CHAPTER 2

RECENT WAGE DYNAMICS IN ADVANCED ECONOMIES: DRIVERS AND IMPLICATIONS

Nominal wage growth in most advanced economies remains markedly lower than it was before the Great Recession of 2008–09. This chapter finds that the bulk of the wage slowdown can be explained by labor market slack (both headline unemployment and underutilization of labor in the form of involuntary part-time employment), inflation expectations, and trend productivity growth. While involuntary part-time employment may have helped support labor force participation and facilitated stronger engagement with the workplace than the alternative of unemployment, it also appears to have weakened wage growth. This is the case even in economies where measured slack appears low (that is, headline unemployment rates are now at, or below, their averages in the years leading up to the recession). Common factors—beyond slack, productivity, and price inflation—have also exerted downward pressure on wages in recent years, suggesting that the synchronized nature of excess capacity across countries may have amplified its effects. While accommodative policies can help lift demand and lower headline unemployment rates, wage growth may continue to remain subdued until involuntary part-time employment diminishes or trend productivity growth picks up. Inflation rates will also likely remain low unless wage growth accelerates beyond productivity growth in a sustained manner. Assessing the true degree of slack beyond measured headline unemployment rates will be important when judging the appropriate pace of exit from accommodative monetary policies.

Introduction

Close to a decade after the Great Recession of 2008–09, nominal wage growth in most advanced economies remains markedly lower than it was before the recession. This is the case even in countries where unemployment rates are now at, or even below, their averages in the years leading up to the recession. In some instances, recent wage dynamics may reflect a correction from unsustainably high wage growth prior to the Great Recession. The pattern, however, is more widespread.

Nominal wage dynamics, in general, are related to underlying changes in a "real" component—physical output created by labor together with other inputs into production—as well as inflation pressure in the economy. Viewed through this lens, subdued nominal wage growth is, in principle, consistent with a widely recognized slowdown in labor productivity, which can weigh on underlying real wage dynamics, and generally low inflation across advanced economies.[1]

Subdued nominal wage growth has also generally coincided with a reduction in hours per worker and, in some cases, a higher rate of involuntary part-time employment and an increased share of temporary employment contracts. Headline unemployment measures are therefore not as indicative of labor market slack, given this increase in part-time employment and temporary contracts. These developments may also point to persistent changes in the nature of employment relationships between firms and workers in response to technological change and remaining labor market rigidities in some countries that deter employers from hiring on standard, full-time contracts.[2]

From a macroeconomic perspective, shedding light on the forces shaping nominal wage developments could inform the debate on the extent of slack in the economy and the appropriate pace of exit from accommodative monetary policies. As noted in Chapter 1, core inflation rates in most advanced economies remain below targets and have not shown a steady upswing even as growth has generally picked up over the past year. With wages being the largest component of most firms' production costs, the upswing in wages in response to falling unemployment is the main reason core inflation typically picks up as aggregate demand strengthens and excess capacity in the econ-

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[1]On the productivity slowdown, see Fernald (2014); Byrne, Fernald, and Reinsdorf (2016); and Adler and others (2017). On weak inflation rates in advanced economies, see Chapter 3 of the October 2016 *World Economic Outlook* (WEO).

[2]See Bentolila and others (2012) for a discussion of labor market rigidities and the use of temporary contracts.

omy shrinks.[3] Core inflation in advanced economies is thus unlikely to recover in a sustained manner before labor market tightening spurs higher wage inflation. In sum, a better understanding of the forces that weigh on wage growth is important for assessing the appropriate course of monetary policy.

Insights into the drivers of wage dynamics and the role of part-time employment and temporary contracts may also offer perspective on prospects for income inequality and possible policy actions to address the income security of workers with part-time jobs or temporary contracts. The latter could include tackling slack, supporting retraining and reskilling, addressing remaining labor market and structural rigidities, and ensuring fairness of treatment across employees under various types of contracts.

Accordingly, the chapter addresses the following main questions:

- *Drivers:* How well do aggregate macroeconomic factors such as labor market slack, inflation expectations, and trend labor productivity growth account for nominal wage dynamics observed across advanced economies since the Great Recession? How has the evolving mix of full-time versus involuntary part-time employment and open-ended versus temporary work contracts affected labor market slack and hence wage dynamics?
- *Underlying changes:* How have changes in firms' incentives and constraints in recent years (for example, related to changing expectations about medium-term growth prospects, technology, and global production processes) affected nominal wage setting and part-time employment? What impact have shifts in bargaining power (arising, for example, from changes in employment regulations, unionization, and degree of import competition) had on wages and part-time employment?

These are the main findings of the chapter:

- Macroeconomic factors such as labor market slack (both headline unemployment and underutilization of labor in the form of involuntary part-time employment), inflation expectations, and trend productivity growth can account for the bulk of the variation in nominal wage growth at the country level in recent years. The analysis also suggests that common factors have been exerting increasing downward pressure on wage inflation in the aftermath of the global financial crisis and especially during 2014–16. For a number of euro area economies with large precrisis current account deficits, this may reflect policy measures to slow wage growth and improve competitiveness in the aftermath of the global financial crisis and euro area sovereign debt crisis.[4] More broadly, the finding of sizable common factors behind wage weakness could indicate the growing effect on wage setting in any given economy of labor market conditions in other countries (in the context of stronger cross-border economic integration). It could also point to the role of broad-based and synchronized demand weakness across many countries and heightened concern about job losses, which may have hindered wage growth in the aftermath of the global financial crisis and the euro area sovereign debt crisis.
- The relative roles of labor market slack and productivity growth vary across countries. In economies where unemployment rates are still appreciably above their averages before the Great Recession, conventional measures of labor market slack can explain about half of the slowdown in nominal wage growth since 2007, with involuntary part-time employment acting as a further significant drag on wages. Productivity growth is in turn relatively less important because these economies had generally lower productivity growth to begin with, and less of a slowdown.
- In economies where unemployment rates are below their averages before the Great Recession, slow productivity growth can account for most—about two-thirds—of the slowdown in nominal wage growth since 2007. However, even here, involuntary part-time employment appears to be weighing on wage growth, suggesting greater slack in the labor market than captured by headline unemployment rates.
- Involuntary part-time employment has risen more in countries where output is estimated to fall short of its potential. Once the influence of slack is taken into account, involuntary part-time employment has increased more where medium-term growth expectations have fallen more, automation has progressed faster, and the importance of services in the economy has increased.

[3]As noted in Chapter 1, the part of the wage-inflation weakening attributable to lower productivity growth would not translate into weaker price inflation, given that the changes would have no net effect on cost pressures (proxied by unit labor costs).

[4]Also see Kang and Shambaugh (2014).

- The analysis suggests that while accommodative policies can help lift demand and lower headline unemployment rates, wage growth may continue to remain subdued until involuntary part-time employment diminishes or trend productivity growth picks up. Inflation rates will also likely remain low unless wage growth accelerates beyond productivity growth in a sustained manner. Assessing the true degree of slack beyond measured headline unemployment rates will be important when judging the appropriate pace of exit from accommodative monetary policies.

The next section presents a primer on the determinants of wage growth to help set the stage for the empirical analysis. The chapter then takes stock of changes in the labor markets of advanced economies over recent years. In subsequent sections, the forces shaping nominal wage dynamics and employment outcomes at the aggregate level are assessed. The chapter concludes with a discussion of the main policy implications to be drawn from the analysis.

Wage Determination—A Primer

Nominal wages are determined by the interaction between labor demand and supply, which are both subject to multiple, interrelated influences. It is useful to categorize these as influences related to the business cycle and forces that are slower moving (secular).

Over the business cycle, aggregate demand for final output translates into labor demand. In the expansionary phase, employers increase labor input to meet rising final demand. Rising demand for labor can result in a combination of more hours (including overtime), a decline in involuntary part-time employment, and an increase in the number of employed workers. Eventually, as demand continues to rise, the pool of jobseekers (a combination of unemployed plus currently employed workers who are searching for more attractive employment) shrinks relative to vacancies, and employers pay more to attract workers or to retain those on the payroll. To the extent that nominal wages are indexed to consumer price inflation and influenced by the expected path of inflation, rising price pressures in the expansionary phase of the cycle can also boost average nominal wage growth. The opposite happens when final demand weakens and the business cycle turns. Firms may initially hoard labor and, once the slump deepens, lay off workers. Average wage growth would then also weaken, and weakening inflation pressure would transmit back to weaker nominal wage growth. Thus, two key cyclical factors associated with wages are the degree of slack in the economy and inflation expectations.

During the past decade—with a deep and prolonged recession, and fewer and fewer workers working full-time—other dimensions of labor underutilization beyond the standard slack measure of the unemployment rate also appear to have had a bearing on wages.[5] Recent studies have found, for example, evidence of a negative impact of discouraged workers, or a rising share of part-time employment, on wages (Blanchflower and Posen 2014; Smith 2014).[6]

In addition to the business cycle, a key force shaping average wage growth is trend labor productivity growth—increases in the output produced by each hour of labor input in combination with other factors of production. From a firm's perspective, as trend labor productivity growth accelerates, the value of hiring additional workers increases relative to the cost of expanding the payroll.[7] Greater demand for labor translates into rising vacancies relative to jobseekers, and therefore rising pressure on wages. Conversely, as productivity growth weakens, all else equal, profitability declines, along with firms' ability to accommodate wage increases for their existing workers or their willingness to attract new workers with high wages. Thus, wage growth tends to weaken as productivity growth slows. Wage rigidities

[5]See Trigari (2014).

[6]Altig and Higgins (2014) note the negative impact on wages of people working part-time for economic reasons. Other studies look at whether the long-term unemployed affect wage dynamics as much as the short-term unemployed (Stock 2011; Gordon 2013; Council of Economic Advisers 2014; Krueger, Cramer, and Cho 2014; Rudebusch and Williams 2014; Watson 2014), partly motivated by the fact that both price and wage inflation rates in the early aftermath of the Great Recession appeared more robust than would be predicted based on conventional price and wage Phillips curves. These studies have generally noted a greater impact of short-term than of long-term unemployment. Others have noted, however, that in the United States, for example, the long- and short-term unemployment rates evolved closely together in the few decades preceding the Great Recession, and hence it can be difficult to disentangle their impacts (Kiley 2014; Smith 2014).

[7]The acceleration in labor productivity growth can occur through a combination of capital deepening (or an increase in the machinery and equipment each worker operates), improvements in human capital and the average skill composition of the workforce, and a faster pace of technology diffusion that complements the skills of a typical worker. The effects on particular types of workers may vary, depending on the complementarity of technological change with their skills and the tasks they perform, as discussed further below.

(Hall 2005; Taylor 2016) mean that changes in labor productivity may not translate one-for-one into wages immediately; wage growth is thus linked more to the trend of productivity growth (Dew-Becker and Gordon 2005; Yellen 2005).[8,9]

As long as workers are able to bargain for a stable share of the economy's value added, wage growth is generally in line with trend labor productivity growth (Mortensen and Pissarides 1999; Hall 2005). But the strength of the association may waver.[10] When workers' bargaining power improves over the medium term, more trend productivity growth increments are transmitted to wage growth.

Workers' bargaining power is a function of interrelated drivers.[11] These include institutional factors, such as union density, the coverage of collective bargaining agreements, and the degree of centralization of such agreements (for example, sectoral versus firm-level). Labor laws and employment regulations that circumscribe firms' flexibility in laying off workers can have an impact on hiring, wage setting, and terms of employment.[12]

As mentioned earlier, technological changes can also have varying impacts on bargaining power, depending on the complementarity between new technologies and the mix of tasks performed on the job and workers' skills. At one extreme, automation can substitute for some low- or middle-skilled workers whose jobs mostly call for routine inputs implemented under precise instructions (Autor and Dorn 2013; Goos, Manning, and Salomons 2014). This would weaken the bargaining power of such workers and lead to less attractive terms of employment, possibly in lower-skill occupations (for example, weaker wage growth, fewer hours, or an increase in the share of part-time employment). At the other extreme, advances in design technology can be highly complementary for high-skilled workers, such as engineers and architects whose jobs call for complex problem solving, boosting their productivity and ability to command higher wages. Workers' bargaining power can also be influenced by exposure to international competition. This may arise through trade and firms' participation in global supply chains, but it could also stem from the threat of production facilities relocating to economies where costs overall are lower. Automation and increased competition can in turn weaken unionization.

From a firm's perspective, uncertainty about growth over the medium term can also influence hiring decisions and the resulting wage dynamics. At times of greater optimism and certainty about future revenue, firms may be more willing to hire full-time workers, create jobs with open-ended contracts, and pay better wages to retain workers or improve the quality of the match in the labor market. During times of diminished growth expectations, perceptions of downside risks, or uncertainty about the future, firms may be less willing to lock themselves into potentially costly employment arrangements and prefer instead to hire labor part time, or on temporary contracts, with less favorable wages and benefits. Such growth expectations could incorporate both demand and supply components, including future demand and expected productivity growth.

The next section examines the evolution of key labor market indicators in recent years.

Advanced Economy Labor Markets: Surface Healing Masks Deeper Changes

Headline Employment and Wages

Employment

As shown in panel 1 of Figure 2.1, unemployment rates have been generally declining since 2013, but remain elevated in about three-quarters of advanced economies relative to their 2007 levels. These declines are mostly reflective of job creation, not artifacts of working-age members of the population dropping out of the labor force. In fact, as panel 2 of Figure 2.1

[8]A one-for-one relationship between real wages and average labor productivity over the long term would require an elasticity of substitution between capital and labor of one. The elasticity of substitution between capital and labor is important in determining how the labor share in national income responds to changes in the relative costs of labor and capital.

[9]Of course, this link between wages and productivity may not strictly hold at the sectoral level (as illustrated by the Balassa-Samuelson effect).

[10]During the two decades before the Great Recession, for example, the share of value added going to workers had been trending down across advanced economies (Chapter 3 of the April 2017 WEO).

[11]The interrelated nature of these drivers is examined, for example, by Kramarz (2017), who studies the relationship between union strength, offshoring, wages, and employment.

[12]Previous studies show that deregulation of the labor market may temporarily cause an increase in unemployment, but eventually translate into long-term welfare gains (Blanchard and Giavazzi 2003). Chapter 3 of the April 2016 WEO and OECD (2017) show that labor market deregulation has positive effects on employment and output in good times, but can become contractionary in periods of slack.

Figure 2.1. Distribution of Labor Market Indicators

(Percentage-point difference relative to 2007)

Unemployment rates have been generally declining since 2013 but remain elevated in about three-quarters of advanced economies relative to their 2007 levels. These declines are mostly reflective of job creation and not a result of working-age members of the population dropping out of the labor force. In fact, labor force participation has risen in more than half of advanced economies.

Sources: Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: The horizontal line inside each box represents the median, the upper and lower edges of the box show the top and bottom quartiles, and the red markers denote the top and bottom deciles.

shows, labor force participation has risen in more than half of advanced economies relative to 2007 levels, generally reflecting higher participation by workers older than 54 and women in these countries (analyzed in detail in Box 1.1).[13,14] Higher unemployment rates, combined with higher labor force participation rates, leave employment ratios (employed workers as a share of the age 15+ population) very close to or above their pre–Great Recession peak (2007) in about half of advanced economies.[15]

Wages

Panel 1 of Figure 2.2 shows that for virtually all advanced economies, nominal wage growth (measured as nominal compensation per hour, and comparable across countries) remains below pre–Great Recession ranges.[16] This is particularly notable for economies where unemployment rates have declined relatively rapidly and are now close to or below pre–Great Recession averages (Figure 2.2, panel 2). Even in economies where nominal wage growth in 2016 was higher than before the Great Recession, such as Germany and Japan, the gains have been from low bases: a period of wage moderation in Germany intensified by the Hartz labor market reforms and in the midst of Japan's decade-long deflation and shrinking nominal wages.[17]

[13]As noted in Box 1.1, the decline in the population-weighted average labor force participation rate in advanced economies since 2007 is driven by a large decline in the United States.

[14]As highlighted in Chapter 1 of the October 2015 and October 2016 WEO, forecasts in the postcrisis period have generally underpredicted employment growth.

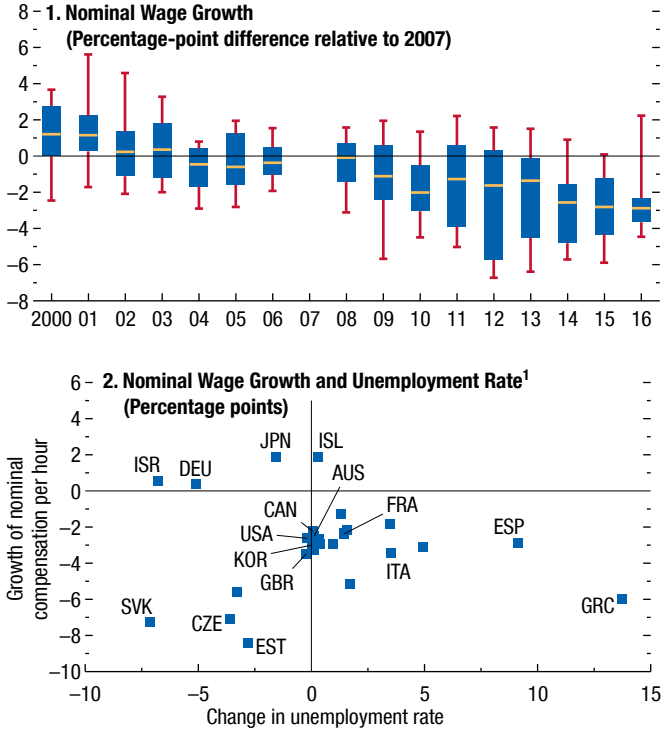
[15]The United States is a notable exception, where a decline of 3 percentage points in the participation rate since 2007 has resulted in a lower employment ratio than before the crisis, despite the decline in the unemployment rate to below its precrisis average.

[16]Growth rates for real wages in about three-quarters of advanced economies are below what they were before the Great Recession, whether viewed as "consumption real wages" (that is, nominal wages deflated by headline consumer price inflation, which influences living standards and labor supply decisions) or as "product real wages" (that is, nominal wages deflated by the GDP deflator, which influences firms' profitability and hiring decisions). See Annex 2.1 for more details on the wage measures and Annex Figure 2.2.1 on the dynamics of real wages.

[17]See Burda and Seele (2016) for a discussion of the effects of the Hartz reforms on the German labor market and Aoyagi and Ganelli (2015) on Japan's labor market outcomes during the 2000s.

Figure 2.2. Distribution of Nominal Wage Growth and Correlation with Changes in the Unemployment Rate

Despite improved headline employment indicators, nominal wages in virtually all advanced economies are growing at a slower pace than before the Great Recession. This is particularly notable for economies where unemployment rates are now close to or below pre-Great Recession averages.



Sources: Eurostat; national authorities; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: The sample in panel 1 excludes Baltic countries. The wage variable used is compensation per hour of workers excluding the self-employed. The horizontal line inside each box represents the median, the upper and lower edges of the box show the top and bottom quartiles, and the red markers denote the top and bottom deciles. Data labels in panel 2 use International Organization for Standardization (ISO) country codes. Outliers and the 10 largest advanced economies (by 2016 nominal GDP in US dollars) are labeled.
[1]Changes shown are 2016 values relative to the 2000–07 average.

Involuntary Part-Time Employment, Temporary Contracts, Hours

A more complete picture of the labor market emerges by considering additional indicators that suggest greater slack in the labor market than captured by headline unemployment rates, and possibly weaker job security than prior to the Great Recession.

Involuntary Part-Time Employment

Panel 1 of Figure 2.3 documents that involuntary part-time employment (workers employed fewer than 30 hours a week who report they would like longer hours) increased across virtually the entire sample in 2009 and remains above the 2007 level in more than three-quarters of countries. In the United States, the share increased from 0.8 percent in 2007 to 1.3 percent in 2016, while in the United Kingdom it rose from 2.4 percent to 3.9 percent, and in France from 5.3 percent to 7.8 percent. Germany is an exception, although its 2016 involuntary part-time employment share (3.1 percent) was above the 2.7 percent average for 2000–07.

As panel 2 of Figure 2.3 shows, the largest increases in involuntary part-time employment occurred in economies with unemployment rates above their 2000–07 averages. But even for economies with rates now close to their 2000–07 averages (points clustered around the vertical axis), the involuntary part-time share of employment is higher than it was before the crisis.

