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Wages: Measurement and Key Drivers



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Abstract

Available sources of hourly wage data in Canada sometimes send conflicting signals about wage growth. This note thus has two objectives: first, we develop a wage measure—the wage-common—to better capture the (underlying) wage pressures reflecting the common trend across the available data sources. Second, we re-examine the relationship between wage growth and macro drivers (labour market slack and labour productivity). We conclude that the wage-common is a superior estimate relative to individual sources because of its timeliness, its lower volatility and its good relationships with fundamentals. Our analysis indicates that labour market slack is the main factor still weighing on the wage-common growth in 2017Q3. Lastly, we investigate globalization (measured by wage growth in other advanced economies) as another potential factor behind the absence of wage pressures in Canada and find no evidence beyond what is already explained by the macro drivers.

Bank topics: Econometric and statistical methods; Labour markets; Recent economic and financial developments

JEL codes: C, C3, C38, J, J3

Résumé

Les sources de données disponibles sur les salaires horaires au Canada envoient parfois des signaux contradictoires quant à la croissance de ceux-ci. La présente note comporte donc deux objectifs : d'abord, nous concevons une mesure commune des salaires (salaires-comm), qui rend mieux compte des pressions sous-jacentes exercées sur les salaires et qui reflète la tendance pour l'ensemble des sources de données. Ensuite, nous réexaminons la relation entre la croissance des salaires et les déterminants macroéconomiques (marge de ressources inutilisées sur le marché du travail et productivité du travail). Nous arrivons à la conclusion que la mesure salaires-comm est une estimation plus efficace que chaque source prise individuellement, étant donné qu'elle est actuelle, moins volatile et bien corrélée avec les facteurs fondamentaux. Selon notre analyse, la marge de ressources inutilisées sur le marché du travail constitue le principal facteur qui continuait de peser sur la croissance de la mesure salaires-comm au troisième trimestre de 2017. Enfin, nous nous penchons sur l'incidence possible de la mondialisation (mesurée par la croissance des salaires dans d'autres économies avancées) dans l'absence de pressions salariales au Canada. Toutefois, ce facteur ne procure aucune information probante au-delà des explications déjà fournies par les déterminants macroéconomiques.

Sujets : Méthodes économétriques et statistiques; Marchés du travail; Évolution économique et financière récente

Codes JEL : C, C3, C38, J, J3

Summary

This note presents a new wage measure—the wage-common—to better capture the (underlying) wage pressures in Canada by extracting a common trend among available, and sometimes diverging, wage measures. Using the wage-common, we re-examine the relationship between wage growth and macro drivers (labour market slack and labour productivity). We also assess whether sluggish wage growth in advanced economies could have exerted a negative drag on wage pressures in Canada. The key findings are as follows:

- The wage-common is a superior estimate relative to individual sources because of its timeliness, its lower volatility and its good relationships with fundamentals.
 - While the Labour Force Survey (LFS) data are the most timely of the wage sources, they are also the least informative for the wage-common because LFS wage movements tend to be more idiosyncratic.
 - Among the individual sources, hourly compensation data from the Productivity Accounts also have a strong link to fundamentals in a wage regression. However, these data are released with a much longer delay (eight to nine weeks).
- In 2017Q4, the wage-common indicated that wage pressures were at 2.2 per cent (year over year [y/y]), up from a low of 1.1 per cent in early 2016 but still below the historical average of 2.7 per cent.
 - However, the rebound witnessed in 2017Q4 for LFS data (up to 2.7 per cent from 1.7 per cent y/y in 2017Q4) should be considered with caution, as the LFS wage signal has tended to be idiosyncratic in the past.
- Results from a wage regression suggest that ongoing drag from past labour market slack is still weighing on wage-common growth in 2017Q3 (removing 0.2 percentage points from its historical average).
 - Given that labour market slack is currently being absorbed, this drag should dissipate over the coming quarters.
 - Sluggish wage growth in other advanced economies does not appear to add any relevant information about Canadian wage growth beyond what is already explained by the macro drivers.

