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Interpreting Monthly Changes in Employment from the Labour Force Survey

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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

CORRECTION NOTICE:

Catalogue Number: 11-626-X, no. 2014033
Original Release date: March 7, 2014.
Corrections have been made to this product.
The publication has been reloaded on March 13, 2014.
Please take note of the following changes:
Data errors were detected in Table 1, "Standard error, month-to-month change and change in average monthly employment growth".
Resolution: Table 1 data were corrected and replaced.

We regret any inconvenience this may have caused.
For more information, please *contact us*.

Interpreting Monthly Changes in Employment from the Labour Force Survey

by André Bernard and Guy Gellatly, Analytical Studies Branch

This *Economic Insights* article discusses a series of questions that are relevant to the interpretation and analysis of monthly changes in employment from the Labour Force Survey (LFS).[1] Intended as a reference document for users of the LFS data, it examines the volatility and statistical precision associated with these fluctuations.[2] Specifically, the article addresses the following questions:

- What does the monthly change in employment measure, and how should it be interpreted?
- To what extent has the volatility of these estimates changed in recent years? How does population growth affect volatility?
- How statistically precise are these month-to-month changes? Has the degree of precision associated with these estimates changed over time? How much additional precision is gained by combining information from several consecutive months?
- How can trend estimates be used to better understand recent movements in the data?

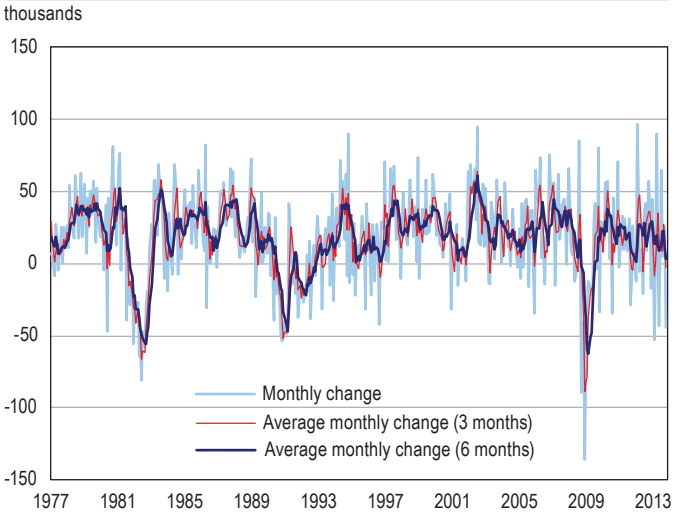
What does the monthly change in employment measure?

The change in employment that is reported in the monthly data release from Statistics Canada's Labour Force Survey (LFS) is widely used to assess basic changes in labour market conditions. It corresponds to the difference between the seasonally adjusted estimated level of employment in the current reference month and the seasonally adjusted estimated level of employment in the previous reference month.

This estimate of employment change is a measure of net employment growth, not a gross flow. It reflects the sum of all employment gains and losses that have occurred from the previous reference month to the current reference month. Consequently, a summary statement such as "employment rose by 29,000 in January", which was reported in the LFS *Daily* release for the month of January 2014, indicates that the seasonally adjusted estimate of employment, as reported for the January reference month, is 29,000 higher than the seasonally adjusted estimate of employment for the December reference month. The gross flows that underlie this net change, in terms of new employment or employment losses from December to January, are typically much larger. For a decomposition analysis of net employment change that examines gross employment creation and gross employment destruction using firm-level data, see Rollin (2012).

As noted above, this measure of employment change is based on seasonally adjusted estimates of the level of employment in both reference months. That is, the actual estimated levels of employment are adjusted in each month, such that regularly occurring, calendar-based events that influence employment levels in these months are not reflected in these month-to-month comparisons. This is done to facilitate more analytically meaningful comparisons of sub-annual employment data over time. Following the above example, this implies that the increase in employment of 29,000 from December to January cannot be interpreted as the difference in the raw count of employment in these months.[3] Rather, it is the estimated growth in employment, net of the effect of seasonality.

Chart 1
Monthly change in employment, seasonally adjusted data, 1977 to 2013



Source: Statistics Canada, Labour Force Survey (LFS).