Temporary Contracts

Along with involuntary part-time employment, the incidence of temporary contractual arrangements has attracted attention in recent years (see Aoyagi and Ganelli 2015; Brainard 2016). These contracts can help reduce unemployment spells, allow workers to avoid gaps in their employment history, and maintain their engagement in the labor force. However, they typically offer briefer employment than do open-ended contracts, less opportunity for workers to develop skills and expand responsibilities, and sometimes weaker benefits. By 2016, in just over half the economies, the temporary contract share was higher than in 2007 (Figure 2.4, panel 1). Temporary contracts are more common now than in 2000–07 for most advanced economies (Figure 2.4, panel 2).[18]

Hours

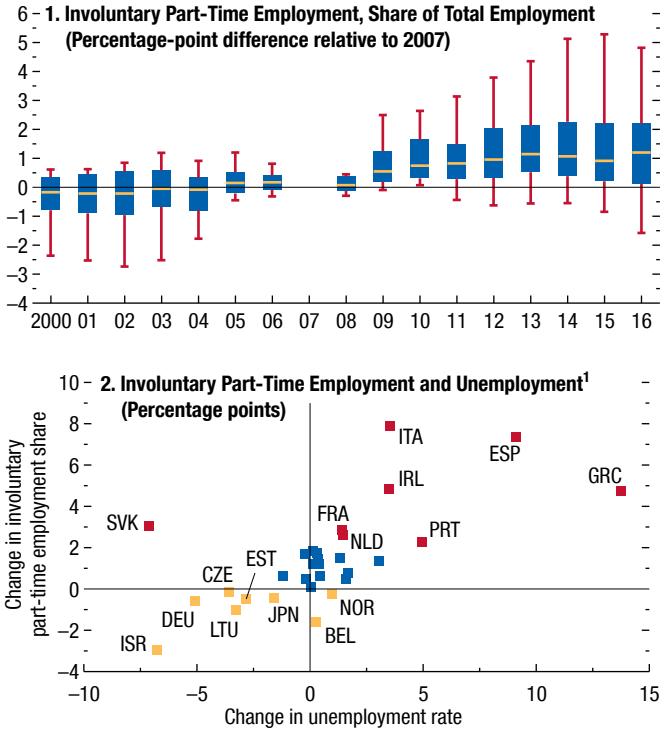
A third category of job attributes, which in part reflects worker preferences, is hours worked per worker. In more than half of the economies, hours per worker are at least 2 percent below 2007 levels (Figure 2.5, panel 1). However, hours had been declining before that, and the pattern has continued.[19]

[18]In the case of Japan, the figure shows that the share of temporary contract workers has dropped by close to 6 percentage points compared with the 2000–07 average. But as noted in IMF (2016), the wider category of "nonregular" workers—those who either (1) are not hired directly by the employer, (2) work part-time, or (3) do not have an open-ended contract—actually increased as a share of overall employment during this period. See also Aoyagi and Ganelli (2015). There are no comparable cross-country data on regular versus nonregular workers.

[19]The measure may understate the decline in hours per job if an individual now accumulates hours across multiple jobs more often than in the past.

Figure 2.3. Job Attributes: Involuntary Part-Time Employment

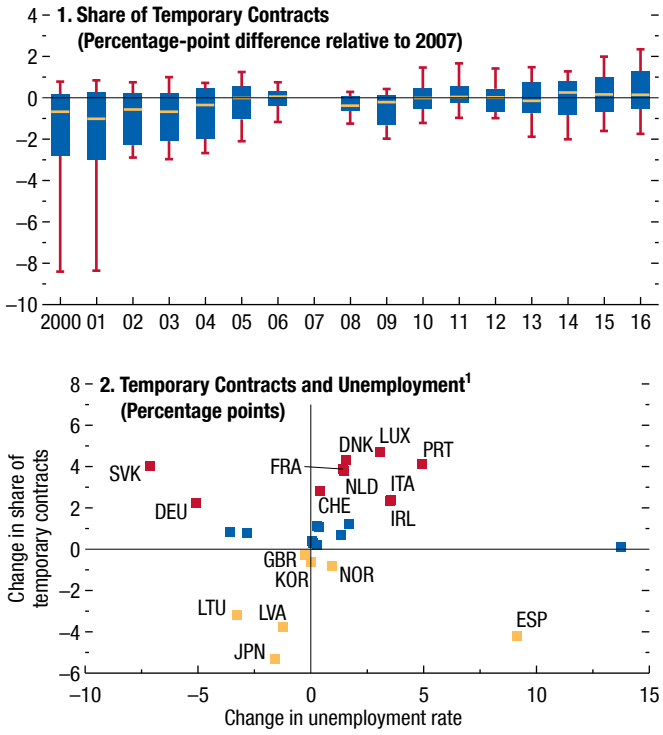
Involuntary part-time employment shares increased across virtually the entire sample in 2009 and remain above the 2007 level in more than three-quarters of the economies. The largest increases occurred in economies with unemployment rates above their 2000–07 averages.



Sources: National authorities; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Involuntary part-time workers are those working less than 30 hours a week because they could not find a full-time position. The involuntary part-time employment share is calculated as the total number of involuntary part-time workers divided by total employment. In panel 1, the horizontal line inside each box represents the median, the upper and lower edges of the box show the top and bottom quartiles, and the red markers denote the top and bottom deciles. In panel 2, countries in gold are those with decreases in the involuntary part-time employment share; countries in red are those with pronounced increases. Data labels in the figure use International Organization for Standardization (ISO) country codes.
[1]Changes shown are 2016 values relative to the 2000–07 average.

Figure 2.4. Job Attributes: Temporary Contracts

The temporary contract share in 2016 is above its 2007 level in over half of advanced economies. Temporary contracts are more common now than in 2000–07, primarily in economies where the unemployment rate remains above its pre-Great Recession average.



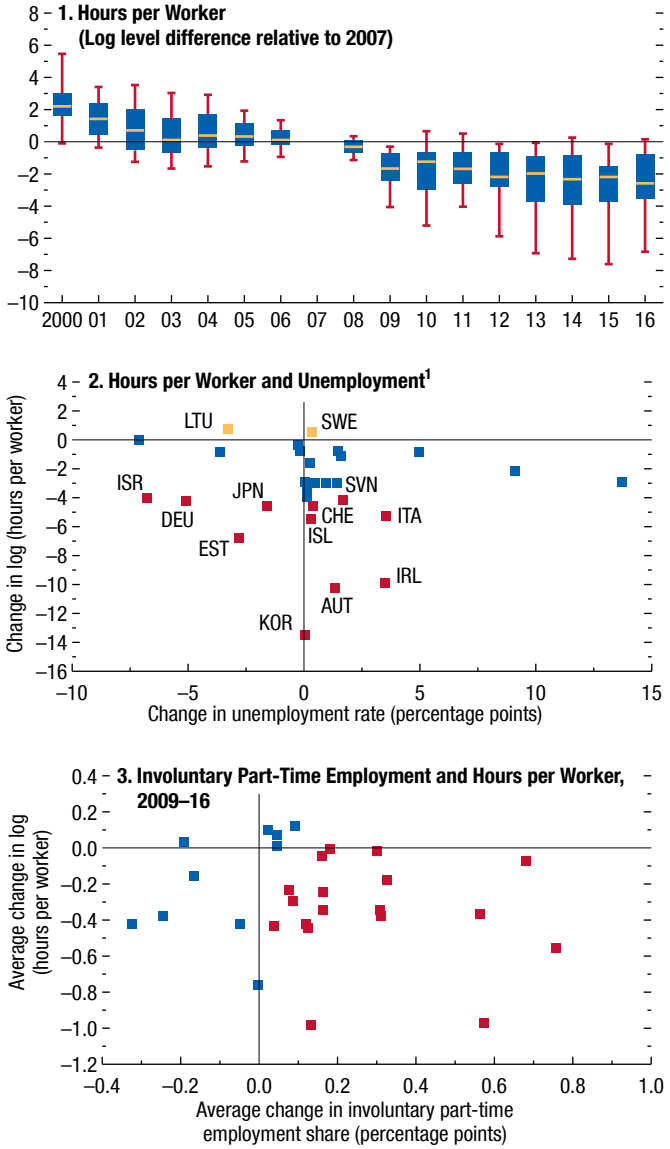
Sources: National authorities; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Temporary workers are those with work contracts of limited duration; thresholds are country specific. The share of temporary contracts is calculated as the number of temporary workers divided by total employment. In panel 1, the horizontal line inside each box represents the median, the upper and lower edges of the box show the top and bottom quartiles, and the red markers denote the top and bottom deciles. In panel 2, countries in gold are those with decreases in the share of temporary contracts; countries in red are those with pronounced increases. Data labels in the figure use International Organization for Standardization (ISO) country codes.
[1]Changes shown are 2016 values relative to the 2000–07 average.

The decline in hours could reflect worker preferences for greater flexibility and willingness to work fewer hours (for example for elderly workers or students who previously may not have been in the labor force). But it could also reflect firms' preference for hiring workers for fewer hours or on an as-needed basis. These just-in-time matches are often governed by agreements between firms and workers. The firm need not guarantee minimum hours, and workers are not obligated to accept an offer made by the firm. These contracts are referred to as "zero-hours contracts" in the United Kingdom; similar agreements govern employment relationships elsewhere, including in Australia and Canada.[20] As Box 2.1 documents, hours declined more in sectors with higher shares of low- and middle-skilled workers, suggesting that factors beyond worker pref-

[20]In the United Kingdom for example, workers on zero-hours contracts as a share of employed workers rose from 0.6 percent in 2010 to 3 percent in 2016 (Haldane 2017).

Figure 2.5. Job Attributes: Hours per Worker

In more than half of advanced economies in 2016, hours per worker were at least 2 percent below 2007 levels. However, this appears to be a continuation of the pre-2007 pattern. Hours per worker have fallen from their 2000–07 averages, regardless of whether unemployment rates are now higher or lower than before the Great Recession. Declining hours also tend to be associated with higher shares of involuntary part-time employment.



Sources: National authorities; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: In panel 1, the horizontal line inside each box represents the median, the upper and lower edges of the box show the top and bottom quartiles, and the red markers denote the top and bottom deciles. In panel 2, countries in gold are those with increases in hours per worker; countries in red are those with pronounced decreases. In panel 3, countries in red display (on average) falling hours per worker and (on average) an increase in the involuntary part-time employment share for 2009–16. Data labels in the figure use International Organization for Standardization (ISO) country codes.
[1]Changes shown are 2016 values relative to the 2000–07 average.

erences were at play. A concurrent rise in involuntary part-time employment also suggests that the decline in hours per worker was driven by reduced demand for hours of work by firms, rather than reduced supply of hours by workers. However, it is still difficult to separate workers' preferences that shape labor supply from the binding constraints of weak labor demand.

Hours per worker have fallen from their 2000–07 averages, regardless of whether unemployment rates are higher or lower than they were (Figure 2.5, panel 2). Declining hours also tend to be associated with higher shares of involuntary part-time employment (panel 3).

Separating Compositional Shifts from Common Patterns across Sectors

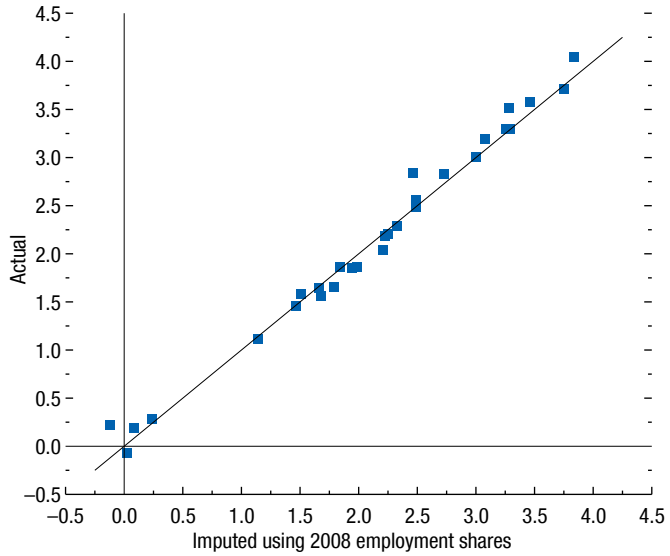
The previous sections point to a widespread change in labor market outcomes (subdued wage growth, larger involuntary part-time employment, higher incidence of temporary contracts, declining hours per worker) compared with the period before the Great Recession. To what extent do these developments mostly reflect common patterns across sectors, or compositional shifts in employment toward sectors where the change in labor market outcomes is more pronounced? Data for 21 sectors across 31 advanced economies since 2000 allow for a deeper look at the underlying role of compositional effects.

Figures 2.6 and 2.7 compare the average change in a job attribute during 2009–16 with the imputed change if employment shares across sectors had remained as they were in 2008. Points on the 45-degree line indicate that the actual change and the imputed change are identical; it is therefore within-sector developments, rather than compositional change across sectors, that drive aggregate dynamics. Conversely, points off the 45-degree line indicate that compositional change contributed to the overall development. Points marked in red are those for which the indicator deteriorated during 2009–16 and compositional change in sectoral employment shares made a quantitatively important contribution to that decline (that is, a shift in employment toward sectors where the deterioration was deeper). The figures indicate that compositional changes seem to play greater roles for part-time employment shares, temporary contracts, and hours per worker than for growth in nominal wages.[21]

[21]Labor mobility across sectors could cause wage growth to be broadly synchronized across sectors such that aggregate wage developments appear to reflect mostly within-sector developments.

Figure 2.6. Average Nominal Wage Growth, 2009–16, Actual versus Imputed Using 2008 Sectoral Employment Shares
(Percent)

Compositional changes do not appear to have an important role in recent nominal wage growth dynamics. All advanced economies are close to the 45-degree line, indicating that aggregate wage growth is driven by within-sector developments.



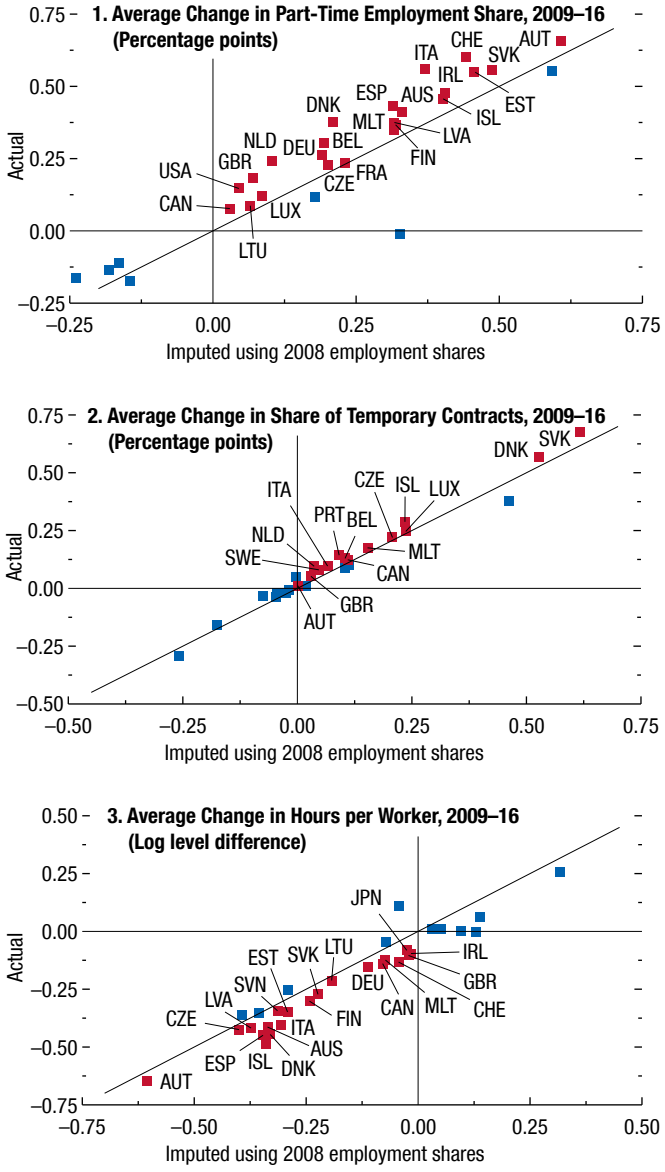
Sources: Eurostat; national authorities; and IMF staff calculations.
Note: The wage variable used is annual wage per worker excluding the self-employed.

- In the case of part-time employment, 26 countries in the sample experienced an increased share of part-time workers. In 12 of the 26 countries, compositional change accounted for more than 25 percent of the increase (and more than half the increase in four countries).
- Regarding the temporary contract share of employment, 19 of the 26 countries experienced an increase. Compositional change accounted for more than 25 percent of the increase in seven of those countries (and more than half in three countries).
- Declines in hours per worker were seen in 25 countries, with compositional change accounting for more than 25 percent of this decrease in 10 countries (and more than half in five countries).

Panels 1 and 2 of Figure 2.8 show that, during 2008–16, declining employment shares in sectors with low part-time employment and temporary contracts (mining and manufacturing), together with faster increases in employment in sectors with higher shares

Figure 2.7. Changes in Labor Market Indicators, Actual versus Imputed Using 2008 Sectoral Employment Shares

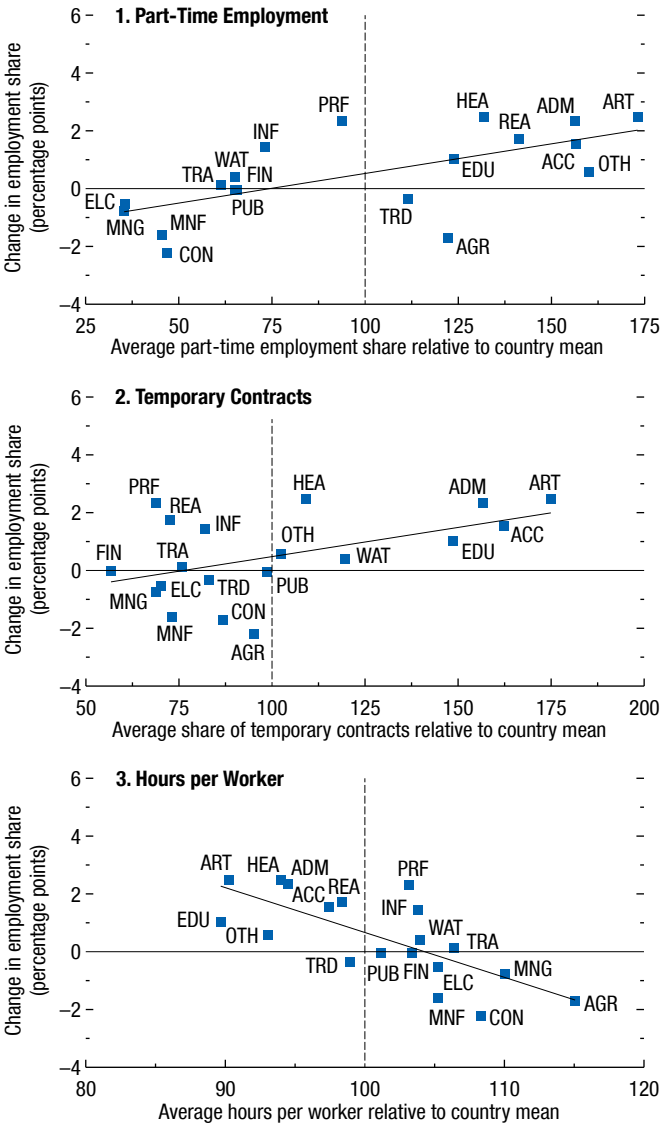
Compositional change played an important role for changes in job attributes. Shifts in employment shares across sectors can explain about 22 percent of the increase in the part-time employment share, 18 percent of the increase in the share of temporary contracts, and 23 percent of the reduction in hours per worker.



Sources: Eurostat; national authorities; and IMF staff calculations.
Note: The part-time employment share is calculated as the number of part-time workers in a sector divided by total employment in the sector. Temporary workers are people with work contracts of limited duration; thresholds are country specific. The share of temporary contracts is calculated as the number of temporary workers in a sector divided by total employment in the sector. Countries in red represent cases in which compositional changes amplified within-sector increases (panels 1 and 2) or decreases (panel 3). Data labels in the figure use International Organization for Standardization (ISO) country codes.

Figure 2.8. Job Attributes and Changes in Sectoral Employment Shares, 2008–16

Compositional shifts in employment toward sectors with relatively high shares of part-time employment and temporary employment and relatively low hours per worker contributed to the overall changes in these job attributes.



Sources: Eurostat; national authorities; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Markers to the right of 100 represent sectors with relatively high values (relative to country mean); markers to the left of 100 represent sectors with relatively low values. ACC = accommodation and food service activities; ADM = administrative and support service activities; AGR = agriculture, forestry, and fishing; ART = arts, entertainment, and recreation; CON = construction; EDU = education; ELC = electricity, gas, steam, and air-conditioning supply; FIN = financial and insurance activities; HEA = human health and social work activities; INF = information and communication; MNF = manufacturing; MNG = mining and quarrying; OTH = other services; PRF = professional, scientific, and technical activities; PUB = public administration and defense; REA = real estate activities; TRA = transportation and storage; TRD = wholesale and retail trade; WAT = water supply, sewerage, waste management, and remediation activities.

of these attributes (services), contributed to rising overall shares of part-time employment and temporary contracts. Panel 3 of Figure 2.8 shows that shifts in employment toward sectors with relatively low hours per worker contributed to the aggregate change in this job attribute.

In sum, sectors that tend to have traditional employment arrangements (smaller shares of temporary contracts and part-time employment, longer hours per worker) have seen outright declines or weaker growth in employment than sectors where arrangements are more flexible. All in all, shifts in employment shares across sectors can explain about 22 percent of the increase in part-time employment, 18 percent of the increase in temporary contracts, and 23 percent of the reduction in hours per worker.

Drivers of Recent Wage Dynamics

As documented in the section "Surface Healing Masks Deeper Changes," nominal wage growth remains lower than before the Great Recession in most advanced economies. Furthermore, rising involuntary part-time employment, a higher incidence of temporary contracts, and a decline in hours per worker suggest broader changes in the labor market in many advanced economies since 2007, and notably even in those where unemployment rates are now below their precrisis averages.

This section studies the determinants of wage growth across advanced economies in recent years. The empirical approach is guided by the sequence outlined in the primer on wage determination. It first explores the role of cyclical factors, such as headline unemployment and inflation expectations and medium-term factors (trend productivity growth), before examining how the changing nature of employment affects wage dynamics. Finally, it explores the influence of slower-moving factors on wage dynamics and involuntary part-time employment.

