



ANALYSIS | Inflation and price developments 20 September 2023 | No. 11

Wage increases prolong period of high core inflation

High wage increases are expected in Denmark and parts of the rest of the world in 2023-24. Over time, higher wages will affect consumer prices and put upward pressure on core inflation. Accordingly, Danish core inflation is expected to remain high in the coming years, even though the significant indirect price effects from energy are abating. However, it is not expected that the Danish economy will face a wage-price spiral, although the risk of inflation expectations deanchoring increases the longer wage and price inflation remains high.

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Prospect of high wage increases in Denmark and abroad

Danish wage increases have been moderate up until mid-2023 in light of labour market pressures and high inflation. However, high wage increases are expected in Denmark and parts of the rest of the world in the coming years.



High wage increases are affecting core inflation and service prices

High wage growth traditionally impacts core inflation and particularly service prices with some time delay. So far, however, wage increases have not been the main driver of the high core inflation.



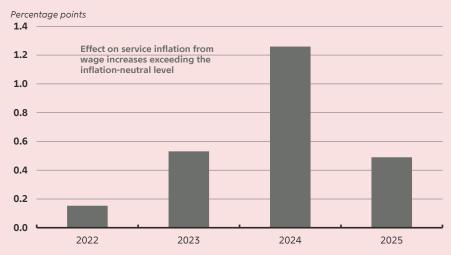
Wage growth prolongs period of high core inflation

Model calculations indicate that an increase in wage growth of 1 percentage point over time can translate into an increase of 0.6 percentage points in core inflation. High wage growth will push up consumer prices and prolong the period of high core inflation in Denmark.

Why is this important?

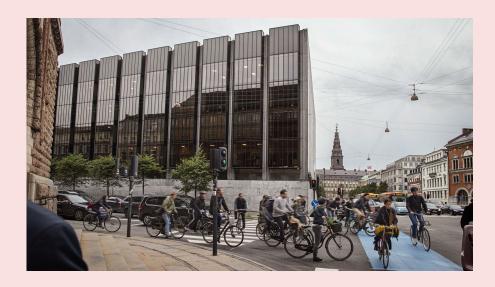
After the elevated inflation peaked in autumn 2022, the focus of the economic debate is now revolving around how quickly it will abate. Wages will play a crucial role in inflation going forward, as the spring collective agreements lay the basis for significant wage increases in Denmark. With this analysis, Danmarks Nationalbank therefore examines how higher wages may be expected to affect consumer prices.

Main chart: Wage increases push up service prices in particular



Note: The chart shows the contribution to service inflation from wage increases above the inflationneutral level, i.e. above productivity growth and an equilibrium inflation of 2 per cent. See the note to chart 12 for a description of the calculation.

Source: Own calculations based on the macroeconomic model ADAM.



Topics

Inflation and price development

01

Prospects for high wage growth in Denmark and abroad

Wage increases in Denmark and parts of the rest of the world have accelerated over the past year, driven by strong labour market pressures and the high inflation, see chart 1. Even though Danish wage increases are still moderate and even somewhat smaller than in, for example, the USA and the euro area, increasing wage growth is expected in the coming years. Following the spring collective wage negotiations, a significant boost in wage increases in Denmark is in the pipeline. Against this background, overall wage growth is expected to increase significantly towards 2024, see chart 2. Higher wage growth is not an isolated Danish phenomenon, and wages in Denmark are estimated to develop roughly in line with those in the euro area over the entire 2023-25 period.¹

CHART 1

Wage increases have accelerated in Denmark, but are currently rising less than abroad despite strong labour market pressures

Wage growth in Denmark, the euro area and the $\ensuremath{\mathsf{USA}}$



Note: The chart shows the Confederation of Danish Employers' (DA) wage statistics in the DA area for Denmark, compensation per employee for the euro area and the Employment Cost Index for the USA. The Y axis is limited to the range from 0 to 7 per cent, as the wage growth measured in the euro area was characterised by large fluctuations during the pandemic in 2020-21, partly due to wage compensation schemes.

Source: Macrobond and the Confederation of Danish Employers.