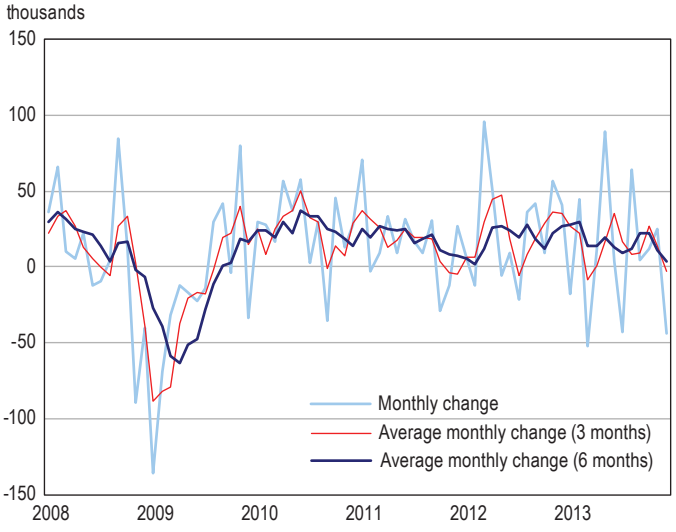
1. The LFS is a monthly survey of about 54,000 households (110,000 respondents each month). It collects information for a specific reference week in the month. The LFS sample is representative of the civilian non-institutionalized population 15 years of age and over.
2. This note complements the post "The Labour Force Survey's volatility - myth or reality?" published on Statistics Canada's blog in November 2013. See http://www.statcan.gc.ca/eng/blog-blogue/cs-sc/volati-eng.
3. For more information on seasonal adjustment, see Wyman (2010).

These month-to-month changes are plotted in Charts 1 and 2, along with their associated three- and six-month moving averages. These charts highlight the extent to which these monthly changes have fluctuated over the full LFS time series (Chart 1) and in more recent years (Chart 2). They also demonstrate the reduction in the period-to-period volatility associated with three and six month moving averages.

Charts 3 and 4 present data on the average monthly change in employment, calculated yearly for the full LFS time series. Chart 3 presents these annual averages based on the monthly change in employment (i.e., based on the month-to-month changes presented in Chart 1). Chart 4 presents these annual averages based on the month-to-month percent change in employment. This latter measure takes into account changes in the size of the employed labour force that occur naturally over time, as employment changes from the previous to current reference month are divided by the level of employment in the previous period.[4]

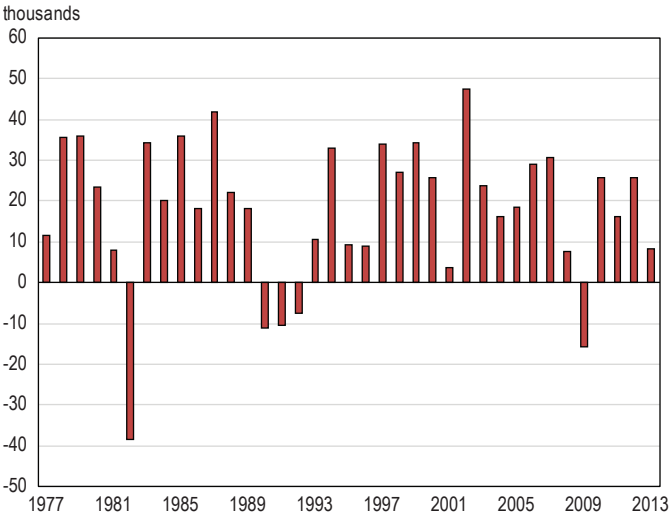
The annual changes reported in Charts 3 and 4 can mask substantial month-to-month variability. In the post-recession period, there has been continued interest in the volatility and precision of these month-to-month changes, insofar as they affect the analysis and interpretation of these labour market data. These issues are examined below.

