CHAPTER 2

WAGE DYNAMICS POST–COVID-19 AND WAGE-PRICE SPIRAL RISKS

Inflation rose markedly in many economies during 2021, reflecting a mix of supply- and demand-side drivers amid recovery from the COVID-19 shock. Although nominal wage growth has so far generally stayed below inflation, some observers have warned that prices and wages could start feeding off each other, with wage and price inflation continually ratcheting up in a sustained wage-price spiral. This chapter unpacks events of the recent past and sheds light on future prospects using a mix of empirical and model-based analyses. Historical episodes in advanced economies exhibiting wage, price, and labor market dynamics similar to those of the current circumstances—in particular, economies in which real wages (nominal wages deflated by consumer prices) have been flat or falling—did not tend to show a subsequent wage-price spiral. Model-based analysis suggests that different shocks underpinned wage and price developments through 2020–21: production capacity shocks predominantly drove wages, while private saving and pent-up demand figured prominently for prices. Empirical analysis suggests that while labor market conditions remain relevant drivers of wage growth, the importance of inflation expectations has recently increased. A forward-looking analysis points to the critical role of the expectations process in shaping prospects. It demonstrates how front-loaded monetary policy tightening, including through its clear communication, can lower the risk that inflation will become de-anchored from its target. Given that inflationary shocks are originating outside the labor market, falling real wages are helping to slow inflation, and monetary policy is tightening more aggressively, the chances of persistent wage-price spirals emerging appear limited.

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Introduction

With the recovery picking up steam after the acute COVID-19 shock, inflation in 2021 started hitting levels that had not been seen in almost 40 years in many economies.[1] A wide array of factors has underpinned the sharp rises in prices, including pandemic-related supply chain disruptions, commodity price shocks, expansive monetary policy and fiscal support, a surge in pent-up consumer demand, and changes in consumer preferences for goods versus services (Figure 2.1, panels 1 and 3).

At the same time, economic recovery brought a resurgence in demand for labor in many sectors. Labor supply was slow to respond, with some workers hesitant to reengage because of ongoing health concerns and difficulties finding child and family care, among other factors.[2] This demand–supply imbalance led to tighter labor markets and increased wage pressures, with average nominal wages (per worker) rising and the unemployment rate falling beginning in the second half of 2020 across economy groups (Figure 2.1, panels 2 and 5 for advanced economies and panels 4 and 7 for emerging market and developing economies).[3]

Growth in nominal wages mostly brought the average level in 2021 back to the pre-pandemic trend, although there were differences across economies. Importantly, nominal wage growth in 2021 did not

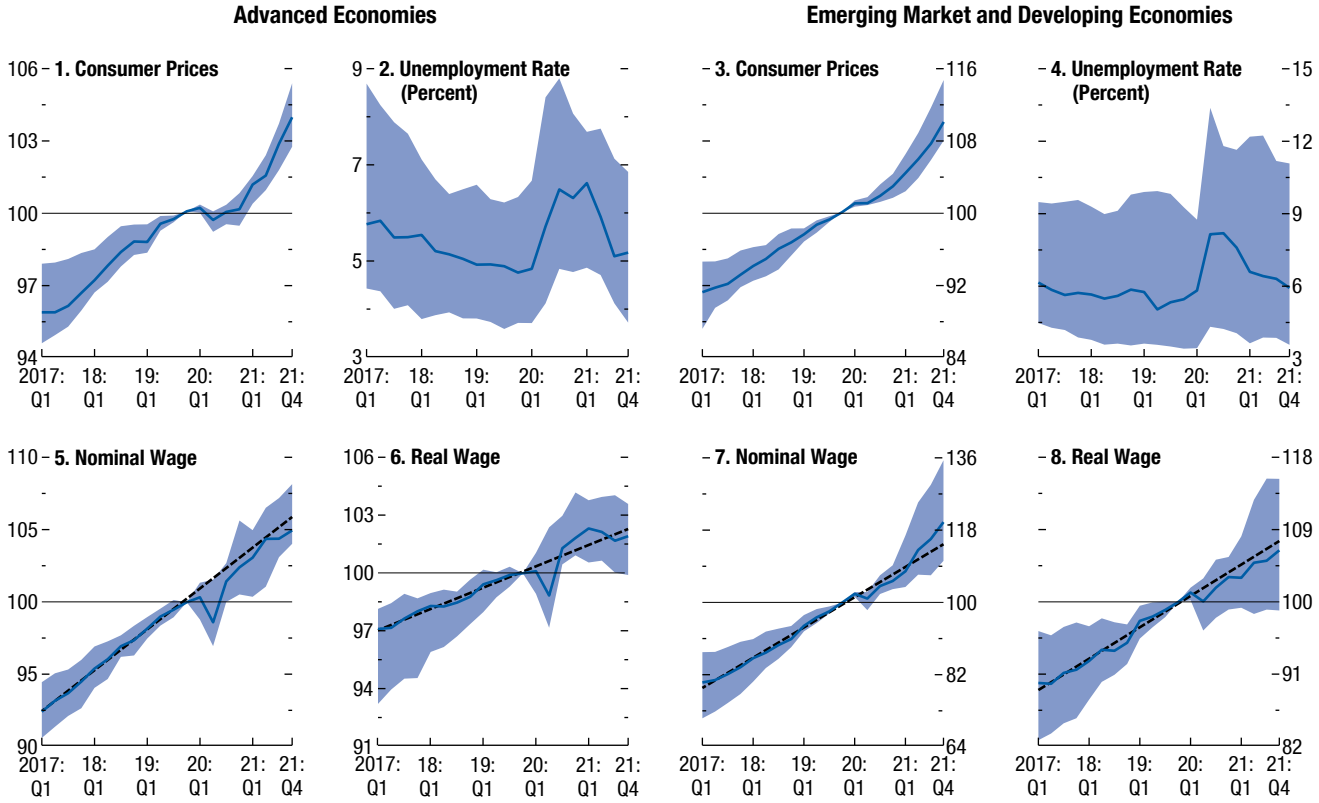
[1]Price inflation is defined with respect to the consumer price index throughout, unless indicated otherwise.

[2]See Bluedorn and others (2021) for a discussion of how the COVID-19 shock generated a "she-cession," reflecting in part the disproportionate impact of these factors on women's employment. See also ILO (2022) for a more recent assessment of the shock's effects on employment and participation and the differentials between men's and women's outcomes.

[3]To achieve the broadest sample coverage possible in the empirical analysis, wages (nominal or real) are defined on a per employed worker basis throughout, unless indicated otherwise. For a smaller sample, the chapter includes some discussion highlighting how hourly wages differ.

Figure 2.1. Recent Wage, Price, and Unemployment Dynamics
(Index, 2019:Q4 = 100, unless noted otherwise)

Consumer price inflation has accelerated markedly since the second quarter of 2020. While the nominal wage largely returned to its pre-pandemic trend, real wages have dipped below their pre-pandemic trend. Unemployment rates have continued to decrease as the economy recovers from the COVID-19 shock.



Sources: Haver Analytics; International Labour Organization; Organisation for Economic Co-operation and Development; US Bureau of Economic Analysis; and IMF staff calculations.
Note: Blue lines represent the median across economies; dashed lines indicate the pre–COVID-19 trend; shaded areas represent the interquartile range across economies. Wages (nominal and real) are calculated on a per worker basis. See Online Annex 2.1 for details on the sample coverage.

fully keep up with price inflation.[4] This means that the path of real wages (nominal wages deflated by consumer prices) was fairly flat or falling (Figure 2.1, panels 6 and 8). Against a backdrop of high or even rising price inflation, these nominal and real wage patterns have continued into the first quarter of 2022 for economies for which data are available.

[4]The distinction between wages per worker and wages per hour became relevant during the pandemic's acute phase, as hours worked were sharply adjusted for many workers (particularly in advanced economies). Annex Figure 2.1.1 shows the dynamics of wages per hour: spiking in the second quarter of 2020 on average across economy groups, but quickly returning to trend. Similarly to the patterns for wages per worker, wages per hour fell short of price inflation by the end of 2021.

At a sectoral level, nominal wages in both industry and services have tended to converge to their common pre-pandemic trends across economy groups (see Online Annex 2.2 for details on the sectoral perspective). In advanced economies, real wages across sectors largely matched their pre-pandemic trend, before deteriorating in the latter half of 2021 as inflation rose, while in emerging market and developing economies, they have stayed mostly below their pre-pandemic trend. Consistent with the picture of wages by sector, sectoral employment shifts so far have appeared to contribute little to overall wage changes for the average economy—common changes in wages across sectors themselves account for the lion's share of the average overall wage change.

Some observers argue that recent wage and price dynamics could change, so that rising inflation

expectations and tighter labor markets push workers to persistently demand wage increases to catch up to or exceed recent inflation. Such a "wage-price spiral" is defined here as an episode of several quarters characterized by accelerating wages and prices (that is, in which both wage and price inflation rates rise simultaneously).[5]

This chapter aims to better understand the current circumstances and prospects for wage and price inflation. To this end, crucial questions addressed include the following:

- **How do wage, employment, and price dynamics in the recovery from the COVID-19 shock compare with pre-pandemic dynamics?** Did historical episodes mirroring 2021 patterns in wages, employment, and prices in advanced economies subsequently evolve into wage-price spirals?
- **How well do inflation expectations and labor market conditions explain recent nominal wage growth in advanced and emerging market and developing economies?** What were the deeper, underlying drivers of wages, prices, and employment during 2020–21?
- **Could wage and price pressures in the wake of COVID-19 lead to high and persistent wage and price inflation?** Have wage and price pressures from past inflationary shocks due to increasing global supply pressures lasted long? Historically, has monetary tightening been effective in reducing wage and price pressures? Looking ahead, how could changes in the formation of wage and price expectations affect prospects, and how should policymakers take them into account?