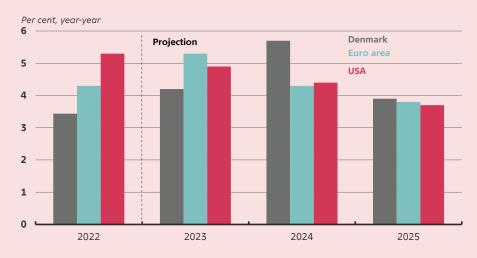


Danish wages increased by 3.4 per cent year-on-year in the 2nd quarter of 2023.

¹ For a more detailed review of Danmarks Nationalbank's projection for wage growth in Denmark, see *Cyclical overview and projection for the Danish economy* in Danmarks Nationalbank (2023a).

CHART 2
Prospect of high wage increases in Denmark and abroad in 2023-24

Wage growth projections





Danish wage growth is expected to be 5.7 per cent in 2024.

Note: The chart shows industrial wages for Denmark, compensation per employee for the euro area and the Employment Cost Index for the USA.

Source: Danmarks Nationalbank (September), ECB (September) and Congressional Budget Office (July).

Wage increases over and above productivity growth will lead to inflation without a corresponding fall in corporate profit margins

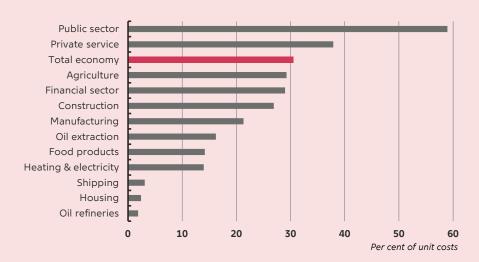
Rising wage growth will eventually be passed on to the prices that companies charge for their goods and services. For example, compensation of employees accounts for a significant part of companies' total costs, although this is subject to marked differences across industries. Specifically, wages account for approx. 30 per cent of unit costs in the Danish economy as a whole, but only about 20 per cent in manufacturing and almost 40 per cent in private services, see chart 3. The remainder of unit costs includes, inter alia, costs of materials and return on capital. Higher wages affect both companies' costs directly through wage costs for employees and indirectly through increased costs for, e.g., materials, when their subcontractors' wage costs also increase and are added to prices. Thus, wage increases have a greater effect on companies' total costs than what can be explained by their own wage costs.

In the shorter term, several factors can potentially affect the relationship between wages and prices. Theoretically, higher inflation is only caused by wage increases in excess of productivity growth and possible adjustments of company profit margins. Firstly, this reflects the fact that a more efficient production reduces the pressure of higher wage costs on companies' costs per unit produced. Thus, their sales prices do not have to increase as much as wages to maintain a given earnings level. Secondly, it is possible that companies will absorb part of the wage increases in their profit margins, for example if the market situation does not allow them to increase sales prices accordingly. In other words, companies set a price that is realistic considering the current supply and demand conditions on the market, regardless of the evolution of their actual costs. Finally, high wage growth can also stimulate demand through higher household disposable income, thereby driving up prices. In principle, this can give a pass-through to inflation that exceeds the wage component of production.

CHART 3

Wages make up a large proportion of companies' costs in Denmark, with pronounced differences across industries

Labour cost share of unit costs





Wages account for almost 40 per cent of companies' costs in the private service sector.

Note: The chart shows the labour cost share of industries' total unit costs in 2021 and measures the direct impact of wage increases in the industry concerned.

Source: Own calculations based on the macroeconomic model ADAM.

Wage increases in excess of productivity growth are a prerequisite for achieving stable price developments over time and do not in themselves pose a problem. This means that in order for inflation to stabilise close to 2 per cent over time, wage increases above this level are necessary, as long as productivity keeps improving in the economy. At the same time, however, it is essential that wage increases do not persistently exceed productivity growth to such an extent that they are no longer compatible with stable inflation over the medium term.

As described above, the effect of high agreed wage increases in Denmark on consumer prices in future will depend, among other things, on the development in productivity and company profit margins. Wage costs per unit produced, i.e. unit labour costs, increased by 3.4 per cent year-on-year in the 2nd quarter of 2023. So far, wages are, thus, rising slightly faster than productivity in Denmark, which is different from the euro area, where unit labour costs have increased more than in Denmark.² However, Danmarks Nationalbank expects Danish wages to rise somewhat more sharply than productivity over the coming years, with the effect that wage growth may have an impact on consumer prices, see *Cyclical overview* in Danmarks Nationalbank (2023a).