Chart 2
Monthly change in employment, seasonally adjusted data, 2008 to 2013



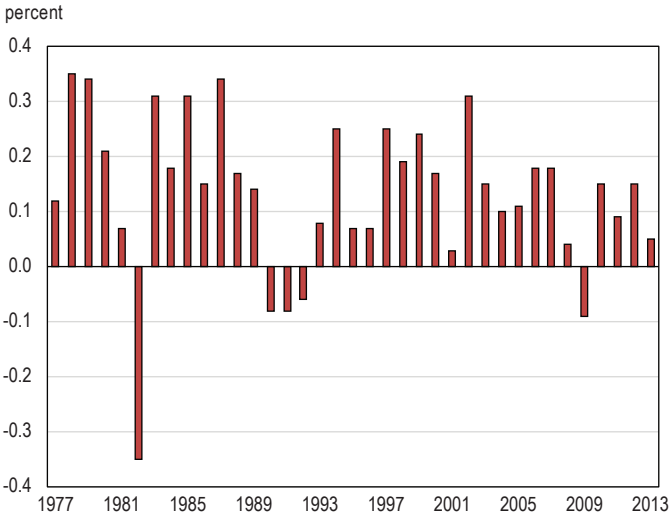
Source: Statistics Canada, Labour Force Survey (LFS).

Chart 3
Average monthly change in employment, by year, 1977 to 2013



Source: Statistics Canada, Labour Force Survey (LFS).

Chart 4
Average relative monthly change in employment, by year, 1977 to 2013



Source: Statistics Canada, Labour Force Survey (LFS).

To what extent has the volatility of these LFS estimates changed in recent years?

Following Cross (2009), changes in volatility can be examined via comparing standard deviations for different sub-periods. A standard deviation is a measure of dispersion around an average. A higher standard deviation indicates that the data series exhibits more fluctuations around a given average.[5]

4. Measures of volatility that do not take these "base effects" into account can create the impression that recent changes in employment are more volatile than in times past. This is examined in a subsequent section.
5. Other measures of volatility can be used. For example, a measure of the smoothness of a series that is used in the literature on seasonal adjustment yields similar results to those presented in this paper.

The standard deviation of the monthly changes in employment from 1976 to 2013 was 31,400, or 0.24% when calculated based on the percent change in employment from month-to-month (Chart 5).

The standard deviation for the 2008 to 2013 period, which includes the large month-to-month changes in employment that occurred during the recession, was 40,700, higher than the historical average of 31,400. However, when based on the percent change, the standard deviation for this period was similar to the historical average.

Compared to historical norms, there is no evidence that the month-to-month changes in employment that were observed in the post-recession period (2010 to 2013) have been more volatile. At 32,800, the standard deviation of the monthly changes in employment from 2010 to 2013 was close to the historical average. More importantly, at 0.19%, the standard deviation based on the percent month-to-month employment change was lower than the historical average.

It should be noted that the annual revisions to the seasonally adjusted LFS estimates tend to reduce the volatility of the monthly changes in employment in comparison with the initial published estimates. Consequently, more recent data will generally exhibit more variability than historical data.

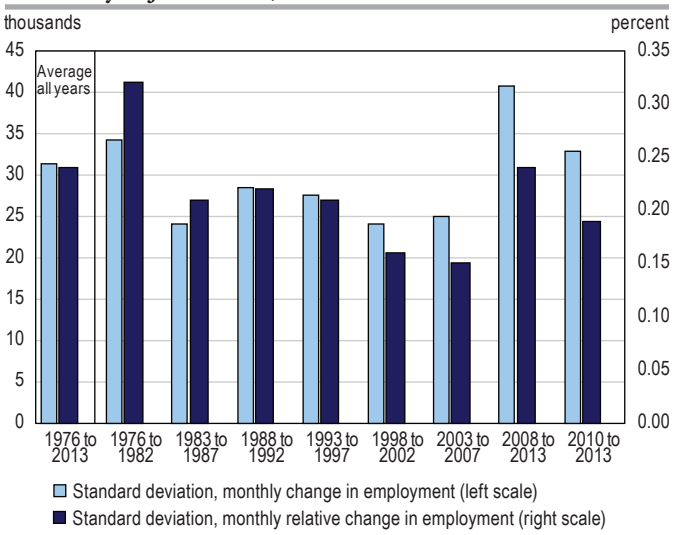
How does population growth affect volatility?

Population growth can increase the volatility of month-to-month changes in employment, when these changes are expressed as the difference in employment levels from period to period. This is especially noteworthy for socio-demographic groups that have experienced relatively high rates of population growth. Converting these estimates into percentage changes takes this problem into account.

Chart 6 presents the standard deviations for employed persons aged 55 and over. Between 2010 and 2013, the absolute standard deviation among workers 55 and over was slightly higher than 17,200, the largest on record and almost 40% higher than the historical average of 12,400 based on data from 1976 and 2013. This result could be interpreted as evidence that these monthly changes are becoming more volatile over time.