Drawing both on empirical and model-based analyses, the chapter's main findings are as follows:

- *Both wage and price inflation picked up in a broad-based manner through 2021, while real wages have tended to be flat or falling across economies on average.* At a sectoral level, nominal wages in both industry and services tended to converge to their common pre-pandemic trends across economy groups. Consequently, sectoral employment shifts appear to explain little of overall wage changes through the end of 2021.
- *On average, wage-price spirals did not follow historical episodes that were similar to the circumstances currently seen in advanced economies.* Although the COVID-19 shock is unusual and the current conjuncture unlike much recent experience, similar historical episodes of inflation in advanced economies—in which real wages were flat or falling—did not tend to entail a wage-price spiral. In fact, inflation tended to fall in the aftermath while nominal wages gradually caught up.
- *Changes in inflation expectations and labor market slack explain wage dynamics in the second half of 2021 relatively well.* In the immediate aftermath of the COVID-19 shock, wage growth across economies was poorly explained by its earlier empirical relationship with expectations and unemployment. However, by the end of 2021, wage growth was broadly in line with the increases in inflation expectations and labor market tightening observed across economy groups on average.
- *Reflecting the pandemic shock's unusual nature, a complex mix of supply and demand shocks underpinned the 2020–21 behavior of wages and prices.* Analysis using a rich multi-sector, multi-economy structural model points to differences in the shocks underlying historical changes in wages and prices. Over the two years since the pandemic's onset, wages have been driven predominantly by production capacity and labor supply shocks (from social distancing and lockdowns), while prices have been more affected by private saving and the release of pent-up demand. How and when (or if) these deeper shocks unwind will matter for how wage and price inflation develop.
- *When wage and price expectations are more backward-looking, monetary policy actions need to be more front-loaded to minimize the risks of inflation de-anchoring.* Using a newly developed model of expectations and wage and price setting, scenario analysis suggests that the observed decline in real wages has acted as a drag so far, reducing price pressures and thereby helping inhibit development of a wage-price spiral dynamic. However, the more backward-looking (adaptive) expectations are, the greater the chances that inflation could de-anchor to a higher-than-target level. The monetary policy response in this inflationary environment should depend on the nature of wage and price expectations: the more backward-looking they are, the quicker and stronger the tightening needed to avert inflation de-anchoring and prevent large declines in the real wage.

Some important caveats to the analysis presented here should be stated up front. First, the empirical analysis is constrained by the availability of data, both across

[5]See Boissay and others (2022) for a similar definition and discussion on the debate about the possible emergence of wage-price spirals in advanced economies. Further discussion of the concept is in this chapter's section titled "Historical Episodes Similar to Today."

economies and over time. Hence, the exact sample coverage differs across exercises. Second, although the empirical methods used are standard, their findings should be interpreted as associational rather than causal. Third, the empirical analysis and study of historical episodes essentially summarize past patterns in the data, which may not be fully representative of the current circumstances. Moreover, if the COVID-19 shock caused a large structural break in the economy's behavior (such as a sharp shift in expectations formation or wage-setting processes), historical analyses may not be as informative about future prospects. The model-based analysis of expectations provides some insurance against structural breaks, since it allows for the possibility of a limited form of regime shifts in its examination of adaptive learning.

The chapter begins by identifying and examining historical episodes exhibiting wage, price, and employment patterns similar to those in the current circumstances, highlighting how the episodes subsequently developed. The chapter continues by studying how well recent wage dynamics can be explained by changes in inflation expectations and labor market slack and the composition of shocks driving these developments. In the penultimate section, the chapter highlights how inflationary shocks and monetary tightening affect wage (both nominal and real) dynamics. The final section considers how the processes for forming expectations regarding wages and prices may interact with the shock and monetary policy's responses to affect the economy's future path.

Historical Episodes Similar to Today

As explained in the introduction, rising inflation, positive nominal wage growth, declining real wages, and declining unemployment characterized the macroeconomic situation in 2021 in many economies. Although unusual, such conditions are not unprecedented. A sample of advanced economies covering the past 40 years (and for a few the past 60 years) reveals 22 other episodes exhibiting similar conditions.[6]

The current coincidence of rising inflation and nominal wage growth has led to concerns that a wage-price spiral—in which both wages and prices accelerate for a prolonged period—could emerge.[7] This section examines whether wage-price spirals have occurred in similar past episodes.

Similar Past Episodes Do Not Show a Wage-Price Spiral Taking Hold

Similar past episodes were not followed by a wage-price spiral, in which both inflation and nominal wage growth keep rising over a prolonged period (Figure 2.2, panels 1 and 3). Nominal wage growth did tend to increase somewhat after these episodes, but inflation edged down on average. In combination, this led to an increase in real wages (Figure 2.2, panel 4). The unemployment rate generally stabilized after the episodes (Figure 2.2, panel 2).

Although the average subsequent path suggests little cause for alarm, there is heterogeneity across historical episodes. A notable example is the United States in the second quarter of 1979, when inflation was on a sharp upward path immediately following the episode, rising rapidly for four quarters before starting to decline. The unemployment rate also rose more than during the other identified episodes. Underlying these changes was an aggressive monetary tightening that began around the time of the inflation peak: the so-called Volcker disinflation. Nominal wage growth—which had not shown signs of continuing its upward path—was relatively flat during this period, leading to a decline in real wages early on. But as inflation came down, the deterioration in real wages decreased.

A similar policy response is observed in many of the other episodes as well. In fact, monetary policy tightening followed most of the past episodes, which helped to keep inflation contained.[8] Thus, the evidence from similar historical episodes suggests that an appropriate

[6]The 22 episodes are identified within a sample of 30 advanced economies for which data on inflation, wages, prices, and unemployment are available at a quarterly frequency going back to 1960 at the earliest. For most economies in the sample, the quarterly data begin on a regular basis only in the 1980s. The selection criteria are that at least three out of the previous four quarters had (1) rising inflation, (2) positive nominal wage growth, (3) declining real wages, and (4) declining or flat unemployment. If the criteria hold for several quarters within three years, only the first episode in which the criteria held is selected. See Online Annex 2.3 and Alvarez and others (forthcoming) for further details and discussion about these episodes.

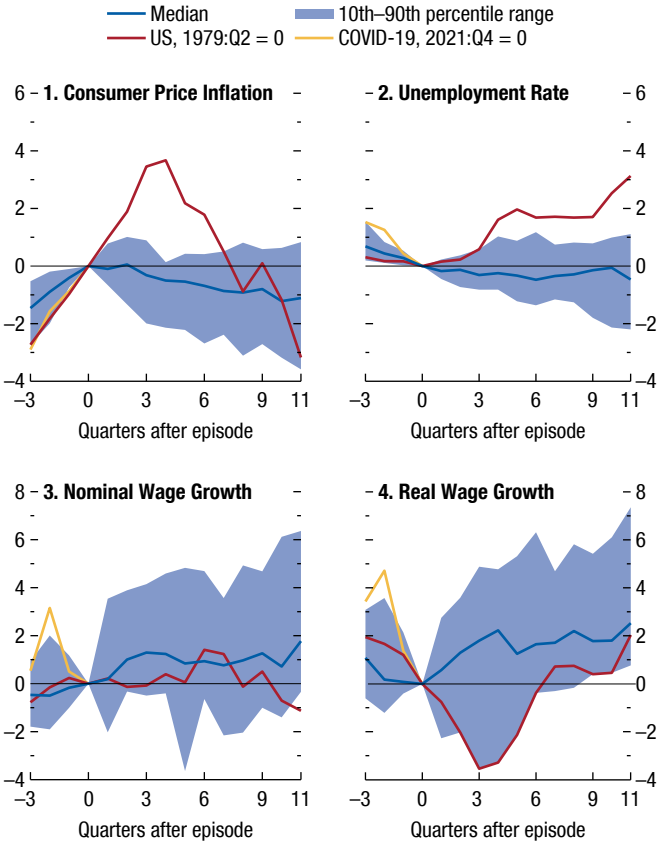
[7]The earlier literature on wage-price spirals has considered a wide array of definitions, ranging from a simple feedback between wages (as a cost of production) and prices, to a coincident acceleration of wages and prices, to a situation in which wage inflation persistently exceeds price inflation. As noted in the introduction, this chapter defines a wage-price spiral as an episode of several quarters characterized by accelerating wages and prices (that is, in which wage and price inflation are rising simultaneously).

[8]Out of the 22 episodes illustrated in Figure 2.2, 13 were followed by monetary policy tightening (Annex Table 2.3.2).

Figure 2.2. Changes in Wages, Prices, and Unemployment after Similar Past Episodes

(Percentage point differences relative to first quarter in which criteria are fulfilled)

After past episodes with similar macroeconomic conditions to today's, consumer price inflation typically declined, while nominal and real wage growth increased.



Sources: International Labour Organization; Organisation for Economic Co-operation and Development; US Bureau of Economic Analysis; and IMF staff calculations.
Note: The figure shows developments following episodes in which at least three of the preceding four quarters have (1) accelerating prices/rising price inflation, (2) positive nominal wage growth, (3) falling or constant real wages, and (4) a declining or flat unemployment rate. Twenty-two such episodes are identified within a sample of 30 advanced economies, the earliest going back to 1960. The COVID-19 episode represents an average of economies in the sample for the period starting in 2021:Q4. See Online Annex 2.3 for details.

monetary policy response can contain the risks of a subsequent wage-price spiral in the current circumstances to very low levels.

Wage-Price Spiral Episodes Did Not Typically Last Long

Turning to past episodes of wage-price spirals (regardless of the behavior of real wages or unemployment), further sustained wage-price acceleration did not typically follow the initial dynamics.[9] Following such episodes, inflation and nominal wage growth on average tended to stabilize in the subsequent quarters, leaving real wage growth broadly unchanged (Figure 2.3, blue lines). At the same time, the unemployment rate tended to edge down slightly.

