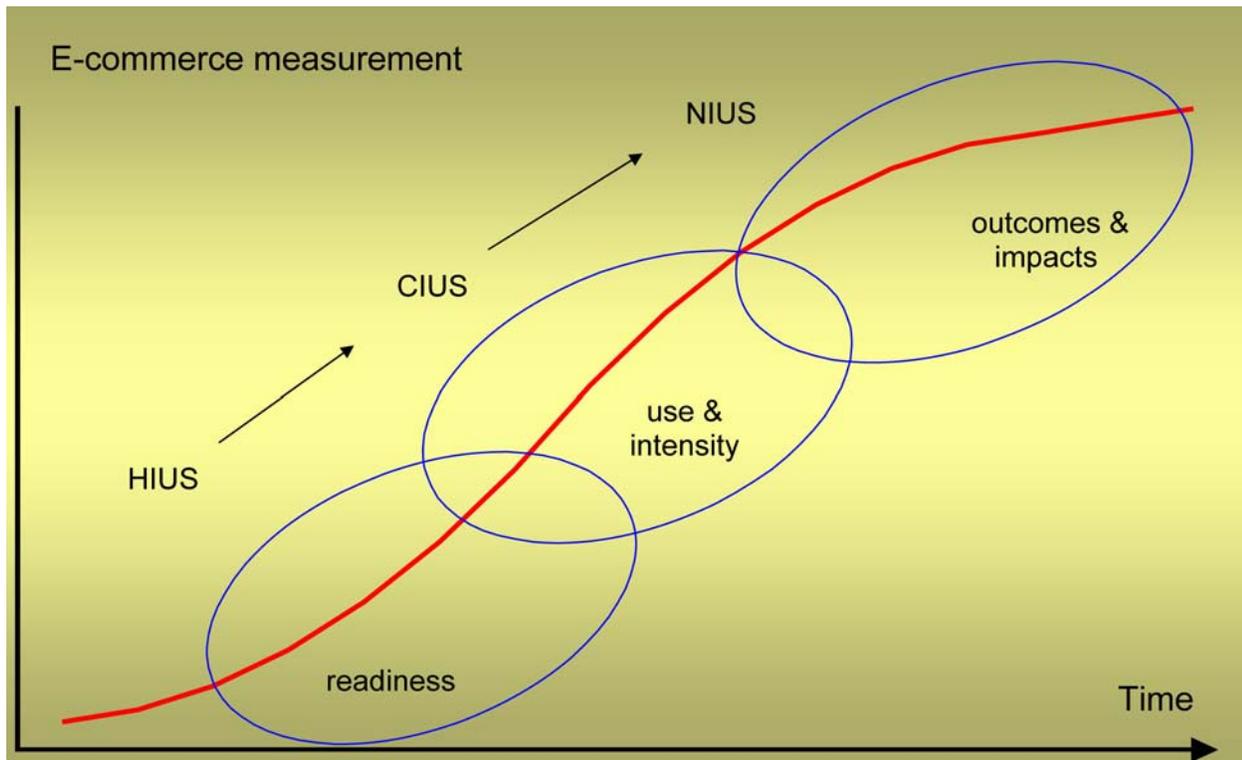
Source(s): Adapted from the OECD (2009, p.11).

Yet another ongoing consideration in developing measurement tools and methods for Internet use has been international comparability. For policy makers in particular, international benchmarking can be a critical policy gauge.[2] Statistics Canada's Internet use surveys (see *Note to Readers*), were designed to conform to the Organisation for Economic Co-operation and Development's (OECD) model surveys. Although, international comparability presents its own challenges (for example, see McKeown and Veenhof, 2009), the potential to compare Canadian data with other countries remains a consideration for the Next Internet Use Survey (NIUS).[3]

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2. See Gault (2006).
3. Statistics Canada is currently redesigning the CIUS for 2010 to help assess Industry Canada's *Broadband Canada: Connecting Rural Canadians* program.

Note to Readers: Data sources and definitions

Data sources

Beginning in 1999, the Household Internet Use Survey (HIUS), conducted annually from 1997 to 2003, asked if anyone in the **household** used the Internet *from home* as part of their buying process, either to research product characteristics or to place orders during the previous 12 months. About 1.8 million households in 1999 had at least one member who used the Internet from home as part of their buying process (Ellison, Earl and Ogg, 2001). Questions were also asked about the number and value of online orders.

Beginning in 2001, these e-commerce questions were extended to include Internet use *from any location* (home, work, school, library or other).

In 2005, the renamed and redesigned Canadian Internet Use Survey (CIUS) asked **individuals** aged 18 years and over about their Internet use. All users, *from any location*, were asked about electronic shopping, including the number and value of orders. In 2007, the target population was expanded to include individuals 16 and 17 years of age. While more than 97% of 16 and 17 year olds used Internet, just 25% reported making online orders accounting for about 2% of the number of orders and 1% of their value.

While the online behaviours of households (HIUS) and individuals (CIUS) should not be compared directly, this study examines the aggregate e-commerce estimates from these surveys.

