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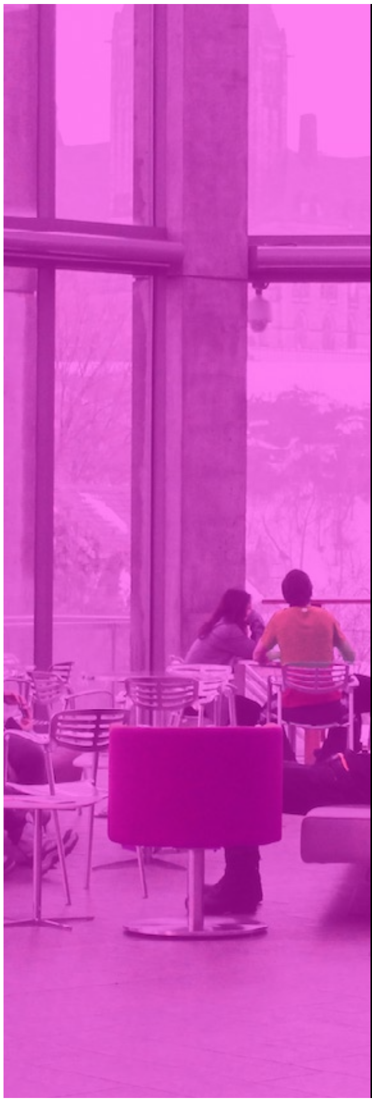
Skills and Productivity

Which Skills Shortages Are Impacting Canadian Productivity?

Impact paper | August 15, 2024



Future Skills Centre Centre des Compétences futures

The Future Skills Centre – Centre des Compétences futures (FSC-CCF) is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead.

The Future Skills Centre was founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada.

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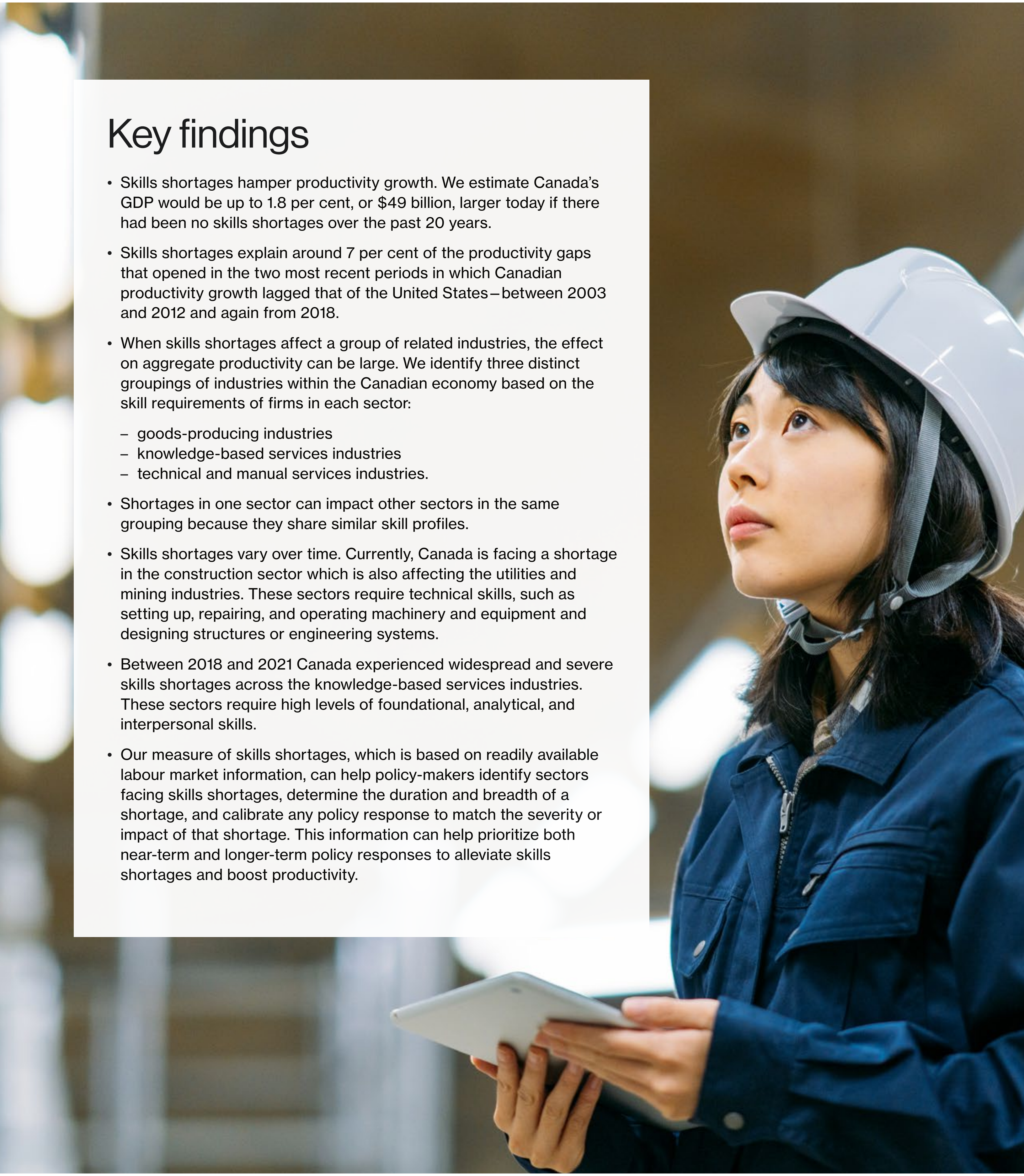
Contents

Key findings

- Skills shortages hamper productivity growth. We estimate Canada's GDP would be up to 1.8 per cent, or $49 billion, larger today if there had been no skills shortages over the past 20 years.
- Skills shortages explain around 7 per cent of the productivity gaps that opened in the two most recent periods in which Canadian productivity growth lagged that of the United States—between 2003 and 2012 and again from 2018.
- When skills shortages affect a group of related industries, the effect on aggregate productivity can be large. We identify three distinct groupings of industries within the Canadian economy based on the skill requirements of firms in each sector:
  - goods-producing industries
  - knowledge-based services industries
  - technical and manual services industries.
- Shortages in one sector can impact other sectors in the same grouping because they share similar skill profiles.
- Skills shortages vary over time. Currently, Canada is facing a shortage in the construction sector which is also affecting the utilities and mining industries. These sectors require technical skills, such as setting up, repairing, and operating machinery and equipment and designing structures or engineering systems.
- Between 2018 and 2021 Canada experienced widespread and severe skills shortages across the knowledge-based services industries. These sectors require high levels of foundational, analytical, and interpersonal skills.
- Our measure of skills shortages, which is based on readily available labour market information, can help policy-makers identify sectors facing skills shortages, determine the duration and breadth of a shortage, and calibrate any policy response to match the severity or impact of that shortage. This information can help prioritize both near-term and longer-term policy responses to alleviate skills shortages and boost productivity.



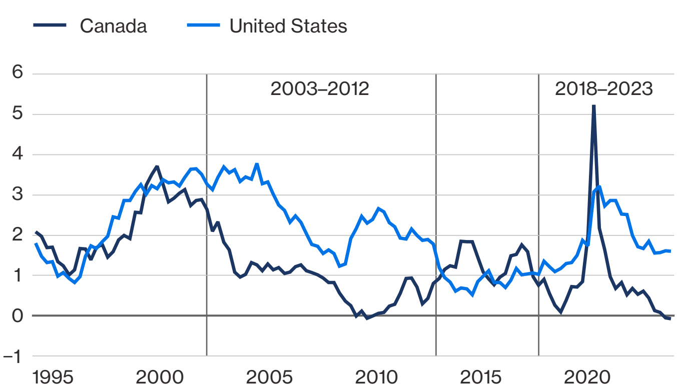
Canada's productivity problem

Canada has a productivity problem. Labour productivity growth—the amount of output produced per hour worked—has stalled. The Canadian economy's labour productivity at the end of 2023 was around the same as it was in 2017.[1] (See Chart 1.) This is the second time that Canada's productivity growth has been notably weaker than the United States' in recent decades, with the first occurring between 2003 and 2012.

