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Digital Transformation in the Service Sector: Insights from Consultations with Firms in Wholesale, Retail and Logistics



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Abstract

Firms increasingly rely on digital technologies such as e-commerce, cloud computing, big data, digital tracking and digital platforms that are reshaping business operations, business models and market structures. In this context, the Bank of Canada consulted with firms in wholesale, retail and logistics, as well as with related industry associations to yield insights on the adoption of digital technologies. Results show that firms are increasingly investing in digital technologies, most often to increase operational efficiency or to enhance customer experience. The survey also aimed to shed light on the various channels through which digital transformation may affect firms' prices in order to discern the implications of digitalization for inflation. Survey respondents point to some disinflationary pressures overall: first, firms view e-commerce as putting downward pressure on prices, due to increased transparency and comparability in online markets, which amplifies competition and reduces firms' pricing power. Second, thanks to the adoption of technologies, cost savings and efficiencies are in some cases being passed on to the customer although, for many firms, cost savings are yet to be realized. Finally, firms view digital technologies as a driver of actual or expected changes in market structure, citing consolidation and concentration of market power among dominant players, forcing smaller players out of the market.

Bank topics: Firm dynamics; Service sector; Inflation and prices

JEL codes: D22; E31; L81; L92; O33

Résumé

Les entreprises ont de plus en plus recours aux technologies numériques, comme le commerce électronique, l'infonuagique, les mégadonnées, la surveillance numérique et les plateformes numériques, qui transforment les activités commerciales, les modèles d'entreprises et les structures de marché. Compte tenu de ce contexte, la Banque du Canada a sondé des entreprises du commerce de gros et de détail et du secteur de la logistique, ainsi que des associations professionnelles connexes, pour en savoir plus sur leur adoption des technologies numériques. D'après les résultats obtenus, les investissements dans les technologies numériques vont croissant, l'objectif étant le plus souvent d'accroître l'efficacité opérationnelle ou d'améliorer l'expérience client. L'enquête vise à mettre en lumière les différents canaux par lesquels la transformation numérique peut influencer sur les prix demandés, et ainsi à mieux cerner les implications de la numérisation pour l'inflation. Les réponses des participants à l'enquête laissent entrevoir des pressions globalement désinflationnistes. Tout d'abord, les entreprises

considèrent que le commerce électronique exerce une pression à la baisse sur les prix en raison de la transparence et la comparabilité accrues dans les marchés en ligne. Cette situation intensifie en effet la concurrence et réduit le pouvoir des entreprises en matière de fixation des prix. Ensuite, le client profite dans certains cas des réductions de coûts et des gains d'efficacité découlant de l'adoption des technologies, quoique les réductions de coûts doivent encore se concrétiser pour nombre d'entreprises. Enfin, les répondants considèrent les technologies numériques comme un facteur à l'origine des changements effectifs ou anticipés des structures de marché. Ils mentionnent ainsi la consolidation du marché et la concentration du pouvoir de marché entre des acteurs dominants, lesquelles contraignent les entreprises de moindre importance à se retirer du jeu.

Sujets : Dynamique des entreprises; Secteur des services; Inflation et prix

Codes JEL : D22; E31; L81; L92; O33

Introduction

Digital technologies, such as mobile technology, big data analytics, cloud storage, sensors, digital platforms and automation, are significantly altering the way firms operate their business and interact with suppliers and customers. In this context, the Regional Analysis Division of the Bank of Canada's Canadian Economic Analysis Department consulted 42 firms and met with 6 industry associations to shed light on digital trends and their implications for firms' investment, employment, costs and prices.¹ Consultations were held with firms in three major sectors: wholesale, retail and logistics. With the objective of understanding the implications of digitalization for inflation, discussions focused on how retailers set prices in an environment of rapidly evolving digital technologies, and what digital transformation implies for the related supply chains (i.e. wholesale and logistics). The survey is part of a larger initiative at the Bank of Canada to understand the impact of digitalization on the economy and on inflation in particular and follows the 2016 year survey of the information technology (IT) industry ([Charbonneau et al. 2017](#); [Dong et al. 2016](#)).

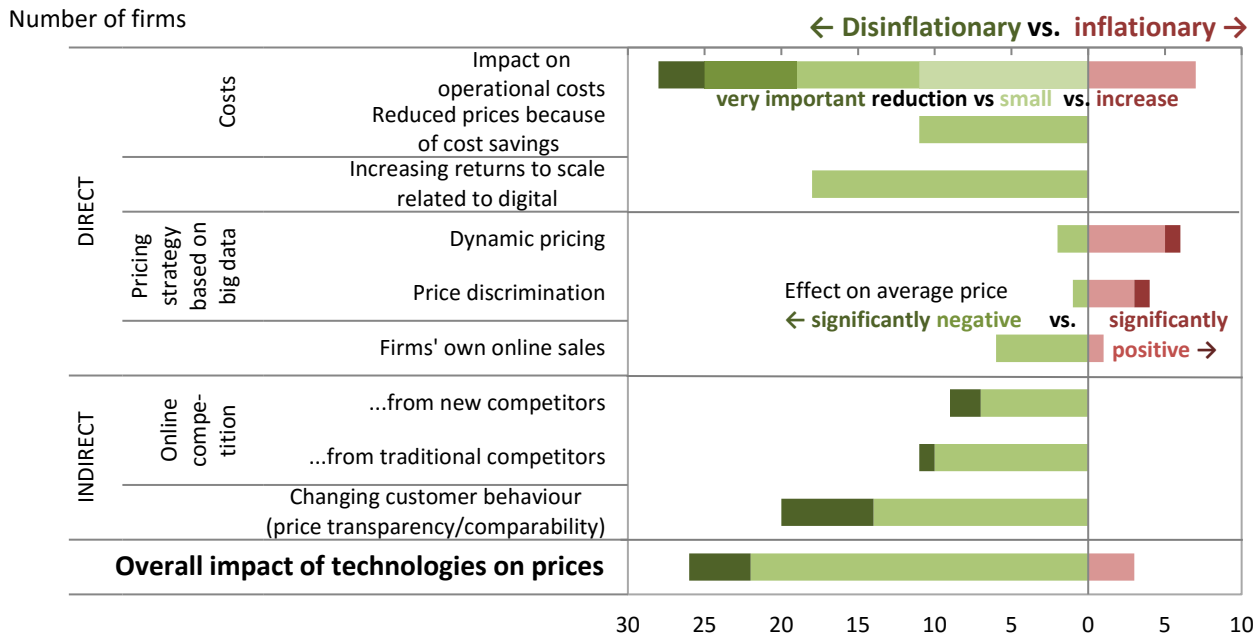
The survey results show that firms are adopting technologies to varying degrees and most often cite efficiency-enhancing initiatives (e.g., digital tracking of products and digital platforms to manage supply chains). Many also focus on customer-facing technologies to enhance customer experience, although the adoption of e-commerce and advanced automation appears to be lagging. The main obstacles to adoption are internal resistance to change, the cost of technologies and talent shortages. Discussions with firms also shed light on how technologies may affect investment and employment decisions. Firms reportedly plan to increase spending on digital technologies, amid a shift from IT investment toward IT expenses. The anticipated impacts of digitalization on employment and total labour cost are ambiguous, as firms reported that they are both reducing labour input due to automation and hiring additional skilled IT staff.