However, in some rare examples, more extreme outcomes followed such episodes. For example, during the US episode starting in the third quarter of 1973, price inflation surged for five additional quarters—spurred by the first Organization of the Petroleum Exporting Countries oil embargo of the 1970s—before starting to come down in 1975 (Figure 2.3, red lines). On the other hand, nominal wage growth did not increase, leading real wage growth to decline. Another relevant example is that from Belgium during 1973, in which both nominal wage growth and price inflation surged markedly before coming down (see Online Annex 2.3). In that case, wage growth was high and exceeded price inflation for a while, partly owing to the wide prevalence of wage indexation.[10]

Farther back in time, another notable example occurred in 1946–48 in the United States, just after World War II concluded. Over those years, price controls due to the war were lifted and pent-up demand was released. As the economy shifted from wartime, price inflation and nominal wage growth picked up during 1946, both reaching about 20 percent year over year by the first quarter of 1947.[11] Thereafter, though, inflation and wage growth started to come down gradually while remaining at high levels for about a year. Toward the latter half of 1948 and into early 1949, inflation came down sharply, as supply chains had readjusted and pent-up

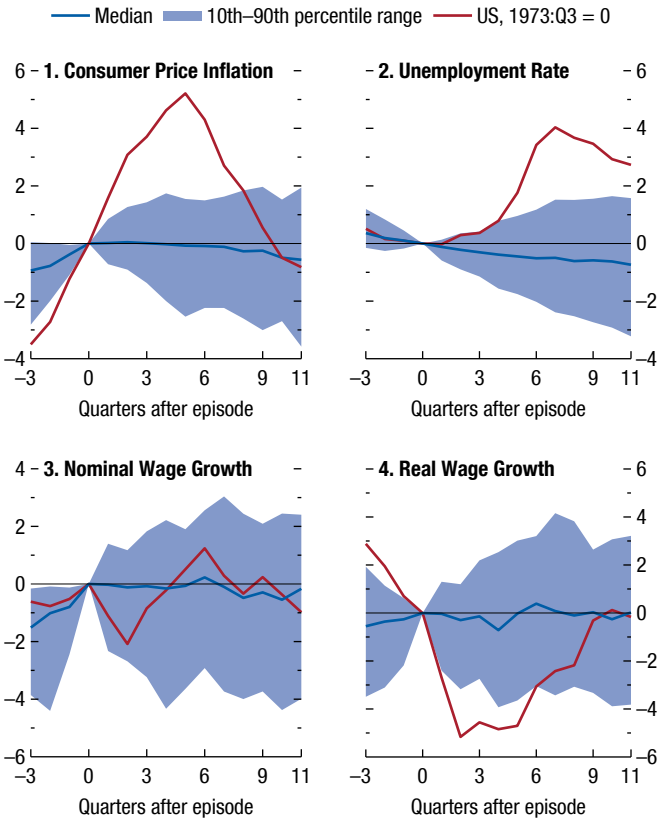
[9]A wage-price spiral episode is identified if, for at least three of the preceding four quarters, (1) wages were accelerating (wage growth was rising) and (2) prices were accelerating (price inflation was rising). Note that these are less restrictive criteria than those used to identify historical episodes similar to today's circumstances.

[10]See also Battistini and others (2022) and Baba and Lee (2022) for further discussion and analysis of the historical effects of oil price and energy shocks on price inflation and wages and the effects' relationship to an economy's structural characteristics.

[11]Wages are proxied by average hourly earnings in manufacturing, as an economy-wide wage measure is not available that far back in time.

Figure 2.3. Changes in Wages, Prices, and Unemployment after Past Episodes with Accelerating Prices and Wages
(Percentage point differences relative to first quarter in which criteria are fulfilled)

A period of stable wage growth and inflation typically followed past episodes with accelerating wages and prices.



Sources: International Labour Organization; Organisation for Economic Co-operation and Development; US Bureau of Economic Analysis; and IMF staff calculations.
Note: The figure shows the developments following episodes in which at least three of the preceding four quarters have (1) accelerating prices/rising price inflation and (2) accelerating nominal wages/rising nominal wage growth. Seventy-nine such episodes are identified within a sample of 30 advanced economies, the earliest going back to 1960. The bands indicate the 10th–90th percentile of the outcomes in the identified episodes. See Online Annex 2.3 for details.

demand became exhausted (with a mild recession in 1949).[12]

Overall, the historical evidence suggests that episodes characterized by about a year of accelerating prices and wages have not generally lasted, with nominal wage growth and price inflation tending to stabilize on average. It is important to remark that this means that inflation and wage growth remained elevated for several quarters on average after these past episodes.[13]

Wage Drivers during the COVID-19 Shock and Recovery

This section studies wage, price, and employment drivers in the context of the pandemic and subsequent recovery. It first examines recent wage dynamics empirically through the lens of the wage Phillips curve, which relates wage growth to inflation expectations and labor market slack. The section then attempts to further unpack wage and price changes over the past two years, using a rich structural model to identify the complex mix of underlying supply and demand shocks driving wages and prices.

An Empirical Decomposition of Recent Dynamics Using the Wage Phillips Curve

Although the COVID-19 shock and recovery bear many unusual features, a recurring question is whether previous economic relationships can still explain recent dynamics. For wages, this means examining whether empirical estimates using the workhorse wage Phillips curve—relating wage growth to measures of inflation expectations, labor market slack, and productivity growth—do well at capturing the variation in wage developments.[14] The chapter first employs this framework to study the pre–COVID-19 wage-setting process. It then uses

[12]See Online Annex 2.3 for further details on this case. Rouse, Zhang, and Tedeschi (2021) also describe this and other past inflationary episodes in the United States with some features similar to those in today's recovery from the pandemic. Caplan (1956) provides a close-in-time and in-depth discussion of the situation in the late 1940s.

[13]The relevance of this finding hinges critically on the sample coverage. As in Figure 2.2, quarterly time coverage for the critical variables starts only in the 1980s or later for most economies. For robustness, the exercise was thus repeated using a narrower wage concept (hourly earnings for the manufacturing sector only) allowing for time coverage back to the early 1970s for more economies. This did not overturn the broad results shown in Figure 2.3, although a few additional extreme outcomes were identified. See Online Annex 2.3 for additional information.

[14]The specification used is based on Chapter 2 of the October 2017 *World Economic Outlook*, inspired by Galí's (2011) work micro-founding the wage Phillips curve as the outcome of a wage-setting process. The baseline specification using the unemployment rate and its change as measures of labor market slack permits wider coverage of advanced and emerging market economies in the sample. Given recent inflation dynamics, the relationship between wage growth and inflation expectations is a key focus of this chapter's study. Online Annex 2.4 includes details on the baseline specification.

the framework to decompose wage growth changes since the pandemic across economy groups, to see how well it performs.

Wage Growth Tends to Rise with Inflation Expectations and Fall with Labor Market Slack

Consistent with earlier empirical and theoretical literature, the analysis suggests that rises in inflation expectations[15] and productivity growth are associated with increases in nominal wage growth, while increases in labor market slack (captured by the unemployment rate and its change) are correlated with a slowdown in wage growth (Figure 2.4, panel 1). These relationships are statistically significant in both the advanced and emerging market economy groups.

The positive relationship with inflation expectations—a focus of the conjuncture—is consistent with a forward-looking wage-setting process in which workers demand higher wages as prices are expected to rise.[16] These nominal wage pressures add to those stemming from increases in the real returns on labor—as captured by productivity growth—and survive even if lagged inflation is controlled for. Wage growth appears to be highly sensitive to inflation expectations in advanced economies: a 1 percentage point increase in inflation expectations is associated with a close to 1 percentage point increase in wage growth (compared with 0.6 percentage point in emerging market economies). This relationship, however, weakened in the period after the global financial crisis, when inflation was remarkably low and stable.[17]

The negative relationship with unemployment is consistent with high (or widening) slack in the labor market, which reduces wage pressures as workers struggle to find jobs and accept lower wages. This last correlation is robust to using other measures of labor market slack, such as unemployment gaps, which allow for time-varying natural unemployment

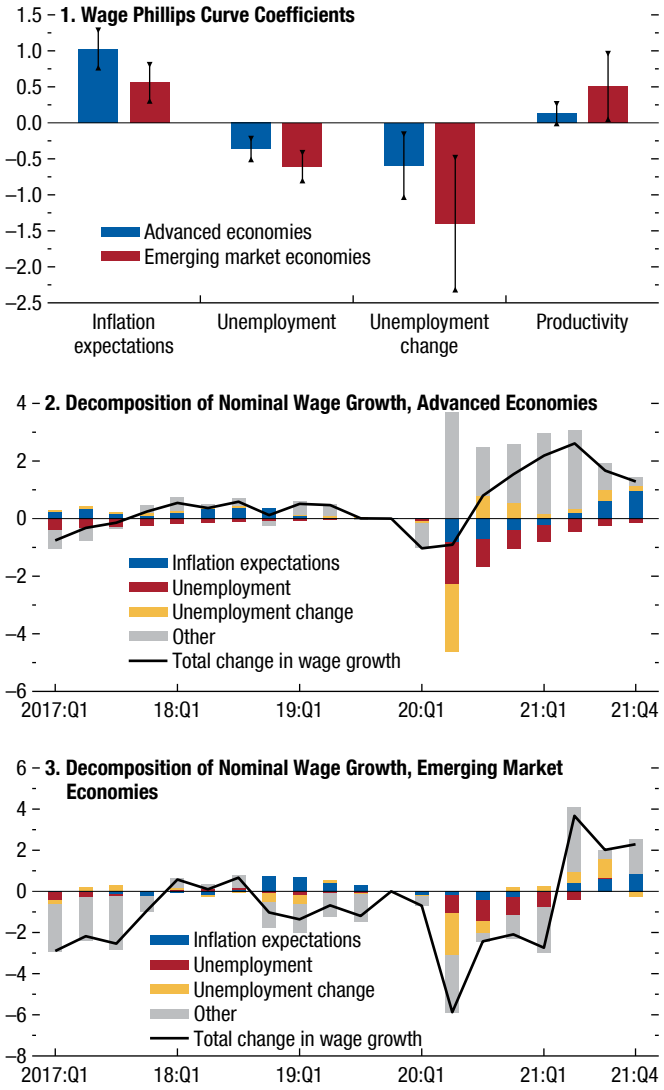
[15]This section focuses on one-year-ahead inflation expectations. See Online Annex 2.1 for details on the measure used.