Chart 1

Canada's productivity growth chronically lags the United States'

(real output per hour worked, business sector, 16–quarter annualized growth, quarterly)



Sources: The Conference Board of Canada; Bureau of Labor Statistics; Statistics Canada.

Also concerning is the consensus view from international organizations that Canada will face weak productivity growth over the coming years.

The International Monetary Fund's latest "World Economic Outlook", released in October 2023, forecasts that GDP per capita in Canada will increase by just 0.1 per cent per year between 2019 and 2028.[2] (See Chart 2.) If these projections materialize, they suggest only marginal growth in Canada's living standards, compared with the moderate growth experienced over the past three decades. The Organisation for Economic Co-operation and Development (OECD) also predicts that Canada's per capita GDP growth will rank last among OECD economies over the next 40 years.[3]

The typical explanations offered for Canada's lagging productivity performance include Canada's industrial structure, declining firm-level innovation, and lacklustre investment in Canadian start-ups and business dynamism.[4,5,6] But, there is a gap in our productivity dialogue–a missing focus on the role of skills shortages. In an increasingly high-skilled, high-value economy, the availability or lack of skills can hinder growth and introduce production bottlenecks that translate into lower productivity.

1 Canada's strong labour productivity growth during the pandemic was largely a result of structural shifts toward industries that carried out essential services. Early in the pandemic, hours worked declined more rapidly than output in response to lockdowns. See Wang, "Impacts of the COVID-19 Pandemic on Productivity Growth in Canada."

2 International Monetary Fund, "World Economic Outlook."

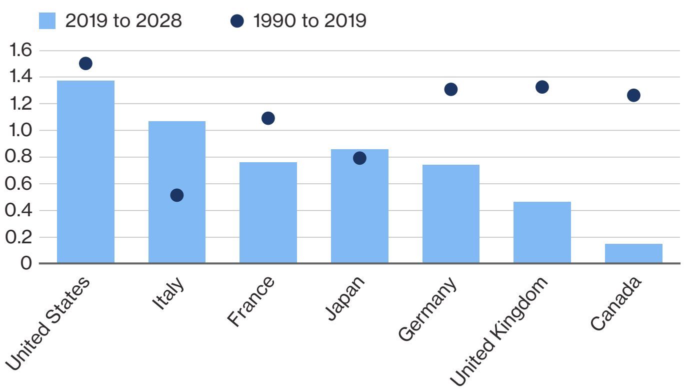
3 Guillemette and Turner, "The Long Game."

4 Sharpe, "Why Are Americans More Productive Than Canadians?"

5 Loertscher and Pujolas, "Canadian Productivity Growth."

6 Gu, *Frontier Firms, Productivity Dispersion and Aggregate Productivity Growth in Canada.*

Chart 2
Canada's GDP per capita is projected to grow much more slowly than its G7 peers
(real GDP per capita, average annualized growth)



Sources: The Conference Board of Canada; International Monetary Fund.

The lack of research into the importance of skills for productivity growth, combined with the fact that policy tools exist that can be highly effective in addressing skills shortages—such as education, training, and skilled migration—suggest that applying a skills lens for productivity is a promising line of enquiry. We study the relationship between skills and productivity and find that skill shortages—of both the technical skills required by goods-producing sectors and the foundational, analytical, and interpersonal skills required by the knowledge-based services sector—have been detrimental to productivity growth in Canada.

A skills lens for productivity

Skills, knowledge, and ability determine how effectively a worker can complete tasks for a given role. It's not just the supply of skills in an economy that matters for productivity—imbalances between the skills that employers demand and the skills of an economy's workforce, including skills shortages or mismatches, affect firms' performance and the wider economy.[7,8]

Firms and workers adjust when faced with skills imbalances, though shortages can persist for some time. In a perfectly competitive labour market, a shortage of a skill would result in an increase in wages for workers possessing that skill. Firms facing higher labour costs would adjust their production processes where possible to reduce demand for the higher-cost skill, and workers would seek out training to acquire the skill, both of which help bring supply and demand for the skill back into balance.

In reality, adjusting production processes takes time and firms cannot directly observe the exact skill set a prospective worker has, while job seekers do not know what prospective employers' skill needs will be. The lack of clear, observable information by job seekers and employers means that skills shortages can persist and weigh on productivity for extended periods.[9,10]

Designing policy to address skills imbalances can have significant effects on productivity but is complicated by the fact that the skills possessed by the workforce and the skills demanded by firms are constantly changing and are not well-known or readily observable at a given time. Cyclical factors can dramatically affect demand for skills, particularly for the skills required by sectors that experience large swings in demand for their output, such as mining or construction. Structural factors also affect skill supply and demand. Technology continues to reshape the skill requirements of many roles, while the increasing labour force participation of women and the aging population also affect both the demand and supply of skills in the workplace.[11]

Labour markets reveal skills imbalances

Determining what effect skills shortages have on productivity is challenging as it is not possible to directly observe and measure which skills are in shortage across the economy. Instead, labour market pressure is commonly used to proxy for skills shortages.[12]

7 Organisation for Economic Co-operation and Development, "Getting Skills Right."
8 Grimshaw, O'Mahony, and Westwood, "Skills for Productivity Growth."
9 Organisation for Economic Co-operation and Development, "Getting Skills Right."
10 This analysis does not determine what factors cause market adjustments to be slow or incomplete, or whether Canada's labour market adjusts more slowly—and is therefore more susceptible to chronic skills imbalances—than other economies. This question is left for future research.
11 Ibid.
12 Ibid.

Measuring skill shortages

Skills shortages, skills mismatch, and labour market pressure are three distinct concepts, though they overlap.[13] Because skills shortages are difficult to observe, we use measures of labour market pressure as a proxy.

Skills shortages arise when the skills sought by firms are not available in the pool of available candidates.

Skills mismatches occur when a worker's skill level exceeds or falls short of those required for their job. Skills shortages can lead to skills mismatches because firms employ workers who are under-skilled for the job.[14]

Labour market pressure is the result of scarce suitable labour; the degree of pressure is indicated by increases in an employee's wages and hours worked and a reduction in the number of people looking for work.

Sources: Mantione; Organisation for Economic Co-operation and Development; The Conference Board of Canada.

13 Mantione, *What's in a Name?*

14 Organisation for Economic Co-operation and Development, "Getting Skills Right."

For example, if an industry or occupation is facing a skills shortage, then it is likely that the number of unfilled job openings is high, the number of people actively looking for work in that area is low, and employment growth is strong (although there are cases where low availability of a particular skill may limit employment growth). Firms trying to recruit and retain workers in this environment will increase wages, and, if they are unable to recruit staff with appropriate skills, will increase the intensity with which their current workforce operates by having them work longer hours or accept a worker with an inferior skills match.

When facing skills shortages, it is the marginal, or additional, hour of work completed by its employees that will be less productive. This is either because the additional hours are worked by newly hired employees with lower skill levels, or in the case where a firm is unable to recruit anyone, by existing workers having to work longer hours. In both cases we can expect that the amount of output produced per hour for these additional hours worked will be lower.

Using multiple labour market indicators to proxy for skills shortages

No single labour market indicator provides a perfect read on skills shortages; each, at best, is a noisy measure.[15] In theory, wages should be an ideal way to measure the balance of supply and demand in a labour market. In reality, wage signals do not always tell the whole story; some firms may increase working hours rather than offer higher wages to meet skills shortages. In addition, average wages may be affected by workforce compositional changes. Wages also reflect macroeconomic trends (such as during a recovery from a recession) which may not reflect skills shortages.