Survey respondents pointed to some disinflationary pressures from digitalization (**Figure 1**). Cost savings and efficiencies realized from adopting new technologies are in some cases passed on to the customer, often under the pressure of competition. Moreover, firms view e-commerce as putting downward pressure on prices, due to greater transparency and comparability in online markets, which increases competition and reduces firms' pricing power. However, a few firms use big data for strategic price setting (implying higher prices). Finally, firms view digital technologies as a driver of actual or expected changes in market structure, citing consolidation and concentration of market power among dominant players, which is forcing smaller players out of the market.

This note discusses the three topics covered in the consultations: (i) the extent of firms' adoption and the type of digital technologies, including objectives and hurdles, (ii) implications for investment and employment, and (iii) any effects on firms' costs and prices (from both internal changes and external pressures).

¹ Details on the sample are provided in **Table A. 1** in **Appendix A**, and the main survey questions are in **Appendix B**.

Figure 1: Summary of survey questions on the impact of digital technologies on firms' costs and prices

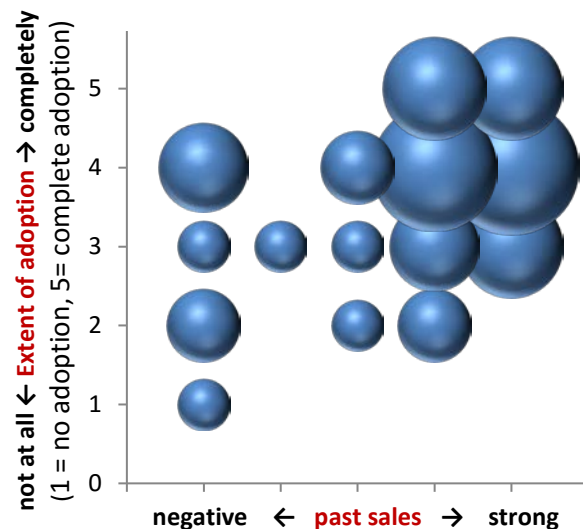


1. Extent of Adoption

The majority of firms reported having implemented digital technologies to at least some extent (Chart 1), with about a third reporting extensive adoption. Only a few firms rated their degree of adoption as none or minimal. Adoption rates were similar across firm sizes, as well as between retail and wholesale firms.² That said, the logistics industry was described by some as lagging, being an “old school” industry with many low-skilled, “blue-collar” workers, especially in transportation. **Overall, adopting firms appear to have experienced better sales performance over the past three years (Chart 1).** In some cases, the correlation reflects the fact that adopters are reaping the benefits from IT investments in terms of sales performance, which is consistent with findings in the literature that investment in IT is productivity-enhancing. For others, the causality is reversed: because the company is doing well, the firm has the means to invest in IT (and firms experiencing difficulties do not have the means to invest).

Chart 1: Adoption of technologies is positively correlated with sales performance

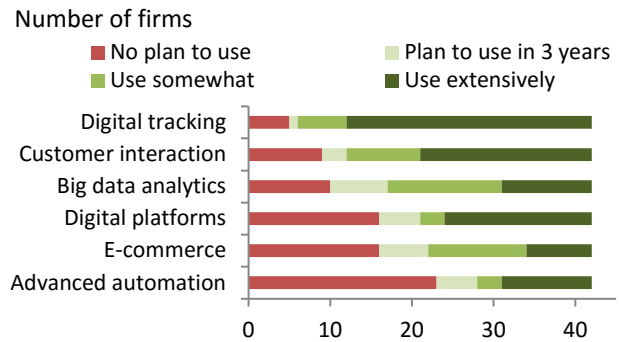
Size of bubbles refers to number of firms



² Note that self-rating is subjective, making comparisons across industries difficult.

The most common digital technologies adopted by firms were digital tracking and product handling, used extensively by over half of the surveyed firms (**Chart 2**), mainly in wholesale and logistics. Examples include warehouse and inventory management systems and digital tracking in real time in distribution centres or warehouses. Some transportation firms also mentioned electronic logging devices (ELDs)³ as an upcoming requirement for trucks operating in the United States. The next most commonly cited technologies were **customer-facing technologies**, such as member portals and mobile applications for customers, customer relationship management (CRM) software, digital marketing and self-checkouts in retail. Results are similar by industry and firm size.