Aggregate Analysis—Cross-Country Evidence

The baseline approach is a panel variant of the wage Phillips curve estimated in Gali (2011), in which wage growth is regressed on expected inflation, lagged inflation, and the unemployment rate.[22] The analysis

[22]The baseline wage measure is compensation per hour, excluding self-employment income. Because the data are insufficient to accu-

focuses on nominal wage growth, examining the influence of past inflation and inflation expectations explicitly, alongside drivers that could be acting through real wage dynamics.

These cyclical drivers can be rationalized as follows. Nominal wage growth depends on expected inflation (if wage setting is forward looking) or on lagged inflation (if backward indexation occurs); in aggregate, it is likely to depend on a combination of the two. Given that the benchmark model assumes a constant natural rate of unemployment and constant hours per worker, the unemployment rate proxies for labor market slack. In other models (described in Annexes 2.2 and 2.3), the output gap is used as an alternative measure of labor market slack. Greater slack in the labor market is expected to slow wage growth. Furthermore, at any given labor market slack and inflation expectations, wage growth can vary, depending on whether the economy is entering or exiting recession. The wage Phillips curves therefore also control for changes in unemployment (Manning 1993; Gali 2011). As described in the primer on wage determination, a key influence on wage growth is trend labor productivity growth. The benchmark model controls for this factor as well.[23]

The panel structure allows for the examination of wage dynamics across advanced economies, exploiting variation in the determinants of wage growth over time and across countries. Robustness tests are conducted by allowing the relationships between wage growth and labor market slack, changes in the unemployment rate, and inflation expectations to be country specific. Allowing coefficients to be country specific can help capture particular features of individual contexts—for instance, the hypothesis that nominal wage growth in the United States has been subdued in recent years in part because employers did not cut wages immediately after the financial crisis (Yellen 2014; Daly and Hobijn 2015), or the idea that wage growth may have been inhibited by a decline in the entry of new firms, a reduction in labor market "churn," and fewer job-to-job transitions—and thus fewer discrete increases in wages that often occur with these transitions.[24] While testing these country-specific hypotheses in detail is beyond the scope of this chapter, two boxes supplement the cross-country analysis by shedding light on particular mechanisms that apply in certain advanced economy contexts. Box 2.2 examines the incidence of nominal wage freezes and cuts using firm-level data from Europe. Box 2.3 studies how wage growth in a broad sample of advanced economies may have been affected by firm-level balance sheet health after the financial crisis.

Slack and Inflation

The analysis indicates that slack and past inflation are statistically significantly associated with nominal wage growth, with expected signs (Annex Table 2.3.1, column 1). A 1 percentage point increase in the unemployment rate is associated with a 0.3 to 0.4 percentage point decline in nominal wage growth, while a 1 percentage point increase in lagged inflation is associated with a 0.2 percentage point increase in nominal wage growth.

Trend Labor Productivity Growth

Firms' profitability and ability to accommodate wage increases are linked to changes in trend labor productivity growth, as discussed in the primer on wage determination. The empirical evidence suggests that nominal wage growth indeed appears to move broadly in line with trend productivity growth (Annex Table 2.3.1, column 2). A 1 percentage point increase in trend productivity growth is associated with a 0.7 percentage point increase in nominal wage growth.[25]

rately determine the shares of value added captured by labor versus capital for the self-employed, the baseline measure does not consider the wages of the self-employed. Results are broadly robust to using alternative wage measures.

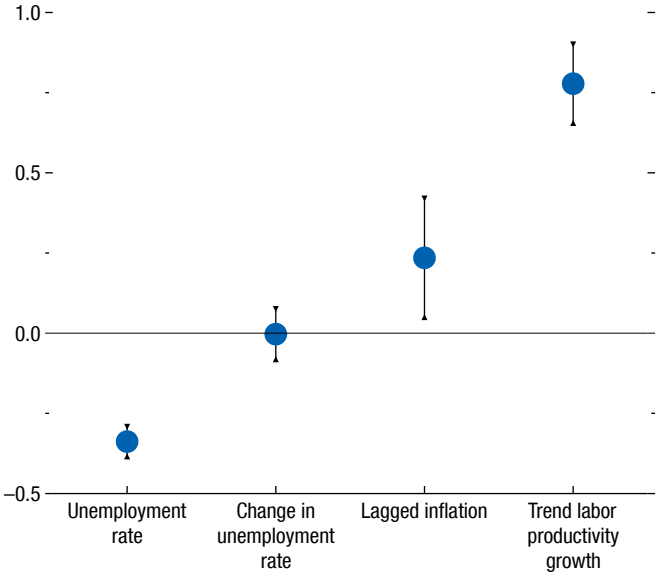
[23]The inclusion of trend productivity growth in wage equations that examine the role of cyclical factors, such as slack and inflation expectations, is argued for by Ball and Moffitt (2001), Dew-Becker and Gordon (2005), Hall (2005), and Yellen (2005). The theoretical motivation for including productivity growth in wage Phillips curves is shown, for example, in Blanchard and Katz (1997), although the authors note that the empirical estimates for US Phillips curves estimated up to the time of writing do not strongly argue for its inclusion in the specification. The pass-through from labor productivity to real wages depends on the bargaining power of workers and the elasticity of substitution between capital and labor (Chapter 3 of the April 2017 WEO). Annex Figure 2.2.3 illustrates the dynamics of trend productivity growth.

[24]Danninger (2016), for example, finds that job-to-job transitions in the United States have slowed for all skill and age groups in recent years. These developments are not necessarily a legacy of the Great Recession. Davis and Haltiwanger (2014) show that worker reallocation rates declined by 25 percent after 2000, suggesting that the labor market had begun to turn less fluid before the Great Recession.

[25]The impact of trend productivity growth on wage growth is consistent with other studies. These results suggest that a 1 percentage point increase in trend productivity growth rate is associated with 0.4 to 0.9 percentage point higher wage growth, a range that includes the impact of about 0.8 percentage point implied in

Figure 2.9. Effects on Growth of Compensation per Hour: Panel Estimation
(Percentage points)

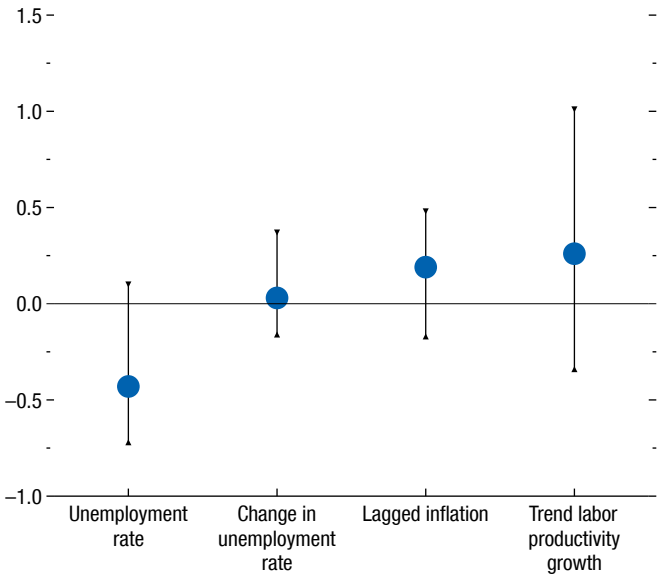
Slack, past inflation, and trend labor productivity growth are statistically significantly associated with nominal wage growth, with expected signs.



Source: IMF staff calculations.
Note: The wage variable used is compensation per hour of workers excluding the self-employed. Markers show estimated coefficients, and lines display 90 percent confidence intervals. Sample excludes Baltic countries. Oil price is used as an instrument for lagged inflation. Figure is based on column (7) of Annex Table 2.3.1.

Figure 2.10. Effects on Growth of Compensation per Hour: Country-by-Country Estimation, Cross-Country Dispersion
(Percentage points)

A country-by-country exploration of the influences of slack, past inflation, and trend labor productivity growth points to country-specific estimates that are broadly consistent with the coefficients obtained from the country panel estimation.



Source: IMF staff calculations.
Note: The wage variable used is compensation per hour of workers excluding the self-employed. Markers show means of country-by-country estimation coefficients, and lines display corresponding interquartile ranges. Sample excludes Baltic countries. Figure is based on column (8) of Annex Table 2.3.1.

Similar patterns emerge through approaches that attempt to reduce concerns about reverse causality from wage growth to inflation (Annex Table 2.3.1, column 3) and by focusing on a sample that excludes smaller advanced economies to ensure that they are not driving the results (Annex Table 2.3.1, columns 5–7). Figure 2.9 shows coefficient estimates for the preferred specification, based on the sample excluding the smaller economies and using instrumental variables to account for possible endogeneity of inflation in the wage equation (Annex Table 2.3.1, column 7).

Furthermore, a country-by-country exploration of the influences of slack, past inflation, and trend productivity growth illustrates that the underlying dispersion of country-specific estimates (Figure 2.10; Annex Table 2.3.1, columns 4 and 8) is broadly consistent with the coefficients obtained from the cross-country panel.[26]

The findings also hold when using the aggregate output gap as a measure of slack (which allows for changes over time in the natural rate of unemployment and cyclical variations in hours per worker), as well as alternative measures of inflation expectations and trend productivity growth (Annex Table 2.3.2).

Karabarbounis and Neiman (2014). A coefficient smaller than 1 implies a less than one-for-one association between increments to productivity growth and wage growth, and indicates that some of the gains from higher productivity growth translate into higher capital income (including rent, interest, dividends and retained corporate earnings). See Chapter 3 of the April 2017 WEO for a more extensive discussion.

[26]The coefficients from the country-by-country specifications are, however, less precisely estimated than the panel coefficients due to smaller samples.

The Changing Nature of Employment and Latent Slack

Recent studies have argued that measured unemployment rates may not accurately capture slack in the United States (with a resulting focus on U-6 as a broader measure of slack) and some parts of the euro area (ECB 2017).[27,28] Furthermore, to the extent that declining unemployment rates partly reflect workers forced into part-time jobs, increases in such types of employment may overstate the tightening of the labor market. Specifically, these workers may be willing to accept slower increases in wages and, at the same time, may continue to seek full-time employment and open-ended contracts. By doing so, they compete with workers employed under more traditional arrangements and, so, weigh on their wage growth as well. True labor market slack may therefore be larger than suggested by headline unemployment rates.[29]

Extensions of the baseline approach examine whether the changing nature of employment (as documented in the section "Surface Healing Masks Deeper Changes") may have contributed to latent slack in the economy that is not picked up in headline unemployment numbers (Annex Tables 2.3.3–2.3.7). The analysis augments the baseline approach by including the shares of involuntary part-time employment and temporary contracts.[30]

A higher share of involuntary part-time employment is associated with lower wage growth, even after controlling for the influence of the variables discussed previously. Across all countries, on average, a 1 percentage point increase in the involuntary part-time employment share is associated with a 0.3 percentage point decline in nominal wage growth. To allow for the possibility that coefficients might vary across countries that have had different degrees of labor market tightening since the crisis, the regressions are also estimated separately for three subgroups. The coefficient is larger for the sample of countries where the unemployment rate is below pre–Great Recession averages. Within this group of countries, a 1 percentage point increase in the involuntary part-time employment share is associated with a 0.7 percentage point decline in wage growth. The estimated effect is only 0.2 percentage point for countries with unemployment appreciably above the pre–Great Recession averages. Though the point estimates are different for these subsamples, these differences are not statistically significant (Figure 2.11 depicts the coefficients shown in Annex Table 2.3.3, columns 5–8).

In contrast to the finding that involuntary part-time employment has weighed on nominal wage growth, the analysis does not detect a role for temporary contracts in affecting wage dynamics. In general, the temporary contract share of employment does not have a statistically significant effect on aggregate wages for the whole sample or different subgroups (Annex Tables 2.3.6 and 2.3.7).[31]

Contributions to Changes in Nominal Wage Growth

Putting the influences of slack, past inflation, and trend productivity growth together, Figure 2.12 examines the contributions of these factors to changes in average nominal wage growth since 2008 relative to 2000–07. For countries with unemployment rates below 2000–07 averages, about two-thirds of the observed decline in nominal wage growth can be explained by slower trend productivity growth—an effect that is larger in 2015–16 than in previous years (given the recent decline in trend productivity growth for this group). Lower slack (captured here using the conventional labor market indicators—that is, the unemployment rate and its change) would have acted to increase nominal wage growth since 2014. However, involuntary part-time employment continues to weigh on nominal

[27]U-6 includes the total unemployed, plus all marginally attached workers and total employed part-time for economic reasons as a percent of the civilian labor force plus all marginally attached workers.

[28]The evidence for the United States appears mixed. Krueger (2015) argues that the measured unemployment rate *overstates* the degree of slack in the United States because long-term unemployed workers have a negligible impact on wage setting. But as the same paper notes, other studies—Aaronson and Jordan (2014), Altig and Higgins (2014), Smith (2014), and Kumar and Orrenius (2016)—do find some evidence on the impact of the long-term-unemployment rate on wage growth, including at the state level.

[29]Aoyagi and Ganelli (2015) study the growing importance of nonregular employment in Japan in recent years. Katz and Krueger (2016) discuss the rise of alternative, flexible work arrangements—temping, contracting, freelancing through short-term gigs—in the United States. They estimate that workers in such arrangements now comprise 16 percent of the US workforce. See also Brainard (2016).

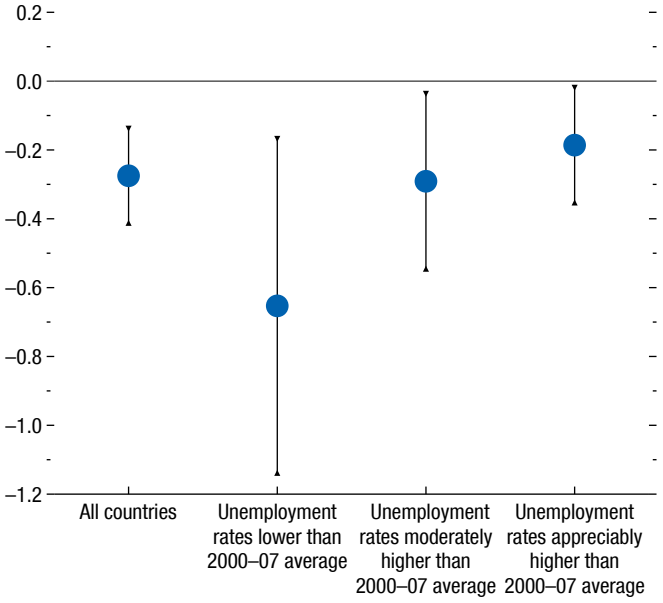
[30]These could be seen as signs of binding constraints on workers (possibly stemming from weak labor demand since the Great Recession), reflecting in part structural developments, though with an important cyclical component. Given that hours per worker also reflect worker preferences, this attribute is not considered here as a measure of latent slack.

[31]This could in part reflect measurement problems for this variable; to ensure cross-country comparability, the analysis uses a measure that does not contain information on regular versus nonregular contracts, but rather one that adheres to a legal definition of temporariness. See also note 18.

Figure 2.11. Effects of Involuntary Part-Time Employment on Growth of Compensation per Hour, 2000–16

(Percentage points)

A higher share of involuntary part-time employment is associated with lower wage growth, even after controlling for the influence of other variables. The effect is more pronounced in countries where the unemployment rate is below pre-Great Recession averages.

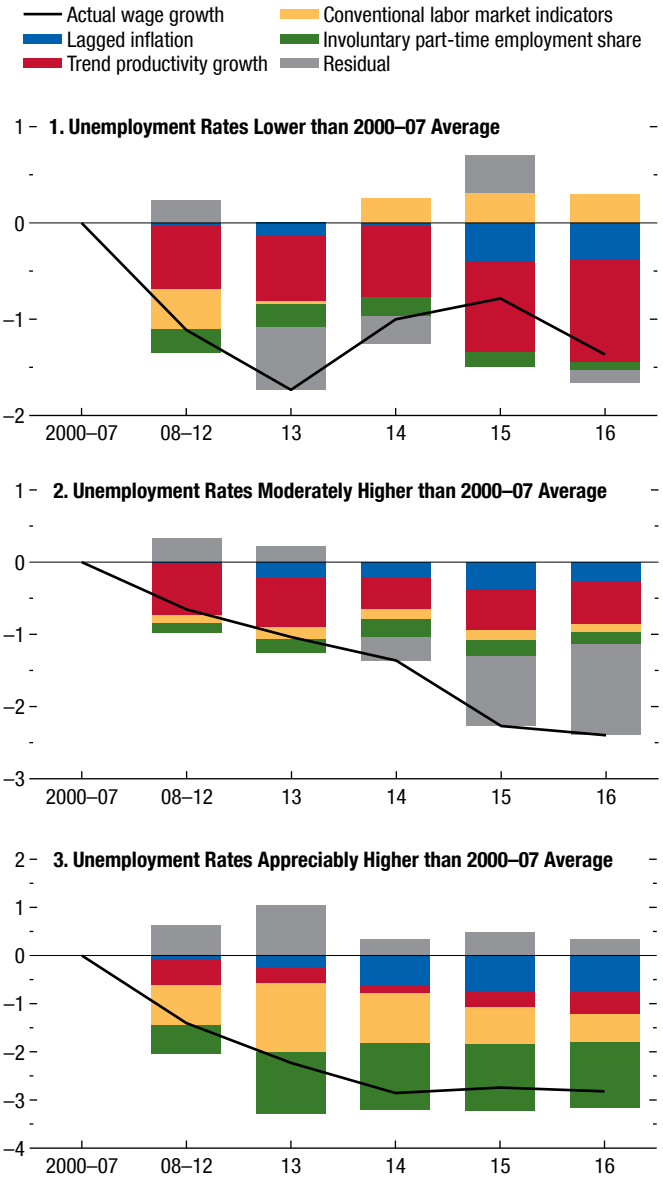


Source: IMF staff calculations.
Note: The wage variable used is compensation per hour of workers excluding the self-employed. Markers show estimated coefficients, and lines display 90 percent confidence intervals. Involuntary part-time workers are those working less than 30 hours a week because they could not find a full-time position. The involuntary part-time employment share is calculated as the total number of involuntary part-time workers divided by total employment. Countries with unemployment rates lower than the 2000–07 average are CZE, DEU, GBR, ISR, JPN, SVK, and USA; countries with unemployment rates moderately higher than the 2000–07 average are those with increases below the median of all countries with unemployment rate increases and comprise AUS, AUT, BEL, CAN, CHE, FIN, ISL, NOR, and SWE; countries with unemployment rates appreciably higher than the 2000–07 average are those with increases above the median of all countries with unemployment rate increases and comprise DNK, ESP, FRA, GRC, IRL, ITA, NLD, PRT, and SVN. Abbreviations in note use International Organization for Standardization (ISO) country codes. Figure is based on columns (5) to (8) of Annex Table 2.3.3.

Figure 2.12. Decomposition of Wage Dynamics, 2000–16

(Percentage-point change relative to 2000–07 average)

For countries with unemployment rates below 2000–07 averages, a large part of the decline in nominal wage growth can be explained by slower trend labor productivity growth, while lower slack would have acted to increase nominal wage growth. In contrast, in countries with unemployment rates still above what they were before the crisis, both conventional labor market slack measures and involuntary part-time employment weigh on nominal wage growth.



Source: IMF staff calculations.
Note: The wage variable used is compensation per hour of workers excluding the self-employed. Involuntary part-time workers are those working less than 30 hours a week because they could not find a full-time position. The involuntary part-time employment share is calculated as the total number of involuntary part-time workers divided by total employment. Groups are as defined in Figure 2.11. The decomposition is based on the coefficients reported in column (5) of Annex Table 2.3.3 and is weighted by GDP at market exchange rates across countries.

wage growth (Figure 2.12, panel 1). In contrast, in countries with unemployment rates still above what they were before the crisis, conventional measures of labor market slack can explain about half of the slowdown in nominal wage growth since 2007, with involuntary part-time employment further weighing on wages (although part-time employment, even if involuntary, may have supported labor force participation and facilitated stronger engagement with the workplace than the alternative of unemployment). Productivity growth plays

a smaller role, possibly as it was already slow in the years before the crisis (Figure 2.12, panels 2 and 3).