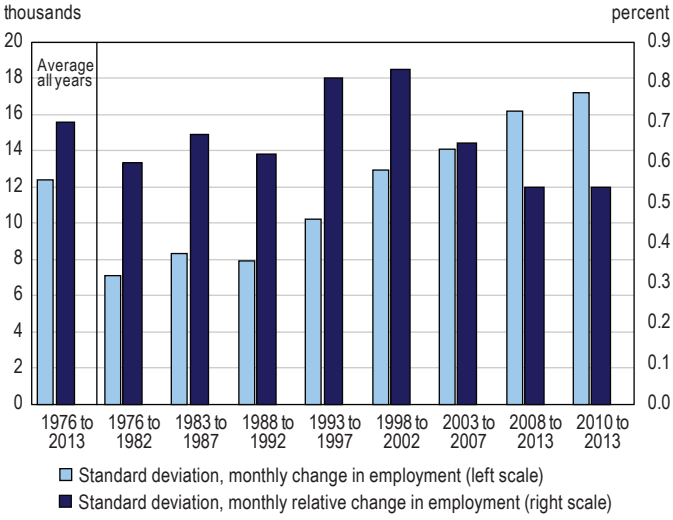
This result, however, largely reflects the general growth in the population and population aging, both of which have increased the share of older workers in the labour force.[6] Standard deviations associated with the percent changes in employment, which adjust for this base effect, yield a markedly different view. Between 2010 and 2013, this standard deviation was slightly over 0.5%, close to the lowest on record and more than 20% lower than the historical average of 0.7%. This shows that the month-to-month changes in employment for this group are in fact less, not more, volatile.

Chart 5
Standard deviation, monthly change in employment, seasonally adjusted data, 1976 to 2013



Source: Authors' calculations from Statistics Canada, Labour Force Survey (LFS).

Chart 6
Standard deviation, monthly change in employment, 55 years and over, seasonally adjusted data, 1976 to 2013



Source: Authors' calculations from Statistics Canada, Labour Force Survey (LFS).

6. In 1976, there were 1.1 million individuals employed among the 55 and over, representing 11.7% of total employment. In 2013, there were 3.4 million individuals employed among that age group, representing 19.0% of total employment.

How statistically precise are estimates of the monthly change in employment?

The standard error, the measure of sampling error in a survey, provides information on the extent to which a survey estimate is statistically precise.[7] As stated in The Guide to the Labour Force Survey, "the standard error is a measure that quantifies how different the sample estimate might be from a census value" (Statistics Canada, 2013a).[8] The following sections present and discuss standard error estimates associated with the month-to-month changes in employment, and illustrate how improvements in statistical precision can be made by combining information on changes in employment over several months.

The reported standard error associated with the monthly change in employment reported for the January 2014 reference month was 28,900 (Statistics Canada, 2014).[9] This standard error has remained constant over time, at about 29,000 (Chart 7). Considering that the employment base has increased steadily over the years, recent estimates of employment change from the LFS are, at minimum, as statistically reliable as they have been in times past.

Using the standard error reported above, it is possible to infer that there is a:

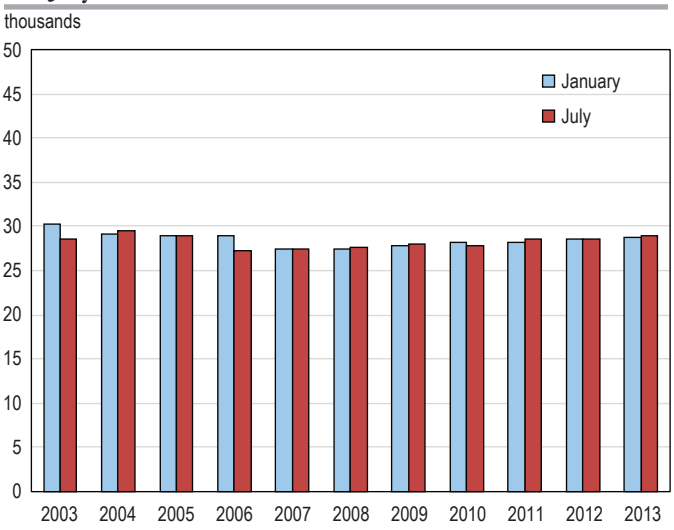
- 68% chance that the true value of a monthly change in employment is within **one** standard error of the estimate (+/- 28,900);
- 90% chance that the true value is within **1.6** standard error of the estimate (+/- 46,240);
- 95% chance that the true value is within **two** standard errors of the estimate (+/- 57,800).