Chart 2: Digital tracking and technologies to interact with customers are used most frequently



Somewhat fewer firms (about half) use **big data analytics**, and several more are planning to use big data in the next three years. Data gathered from sensors and online activity are often stored on the cloud. Big data analytics finds applications in all three target industries. For example, some large retailers mentioned the importance of data from online shoppers to improve customer experience: for example, to better advertise, price or suggest other products, thereby boosting revenue and increasing loyalty. Some logistics firms and wholesalers use data from digital tracking technology to predict future flows of work and cost, improve decision making, evaluate profitability, and monitor employee productivity, while a few named compliance as the reason to collect data. The trucking industry uses big data to make decisions about speed, frequency of gear changes, etc. that will lead to fuel savings and improve productivity and safety. However, a number of firms noted that they are gathering data and have yet to learn how they can use analytics to turn raw data into insights and sensible decisions.

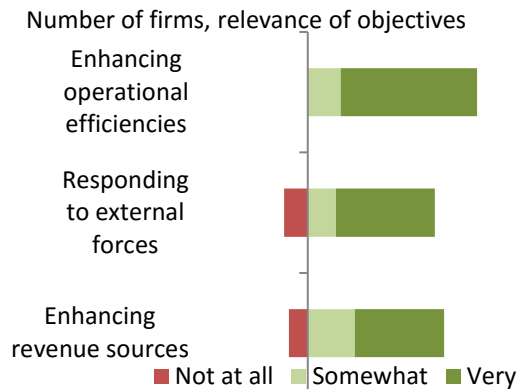
Almost half of firms, most frequently in logistics, use digital platforms, for example, to interact with third parties. Firms use platforms for sharing data or tracking inventory with customers and suppliers, for supply chain collaboration, or internally e.g., for enterprise resource planning (ERP). An example used by several trucking and freight forwarding firms is an electronic marketplace that links trucks with freight that they can pick up and “back-haul” after dropping off their cargo.

About half of firms used or are starting to use e-commerce, including web portals for placing orders and mobile apps, with adoption concentrated among retail and wholesale firms. The transformation was reportedly consumer-driven, whereas retailers were lagging in implementing the technology. They also lack expertise in designing web layouts that entice buying and moving from desktop to mobile platforms, given that 70 per cent of consumer research visits are reportedly on mobile devices. Only a third of firms, mainly in distribution centres or ports, use **advanced automation technologies**, such as warehouse automation, machine-to-machine communication and automated container loading and unloading.

³ A digital technology for automatically tracking trucks, soon to be a legislated requirement in the United States.

The main objective in implementing technologies is enhancing operational efficiencies and reducing costs: Almost every firm rated efficiency as at least a somewhat relevant objective (**Chart 3**). In the retail and wholesale sectors, firms are automating processes (such as pricing and reporting) in stores and distribution centres to improve productivity and lower costs. In trucking, innovative technologies aim at increasing fuel efficiency (e.g., through platooning),⁴ although variable costs such as fuel remain important. Moreover, firms cited the need to respond to **external forces**, such as meeting customer expectations and regulatory or security standards, as well as not falling behind competitors. Finally, about two-thirds of firms said that they are adopting technologies with the aim of **enhancing revenue sources**, particularly in retail, by improving customer experience and services, including omni-channel retailing, and finding more targeted ways of accessing consumers.

Chart 3: The main objective is to reduce costs



Note: The main objectives are not mutually exclusive.

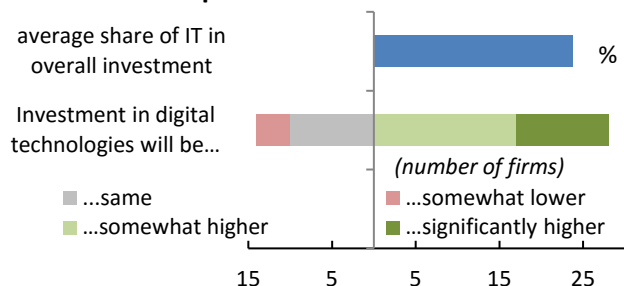
The major obstacles to implementing technology were related to internal rigidity or reluctance to change, for several reasons, most commonly, the presence of an older workforce. For about one-third of firms, the cost of technology relative to their sales or limited investment budget is a major obstacle. Some also mentioned difficulties in finding the right talent, particularly in industries that are less “appealing,” such as logistics; however, not all firms were looking to hire IT staff, particularly small firms. A few mentioned unclear returns on investment, training and implementation time, and lack of economies of scale in Canada to spread out costs.

2. Impact on Investment and Employment

1) Firms plan to spend more on digital technologies and are increasingly expensing rather than capitalizing them.

IT investment is expected to grow from a modest proportion of overall investment. Although almost all firms consider investment in digital technologies an important driver of growth, the proportion of digital spending in the overall investment envelope varies from firm to firm. The average ratio of digital spending to total investment is about 24 per cent (**Chart 4**). In general, firms in the logistics industry have a smaller proportion of digital spending due to

Chart 4: Firms plan to increase investment in IT



⁴ Platooning means grouping vehicles into platoons (i.e., decreasing the distance between trucks using electronic coupling for simultaneous acceleration and braking) to reduce fuel costs. Other technologies include automated decisions, cameras, anti-idling technologies, data analytics to determine best routes, etc.

the capital-intensive nature of the industry. Over the next 12 months, two-thirds of firms expect digital spending to be somewhat or significantly higher than in the past 12 months (**Chart 4**), citing the need to continuously develop and maintain digital technologies.