Business e-commerce

The 1999 Survey of Electronic Commerce and Technology (SECT) estimated $4.4 billion worth of Internet sales by private and public sector enterprises in Canada (Peterson, 2001). By 2007, online sales – business-to-business (B2B) plus business-to-consumer (B2C) – had reached $62.7 billion. The CIUS and SECT estimates differ as the former measures only consumer purchases, including online purchases from international Websites. SECT measures both the B2B and B2C sales of Canadian enterprises, including to individuals and organizations outside of Canada.

E-commerce defined

To date, Canada has used the OECD's *narrow* definition of e-commerce whereby an Internet transaction "is the sale or purchase of goods or services, whether between businesses, households, individuals, governments, and other public or private organizations, conducted over the Internet". The goods or services are ordered over the Internet, but the payment and the ultimate delivery of the good or service may be conducted on or off-line. This 'narrow' definition excludes orders received or placed by telephone, facsimile or other computer-mediated networks such as EDI.

An OECD Expert Working Group is proposing an update to the definition of e-commerce which would drop the network-based distinction between the *broad* and *narrow* definitions. The group suggests that rapid technological development complicates the ability of respondents, businesses in particular, to distinguish between sales carried out through different types of computer-mediated applications. Such a change will not have an impact on e-commerce concepts or data from either the 2009 CIUS or the redesigned 2010 CIUS.

3   Trends in Internet shopping

The examination of Internet shopping in Canada begins in 2001 when 13.4 million online orders were made by over 2.2 million *households* (Chart 2*)*. By 2007, the Internet was used to make almost 70 million orders by about 8.4 million Canadian *individuals* aged 16 years and older.[4] While growth in the number of orders has been increasing, it appears to have slowed between 2005 and 2007. The 2009 CIUS will provide another data point to determine whether this declining growth rate signals a trend or is an aberration of sorts.[5]

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4.   In 2007 Canada ranked 16th, above the OECD member average, for individuals who purchased goods or services online. The top three countries were Japan, Norway and the United Kingdom with the United States ranked 11th (OECD, 2008).

5.   For example, the growth rate in orders from 2003 to 2005 may be artificially high. With a household survey in 2003 using proxy reporting for all members, there may be some under-reporting of orders made by other household members. Conversely with an individual survey in 2005, there is perhaps some over-reporting of joint household purchases, such as family vacations, made by one member.

Chart 2
Number of online orders made by households (2001, 2003) and individuals (2005[1], 2007[2])
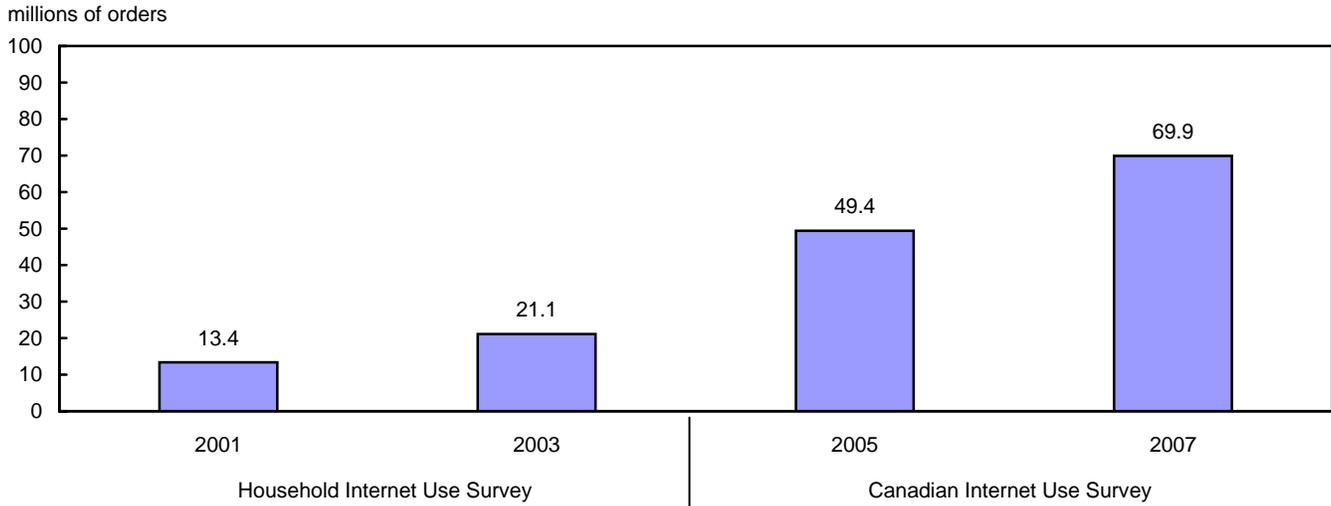
millions of orders