[16]Additional robustness checks, including lagged inflation as a regressor, are shown in Online Annex 2.4.

[17]See Online Annex 2.4 for a discussion of how coefficients have declined in advanced economies. Part of this observed flattening in the wage Phillips curve may reflect improvements in monetary policy credibility, as discussed by Hazell and others (2022) for the price Phillips curve.

Figure 2.4. A Look at Nominal Wage Growth through the Lens of the Wage Phillips Curve
(Percentage points)

Wage dynamics during COVID-19 did not follow the wage Phillips curve relationship closely, but more recent nominal wage growth is consistent with rising inflation expectations and labor market tightening.



Source: IMF staff calculations.
Note: Panel 1 reports the estimated effects (coefficients) from 1 percentage point rises in the indicated variables from a wage Phillips curve regression. The sample covering 2000:Q1–19:Q4 consists of 31 advanced and 15 emerging market economies. Whiskers indicate 90 percent confidence intervals. See Online Annex 2.1 for further details on the sample and estimation. For panels 2 and 3, bars show contributions of each component relative to the contributions observed in 2019:Q4. Contributions are calculated using pooled wage Phillips curve coefficients for the indicated economy group. Line depicts average overall nominal wage growth per worker observed relative to 2019:Q4. Only economies with continuously available data from 2017:Q1–21:Q4 are used for the contributions and aggregated using GDP purchasing-power-parity weights. "Other" category contains the contributions of productivity growth, the residual, and time fixed effects.

rates and unemployment-to-vacancy ratios.[18] Point estimates suggest that emerging market wages can be more sensitive than those in advanced economies to changes in labor market and productivity conditions, although variation in past experiences is substantial.

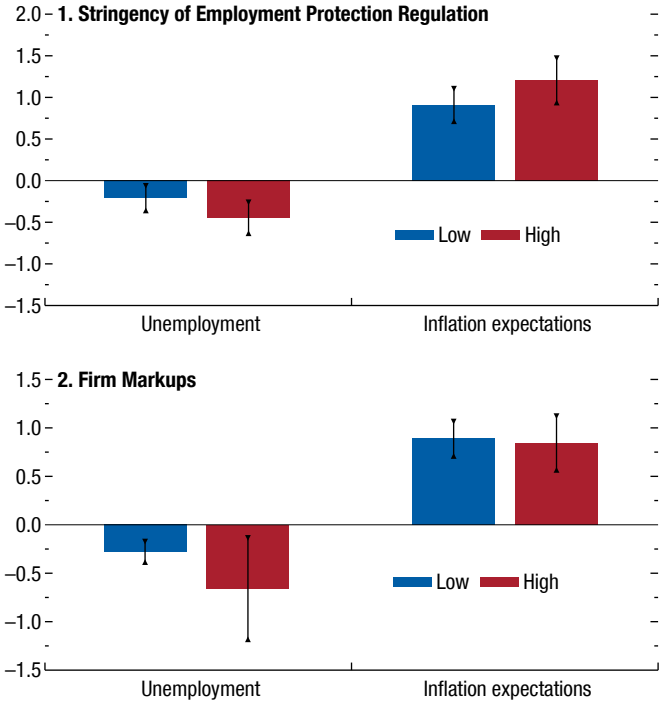
Part of the heterogeneity in experiences could be due to differences across economies and over time in structural factors that may affect wage-setting processes. In economies with more stringent employment protections, wage growth appears to be on average more sensitive to changes in labor market slack (unemployment) and inflation expectations (Figure 2.5, panel 1). This would be consistent with labor prices (wages) adjusting faster to changing conditions when restrictions on labor quantities (firing or hiring of workers) are present. In economies in which firms exhibit greater market power in product markets—as proxied by the average price markup—wages appear slightly more responsive to unemployment changes (Figure 2.5, panel 2). Such a finding is consistent with evidence from the literature showing that higher-markup firms are more likely to use their margins to absorb cost changes and preserve their market shares.[19]

Relatedly, using long cross-sectional time series for Europe that help identify the effects of within-economy structural changes, Baba and Lee (2022) find that the pass-through of inflation shocks (captured by oil price changes) to wages can increase when union density and the degree of centralized bargaining are high.[20] Although disentangling specific structural factors that cause differences in wage setting is empirically challenging, these results and others from the literature suggest that regulatory, institutional, and structural features affect wages' responsiveness to changes in inflation expectations and slack.

Figure 2.5. The Role of Structural Characteristics in Wage Dynamics

(Percentage points)

Regulatory and structural features can shape how unemployment and inflation expectations affect nominal wages.



Source: IMF staff calculations.
Note: The figure shows average marginal effects of unemployment and inflation expectations on nominal wage growth, conditional on the level of the structural characteristic. High (low) refers to the average value of each structural indicator, given that it is above (below) the cross-economy median. "Stringency of employment protection regulation" refers to a composite indicator on the stringency of regulations related to individual dismissal of workers on regular contracts. The indicator of "firm markups" (a measure of firms' market power in output markets) is the sales-weighted average of sectoral markups. See Online Annex 2.4 for details.

[18]There has recently been much discussion about how alternative slack measures—such as unemployment rate gaps (unemployment rate minus natural rate of unemployment) and the ratio of the number of unemployed people to the number of job vacancies in an economy—could perform better. In robustness checks for the larger sample, using the unemployment gap does not make any marked differences in the relationships discussed. To study the unemployment-to-vacancy ratio, a further robustness check using the US (for which data are available on a sufficiently long basis) was also conducted, with broadly similar results, although the unemployment-to-vacancy ratio performed better in explaining recent wage growth. This is similar to the evidence from Ball, Leigh, and Mishra (forthcoming), who find that the price Phillips curve using the unemployment-to-vacancy ratio explains inflation since the COVID-19 shock better in the US than alternative measures, without sacrificing its explanatory power before the pandemic. See Online Annex 2.4 for further details.

[19]See Box 2.1 for some discussion of this mechanism and Box 1.2 for a discussion of the relationship between market power and inflation.

[20]Battistini and others (2022) also analyze the effects of energy shocks, comparing the second-round effects in the 1970s with those from today using model simulations calibrated to the relevant economic features. They find only limited second-round effects in the present circumstances, unlike what was observed in the 1970s. This difference likely reflects changes in economic structure, particularly in labor market bargaining and wage-setting processes. See also Boissay and others (2022) for additional discussion.

Wage Changes Were Highly Unusual in the Acute Pandemic Phase but Recently Appear Broadly in Line with Developments in Inflation Expectations and Slack

How wages respond to changing conditions in labor markets and inflation also depends on the sources of shocks and their mechanics. The COVID-19 shock's unprecedented nature and asymmetric sectoral effects meant that, overall, average wages did not move in line with the relationships predicted by the wage Phillips curve. A decomposition of average wage growth in advanced and emerging market economies using the wage Phillips curve unveils several notable features (Figure 2.4, panels 2 and 3).

First, both the acute shock and the recovery were unique, exhibiting abrupt swings that deviated from those explained by inflation expectations and unemployment changes according to the estimated wage Phillips curve.[21] Only part of these deviations was due to movements in hours worked, as employers and employees adjusted along the intensive margin of employment.[22] Importantly, the deviations were quantitatively and qualitatively different from those observed in the years preceding the pandemic and during the global financial crisis.[23] They also differed across economies. At the beginning of the pandemic, the drop in wage growth was less prominent than predicted by inflation and unemployment movements in advanced economies (particularly in the US), while the opposite was true in emerging markets.[24]

Second, in both advanced and emerging market economies, the recovery of wage growth since the crisis peak has been largely in line with the observed drops in unemployment and increase in inflation expectations. In fact, by the end of 2021, wage growth in advanced economies did not seem to be abnormally above that predicted by falling unemployment and rising inflation expectations alone, with a shrinking contribution of the residual and other components in both advanced and emerging market economies. On average, the rise in inflation expectations appears to account for more of the very latest movements in wage growth.[25] Chapter 1 provides evidence on how the average and distribution of inflation expectations have evolved in 2022 for selected economies.

Relative Contributions of Supply and Demand Shocks to Wages and Prices

The large, unexplained movements in wage growth observed during the COVID-19 shock and recovery likely reflect the shock's unprecedented and complex nature, as well as the large policy responses. To help unpack the breakdown of the wage Phillips curve during the pandemic's acute phase, this subsection deploys a rich multi-economy, multisector general equilibrium model featuring nominal rigidities and credit constraints. Based on recent work by Baqaee and Farhi (2022a, 2022b) and Gourinchas and others (2021), the model facilitates the study of how different demand and supply shocks propagate and contribute to wage, price, and employment changes.

In total, seven types of shocks are considered, all of which have been cited as being important for understanding the COVID-19 shock and its effects. On the supply side, the model includes three types of shocks:

- *Production capacity (or labor supply) shocks*, arising from lockdowns and social distancing, which had a particularly large impact on labor supply: These shocks are calibrated according to changes in the number of hours worked by sector over time.
- *International trade cost shocks*, as measured by the shipping costs by product for US imports: Freight and insurance costs showed marked increases starting in 2020.
- *Commodity price changes for energy and food:* Energy and food prices went up by 85 percent and 20 percent year over year, respectively, in 2021.

[21]The large increase in temporary layoffs observed in some economies, which were particularly concentrated among lower-paid workers, could partly explain these wage growth swings (Duval and others 2022). This reason is also cited for some of the strange behavior of the price Phillips curve in the United States (Ball and others 2021).

[22]See Online Annex 2.4 for a decomposition including hours worked using a more limited sample of economies.