On average, a slim majority (57 per cent) of spending on digital and information technologies is expensed (rather than capitalized). In general, spending on software as a service (SaaS), software developed and maintained by own staff, cloud server, etc. is considered expenses, while spending on IT infrastructure and software purchases is considered an investment. Several firms indicated that they need to comply with accounting principles to decide how to classify spending on IT.⁵ **Many noted that the trend of digital spending is shifting away from capitalization and toward expenses** as firms' spending moves from initial investments (capitalized) to maintenance of existing systems and increasing SaaS, and as firms shift toward cloud-based software (expensed) and hiring their own programmers to develop software internally. These trends may help to explain the slowdown in ICT investment observed in the past decade.⁶

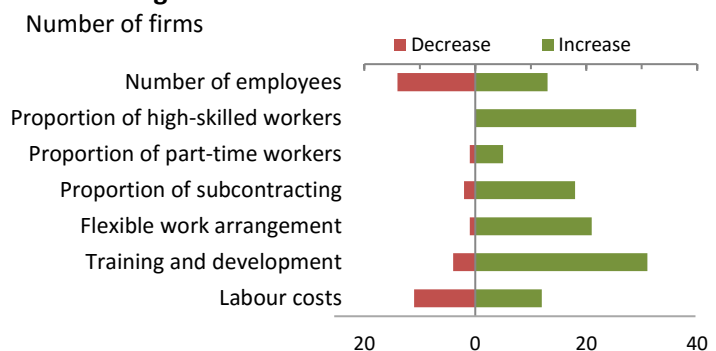
Most firms do not see digital expenditures having any impact on their other investment spending.

Some noted that technology adoption may allow for more efficient use of physical capital, while others cited a small crowding-out effect due to budget constraints. A few suggested that digital spending could generate an increase in other investments: for example, in building the e-commerce platform, higher investment in machinery and equipment (M&E) and structures is needed to support fulfillment and distribution centres. Others mentioned that digital technologies are often built into new M&E (e.g., sensors in trucks or trailers).

2) Digitalization may displace workers, but it also leads to more high-skilled hires and training.

Overall, digital adoption is ambiguous for employment (Chart 5). In some cases, adopting digital technologies reduces the number of employees by increasing productivity and introducing automation. In others, in addition to observing the efficiency enhancement, digitalization drives growth such that the net impact on employee numbers is still positive. For some firms, workforce reductions due to

Chart 5: Digitalization transforms the workforce



⁵ Note that there is an inconsistency in how software is recorded: while in *accounting*, software is usually treated as an *expense* (Morah 2009), and research and development to generate assets such as software is *expensed* (Durbin and Paul 2016), in the *national accounts*, both purchases and in-house development of software are considered *investments* (Statistics Canada 2014).

⁶ Since 2004, ICT investment has declined in nearly all of the G20 economies (OECD 2017). Van Ark et al. (2016) note a rapid increase in business spending on digital services including cloud computing, data analytics and other information services, together with a decrease in investment in digital assets (e.g., computers, peripherals, communications equipment).

labour-saving technologies are offset by the need to hire staff, such as IT and customer service employees, or contractors. In retail, for example, lower headcounts due to automated warehouses have reportedly been offset by more jobs to support online sales growth.⁷

Many firms report that the proportion of high-skilled and subcontracting workers has increased due to digitalization (Chart 5). As a result, labour costs also go up, since firms need to pay more for the positions requiring digital skills. Since these skills are in demand by various industries, several firms noted the difficulty in attracting and retaining digital talent. In many cases, adopting digital technologies drives efficiency gains, resulting in lower wage bills elsewhere or lower labour costs per unit of output.

The adoption of digital technologies has led to more training needs and flexible work arrangements, such as teleworking, as well as leaner and flatter organizational structures. Some firms noticed that the change in labour-management practices has helped to reduce job turnover. It can be a challenge, however, for some older workers to adapt to the new technologies. A few firms noted that they have been hiring more millennials, who are more comfortable using technology and enjoy the more tech-friendly environment.

3. Impact on Prices: Direct and Spillover Effects

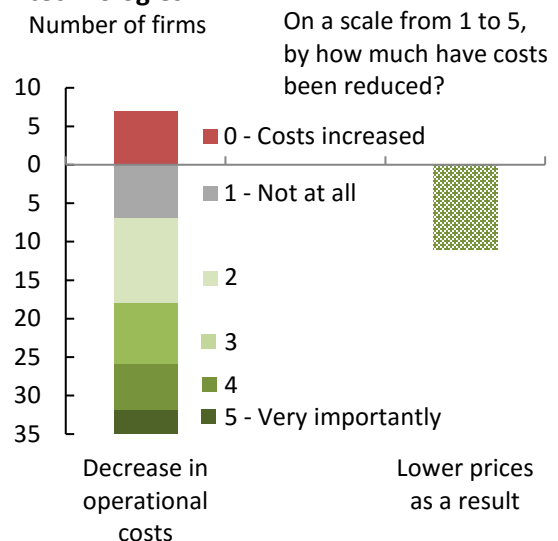
Digital technologies may affect firms' pricing decisions through various channels (see [Charbonneau et al. \[2017\]](#) for a literature review). Firms were asked about any *firm internal* effects on their prices, including through 1) cost reduction and impact on scalability, 2) big data analytics, and 3) online sales.

External pressures on prices may result from 4) online competition and changes in market structure, and 5) changes in consumer behaviour.

1) Digital technologies entail efficiencies and an overall modest reduction in operational costs, with some pass-through to prices.

On balance, firms have seen some reduction in operational costs but, for many, efficiencies have yet to be realized. Only about a fifth of firms have seen important reductions in costs due to the adoption of technologies (**Chart 6**). Firms cited the ability to scale up with little extra cost, less supervisory work, and the automation and optimization of resources, such as the ability to right-size labour costs in real time. Several firms

Chart 6: Firms saw a modest reduction in operational costs thanks to the adoption of technologies



⁷ In trucking, while platooning and driverless trucks may eventually make drivers redundant, regulatory requirements in the near term still require one driver in each truck. As well, ELDs may actually increase demand for truck drivers, since they limit possibilities for drivers to illegally work long hours.

have seen only small cost reductions, for example, because labour cost remains important (e.g., in the case of unionized labour).