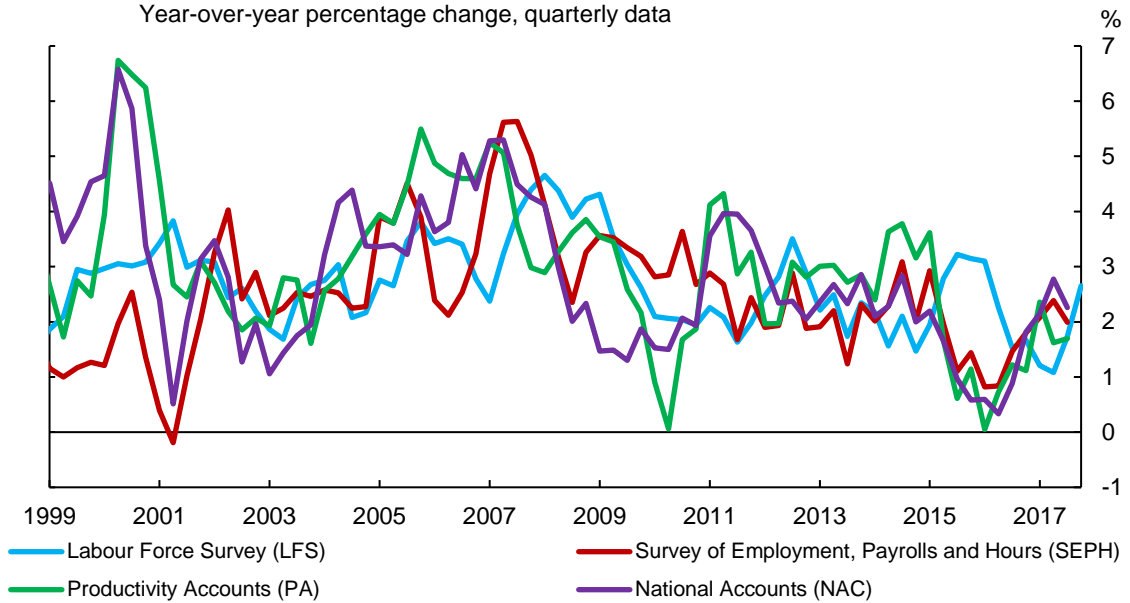
1. Is There a Need for Another Indicator?

While the exact amount of slack in the labour market is subject to uncertainty, there are several indicators that suggest it has begun to dissipate over the last year. For example, monthly job gains have been strong—averaging 35,000 in the last year compared with the post-2001 average of 18,000—and the unemployment rate now stands at 5.7 per cent, its lowest point since 1976. One area of concern, however, remains wage growth: while it continues to improve from its trough reached early in 2017, consistent with the labour market approaching full employment, most measures still remain below their post-1998 averages.

Wage growth data from the Labour Force Survey (LFS) and the Survey of Employment, Payrolls and Hours (SEPH) are the two main sources of wage growth data monitored by Bank staff; however, these data are volatile and can send diverging signals over certain periods, making it difficult to identify the most reliable source and the appropriate signal for wage pressures. This is particularly evident following the decline in commodity prices in late 2014, when the LFS wage measure diverged substantially from the other three wage series (**Chart 1**).

Chart 1: Wage growth provides conflicting signals

Year-over-year percentage change, quarterly data



Sources: Statistics Canada and Bank of Canada calculations

Last observation: SEPH, PA and NAC 2017Q3;
LFS 2017Q4

Additional information on domestic labour cost pressures can be gathered from hourly compensation data from the Productivity Accounts (PA) and wages and salaries data from the National Accounts (NAC), although their dynamics can differ from LFS and SEPH. These sources are also published with a longer lag than LFS (**Chart 1**).^{1,2}

As such, there is room for improvement in how we measure and analyze wage growth. A new measure of wage pressures from labour—the wage-common—summarizing the information contained in LFS, SEPH, PA and NAC data is presented in this paper and described in Section 2. The properties of this new indicator are assessed in Section 3. The relationship between the wage-common and fundamentals is investigated in Section 4, with a focus on the potential role of globalization, measured as wage growth abroad, in explaining the recent weakness in wages.

2. What is the Wage-Common?

Estimation method

A dynamic factor model is used to extract the common signal from LFS, SEPH, PA and NAC data. Each indicator is decomposed into two components: a common component that tracks co-movement between the four wage measures and an idiosyncratic component that captures any source-specific movement (equation 1). The unobserved common factor x_t , capturing the underlying wage growth of the four wage measures, is assumed to follow a first-order autoregressive dynamic (equation 2).

$$\begin{bmatrix} LFS_t \\ SEPH_t \\ PA_t \\ NAC_t \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} x_t + \begin{bmatrix} \mu_{1,t} \\ \mu_{2,t} \\ \mu_{3,t} \\ \mu_{4,t} \end{bmatrix} \quad (1)$$

$$x_t = \rho x_{t-1} + \epsilon_t \quad (2)$$

The parameters β , x_t , the covariance matrix of both the measurement shocks (μ_t) and the transition shock (ϵ_t) are estimated within a state-space framework using the Kalman filter (see Durbin and Koopman 2012). Estimation is performed using quarterly growth rates from 1997Q2 to 2017Q4 (**Chart B-1 in Appendix B**). Given the model parameters, we obtain the smoothed estimate of x_t , from which we construct the wage-common by

¹ The NAC hourly wages and salaries data are obtained by dividing labour income by total hours worked from SEPH. **Table A-1 in Appendix A** describes the different wage sources in more detail.