15 Ibid.

To cut through the noisiness of each individual indicator, we use six common labour market indicators at the industry level to construct our skills shortage proxy:

- the change in share of workers working overtime hours
- the change in the average hours worked per week
- employment growth
- the unemployment rate[16]
- wage growth
- change in the labour share of income.

To leverage all of these indicators in conjunction, we use principal component analysis to extract a common signal of the degree of labour market pressure, in effect combining our indicators into single series that explains the most amount of variation across each of the six individual series.[17] To abstract from economy-wide trends, we look at the relative labour conditions in 15 industries by using the difference between industry-level and economy-wide labour market indicators.[18] This approach is based on OECD's methodology for estimating skills shortages using labour market indicators as a proxy.[19] Our industry-level approach also allows for us to control for differences in average capital intensity and labour conditions across industries.

Notably, our measure does not include the vacancy rate—which measures the proportion of jobs that are unfilled for a given period—due to data limitations.[20] Over the sample for which we observe our labour market pressure measure and the vacancy rate, we find the measures are positively correlated, and our measure of labour market pressure tends to lead the vacancy rate by one year. See Appendix A for details.

16 The inverse of the unemployment rate is used so that an increase in all our indicators corresponds to an increase in labour market tightness.

17 See Appendix A for a detailed description of the methodology.

18 See Table 1 in Appendix A for the list of industries and their North American Industry Classification System (NAICS) identifiers.

19 Our approach differs from OECD's approach described in *Getting Skills Right* in a few key respects: i) we estimate labour tightness at the industry rather than occupation level to match productivity accounts data; ii) we use additional labour market indicators (share of workers working overtime and the share of income accruing to labour) though we do not include a measure of underqualification; iii) we use principal component analysis to combine individual indicators rather than using fixed weights—our results are robust to the latter.

20 Statistics Canada's Job Vacancy and Wage Survey (JVWS) is available only from 2015 and the Survey of Employment, Payrolls and Hours (SEPH) reported vacancy rates only from 2011 to 2019, with 12 per cent of observations missing values due to unreliability.

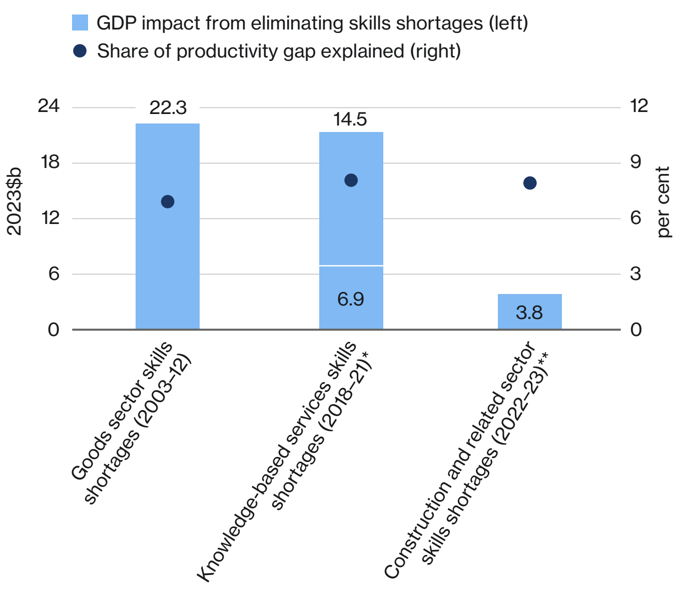
Skills shortages lower productivity growth

Not having enough workers with the right skills hampers Canada's productivity growth. Over the past 20 years, Canada has experienced three distinct periods where skills shortages in major industrial clusters contributed to weak productivity growth, 2003–12, 2018–21, and 2022–23. In each of these periods, around 7 per cent of the gap between U.S. and Canadian productivity growth can be explained by skills shortages.[21] (See Chart 3.) Without the skills shortages observed since 2018, Canada's productivity growth would have averaged 0.3 per cent versus 0.1 per cent per year, and GDP would be up to $26 billion larger in total over the last six years.

Chart 3

Skills shortages explain 7 per cent of the gap between U.S. and Canadian productivity during periods of weaker Canadian productivity

(cumulative GDP effect in 2023 Canadian dollars (left); share of productivity gap explained (right)



*$6.9 billion is the estimated effect of skills shortages in 2018 and 2019, $14.5 billion is the estimated effect of skills shortages in 2020 and 2021 which may be affected by lockdowns in non-essential sectors; the share of the gap explained is calculated over the pre-COVID years.

**Related sectors include utilities and mining.

Sources: The Conference Board of Canada; Statistics Canada, Bureau of Labor Statistics.

Skills shortages in one industry can impact others

Shortages in one industry can impact the available skills supply, and hence productivity, in others with similar skill requirements. We find that there are three distinct groupings of industries most similar to each other in terms of the skill requirements they place on their workers, which we term: i) *goods-producing industries;* ii) *knowledge-based services industries;* and iii) *technical and manual services industries*. (See Chart 4.) These groups, or clusters, are determined using an unsupervised machine-learning technique using the 33 skills included in the Occupational and Skills Information System (OaSIS) database, aggregated up from 900 occupations to our 15 industries.[22] This algorithm allocates industries to clusters to minimize the distance between each industry and the centre of the cluster to which it belongs.

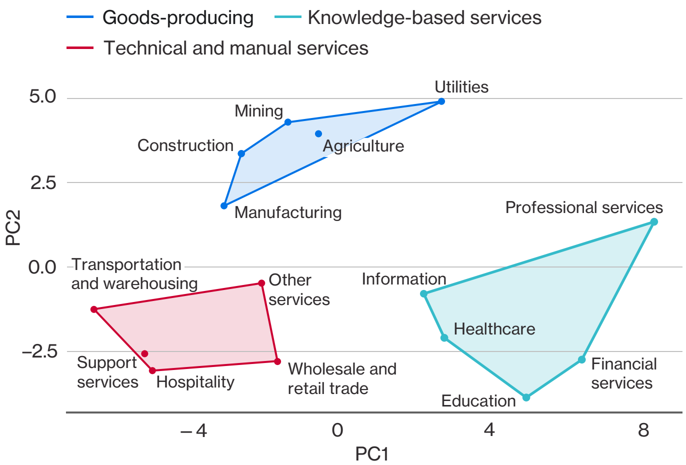
In addition to skills, OaSIS's database covers 49 abilities and 44 types of knowledge, each ranked on a 0–5 scale, as well as information on the importance of 40 work activities that employees perform. Using these other dimensions of OaSIS's database broadly confirms these three groupings but also provides some additional insights.[23] Clustering over knowledge profiles reveals that the knowledge-based services industries tend to be more specialized. Healthcare and education require specialized knowledge and both of these industries are distinct from each other and all other industries. Professional services and financial services also require specialized knowledge, though the knowledge profile between the two sectors is very similar, which is consistent with the correlation observed in their labour market pressure indicators in our sample.

21 See box "Estimating the contribution of skills shortages to productivity growth."

22 Employment and Social Development Canada, "Occupational and Skills Information System (OaSIS) Methodology."

23 See Appendix A for the full set of industry clusters.

Chart 4
There are three distinct groups of industries in terms of common skill demand
(k-means clusters, 1st and 2nd principal component)



Sources: The Conference Board of Canada; Employment and Social Development Canada.