The domestic conditions driving wages (such as unemployment) could have a significant common component, given economic linkages between countries as well as the common influence of global factors. In addition, domestic conditions in one country could have direct spillover effects on wage setting in others. For instance, relative wage weakness in one country could put downward pressure on wages in other countries, given the threat of production relocation toward lower-cost destinations. These common factors would be picked up by statistically significant time effects in the regressions. The estimated year fixed effects tend to be correlated with advanced economy averages of lagged inflation, trend productivity growth, unemployment, and involuntary part-time employment. These forces together can explain over 70 percent of the total variation in the estimated year fixed effects. However, as illustrated in Figure 2.13, even beyond these factors, there is a negative residual after 2009, and especially during 2014–16. The residual could be picking up the effects of increased integration that make external conditions matter more and, in general, weigh on wage growth. Its increasing importance after the Great Recession and after the euro area sovereign debt crisis could point to downward pressure on wage demands as a result of synchronized recessions, and, in some cases, policy measures to slow wage growth and improve competitiveness. These findings thus corroborate the earlier findings on the importance of slack and lagged inflation on wage growth and also point to the effects of additional common external factors.[32]

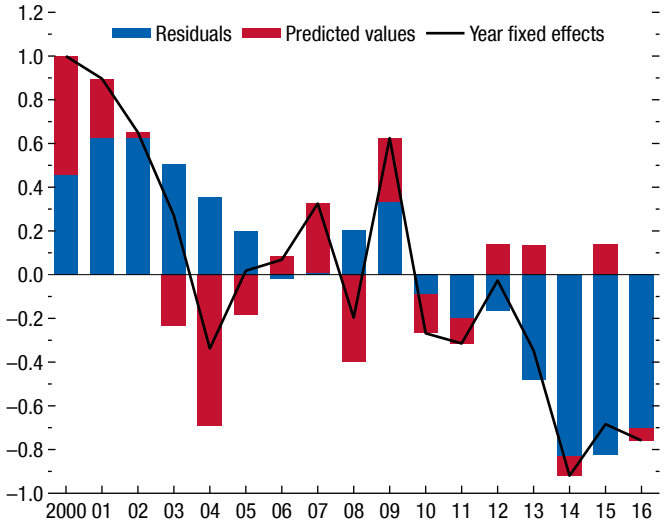
Underlying Drivers

Subdued nominal wage growth and changes in the nature of employment have taken place in an environment of declining potential growth, changes to global production processes related to automation and trade integration, and changes in labor market institutions (Figures 2.14 and 2.15). Further extensions of the baseline approach to include these slower-moving factors show that a proxy for automation (the relative price of investment goods) and diminished medium-term growth expectations appear to weigh on wage growth alongside the influence of the forces discussed above.[33]

While other results are robust to whether the years of the Great Recession are included or not, some coefficients are sensitive to the choice of period, as shown in Annex Tables 2.3.8 and 2.3.9. Automation—as proxied by a decline in the relative price of investment goods—and diminished medium-term growth expectations consistently weigh on nominal wage growth, regardless of whether the Great Recession years are included. However, the coefficient on the change in union density is sensitive to both the choice of sample years and the inclusion of its level as an additional control.

Figure 2.13. Year Fixed Effects and Common Drivers, 2000–16
(Index)

The estimated year fixed effects tend to be correlated with advanced economy averages of lagged inflation, trend productivity growth, unemployment, and involuntary part-time employment. However, even beyond these factors, there is a negative residual after 2009, and especially during 2014–16. This could be picking up the effects of increased integration as well as downward pressure on wage demands as a result of synchronized recessions.



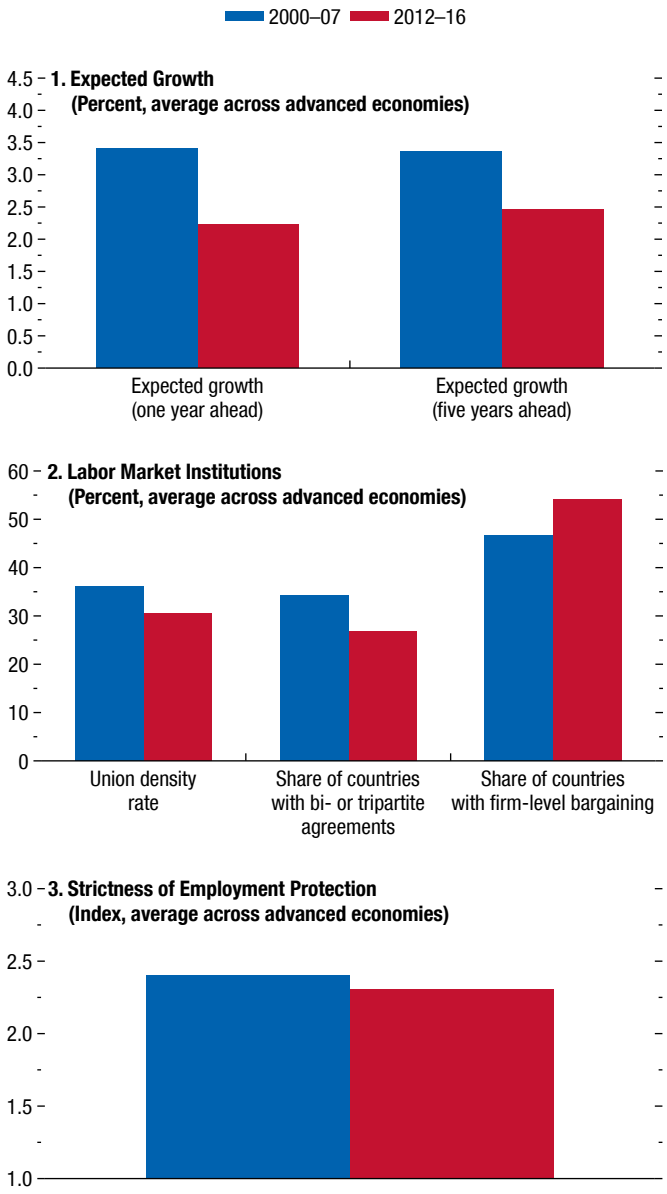
Source: IMF staff calculations.
Note: Year fixed effects are based on the panel ordinary least squares regression in column (1) of Annex Table 2.3.3. Residuals are from a regression of these year fixed effects on advanced economy averages of the drivers shown in Figure 2.12 and a constant. Year fixed effects and predicted values are subsequently renormalized such that year fixed effects over 2000–16 average to zero.

[32]Annex Figure 2.3.1 shows a decomposition similar to that in Figure 2.12, based on a regression with year fixed effects. The relative importance of the different drivers (slack versus productivity) shown in Figure 2.12 remains valid when year fixed effects are included.

[33]A decline in the relative price of investment goods can lower the cost of automating routine tasks (Autor and Dorn, 2013). However, this proxy may not fully capture the impact of automation on wages—for example, advances in artificial intelligence that allow for automation may not be perfectly measured in the relative price of investment goods.

Figure 2.14. Changes in Growth Expectations and Labor Market Institutions

Subdued nominal wage growth and changes to the nature of employment have taken place in an environment of declining potential growth and weakening worker bargaining power.



Sources: Institutional Characteristics of Trade Unions, Wage Setting, State Intervention, and Social Pacts database; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Union density rate refers to net union membership as a proportion of wage earners in employment (simple average across countries); bi- or tripartite agreements refers to the existence of a bipartite council of a central union and employers and/or the existence of a tripartite council with government participation. Firm-level bargaining denotes whether bargaining takes place predominantly at the local/company level. Strictness of employment protection refers to individual and collective dismissals (regular contracts). The sample consists of 26–33 advanced economies.

Changes in regulations related to individual and collective dismissals (a measure of employment protection; see Annex 2.3.1 for details) do not have a statistically significant effect on nominal wage growth. Because these factors may be interrelated (an increase in global value chain participation and offshoring of production can, for example, contribute to lower unionization), ascribing precise contributions to each factor's influence on recent wage dynamics is inherently difficult. Nevertheless, as seen in Figure 2.15, the limited decline in the relative price of investment goods in recent years compared with the earlier downward trend suggests that automation (as proxied by this measure) may not have made a large contribution to the subdued wage dynamics following the Great Recession.[34]

Such slower-moving forces may have also played a role in the increase in involuntary part-time employment, beyond the influence of cyclical factors (Annex Table 2.3.10). While a more negative output gap (shortfall of actual output relative to the economy's potential) is associated with an increase in the involuntary part-time employment share, other factors, such as medium-term growth expectations and automation, also appear to have had an influence (Figure 2.16). With declining medium-term growth expectations, firms may have preferred to hire workers part-time. Automation of work processes could have also led to structurally lower demand for labor. A higher services sector share of employment is also associated with an increase in involuntary part-time employment, consistent with the compositional shifts documented in the section on how surface healing masks deeper changes in advanced economy labor markets.

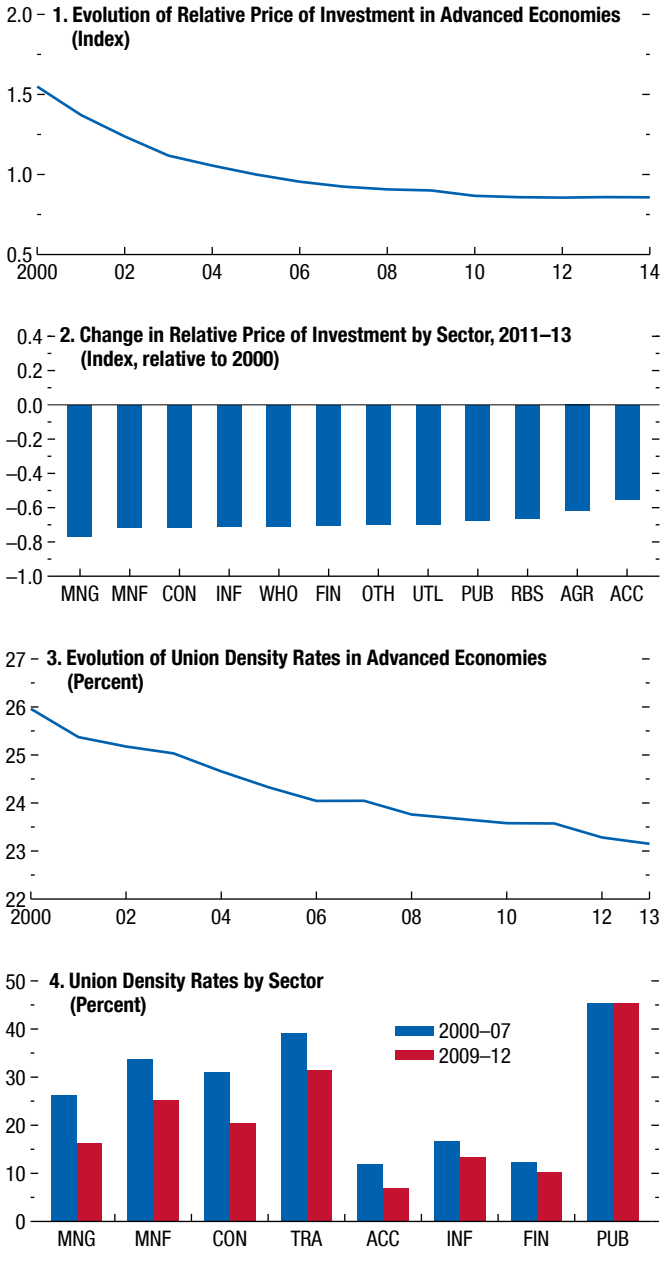
Summary and Policy Implications

Recent labor market developments in advanced economies point to a possible disconnect between unemployment and wages. Whereas in many economies headline unemployment is approaching ratios seen before the Great Recession, or has even dipped below those levels, nominal wage growth rates continue to grow at a distinctly slower pace. For some economies, this may reflect policy measures to slow wage growth and improve competitiveness in the

[34]Studies focusing on long-term effects of automation tend to find larger effects on the wages of particular groups, for example middle-skilled workers (see Autor and Dorn 2013 and Chapter 3 of the April 2017 WEO).

Figure 2.15. Long-Term Drivers of Labor Market Dynamics

Technological advancements, captured by a declining relative price of investment, and falling union density rates could act as additional drivers of labor market dynamics.

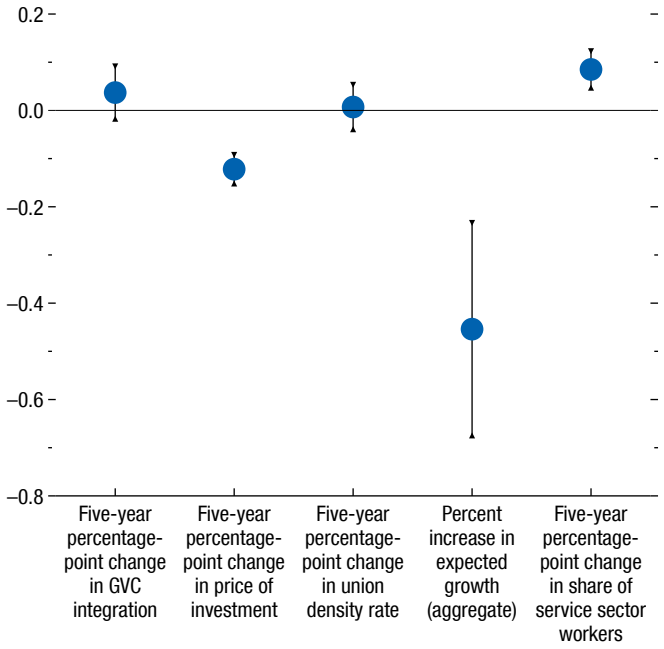


Sources: Institutional Characteristics of Trade Unions, Wage Setting, State Intervention, and Social Pacts database; Penn World Tables Capital Detail; World Bank, World Development Indicators database; and IMF staff calculations.
Note: Numbers for advanced economies are calculated by first aggregating over sectors to the country level using sectoral value added as weight, and subsequently aggregating over countries using nominal GDP as weight. Sectoral numbers are calculated by aggregating over countries using sectoral value added as weight. Sector abbreviations are as defined in Figure 2.8.

Figure 2.16. Effects on Involuntary Part-Time Employment Share, Aggregate Analysis

(Percentage points)

Larger declines in the relative price of investment, lower expected growth, and a higher share of service workers are associated with a higher share of involuntary part-time employment.



Source: IMF staff calculations.
Note: Markers show estimated coefficients, and lines display 90 percent confidence intervals. Figure is based on columns (2) to (6) of Annex Table 2.3.10. GVC = global value chain.

aftermath of the global financial crisis and euro area sovereign debt crisis. Moreover, wage weakness appears to have a common component across advanced economies, which could reflect larger cross-border spillovers of weak labor market conditions since the Great Recession. Subdued nominal wage growth has also occurred in a context of a higher rate of involuntary part-time employment, an increased share of temporary employment contracts, and a reduction in hours per worker.

The analysis finds that aggregate developments in part-time employment, temporary contracts, and hours, in part, reflect compositional shifts in employment away from sectors that tend to have traditional employment arrangements (smaller shares of part-time employment, a smaller proportion of temporary contracts, longer hours per worker) toward sectors where more flexible arrangements dominate.

However, there is less evidence that sectoral shifts in employment account for subdued wage growth. Rather, the analysis finds that, at the country level, labor market slack, together with weak productivity growth and low inflation expectations, are the main forces weighing on wage growth. Automation (proxied by the relative price of investment goods) appears to have made a small contribution to subdued wage dynamics following the Great Recession due to a limited decline in the relative price of investment goods in recent years compared with the previous downward trend. The analysis suggests that automation could weigh on wage growth more substantially in the future if the decline in the relative price of investment goods were to pick up again. However, inferences about the impact of automation are not straightforward given that, as noted previously, the relative price of investment goods is just one channel through which its influence on wage growth may play out.

Comparing the years since 2008 with 2000–07, the chapter finds that in economies where unemployment rates are still appreciably above their averages before the Great Recession, conventional measures of labor market slack can account for about half of the slowdown, with involuntary part-time employment acting as a further significant drag on wages. In these economies, wage growth is unlikely to pick up unless slack diminishes meaningfully—an outcome that will require continued accommodative policies to boost aggregate demand.

In economies where unemployment rates are now below their averages before the Great Recession and measured slack appears low, slow productivity growth can account for about two-thirds of the slowdown in nominal wage growth since 2007. Even in these economies, involuntary part-time employment, while it may have helped labor force participation and continued engagement with the workplace, appears to be weighing on wage growth, alongside slower-moving drivers.

The evidence further indicates that countries experiencing a slowdown in trend productivity will face headwinds to wage growth, even if unemployment rates decline. Inflation rates will also remain low unless wage growth accelerates beyond productivity growth in a sustained manner. In such cases, accommodative policies can help stimulate demand and lower headline unemployment rates, but overall wage growth (and hence inflation) may continue to remain subdued until involuntary part-time employment diminishes or trend productivity growth picks up. Assessing the true degree of slack beyond measured headline unemployment rates will be important when determining the appropriate pace of exit from accommodative monetary policies.

The evidence also suggests that involuntary part-time employment is in turn associated with both cyclical factors and slower-moving drivers, such as automation, diminished medium-term growth expectations, and the growing importance of the services sector. Some of these developments point to a persistent shift in the nature of work and employment relations. Policymakers may therefore need to enhance efforts to address the vulnerabilities that part-time workers face. Examples of possible initiatives in that regard include strengthening secondary and tertiary education to upgrade skills over the longer term; broadening minimum wage coverage where it does not currently include part-time workers; offering prorated paid annual, family, and sick leave to secure parity with full-time workers; and providing subsidized training for part-time workers for reskilling and retooling (see also the October 2017 *Fiscal Monitor* and Golden 2016 for a summary of measures taken by various cities in the United States, for example). However, any policy actions to address the income security of workers that hold part-time jobs or temporary contracts should be designed to minimize possible adverse impacts on the flexibility of labor markets and job creation.

More generally, the rise of part-time employment and temporary contracts challenges the current structure of social insurance systems—instituted in many advanced economies in the aftermath of the Great Depression and World War II—which may be better equipped to handle "binary" employment status (people in the labor force are either employed full-time or unemployed). To the extent that changes in the nature of employment are not purely cyclical, but also related to longer-term shifts in structural factors, a broader rethinking of the nature of social insurance may be needed.

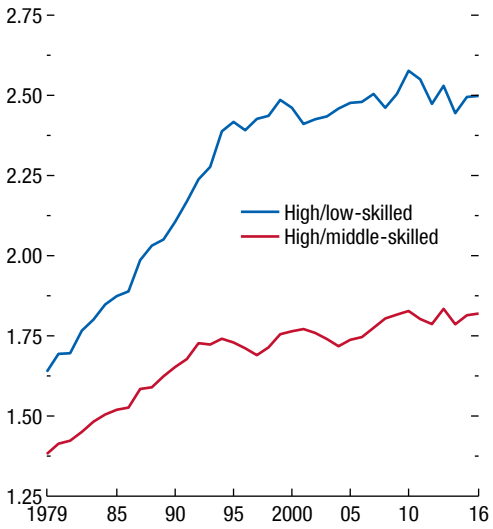
Box 2.1. Labor Market Dynamics by Skill Level

The skill premium—the ratio of the wages of skilled to unskilled workers—has been the focus of a wide body of research in recent years. Several studies look at the flattening in the skill premium in the United States since 2000 (Figure 2.1.1) and attribute it to: (1) the maturation of the information technology revolution slowing the demand for highly educated labor (Beaudry, Green, and Sand 2014, 2016), (2) a leveling off of the complementarity between highly educated labor and new production technologies (especially those that rely on computers and related organizational capital), and (3) rising competition between education groups for increasingly scarce well-paid jobs (Valletta 2016; Autor 2017).[1]

Few studies, however, have analyzed the recent evolution of the skill premium in European economies.[2] This box focuses on the evolution of labor market indicators by skill level in European economies during the most recent decade, using three cross-sections of data for 2006, 2010, and 2014.[3]

The results suggest that while low- and middle-skilled workers in Europe were hurt on the extensive margin (hours and employment, respectively), the past decade brought relative gains for these groups in terms of hourly wages.

Figure 2.1.1. Evolution of Skill Premiums in the United States



Sources: US Bureau of Labor Statistics; and IMF staff calculations.
Note: Low-skilled refers to workers with less than a high school diploma; middle-skilled refers to high school graduates with no college education; high-skilled refers to those with at least a bachelor's degree.

Shrinking Wage Dispersion

The skill premium declined in European economies between 2006 and 2014 (Figure 2.1.2); this is true in the case of the ratio of wages for high- to low-skilled workers as well as for high- to middle-skilled workers. In the United States, the former also declined over this period, however, the latter showed a small increase, pointing to relative wage losses of middle-skilled workers.

Examining variation across sectors reveals that sectors with a higher share of low-skilled workers saw higher nominal wage growth. Naturally (given that the shares add up to 1) the opposite is the case for sectors with a higher share of high-skilled workers (Figure 2.1.3).

Hollowing Out of Employment

Changes in employment point to hollowing out in European economies as well—in line with the liter-

The author of this box is Zsóka Kóczán.

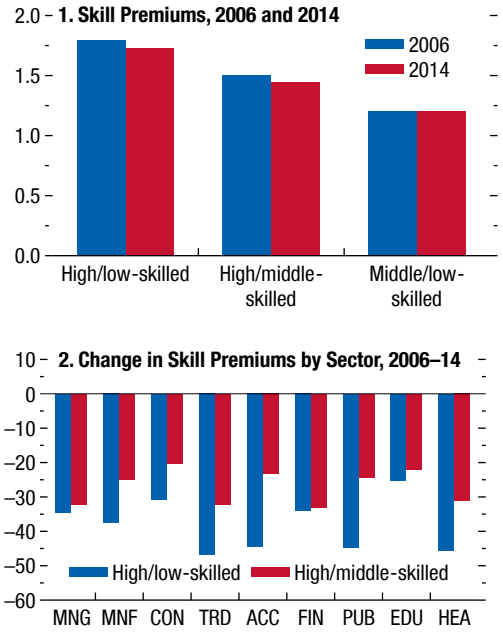
[1]Earlier studies link the widening wage dispersion in some advanced economies (in particular the United States and the United Kingdom) in the 1980s, and to a lesser extent the 1990s, to trade liberalization (Wood 1991, 1994, 1995; Leamer 1992, 1996; Burtless 1995), more intensive trade and migration (Borjas and Ramey 1995), outsourcing (Feenstra and Hanson 1996, 2001), or skill-biased technological change (Katz and Murphy 1992; Berman, Bound, and Griliches 1994; Autor, Katz, and Krueger 1998; Katz and Autor 1999; DiNardo and Card 2002; Autor, Katz, and Kearney 2008). Autor and Dorn (2013) analyze the polarization of employment and earnings in the United States between 1980 and 2005 and emphasized the role of automation of routine tasks.