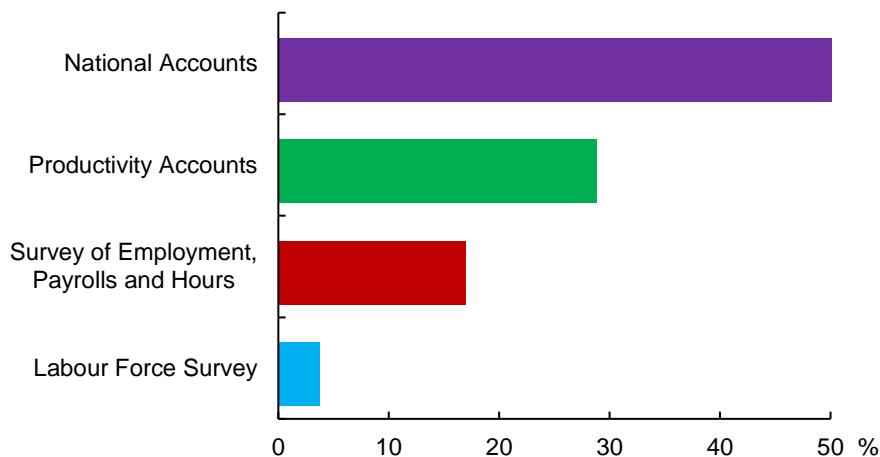
² For simplicity, we use wage pressures instead of domestic cost pressures coming from labour for the remainder of the note, despite the fact that wage-common is a blend of hourly wage growth (LFS and SEPH), hourly compensation and wages and salaries (PA and NAC, respectively).

benchmarking with the average of the four aggregate wage inputs and its respective standard deviation.

The wage-common has several advantages over individual wage indicators or a simple average. First, it helps to filter out the misleading individual signals; less weight is put on the sources that have more idiosyncratic dynamics. Second, the wage-common has a temporal dynamic: it averages not only across the four wage indicators but also over time. Third, the wage-common is available at the same time as the LFS data even if the SEPH, NAC or PA data have not yet been released, because it combines the past wage-common information (including all four signals of the previous quarter) and current available signals. For example, at the time of writing, we have LFS wage growth data for 2017Q4 to inform the wage-common, while the latest available data for the other measures are available only up to 2017Q3.

Chart 2 shows the weights of each indicator in the wage-common when all four wage data sources are available for a reference quarter.³ NAC data are the most informative source, followed by PA and SEPH. LFS data do not contribute much because they don't share similar historical dynamics with the other lagged sources.⁴ The fact that LFS data contribute the least to the wage-common highlights a key feature of using this estimation method: the first signal is not necessarily the most informative about wage pressures. Hence, LFS data become less instructive each time new data are released because the other sources are found to be more reliable signals for the wage-common measure.

Chart 2: Wage-common gives more weight to delayed data sources that share a similar dynamic



Source: Bank of Canada calculations

³ The weights refer to the relative Kalman gains.

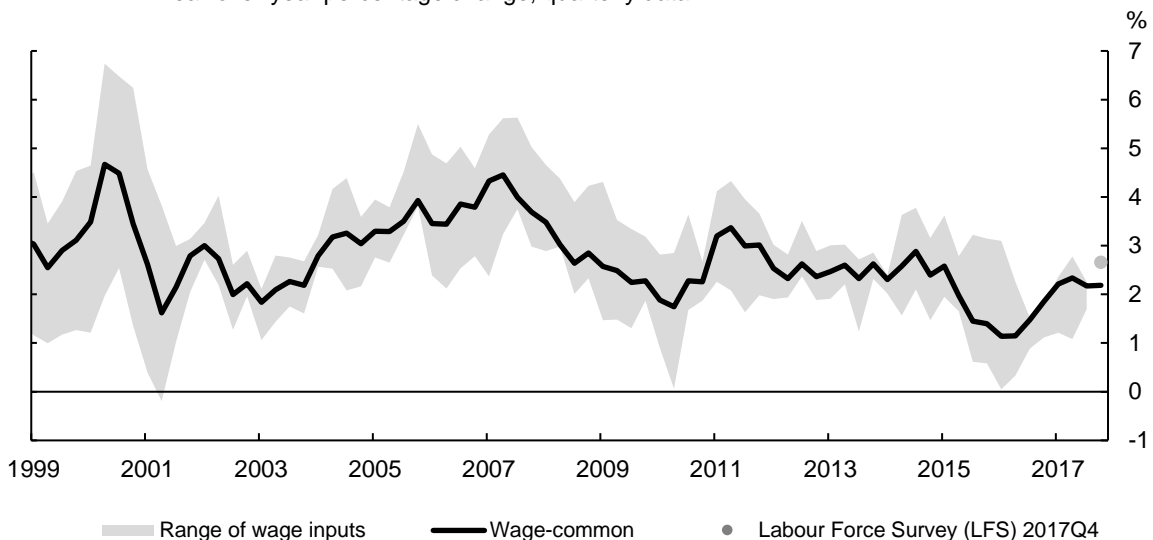
⁴ LFS correlations with the other three indicators are the lowest.