The development in earnings does not suggest that all companies are able to absorb the higher wage increases fully in their profit margins. Profit margins in the private non-primary sector excluding utilities and transport, which is an employment-intensive sector and closely linked to domestic price formation, have increased slightly since the pandemic and until the 2nd quarter of 2023, see *Corporate earnings and inflation* in Danmarks Nationalbank (2023a) for a discussion of corporate earnings and their impact on price developments in recent years. In some sectors, such as manufacturing, companies' profit margins

 $^{^2}$ According to Eurostat, unit labour costs based on hours worked increased by 6.7 per cent year-year in the euro area in the second quarter of 2023.

have even declined since 2019 as measured by unit profits, i.e. gross operating surplus in relation to gross value added in volumes. Together with the expected productivity development, this supports the view that the Danish economy is facing an economic cycle in which high agreed wage increases will give rise to a shift in the driver of consumer prices from energy to wages, thus prolonging the period of high core inflation.

02

High wage increases are affecting core inflation, particularly service prices

As wages and prices are interdependent, it is generally difficult to establish the causal link between them. This means that higher prices may lead to greater wage increases, just as higher wages may cause prices to go up. However, in the current situation, the high agreed wage increases in Denmark are clearly not the main reason for the sharp and sudden inflation in 2021-22, but rather a reaction to it.³ Rising wages thus lead to a recovery in real wages, i.e. the purchasing power that workers actually derive from their wages. Nevertheless, wage increases will likely prolong underlying inflationary pressures for some time, but without giving rise to a wage-price spiral in the main scenario for the Danish economy. However, the risk of inflation expectations deanchoring will increase the longer wage and price inflation remains high.⁴

Calculations show that wage increases spill over into consumer prices

Experience from recent decades indicates that wage increases often precede consumer price increases in Denmark, thus having a spillover effect on inflation. For example, the correlation between wage growth today and core inflation is strongest after a few quarters, see chart 4. When the correlation between the two is not at its peak within the same quarter, but instead increases afterwards, this indicates that wages are rising before core inflation. This suggests that higher wages traditionally impact Danish consumer prices with some delay. The calculations also show that the correlation between wages and service prices is stronger and more sustained than for goods, partly because service industries are often wage-intensive, making service prices more likely to react more to wage increases.

³ Based on a model calculation, the International Monetary Fund has found that approximately half of Danish wage growth in 2022 can be explained by the lagged inflation, and that the tight labour market measured by the unemployment gap has also contributed to wage increases, see Huidrom (2023).

⁴ For a more detailed discussion of what a wage-price spiral is, see *Inflation expectations are still well-anchored* in Danmarks Nationalbank (2023b).

CHART 4

Correlation analysis shows that wage growth in Denmark often rises before core inflation and is closely related to service prices

Correlation between wage growth at time t=0 and inflation at time t



Note: The chart shows unconditional lead-lag correlations between year-on-year DA wage growth and different parts of HICP inflation over the period from the 1st quarter of 2001 to the 4th quarter of 2021

Source: Macrobond and own calculations.

In addition to the simple correlation analysis, formal statistical tests also suggest that higher wages affect core inflation beyond the lagged values of core inflation itself, see chart 5. This suggests that wage increases in Denmark provide useful information to predict future changes in core inflation and service prices in particular. Conversely, the statistical test shows that price increases have not had any appreciable impact on wage increases in the period under review. This reflects, among other things, that inflation has been low for much of the period and, thus, has not had a major impact on wage demands, which probably does not hold true for the period of extraordinarily high inflation in 2022-23.

CHART 5

Statistical tests indicate that wage increases have previously caused increased inflation in Denmark

P value from Granger causality test



Wage increase cause price increase?