[2]Parteka (2010) notes the increasing wage gap for low-skilled workers in the EU15 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom) during 1995–2005 in most sectors, and EU (2015) finds that earnings inequality increased from 2006 to 2011 in two-thirds of the members of the European Union. Cho and Díaz (2016), however, note that the skill premium fell in 2000–08 in the Baltic countries.

[3]Low-skilled workers are defined as those with up to lower-secondary education, middle-skilled as those with upper-secondary or postsecondary nontertiary education, and high-skilled as those with tertiary education.

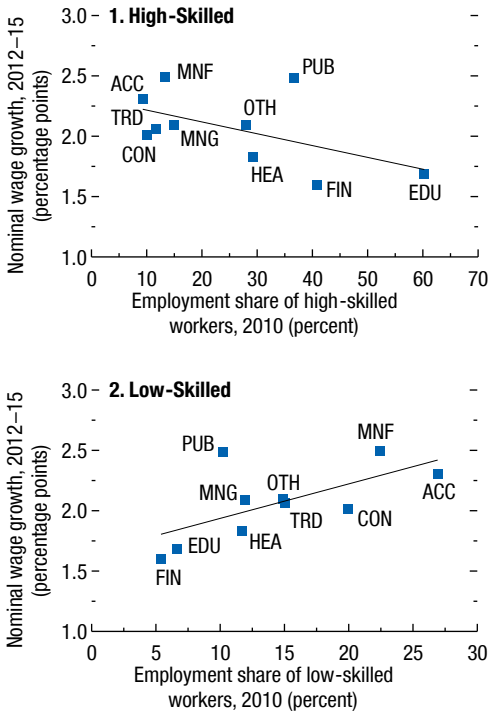
Box 2.1 *(continued)*

Figure 2.1.2. Skill Premiums and Changes in Skill Premiums in European Economies



Sources: Eurostat; and IMF staff calculations.
Note: Low-skilled refers to workers with less than a high school diploma; middle-skilled refers to high school graduates with no college education; high-skilled refers to those with at least a bachelor's degree. The figure shows simple averages across sectors and economies. ACC = accommodation and food service activities; CON = construction; EDU = education; FIN = financial and insurance activities; HEA = human health and social work activities; MNF = manufacturing; MNG = mining and quarrying; PUB = public administration and defense; TRD = wholesale and retail trade.

Figure 2.1.3. Nominal Wage Growth by Sector and Skill Group



Sources: Eurostat; and IMF staff calculations.
Note: Low-skilled refers to workers with less than a high school diploma; high-skilled refers to those with at least a bachelor's degree. ACC = accommodation and food service activities; CON = construction; EDU = education; FIN = financial and insurance activities; HEA = human health and social work activities; MNF = manufacturing; MNG = mining and quarrying; OTH = other services; PUB = public administration and defense; TRD = wholesale and retail

ature on the United States.[4] The employment shares of middle-skilled workers fell, while those of low- and high-skilled workers increased (Figure 2.1.4). This pattern can be observed in all sectors, however, during this period it was starkest in services (finance, public administration, health, education). While sectoral data on the price of investment is limited, there are some evidence that sectors more exposed to technological change (that experienced larger declines in their price of investment goods) also saw more pronounced hollowing out declines in the employment shares of middle-skilled labor.[5]

Falling Hours among Low-Skilled Workers

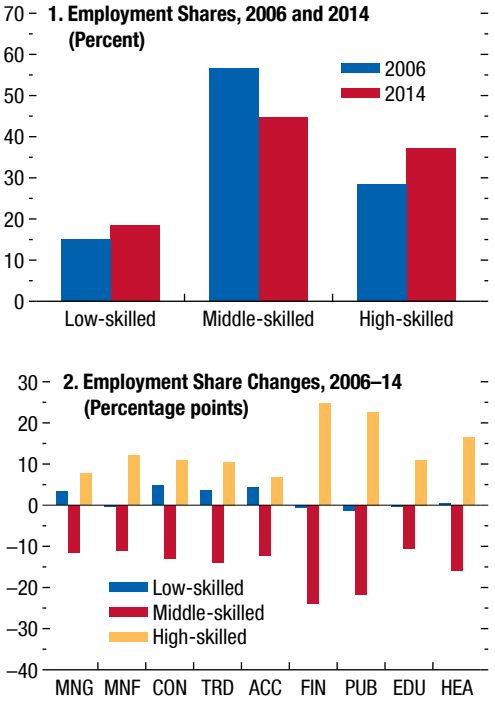
Middle-skilled workers lost out in terms of employment shares, but low-skilled workers appear to have experienced a larger decline in hours than other skill groups. Country-sector-level data on hours by skill level are unfortunately not readily available. However,

[4]See also Das and Hilgenstock (forthcoming) for a larger sample of advanced as well as emerging market economies.

[5]Chapter 3 of the April 2017 *World Economic Outlook* highlights a particularly large impact of technology (declining price of investment and exposure to routinization) on the labor share of middle-skilled workers.

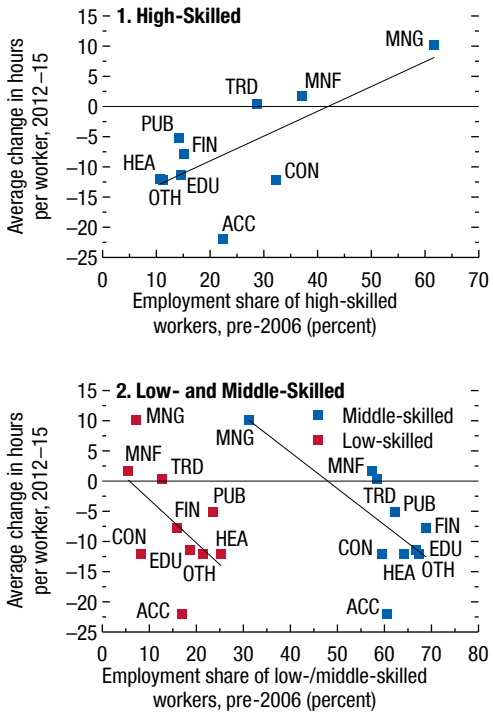
Box 2.1 *(continued)*

Figure 2.1.4. Employment Shares by Skill



Sources: Eurostat; and IMF staff calculations.
Note: Low-skilled refers to workers with less than a high school diploma; middle-skilled refers to high school graduates with no college education; high-skilled refers to those with at least a bachelor's degree. ACC = accommodation and food service activities; CON = construction; EDU = education; FIN = financial and insurance activities; HEA = human health and social work activities; MNF = manufacturing; MNG = mining and quarrying; PUB = public administration and defense; TRD = wholesale and retail trade.

Figure 2.1.5. Employment Shares by Skill and Changes in Hours per Worker



Sources: Eurostat; and IMF staff calculations.
Note: Low-skilled refers to workers with less than a high school diploma; middle-skilled refers to high school graduates with no college education; high-skilled refers to those with at least a bachelor's degree. ACC = accommodation and food service activities; CON = construction; EDU = education; FIN = financial and insurance activities; HEA = human health and social work activities; MNF = manufacturing; MNG = mining and quarrying; OTH = other services; PUB = public administration and defense; TRD = wholesale and retail trade.

sectors with larger shares of low-skilled workers have seen larger declines in hours (Figure 2.1.5). This agrees with the findings of EU (2015), which highlights significantly higher inequality levels for annual earnings than inequality measures for monthly and hourly wages. Number of months and, to a lesser extent, hours worked in the year appear to be significant sources of variation.

Box 2.2. Worker Contracts and Nominal Wage Rigidities in Europe: Firm-Level Evidence

This box examines the evolving nature of worker contract types and their potential implications for wage dynamics in Europe during the postcrisis period. The data set used in the analysis is from the Wage Dynamics Network (WDN), constructed to capture determinants of nominal wage dynamics for a large sample of European firms (see Izquierdo and others 2017 for further details on the data set).[1] The data set is generated by three waves of surveys conducted in 2007, 2010, and 2014.

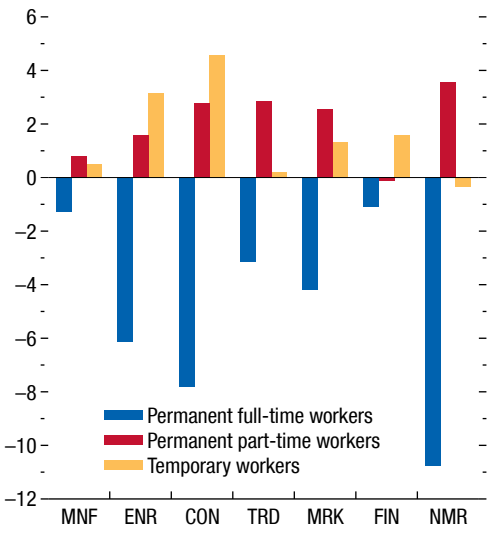
Changes in Worker Contract Type

Worker contract type in the firm-level survey falls into one of three categories: permanent full-time, permanent part-time, and temporary. Examining these three categories of contracts by sector during 2007–14, the patterns seen in nonmanufacturing sectors appear to diverge from those registered in the manufacturing sector.

Most nonmanufacturing sectors appear to have experienced a sharp decline in the permanent full-time worker share and increases in more flexible contracts, such as permanent part-time hires and workers on temporary contracts (Figure 2.2.1). In particular:

- *Permanent full-time worker share:* The permanent full-time worker share, averaged across nonmanufacturing sectors, declined from 81.8 percent in 2007 to 77.3 percent in 2014; in contrast, the share of permanent full-time workers stayed relatively stable for the manufacturing sector: 87.2 percent in 2007 and 85.9 percent in 2014.
- *More flexible contracts:* The flip side of the above development is that the nonmanufacturing sectors experienced a higher increase in both the permanent part-time worker and temporary worker share of employment compared with the manufacturing sector. The share of permanent part-time workers increased by over 2 percentage points from 9.5 percent in 2007 to 11.8 percent in 2014 for nonmanufacturing sectors, whereas the manufacturing sector experienced a mild increase in this category of less than a percentage point, from 5.6 percent to 6.4 percent over the same period. Similarly, the share of temporary workers in nonmanufacturing sectors rose from 8.6 percent in 2007 to 10.3 percent in 2014, while the share remained broadly unchanged for the manufacturing sector in these two periods (7.1 percent in 2007 and 7.6 percent in 2014).

Figure 2.2.1. Changes in Employment Shares
(Percentage points)



Sources: Wage Dynamics Network, 2007, 2009, and 2014 waves; and IMF staff calculations.
Note: CON = construction; ENR = energy; FIN = financial intermediation; MNF = manufacturing; MRK = market services; NMR = nonmarket services; TRD = trade.

The magnitude of the decline in the permanent full-time worker share also varies across countries and appears related to the extent of healing in headline unemployment following the Great Recession (Figure 2.2.2). Countries whose unemployment rate is now below the 2000–07 average (blue bars) experienced a smaller decline in the share of permanent full-time workers than those where unemployment rate remains above the 2000–07 average (red bars).[2] Although the increase in the temporary contract share is more pronounced for most of the nonmanufacturing sectors for countries in the first group, countries in the second group show a higher increase in the share of permanent part-time workers in some sectors, such as trade and energy.

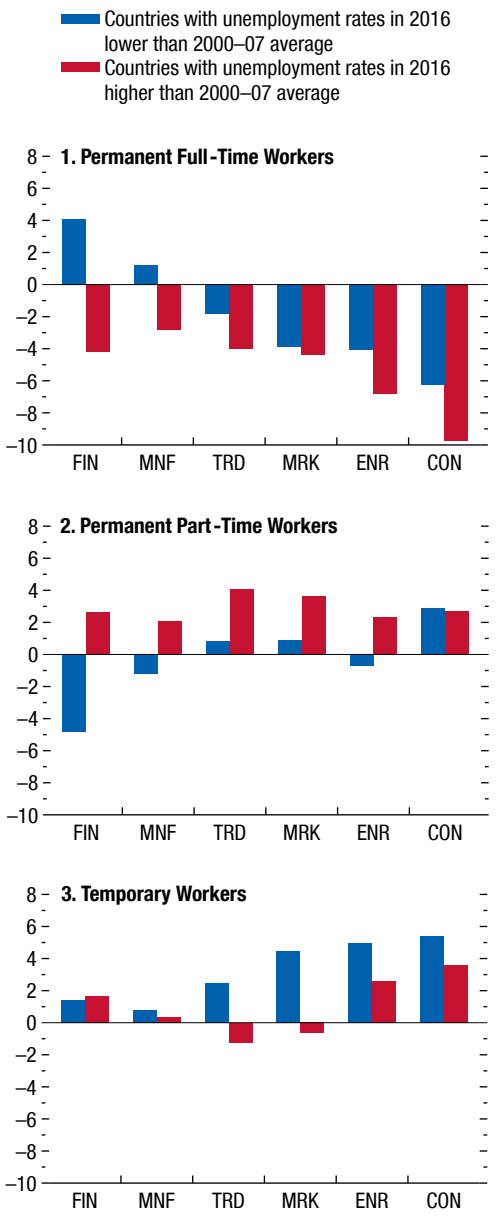
The author of this box is Gee Hee Hong.

[1]The author would like to thank the European Central Bank for making the WDN data sets available for this analysis.

[2]Countries with relatively high unemployment rates are those where the unemployment rate in 2016 was higher than their respective average unemployment rate between 2000 and 2007. These include Austria, Belgium, Cyprus, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia, Spain, and Switzerland. Countries with relatively low unemployment rates are those where the unemployment rate in 2016 was lower than their respective average unemployment rate between 2000 and 2007. These include the Czech Republic, Estonia, Germany, Malta, the Slovak Republic, and the United Kingdom.

Box 2.2 *(continued)*

Figure 2.2.2. Changes in Employment Shares, 2007–14
(Percentage points)

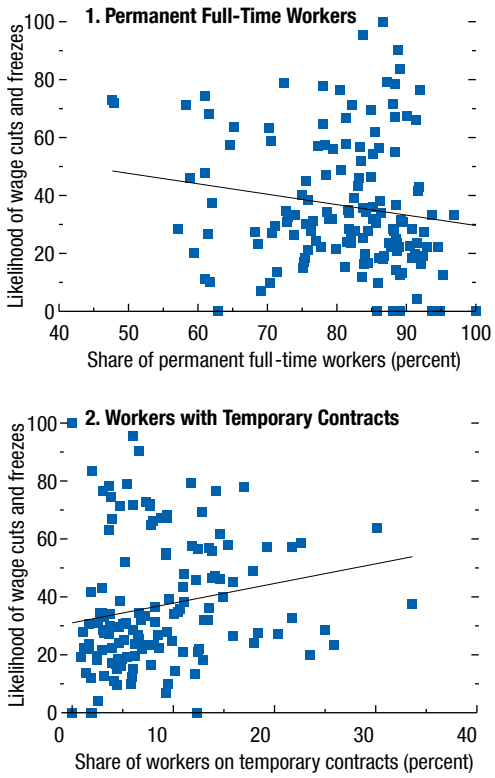


Sources: Wage Dynamics Network, 2007, 2009, and 2014 waves; and IMF staff calculations.
Note: CON = construction; ENR = energy; FIN = financial intermediation; MNF = manufacturing; MRK = market services; TRD = trade.

Wage Dynamics

Across the sample of 20,000 firms surveyed in 2014, sectors with a higher share of workers on temporary contracts also tend to have higher wage cuts and freezes. Figure 2.2.3 shows a positive relationship across sectors between the share of workers on temporary contracts and the fraction of firms within the sector reporting wage cuts and freezes. In contrast, there is a negative relationship between the share of permanent full-time workers and the fraction of firms with wage cuts and freezes. The patterns thus suggest an association between worker contract type and wage setting: sectors with a larger share of workers on more traditional contracts (permanent full-time) tend to experience fewer wage cuts and freezes as well.

Figure 2.2.3. Wage Cuts and Freezes, 2014
(Percent)



Sources: Wage Dynamics Network, 2007, 2009, and 2014 waves; and IMF staff calculations.
Note: Each marker in the figure represents a country sector.

Box 2.3. Wage and Employment Adjustment after the Global Financial Crisis: Firm-Level Evidence

How have revenue growth performance and volatility affected firms' labor-related decisions in the postcrisis period? What role has firm-level financial vulnerability at the outset of the crisis played when it comes to postcrisis firm-level labor market choices?

This box looks at these questions using the ORBIS data set compiled by Bureau van Dijk. It is a rich, cross-country, firm-level data set that contains firms' balance sheet variables as well as total wage bill and total employment information.[1] The box first explores the association between recent growth (which arguably influences firm-level growth expectations) and uncertainty, and firms' wages and employment growth following the global financial crisis. To assess the potential effect of financial-crisis-related factors on firms' wage and employment decisions, the box further explores whether firms with different degrees of ex ante financial vulnerability exhibit different wage and/or employment adjustment patterns in the postcrisis period.

The evidence suggests that firms with stronger recent growth performance (and thus arguably more optimistic growth expectations) and low volatility exhibit higher wage and employment growth. Moreover, firms with weaker balance sheets before the crisis experience lower growth in wages and employment following the crisis, which highlights the potential role of crisis-related legacies in firms' labor-related decisions in the postcrisis period.

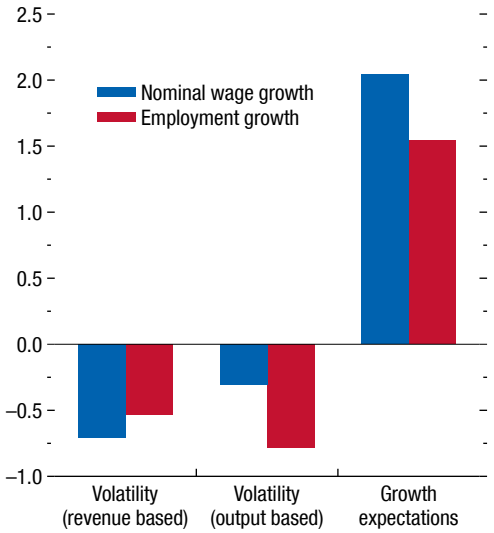
Growth Expectations and Uncertainty as Determinants of Wage and Employment Growth

To the extent that recent growth influences expectations about future growth (for example, if firms form adaptive expectations), trailing five-year average revenue growth can be considered a proxy for firm-level medium-term growth expectations. Moreover, the standard deviation of

The author of this box is Gee Hee Hong.

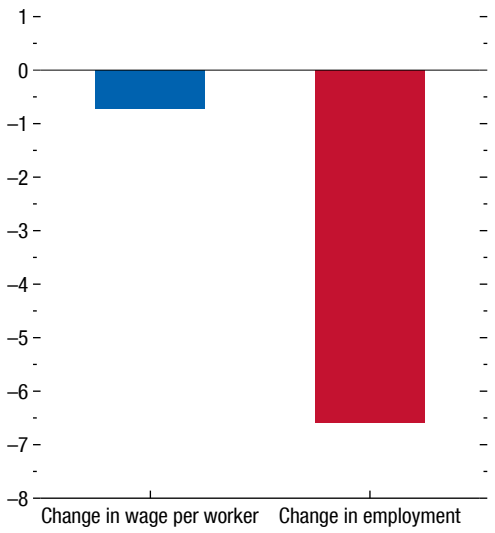
[1]Comparability of the variables across countries and over time is ensured as described in Duval, Hong, and Timmer (2017), following the methodology of Gal and Hijzen (2016).

Figure 2.3.1. Estimated Nominal Wage Growth and Employment Growth Differences Based on Uncertainty and Growth Expectations
(Percentage points)



Sources: ORBIS; and IMF staff calculations.
Note: Wage is defined as total wage bill divided by total employment for each firm. The blue bars show the estimated wage growth differences between firms with high uncertainty/growth expectations (75th percentile) and those with low uncertainty/growth expectations (25th percentile). The red bars show the corresponding employment growth differences.

Figure 2.3.2. Wage and Employment Growth by Debt Maturity in 2008
(Percentage points)



Sources: ORBIS; and IMF staff calculations.
Note: The left bar represents the estimated difference in postcrisis wage growth minus precrisis wage growth between a firm with a high ratio of debt maturing in 2008 (75th percentile) and a firm with a low ratio of debt maturing in 2008 (25th percentile). The right bar represents the estimated difference in postcrisis employment growth minus precrisis employment growth between the two types of firms.

Box 2.3 *(continued)*

revenue growth (volatility)—or its ratio to average revenue growth over the trailing five-year interval (coefficient of variation)—can be considered a proxy for firm-level uncertainty about the operating environment.

The evidence suggests that firms with more optimistic growth expectations or lower volatility show stronger wage and employment growth in the postcrisis period.[2] Figure 2.3.1 compares the differences in average wage and employment growth rates since 2008 between firms whose volatility and growth expectations are in the 25th and 75th percentiles. Wage growth is 0.3 to 0.6 percentage point lower for firms with higher volatility than for their counterparts with lower volatility (depending on the measure used to construct volatility). In addition, firms whose growth expectations are more optimistic show 2 percentage points stronger wage growth than their less optimistic counterparts. Similarly, for employment growth, firms with higher volatility experience 0.5 to 0.8 percentage point lower employment growth than those with lower volatility. Optimism in growth expectations contributes positively to employment growth as well: firms with more optimistic expectations experience nearly 1.5 percentage points higher employment growth than those that are less optimistic.