Skills shortages in knowledge-based services weakened productivity from 2018

The most recent period where Canadian productivity growth lagged the U.S. began in 2018. This coincides with when the knowledge-based services sectors—which includes financial services, professional services, healthcare, education, and information services—experienced persistent skills shortages in the lead up to and during the height of the pandemic. Our estimates suggest that these shortages reduced aggregate productivity growth by 0.1 percentage points per year in 2018 and 2019 and by 0.3 percentage points per year in 2020 and 2021. Eliminating these skills shortages in 2018 and 2019 would have therefore boosted GDP by $7 billion, closing by 8 per cent the productivity gap that opened up between Canada and the U.S. over this period. Our estimates imply that eliminating skills shortages in knowledge-based services alone would have increased GDP by $15 billion over 2020 and 2021.[24]

Skills shortages in the construction sector are currently weighing on productivity

Skills shortages in knowledge-based services were resolved in 2022, though the most recent estimates of our labour market tightness indicator suggest that some goods-producing sectors are currently struggling to find appropriately skilled workers. Skills shortages reduced productivity growth over 2022 and 2023 in construction, and to a lesser extent in the utilities and mining sectors, explaining 8 per cent of the overall gap between U.S. and Canadian productivity over this period. Eliminating shortages in the construction sector alone would have increased GDP by $2.4 billion over the past two years, and GDP would be nearly $4 billion higher if they were eliminated across all three sectors.

Persistent skills shortages in goods sectors weakened productivity in the 2000s

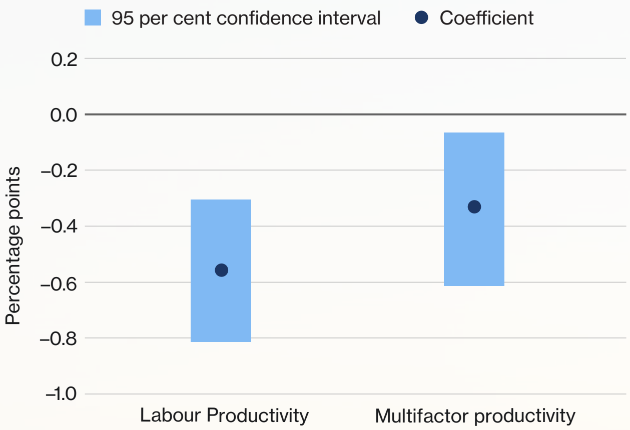
This is not the first time that skills shortages in goods-producing sectors have weighed on Canadian productivity. Shortages in the goods-producing sector between 2003 and 2012 reduced productivity growth by 0.1 percentage points per year. Eliminating these would have increased GDP by $22 billion and closed the gap between U.S. and Canadian productivity during this period by 7 per cent.

24 Our proxy for skills imbalances is based on relative labour market conditions, and therefore may be influenced by lockdowns in non-essential services during the height of the pandemic.

Estimating the contribution of skills shortages to productivity growth

We find a negative and statistically significant relationship between our proxy for skills shortages and productivity. When industries are facing relatively tighter labour markets than the rest of the economy—indicating that skills in that sector are in short supply—we find that they experience lower labour and multifactor productivity growth.
(See Chart 5.)

Chart 5
Skills shortages lead to lower labour productivity and multifactor productivity growth
(coefficient estimates and confidence intervals)



Note: Productivity growth response to a 1 standard deviation increase in labour market tightness.
Sources: The Conference Board of Canada.

To calculate the contribution these skills shortages are having on aggregate labour productivity, we multiply the labour productivity coefficient estimate by each industry's measure of skills shortage and scale these by each industry's share of overall output. Because our measure of skills shortages varies over time, this produces a set of time series of skills shortages' contribution to productivity growth, by sector.

The key assumption underpinning our analysis is that skills shortages drive the observed relationship between labour market pressure and productivity. Though, there may be other factors that are correlated with our labour market imbalance indicator that also affect productivity growth. To be confident that skills are driving this relationship, we conduct a large number of sensitivity and robustness checks. For example, we find consistent results even when controlling for firm entry and exit rates, which confirms we are not picking up that less-productive firms tend to exit when labour markets are loose. We also find consistent results when we allow for both more or less cyclical variation in our labour market pressure indicator. We also confirm that results are not driven by the inclusion of a particular labour market indicator or industry, by dropping one indicator and one industry at a time and re-running our analysis.[25]

25 For a detailed discussion of these robustness and sensitivity checks, see Appendix A.

Which skills do we need?

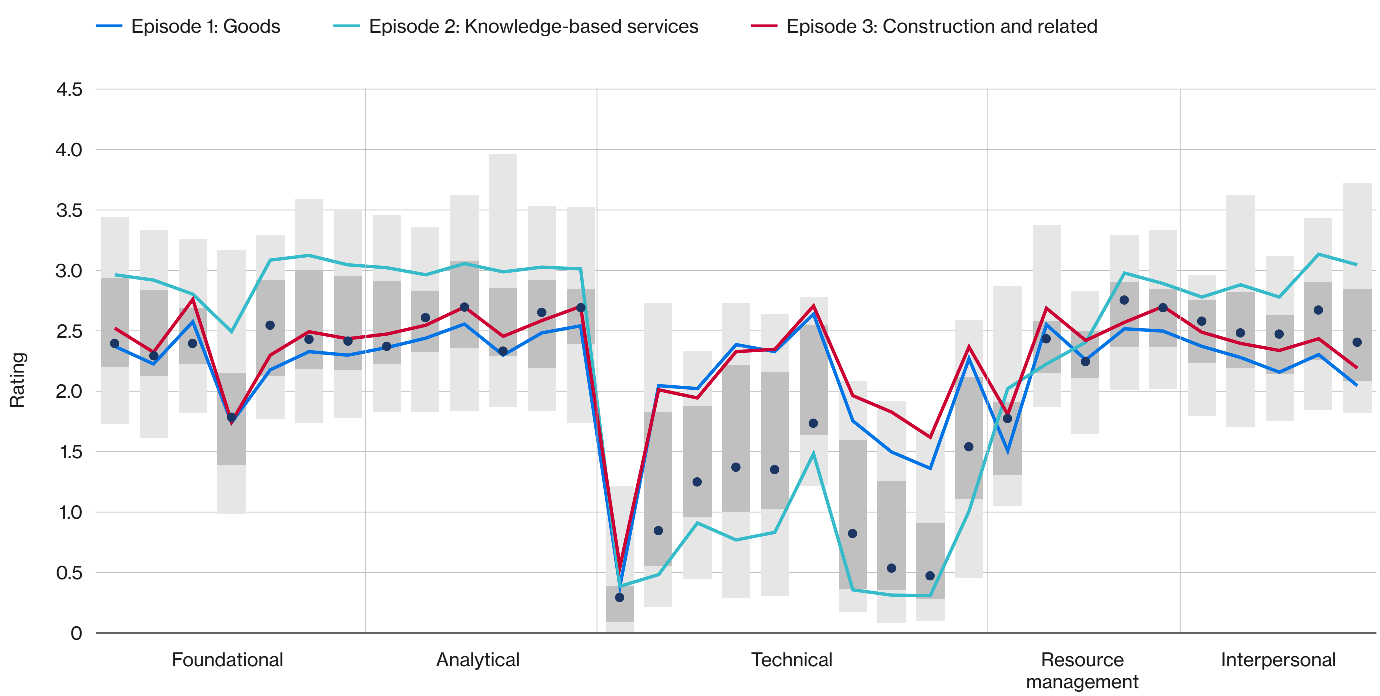
The skills that Canada needs at a given point in time depends on which industries are facing skills shortages. For example, knowledge-based services faced skills shortages in the lead up to and during the pandemic. We know from the OaSIS database that these industries require relatively higher levels of foundational, analytical, and interpersonal skills than other sectors. (See Chart 6.) By comparison, the current skills shortages facing the construction and associated sectors imply that technical skills are in short supply, as was the case during the goods-producing sector skills shortage in the 2000s.

Comparing the broad skill requirements over these episodes, the skills demanded by the knowledge-based services sector tend to be skills that are generally required across all sectors, but at a higher level. The median industry requires a low-to-moderate level of foundational, analytical, and interpersonal skills across its workforce, and even the industry with the lowest requirement across each of these skills demands at least some proficiency. Compare this with the technical skills demanded by goods-producing industries. The median industry requires only the lowest level of technical skill proficiency, implying that for half the industries in our sample, technical skills are generally not required on a day-to-day basis.