The recent dynamics of the wage-common

Chart 3 confirms that the wage-common filters out episodes of noisy signal. The wage-common depicts a clear signal of upward pressures from 2005–07, a period that coincides with excess demand in the labour market. While the other measures also show upward pressures, they were much more erratic (**Chart B-2 in Appendix B**). Additional evidence that the wage-common appears to closely track business cycles is that it further declined after the Great Recession and again following the commodity price decline. For example, it largely ignores the dynamic of LFS wage growth in 2015 and 2016, when that measure was at odds with the other sources (**Chart B-2 in Appendix B**). Lastly, the wage-common indicates that wage pressures were at 2.2 per cent (year over year [y/y]) in 2017Q4, up from a low of 1.1 per cent in early 2016 but still below historical average (2.7 per cent). However, the rebound witnessed in 2017Q4 for LFS (up to 2.7 per cent from 1.7 per cent y/y in 2017Q4) should be considered with some caution, since the LFS signal has tended to be more idiosyncratic in the past.

Chart 3: Wage-common filters out episodes of noisy signal

Year-over-year percentage change, quarterly data



Last observation: National Accounts, Productivity Accounts and Survey of Employment, Payrolls and Hours 2017Q3; LFS and wage-common 2017Q4

Sources: Statistics Canada and Bank of Canada calculations

We also explored whether using sectoral data yields a similar dynamic to the wage-common (**Box 1**). The sectoral analysis suggests there is no evidence that the wage-

common dynamics are dominated by wage movements in a few sectors, but reflects broad-based wage dynamics across sectors.⁵

3. How Does the Wage-Common Compare with Existing Indicators?

We evaluate the performance of the wage-common relative to five alternative benchmarks: LFS, SEPH, PA, NAC and a simple average of the four. **Table 1** shows that the wage-common outperforms or performs well compared with all benchmarks, based on several criteria. Indeed, the wage-common is timely, less volatile and more correlated with the labour gap and output gap than other indicators are.

To be informative for monetary policy, a good indicator of wage pressures should also exhibit strong relationships with fundamentals. To have a better understanding of wage dynamics, we estimate a simple wage regression relating wage dynamics to the amount of slack in the labour market and to labour productivity.⁶

Table 1: Wage-common is the preferred wage indicator*						
	LFS	SEPH	PA	NAC	Average	Wage-common
Timeliness	1 week	7–8 weeks	8–9 weeks	8 weeks	8–9 weeks	1 week
Volatility (σ) **	0.83	1.11	1.36	1.33	0.85	0.76
Persistence from AR(1) model **	0.83	0.79	0.80	0.82	0.83	0.85
Correlation with the output gap **	0.29	0.14	0.61	0.71	0.64	0.71
Correlation with the labour gap **	0.41	0.14	0.43	0.55	0.53	0.55
Link with fundamentals (R^2) ***	0.27	0.13	0.46	0.16	0.29	0.27

* Results are based on a sample from 1998Q2 to 2017Q3.

** Year-over-year wage growth is used for these statistics.

*** From the wage regression.

Note: LFS means Labour Force Survey; SEPH means Survey of Employment, Payrolls and Hours; PA means Productivity Accounts; NAC means National Accounts; and AR means autoregressive.

⁵ Regional breakdown is not considered because provincial data are not available for all sources.

⁶ More specifically, quarterly nominal wage growth is regressed on the labour market slack and labour productivity growth, with inflation added as a necessary control variable. Labour market slack is represented by the labour input gap, which represents the deviation of labour input (i.e., total employment multiplied by average hours worked) from its estimated trend.