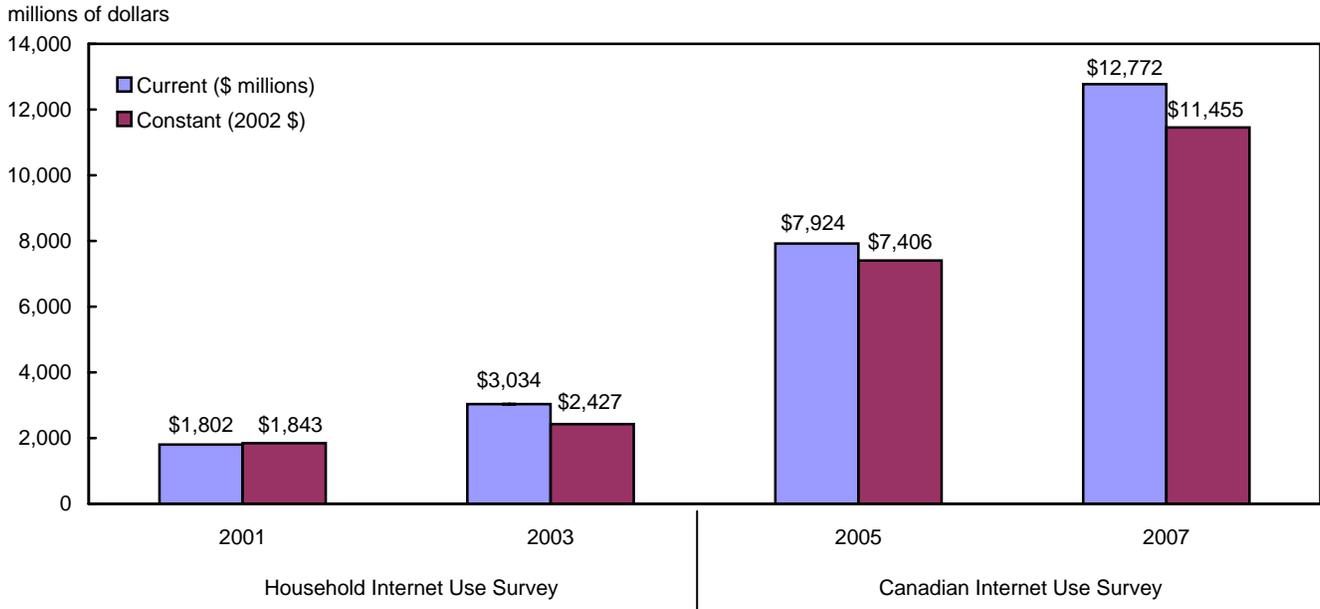|	Household Internet Use Survey		Canadian Internet Use Survey	
	2001	2003	2005	2007
millions	13.4	21.1	49.4	69.9

1. Canadians aged 18 and over.
2. Canadians aged 16 and over.
Source(s): Statistics Canada, Household and Canadian Internet Use Surveys.

The value of online orders made by Canadians in 2007 was $12.8 billion (Chart 3). Although increasing, growth in the value of online orders has slowed, particularly between the 2003 to 2005 period and 2005 to 2007 period. In addition to the change from a household survey to one of individuals in 2005, several factors may have influenced e-commerce growth including currency exchange rates, business strategies, and consumer behaviour.

The exchange rate between the Canadian and American dollars can influence the cross-border shopping behaviour of Canadians, both on and off-line. According to the 2007 CIUS, for every $100 spent online, $56 was to Canadian vendors, down from $63 in 2005.[6] Changing business models can also reduce the online shopping options available to consumers. In retailing for example, many companies continue to alter their business plans in an attempt to find the right online functionality. Finally, there has been increased media coverage of data breaches by retailers which may affect online shopping behaviour and consumer confidence in online ordering and payment. In some cases, these concerns may be strong enough to act as a barrier to e-commerce.[7]

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6. From below 80 cents in May of 2005, the Canadian dollar was near par with the American dollar for much of 2007(
   www.bankofcanada.ca/en/rates/exchange-avg.html). However, a Statistics Canada study on cross-border shopping (Roy, 2007) observed that, whether measured by the number of same-day auto trips across the border, the average amount spent on these trips or online shopping, or by the amount spent online shopping, increases were minimal relative to retail sales. The study uses low-value shipments to Canada by couriers as a proxy for receiving a product ordered online, which includes business demand and excludes digitally delivered products.
7. According to the 2007 CIUS, less than one-third (32%) of Internet users who were very concerned about online credit card use reported making an online purchase, compared to 60% who were less concerned.

Chart 3
Value of online orders by households (2001, 2003) and individuals (2005[1], 2007[2])

millions of dollars

Household Internet Use Survey — 2001, 2003
Canadian Internet Use Survey — 2005, 2007

1. Canadians aged 18 or over.
2. Canadians aged 16 or over.
Source(s): Statistics Canada, Household and Canadian Internet Use Surveys.

The growth in online sales between 2005 and 2007 was driven by a combination of more online consumers and existing Internet shoppers buying more. The number of online consumers aged 18 years and older grew by 18% over the two years. And in 2007, these online consumers reported an average of 8.4 orders worth $1,554, up from 7.2 and $1,150 in 2005, a 16% and 35% increase respectively.

Despite this growth, online sales continue to represent just a fraction of total consumer expenditure on goods and services. To illustrate, total retail sales in Canada were about $412 billion in 2007. The next section examines the pattern of online sales by product category which suggests that the impact of e-commerce has been complementary to traditional retail. This next section will also examine the continued concentration in online sales and some of the factors that influence this shopping behaviour.