[23]See Online Annex 2.4 for a similar decomposition over the period spanning the global financial crisis.

[24]Worker composition shifts during this period, particularly in the US, where greater employment losses among low-wage workers pushed average wages upward at the start of the pandemic, could partly explain the differences.

[25]The prominence of tighter labor markets for higher wage growth in the latest period appears greater when unemployment-to-vacancy indicators—particularly for the case of the United States—are considered, as these indicators point to tighter labor markets than before the pandemic. Alternative labor market slack measures co-moved closely during the pandemic, but the degree of tightening relative to the fourth quarter of 2019 varies for some economies (including the US) depending on the measure used. See Online Annex 2.4 for details.

The analysis also incorporates four types of demand shocks:

- *Changes in private saving behavior:* These shocks are calibrated by adjusting households' discount rate to track saving rates over time.
- *Consumption composition changes:* The pandemic led to a large reallocation of consumption away from services toward goods, driven by both availability and preferences. Consumer taste shocks are derived using changes in expenditure shares for different types of goods and services over time.
- *Fiscal policy support*, which was substantial in many advanced economies in 2020: This shock is derived from changes in government consumption and changes in spending on unemployment insurance.
- *Monetary policy support*, which was also extensive: This shock is obtained by calibrating the domestic interest rate to that observed for central bank policy rates.

A historical decomposition of key economic variables—including wages and prices—for the United States, euro area, and Mexico (an emerging market economy) are presented for 2020 and 2021 (Figure 2.6).[26]

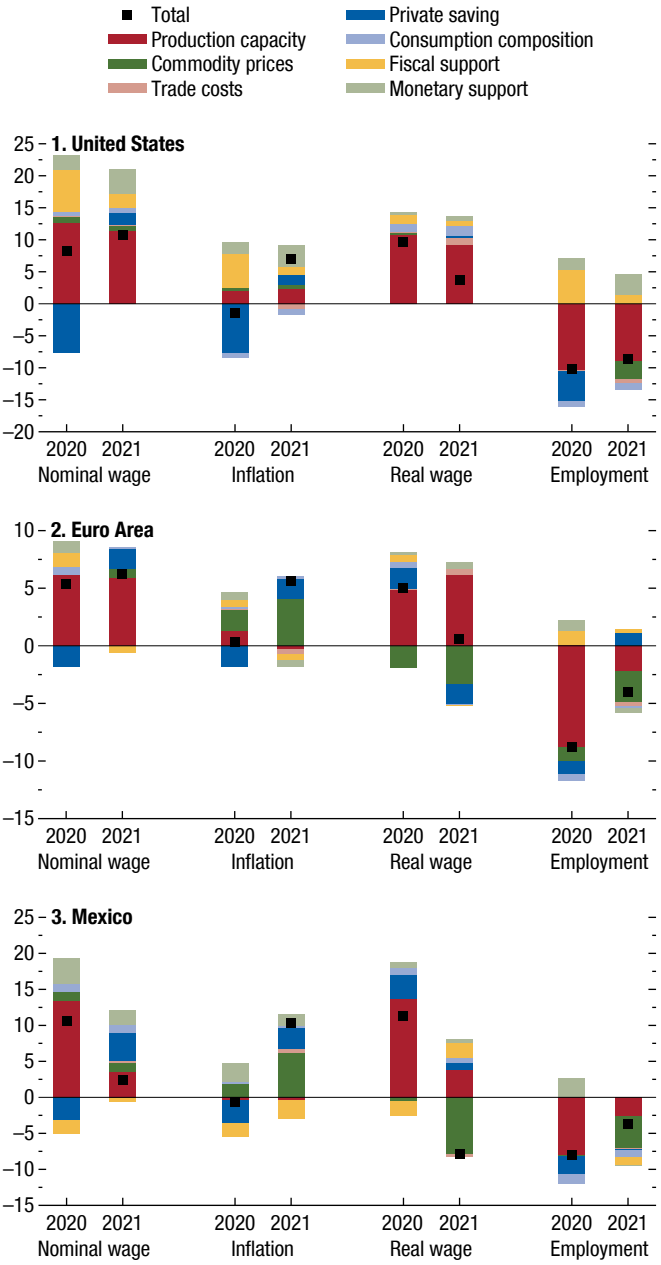
Wage Changes since 2019 Have Been More Related to Supply-Side Shocks from the Pandemic, While Demand-Side Shocks Have Contributed More to Price Changes

Although all shocks contribute to the variation in an economy, two main contributors emerge from the results. First, reductions in production capacity (dark red bars in Figure 2.6) were the predominant contributors to nominal wage changes during 2020 and 2021. Second, changes in households' saving behavior (dark blue bars) were one of the most important drivers of price changes over the same years. These findings suggest that the future paths for these variables could depend heavily on whether and how these shocks unwind, as well as on whether new shocks arise.

[26]The impacts of individual shocks do not necessarily add up to the total impact in combination because of interactions in general equilibrium. It is also important to note that the total model-based impacts by variable are broadly aligned, but not exactly equal to actual outturns. The economies studied were selected based on a combination of their economic size, availability of data required for the model calibration (which is a constraint for many emerging market and developing economies), and diversity of policy support responses.

Figure 2.6. Drivers of Changes in Wages, Prices, and Employment during the COVID-19 Pandemic and Recovery
(Cumulative percent change, relative to pre–COVID-19 trend)

Reductions in production capacity and changes in households' saving behavior were the predominant contributors to wage and price changes during the pandemic.



Source: IMF staff calculations.
Note: Nominal and real wages are defined on a per hour basis for the results exhibited in this figure. Estimated impacts are calculated using a multi-sector, multi-economy general equilibrium model based on Baqaee and Farhi (2020). See Online Annex 2.5 for further details. The impacts of individual shocks do not necessarily add up to the total impact in combination as a result of interactions in general equilibrium. Total impacts are model-based and broadly aligned with outturns.

In 2020, the main determinant of wages and employment across all three economies was the drop in production capacity that took place early in the pandemic (dark red bars). Lockdowns and the rise in social distancing due to the pandemic translated into decreases in production capacity and a lower labor supply. These decreases led to a decline in employment and an increase in hourly wages.

The second key driver in 2020, particularly for prices, was the rise in private saving (dark blue bars)—a contractionary force for aggregate demand—due to the myriad uncertainties surrounding the pandemic and its consequences. This negative demand shock had the usual disinflationary impact on nominal wages and consumer prices, particularly in the United States. Finally, the expansive fiscal and monetary policy responses in the United States and the euro area limited early damages to employment from the pandemic and helped support nominal wages.[27] In contrast, fiscal policy support in Mexico shrank in 2020, pulling wages and prices down to some extent (yellow bars). Monetary policy expansion in Mexico was effective at sustaining employment, along with pushing nominal wages and prices up (light green bars). For all three economies, the combination of a sharp increase in nominal wages and muted price responses led to strong increases in real wages.

In 2021, the main driver overall was the rebound in aggregate demand running ahead of production capacity—a supply-demand imbalance. The positive impact on consumer prices as private savings began to be drawn down—a reversal of the negative impact of higher savings in 2020—shows this most clearly. Production capacity recovered somewhat last year, especially in the euro area and Mexico, but the recovery was not enough to fully boost employment as the cumulative impact was still negative. Continued monetary accommodation in the United States also pushed wages and prices up further. For the euro area and Mexico, the inflationary effects of monetary support were reduced. Fiscal policy support across economies decreased in 2021 compared with 2020, relieving some of the earlier upward pressure on prices.[28] The mix of nominal wage and price changes led real wages to decline across the board last year, especially in Mexico.

The other major contributor to wages and prices in 2021 was the steep rise in commodity prices (dark green bars). The euro area and Mexico felt the impacts of those energy and food shocks on economy-wide prices more strongly than the United States, but commodity price rises were a drag on employment across the board. Commodity prices have risen even further in 2022 (particularly with the shock of the Russian invasion of Ukraine) and are pushing inflation up even more. Wage and price prospects will depend in part on how long these and other shocks persist.

Inflation De-anchoring: Expectations and Policy Responses

Beyond the potential for more persistent and additional inflationary demand and supply shocks, the risks for inflation de-anchoring or the emergence of a wage-price spiral will also depend on how businesses and workers form their expectations for wages and prices. This section delves into this issue. It first studies empirically the dynamic responses of wages, prices, and expectations about them to an inflationary shock (driven by global supply pressures) and monetary policy tightening.

Building on the insights from the empirical exercise, the section then demonstrates how the dynamic effects of inflationary shocks and the effectiveness of monetary policy responses depend critically on how wage and price expectations are formed. Taking account of current monetary policy plans, it considers a couple of forward-looking scenarios under different assumptions about the formation of wage and price expectations. The findings suggest that more backward-looking expectations will require stronger monetary policy responses to reduce the risks of de-anchoring, but they also indicate that the risks of a wage-price spiral are low.

[27]Note that there are important aspects of the design and composition of fiscal support policies that the model abstracts away from. See Chapter 3 of the April 2021 *World Economic Outlook* and the October 2022 *Fiscal Monitor* for a discussion on how the appropriate mix of job retention support and other measures may make fiscal policy support more effective.

[28]Fiscal support likely had further, indirect inflationary effects through its effects on private saving and labor supply as a result of income transfers, but these channels are difficult to quantify precisely in the Baqaee and Farhi (2020) model used here. See Online Annex 2.5 for further details. See Ramey (2016) for a summary of the considerable empirical literature on the dynamic effects of fiscal support.