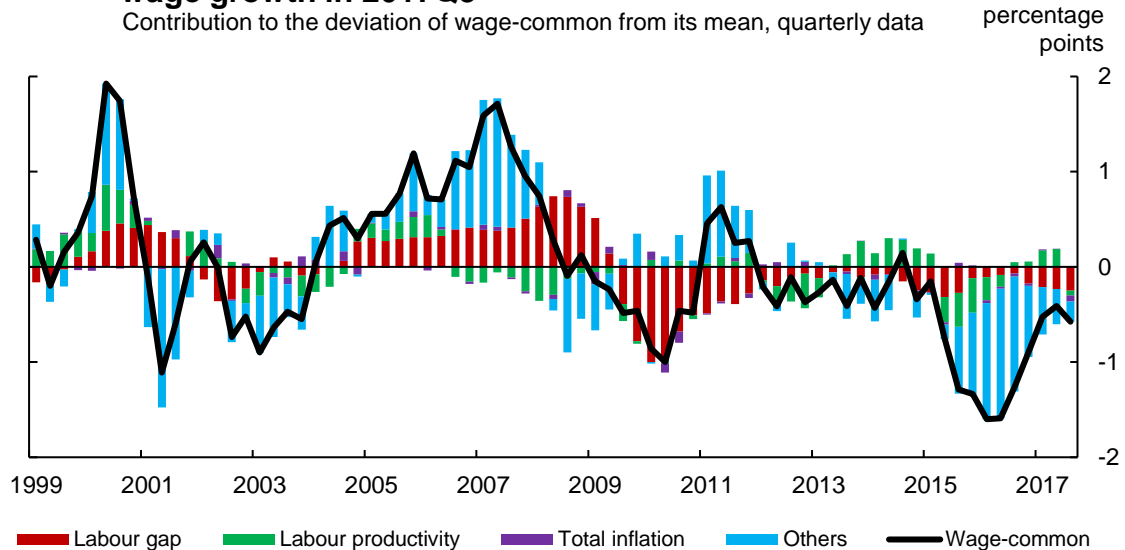
About 30 per cent of the variability in the wage-common is explained by fundamentals, and results are similar for the LFS and the average of the measures but higher for PA (last line of **Table 1**). However, LFS wage growth is found to have a much poorer relationship with the output gap over the post-recession period, while the wage-common still shows a strong correlation. Overall, while the PA dynamic may be somewhat more anchored to key fundamentals, its long delay of publication makes the wage-common a good compromise to extract all relevant information about underlying wage growth in a more timely fashion.

4. Can the Recent Dynamics of the Wage-Common Be Explained?

Decomposition of the wage-common

The results from the wage equation are used to decompose the year-over-year percentage change of the wage-common (**Chart 4**). The chart suggests that labour slack was the most important fundamental driver of the wage dynamic over the last 20 years, with a more limited role played by labour productivity. Consumer price index (CPI) inflation has been a marginal source of contribution over the estimation period.

Chart 4: Labour market slack is the main driver behind the weakness in wage growth in 2017Q3



Sources: Statistics Canada and Bank of Canada calculations

Last observation: 2017Q3

The recent wage dynamic appears to be partly driven by labour productivity growth. Following its persistent drag over 2015 and 2016, labour productivity became a main

contributor to the gradual pickup of wage growth in the first half of 2017. However, wage growth is no longer benefiting from strong productivity gain in 2017Q3. Past labour slack still remains a drag as of 2017Q3 (removing 0.2 percentage points from its historical average).⁷ Since the labour slack is currently being absorbed, this drag should disappear over the coming quarters (**Chart B-3** in **Appendix B**).

Other factors (residuals) seem to be less of a drag on wage growth, as the effects of the commodity price decline are now behind us. Indeed, the residuals have been large and negative from 2015 to mid-2016 but that drag is diminishing, a result consistent with previous work (Brouillette et al. 2017). Those factors could include the lingering effects from labour reallocation following the decline in commodity prices in late 2014 and changes in labour composition. Another factor not yet explored is how wages in other countries could impact wages in Canada in a global economy. Thus, in the next section we investigate whether modest wage growth observed in other advanced economies could account for the recent unexplained weakness in wage growth in Canada.

Accounting for global weak wage growth

A factor that could explain the absence of wage pressures is the sluggish wage growth in other advanced economies. **Chart B-4** in **Appendix B** shows two international wage growth measures: one derived from a principal component analysis (PCA), i.e., a global factor for wage growth, and the other being a trade-partner-weighted average.⁸ Both measures of global wage growth decreased after 2008 and have not yet recovered, particularly the global factor. Lower wage growth could reflect increased reliance on foreign labour in the production process through offshoring or outsourcing business activity to low-wage countries. This in turn could have exerted downward pressure on wage growth in advanced economies by, for instance, lowering the bargaining power of workers.

To examine the potential effect of globalization through the wage channel on the wage-common, we regress the wage-common residuals from **Chart 4** on each global wage measure separately. In both cases, the estimated coefficient of the global wage variable is not significant. These results suggest that global wage measures do not add any useful information beyond what is already embedded by the fundamentals.

⁷ Even though the peak impact of labour slack on the wage-common lags by two quarters, its cumulative impact is felt over a year.

⁸ The international wage measures are calculated with the growth of private sector hourly earnings indices of advanced economies available on the [OECD website](#). These economies are Korea, Australia, New Zealand, Sweden, the United States, the Euro area (19 countries), Denmark and Japan.

References

Brouillette, D., J. Ketcheson, O. Kostyshyna and J. Lachaine. 2017. "[Wage Growth in Canada and the United States: Factors Behind the Recent Weakness.](#)" Bank of Canada Staff Analytical Note No. 2017–08.

Durbin, J. and S. J. Koopman. 2012. *Time Series Analysis by State Space Methods: Oxford Statistical Science Series*. 2nd ed. Oxford University Press.