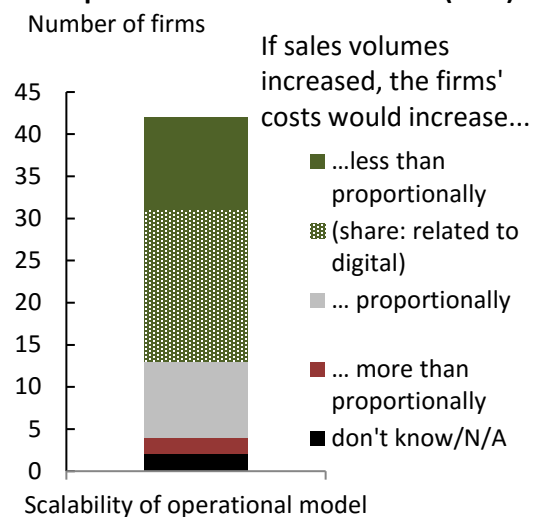
About a quarter of firms use cost savings to reduce their prices (Chart 6) to the benefit of their customers, often under the weight of competitive pressures. In rail, earlier productivity gains associated with adopted technologies have reportedly been passed through to customers, although the pace of pass-through has slowed. Firms not passing on cost savings reported enjoying higher margins or reinvesting in the firm, while, for some, cost savings merely help to offset weakness elsewhere.

However, a third of firms have seen no reduction, or even an increase, in costs (Chart 6), referring to increased IT expenses, such that the costs still exceed the benefits, but these firms are hoping to reach a tipping point soon. Retailers also mentioned that selling “omni-channel” (offline and in-store) is costly but necessary to access wider markets or to remain competitive. For several firms, costs are unchanged, due to offsetting effects, too limited investment in IT, a focus on sales-enhancing rather than cost-reducing technologies, or because efficiency gains are not reducing costs (e.g., through reduced transaction times, faster sales or delivery, or back-office tasks). Limited cost gains are consistent with arguments that the economy is still in an “installation phase.”⁸

A number of firms also saw cost reductions in the supply chain following the adoption of technologies, citing more efficient transactions with suppliers, a better stream of information, just-in-time inventory management and the ability to predict work or lead times based on past data. **Yet, the majority of firms have seen no impact on costs in their supply chain** and judge that optimization had a long way to go. Reasons given include limited investment on behalf of related parties such as suppliers and transportation tiers, legacy processes or being at the early stages of implementation.

The literature argues that digital technologies can allow for more-scalable operational models and increasing returns to scale (IRTS).⁹ Indeed, the majority of firms report that costs would increase less than proportionally if sales increased; and **several related IRTS to digital technologies (Chart 7)**. For example, firms can leverage existing labour more extensively or handle inventory at little extra cost if sales increased. A number expected such scaling gains to take hold only in the future, once

Chart 7: Most firms would see a decrease in cost per unit if volumes increased (IRTS)



⁸ Efficiencies from the adoption of digital technologies should manifest themselves in increased productivity, but productivity growth has been weak. Some researchers argue that slow diffusion of technology or limited adoption can explain why productivity growth has not (yet) increased ([van Ark 2016](#)).

⁹ See, for example, [Brzustowski et al. \(2010\)](#)

they are able to fully exploit the benefits of the technologies they are in the process of implementing.¹⁰

2) About half of respondents collect big data, with a few positive effects on prices

For most firms collecting big data, analysis allows for better monitoring, prediction and planning (see Section 1), and **some firms, mainly retailers, adjust prices based on big data analytics (Chart 8)**. For example, firms that are adapting prices to demand (**dynamic pricing, Chart 8**) mentioned “pattern analysis,” which allows them to discount less and sell more when demand is strong or inelastic, and identifying demand “hot spots” in the market, where they can charge higher prices. A few firms are able to **price discriminate (Chart 8)** based on big data algorithms, for example, by showing different prices online, depending on which websites consumers have already visited. Based on big data analysis of competitors’ prices, a firm may also price more aggressively (e.g., just below market price) to win a customer or target and tailor add-on services based on its knowledge of the customer, which implies higher prices. Some mentioned that price discrimination comes at the cost of potentially frustrating customers. A few mentioned the ability to recommend other products, based on algorithms, which tends to increase the bundle price.

3) E-commerce is growing rapidly, with a few firms citing a direct (downward) effect on their prices
To date, only about half of firms, predominantly retailers, sell online (Chart 9). For those firms that offer e-commerce, online activity makes up about one-fifth of their total sales. Online sales represent an important share of total sales for half of them, but are marginal for the rest, including several retailers just getting started. Firms almost unanimously saw an increase in the share of online sales, in most cases significantly so or compared with no online presence at all three years ago. The impact of online sales on firms’ business is generally positive, with firms citing an overall increase in sales and market share, better relationship building with customers, and customer

Chart 8: Firms report little impact of big data on pricing

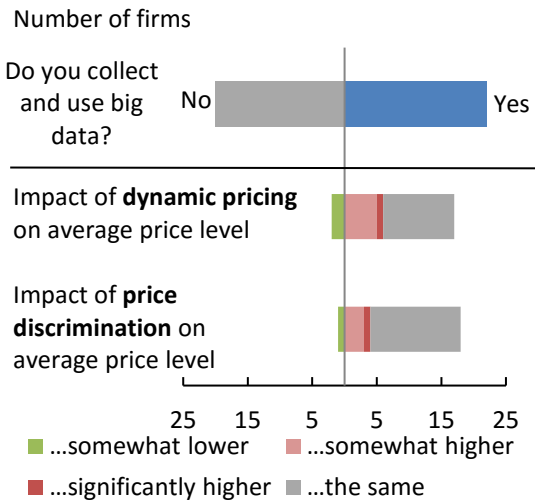
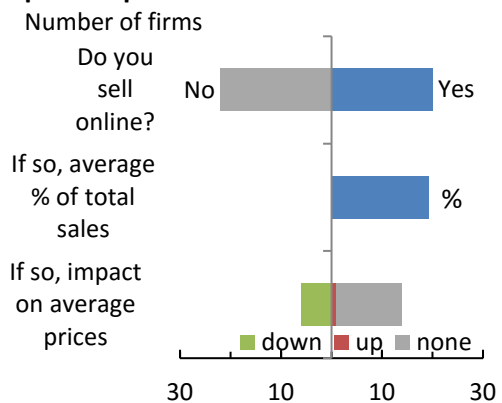