Inflationary Shocks and Monetary Tightening

The empirical analysis estimates the dynamic effects of inflationary shocks and monetary tightening on wages and prices using local projections. Inflationary shocks are proxied by the Federal Reserve Bank of New York's Global Supply Chain Pressure Index, which captures the state of international supply chain pressures and disruptions (which are highly relevant to the current circumstances).[29] The index can be regarded as reflecting supply-side variation, since the manufacturing data and transportation costs used in its construction have been purged of demand factors. Finally, to account for differences in economies' exposures to global supply chain developments, the index is interacted with trade openness by economy.[30]

For a one-standard-deviation increase in global supply chain pressures, the inflation response outstrips that of nominal wage growth (Figure 2.7, panels 1 and 6). Both realized and short-term expected inflation increase persistently, taking three years (beyond the horizon shown) before reverting to their long-term means. In parallel, nominal wage growth increases slightly in the very near term and then deteriorates as the shock's depressive effects on activity take hold. Together, these dynamics engender a fall in real wage growth (Figure 2.7, panel 5). Most important, there are no signs that such inflationary shocks kick off a wage-price spiral.[31]

In contrast, monetary tightening brings inflation down, with similar depressive effects on nominal wage growth. To estimate the effects of monetary policy tightening, the analysis uses the series of identified European Central Bank monetary shocks from Jarociński and Karadi (2020).[32] The impact of a one-standard-deviation monetary tightening on realized and expected inflation is shorter lived than the effect of an inflationary supply chain shock (Figure 2.7, panels 3 and 4). At the same time, nominal and real wage growth decline, further helping mitigate any inflationary pressures (Figure 2.7, panels 7 and 8). In the background, the unemployment rate rises alongside increases in the long-term rates on government debt.[33]

This empirical evidence suggests that supply-chain-related inflationary shocks tend to have temporary effects on inflation and wage growth and do not give rise to a wage-price spiral. However, supply chain pressures do appear to have a more prolonged effect on expected inflation than monetary tightening. The differences in dynamic effects may suggest that monetary policymakers should respond aggressively to such shocks, particularly in contexts like the current conjuncture, in which inflation is high and rising and wage growth is sensitive to inflation expectations (as shown earlier).

If inflation expectations become less anchored to the monetary policy target rate, the effects on wages and prices could change and increase the risks of a persistent wage-price spiral emerging. When inflation expectations are more anchored, they are comparatively less sensitive to an inflationary shock from higher global supply chain pressures, implicitly decreasing the risk of future de-anchoring (Figure 2.8, red line compared with blue line).[34]

[29]The estimation sample excludes the United States and includes a set of small open advanced economies in the euro area to help avoid the reverse causality and simultaneity concerns that would arise with the inclusion of large economies, which could have sizable direct effects on the global economy (given the inflationary shock considered). Moreover, recent evidence suggests that changes in the index have had a meaningful impact on inflation in euro area producer prices and consumer goods prices (Akinci and others 2022). The sample comprises 16 economies: Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, The Netherlands, Portugal, the Slovak Republic, Slovenia, and Spain. To avoid confusion with the large number of shocks occurring with the COVID-19 pandemic, the estimation sample ends in the fourth quarter of 2019. See Benigno and others (2022a, 2022b) for details on the construction of the index.

[30]Trade openness is defined here as the sum of an economy's imports and exports as a share of GDP. To address concerns about simultaneity, the estimation uses the lagged value of the supply chain pressure index. See Online Annex 2.6 for further details on the empirical specification and set of controls included.

[31]Behind the scenes, the long-term interest rate on government bonds and the unemployment rate increase in response to such a shock. These increases could reflect the effects of endogenous monetary tightening in response to the adverse supply shock. See Online Annex 2.6 for further details on the dynamic responses of the long-term interest rate and the unemployment rate, along with a more detailed discussion of the specification and robustness.

[32]See Online Annex 2.6 for a detailed description of the analysis. Note that the effect of monetary policy shocks could be seen as lower-bound estimates since the effective lower bound may reduce the variation in some of the overnight indexed swap rates used in the construction of the shock.

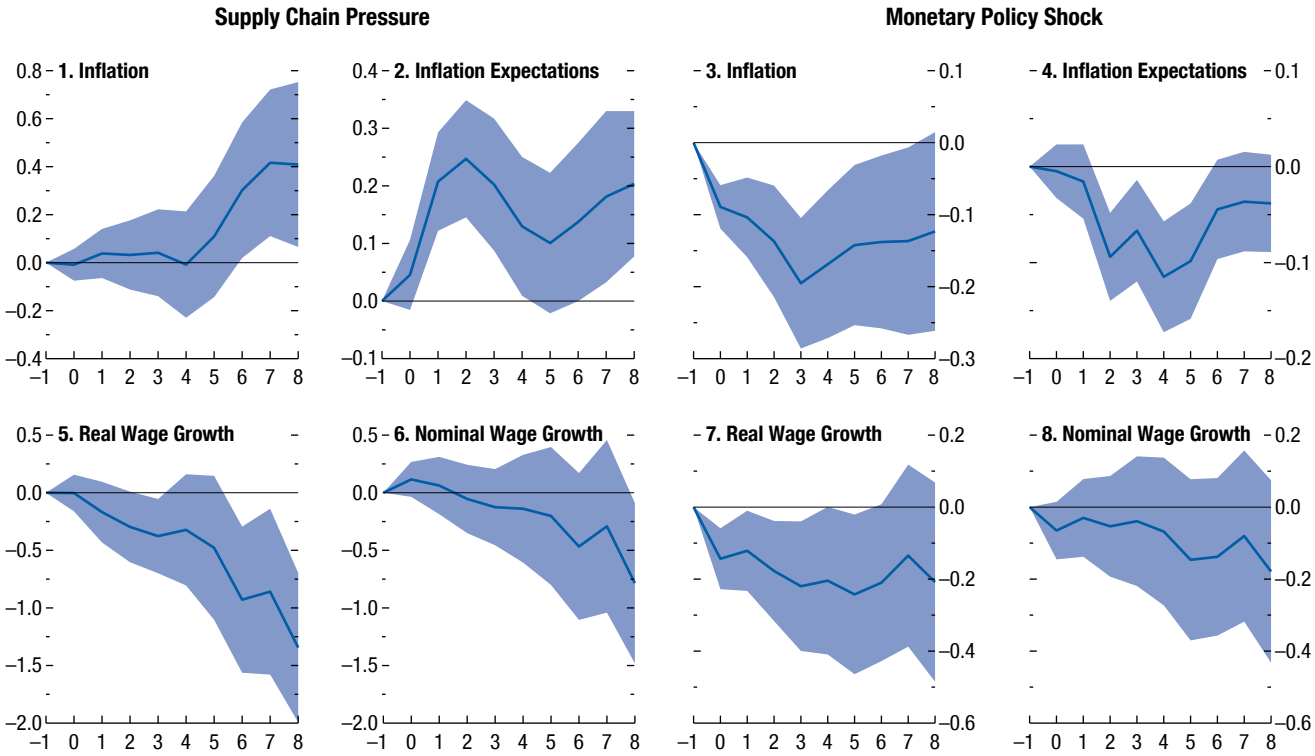
[33]See Online Annex 2.6 for further details.

[34]The Global Supply Chain Pressure Index is interacted with a dummy equal to one if the lagged economy's strength of inflation anchoring, proxied by the Bems and others' (2021) index, is above the cross-economy and cross-time median of the indicator. See Online Annex 2.6 for details on the construction of the indicator. This result is also in line with that of Carrière-Swallow and others (2022), who find that increases in the Baltic Dry Index lead to larger inflationary effects among economies with weaker monetary policy frameworks. To better anchor expectations, the recent literature has emphasized the role played by central banks' communication strategies and guidance, in addition to more traditional policy actions, such as interest rate changes (Coibion, Gorodnichenko, and Weber 2022).

Figure 2.7. Cumulative Effects of Supply Chain Pressures and Monetary Tightening on Wages and Prices

(Percentage points; dynamic response)

Increases in supply chain pressures tend to raise inflation and depress wage growth, with more persistent effects on inflation expectations. Monetary tightening is effective at bringing both inflation and inflation expectations down, but the actions required to offset inflationary shocks from supply chain pressures could be large.



Sources: Federal Reserve Bank of New York; Haver Analytics; Jarociński and Karadi (2020); Organisation for Economic Co-operation and Development; and IMF staff calculations.

Note: Lines show the estimated impulse responses of the indicated variable to the indicated shock, with the shaded area representing the 90 percent confidence interval. The horizontal axes show time in quarters, where $t = 0$ is the initial impact quarter of the shock. The estimation sample includes euro area economies during 1999:Q4–2019:Q4. Panels 1, 2, 5, and 6 are the responses to a supply chain pressure shock, defined as a one-standard-deviation increase in the Federal Reserve Bank of New York's Global Supply Chain Pressure Index. To account for economies' different degrees of exposure, the index is weighted by an economy's trade openness. Panels 3, 4, 7, and 8 are the responses to a one-standard-deviation monetary policy shock, as identified in Jarociński and Karadi (2020). "Inflation expectations" are 12-month-ahead expected inflation. See Online Annex 2.1 for details on the sample and Online Annex 2.6 for further details on the estimation.

The Role of Expectations and Monetary Policy Responses in Wage and Price Inflation

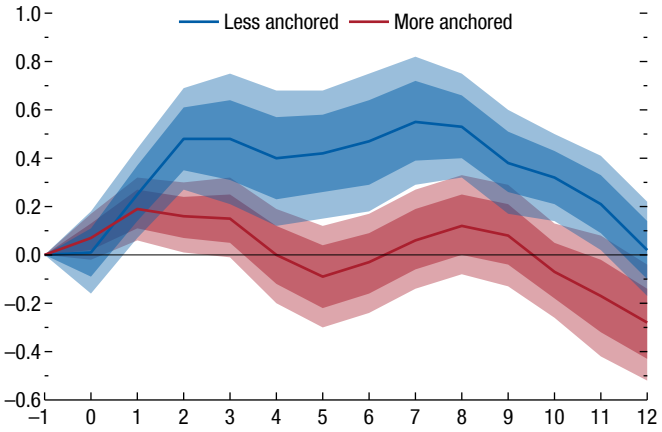
Central banks often discuss the importance of monitoring price expectations to assess the proper stance of monetary policy, aiming to ensure that expectations do not drift away from central bank targets. As the world economy recovers from a global pandemic and inflation reaches levels not seen in decades in many economies, there are concerns about a break from recent-past trends, with expectations changing sharply. This subsection zooms in on how differences in the expectations formation process can affect an economy's dynamics, with particular focus on the behavior of nominal wages and prices.