To illustrate the interpretation of these confidence intervals, consider the estimated change in employment for two recent month-to-month periods, from July 2013 to August 2013, and from December 2013 to January 2014.

The LFS *Daily* release for the August 2013 reference month reported that net employment had increased by 59,000 from July to August. Based on the 28,900 standard error, the 68% confidence interval of that estimate ranged from employment gains of 30,100 to 87,900, the 90% confidence interval ranged from employment gains of 12,760 to 105,240 and the 95% confidence interval ranged from employment gains of 1,200 to 116,800.[10]

It is therefore possible to infer with 95% certainty that, on net, employment increased from July to August. What is less certain is how strong employment growth was in that month.

Chart 7
Standard error, monthly change in employment, January and July 2003 to 2013



Note: The standard error for the January reference month (released in February) corresponds to the 12-month period ending in December, and the standard error for the July reference month (released in August) corresponds to the 12-month period ending in June.
Source: Labour Force Information, Statistics Canada Catalogue no. 71-001-X, February 2003 to August 2013.

In the more recent month-to-month period, December 2013 to January 2014, there is more uncertainty as to whether net employment grew or fell. This is because, at 29,000, the estimated change in employment was smaller. This estimated increase is statistically significant at the 68% level, but not at the 90% or 95% levels.

How much precision is gained by combining information from several consecutive months?

More statistically precise inferences about the pace of employment growth can be obtained by combining information from several consecutive months. As shown in Table 1, the standard errors associated with the difference in the average monthly change in employment calculated over periods of three, six and twelve months are smaller than the standard error based solely on the current and previous reference months.

For example, in the Labour Force Survey Daily release for the month of December 2013, it was reported that employment gains had averaged 8,500 per month in 2013, which was lower than the average employment growth of 25,900 per month observed in 2012. Using the standard error associated with the

7. Note that there are other sources of potential statistical errors associated with survey estimates, including employment estimates, such as the estimation of seasonal factors that are necessary to produce seasonally adjusted data. LFS data are annually revised to reflect the most current seasonal factors.
8. See Bureau of Labor Statistics (2013) for a discussion of sampling errors associated with the Current Employment Survey (CES) and the Current Population Survey (CPS) in the United States.
9. Standard errors reported in this section are based on the seasonally unadjusted employment series. However, studies have shown that standard errors for the LFS based on seasonally unadjusted data are close to those based on seasonally adjusted data (Statistics Canada, 2013a).
10. As stated previously, these confidence intervals do not take into account statistical errors resulting from the seasonal adjustment and non-sampling errors. These values are approximations. See Statistics Canada (2013) for more details.

average monthly change over two consecutive twelve-month periods (8,000), it is possible to infer with more than 95% certainty that the pace of job growth was significantly slower in 2013 compared to 2012.

These gains in precision align with other advantages of utilizing information on employment change over multiple periods, as successive monthly movements in the same direction are more likely to signal a change in labour market conditions and are less likely to be influenced by irregular events or sampling error (Statistics Canada, 2013a).

How can trend estimates be used to better understand recent movements in the data?

Trend estimates are useful for analyzing general patterns in sub-annual time series data, as they lessen the impact of irregular events that influence seasonally adjusted estimates. When used as a supplement to seasonally adjusted data, trend estimates can provide contextual information on how economic conditions have been changing over time. These trend data can be useful for analyzing changes in employment based on the LFS.

Chart 8 presents the seasonally adjusted, monthly employment estimates from the LFS along with the associated trend line. Chart 9 then presents data on monthly changes in LFS employment, along with the associated trend. These trend lines are computed using the Dagum and Luati (2009) linear filter, which correspond to moving weighted averages of the seasonally adjusted series.

As can be seen in Charts 8 and 9, trends associated with changes in employment are much less volatile than the original, seasonally adjusted series. Trend estimates computed using this linear filter are used by Statistics Canada analysts to analyze employment changes when preparing the monthly LFS *Daily* release.