4 Patterns in Internet shopping

4.1 Complement and substitute

In a study of the expected outcomes of digital technologies, Sciadas (2006) finds that many have not yet materialized. For instance, e-commerce sales do not seem to justify initial fears of the negative consequences on traditional retail. However, it is apparent that the Internet has changed consumer behaviour fundamentally, perhaps in ways not always anticipated.

The Internet is becoming a substitute for some types of products, particularly those which can be delivered easily, either on or off-line. For instance, almost one-half (45%) of online consumers in Canada reported making travel arrangements over the Internet during 2007 (Table 1) while more than one-third (37%) purchased books or magazines, some of which can be delivered online or inexpensively by courier. Indeed, for travel services and 'other entertainment products', such as concert or sports tickets, the Internet has altered the business model of suppliers as well as the behaviours of consumers.

Text table 1
Types of products[1] ordered online by households (2001, 2003) and individuals (2005[2], 2007[3])

	Households		Individuals	
	2001	2003	2005	2007
	percent			
Shoppers ordering				
Travel services and arrangements	16	22	36	45
Books, magazines and newspapers	28	30	35	37
Other entertainment products	11	10	25	33
Clothing, jewellery and accessories	18	17	25	30
Music	12	11	16	22
Computer software	14	14	20	20
Consumer electronics	7	11	16	20
Flowers, gifts	5	4	13	16
Toys and games	6	6	12	15
Videos and digital video discs (DVD's)	5	8	14	14
Computer hardware	6	6	12	13
Housewares (furniture and appliances)	6	7	8	11
Sports equipment	6	6	7	9
Health, beauty and vitamins	5	5	8	9
Automotive products	3	3	6	8

1. Some product categories changed slightly from HIUS to CIUS; for example, pharmaceuticals were separated from the 'health, beauty and vitamins' category.
2. Canadians aged 18 and over.
3. Canadians aged 16 and over.
Source(s): Statistics Canada, Household and Canadian Internet Use Surveys.

For other types of products, particularly those which cannot be delivered at the time of purchase, the Internet has become complementary to traditional shopping behaviour (Table 2). In 2007, the Internet was used to browse for consumer electronics (44% of window shoppers) as well as furniture and large appliances (43%). Such browsing was often followed by a trip to a retail location. Of the more than 11 million "window shoppers" in 2007, almost two-thirds (64%) reported making a subsequent purchase directly from a store. Grau (2008) reports that Canadians, while avid online product researchers on par with Americans, are much more likely to make a subsequent purchase in-store rather than online.

Text table 2
Types of products browsed online by households (2001, 2003) and individuals (2005[1], 2007[2])

	Households		Individuals	
	2001	2003	2005	2007
	percent			
Shoppers browsing				
Consumer electronics	22	26	42	44
Housewares (furniture and appliances)	26	31	39	43
Travel services and arrangements	16	14	37	42
Clothing, jewellery and accessories	26	27	37	41
Books, magazines and newspapers	16	12	28	31
Automotive products	21	19	26	28
Other entertainment (for example, tickets)	5	4	23	26
Music	11	7	22	24
Toys and games	8	6	18	21
Computer hardware	12	9	20	21
Videos and digital video discs (DVD's)	6	6	18	19
Real estate	6	4	16	19
Computer software	11	9	19	19
Sports equipment	9	8	16	17
Flowers and gifts	4	3	12	13

1. Canadians aged 18 and over.
2. Canadians aged 16 and over.
Source(s): Statistics Canada, Household and Canadian Internet Use Surveys.

An indicative product category is clothing, jewellery and accessories, which ranked fourth in prevalence for both orders and window shopping in 2007 (Tables 1 and 2). It appears that some retailers in this category have moved almost seamlessly from catalogue to Internet-based sales while, for others, it is not always clear whether to extend the Website beyond product information to a transactional capability. Some retailers are altering their business plans in an attempt to find the right online functionality.[8]

Demographics can also explain some of the variations in product categories. In 2007, for example, middle-aged individuals were more likely to purchase furniture and appliances (12% of those aged 30 to 45 years purchased house wares online compared to 6% of those under age 30). Conversely, younger Canadians were more inclined to purchase clothing, jewellery and accessories over the Internet (37% of those under 30 years of age compared to 28% of those aged 30 to 45).

4.2   Concentration

Despite substantial growth in e-commerce over the last few years, not all Canadians have participated equally. In 2007, more than 8.4 million Canadians aged 16 and over (or 32%) made, on average, just over 8 orders valued at $1,520. However, a relatively small group of online consumers in Canada accounted for the bulk of this expenditure. Charts 4 and 5 divide online shoppers into expenditure quartiles, or four equal groups, based on the total value of their orders.[9]

The biggest online spenders, those in the top 25%, racked up more than $1,500 in expenditures during 2007, averaging almost three times the number of orders and more than ten times the total expenditure than other online consumers. Indeed, these top online spenders, just 8% of Canadians and 25% of online shoppers in 2007, accounted for nearly half (46%, Chart 4) of the online orders and more than three-quarters (78%, Chart 5) of their value. These shares have increased from 2005, when the top 25% of online spenders accounted for 44% of orders and 76% of their value (McKeown and Underhill, 2007).