Note: The chart shows the p value from a Granger causality test in a VAR model with DA wage growth and different parts of the HICP index estimated over the period from the 1st quarter of 2001 to the 4th quarter of 2021. A Granger causality test shows whether lagged X values have explanatory power for Y beyond that which can be explained by the lagged Y values themselves. The null hypothesis of lack of Granger causality from X to Y is rejected if the p value is below 5 per cent.The p value is defined as the probability of obtaining a test result that is at least as extreme as the actual observed test result, if the null hypothesis is correct. A low p value is thus an indication that X has explanatory power for Y.

Source: Macrobond and own calculations.

High service inflation in Denmark is hardly due to wages already

The statistical analysis above and chart 3 with an overview of companies' wage costs across industries both suggest that high wage increases have a particular impact on service prices. Danish service prices are currently rising faster than wages due to, among other things, indirect energy effects and shifts in demand patterns following the pandemic, which have resulted in large price increases in, e.g., restaurants, hotels and travel, see chart 6. Therefore, there is no evidence that wage spillovers are a significant explanation for the strong underlying inflationary pressures at this moment. To some extent, prices are to be expected to rise faster than wages after a sudden shock to the economy, as prices are usually changed faster than wages, which often evolve gradually through annual wage reviews, job changes or collective bargaining. At the same time, the fact that wages are slow to adjust relative to prices of other production inputs combined with the high share of labour costs in services means that price increases for services are traditionally relatively persistent once they take a hold.5

⁵ For a discussion of inflation persistence in Denmark, see the chapter *Inflation is on the wane* in Danmarks Nationalbank (2023b).

CHART 6

Service prices are currently rising more sharply than wages in Denmark due to indirect energy effects and shifts in demand

Wages, core inflation and service prices in Denmark



Note: Core inflation shows the HICP excluding energy and unprocessed foods, while wages refer to the Confederation of Danish Employers' wage statistics in the DA area.

Source: Macrobond and own calculations.

03

Wages are not yet the primary driver of high core inflation

It is possible that wage increases will impact prices of certain goods and services in particular. Therefore, to get an idea of whether higher wage growth is currently affecting inflation, an indicator of wage-sensitive consumer prices, i.e. those parts of core inflation that have historically had the closest correlation with wage growth, is established, see box 1 for a more detailed description.

вох 1

How is the wage-sensitive core inflation calculated?

Wage-sensitive core inflation consists of those components of core inflation that have a significant and positive correlation with wage growth in the previous year. Specifically, wage-sensitive consumer prices have been selected by estimating a number of regression models in the period from the 1st quarter of 1997 to the 1st quarter of 2020, when the annual rate of increase in 67 subparts of the HICP index excluding energy and unprocessed foods is explained by its own lag and wage growth in the DA area the previous year. If the coefficient of the lagged wage growth is significantly positive, the consumer price in question is designated as wage sensitive, after which it is weighted together with all other wage-sensitive consumer prices in a new price index.

Overall, the selected wage-sensitive consumer prices account for almost 30 per cent of the weight of Danish core inflation and primarily include a number of service prices, including services related to sports and leisure, services related to housing and rent. Some of the prices are probably not driven solely by wages, but simply correlate with them. The calculation for the euro area is basically similar to the Danish one and uses compensation per employee as a measure of wage growth.

Wage-sensitive consumer prices are rising less than core inflation

The results show that the increase in wage-sensitive consumer prices in Denmark is smaller than core inflation as a whole, see chart 7. This suggests that wages are not yet the main driver of core inflation, although the indicator is based on historical correlations, not necessarily having a causal interpretation. In other words, price increases may also be driven by other factors besides wages. The moderate increase in wage-sensitive consumer prices reflects, among other things, the fact that Danish wage growth was still relatively subdued until the 2nd quarter of 2023.

Similar calculations of wage-sensitive consumer prices for the euro area show basically the same trends as in Denmark until mid-2023, see chart 8. The development in wage-sensitive consumer prices in both Denmark and the euro area is in contrast to the USA, where similar analyses indicate that wage-sensitive service inflation peaked in the 2nd half of 2022, before declining again throughout this year, see Council of Economic Advisors (2023). The difference is partly explained by the fact that US wage growth increased faster after the pandemic than in Denmark and the euro area.