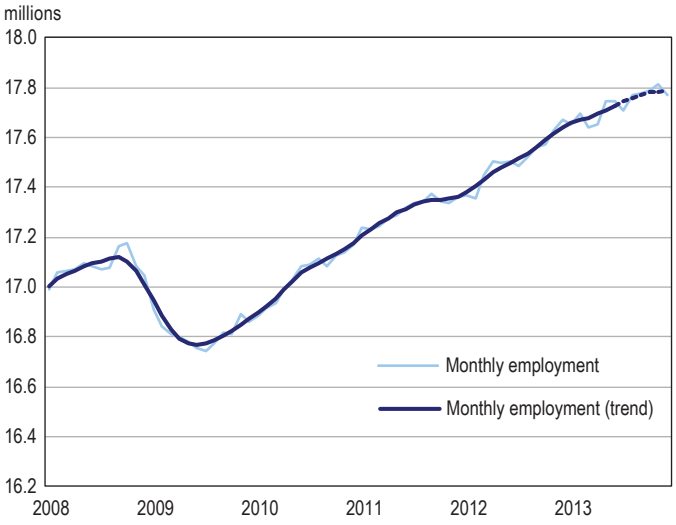
Table 1
Standard error, month-to-month change and change in average monthly employment growth

	Standard error	68% confidence interval	90% confidence interval	95% confidence interval
Month-to-month	28,900	+/- 28,900	+/- 46,200	+/- 57,800
Last three months over previous three months	22,100	+/- 22,100	+/- 35,400	+/- 44,200
Last six months over previous six months	13,500	+/- 13,500	+/- 21,600	+/- 27,000
Last 12 months over previous 12 months	8,000	+/- 8,000	+/- 12,800	+/- 16,000

Note: Standard errors reported in this table are averages over the 12 months period ending in December 2013. The standard error for the month-over-month change corresponds to the standard error published in Statistics Canada (2013b) and Statistics Canada (2014).

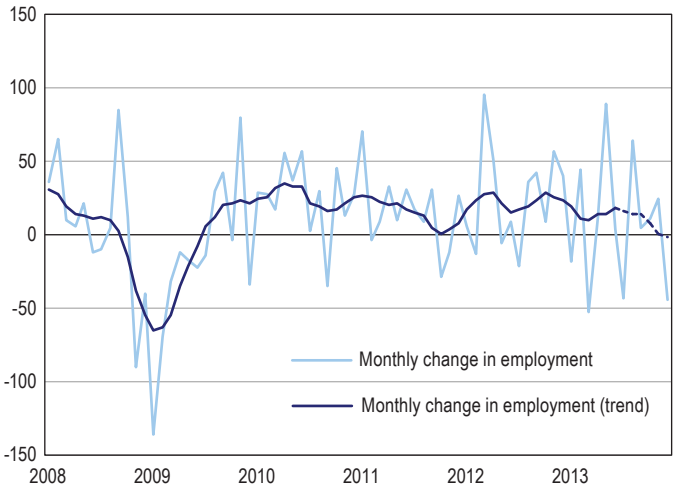
Source: Statistics Canada, Labour Force Survey (LFS).

Chart 8
Monthly employment and associated trend line, seasonally adjusted data, 2008 to 2013



Note: Trend estimates have been computed using the Dagum and Luati (2009) linear filter. The higher variability associated with the trend-cycle estimates is indicated with a dotted line on the chart.
Source: Statistics Canada, Labour Force Survey (LFS).

Chart 9
Monthly change in employment estimates and associated trend line, seasonally adjusted data, 2008 to 2013



Note: Trend estimates have been computed using the Dagum and Luati (2009) linear filter. The higher variability associated with the trend-cycle estimates is indicated with a dotted line on the chart.
Source: Statistics Canada, Labour Force Survey (LFS).

Conclusion

This article has discussed various statistical questions that are relevant to the interpretation and analysis of the monthly changes in employment reported from the Labour Force Survey. It shows that when using month-to-month percent changes in employment, a measure that takes into account growth in the size of the employment base, the monthly changes in employment in the current post-recession period are no more volatile than historical norms. It also demonstrates the gains in statistical precision that can be obtained from using multi-period averages. Finally, it reports on how trend estimates can be used to provide contextual information that supplements the monthly changes in employment that are reported from the LFS.

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