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8. For example, in January 2009 the Canadian Tire Corporation stopped selling its merchandise online as a cost cutting measure. The company felt that the site was primarily being used as a research tool by customers and not making enough money to justify the expense (Shaw, 2009).
9. The expenditure quartiles were defined by assigning those reporting $500 into the second and third quartiles in a random fashion. Also, the 'top quartile' represents slightly less than 25% of the online buyers.

Chart 4
Proportion of online orders (number) by expenditure quartile, 2007

Legend: □ $0   ■ < $200   □ $200 to $500   □ $500 to $1,500   ■ > $1,500
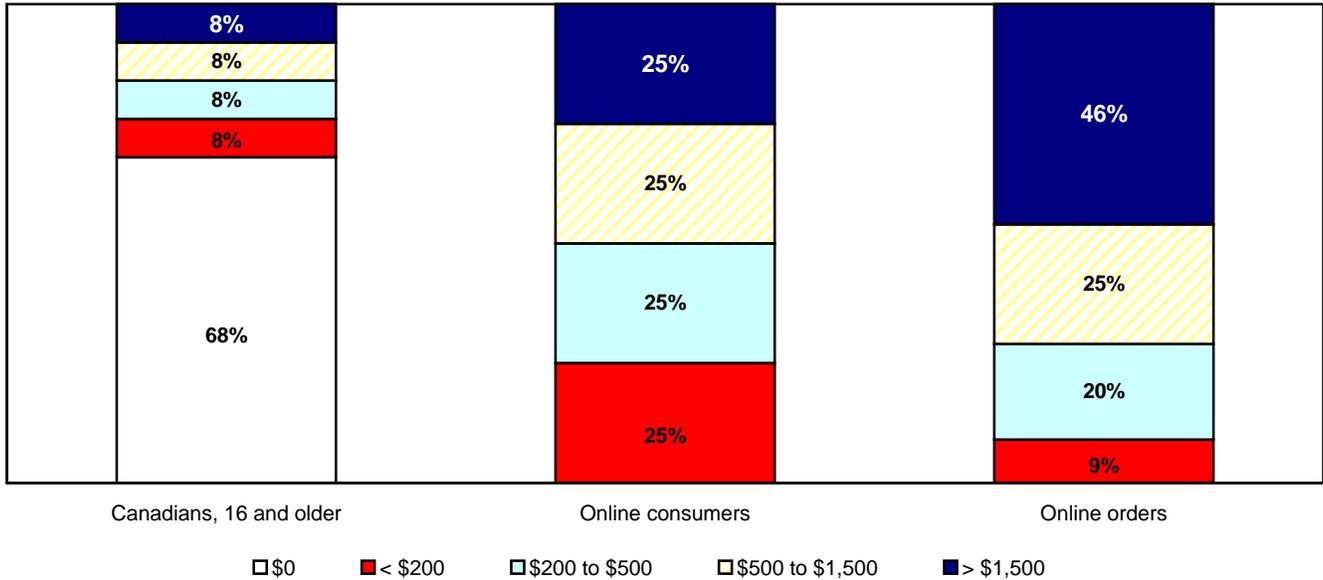
Source(s): Statistics Canada, Canadian Internet Use Survey.

To a large extent, recent growth in online sales was driven by the top online consumers buying more (from 12.8 orders worth $3,056 in 2005 to 15.7 orders worth $4,576 in 2007). Who were these top online spenders? As was the case in 2005, the top online spenders in 2007 had higher levels of household income and education than did other online shoppers.[10] They also have a greater breadth and experience online with more than 90% having used the Internet for at least 5 years and for an average of 15 online activities in 2007. With this level of 'online comfort', 85% of the top spenders reported using a credit or bank card online during 2007 for some or all of their purchases.

10. The top (quartile) online consumers had an average household income of $122,000 and 45% had a university degree (compared to an average household income of $90,000 and 31% with a university degree for the remaining 75% of online consumers).