Chart 6

Current skills shortages are in industries with higher technical skill requirements

(average skill level across industries; range shown in grey)



Note: Dark grey indicates interquartile range, light grey overall range, and blue dot the median across industries. Skill profiles for episodes weighted by contribution to productivity gap. Skill requirements are rated: 0 (not required), 1 (lowest), 2 (low), 3 (moderate), 4 (high), and 5 (highest).
Sources: The Conference Board of Canada; Employment and Social Development Canada.

We can narrow this down further and determine the five specific skills facing the largest degree of shortage out of the 33 skills captured by OaSIS, calculated as the size of the gap between each individual skill requirement and the median skill requirement for each episode.[26] (See Table 1.)

- Episode 1: During the goods sector skills shortage between 2003 and 2012, skills shortages were experienced across all goods-producing sectors, but the impact on aggregate productivity was largest for construction, manufacturing, and mining. The five largest skill gaps were all technical skills related to machinery and equipment: preventative maintenance, operation and control, operation monitoring, setting up and repairing.
- Episode 2: During the knowledge-based services skills shortage between 2018 and 2021, skills shortages were broad-based across the knowledge-based sectors, with the largest drag on productivity coming from the financial services sector. The five largest individual skill gaps span three broad skill categories and include, in order: digital literacy, oral comprehension, learning and teaching strategies, critical thinking, and social perceptiveness.
- Episode 3: The current skills shortage in the goods-producing sector largely reflects shortages in the construction sector. The five largest skill gaps are all in the technical skills category: setting up equipment, maintenance, product design of structures and engineering systems, repairing, and operation monitoring of equipment.

Table 1
Skills classification

Foundational	Analytical	Technical	Resource management	Interpersonal
Reading	Critical thinking	Digital production	Financial resources	Coordinating
Writing	Decision-making	Maintenance	Material resources	Instructing
Numeracy	Evaluation	Equipment selection	Personnel resources	Negotiating
Digital literacy	Learning and teaching	Operation and control	Monitoring	Persuading
Active listening	Problem solving	Operation monitoring	Time management	Perceptiveness
Oral comprehension	Systems analysis	Quality control		
Oral expression		Repairing		
		Setting up		
		Product design		
		Troubleshooting		

Notes: Skill names shortened for brevity. The order of skills in the table match the order in Chart 6.
Sources: Employment and Social Development Canada; The Conference Board of Canada.

26 Employment and Social Development Canada, “Skills and Competencies Included in the Occupational and Skills Information System (OaSIS).”

Understanding the context of skills shortages

Considering the context of a skills shortage informs how best to respond. While our measure of labour market imbalance will indicate whether each of the 15 industries in our sample is facing a skills shortage in a given year, any policy-maker response needs to be calibrated to the severity or impact of that shortage. For example, their response should consider the breadth of the shortage across industry clusters, the duration of the shortage, the specific skills that are in shortage, and where possible, to try to understand the driver of the shortage.

Breadth

Broader skills shortages are more likely to result in weaker aggregate productivity growth and therefore benefit to a greater degree from policy-maker intervention. In the episodes where skills shortages have meaningfully reduced productivity across Canada, shortages have been experienced across multiple industries within the industry skill clusters identified in Chart 4. (See Chart 7.) A broader skills shortage across industries with similar skill requirements is more likely to reflect actual skills shortages rather than other idiosyncratic factors affecting a specific industry's labour market.

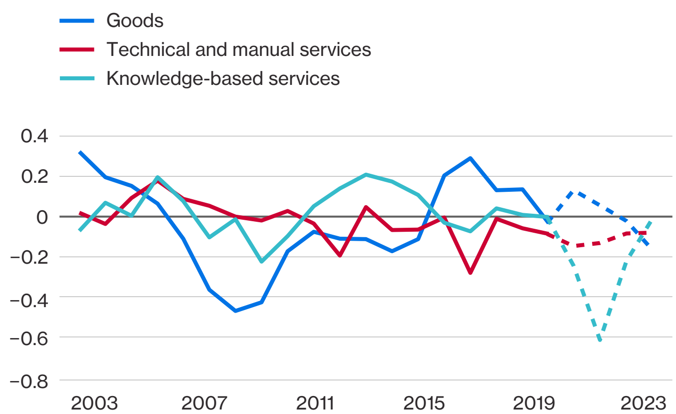
Duration

The longer a skills shortage has persisted, the more likely that it would benefit from policy intervention. Our measure of skills shortages can be noisy, and bounce around year to year. A string of several years of skills shortage for a particular sector is more likely to reflect a skills shortage, rather than noise or idiosyncratic factors. In addition, even in cases where our proxy for skills imbalance is picking up an actual skills shortage, some imbalances will resolve themselves relatively quickly without intervention as the cause of the shortage abates and/or firms and workers adjust.

Chart 7

Skills shortages in the goods- and knowledge-based services sectors were broad-based and weighed on productivity growth

(percentage point change in labour productivity growth due to skills shortages)



Note: four-year rolling average. Dotted line represents estimates for 2020–23, holding labour share of income fixed at 2019 levels.
Sources: The Conference Board of Canada.

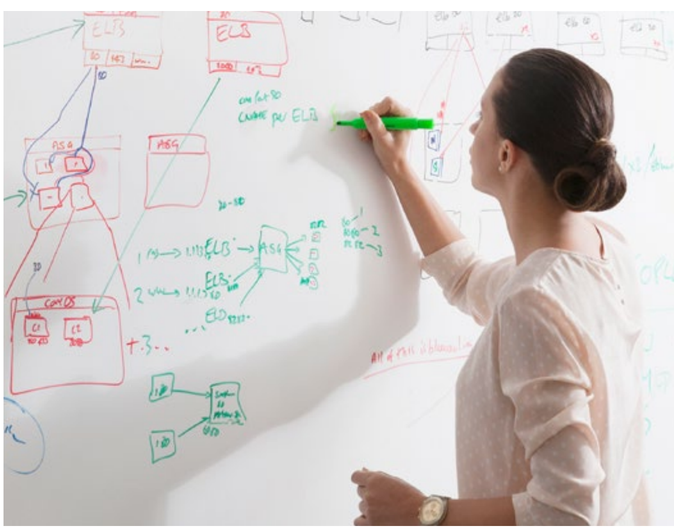
Specific skills

Any potential intervention must also consider what skills are specifically in shortage and the mechanisms available for increasing those skills in the workforce. Some skill increases can be achieved quickly. A small increase in more specialized skills might be possible through micro-credentials. Or an increase in a skill widely possessed across the workforce (e.g., foundational or interpersonal skills) may be achievable through on-the-job training. Conversely, addressing large imbalances in analytical or technical skills may take longer, and require encouraging more students and career transitioners to enter specific education pathways such as undergraduate university study or apprenticeships and college. In these cases, interventions may take several years to have an impact.

Drivers

Skills shortages reflect an imbalance in the supply of skills in the workforce relative to the demands of firms. In cases where a shortage reflects a sharp change in the demand for skills, determining whether this shift in demand is likely to persist can help inform the optimal response. This is of course difficult to determine in real time; for example, it was not possible *ex ante* to know whether the increases in oil prices in the early 2000s, which boosted demand for technical skills in the goods-producing sectors, were likely to be persistent, or how long the COVID-19 pandemic and associated restrictions were likely to impact both the supply and demand for the analytical skills required by the knowledge-based services sectors.

More generally, our measure of labour market pressure does not indicate whether an imbalance is due to a change in supply or demand for labour and is agnostic about the driver of these shifts. But this information can be important when considering the appropriate response to address a skills imbalance. For example, a skills shortage in an individual sector could reflect relative wage and working conditions, in which case increasing the supply of skills through training and education programs may not solve the problem.