[2]The two main dependent variables are the annual growth rate of total employment for each firm and the annual growth rate of wage per employee, in which the wage per employee is calculated as the total wage bill divided by the total number of employees for each firm.

Financial Frictions and Labor-Related Decisions

Firms whose financial vulnerability was higher before the crisis appear to exhibit weaker wage and employment growth in its aftermath, which highlights the potential role of financial frictions or crisis-related legacies in wage and employment adjustments following the crisis.

Adopting the difference-in-differences methodology that compares the averages of precrisis and postcrisis wage and employment growth following Duval, Hong, and Timmer (2017), firms with ex ante more vulnerable balance sheets—higher leverage and rollover risk entering the financial crisis—exhibit lower wage and employment growth in the postcrisis years. The results are robust to controlling for labor productivity and multifactor productivity, following Wooldridge (2009).[3]

Table 2.3.1 reports the results. Controlling for different measures of productivity, a 10 percentage point higher leverage ratio before the crisis is associated with 0.1 percentage point weaker growth in wages and employment after the crisis. Similarly, firms with higher precrisis rollover risk show about 0.3 to 0.4 percentage point weaker growth in wages and employment.

[3]Rollover risk, measured as the ratio of current liabilities (that is, debt maturing within a year) to total sales in the 2007 balance sheet, allows for a causal interpretation. Firms' debt structure in 2007 is unlikely to be associated with other unobserved firm characteristics affecting wage and employment decisions given that the timing of the global financial crisis was not foreseen from the vantage point in 2007 (Almeida and others 2012; Duval, Hong, and Timmer 2017).

Table 2.3.1. Precrisis Financial Vulnerabilities and Postcrisis Labor Adjustments

	(1)	(2)	(3)	(4)
	Changes in Log(average wage/worker)		Changes in Log(employment)	
Leverage Precrisis[1]	–0.0130***	0.005	–0.011***	–0.010***
	(0.003)	(0.005)	(0.003)	(0.003)
Debt Maturing 2008[2]	–0.038***	–0.036***	–0.034***	–0.032***
	(0.005)	(0.004)	(0.005)	(0.004)
Productivity (multifactor productivity)[3]	0.790***		0.464***	
	(0.145)		(0.119)	
Productivity (labor productivity)[4]		0.540***		0.343***
		(0.123)		(0.111)
Country Fixed Effects	yes	yes	yes	yes
Sector Fixed Effects	yes	yes	yes	yes
Number of Observations	82,162	98,386	82,204	98,420
R^2	0.0253	0.0280	0.0269	0.0268

Source: IMF staff calculations.
Note: Changes in log(average wage/worker) is the difference between average wage per worker between the postcrisis and precrisis periods. Changes in log(employment) is the difference between log of average employment between the postcrisis and precrisis period. Standard errors in parentheses are clustered at the country-sector level. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]Average precrisis debt-to-assets ratio.
[2]Amount of debt maturing in 2008 divided by average total precrisis sales.
[3]Calculated using the methodology introduced by Wooldridge (2009).
[4]Calculated as the ratio of value-added output to total employment at the firm level.

Annex Table 2.1.1. Country Coverage

Aggregate Analysis	Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Lithuania, Netherlands, New Zealand, Norway, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States
Sectoral Analysis	Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Slovak Republic, Slovenia, Sweden, United Kingdom, United States

Annex Table 2.1.2. Data Sources

Indicator	Source
Compensation, Wages	Eurostat; national authorities; Organisation for Economic Co-operation and Development
Employment	Eurostat; national authorities; Organisation for Economic Co-operation and Development
Part-Time Employment	Eurostat; national authorities; Organisation for Economic Co-operation and Development
Involuntary Part-Time Employment	Eurostat; national authorities; Organisation for Economic Co-operation and Development
Temporary Employment	Eurostat; national authorities; Organisation for Economic Co-operation and Development
Hours per Worker, Total Hours	Eurostat; national authorities; Organisation for Economic Co-operation and Development
Output Gap	IMF, World Economic Outlook database
Inflation, Expected Inflation	Consensus Forecast database; IMF, World Economic Outlook database
Unemployment Rate	IMF, World Economic Outlook database
Productivity	Eora Multi-Region Input-Output table; Eurostat; national authorities; Organisation for Economic Co-operation and Development
Indicators of Employment Protection	Organisation for Economic Co-operation and Development
Expected Growth (aggregate)	IMF, World Economic Outlook database
Gross Output (sectoral)	Eora Multi-Region Input-Output database
Relative Price of Investment Goods (aggregate)	World Bank, World Development Indicators
Price of Investment (sectoral)	Penn World Tables Capital Detail
Capital Intensity	Penn World Tables
Exports, Final Exports, Final Imports	World Input-Output Database
Foreign Value Added Share of Exports	Eora Multi-Region Input-Output database
Labor Market Policies	Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention, and Social Pacts

Source: IMF staff compilation.

Annex 2.1. Country Coverage and Data

The aggregate analysis is based on both quarterly and annual data for 29 advanced economies during 2000:Q1–16:Q4. Sectoral regressions are based on annual data for 20 advanced economies during 2000–15.

The primary data sources for labor market variables are Eurostat, the Organisation for Economic Co-operation and Development (OECD), and national authorities. Key sources for other variables used in this chapter are the Eora Multi-Region Input-Output database; Database on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts (ICTWSS); IMF World Economic Outlook database; and the OECD.

Annex 2.2. Empirical Methodologies

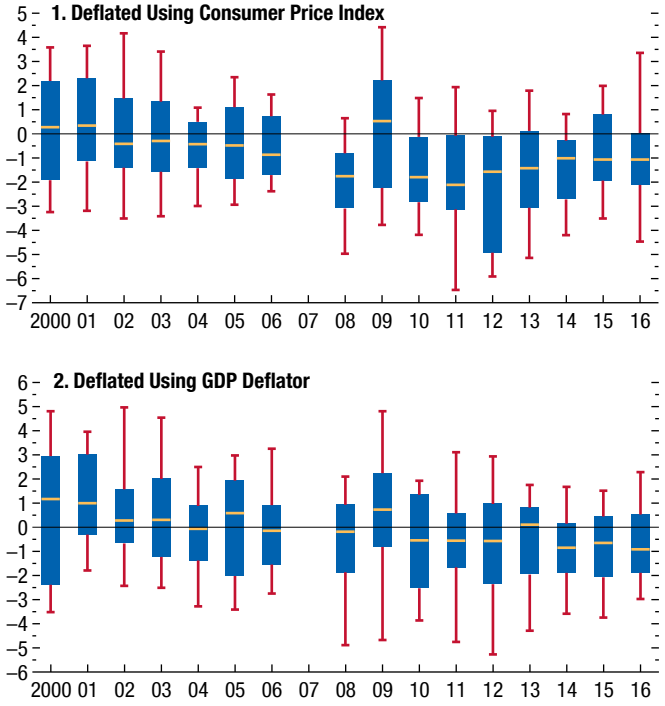
Aggregate Analysis

The aggregate analysis uses a wage Phillips curve framework proposed by Gali (2011). The original equation used by Gali (2011) is similar to equation (2.1):[35]

[35]Gali's wage Phillips curve includes both the current and previous periods' unemployment rate given that the unemployment rate in the United States follows an autoregressive (2) process, in which the expected unemployment rate is a function of current and previous unemployment rates. The analysis in this chapter uses a similar argument for controlling for the change in unemployment rate: it captures the expectation of the evolution of unemployment rates beyond the current rate. Intuitively, this captures the importance of whether a country is entering a recession (rising unemployment rates) or recovering from one (falling unemployment rates).

Annex Figure 2.2.1. Distribution of Real Compensation Growth Measures

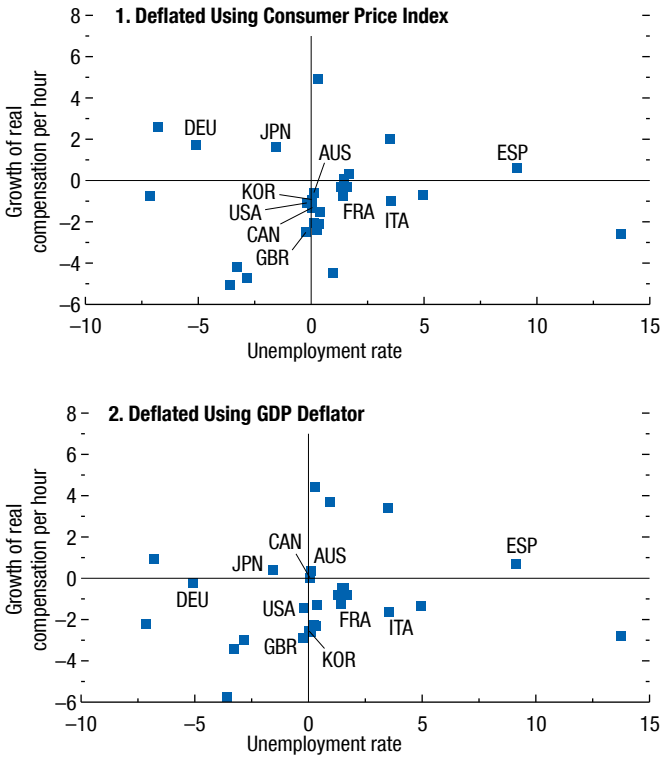
(Percentage-point difference relative to 2007)



Sources: Eurostat; national authorities; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: The sample excludes Baltic countries. The wage variable used is compensation per hour of workers excluding the self-employed. The horizontal line inside each box represents the median, the upper and lower edges of the box show the top and bottom quartiles, and the red markers denote the top and bottom deciles.

Annex Figure 2.2.2. Growth of Real Compensation per Hour and Unemployment Rates

(Percentage-point change, 2016 relative to 2000–07 average)



Sources: National authorities; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: The wage variable used is compensation per hour of workers excluding the self-employed. Data labels in the figure use International Organization for Standardization (ISO) country codes. The 10 largest advanced economies (by 2016 nominal GDP in US dollars) are labeled.

$$\pi^{w}_{i,t} = \alpha_i + \theta \pi_{i,t-1} + \beta_1 u_{i,t} + \beta_2 \Delta u_{i,t} + \varepsilon_{i,t}, \quad (2.1)$$

in which, for country i and time t, $\pi^{w}_{i,t}$ is the nominal wage growth, $\pi_{i,t-1}$ is lagged year-over-year inflation, $u_{i,t}$ is the unemployment rate, and $\Delta u_{i,t}$ is the change in the unemployment rate.

To explore how productivity growth and labor underutilization may affect aggregate wage growth, equation (2.1) is augmented with two sets of variables: trend productivity growth and labor market underutilization measures. Equation (2.2) is estimated:

$$\pi^{w}_{i,t} = \alpha_i + \theta \pi_{i,t-1} + \beta_1 u_{i,t} + \beta_2 \Delta u_{i,t} + \gamma \bar{g}^{Y/H}_{i,t} + \varphi \vec{Z}_{i,t} + \varepsilon_{i,t}, \quad (2.2)$$

in which $\bar{g}^{Y/H}_{i,t}$ is the trend of the growth rate of real output per hour, and $\vec{Z}_{i,t}$ are labor underutilization measures. These measures include the share of employed workers who take part-time jobs involuntarily, with part-time jobs defined as less than 30 hours a week, and the share of employed workers who have temporary work contracts. The primer earlier in this chapter explains why these drivers matter for wage growth. As noted there, the analysis focuses on nominal wage growth; Annex Figures 2.2.1 and 2.2.2 illustrate real wage dynamics for reference.

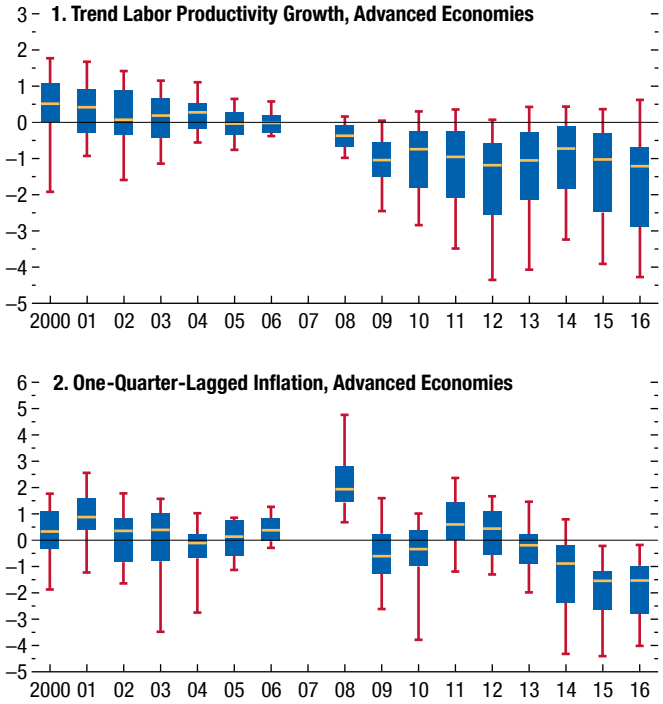
Annex Figure 2.2.3 shows the dynamics of two key drivers in equation (2.2): trend productivity growth and lagged inflation (a proxy for inflation indexation).

The analysis examines several robustness tests:

- *Data frequency:* The labor market underutilization measures (involuntary part-time and temporary contract employment shares) are not available at quarterly frequency—hence the analysis of their impact on aggregate wage growth in Annex

Annnex Figure 2.2.3. Factors Associated with Nominal Wage Growth

(Percentage point difference relative to 2007)



Sources: Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Trend labor productivity growth is calculated as five-year trailing averages. Annual averages over four quarters are shown in panel 2. The horizontal line inside each box represents the median, the upper and lower edges of the box show the top and bottom quartiles, and the red markers denote the top and bottom deciles.

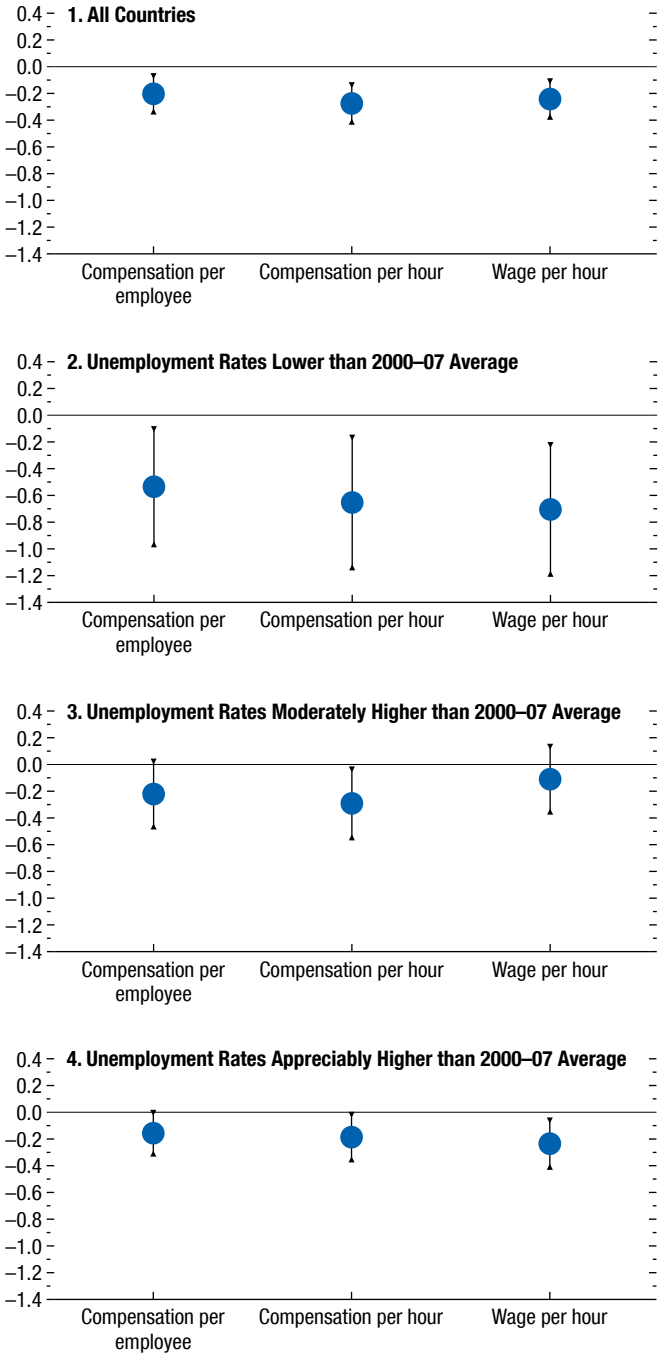
Tables 2.3.3–2.3.9 uses data at annual frequency.[36] Robustness tests suggest that interpolation to quarterly series (uniform values across quarters or linear interpolation) does not significantly affect the results.

- *Alternative wage measures* (Annex Table 2.3.5; Annex Figure 2.2.4): Robustness tests examine different choices of wage measures as the dependent variable in equation (2.2)—aggregate compensa-

[36]The unemployment rate and its change and trend productivity growth are defined using annual data; lagged inflation is based on the year-over-year change in the consumer price index lagged by one quarter (wage contracts may not be set in a synchronized way, hence inflationary shocks may affect aggregate wages with a short lag). Results are broadly robust to, instead, using annual inflation with a one-year lag. In some specification (for example, Annex Table 2.3.3, column 5), this can lead to more plausible lagged inflation coefficients.

Annex Figure 2.2.4. Effects of Involuntary Part-Time Employment on Compensation and Wages, 2000–16

(Percentage points)



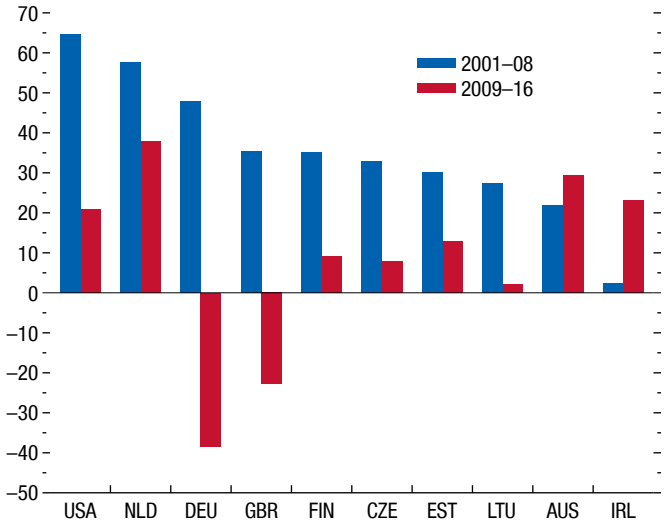
Source: IMF staff calculations.
Note: Markers show estimated coefficients, and lines display 90 percent confidence intervals. Involuntary part-time workers are those working less than 30 hours a week because they could not find a full-time position. The involuntary part-time employment share is calculated as the total number of involuntary part-time workers divided by total employment. Groups are as defined in Figure 2.11. Figure is based on Annex Tables 2.3.4 and 2.3.5.

tion divided by total employees (compensation per employee), aggregate wage bill divided by total employees (wage per employee), aggregate compensation divided by total hours (compensation per hour), and aggregate wage bill divided by total hours (wage per hour, which includes aggregate social contributions of employers). Annex Figure 2.2.5 further illustrates that public sector wages are unlikely to have been an important driver of aggregate wages during 2009–16.

- *Alternative measures of explanatory variables:* The magnitude and significance of the coefficients are, in general, robust to alternative measures of slack, inflation expectations, and trend productivity growth (Annex Table 2.3.2).
- *Country-by-country regressions:* The significance and the magnitude of the coefficients of trend productivity growth and the involuntary part-time employment share are broadly similar when relying on country-by-country regressions (Annex Table 2.3.1, columns 4 and 8).
- *Instrumental variables:* Reverse causality from wage growth to price inflation may occur if firms pass faster growth in labor costs on in the prices they charge. This is alleviated by instrumenting lagged inflation with past changes in oil prices, which is critical in helping identify the degree of inflation indexation.[37] There are two possible concerns regarding the validity of oil price changes as the instrumental variable for lagged inflation: first, global demand shocks may drive both oil prices and wage growth. This is partly alleviated by the current wage Phillips curve equation already controlling for several channels through which global demand shocks could influence wages—slack and change in slack. The second concern is whether there could be reverse causality from wage growth to other inflation drivers. However, this too is unlikely to drive the main results—lower wage growth should cause lower labor market slack, which would bias the ordinary least squares estimates of the impact of slack on wage growth downward rather than upward. Similar logic applies to the labor underutilization measure. The main result—that involuntary part-time employment weighs on wage growth—is not sensitive to using ordinary least squares or instrumental variables estimation.[38]

[37]Addressing this reverse causality could be expected to reduce the coefficient of lagged inflation. Annex Table 2.3.3 suggests that this is indeed the case for groups A and C. There could be some idiosyncratic reasons biasing the ordinary least squares estimate of lagged inflation downward for group B (the coefficient is negative and insignificant).

Annex Figure 2.2.5. Correlations between Aggregate Wage Growth and Two-Quarter-Lagged Public Wage Growth
(Percent)



Sources: Eurostat; national authorities; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

The effects of secular drivers on job attributes are examined using a cross-country panel regression of 36 countries from 2000 to 2016, including country and year fixed effects, and controlling for the output gap. In this analysis, the share of involuntary part-time workers at the country level is the main dependent variable. Potential secular drivers include measures of worker bargaining power (proxied by the five-year change in the union density rate), the five-year change in the share of employment in the services sector, technological change (proxied by the five-year change

[38]Reverse causality from wage growth to trend productivity growth may cause upward bias in the effect of trend productivity growth through employment growth. However, estimated coefficients of the labor productivity trend are often lower than what is implied from other studies in the literature (for instance, Karabarbounis and Neiman 2014), especially if the sample is restricted to the post–Great Recession period. Together, these suggest that downward attenuation bias may dominate reverse causality, causing an underestimation of the role of trend productivity growth. Results are broadly unchanged when imposing the coefficient of trend productivity growth to be 1 or the value implied from other studies.