In contrast to the wage-sensitive consumer prices, oil price-sensitive core inflation has slowed down somewhat during 2023. This suggests that indirect

energy price effects have peaked in Denmark, meaning that energy prices have fallen and are no longer causing new increases in corporate costs which are then passed on to consumers. This assessment is also supported by model calculations showing that indirect energy price effects pushed Danish core inflation up by less in the 2nd quarter of 2023 than at the turn of the year, see

CHART 7

In Denmark, the wage-sensitive components of core inflation are rising less than core inflation as a whole

Wage-sensitive core inflation in Denmark



In Denmark, the most wage-sensitive

consumer prices rose by 3.8 per cent year-on-year in July.

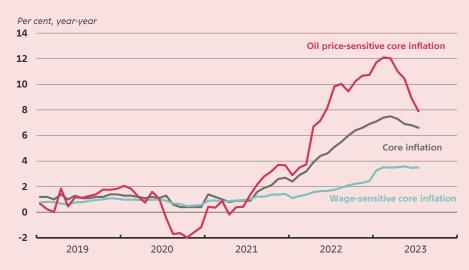
Note: See box 1 for a description of wage-sensitive core inflation. Core inflation refers to HICP excluding energy and unprocessed foods. The oil price sensitive elements of core inflation consist of the prices that are affected by oil price fluctuations, including transport and horticultural products. For a more detailed definition, see Mortensen and Staghøj (2015).

Source: Macrobond, Statistics Denmark and own calculations.

CHART 8

In the euro area, wage-sensitive consumer prices are also rising less than core inflation

Wage-sensitive core inflation in the euro area



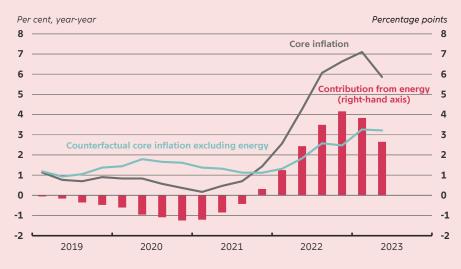
Note: See box 1 for a description of wage-sensitive core inflation. Core inflation refers to HICP excluding energy and unprocessed foods. Oil price-sensitive core inflation is based on the ECB's methodology (2014).

Source: Macrobond, ECB and own calculations.

CHART 9

Model calculation shows that indirect energy price effects are exerting a smaller upward pressure on Danish core inflation than before

Indirect contribution of energy to core inflation



Note: Core inflation is HICP inflation excluding energy and unprocessed foods measured with constant taxes. The methodology is described in box 3 in Danmarks Nationalbank (2023b).

Source: Macrobond, Eurostat and own calculations.



Core inflation was just over 3 per cent year-on-year in the 2nd quarter of 2023, excluding indirect energy price effects. 04

High wage growth will push up inflation in the coming years

To have an informed perspective of the development of Danish core inflation in the coming years, it is necessary to understand the extent and timing of the expected pass-through from higher wages to consumer prices. Therefore, in order to get an indication of the extent to which wage increases are expected to push up inflation over the projection period, two separate calculations based on a statistical model and the macroeconomic model ADAM, respectively, are performed. The two model calculations basically indicate that wage increases in Denmark affect consumer prices over time and particularly impact services. The calculations thus support Danmarks Nationalbank's expectation that Danish core inflation will remain relatively high in the coming years, despite the fact that the significant indirect price effects from energy are falling.

Statistical model calculations suggest that higher wage increases usually push up core inflation with some lag

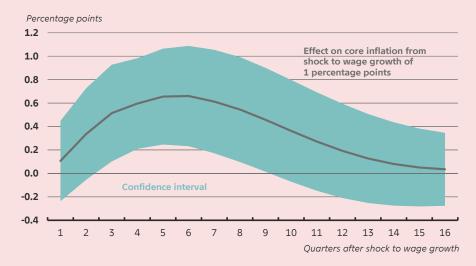
Specifically, the statistical model calculation shows, for example, that a shock to wage growth of 1 percentage point will increase core inflation in Denmark by approx. 0.6 percentage points after 1-2 years, see chart 10. The fact that the pass-through is higher than the share of wages in total corporate costs in chart 3 may reflect that wage growth is at the same time exerting demand pressures on consumer prices. In addition, the calculation also captures, to a certain extent, the effect of simultaneous foreign wage increases rather than pure Danish wage growth and indirect wage effects caused by expenses for e.g. materials purchased from subcontractors. Finally, the calculation is subject to statistical uncertainty, as illustrated by the confidence interval, which includes a relatively wide range for the most likely actual pass-through.