How policy-makers can address Canada's low productivity

We have demonstrated that skills matter for productivity. Skills shortages, in both goods-producing and knowledge-based services sectors, explain around 7 per cent of the gap between U.S. and Canadian productivity growth that opened up in the 2000s and again in 2018. Eliminating these skills shortages would have increased GDP by up to $49 billion. Governments, firms, and workers all have an incentive to align skills demand and supply, though imperfect information hinders this adjustment process. Policy-makers, therefore, have a role in identifying which parts of the economy are facing skills shortages to help inform potential policy responses.

Recommendation 1: Monitor which skills are in short supply, as well as the context of skills shortages

Measures of skills imbalances like the ones used here can be used to monitor which parts of the economy are facing skills shortages. Combining these insights with data on occupational skill requirements, such as the OaSIS database, shows which specific skills are in short supply at a given point in time. Our measure of skills shortages changes over time, indicating not only whether an industry is currently facing a skills shortage, but also for how long the shortage has persisted, and how volatile skills imbalances have been historically. Our groupings of industries based on skill requirements can help determine how broad a skills shortage is across sectors with similar skill demands. These factors provide important context to inform any response to address skills shortages.

Recommendation 2: Deploy near-term solutions such as immigration and streamlined credential recognition to address skills shortages

Immigration has an important role to play in rapidly reducing skills imbalances in industries where worker and skills demand can be volatile. The federal government, in consultation with the provinces, determines the level and composition of Canada's annual immigration intake.[27] Historically, the immigration system was not set up to select immigrants with the skills and experience in in-demand occupations; rather, it prioritized high levels of education and language proficiency in French and English.[28] This appears to be changing.

In 2023, Immigration, Refugees and Citizenship Canada began selecting immigrants based on work experience, known as Category-based selection in the Express Entry program, and this list includes candidates with experience in the skilled trades.[29] The Provincial Nominee Program can also facilitate meeting these in-demand needs. Success in addressing skills imbalances through immigration requires not only that programs target in-demand skills and understand the transferability of skills between occupations, but also that these skills and qualifications of new Canadians are recognized and accepted by employers.

Recommendation 3: Use education and training policy to address persistent imbalances.

Education and training programs shift the supply of skills more gradually than targeted immigration, though they have the advantage that Canada is not competing with other countries for a fixed pool of skilled migrants. While education policy is the responsibility of provincial governments, tweaking education and training programs to address skills imbalances are not solely incumbent on the provinces; firms and industry associations have a role to play in articulating their requirements and providing training programs for their existing workforce.

For sectors with persistent skills shortages and strong future growth prospects, longer-term training and education-based solutions are critical to ensure the Canadian workforce has the skills employers require in the future. In addition to education and training policy, there may also be broader policy initiatives that can help support more rapid skills adjustment by workers and firms when facing skills shortages.

Addressing the current skills shortage

Skills shortages in the construction sector, as well as mining and utilities, are currently weighing on productivity in Canada and have reduced GDP by close to $4 billion over the past two years. Increasing the technical skills of the Canadian workforce that these industries require will boost productivity, which in turn will drive an increase in living standards. While this technical skills shortage has lasted only for two years to date and demand in construction and mining has historically been volatile, skills shortages in the construction industry are expected to persist over the coming decade as construction workers reach retirement age and demand from home construction accelerates.[30]

Putting our recommendations into practice means that both short-and longer-term solutions are required. Targeted skilled immigration has an important role to play in rapidly reducing technical skills shortages combined with investment in training and education to increase the pipeline of appropriately skilled workers. Indeed, Budget 2024 included measures to encourage Canadians to explore education pathways into the trades as well as allocating more resources to help streamline foreign credential recognition in the construction sector.[31] Developing a comprehensive policy response to address technical skills shortages, and any future skills shortage that arises in Canada, would benefit from further work exploring skills shortages at a more granular level.

27 De La Durantaye-Guillard, Brosseau, and Elgersma, *Immigration Policy Primer.*
28 Craft, Forge, and Dennler, *Work in Progress.*
29 Immigration, Refugees and Citizenship Canada, "Express Entry Rounds of Invitations."
30 Government of Canada, *Budget 2024.*
31 Ibid.

Appendix A

Technical methodology

Skills proxy methodology and estimation approach

Our proxy for skills availability at the industry level is the first principal component of a suite of relative labour market indicators (LMI) at an annual frequency, estimated at the industry level.

Specifically, the relative deviation from the aggregate Canadian economy is calculated for six LMIs:

- percentage point change in the share of workers working more than 40 hours per week. Source: Statistics Canada, Table 14-10-0036-01;
- change in the average actual hours worked at main job. Source: Statistics Canada, Table 14-10-0036-01;
- log difference in employment. Source: Statistics Canada, Table 14-10-0022-01;
- inverse of the unemployment rate. Source: Statistics Canada, Table 14-10-0022-01;
- log difference in the average weekly wage rate. Source: Statistics Canada, Table 14-10-0063-01;
- percentage point change in the labour share of nominal value added. Source: Statistics Canada, table 36-10-0480-01.

Specifically, for each industry (*i*) and time period (*t*), a relative measure of each of the six LMIs is computed:

$$relative\ LMI_{i,t} = LMI_{i,t} — aggregate\ LMI_t$$

Using these relative labour market variables allows us to abstract from the economy-wide business cycle, and instead focus on industry-specific changes in labour market conditions.

For each industry we standardize each relative LMI variable and calculate the first principal component (PC1) of these six relative LMIs. PC1 is estimated separately for each of the 15 industries listed in Table 1, allowing the factor loadings, or weights, to vary by industry:

This first principal component captures the relative degree of labour market tightness or skills shortage for each industry. The higher the value for PC1, the greater the degree of labour and skills shortage in that particular industry.

Productivity growth is then regressed on this measure of labour market tightness:

$$\Delta \ln(Productivity_{i,t}) = ßPC1_{i,t} + n_i + T_t + \mu_{i,t}$$

We estimate the effect of labour market tightness on both:

- the log difference of labour productivity, measured as chained (2012) dollars per hour. Source: Statistics Canada, Table 36-10-0480-01);
- the log difference of multifactor productivity based on value-added. Source: Statistics Canada, Table 36-10-0217-01.

Labour productivity is a function of the quality of labour, availability of capital, and how effectively labour is able to utilize this capital. If labour market tightness is negatively correlated with investment, then a negative coefficient ($\hat{ß}$) on labour market tightness could reflect less capital deepening, rather than anything to do with skills. To ensure our results are being driven by labour quality or the effectiveness with which labour is able to utilize capital—both of which are reflective of worker skills—we regress multifactor productivity, which controls for the stock of capital, on our measure of relative labour market conditions.

This model is estimated over 22 years (1998 to 2019) with heteroscedasticity-robust standard errors. We include industry fixed effects (n_i), to control for the fact that industries have different levels of trend productivity growth, and year fixed effects (T_t), to account for any common changes in productivity across all industries in a particular year.

Table 1

Industry names and North American Industry Classification System correspondence

Short industry name	Long industry name	NAICS
Agriculture	Agriculture	11A,115
Mining	Forestry, fishing, mining, quarrying, oil and gas	113, 114, 21
Utilities	Utilities	22
Construction	Construction	23
Manufacturing	Manufacturing	3A
Wholesale and retail trade	Wholesale and retail trade	41,4A
Transportation and warehousing	Transportation and warehousing	4B
Financial services	Finance, insurance, real estate, rental and leasing	52,53
Professional services	Professional, scientific, and technical services	54
Support services	Business, building, and other support services	551113,56
Education	Educational services	61
Healthcare	Healthcare and social assistance	62
Information	Information, culture, and recreation	51,71
Hospitality	Accommodation and food services	72
Other services	Other services (except public administration)	81

Note: Long industry name refers to the NAICS industry classification system used in the labour force survey; the NAICS code represents the correspondence used to match the productivity accounts.
Sources: The Conference Board of Canada; Statistics Canada.