The analysis estimates a small, standard dynamic stochastic equilibrium model conditional on different expectation formation processes, thereby isolating their role in shaping the economy's response to shocks and policy actions. The model incorporates price and wage Phillips curves (which relate price and wage inflation, respectively, to expectations, the gap between real wages and productivity, and slack in the economy), an investment-savings curve (relating output to the nominal interest rate and inflation expectations), and a monetary policy reaction function.[35]

[35]See Online Annex 2.7 for more details about the model and its structure. See also Alvarez and Dizioli (forthcoming).

Figure 2.8. Cumulative Effects of Supply Chain Pressures on Inflation Expectations
(Percentage points; dynamic response)

More anchored inflation expectations respond less to supply chain pressures.



Sources: Bems and others (2021); Federal Reserve Bank of New York; Haver Analytics; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Lines show the estimated impulse responses of inflation expectations (12 months ahead) to a one-standard-deviation rise in the Federal Reserve Bank of New York's Global Supply Chain Pressure Index (weighted by an economy's trade openness), conditional on the strength of inflation anchoring (defined by Bems and others [2021] over a five-year-ahead horizon). The red (blue) line is the response for economies with inflation anchoring above (below) the cross-economy median. Lighter-shaded areas represent the 90 percent confidence interval; darker-shaded areas are the 68 percent confidence intervals. The horizontal axis shows time in quarters, where $t = 0$ is the initial impact quarter of the shock. The estimation sample includes euro area economies during 1999:Q4–2019:Q4. See Online Annex 2.1 for details on the sample and Online Annex 2.6 for further details on the estimation.

With acknowledgment of the uncertainties surrounding expectations at the current juncture, three kinds of expectations formation processes are considered:

1. *Rational expectations:* Standard in much economic modeling because of the tractability of rational expectations, businesses and households understand the economy's complete structure, including the distribution of potential shocks. This means that businesses and households make accurate forecasts on average about future outcomes so that their expectations about the future are correct in the absence of further shocks.
2. *Fully adaptive expectations:* At the other extreme, businesses and households have fully adaptive expectations, which means they look at the value of a variable only in the recent past and assume that it will stay at that value in the future. Therefore, they project future variables to be exactly equal to their latest realization.
3. *Adaptive learning:* Partway between rational expectations and fully adaptive expectations, adaptive learning assumes that businesses and households form expectations using small statistical models for key variables such as wages and prices. They update these expectations regularly as new data become available, learning from their mistakes and adjusting their expectations process.[36]

How Wage and Price Expectations Form Matters More the Farther Away Inflation and Inflation Expectations Are from Target

Estimating the model for the United States, a scenario in which there are no new shocks to inflation and interest rates are exogenously set according to the Federal Reserve's dot plot as of June 2022, a soft landing appears feasible if expectations for wages and prices are rational (Figure 2.9, dashed lines).[37] In this case, the current inflationary shock is assumed to dissipate smoothly over the subsequent 12 quarters, allowing the output gap to converge smoothly to zero and core inflation to come down to the Federal Reserve's target of 2 percent.

In contrast, if wage and price expectations are fully adaptive, there is a fast near-term acceleration in wage and price inflation because businesses and households expect them to be identical to their most recent realizations, which have been higher than usual (Figure 2.9, red lines). Moreover, the economy is still facing large cost-push shocks that exacerbate price pressures and mostly offset the near-term disinflationary effects of falling real wages (since wage growth does not keep up fully with price inflation). As shocks dissipate and the real wage gap becomes even more negative, price inflation quickly declines after five quarters. However, although inflation comes down and there are no further future shocks assumed, price inflation remains 1.5 percentage points over target even 12 quarters later. To bring inflation down more quickly under this type of expectations formation, monetary policy would need to tighten much more sharply than is currently anticipated.

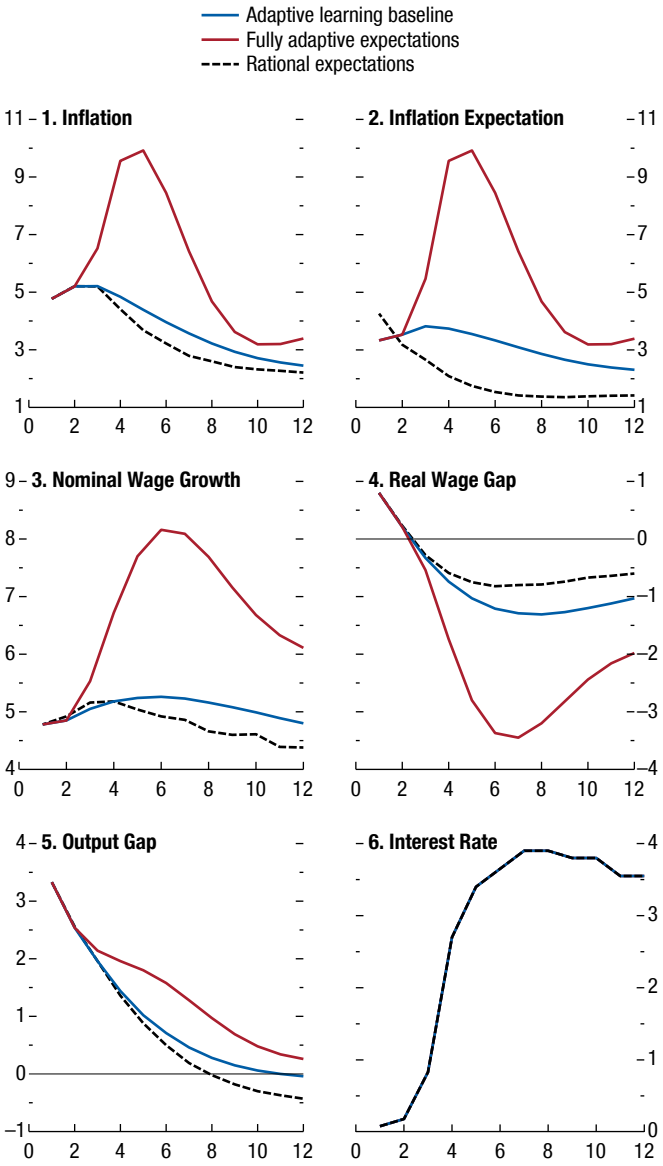
[36]See Online Annex 2.7 for further discussion of the alternative expectations formation processes, including the specific functional forms assumed for the adaptive learning process.

[37]The findings do not change in a meaningful way if monetary policy instead follows the estimated monetary policy reaction function, pointing to a high degree of consistency between the reaction function and announced policy. See Online Annex 2.7.

Figure 2.9. Near-Term Scenarios with Set Interest Rate Path under Different Expectations

(Percent)

With cost-push shocks originating outside the labor market, real wage dynamics help to stabilize inflation even when wage and price expectations are backward-looking (adaptive). If policy actions are not sufficiently responsive, inflation and inflation expectations can de-anchor from target the more adaptive the expectations.



Source: IMF staff calculations.
Note: The responses illustrate scenarios calibrated to the United States, assuming that the inflationary shocks as of early 2022 dissipate as estimated based on previous experience. Inflation is core inflation. The horizontal axes show time in quarters since 2021:Q4. See Online Annex 2.7 for further details on the structure and estimation of the underlying small dynamic stochastic general equilibrium model.

Under adaptive learning, which is the most realistic of the three expectations processes since the process is estimated to fit recent data on wage and price dynamics, the paths of inflation, wage growth, and the output gap lie between those for rational and fully adaptive expectations (Figure 2.9, blue lines). There is somewhat greater inertia than with rational expectations, but nowhere near the level seen in the fully adaptive case.[38] Even so, while the output gap mostly closes, inflation is still about half a percentage point above target after 12 quarters.

The results from simulations of the model estimated for the case of Brazil—an emerging market economy—exhibit broad patterns across the three expectations processes that are similar to those for the United States (see Online Annex 2.7). However, they show an even greater sensitivity to inflationary shocks and higher risks of de-anchoring in general. The greater sensitivity could entail a stronger reaction from the central bank to anchor expectations.

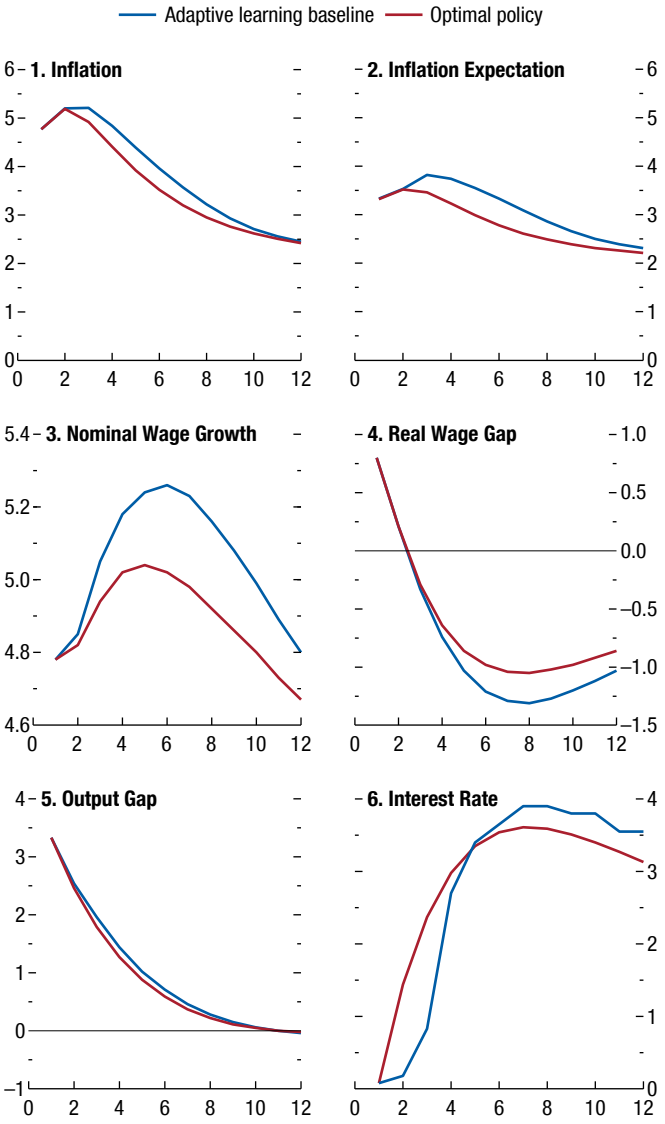
In all cases, the dynamics of real wages are critical to the evolution of wage and price inflation since they can affect price pressures. For simplicity, wages are the only determinant of marginal costs in the model employed here. Because of this, the model can also illustrate the likelihood of a wage-price spiral dynamic taking hold. This modeling choice not only allows the assessment of the likelihood of wage-price spirals in the simulated scenarios but also shows that wages can be an important anchor to inflation when cost-push shocks hit an economy. When inflationary cost-push shocks occur, the negative real wage gap characterizing the current circumstances helps anchor inflation, even in the case of fully adaptive expectations.[39] When the real costs of labor fall, they help bring inflation down. Moreover, the larger the increase in inflation, the more negative the real wage gap becomes and the more powerful this anchoring mechanism is. Using a different methodology and focusing on the United States, Box 2.1 empirically examines the feedback from wages