The estimated pass-through reflects how core inflation has historically responded to higher wage increases, and it is possible that the picture will change in future. International studies of the interaction between wages and prices indicate, for example, that the pass-through depends, among other things, on the state of the economy and thus may fluctuate over time, see box 2.

CHART 10

Statistical model calculations show that wage increases in Denmark usually push up core inflation with some lag

Effect on core inflation of shock to wage growth



wage growth of
1 percentage point
will translate into
an increase of 0.6
percentage points
in core inflation.

Statistical model shows that an

increase in Danish

Note: The effect is calculated using a structural auto-vector regression model (SVAR) estimated in the period from the 1st quarter of 2001 to the 4th quarter of 2021 with the following variables:

Danmarks Nationalbank's unemployment gap, year-on-year DA wage increase and year-on-year HICP excluding energy and unprocessed foods with constant taxes. The shock is identified using a Cholesky causal order in that order. The green area shows a 95 per cent confidence interval.

 ${\tt Source: Own \ calculations.}$

вох 2

International studies find that the pass-through from higher wages to inflation depends on the state of the economy

A number of international studies generally confirm the impression from chart 10 that higher wages typically affect inflation, although the exact pass-through varies across countries and depends, among other things, on the state of the economy. For example, according to an analysis by the European Central Bank, the ECB, rising wages are more likely to affect inflation in the euro area if the economy is driven by a demand shock rather than a supply shock, just as the pass-through is higher in periods of high inflation, see Bobeica et al. (2019). Similarly, in a group of advanced economies, BIS (2022) finds that the pass-through from wages to inflation is greater when price increases are high. There is also evidence that booms increase the pass-through from wages to prices in the euro area compared to recessions, see Hahn (2020). This may be due, among other things, to the fact that companies have greater pricing power during a boom and can thus more easily pass on wage increases to their sales prices instead of absorbing them into profit margins. In addition, an analysis from the International Monetary Fund concludes that the pass-through from wages to prices among European countries is lower when corporate earnings are already high, inflation expectations are well anchored and there is intensive competition, see Boranova et al. (2019).

The pass-through from wages to inflation is not necessarily the same across countries. Among the four largest euro area countries, for example, the ECB has found a pass-through from unit labour costs to the gross value added deflator ranging from 0.4 in Germany to around 0.7 in France, see Bobeica et al. (2019). The results for Germany are consistent with a number of different model calculations in Deutsche Bundesbank (2019), which overall indicate that German consumer prices increase by 0.3 per cent when labour costs increase by 1 per cent. The fact that the pass-through is lower than the Danish results in chart 10 reflects, among other things, that the Danish results are calculated based on core inflation, which is more wage-intensive. In Denmark, an analysis from Danmarks Nationalbank based on microdata estimates that the pass-through of wage increases to producer prices is about a third after one year, see Hviid and Renkin (2020).

In the USA, recent studies have pointed out that the pass-through from wages to core inflation has slowed in recent decades to a modest level, see Peneva and Rudd (2015). The conclusion is also supported by the empirical analysis in Bobeica et al. (2021), which shows that the US pass-through has declined since the 1990s to a level around 0.1. This may be driven by more well-anchored inflation expectations, increased trade integration and companies' increasing market power. In the euro area, by contrast, there is no indication that the pass-through from wages to inflation has slowed over the same period, remaining broadly unchanged over time at around 0.5. The spillover effect of wages on inflation potentially occurs through different channels. However, Shapiro (2023) argues that higher wage increases in the USA affect service prices in particular because they increase corporate costs (supply channel) and only to a lesser extent due to higher household incomes (demand channel).