Annex Table 2.2.1. Aggregate Forces and Sectoral Exposures

	Measure	Aggregate Variable	Sectoral Variation
Near-Term Factors	Slack inflation	Aggregate output gap, inflation	Interaction with sectoral correlation
Medium-Term Factors	Trend productivity growth		Five-year trailing average of productivity growth
Long-Term Factors	Expected growth	Expected growth (one and five years ahead)	Interaction with sectoral correlation; sectoral expected growth (adaptive)
	Trade openness		Exports, intermediate exports, global value chain participation, final imports
	Technological progress	Change in relative price of investment	Interaction with sectoral capital intensity; change in sectoral price of investment
	Worker bargaining power	Union density rate, bi- or tripartite agreement, level of bargaining	Interactions with sectoral characteristics: high expected growth, high volatility
	Ease of hiring and firing	Ease of hiring and firing	Interactions with sectoral characteristics: high expected growth, high volatility

Source: IMF staff compilation.
Note: Sample comprises 20 advanced economies: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Slovak Republic, Slovenia, Sweden, United Kingdom, and United States.

in the relative price of investment), growth expectations, and global value chain integration (proxied by the five-year change in foreign value added as a percent of exports).

Sectoral Analysis

As a complement to the aggregate analysis, drivers of nominal wage growth and part-time employment shares are examined at the sectoral level.[39] Following the structure of the aggregate analysis, sector-level regressions explore the roles of slack, medium-term growth expectations, technological progress, increased trade integration, and changes in labor market institutions.[40] These are examined as possible drivers of nominal wage growth and part-time employment to determine their effect on different margins of adjustment. The analysis exploits variation in sectoral exposure to aggregate forces to shed light on mechanisms that operate within countries.[41]

As noted earlier, across several advanced economies, a rise in involuntary part-time employment has accompanied subdued wage growth, even as headline employment has fallen. These developments have occurred in the context of falling growth expectations and declines in worker bargaining power, as shown in Figures 2.14 and 2.15.[42]

The sectoral analysis examines the effects of increasing trade openness, automation (captured by the declining relative price of investment), and slowing sectoral growth rates (used to construct a measure of adaptive growth expectations at the sectoral level) on nominal wage growth and part-time employment as a share of total employment.[43] It does so by exploiting sectoral variations in exposure to aggregate forces (Annex Table 2.2.1). For instance, country-level slack could be expected to matter more for labor market dynamics in sectors that are more correlated with the aggregate economy, and the effects of a decline in the aggregate relative price of investment could vary by the initial capital intensity of the sector.

The analysis relies on annual data for a sample of 20 advanced economies starting in 2000, and relates changes in nominal wage growth to the same cyclical and secular drivers used in the aggregate analysis, controlling for country, sector, and year fixed effects:

[39]Estimates of involuntary part-time employment are not available at the sectoral level, so the focus here is on total part-time employment, including both voluntary and involuntary.

[40]Control variables are in line with those used in ECB (2009) and EC (2003), as well as in the literature on interindustry wage differentials and wage dispersion (for example, Erdil and Yetkiner 2001; Koeniger, Leonardi, and Nunziata 2007; and Du Caju and others 2010). Wage regressions also control for inflation and (sectoral) trend productivity growth.

[41]The regressions also control for country, sector, and year fixed effects.

[42]Panel 4 of Figure 2.15 shows the decline in union density rates occurring in most sectors, with the notable exception of public administration; coverage of sectoral union density rates is unfortunately too limited to be included in the regression analysis.

[43]Sectoral expected growth is measured as the five-year trailing average of sectoral gross output growth rates. As noted above, this could be capturing expected productivity growth as well as demand conditions.

$$y_{ijt} = \alpha_i + \mu_j + \tau_t + \beta X_{ijt} + \gamma Z_{jt}, \quad (2.3)$$

in which y_{ijt} is nominal wage growth, X_{ijt} includes measures that vary at the country-sector level, such as the share of part-time employment, how correlated a sector's gross output growth is with the overall economy, sectoral trend productivity growth (measured again using a five-year trailing average), sectoral expected growth (an adaptive measure based on a five-year trailing average of sectoral gross output growth), and the five-year change in final imports as a share of gross output.

Z_{jt} includes measures that vary only at the country level, such as the aggregate output gap and (lagged) inflation, the change in the relative price of investment, and measures of worker bargaining power (proxied again using the five-year change in the union density rate). To exploit sectoral variation in exposure to aggregate forces, these are interacted with sectoral characteristics, looking at the interaction of the aggregate output gap with the correlation of the sector and the aggregate economy and the interaction of the change in the relative price of investment with sectoral capital intensity.

As in the aggregate regressions, the sectoral analysis relates the share of part-time employment to slack (captured using the output gap and how correlated a sector is with the aggregate economy and the interaction between these two variables) and to secular drivers: expected growth, change in final imports as a share of gross output, change in the relative price of investment (also interacted with capital intensity), and change in the union density rate.

Annex 2.3. Empirical Results

Aggregate Analysis

Annex Tables 2.3.1 and 2.3.2 show estimates of wage Phillips curves using ordinary least squares and instrumental variables estimations, for the full sample as well as a sample excluding the Baltic countries, and for alternative measures of the dependent and explanatory variables.

Annex Table 2.3.1. Estimates of Wage Phillips Curves

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Advanced Economies				All Advanced Economies Excluding Baltic Countries			
	OLS	OLS	IV[1]	Country-by-Country OLS[2]	OLS	OLS	IV[1]	Country-by-Country OLS[2]
Unemployment Rate	–0.332***	–0.366***	–0.394***	–0.464	–0.261***	–0.281***	–0.338***	–0.428
	(0.0261)	(0.0257)	(0.0284)		(0.0249)	(0.0249)	(0.0279)	
Change in Unemployment Rate	–0.114***	–0.0836**	–0.124***	0.00042	–0.0386	–0.0111	–0.00301	0.0313
	(0.0381)	(0.0373)	(0.0419)		(0.0427)	(0.0425)	(0.0474)	
Lagged Inflation	0.215***	0.161***	0.291***	0.177	0.216***	0.190***	0.235**	0.187
	(0.0438)	(0.0431)	(0.110)		(0.0435)	(0.0432)	(0.112)	
Trend Productivity Growth Rate[3]		0.697***	0.922***	0.344		0.446***	0.778***	0.261
		(0.0725)	(0.0732)			(0.0729)	(0.0742)	
First-Stage F-statistics above 10			yes				yes	
Country Fixed Effects	yes	yes	yes		yes	yes	yes	
Year Fixed Effects	yes	yes	no		yes	yes	no	
Number of Observations	1,889	1,889	1,857		1,766	1,766	1,736	
R^2	0.472	0.498	0.478		0.438	0.450	0.419	
Memorandum:								
The coefficient of trend productivity growth rate implied from other studies: 0.781.[4]								

Source: IMF staff calculations.
Note: Dependent variable = year-over-year growth rate of compensation per hour of workers excluding the self-employed. Sample is of quarterly frequency from the first quarter of 2000 to the fourth quarter of 2016. See Annex Table 2.1.1 for countries in the sample. IV = instrumental variable. OLS = ordinary least squares. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[2]Averages of the estimates of country-specific wage Phillips curves.
[3]Five-year trailing average of the labor productivity growth rate.
[4]Karabarbounis and Neiman (2014).

Annex Table 2.3.2. Estimates of Wage Phillips Curves with Alternative Measures

	(1)	(2)	(3)	(4)	(5)
	Benchmark[1]	Alternative Measure of Labor Market Slack[3]	Alternative Measure of Inflation Expectations[4]	Alternative Measure of Trend Productivity Growth[5]	Restricting the Coefficient of Trend Productivity Growth[6]
	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]
Unemployment Rate	–0.339***		–0.220***	–0.347***	–0.339***
	(0.0291)		(0.0236)	(0.0296)	(0.0287)
Output Gap		0.291***			
		(0.0331)			
Change in Unemployment Rate	0.0244	0.0279	–0.0935***	–0.00512	0.0240
	(0.0480)	(0.0502)	(0.0397)	(0.0479)	(0.0447)
Lagged Inflation	0.195	0.149	0.735***	0.302***	0.196*
	(0.120)	(0.128)	(0.0594)	(0.117)	(0.108)
Ten-Year Inflation Expectation			0.265***		
			(0.0594)		
Trend Productivity Growth Rate: Five-year[7]	0.783***	0.645***	0.553***		0.781
	(0.0720)	(0.0727)	(0.0634)		
Trend Productivity Growth Rate: Three-year[8]				0.410***	
				(0.0692)	
First-Stage F-statistics above 10	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no
Number of Observations	1,656	1,656	1,656	1,656	1,656
R^2	0.406	0.369	0.379	0.396	0.284

Source: IMF staff calculations.
Note: Dependent variable = year-over-year growth rate of compensation per hour of workers excluding the self-employed. Sample is of quarterly frequency from the first quarter of 2000 to the fourth quarter of 2016. See Annex Table 2.1.1 for countries in the sample. IV = instrumental variable. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The sample size is slightly smaller than that in Annex Table 2.3.1, as this table ensures the sample size consistency for columns (1) to (5).
[2]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[3]Output gap replaces unemployment rate as the measure of the labor market slack.
[4]Lagged inflation is replaced by lagged inflation and 10-year inflation expectation, with the sum of the two coefficients assumed to be 1.
[5]Three-year trailing average of productivity growth replaces five-year trailing average of productivity growth.
[6]The coefficient of trend productivity growth is imposed to be 0.781, to address the reverse causality from wage growth to trend productivity growth.
[7]Five-year trailing average of labor productivity growth rate.
[8]Three-year trailing average of labor productivity growth rate.

Oil price changes are common across countries, so instrumental variables results do not control for year fixed effects. The main results are not sensitive to the choice of estimation method—ordinary least squares including year fixed effects or instrumental variables without year fixed effects (Annex Figure 2.3.1 compared with Figure 2.12). The share of variation in wage growth explained by inflation drivers is broadly similar across the two approaches.[44]

Annex Tables 2.3.3–2.3.5 augment the wage Phillips curve specification in Annex Table 2.3.1 further with the share of involuntary part-time employment, and examine robustness to using different measures of wages, as well as exploring differences across countries with unemployment rates below, moderately above, and appreciably above 2000–07 averages.

Annex Tables 2.3.6 and 2.3.7 conduct a similar exercise for the temporary contract employment share instead of involuntary part-time employment share. Results are very similar if both the involuntary part-time employment share and temporary contract employment share are controlled for simultaneously. These labor market underutilization measures do not appear to affect the sensitivity of wage growth to unemployment rates—they are thus included additively.

As described above, Annex Table 2.3.8 augments the wage Phillips curve with secular drivers. Because wage

[44]Further analysis relating the residuals from the wage Phillips curve analysis to the global output gap (weighted by dollar GDP) suggests that the global output gap is not significant in explaining such residuals.

growth rates were volatile during the Great Recession, Annex Table 2.3.9 examines robustness to excluding the years 2008 and 2009.

Annex Table 2.3.10 zooms in on the determinants of job attributes and examines the drivers of involuntary part-time employment, linking it to the output gap and the secular drivers explored above.

Sectoral Analysis

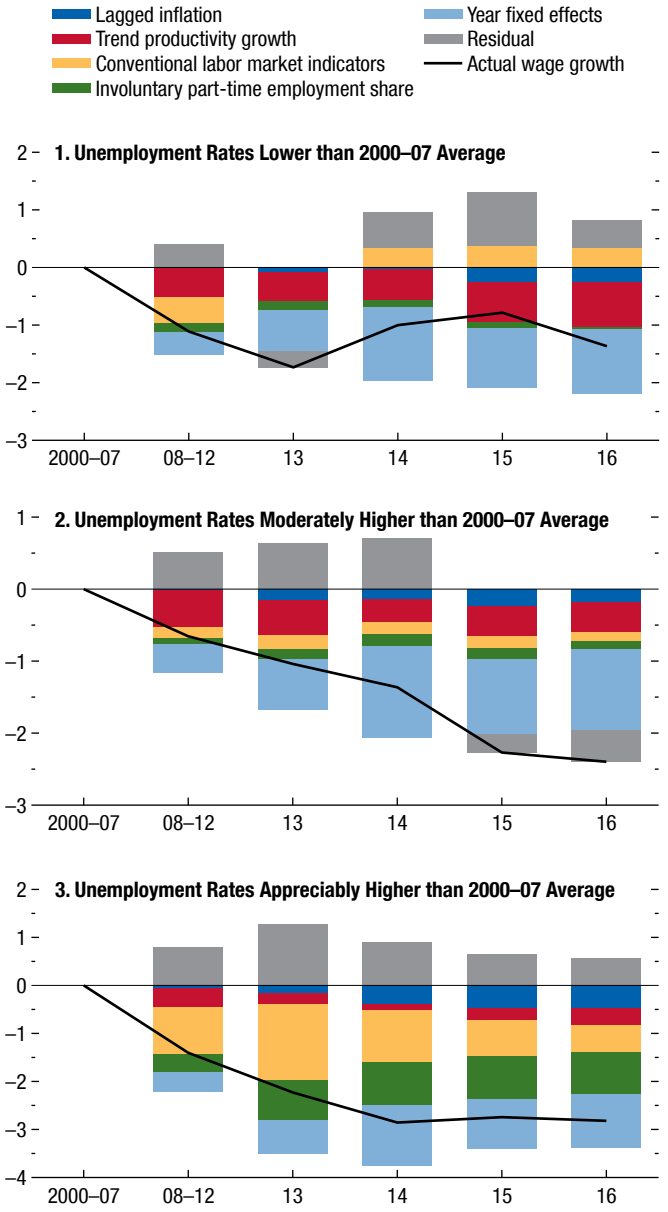
Sectoral data have many more missing observations than country-level data, resulting in an unbalanced panel, and sectoral measurements are likely noisier. Although the results of the sectoral regressions are not as conclusive as those based on the country panel regressions presented earlier, they tend to be consistent.

Annex Tables 2.3.11 and 2.3.12 report the results of the sectoral analysis, linking growth in nominal wages and part-time employment to cyclical and secular drivers. These include country, sector, and year fixed effects—results are robust to including interacted sector-year fixed effects instead, which would pick up common sectoral developments across countries. Diminished sector-specific slack is associated with higher nominal wage growth in countries where unemployment in 2016 was below 2000–07 averages (as captured by the sum of the impacts of the aggregate output gap, the correlation between the sector and the aggregate economy, and their interaction; see Figure 2.3.2, panel 1). Automation and medium-term growth expectations have been generally associated with lower wage growth in these economies. Where unemployment rates are still appreciably above 2000–07 averages, slack and past inflation are the largest drags on nominal wage growth (Figure 2.3.2, panel 3). For countries with unemployment rates only moderately above their former averages, structural factors—automation and medium-term growth expectations—play a role (Figure 2.3.2, panel 2). Although sectoral productivity growth does not have a significant effect in the sectoral analysis, this finding could result from spillovers of wage pressures across sectors and cross-sector labor mobility. These spillovers tend to weaken links between sector-level drivers and sectoral nominal wage growth.

Automation and lower sectoral medium-term growth expectations are also associated with higher shares of part-time employment across sectors,

Annex Figure 2.3.1. Decomposition of Wage Dynamics, 2000–16

(Percentage-point change relative to 2000–07 average)



Source: IMF staff calculations.
Note: The wage variable used is compensation per hour of workers excluding the self-employed. Involuntary part-time workers are those working less than 30 hours a week because they could not find a full-time position. The involuntary part-time employment share is calculated as the total number of involuntary part-time workers divided by total employment. Groups are as defined in Figure 2.11. The decomposition is based on the coefficients reported in column (1) of Annex Table 2.3.3 and is weighted by GDP at market exchange rates across countries.

Annex Table 2.3.3. Estimation of Wage Phillips Curve Augmented with Involuntary Part-Time Employment Share by Country Group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full Sample	Group A	Group B	Group C	Full Sample	Group A	Group B	Group C
	OLS	OLS	OLS	OLS	IV[1]	IV[1]	IV[1]	IV[1]
Involuntary Part-Time Employment Share	–0.177**	–0.503*	–0.336**	0.0159	–0.275***	–0.653**	–0.291*	–0.186*
	(0.0830)	(0.274)	(0.139)	(0.124)	(0.0829)	(0.294)	(0.154)	(0.101)
Unemployment Rate	–0.187***	–0.0178	–0.00699	–0.280***	–0.182***	0.0855	–0.284	–0.395***
	(0.0445)	(0.128)	(0.186)	(0.0686)	(0.0438)	(0.146)	(0.186)	(0.0722)
Change in Unemployment Rate	–0.349***	–0.690***	–0.609**	–0.128	–0.263***	–0.449**	–0.830***	0.0821
	(0.0960)	(0.244)	(0.271)	(0.129)	(0.0887)	(0.181)	(0.247)	(0.117)
Lagged Inflation	0.193***	0.378***	–0.183	0.156	0.300*	0.287	0.397	–0.279
	(0.0728)	(0.129)	(0.124)	(0.206)	(0.164)	(0.282)	(0.248)	(0.292)
Trend Productivity Growth Rate[2]	0.456***	0.634*	–0.131	0.699***	0.624***	0.763***	0.00955	0.986***
	(0.112)	(0.348)	(0.189)	(0.170)	(0.106)	(0.223)	(0.176)	(0.170)
First-Stage F-statistics above 10	yes	yes	yes	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	no	no	no	no
Number of Observations	411	117	146	148	411	117	146	148
R^2	0.610	0.709	0.649	0.723	0.577	0.652	0.458	0.660

Source: IMF staff calculations.
Note: Dependent variable = annual growth rates of compensation per hour of workers excluding the self-employed. Sample is of annual frequency from 2000 to 2016. See Annex Table 2.1.1. for countries in the full sample. A few countries are not in the sample due to missing data on involuntary part-time employment share. Country groups are divided by comparing unemployment rate in 2016 with 2000–07 average. Group A (2016 unemployment lower than 2000–07): Czech Republic, Germany, Japan, Israel, Slovak Republic, United Kingdom, and United States. Group B (2016 unemployment moderately higher than 2000–07): Australia, Austria, Belgium, Canada, Switzerland, Finland, Iceland, Norway, and Sweden. Group C (2016 unemployment appreciably higher than 2000–07): Denmark, Spain, France, Greece, Ireland, Italy, Netherlands, Portugal, and Slovenia. IV = instrumental variable. OLS = ordinary least squares. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[2]Five-year trailing average of the labor productivity growth rate.

Annex Table 2.3.4. Estimation of Wage Phillips Curve Augmented with Involuntary Part-Time Employment Share: Full Sample and Countries with Unemployment Rates Lower than 2000–07 Average

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample			Countries with Unemployment Rate Lower than 2000–07 Average (Group A)		
	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]
	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]
Involuntary Part-Time Employment Share	–0.203**	–0.275***	–0.242***	–0.535**	–0.653**	–0.705**
	(0.0803)	(0.0829)	(0.0805)	(0.261)	(0.294)	(0.292)
Unemployment Rate	–0.167***	–0.182***	–0.177***	–0.0174	0.0855	0.103
	(0.0424)	(0.0438)	(0.0422)	(0.130)	(0.146)	(0.145)
Change in Unemployment Rate	–0.473***	–0.263***	–0.321***	–0.574***	–0.449**	–0.567***
	(0.0859)	(0.0887)	(0.0853)	(0.161)	(0.181)	(0.180)
Lagged Inflation	0.509***	0.300*	0.309*	0.491*	0.287	0.253
	(0.159)	(0.164)	(0.162)	(0.250)	(0.282)	(0.279)
Trend Productivity Growth Rate[3]	0.413***	0.624***	0.701***	0.659***	0.763***	0.760***
	(0.103)	(0.106)	(0.102)	(0.198)	(0.223)	(0.222)
First-Stage F-statistics above 10	yes	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no	no
Number of Observations	411	411	410	117	117	117
R^2	0.570	0.577	0.603	0.705	0.652	0.663

Source: IMF staff calculations.
Note: Sample is of annual frequency from 2000 to 2016. See the notes in Annex Table 2.3.3 for countries in the full sample and group A. IV = instrumental variable. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The dependent variable of the regression, defined as annual growth rates.
[2]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[3]Five-year trailing average of the labor productivity growth rate.