Chart 5
Proportion of online orders (value) by expenditure quartile, 2007

□ $0	■ < $200	□ $200 to $500	□ $500 to $1,500	■ > $1,500
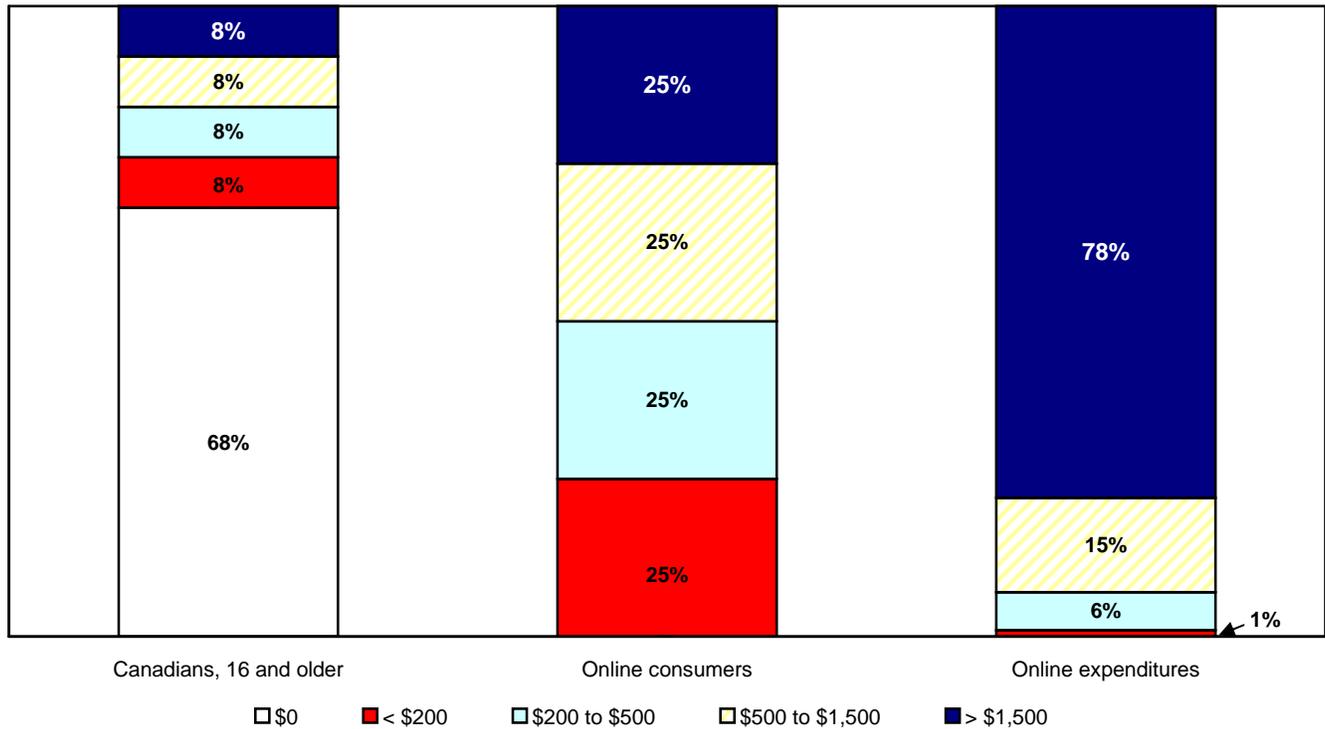
Source(s): Statistics Canada, Canadian Internet Use Survey.

What were these top online spenders buying? In 2007, they were more likely to report purchasing all types of products than other online consumers (data not shown). Two types of purchases in particular were prominent among the top spenders: More than three-quarters reported making online travel arrangements and one-quarter reported buying computer hardware. A previous study found that online travel services, because of frequency, and online computer hardware, because of the expense, tend to generate higher online expenditures (McKeown and Underhill, 2007).

4.3   Determinants

This section compares the socio-economic characteristics and online behaviours of those Canadians who used the Internet to make electronic orders in 2007 with those users who did not. Tables 3 and 4 list the variables of interest along with their expected influence on Internet shopping propensity (see *Note to Readers: Multivariate logistic model*). A multivariate model based on previous work (Noce and McKeown, 2008) is used to disentangle the statistical influence of these variables. The model excludes those Canadians who used the Internet only from locations outside of home.[11]

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11. In 2007, almost 1.2 million Canadians (6% of Internet users) used the Internet for personal reasons *but* not from home. These non-home users were asked questions about e-commerce but not about frequency, duration or specific uses. On average they made about 5 orders online worth $827 but accounted for less than 2% of the total number and value of orders.

Text table 3
Factors thought to influence online shopping, continuous variables - 2007

	Online purchase relationship	Expected
x_1 Individual age	non-linear	Unknown
x_2 Log_{10} (Household income)	increase with income	Positive
x_3 Number of online activities	increase with activity	Positive

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Note to Readers: Multivariate logistic model

In the model, the dependent variable takes a value of 1 for an Internet user who reported making a purchase online and 0 for those who did not. Some independent variables are entered as continuous and others as discrete predictors (see *Appendix A*). A control model included those factors such as age, income and education (x_1, x_2 and x_4 to x_6) found to be important for Internet use (Noce and McKeown, 2008). The full model added breadth of use (x_3), speed of connection (x_7) and years online (x_8) as well as security concerns (x_9).

Age and income (x_1 and x_2) were entered into the model as continuous control variables. However, the effect of age is not linear since both younger and older Canadians account for a lower proportion of online orders than the average. Household income was positively skewed and transformed logarithmically to base 10. Although logistic regression does not rely on the same distributional assumptions as Ordinary Least Squares, the solution is more stable if the predictors have a multivariate normal distribution (UCLA, 2004). The breadth of use, measured by the number of online activities (x_3), had a coefficient of 0.207. In other words, the odds of purchasing online increased by just over 20% with each additional activity reported (e.g. email, online banking, view news or sports, etc.).