Scenario calculation using the macroeconomic model ADAM shows that higher wage increases will add to inflation in 2023-25

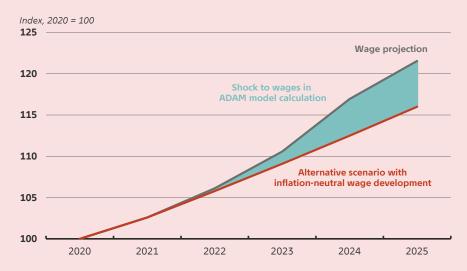
As an alternative to quantifying how consumer prices will develop after a wage shock, one could instead look into what will happen in a given wage development scenario. Such a scenario calculation is made below using the macroeconomic model ADAM and may, among other things, be used to get an indication of how much Danmarks Nationalbank's assumed wage growth, if seen in isolation, will increase Danish inflation over the projection period. In the scenario, the effect on consumer prices of a development corresponding to the difference between wage developments in Danmarks Nationalbank's projection and an alternative inflation-neutral development given by the sum of structural productivity growth of 1.1 per cent and equilibrium inflation of 2 per

⁶ There are some differences between the two methods, which means that the results are not directly comparable, but instead complement each other. Firstly, the ADAM calculation shows how inflation will develop, assuming that wages develop in a certain way. On the other hand, the statistical model (SVAR) tells us how inflation and wages will develop if wage growth increases by 1 percentage point, i.e. there are feedback effects between inflation and wages after the shock. Secondly, the statistical model (SVAR) calculates the pass-through to core inflation measured by constant taxes, which are arguably more wage-intensive than the actual inflation used in the ADAM calculation. The shocks to wages are also not identical. Thirdly, in the ADAM calculation, foreign wages are unchanged, while it is possible that the statistical model (SVAR) to some extent also captures simultaneous foreign wage increases rather than only Danish wage growth.

CHART 11

cent is calculated, see chart 11.⁷ The scenario thus captures the extent of the additional inflation that occurs when Danish wages rise more than what is compatible with consumer price increases of 2 per cent over time.

Wages in Danmarks Nationalbank's projection will rise more than in an alternative scenario consistent with inflation of 2 per cent over time



Note: The chart shows industrial wages. *Inflation-neutral wage developments* correspond to annual structural productivity growth of 1.1 per cent and inflation of 2 per cent.

Source: Own calculations based on the macroeconomic model ADAM.

The results show that high wage increases that follow the developments described above increase Danish inflation as measured by the CPI consumer price index by 0.3 percentage points in 2023, rising to 0.7 percentage points in 2024, after which the effect will gradually decline in 2025, see chart 12. If realised productivity growth was to be lower than projected in the scenario, this would lead to a stronger wage pass-through to prices and vice versa.

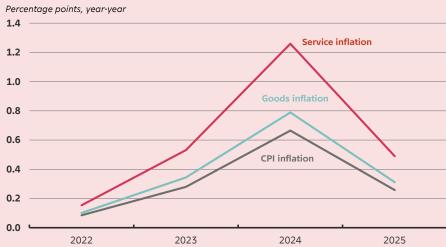
There is considerable variation in the results across different parts of consumer prices. For example, the calculation points to wage growth increasing service inflation by 1.3 percentage points in 2024, which is somewhat more than the effect on both inflation as a whole and the prices of goods. The greater impact on service prices is due, among other things, to the fact that services are relatively wage-intensive, and wage increases therefore affect their production costs and selling prices more than in other industries. In addition, the increase in headline inflation is curbed by the fact that a number of consumer prices such as car consumption, petrol and oil only react to a limited extent to wage increases in Denmark.

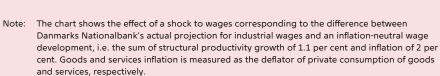
 $^{^7}$ The assumed productivity growth in the scenario is roughly in line with the assumption in the Danish Government's convergence programme, see the Danish Government (2023).

CHART 12

ADAM model calculation suggests that wages are pushing up inflation – especially in wage-intensive industries such as services

Effect on inflation of shock to wages





Source: Own calculations based on the macroeconomic model ADAM.



The ADAM model calculation indicates that wage increases will lead to a 1.3 percentage point rise in service inflation in 2024.

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Working Papers present research work by both Danmarks Nationalbank's employees and our partners. Working Papers are primarily targeted at professionals and people with an interest in central banking research as well as economics and finance in a broader sense.

The analysis consists of a Danish and an English version. In case of doubt regarding the correctness of the translation the Danish version is considered to be binding.

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