Chart 9: About half of firms sell online, with a small negative direct price impact



¹⁰ Firms not seeing any gains in scalability related to technologies were concentrated in logistics and referred to still-significant capital expenditures or labour costs needed to increase operations, or to a high share of variable costs (e.g., fuel).

retention or reduced costs.

Firms tend to charge the same price online and in-store, at least for now (Chart 9). Firms whose online sales are having an impact on their prices find that it is negative. Increased price transparency and comparability online are putting downward pressure on some firms' prices, since they now feel forced to match the prices of their (online) competitors. Online sales may also be less profitable (fewer bundle-buys) and skewed toward lower-margin goods compared with in-store sales, adversely affecting profits.

4) Changes in market structure and competition exert downward pressure on prices

The literature suggests several hypotheses on how digitalization may affect market structure. Survey participants stated that **winner-takes-most/dominance of superstar firms is the most representative dynamic affecting market structure in their industry**, particularly in retail and logistics. Many firms agree that digital technologies tend to hurt smaller firms and allow dominant firms (e.g., Amazon) to become even bigger, and have observed increased industry concentration. Firms argue that only larger businesses can afford to invest in digital technologies, sell online and market on the web, quickly leaving behind small independents with limited financial resources (e.g., "Mom and Pops" and non-adopters).¹¹ Price transparency and comparability are viewed as skewing sales toward the most competitive firm, reinforcing the winner-takes-most dynamic. Large firms may also develop an "ecosystem," where customers are enticed to go with the same provider for subsequent purchases.

Yet, several firms see a "democratizing force" in how technologies allow smaller players to reach markets more easily. Respondents refer to lower barriers to entry, since business can theoretically be done anywhere and selling online provides a level playing field for smaller firms. Firms in the logistics industry cited a surge of smaller players as the cost of tracking and warehousing technologies declines, and the emerging "Uber of logistics."¹²

Finally, some mentioned that **business models are becoming more vertically integrated**; for example, trucking companies moving into logistics, including warehousing, and becoming more integrated with their customers' systems; retailers ordering directly from manufacturers; and wholesalers buying manufacturers to grow their margins through vertical integration.

Online competition is holding prices down, although the impact appears smaller than from traditional competition (Chart 10). Competitive pressure from new online sellers (such as born-digital Amazon), however, appears about on par with that from online sales of traditional retailers (e.g., Walmart). Retailers reported checking their competitors' prices and engaging in price matching or price beating to remain competitive. A few mentioned that the market is becoming "more efficient," since customers can easily determine the lowest price offered.

¹¹ For example, only large trucking firms may be able to afford the significant upfront costs for eLogs and new trucks that are more expensive because of sensors, cameras and geotrackers.

¹² The term refers to on-demand logistics services that match carriers (e.g., trucks, motorbikes or vans) with shippers. Businesses can use the service via apps to move and deliver their goods in a flexible way.

5) Customers exploiting online price transparency and comparability put downward pressure on prices.

Firms observe customers researching prices and being better informed about the product and competitors' offers at the time of purchase, given the low cost of comparison. **The majority of firms feel this behaviour negatively affects their prices, sometimes significantly so.** In addition to building online brand recognition or credible seller status, firms need to offer prices within a narrow margin of their competitors' or must even match the best price so as not to lose the customer. For many, the changing behaviour of customers magnifies competitive pressures, including from foreign firms. Some merely note that customers research product features, prices and availability before or while in the store, without seeing such behaviour affect their prices. Firms feeling shielded from downward pressure on prices cited reasons such as customized products and prices, having contracted or fixed prices, not selling products exposed to online competition, or dealing with older customers, who tend to shop less online.

Overall, firms judge that, with digital technologies, their prices are somewhat lower (Chart 11). Almost all trade firms see an overall negative impact on prices; results are mixed for logistics firms. More-transparent pricing and increased competition, cost savings (due to operational efficiencies, lower transaction costs and automation) that are passed on to the customer, scalability benefits and supply-chain efficiencies are among the factors most often cited. Some firms stated that service, customization or increased quality provide some protection against price pressures. Only a few judge that prices are somewhat higher with technologies, for example, since digital investments will be priced into products.

Looking ahead, the majority of firms expect some or major transformation of their industry (Chart 12), particularly in retail and logistics. Logistics firms most often referred to driverless trucks (with the potential to revolutionize logistics and reduce costs importantly), autonomous cars and car-sharing, as well as drone delivery. Other technologies with disruptive momentum include 3-D printing and platooning. Moreover, pick-and-place

Chart 10: Deflationary impact from online competition no stronger than from offline
Number of firms

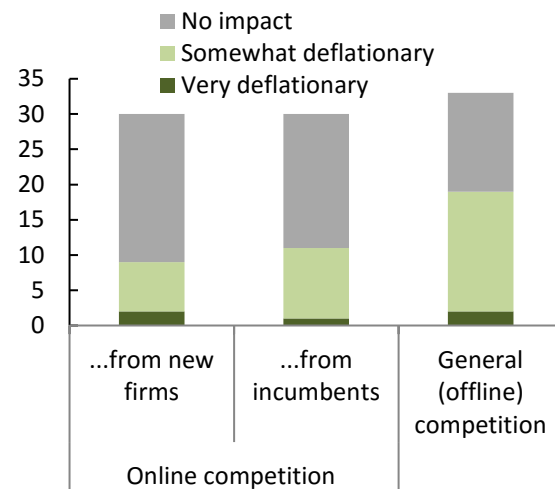


Chart 11: Overall impact of digital technologies is viewed as somewhat disinflationary
Number of firms