Text table 4
Factors thought to influence online shopping, discrete variables - 2007

|	Online purchase relationship		Expected
	= 0	= 1	
	percent		odds ratio
x_4 Location (0 = rural and small town)	42	46	> 1
x_5 Sex (0 = female)	43	47	> 1
x_6 Education (0 = no post-secondary)	32	52	> 1
x_7 High speed connection (0 = no)	34	47	> 1
x_8 Online experience (0 = less than 2 years)	18	49	> 1
x_9 Online credit card (0 = no, some concern)	61	34	< 1

Source(s): Statistics Canada, Canadian Internet Use Survey.

Chart 6 presents odds ratios to assess the effect of discrete variables (x_4 to x_9) on the propensity to shop online. For example, controlling for other variables the odds of an individual with at least some post-secondary education buying online were more than one and a half times greater (1.53) than someone with less education. The effect of a high-speed connection from home is small; those with high speed had slightly higher odds of making an online purchase. A study of Internet use and broadband found that the speed of connection alone does not explain differences in the sophistication of use (Middleton and Ellison, 2008).[12]

Interestingly, men had slightly lower odds of purchasing online compared to women, controlling for other factors. Canadians residing in urban locations also had slightly lower odds in 2007 of making an online purchase than did individuals residing in rural areas and smaller towns, controlling for other factors. Perhaps the lower odds of an urban 'home user' ordering online reflects more options for purchasing at a retail store location in urban areas.

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12. This study used the CIUS to examine differences in household online purchases by speed of connection but did not consider data on "window shopping".

Odds ratios showing the likelihood of being an online shopper, selected variables, 2007

ratio

(Reference group)
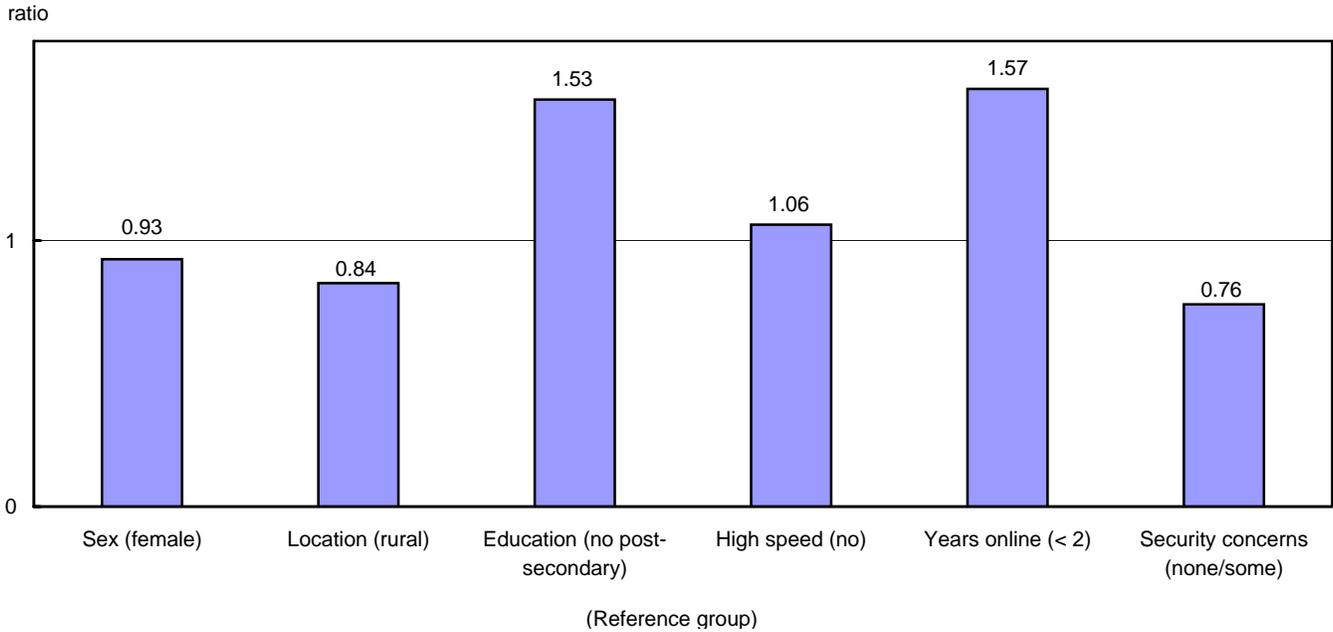
Source(s):   Statistics Canada, Canadian Internet Use Survey.

According to Zamaria and Fletcher (2008), Canadians are more worried about the security of financial information online than are residents of the United States (U.S.) and other selected countries. Grau (2008) also finds that concern over the security of credit card payments holds Canadians back from buying more online. In the model, Canadians who were very concerned about online credit card use had only about three-quarters (0.76) the odds of making an online order than those who were either somewhat or not concerned, controlling for other factors (Chart 6).

This finding may also be acting as a proxy for individual 'online comfort.' Previous research suggests that online transactions require a certain 'self-efficacy' or belief in one's ability to accomplish certain tasks online (Underhill and Ladds, 2007).[13] Eastin and LaRose (2000) find that up to two years' online experience may be required to achieve a requisite level of Internet self-efficacy. Indeed, the model finds that the odds of making an online purchase for someone who had been using the Internet for at least two years in 2007 were more than one and a half (1.57) greater than someone with less experience (Chart 6).