Annex Table 2.3.5. Estimation of Wage Phillips Curve Augmented with Involuntary Part-Time Employment Share: Countries with Unemployment Rates Moderately Higher and Appreciably Higher than 2000–07 Average

	(1)	(2)	(3)	(4)	(5)	(6)
	Countries with Unemployment Rates Moderately Higher than 2000–07 Average (Group B)			Countries with Unemployment Rates Appreciably Higher than 2000–07 Average (Group C)		
	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]
	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]
Involuntary Part-Time Employment Share	–0.221	–0.291*	–0.110	–0.157*	–0.186*	–0.235**
	(0.147)	(0.154)	(0.147)	(0.0923)	(0.101)	(0.105)
Unemployment Rate	–0.203	–0.284	–0.147	–0.358***	–0.395***	–0.375***
	(0.177)	(0.186)	(0.187)	(0.0663)	(0.0722)	(0.0751)
Change in Unemployment Rate	–1.429***	–0.830***	–0.743***	–0.0369	0.0821	–0.0381
	(0.235)	(0.247)	(0.241)	(0.107)	(0.117)	(0.121)
Lagged Inflation	0.522**	0.397	0.780***	–0.126	–0.279	–0.369
	(0.236)	(0.248)	(0.259)	(0.268)	(0.292)	(0.304)
Trend Productivity Growth Rate[3]	–0.183	0.00955	0.0518	0.834***	0.986***	1.082***
	(0.168)	(0.176)	(0.167)	(0.156)	(0.170)	(0.177)
First-Stage F-statistics above 10	yes	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no	no
Number of Observations	146	146	145	148	148	148
R^2	0.487	0.458	0.389	0.681	0.660	0.652

Source: IMF staff calculations.
Note: Sample is of annual frequency from 2000 to 2016. See the notes in Annex Table 2.3.3 for countries in groups B and C. IV = instrumental variable. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The dependent variable of the regression, defined as annual growth rates.
[2]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[3]Five-year trailing average of the labor productivity growth rate.

Annex Table 2.3.6. Estimation of Wage Phillips Curve Augmented with Temporary Contract Employment Share: Full Sample and Countries with Unemployment Rates Lower than 2000–07 Average

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample			Countries with Unemployment Rate Lower than 2000–07 Average (Group A)		
	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]
	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]
Temporary Contract Employment Share	–0.0274	–0.0866	–0.0861	0.0498	–0.115	–0.146
	(0.0566)	(0.0584)	(0.0561)	(0.135)	(0.174)	(0.176)
Unemployment Rate	–0.244***	–0.297***	–0.277***	–0.0666	0.262	0.308
	(0.0428)	(0.0441)	(0.0427)	(0.219)	(0.281)	(0.285)
Change in Unemployment Rate	–0.428***	–0.181*	–0.249***	–0.392*	–0.291	–0.375
	(0.0974)	(0.100)	(0.0960)	(0.203)	(0.261)	(0.265)
Lagged Inflation	0.556***	0.259	0.281	0.431	–0.167	–0.249
	(0.182)	(0.188)	(0.183)	(0.430)	(0.553)	(0.561)
Trend Productivity Growth Rate[3]	0.503***	0.736***	0.806***	0.987***	1.130***	1.133***
	(0.118)	(0.122)	(0.116)	(0.195)	(0.251)	(0.254)
First-Stage F-statistics above 10	yes	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no	no
Number of Observations	388	388	387	88	88	88
R^2	0.617	0.616	0.648	0.732	0.591	0.575

Source: IMF staff calculations.
Note: Sample is of annual frequency from 2000 to 2016. See the notes in Annex Table 2.3.3 for countries in the full sample and group A. IV = instrumental variable. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The dependent variable of the regression, defined as annual growth rates.
[2]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[3]Five-year trailing average of the labor productivity growth rate.

Annex Table 2.3.7. Estimation of Wage Phillips Curve Augmented with Temporary Contract Employment Share: Countries with Unemployment Rates Moderately Higher and Appreciably Higher than 2000–07 Average

	(1)	(2)	(3)	(4)	(5)	(6)
	Countries with Unemployment Rate Moderately Higher than 2000–07 Average (Group B)			Countries with Unemployment Rate Appreciably Higher than 2000–07 Average (Group C)		
	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]	Compensation per Employee[1]	Compensation per Hour[1]	Wage per Hour[1]
	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]	IV[2]
Temporary Contract Employment Share	–0.0416	–0.158	–0.138	–0.106	–0.107	–0.101
	(0.0987)	(0.102)	(0.0975)	(0.0818)	(0.0875)	(0.0919)
Unemployment Rate	–0.489***	–0.446***	–0.383**	–0.383***	–0.426***	–0.411***
	(0.153)	(0.158)	(0.153)	(0.0699)	(0.0748)	(0.0786)
Change in Unemployment Rate	–1.227***	–0.636**	–0.610**	–0.0615	0.0538	–0.0717
	(0.249)	(0.257)	(0.250)	(0.117)	(0.126)	(0.132)
Lagged Inflation	0.384	0.128	0.563*	0.0161	–0.104	–0.132
	(0.274)	(0.283)	(0.293)	(0.272)	(0.291)	(0.306)
Trend Productivity Growth Rate[3]	0.0832	0.303*	0.277*	0.862***	1.000***	1.097***
	(0.158)	(0.163)	(0.155)	(0.190)	(0.204)	(0.214)
First-Stage F-statistics above 10	yes	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no	no
Number of Observations	147	147	146	153	153	153
R^2	0.607	0.582	0.564	0.667	0.647	0.637

Source: IMF staff calculations.
Note: Sample is of annual frequency from 2000 to 2016. See the notes of Annex Table 2.3.3 for countries in groups B and C. IV = instrumental variable. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The dependent variable of the regression, defined as annual growth rates.
[2]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[3]Five-year trailing average of the labor productivity growth rate.

and the associations are broadly similar in size to those found in the aggregate analysis for involuntary part-time employment (Figure 2.3.3; Annex Table 2.3.12).

Annex Table 2.3.13 reports the robustness test in which growth in nominal wages, employment, and part-time employment are treated as jointly determined and estimates the system using three-stage least squares, which treats the dependent variables as endogenous, instruments them using the exogenous variables, and allows them to be correlated with disturbances in the system's equations.

The results are also robust to looking at three-year nonoverlapping averages of the dependent and explanatory variables instead of annual data. Furthermore, as in the aggregate analysis, results are robust to omitting smaller advanced economies (the Baltic countries). While skill composition is not included in the baseline specifications due to data limitations, the results are robust to including it as an additional control.

Further robustness tests have explored alternative trade measures, such as exports and intermediate exports as a share of gross output and global value chain participation, aggregate expected growth (one and five years ahead) interacted with sectoral correlation instead of sectoral expected growth, and further measures of worker bargaining power. Such further measures include whether the country has a bi- or tripartite agreement, whether bargaining is done predominantly by firms (as opposed to at the sector or country level), the ease of hiring and firing, and the strictness of employment protection regulation. Results on other variables are broadly comparable to those in the baseline regressions.

Annex Table 2.3.8. Estimation of Wage Phillips Curve Augmented with Structural Variables

	(1) IV[1]	(2) IV[1]	(3) IV[1]	(4) IV[1]	(5) IV[1]	(6) IV[1]	(7) IV[1]	(8) IV[1]	(9) IV[1]
Involuntary Part-Time Employment Share	–0.275***	–0.306***	–0.192**	–0.200**	–0.166*	–0.225***	–0.272***	–0.0840	–0.0570
	(0.0829)	(0.0947)	(0.0845)	(0.0976)	(0.0977)	(0.0794)	(0.0830)	(0.133)	(0.125)
Unemployment Rate	–0.182***	–0.226***	–0.211***	–0.293***	–0.365***	–0.199***	–0.177***	–0.333***	–0.362***
	(0.0438)	(0.0556)	(0.0492)	(0.0688)	(0.0590)	(0.0444)	(0.0446)	(0.0948)	(0.0902)
Change in Unemployment Rate	–0.263***	–0.225**	–0.137	–0.284***	–0.0325	–0.247***	–0.267***	–0.295**	–0.334***
	(0.0887)	(0.0969)	(0.0833)	(0.109)	(0.0887)	(0.0893)	(0.0887)	(0.130)	(0.123)
Lagged Inflation	0.300*	–0.0452	0.00644	–0.380	–0.236	0.199	0.308*	–0.432	–0.540
	(0.164)	(0.280)	(0.197)	(0.311)	(0.206)	(0.186)	(0.164)	(0.332)	(0.327)
Trend Productivity Growth Rate	0.624***	0.720***	0.845***	0.497***	0.594***	0.570***	0.628***	0.231	0.325**
	(0.106)	(0.118)	(0.109)	(0.123)	(0.117)	(0.101)	(0.107)	(0.168)	(0.156)
Change in Foreign Value Added as a Share of Exports[2]		0.0944**							
		(0.0424)							
Change in the Relative Price of Investment[2]			0.114***						
			(0.0302)						
Change in the Union Density Rate[2]				–0.330***					–0.340***
				(0.0774)					(0.0774)
Change in Individual and Collective Dismissal Regulation[2]					–0.259				
					(0.918)				
Expected Growth						0.459**			
						(0.180)			
Change in the Share of Service Sector Workers[2]							–0.0194		
							(0.0327)		
Union Density Rate (Level)								0.322***	0.186***
								(0.0836)	(0.0678)
First-Stage F-statistics above 10	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no	no	no	no	no
Number of Observations	411	361	316	288	247	411	411	267	264
R^2	0.577	0.561	0.596	0.590	0.603	0.589	0.578	0.501	0.567

Source: IMF staff calculations.
Note: Dependent variable = annual growth rates of compensation per hour of workers excluding the self-employed. Sample is of annual frequency from 2000 to 2016. See Annex Table 2.1.1 for countries in the sample. IV = instrumental variable. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[2]Relative to five years ago.

Annex Table 2.3.9. Estimation of Wage Phillips Curve Augmented with Structural Variables: Excluding 2008 and 2009

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	IV[1]	IV[1]	IV[1]	IV[1]	IV[1]	IV[1]	IV[1]	IV[1]	IV[1]
Involuntary Part-Time Employment Share	–0.213**	–0.227	–0.168*	–0.215*	–0.193	–0.173**	–0.205**	–0.212	–0.169
	(0.0912)	(0.139)	(0.102)	(0.123)	(0.131)	(0.0862)	(0.0913)	(0.198)	(0.178)
Unemployment Rate	–0.174***	–0.205***	–0.186***	–0.301***	–0.319***	–0.196***	–0.162***	–0.367	–0.380*
	(0.0428)	(0.0657)	(0.0549)	(0.105)	(0.0768)	(0.0446)	(0.0435)	(0.230)	(0.227)
Change in Unemployment Rate	–0.400***	–0.321*	–0.280**	–0.308*	–0.129	–0.352***	–0.406***	–0.495**	–0.507**
	(0.118)	(0.183)	(0.131)	(0.168)	(0.152)	(0.127)	(0.118)	(0.229)	(0.213)
Lagged Inflation	0.502**	0.351	0.180	–0.583	–0.254	0.354	0.520**	–1.289	–1.417
	(0.208)	(0.598)	(0.346)	(1.107)	(0.677)	(0.251)	(0.207)	(2.101)	(2.053)
Trend Productivity Growth Rate	0.768***	0.826***	0.891***	0.471***	0.662***	0.721***	0.779***	–0.0674	0.151
	(0.101)	(0.118)	(0.120)	(0.154)	(0.130)	(0.0968)	(0.101)	(0.662)	(0.466)
Change in Foreign Value Added as a Share of Exports[2]		0.0262							
		(0.0452)							
Change in Relative Price of Investment[2]			0.0911***						
			(0.0338)						
Change in Union Density Rate[2]				–0.390*					–0.483
				(0.234)					(0.373)
Change in Individual and Collective Dismissal Regulation[2]					–0.390				
					(1.653)				
Expected Growth						0.414**			
						(0.197)			
Change in Share of Service Sector Workers[2]							–0.0424		
							(0.0308)		
Union Density Rate (Level)								0.542	0.302
								(0.510)	(0.302)
First-Stage F-statistics above 10	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no	no	no	no	no
Number of Observations	361	311	274	241	203	361	361	221	219
R^2	0.678	0.676	0.654	0.612	0.632	0.682	0.680	0.264	0.369

Source: IMF staff calculations.
Note: Dependent variable = annual growth rates of compensation per hour of workers excluding the self-employed. Sample is of annual frequency from 2000 to 2016. See Annex Table 2.1.1 for countries in the sample. IV = instrumental variable. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The instrumental variable for lagged inflation is the two-quarter-lagged change in oil price.
[2]Relative to five years ago.

Annex Table 2.3.10. Drivers of Involuntary Part-Time Employment Share, Aggregate Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Output Gap	–0.265***	–0.263***	–0.172***	–0.238***	–0.172***	–0.245***
	(0.030)	(0.029)	(0.029)	(0.031)	(0.033)	(0.030)
Expected Growth		–0.454***				
		(0.134)				
Change in Relative Price of Investment[1]			–0.122***			
			(0.018)			
Change in Foreign Value Added as a Share of Exports[1]				0.037		
				(0.033)		
Change in Union Density Rate[1]					0.007	
					(0.028)	
Change in Share of Service Sector Workers[1]						0.085***
						(0.023)
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes	yes
Number of Observations	386	386	357	361	288	386
R^2	0.447	0.465	0.548	0.447	0.474	0.467

Source: IMF staff calculations.
Note: Dependent variable = involuntary part-time employment share in logs. Sample is of annual frequency from 2000 to 2016. See Annex Table 2.1.1 for countries in the sample. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]Relative to five years ago.

Annex Table 2.3.11. Drivers of Sectoral Nominal Wage Growth

	(1) Group A	(2) Group B	(3) Group C
Aggregate Output Gap	–0.221**	0.0417	0.177*
	(0.0750)	(0.119)	(0.0867)
Correlation of Sectoral and Aggregate Output Growth	0.321	–0.599	0.179
	(1.077)	(0.606)	(0.310)
Aggregate Output Gap × Correlation	–0.183	–0.123	0.319*
	(0.138)	(0.102)	(0.158)
Lagged Inflation	0.182	0.304	0.492**
	(0.295)	(0.216)	(0.195)
Trend Productivity Growth Rate[1]	–0.0229	–0.0387	–0.00741
	(0.0889)	(0.0286)	(0.0306)
Part-Time Employment Share	0.0215	–0.00107	0.00870
	(0.0254)	(0.0193)	(0.00999)
Expected Growth (Sectoral)	0.189*	0.134**	0.0135
	(0.0716)	(0.0483)	(0.0256)
Change in Final Imports as a Share of Gross Output[2]	0.0943	0.0213	0.0209
	(0.0494)	(0.0384)	(0.0262)
Change in Relative Price of Investment[2]	0.256**	0.0701	–0.0215
	(0.0861)	(0.0369)	(0.0427)
Country Fixed Effects	yes	yes	yes
Sector Fixed Effects	yes	yes	yes
Year Fixed Effects	yes	yes	yes
Number of Observations	349	447	493
R^2	0.400	0.111	0.355

Source: IMF staff calculations.
Note: Dependent variable = year-over-year percent change in nominal wages and salaries per worker (excludes self-employment and employers' social contributions) for NACE revision 2 sectors. NACE = Statistical Classification of Economic Activities in the European Community. Sample is of annual frequency from 2000 to 2015. See notes for Annex Table 2.3.3 for countries in different groups. The following countries are absent in respective groups due to data constraints: Japan (A), Israel (A), Iceland (B), Switzerland (B), and Greece (C). Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]Five-year trailing average of the labor productivity growth rate.
[2]Relative to five years ago.

Annex Table 2.3.12. Drivers of Sectoral Part-Time Employment Shares

	(1)	(2)	(3)	(4)	(5)	(6)
Aggregate Output Gap	–0.0273	–0.00807	0.0237	0.00105	0.0124	–0.00168
	(0.0710)	(0.0685)	(0.0736)	(0.0781)	(0.0595)	(0.0830)
Correlation of Sectoral and Aggregate Output Growth	–0.318	–0.355	–0.321	–0.290	0.254	–0.441
	(0.512)	(0.514)	(0.454)	(0.478)	(0.479)	(0.773)
Aggregate Output Gap × Correlation	–0.0703	–0.0779	–0.115	–0.0297	–0.0204	0.0285
	(0.0739)	(0.0727)	(0.0788)	(0.0686)	(0.0924)	(0.0831)
Expected Growth (Aggregate)		–0.615*				
		(0.322)				
Expected Growth (Sectoral)			–0.137**			
			(0.0573)			
Change in Final Imports as a Share of Gross Output[1]				–0.0577		
				(0.0367)		
Change in Relative Price of Investment[1]					–0.147***	
					(0.0464)	
Change in Relative Price of Investment × Capital Intensity					0.00118**	
					(0.000419)	
Capital Intensity					5.052	
					(4.032)	
Change in Union Density Rate[1]						0.106
						(0.0749)
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Sector Fixed Effects	yes	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes	yes
Number of Observations	2,103	2,103	2,103	1,687	1,710	1,562
R^2	0.806	0.806	0.807	0.811	0.810	0.824

Source: IMF staff calculations.
Note: Dependent variable = part-time employment shares for NACE revision 2 sectors. NACE = Statistical Classification of Economic Activities in the European Community. Sample is of annual frequency from 2000 to 2015. See Annex Table 2.1.1 for countries in the sample. Standard errors in parentheses.
* $p < .10$; ** $p < .05$; *** $p < .01$.
[1]Relative to five years ago.

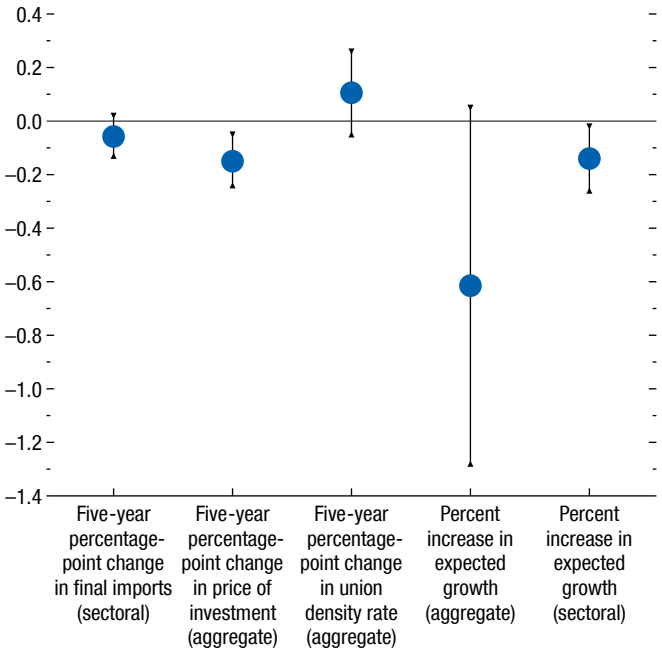
Annex Figure 2.3.2. Decomposition of Sectoral Wage Dynamics, 2000–15

(Percentage-point change relative to 2000–07 average)

Source: IMF staff calculations.
Note: Groups are as defined in Figure 2.11. Structural factors include automation (proxied by the relative price of investment), trade, and expected growth. Regressions also control for trend labor productivity growth, the share of part-time employment, as well as country and sector fixed effects. The decomposition is based on the coefficients reported in Annex Table 2.3.11 and is weighted by GDP at market exchange rates across countries. Only statistically significant coefficients are shown.

Annex Figure 2.3.3. Effects on Part-Time Employment Share, Sectoral Analysis

(Percentage points)



Source: IMF staff calculations.
Note: Markers show estimated coefficients, and lines display 90 percent confidence intervals. Figure is based on columns (2) to (6) of Annex Table 2.3.12.

Annex Table 2.3.13. Drivers of Nominal Wage Growth, Employment Growth, and Part-Time Employment

	(1)	(2)	(3)	(4)	(5)
	Nominal Wage Growth[1]		Employment Growth[1]		Part-Time Employment[1]
	3SLS[2]	3SLS[3]	3SLS[2]	3SLS[3]	3SLS[3]
Aggregate Output gap	0.284***	0.241***	–0.0682	–0.0513	–0.0907
	(0.0334)	(0.0322)	(0.0786)	(0.0641)	(0.0816)
Correlation of Sectoral and Aggregate Output Growth	–0.388**	–0.412**	–1.001**	–0.226	–0.698*
	(0.172)	(0.163)	(0.404)	(0.324)	(0.413)
Aggregate Output Gap × Correlation	0.321***	0.269***	0.606***	0.644***	0.000166
	(0.0548)	(0.0531)	(0.129)	(0.106)	(0.135)
Lagged Inflation	0.207***	0.210***	0.0552	–0.0967	0.131
	(0.0573)	(0.0578)	(0.135)	(0.115)	(0.147)
Expected Growth (Sectoral)	0.0205	0.0226*	–0.0700**	–0.0337	–0.106***
	(0.0138)	(0.0137)	(0.0324)	(0.0272)	(0.0347)
Change in Final Imports as a Share of Gross Output[4]	–0.0103	–0.00520	0.0280	0.0218	0.0588**
	(0.0110)	(0.00973)	(0.0258)	(0.0194)	(0.0247)
Change in the Relative Price of Investment[4]	0.102***	0.115***	0.0294	0.0133	–0.0683
	(0.0228)	(0.0213)	(0.0537)	(0.0424)	(0.0540)
Country Fixed Effects	yes	yes	yes	yes	yes
Sector Fixed Effects	yes	yes	yes	yes	yes
Year Fixed Effects	no	no	no	no	no
Number of Observations	1,833	1,526			

Source: IMF staff calculations.
Note: Sample is of annual frequency from 2000 to 2015. See Annex Table 2.1.1 for countries in the sample. 3SLS = three-stage least squares. Standard errors in parentheses. * $p < .10$; ** $p < .05$; *** $p < .01$.
[1]The dependent variable of the regression, defined as annual growth rates and share of total employment.
[2]System estimated using 3SLS for nominal wage growth and employment growth as the endogenous dependent variables.
[3]System estimated using 3SLS for nominal wage growth, employment growth, and the share of part-time employment as the endogenous dependent variables.
[4]Relative to five years ago.

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