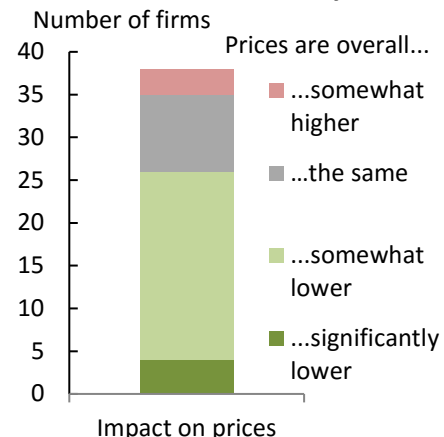
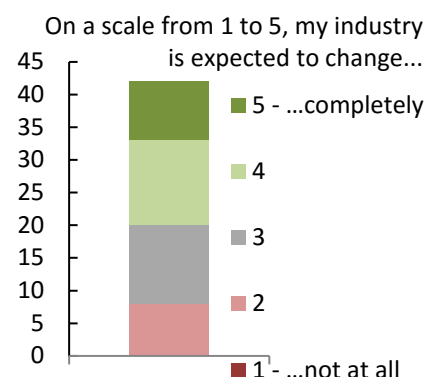


Chart 12: Most firms expect an important transformation of their industry
Number of firms



robots may significantly reduce costs and increase speed in warehousing. Firms also expect to see new business opportunities and models going forward,¹³ but also fewer physical stores.

By and large, the overall impact of digital technologies on firms' business is viewed as positive. Again, cost savings and operational efficiencies are the main reason for firms to view the impact as favourable overall, while some embrace opportunities for improving customer service and reaching more customers and exports via the web. A number welcome the disruption and consolidation in their industry that is being driven by technologies, forcing out smaller players and rebalancing the playing field. On the flip side, firms suffering from changes cite consolidation, decreasing importance of relationships with customers at the expense of price competitiveness, lower prices and lower profits.

Conclusion

Consultations with firms in retail, wholesale and logistics reveal that digital technologies are reshaping business operations and interactions with suppliers and customers in important ways.

While retailers focus on customer-facing technologies such as e-commerce, most respondents focus on cost-reducing initiatives (e.g., digital product tracking and automation in warehousing). Such technologies appear to reduce, or are expected to reduce, firms' costs, while also allowing more-scalable operations (implying IRTS), although several firms are lagging or struggling with implementation costs and hurdles. With the exception of a few positive effects of pricing strategies based on big data (e.g., dynamic pricing and price discrimination), the impact on firms' prices is negative, stemming from increased price transparency and comparability, which amplify (online) competitive pressures, and consolidation and concentration among industry leaders with the lowest prices.

We draw some tentative implications for monetary policy: Survey results point to some disinflationary pressures from digitalization, although the quantitative effects are uncertain and, moreover, difficult to disentangle from other factors, such as globalization. The continued increase in e-commerce (from a low level in Canada, but growing rapidly, particularly in favour of global players)¹⁴ may amplify disinflationary pressures stemming from increased online competition over the coming years, although the permanence of such an effect is unclear. More-scalable operations and new business models could also imply a weaker link between firms' capacity pressures and inflation. As well, policy-makers need to be aware of the ambiguous effects on employment and the adverse implications for smaller, less digitally savvy firms; the winner-takes-most dynamic drives less-efficient players out of the market, but also leads to higher industry concentration.

¹³ Examples of *new business opportunities* include manufacturers integrating technologies, moving the sector into service provision (e.g., [Rolls-Royce](#) and [Michelin](#) have moved to a service model). Examples of *new business models* include manufacturers directly selling to consumers without intermediaries such as distributors and retailers, and digital companies offering "free" services by generating revenue not from a sale but from advertising.

¹⁴ [Sklar \(2017\)](#) estimates that nearly half of online purchases in Canada are from foreign retailers.

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Appendix A

Table A.1: Sample summary statistics (42 firms) ¹⁵

	# of firms	%
Distribution by sector		
Retail (NAICS 44–45)	15	36
Wholesale (NAICS 41–42)	9	21
Logistics ¹⁶ (NAICS 48–49)	18	43
Distribution by region		
British Columbia and Yukon	8	19
Prairies & Northwest Territories	8	19
Ontario	7	17
Quebec	12	28
Atlantic	7	17
Distribution by firm size (# of employees)		
Small (less than 100)	5	12
Medium (100 to 500)	15	36
Large (greater than 500)	22	53

Appendix B: Discussion Guide

The following questions formed our discussion guide with firms participating in our survey. Some probing and clarification components of questions, as well as questions with responses not summarized in the analytical note, were removed.

Introduction

A1. Please describe your firm and business model.

A2. On average, how would you characterize your firm's annual sales growth over the past 3 years? **(Chart 1)**

- Strong
- Moderate
- Weak
- Flat
- Negative

A3. Over the next 12 months, do you expect your firm's sales growth to be

- Strong
- Moderate
- Weak
- Flat
- Negative

¹⁵ The survey was conducted from August 10 to September 19, 2017.

¹⁶ Logistics includes warehousing and distribution and excludes pure consumer transportation services.

Extent of adoption

B1. What are the major developments in digital technologies in your industry?