13. As Middleton and Ellison (2008) assert, those who have the knowledge and experience gain the most benefit from the Internet while those who lack the skills, knowledge and self-confidence may be left further behind.

5   Summary

Despite substantial growth in online sales from 2001 to 2007, Internet shopping continued to be concentrated along particular product categories and among relatively few Canadians. However, along with increasing product availability, the Internet will continue to have a unique advantage as a channel for commerce, particularly for serving niche markets such as specialty food, rare cars and antiques, books and instructions, and vacation spots (Rowland, 2006). Such markets may be substantive but geographically dispersed.

In 2007, the top 25% of online consumers, just 8% of Canadians, accounted for almost half of the purchases made and more than three-quarters of the value. In the U.S., research indicates online retail sales are beginning to mature and that most new growth is expected from existing online shoppers spending more (JupiterResearch, 2007). The results presented here highlight three factors suggesting that new online consumers should also contribute significantly to growth in e-commerce sales.

First, experience online has a positive effect on the propensity to make an online order. By 2007, 54% of Internet users reported five or more years online, up from 45% in 2005. The 2009 CIUS should find an increasing average number of years online among Canadians, as well as a greater breadth of use and higher odds of making an online order. Online banking and window shopping can be considered as prerequisite behaviours or precursors to placing an online order. In 2007, just under half (43%) of Canadians used the Internet to window shop and for electronic banking and paying bills, up from 37% in 2005.

A second underlying factor is demographic. The observed age differences in online behaviour are not an age effect *per se* but rather a cohort effect. Almost all Canadians 16 and 17 years (97%) were online during 2007, but they accounted for less than 2% of the number of online orders.[14] However, they are part of the first generation that has grown up with the Internet and will start to earn income over the next few years. These younger users will likely continue to expand their use of the Internet, particularly with the incorporation of e-commerce into social networking and virtual world sites.

Technology is another factor to consider. The Internet is becoming more mobile, allowing for connections through multiple platforms, making online purchasing even more convenient, particularly for digitally delivered services. Such convenience, combined with increasing Website functionality and product availability, should entice many more Canadians, with increasing Internet experience, to begin shopping online. While the short term impact of the economic downturn on e-commerce is less certain,[15] data from the 2009 CIUS will serve to further assess these trends and patterns.

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14. More than four of five online shoppers reported using a credit card for some of their online purchases in 2007 but about one-third of Canadians aged 16 and 17 did not have a credit card.
15. With more emphasis on cost savings by both businesses and consumers, this may serve to encourage online selling in some product categories and discourage it in others. For example, Ker (2009) finds that Canadians were spending more of their retail dollar during 2008 on frequently purchased goods such as food and beverages as well as fuels but less on big ticket items.

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Appendix I — Multivariate logistic regression

For the binary logistic regression, the goodness of fit is measured by a transformation on the maximum likelihood estimate (MLE) such that,

(A1) Goodness of Fit = -2 log(L), where L (likelihood) = Π pi Π (1-pi).

The -2log(L) value is approximately distributed as a χ^2 with degrees of freedom equal to the number of variables. Since the MLE is a probability and thus cannot exceed 1, its log will be negative. As the fit improves, the ML probability increases toward 1, the log will also increase (although remain negative) and the -2log(L) will be smaller. An additional variable improves the model fit if it reduces the -2log likelihood (Table I). The initial 'control' model included social and demographic characteristics ($x_1, x_2,$ and x_4 to x_6) such as age, income and location, found to be of importance to Internet use. The 'full' model includes online behaviours (depth, breadth and experience - x_3, $x_7,$ and x_8 - as well as credit card concern, x_9.). The 'final' model treats experience as a categorical variable; all variables remain significant while the overall fit of the model is improved (Table I).

Text table I
Model for propensity to purchase online

Model	-2Log (likelihood)	Nagelkerke R^2
Internet Home users		
Control model	23,433,835.754	0.102
Full model	19,155,318.269	0.289
Final model	18,971,136.067	0.300

The Nagelkerke statistic is a pseudo R^2 that attempts to provide a logistic analogy to the R^2 in Ordinary Least Squares (OLS). Although the Nagelkerke varies from 0 to 1, as does R^2 in OLS, it does not indicate the proportion of variance explained by the predictors (UCLA, 2004). Rather, it indicates the proportion of unaccounted variance that is reduced by adding variables to the model compared to the null model (i.e. just the constant). The Nagelkerke value increased from 0.102 in the control model to 0.300 in the final model.

For continuous variables, the interpretation of slope coefficients is similar to that of OLS regression. For the discrete predictor variables, the regression coefficient (**B**) is equal to the log odds ratio of the event for the use or non-use of the Internet by an individual. Odds are defined as p/q or p/(1 - p), where p = the probability of the event and q = (1 - p). A log odds ratio is defined as:

(A2) ln[p1/(1 - p1)]/[p0/(1 - p0)].