STAFF MEMO

Price spillovers in Norway: Less prevalent after the 1980s

NO. 12 | 2023

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NORGES BANK

ISSN 1504-2596 (online)
ISBN 978-82-8379-278-2 (online)

Price spillovers in Norway: Less prevalent after the 1980s*

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June 2023

Abstract

This Staff Memo considers some of the available evidence on relative price shocks as a driver of Norwegian inflation dynamics in high- versus low-inflation regimes. The results suggest that relative price shocks have largely been transient over the past two-three decades. However, this has been a period of low and stable inflation. Evidence from the 1980s suggest that relative price shocks had greater passthrough to other prices, and thus core inflation, in a high inflation regime.

Keywords: Inflation, relative prices

*The views and conclusions expressed in this publication are those of the author and are not necessarily shared by Norges Bank. They should therefore not be reported as representing the views of Norges Bank. The author would like to thank Ørjan Robstad, Francesco Furlanetto, Inga Nielsen Friis, Per Espen Lilleås, Ole Christian Bech Moen and participants at seminars in Norges Bank for useful inputs and comments. The author is responsible for any errors and omissions.

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1 Introduction

As in many other countries, Norway has recently experienced a surge in inflation. Much of the existing empirical understanding of Norwegian inflation dynamics builds on decades of low and stable inflation. Whilst there are many important reasons for this, such as the adoption of inflation targeting and the improved quality of data, it can make our understanding of inflation more uncertain when it is high. This Staff Memo focuses on historical evidence of Norwegian sector-specific price dynamics in high- versus low-inflation regimes. Specifically, it considers whether there is evidence suggesting that the importance of relative price shocks has been greater when inflation is high.[1]

In this Memo, relative price shocks are understood as idiosyncratic disturbances in the prices of individual subgroups of the consumer price index (CPI). An example is a change in electricity prices that is unrelated to changes in other prices. Such a shock can "spill over" to other prices in the economy by raising costs in other sectors, in turn potentially trigger price increases on other goods and services. However, relative price shocks need not necessarily spread to other prices through such a cost channel. They could also trigger more widespread price increases through, for example, a wage channel, or a broader expectations channel among both businesses and consumers.

Underlying this analysis is the idea that passthrough dynamics could be different in a high- versus low-inflation environment. This belief is, for example, in line with rational inattention. Rational inattention refers to the idea that agents' information processing is capacity constrained (Sims, 2003). Agents acting on limited information basis will tend to have weaker response patterns compared to a full-information agent. However, this response will crucially depend on the surrounding economic environment.[2] For example, when inflation is low and stable, it can be rational for economic agents to largely treat price fluctuations as transient. In contrast, when the volatility and level of inflation rises, evidence suggests that expectations tend to become less rigid.[3] This could contribute to relative price shocks having higher rates of passthrough to other price indices in a high-inflation environment.

We apply the methodology used in Borio et al. (2021) to estimate the pass-through of relative price shocks in two periods: one with low and one with high inflation. Adapting this method to Norwegian data, we find that relative price shocks on average had a larger passthrough to other prices during the high inflation of the 1980s, compared with during the low inflation of the 1990s and 2000s. It is difficult to directly apply this result to the more recent rise in inflation. There is not yet enough aggregate data from this period to reach a robust conclusion. Furthermore, there are structural differences between the economy in 1980s and the 2020s, making direct comparison fraught. However, the exercise helps illustrate some potential risks attached to persistent price growth.

[1] This Staff Memo also serves as documentation of the methodology behind some of the empirical results discussed in the box on price dynamics in Norges Bank's *Monetary Policy Report 4/22*, Norges Bank (2022)

[2] See, for example, Mackowiak et al., 2023

[3] For example, consider (Coibion and Gorodnichenko, 2015)

1.1 Background

There are two important differences between inflation in the 1970s and 80s compared with the 1990s and 2000s: inflation was (1) higher and (2) more volatile. Figure 1 illustrates this first point. It shows the evolution of Norwegian headline inflation since 1980.[4] High inflation in the 1980s was a continuation of high price growth in the 1970s. However, we only consider the 1980s onwards due to the poor availability of more disaggregate price data before 1979.