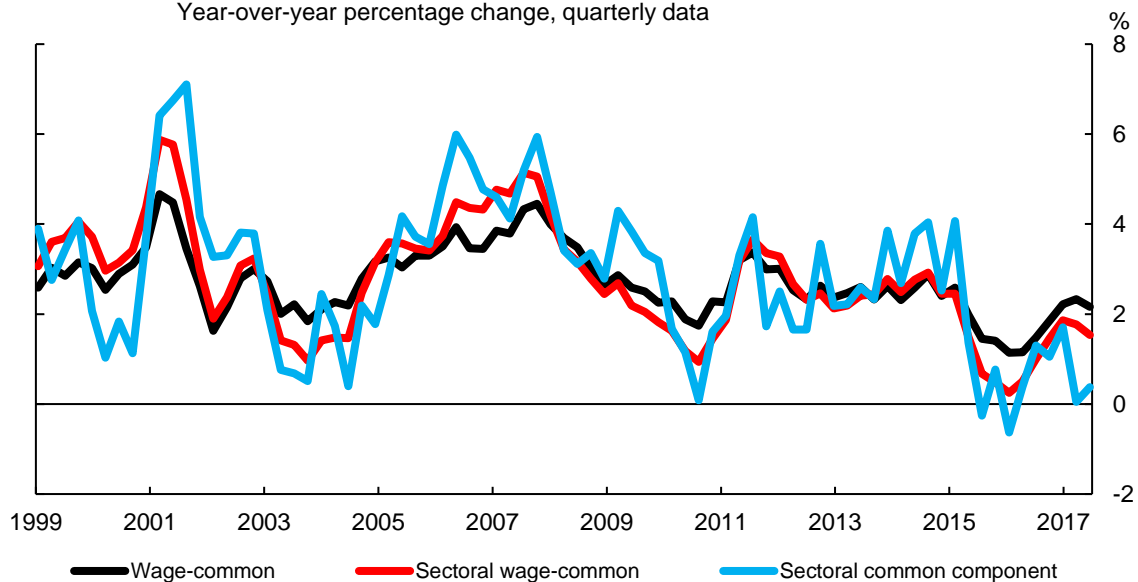
Box 1. Is the wage-common driven by sectoral movements?

The wage-common is the common trend among four aggregate wage inputs described in **Table A-1 of Appendix A**. Yet, to use it as an indicator of wage pressures, we must ensure that the aggregate common trend is not driven by the dynamics of a handful of sectors common to each source of wage data. To test this conjecture, we use two disaggregated approaches. The first involves performing a principal component analysis (PCA) on each wage source to extract indicators measuring broadness across their sectors. Based on these new wage inputs, we apply the same methodology as in Section 2 to estimate the sectoral wage-common.⁹ The second approach is to extract a common component using sectoral breakdown across wage sources (sectoral common component).

Over most of the sample period, the alternative benchmarks depict similar dynamics, although they are more volatile (**Chart 1-A**). This provides confidence that the wage-common dynamic is not dominated by a few sectors and likely reflects broad-based movements across sectors. This further supports our preference for the aggregated approach, since moving to a more complex disaggregated view does not materially provide better gauge for the direction of wage pressures in Canada.

Chart 1-A: Alternative benchmarks point to similar dynamics

Year-over-year percentage change, quarterly data



Sources: Statistics Canada and Bank of Canada calculations

Last observation: 2017Q3

⁹ National Accounts and Survey of Employment, Payrolls and Hours do not provide the same classification breakdown at the sectoral level.

APPENDIX A | Summary Table of Wage Inputs Used

Table A-1: Information on wage inputs included in the wage-common				
	Labour Force Survey (LFS)	Survey of Employment, Payrolls and Hours (SEPH)	Canadian Productivity Accounts (PA)	Canadian National Accounts (NAC)
Data source	56,000 representative households	Total payroll employment and payrolls from CRA Payroll Deduction administrative source (census); other variables collected by the Business Payrolls Survey (15,000 firms)	Administrative data, surveys by Statistics Canada (SEPH, LFS), Labour Statistics program of the Public Sector Statistics Division	Administrative files (CRA T4), surveys by Statistics Canada (SEPH)
Frequency	Monthly	Monthly	Quarterly	Quarterly (monthly is available when quarterly data are released)
Wages and compensation	Wages/salaries before taxes and other deductions (including tips, commissions and bonuses) of employees at their main job	Gross taxable payroll before source deductions (including overtime pay) of employees	Total compensation including salaries and supplementary labour income of employees (including special payments), plus an imputed labour income for self-employed workers	Wages and salaries
Supplementary labour income	Not included	Not included	Included	Not included
Special payments	Not included	Not included	Included	Not included
Coverage	Employees in main job; employees on parental leave, strike and lock-out are also covered	Employees in all jobs	Employees in all jobs and self-employed	Employees in all jobs

APPENDIX B | Charts

Chart B-1: Wage-common and its indicators (q/q)