[38]The model is estimated over a period in which the monetary policy framework had high credibility, and hence the adaptive learning process begins centered on the inflation target, similar to the anchoring that occurs with rational expectations. Consequently, a very large shift in how expectations are formed would be needed to push the adaptive learning scenario to approximate the fully adaptive case. The greater economic inertia seen in the adaptive learning case is a function of the greater inertia in expectations.

[39]A negative real wage gap means that the real wage (the ratio of the wage to the price level) has not kept up with labor productivity.

Figure 2.10. Optimal Policy Scenario under Adaptive Learning Expectations
(Percent)

Front-loading monetary policy tightening is optimal to lessen the buildup of inflation expectations, helping to achieve target more quickly and smoothly.



Source: IMF staff calculations.
Note: The responses illustrate scenarios calibrated to the United States, assuming that the inflationary shocks as of early 2022 dissipate as estimated based on previous experience. Inflation is core inflation. The horizontal axes show time in quarters since 2021:Q4. Optimal policy is determined using an objective function that equally weights output and inflation deviations from potential and target, respectively, with some weight given also to policy rate smoothing. See Online Annex 2.7 for further details on the structure and estimation of the underlying small dynamic stochastic general equilibrium model.

to prices by sector and finds only limited pass-through from wage-cost shocks to prices.

As alluded to earlier, more backward-looking expectations will typically require a faster and stronger monetary tightening in response to an inflationary shock. But how much faster? For the case of the United States, with a positive output gap and persistent cost-push shocks, if expectations are formed through adaptive learning, a central bank that minimizes a standard welfare function would choose to initially tighten policy more and start easing earlier than the path implied by the Federal Reserve's dot plot as of June 2022 (Figure 2.10).[40] Even so, it would take several quarters for inflation to come down, although the inflation gains would accumulate over time. Monetary policy affects inflation dynamics through three channels: (1) higher interest rates lower the output gap and real wages through the wage and price Phillips curves; (2) as expectations are partially adaptive, lower inflation realizations contribute to lower expected inflation; and (3) through recognizing mistakes in their forecasts, businesses and households learn over time and place less importance on past outcomes when it comes to their expectations.

Conclusions

Many economies have seen sharp rises in price inflation since 2021 as adverse supply shocks buffet the global economy and labor markets appear tight in the wake of the acute COVID-19 shock. These inflation rises have raised concerns among some observers that prices and wages could start feeding off each other and accelerate, leading to a wage-price spiral dynamic. Using a mix of empirical and model-based analyses, this chapter has examined recent developments, trying to shed light on the prospects for wages and the chances that a wage-price spiral could emerge.

Although wage and price inflation picked up in a broad-based manner through 2021, real wages tended to be flat or falling across economies on average. This is an important aspect of the current conjuncture, since falling real wages can be disinflationary by lowering

[40]The determination of an optimal monetary policy response depends on the following assumptions: (1) the central bank minimizes a welfare function that equally weighs output and inflation deviations (a quadratic loss function) and (2) the central bank knows the expectations formation process and has full information on future cost-push shocks. See Online Annex 2.7 for more details on the exercise.

firms' real costs. An analysis of historical episodes with features similar to today's suggests that these episodes did not tend to be followed by a wage-price spiral. In fact, inflation tended to fall gradually afterward on average, and nominal wages gradually caught up over several quarters. However, in some cases, inflation remained elevated for a while.

Wage dynamics during 2020 and into early 2021 are poorly explained by inflation expectations and labor market slack, likely reflecting the highly unusual constellation of shocks arising with the COVID-19 pandemic. Model-based analysis of 2020–21 wages and prices suggests disparate underlying shocks: wages were driven predominantly by production capacity and labor supply shocks, while private saving was important for price changes. That said, in the second half of 2021, wage growth appears to be relatively well explained by inflation expectations and labor market slack on average, potentially pointing to a gradual shift toward more normal economic dynamics. Of course, this shift is highly contingent on whether the earlier shocks continue unwinding and whether new shocks arise.

Finally, the analysis suggests a critical role for the expectations formation process in shaping wage and price prospects. When wage and price expectations are more backward-looking, monetary policy actions need to be more front-loaded to minimize the risks of inflation de-anchoring. As monetary policy tightens more aggressively and the decline in real wages helps reduce price pressures, according to the scenario analysis, the risk of a persistent wage-price spiral emerging in the current episode is contained on average, assuming no more persistent inflationary shocks or structural changes in wage- and price-setting processes (such as sharply higher pass-through from prices to wages or vice versa).

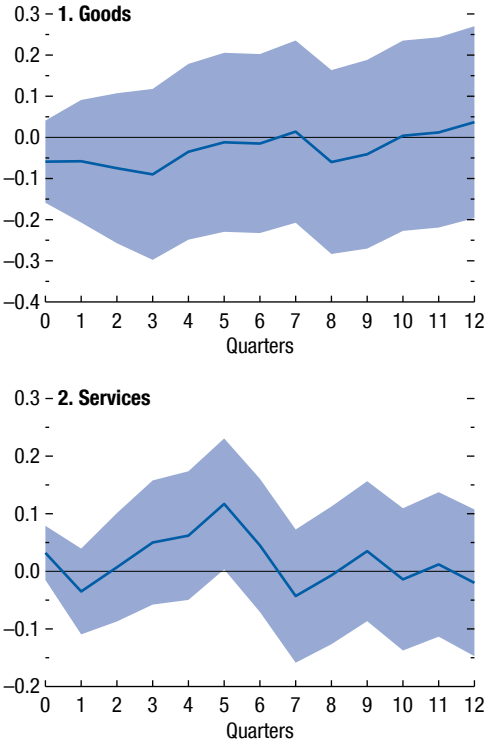
Box 2.1. Pass-Through from Wages to Prices: Estimates from the United States

The empirical literature offers limited evidence on the pass-through of wages to consumer prices. At the macroeconomic level, the link between labor cost and price inflation has weakened over the past three decades.[1] Meanwhile, analysis at a more disaggregated level has not reached much of a consensus on the pass-through of labor costs to retail prices.[2]

Using a novel estimation approach, this box finds that the recent pickup in nominal wage growth has added only modestly to consumer price inflation, mostly through its effects on prices of certain services. The analysis studies the pass-through of labor costs to consumer prices (as measured by the personal consumption expenditure, or PCE, price index) by looking at disaggregated sectoral data. The main empirical challenge is that consumer prices, which reflect the final product of multiple production processes, cannot be readily matched to the costs of labor inputs, which are recorded at the industry level. To overcome this measurement problem, input-output matrices are used to construct the cumulative costs of labor inputs (traced through the supply chain of intermediate goods and services) for 73 subcomponents of the PCE index. Using the local projection method in Heise, Karahan, and Şahin (2020), with sectoral productivity growth and time and industry fixed effects controlled for, the impulse response of prices to wage changes shows a pass-through of about 10 percent to services after five quarters, but no measurable pass-through to goods prices (Figure 2.1.1). The lack of pass-through in goods compared with that in services could be due to firms absorbing more labor cost changes, on the back of higher market power and import penetration. The estimated pass-through appears materially unchanged from the mid-2000s up to the pandemic.

There is some tentative evidence that the pass-through from wages to service prices is stronger during periods or in sectors in which labor costs increased more quickly. Pre-2020 data suggest that contemporaneous pass-through in the services sector picks up to 20 percent (and is statistically significant at the 99 percent confidence level) when wage growth is at or above the 75th percentile (that is, 3.9 percent), while pass-through is about zero in periods with lower wage growth. In addition, the cross section from the sectoral data suggests that the point estimate of the pass-through from wages to service prices has been increasing since the first quarter of 2021 but is not statistically significant.

Figure 2.1.1. Pass-Through from Wages to Prices
(Percent)



Sources: US Bureau of Economic Analysis; US Bureau of Labor Statistics; and IMF staff calculations.
Note: Lines show the dynamic pass-through from a 1 percentage point change in current wage growth (at $t = 0$, measured by the four-quarter change in wages) to inflation (measured by the four-quarter change in the indicated sectoral prices). Shaded areas show the 90 percent confidence interval.

The authors of this box are Moya Chin and Li Lin.

[1]See Bobeica, Ciccarelli, and Vansteenkiste (2021) for evidence on this.

[2]For further background on the debate, see Rissman (1995) and Heise, Karahan, and Şahin (2021), among others.

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