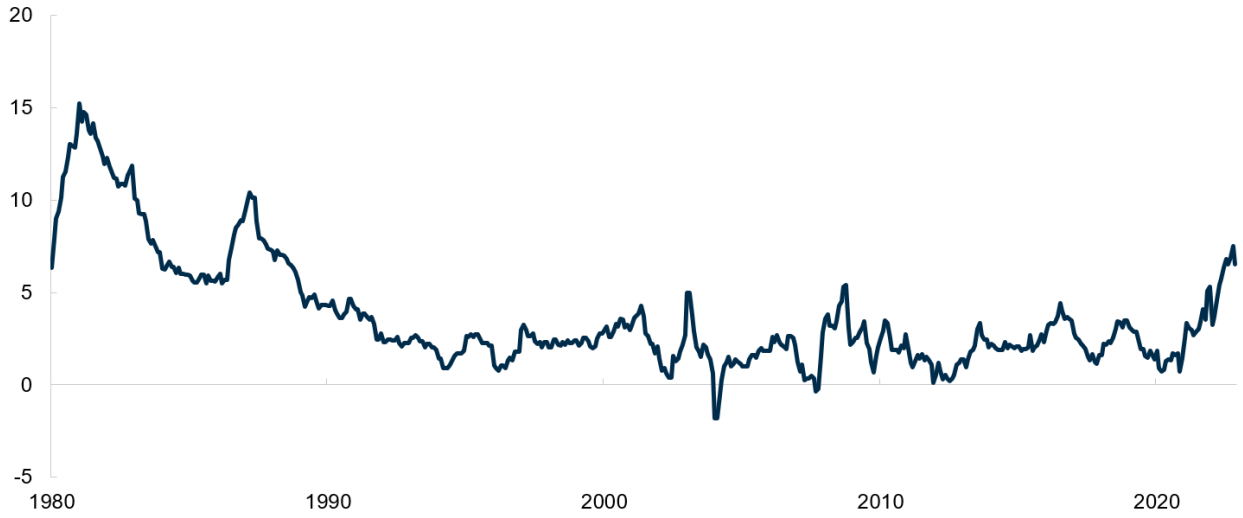

Figure 1: Headline inflation. Twelve-month growth. 1980-2022.[5]

Average inflation in the 1980s was above 8 percent, see table 1. The subsequent decades have had much lower inflation, consistently averaging between 2 and 3 percent. The same trend is evident from an estimated consumer price index adjusted for tax changes and excluding energy products (CPI-ATE),[6] showing a decline from 8,3 percent average core inflation in the 1980s to just above 2 percent in the 1990s, 2000s and 2010s.

In addition to high inflation levels, price growth in the 1980s was characterized by significantly higher volatility. As inflation declined, there was a notable decline in the volatility of price growth. Table 1 compares the standard deviation of inflation in each decade, showing a sharp decline in the 1990s, especially for CPI-ATE.

We also observe that the average correlation between subgroups of CPI[7] similarly declined after the 1980s, see table 1. The decline in observed correlation across sub-components can be caused by several different factors. For example, if prices across different sectors are no longer being driven by

[4]Note that, unless otherwise stated, all data on aggregate and subgroup price indices are retrieved from Statistics Norway

[5]Source: Statistics Norway

[6]Data on the CPI-ATE is published by Statistics Norway from 2002 onwards. Prior to this, an estimated CPI-ATE series is used.

[7]The calculation is based on 51 subgroups of CPI with full data back to 1980, see Statistics Norway

common, underlying shocks, correlation will appear to decrease. Lower spillover from one relative price shock to other prices could similarly decrease correlation between subindices, as they would tend to co-move less. Below, we attempt to shed light on how these relative price shocks appear to have passed through more to core inflation when inflation has been high.

	Headline CPI		CPI-ATE		Correlation
	Average	Std. dev.	Average	Std. dev.	
1980-1989	8.34	2.92	8.29	2.72	0.35
1990-1999	2.45	0.87	2.13	0.76	0.07
2000-2009	2.09	1.31	1.71	0.88	0.08
2010-2019	2.11	0.88	1.86	0.75	0.07

Table 1: Descriptive statistics by decade. Twelve-month consumer price growth.[8]

2 Methodology

The analysis follows the methodology in Borio et al. (2021) to compare the importance of relative price shocks in a high-inflation period with a period of lower and more stable inflation. The method has two steps: first, we estimate a time series of idiosyncratic price shocks for each subgroup of CPI that has sufficient historical data.[9] Secondly, we use these shocks to estimate their passthrough to headline inflation twelve months ahead.