Effect of skills on productivity-detailed results

Tighter labour markets, as measured by PC1, are associated with weaker labour and multifactor productivity growth at the industry level. (See Table 2.)

We run robustness checks that confirm our results are not sensitive to:

- using actual rather than relative labour market conditions;
- the set of labour market indicators used to calculate the first principal component;
- the set of industries included;
- the sample period;
- including other factors that may drive productivity which are correlated with labour market tightness (e.g., business dynamism);
- using the relative trend of each labour market indicator to abstract from cyclical factors;
- including lags of both productivity and labour market tightness.

Table 2

Regression of log difference of productivity on relative labour market tightness
(annual; 1998 to 2019)

	I Labour productivity	II Multifactor productivity
$PC1_{i,t}$	–0.0056*** (0.0013)	–0.0034** (0.0014)
Observations	330	330
Fixed effects	Industry, year	Industry, year
R^2	0.273	0.254

Note: heteroskedasticity-consistent standard errors in parentheses
* p < 0.10, ** p < 0.05, *** p < 0.01
Source: The Conference Board of Canada.

Exploring different methods of constructing labour tightness

To ensure that our results are not being driven by the way our labour market tightness measure abstracts from the business cycle, we estimate two specifications at opposite ends of the spectrum. Specification III uses a PC1 calculated on actual rather than relative labour market indicators, so does not attempt to abstract from the business cycle at all. Specification IV, on the other hand, removes even more of the cyclical component, by first extracting the trend of each labour market indicator using a Hodrick–Prescott filter (λ=6.25) and expressing this relative-to-overall economy trend to construct PC1. This approach matches how the Organisation for Economic Co-operation and Development (OECD) constructs its relative labour market balance indicator. In both cases the results are consistent with our baseline specification. (See Table 3.) We also ensure that our results are not sensitive to using principal component analysis by using fixed equal weights to combine our normalized relative labour market indicators (where like OECD's method, all indicators have weight w except the change in employment which has weight $0.5w$).

Varying the set of labour market indicators used

To ensure that our results are not driven by the inclusion of a specific labour market indicator, and in particular the concern is for indicators such as hours worked – in which measurement error common to the dependent and independent variables would drive a negative relationship – we construct and test multiple versions of our relative labour market tightness indicator by dropping one labour market indicator each time and find consistent results. (See Table 4.)

Dropping the labour share of income, which is available only to 2019 at the industry level, allows us to confirm that our results hold when including 2020, 2021, and 2022.

Table 3

Regression of log difference of labour productivity on labour market tightness

(annual; 1998 to 2019)

	III Actual LMIs	IV Relative trend LMIs	V Fixed weights
$PC1_{i,t}$	–0.0028** (0.0014)	–0.0033*** (0.0010)	–0.0084** (0.0035)
Observations	330	330	330
R^2	0.233	0.241	0.233

Note: heteroskedasticity-consistent standard errors in parentheses, includes industry and year fixed effects
* p < 0.10, ** p < 0.05, *** p < 0.01
Source: The Conference Board of Canada.

Table 4

Specification VI regression of log difference of labour productivity on relative labour market tightness

(annual; 1998 to 2019)

	Excluding average hours	Excluding overtime share	Excluding unemployment	Excluding unemployment rate	Excluding wages	Excluding labour share
$PC1_{i,t}$	–0.0065*** (0.0014)	–0.0037** (0.0015)	–0.0048*** (0.0014)	–0.0058*** `(0.0014)	–0.0046*** (0.0014)	–0.0048*** (0.0013)
Observations	330	330	330	330	330	330
R^2	0.274	0.239	0.258	0.272	0.255	0.257

Note: heteroskedasticity-consistent standard errors in parentheses, includes industry and year fixed effects
* p < 0.10, ** p < 0.05, *** p < 0.01
Source: The Conference Board of Canada.

Varying the set of industries included

Our results are not driven by a particular industry; we find our estimates of the effect of labour market tightness on productivity is consistent when we run our regression dropping one industry at a time. (See Table 5.)

Including measures of business dynamism

It is possible that the relationship we observe between labour markets and productivity is driven by a third factor, such as business dynamism. When business conditions are weak, it is likely that the least productive firms are the ones that exit. In Canada, exit rates have been found to Granger cause productivity, and this relationship is positive—when exit rates increase, productivity increases.[1] To rule this out as the main driver of our results, we include measures of business dynamism: entry, exits, and the share of employment created or destroyed by firm entry and exit.

This measure is available for all our industries except *education* and *health*, and the definition of *agriculture* and *forestry, fishing, mining, quarrying, oil and gas* differ—in the dynamism data, the forestry and fishing sub-industries are included with agriculture.

Our results are not driven by business dynamism; the effect of labour market tightness on labour productivity remains statistically and economically significant when including measures of business dynamism (Specification XI). Simple correlation tests suggest that *mining, quarrying, oil and gas* is the only industry where entry and exit rates are positively and negatively correlated with our measure of labour market tightness, respectively; excluding this sector also yields consistent results (Specification X).

Table 5

Specification VII regression of log difference of labour productivity on relative labour market tightness

(annual; 1998 to 2019)

	Coefficient (standard error)	Observations	R^2
Excluding agriculture	−0.0044*** (0.0012)	308	0.266
Excluding mining	−0.0044*** (0.0012)	308	0.300
Excluding utilities	−0.0056*** (0.0013)	308	0.288
Excluding construction	−0.0058*** (0.0014)	308	0.276
Excluding manufacturing	−0.0054*** (0.0014)	308	0.265
Excluding wholesale and retail trade	−0.0057*** (0.0014)	308	0.269
Excluding transportation and warehousing	−0.0059*** (0.0014)	308	0.271
Excluding financial services	−0.0062*** (0.0014)	308	0.294
Excluding professional services	−0.0059*** (0.0014)	308	0.271
Excluding support services	−0.0053*** (0.0013)	308	0.278
Excluding education	−0.0059*** (0.0013)	308	0.293
Excluding healthcare	−0.0055*** (0.0014)	308	0.261
Excluding information	−0.0056*** (0.0014)	308	0.266
Excluding hospitality	−0.0059*** (0.0014)	308	0.273
Excluding other services	−0.0060*** (0.0014)	308	0.283

Note: heteroskedasticity-consistent standard errors in parentheses, includes industry and year fixed effects

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: The Conference Board of Canada.

1 St-Amant and Tessier, *Firm Dynamics and Multifactor Productivity.*

Table 6

Regression of log difference of labour productivity on relative labour market tightness
(annual; 1998 to 2019)

	VIII Baseline excluding education and healthcare	**IX Including business dynamism**	**X Including dynamism; excluding mining**
$PC1_{i,t}$	–0.0063*** (0.0015)	–0.0056*** (0.0015)	–0.0051*** (0.0014)
Entry $rate_{i,t}$		–0.0044*** (0.0016)	–0.0017 (0.0016)
Exit $rate_{i,t}$		0.0029 (0.0034)	–0.0016 (0.0029)
Employment creation rate by $entries_{i,t}$		0.0067 (0.0053)	0.0059 (0.0056)
Employment destruction rate by $exits_{i,t}$		–0.0080** (0.004)	–0.0064 (0.0093)
Observations	260	247	228
R^2	0.283	0.304	0.275

Note: heteroskedasticity-consistent standard errors in parentheses, includes industry and year fixed effects
* p < 0.10, ** p < 0.05, *** p < 0.01
Source: The Conference Board of Canada.

Including lags of productivity and labour market tightness

To ensure our labour market tightness measure helps explain productivity over and above what past productivity growth alone would tell us, we include lags of productivity growth in our specification. We also include lags of our independent variable—labour market tightness—to see whether skills imbalances tend to have only contemporaneous effects, or whether a skills imbalance in a particular year can have prolonged effects on productivity, even after the shortage is resolved.

We find that increased labour market tightness reduces productivity growth even after controlling for past productivity growth, and that the effect of labour market tightness is contemporaneous only. (See Table 7.)