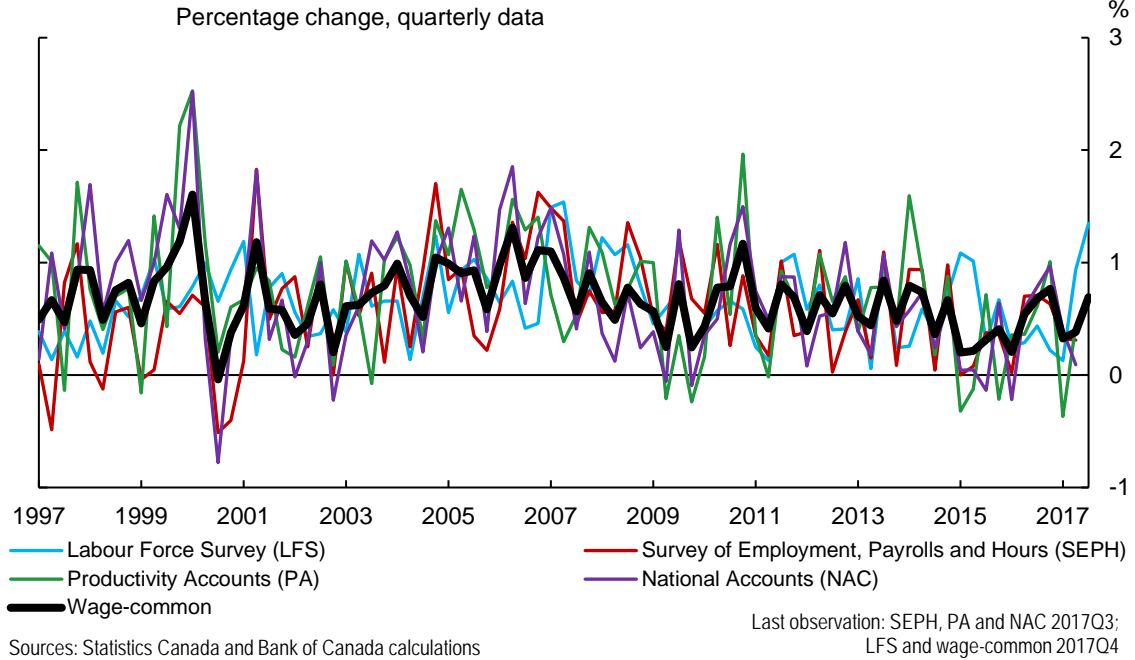


Chart B-2: Wage-common and its indicators (y/y)

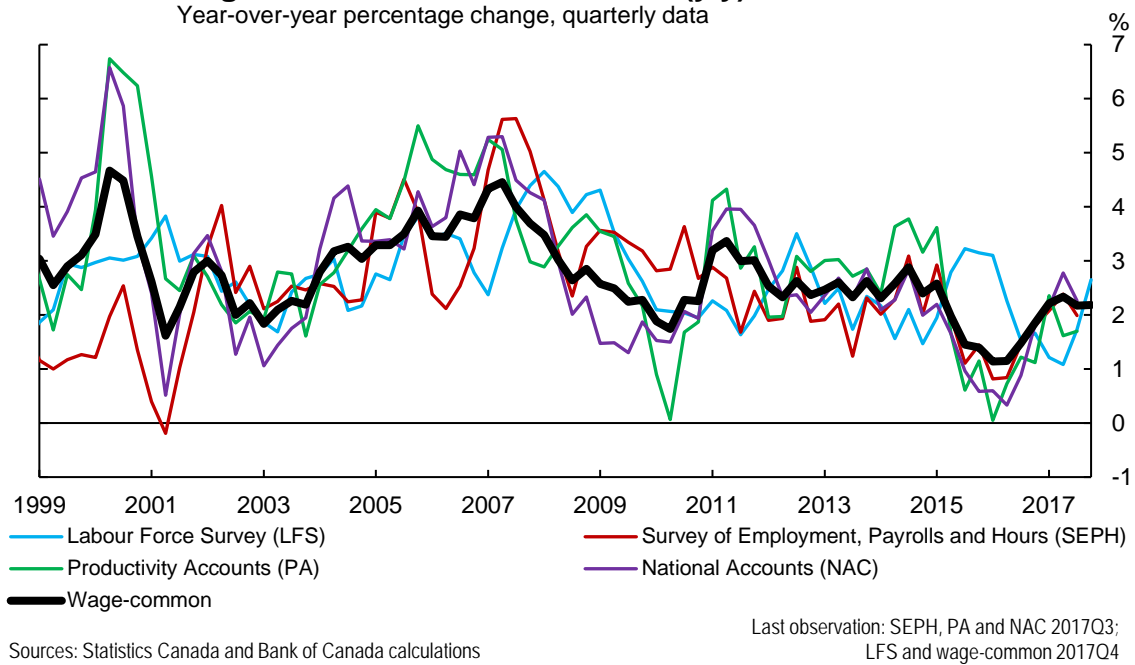
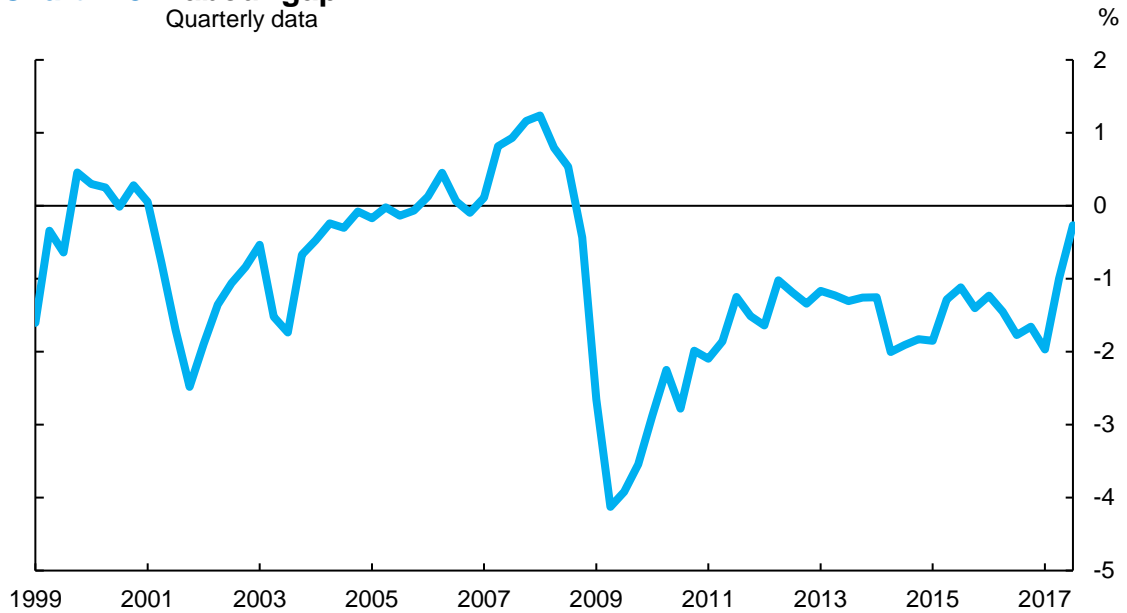