B2. To what extent has your firm adopted these digital technologies just mentioned? On a scale of 1 to 5, with 1 being “not at all” and 5 being “completely.” **(Chart 1)**

B3. To what extent do you use or plan to use these digital technologies just mentioned? **(Chart 2)**

	Firm			
	No plan to use / n/a	Plan to use over the next 3 years	Use to some extent	Use extensively
a. Digital tracking & handling of products/inventory				
b. Advanced automation and interconnected devices, including sensors ¹⁷ and machine-to-machine communication				
c. Technologies to interact with or manage customers				
d. E-commerce (B2B and B2C)				
e. [Big] data analytics processing & cloud computing				
f. Digital platforms ¹⁸ for interaction with related parties				
g. Others				

B4. What is the main objective of implementing technologies? **(Chart 3)**

	Relevance		
	Not at all	Somewhat	Very
a. Enhancing revenue sources (increase top line)			
b. Enhancing operational efficiencies/reduce costs (increase bottom line)			
c. Responding to external forces (supply chain, customer demands, competition etc.)			
d. Other, specify			

B5. What are the major obstacles or challenges you encounter (both within your company and outside of your company) when adopting digital technologies?

Impact on investment and employment

C1. In general, what types of spending would you categorize as a recurrent expense, and what types would you capitalize as an investment? What is the proportion of your IT and digital spending that is considered an expense versus an investment (capitalized)?

C2. What is the approximate proportion of your investment envelope that you spend on digital and information technologies? _____% **(Chart 4)**

C3. Compared with the past 12 months, over the next 12 months, your spending on digital and information technologies will be **(Chart 4)**

- ☐ Significantly higher
- ☐ Somewhat higher
- ☐ About the same

¹⁷ Environment-sensing devices (e.g. light sensors, infrared imaging and night vision sensors, motions sensors, etc.) that enable real-time data gathering, analytics and decision making. They are often networked to collaborate with other smart objects, humans or applications.

¹⁸ Digital platforms allow interaction with suppliers, consumers and employees to create or exchange goods, services and social interaction.

- Somewhat lower
- Significantly lower

C4. How does the adoption of digital technologies by your firm affect your other investment spending (M&E, structure), if at all?

C5. How does adoption of digital technologies affect the size and composition of your workforce and the way you manage it? **(Chart 5)**

	+	no change	-	not relevant
# of employees (net effect)				
Proportion of high-skilled workers				
Proportion of part time workers				
Proportion of sub-contracting				
Flexible work arrangement				
Training and development				
Organizational structure				
Other				

Impact on prices via various channels

Operational Costs

D1. To the best of your knowledge, by how much has the adoption of these technologies reduced operational costs? On a scale of 1 to 5, with 1 being “not at all” and 5 being “very importantly”. **(Figure 1), (Chart 6)**

D2. How are digital technologies affecting your supply chain? If so, to what degree does this have an impact on your costs?

D3. Are there any other ways that digital technologies affect your costs?

D4. What do you do with such cost savings? **(Chart 6)**

D5. If your sales volumes increased, would your costs increase proportionally, less, or more? Is this in any way related to the adoption of digital technologies (e.g. scalability of selling online, higher share of costs that is fixed due to digitalization of processes, etc.)? Explain **(Figure 1), (Chart 7)**

D6. How has the adoption of digital technologies affected your ability to increase your output with present resources/costs?

Pricing strategies

D7. Do you collect and use big data on your customer (e.g. via online purchases, fidelity programs, or apps)? If so, what for? **(Chart 8)**

D8. Has this changed the way you set prices? **(Figure 1)**

- Do you charge different customers different prices? If so, are your prices overall higher or lower as a result? **(Chart 8)**
- Do you set prices as a function of big data demand analysis? If so, are your prices overall lower or higher as a result? **(Chart 8)**

E-commerce (B2B and B2C)

D10. What is the approximate proportion of your online sales in total sales? _____% **(Chart 9)**

D10-a. How has the proportion of online sales changed compared with 3 years ago, roughly?

D10-b. How would you describe the impact of online sales on your business (e.g. your sales)?

D10-c. How would you describe the impact of your online sales on your prices? **(Figure 1), (Chart 9)**

Effects of digitalization in your industry and target markets

D11. How have digital technologies changed the market structure in your industry, if at all?

D12. Which of the two statements describes better what is happening in your industry?

- ☐ digital technologies allow dominant/superstar players to win more market shares
- ☐ digital technologies make it easier for new companies to enter the market and allow existing companies to reach more consumers more easily (e.g. expand into new geographical markets)
- ☐ Both
- ☐ Neither

D13. To what extent do you expect the continued evolution of digital technologies to change your industry over the next 3 years? On a scale of 1 to 5, with 1 being “no change” and 5 being “complete transformation” **(Chart 12)**

D14. How would you describe the impact of digital technologies employed by your competitors or firms in your industry on your pricing behaviour or strategies?

D15. Please rate how each of the factors below currently affects your prices (very inflationary (++) to very deflationary (--)), if at all. **(Figure 1), (Chart 10)**

Impact via competitors	++	+	no impact	-	--	Dk/not relev.
Online competition from <i>new</i> competitors						
Online competition from your <i>traditional</i> competitors						
General competition unrelated to online sales						

D16. Did you notice any change in the way your customers research prices (e.g. online) and react to your prices? If so, how does it affect your pricing? **(Figure 1)**

D17. Taking all together would you say your prices are higher or lower than without digital technologies? **(Figure 1)**

- ☐ Significantly higher
- ☐ Somewhat higher
- ☐ About the same
- ☐ Somewhat lower
- ☐ Significantly lower
- ☐ DK/NA

D17. Over the next 3 years, taking all together, how would you describe the impact of digital technologies on your prices compared to what you have seen to date? **(Chart 11)**

Conclusion

E1. Overall, how would you characterise the impacts of digital technologies on your firms' broad outlook (for the next 3 years or so)?

- Very favourable
- Somewhat favourable
- Neutral/offsetting/depends
- Somewhat unfavourable
- Very unfavourable

E2. Are there any other issues facing your firm or industry relating to digital technologies that you would like to discuss?