Table 7

Regression of log difference of labour productivity on relative labour market tightness
(annual; 1998 to 2019)

	XI Baseline including lagged productivity	**XII Baseline including lagged LMI**	**XIII Baseline including lagged productivity and LMI**
$PC1_{i,t}$	–0.0058*** (0.0013)	–0.0060*** (0.0014)	–0.0059*** (0.0013)
$d(log(labour\ productivity)_{i,t-1}$	0.0677 (0.1106)		0.0582 (0.1143)
$PC1_{i,t-1}$		–0.0011 (0.0012)	–0.0007 (0.0012)
Observations	315	315	315
R^2	0.286	0.284	0.286

Note: heteroskedasticity-consistent standard errors in parentheses, includes industry and year fixed effects
* p < 0.10, ** p < 0.05, *** p < 0.01
Source: The Conference Board of Canada.

Relationship between labour market tightness and vacancy rates

To check how our measure of labour market tightness compares with the vacancy rate, we construct an annual measure of the average vacancy rate from 2011 to 2022, splicing together series from Statistic Canada's Job Vacancy and Wage Survey (JVWS) and Survey of Employment, Payrolls and Hours (SEPH). Statistics Canada's JVWS is available only from 2015 and the SEPH reported vacancy rates only from 2011 to 2019, with 12 per cent of observations missing values due to unreliability.[2] We use the common sample of both vacancy rate series to predict what the JVWS series would have been before 2015 given the observed relationship with the SEPH observations at the industry level, interpolating for missing values where required. We regress this vacancy rate series on our measure of labour market imbalance and find a positive correlation, and that our measure of labour market imbalance tends to lead the vacancy rate by around a year.

Table 8

Regression of vacancy rate on relative labour market tightness

(annual; 2011 to 2022)

	XIV Contemporaneous	XV Contemporaneous and lagged
$PC1_{i,t}$	0.0020 (0.0576)	0.0140 (0.0578)
$PC1_{i,t-1}$		0.1207* (0.0722)
Observations	180	180
R^2	0.604	0.619

Note: heteroskedasticity-consistent standard errors in parentheses, includes industry and year fixed effects

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: The Conference Board of Canada.

Constructing skills profiles by industry

OaSIS provides skill, ability, knowledge, and work activity profiles for over 900 occupations. But our analysis requires us to construct industry-level skills profiles to match what we use for estimating the effect of skills imbalances on productivity. This is a three-step process:

- Aggregate OaSIS skills-rating by occupation from 7-digit to 5-digit National Occupational Classification (NOC), where needed, using simple averages.
- Construct 3-digit and 5-digit North American Industry Classification System (NAICS) skills profiles using occupation employment shares by industry from the 2021 Census.
- Aggregate up to our industry groupings, weighting by employment share (approximately 2-digit NAICS with some differences to match Statistics Canada's grouping of industries in labour market data).

Clustering over skills, ability, knowledge, work activities, and skills imbalances

OaSIS provides an extremely rich and detailed picture of the demands of individual occupations; our industry profiles preserve all these different dimensions and contain ratings on a 1–5 scale of the 33 skills, 49 abilities, 44 types of knowledge, and 40 work activities.

K-means clustering is an unsupervised machine learning approach that attempts to sort a certain number of observations, in our case, industries, into a specified number of sensible groups or clusters. This is the same approach used for a similar exercise in previous Conference Board research, which grouped 500 occupations based on their skills profiles using the O*NET database into eight clusters.[3] The assignment of an industry to a cluster is based on minimizing the Euclidean distance between industries and centre of the cluster to which it belongs. We use elbow graphs to choose the optimal number of clusters. This is a plot of the number of clusters against the amount of variation explained. Adding more clusters mechanically increases the amount of variation explained, but there is generally a point where the *increase* in variation explained slows, or where the "elbow" is located in the plot. The benefit of adding additional clusters beyond this point is diminished. These elbow graphs suggest that the optimal number of clusters is three for skills, knowledge, and work activities, and six for knowledge.

Table 9 presents the exhaustive list of cluster membership by industry. Skills and work activity produce identical groupings of industries. The optimal number of clusters based on knowledge is six rather than three, suggesting that *agriculture*, *health and social assistance*, and *education* have specialized knowledge requirements. When clustering over abilities, there are some goods industries, such as *utilities and manufacturing*, that look more like technical and manual services. *Transportation and warehousing* more closely resembles the goods sector in terms of both abilities and knowledge.

2 Statistics Canada, Job Vacancy and Wage Survey (JVWS); Statistics Canada, Table 14-19-0226-01.

3 Gabler, *Beyond Blue and White Collar.*

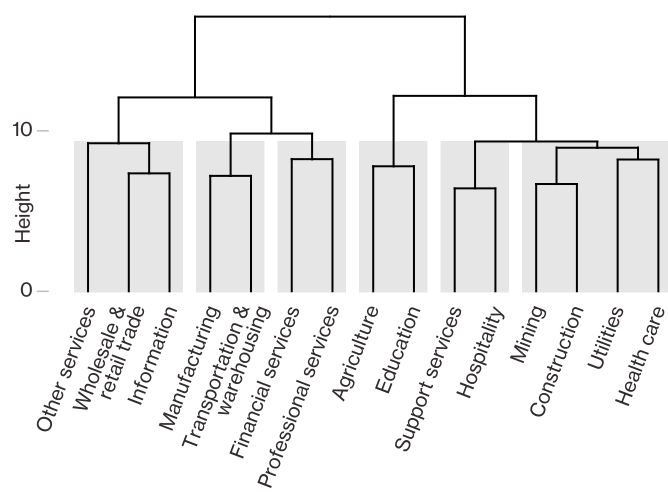
Table 9
Cluster membership by work dimension and industry

	Skills	Abilities	Knowledge	Work Activities
Agriculture	Goods	Goods	Unique	Goods
Mining	Goods	Goods	Goods	Goods
Construction	Goods	Goods	Goods	Goods
Utilities	Goods	Technical and manual	Goods	Goods
Manufacturing	Goods	Technical and manual	Goods	Goods
Transportation and warehousing	Technical and manual	Goods	Goods	Technical and manual
Wholesale and retail trade	Technical and manual	Technical and manual	Technical and manual	Technical and manual
Support services	Technical and manual	Technical and manual	Technical and manual	Technical and manual
Hospitality	Technical and manual	Technical and manual	Technical and manual	Technical and manual
Other services	Technical and manual	Technical and manual	Technical and manual	Technical and manual
Information	Knowledge-based services	Knowledge-based services	Technical and manual	Knowledge-based services
Financial services	Knowledge-based services	Knowledge-based services	Knowledge-based services	Knowledge-based services
Professional services	Knowledge-based services	Knowledge-based services	Knowledge-based services	Knowledge-based services
Education	Knowledge-based services	Knowledge-based services	Unique	Knowledge-based services
Healthcare	Knowledge-based services	Technical and manual	Unique	Knowledge-based services

Source: The Conference Board of Canada.

Chart 7 showed that the goods industries have faced similar periods of relative skills shortages over the past 20 years. To examine more formally which industries experience similar labour market imbalance over time, we use hierarchical clustering based on the error sum of squares.[4] This technique starts with 15 clusters each with one member, and then iteratively reduces the number of clusters by one each time to minimize the error sum of squares. This produces groups of industries into clusters that exhibit the most similar evolution of our labour market proxy for skills over our sample. This technique produces clusters broadly consistent with the k-means clustering analysis, and particularly using the knowledge dimension. (See Exhibit 1.) For example, mining, construction, and utilities appear in the same group, as does manufacturing and transportation and warehousing.

Exhibit 1
Hierarchical clustering over relative labour market tightness indicator
(Ward error sum of squares objective function)



Sources: Ward; The Conference Board of Canada.

4 Ward, "Hierarchical Grouping to Optimize an Objective Function."

Appendix B

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