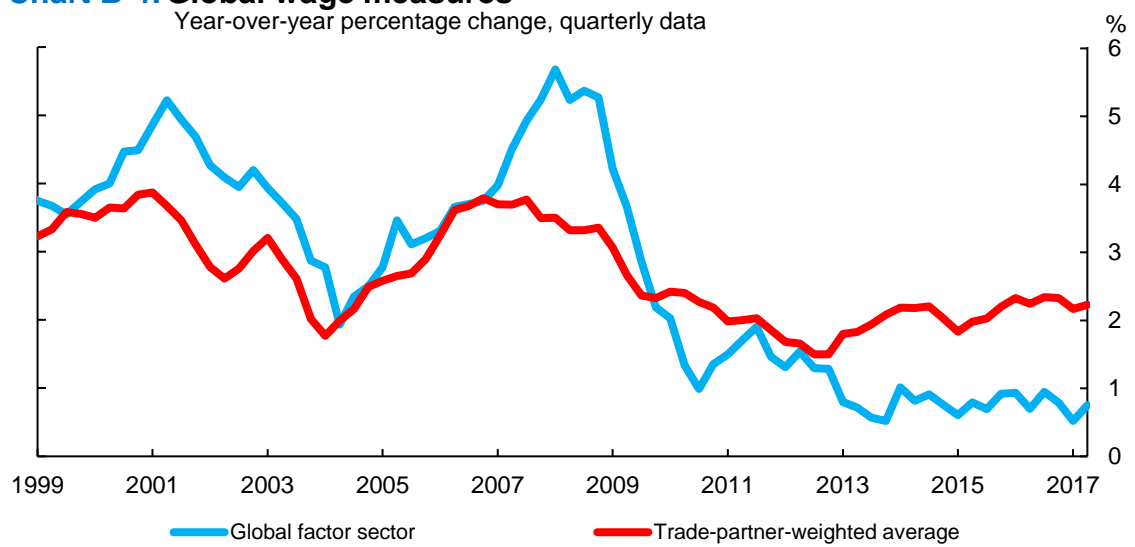
Chart B-3: Labour gap
Quarterly data



Source: Bank of Canada calculations

Last observation: 2017Q3

Chart B-4: Global wage measures
Year-over-year percentage change, quarterly data



Note: This series is constructed with private wage series from the Republic of Korea, Australia, New Zealand, Sweden, the United States, Denmark, Japan and the Euro area (19 countries).

Sources: Statistics Canada; The Organisation for Economic Co-operation and Development, Innovation, Science and Economic Development Canada and Bank of Canada calculations

Last observation: 2017Q2