To estimate relative price shocks, we separately estimate a regression of monthly price growth in each subgroup on a measure of the common driver of inflation, as showed in equation 1.

$$\Delta p_{i,t} = \alpha_i + \lambda_i PC_t + \epsilon_{i,t} \tag{1}$$

$$\lambda_i PC_t = \lambda_{1i} PC1_t + \lambda_{2i} PC2_t + \lambda_{3i} PC3_t \tag{2}$$

The common driver of inflation, PC_t, consists of the first three principal components estimated across all included sub-indices of the CPI,[10] see equation 2. We diverge from Borio et al. (2021) by using the first three principal components, rather than only the first. This appears to be more suited to Norwegian data, capturing different drivers of inflation, such as imported inflation. Given the regression in equation 1, an estimated series of idiosyncratic price changes for each sub-component i is given by the residual $\hat{\epsilon}_{i,t}$.

[8] "Correlation" reports the average correlation between all unique two-way combinations of sub-indices separately for each decade

[9] This includes 51 subgroups, accounting for approximately 60-80 percent of inflation movements at all points in time between 1979 and 2019

[10] Notice that we use sub-indices from the full consumer price index, but below only consider passthrough to total core inflation, see equation 3.

Notice that sector-specific price changes could conceivably affect the principal component, potentially causing endogeneity issues. However, in identifying the idiosyncratic price changes, we assume that any effects from a relative price shock on aggregate price movements occur with a lag of at least one month. If sector-shocks affect the principal component more instantaneously, this method could be underestimating the size of the sector-specific price changes.

In estimating the passthrough of sector-specific price changes to core inflation, we are most interested in relative price shocks that are large and positive, as they are most likely to pass through to other prices.[11] Thus, given a time series of idiosyncratic price changes for each sub-component, we exclude all negative monthly estimated price changes. A large price change is defined as being greater than one standard deviation above the mean of the preceding 12-month period. We call this the series of large positive relative price shocks, $\sigma_{i,t}$.

Given $\sigma_{i,t}$ for all consumption groups i, we divide the sample into two distinct periods: a high-inflation period and a low-inflation period. For each sample, we separately estimate the passthrough of large, positive relative price shocks on core inflation 12 months ahead, using the regression in equation 3.

$$\pi_{t+12} = \mu + \beta_i \sigma_{i,t} + X_t + v_t \tag{3}$$

$$X_t = \gamma(u_t - u_t^*) + \sum_{s=0}^{11} \rho_s \pi_{t-s}^{1m} + \eta r_t + \delta \Delta x_t^{12m} \tag{4}$$

To approximate the causal link from relative price shocks to core inflation, we control for some of the main drivers of inflation, see equation 4. As in Borio et al. (2021), controls for previous monthly changes in inflation and an estimated unemployment gap are included. Additionally, we include controls for the interest rate[12] r_t and twelve-month change in the nominal exchange rate[13] Δx_t^{12m}. Controlling for the exchange rate is especially important for a small open economy such as Norway, where imported inflation is an important source of fluctuations in price growth.

Our high inflation period is defined as 1980-1992. The start date is constrained by the fact that price indices per subgroup of inflation from Statistics Norway is only available from 1979. The low-inflation period spans from 1993 to 2019. We end the sample in 2019 to avoid possible complications from the pandemic and the subsequent rise in inflation. There are 51 consumption groups of the CPI included, pertaining to the groups that have complete available price indices from 1979 through 2019.

[11] In line with Borio et al. (2021).
[12] Given by the 3-month NIBOR
[13] Given by the import-weighted krone exchange rate, I-44.

3 Results

For each inflation regime, we estimate $\hat{\beta}_i$ for all included consumption groups i. We interpret this as a passthrough coefficient of relative price shocks. As in Borio et al. (2021), we compare the distribution of these passthrough coefficients across each regime. A higher passthrough coefficient indicates that price spillover tended to be greater in this period. Figure 2 compares the distribution of estimated passthrough coefficients in the two time periods, excluding outliers. The box indicates the 25th and 75th percentiles of the distributions. The horizontal lines across the centre and the cross marks indicate the median and mean coefficient, respectively.

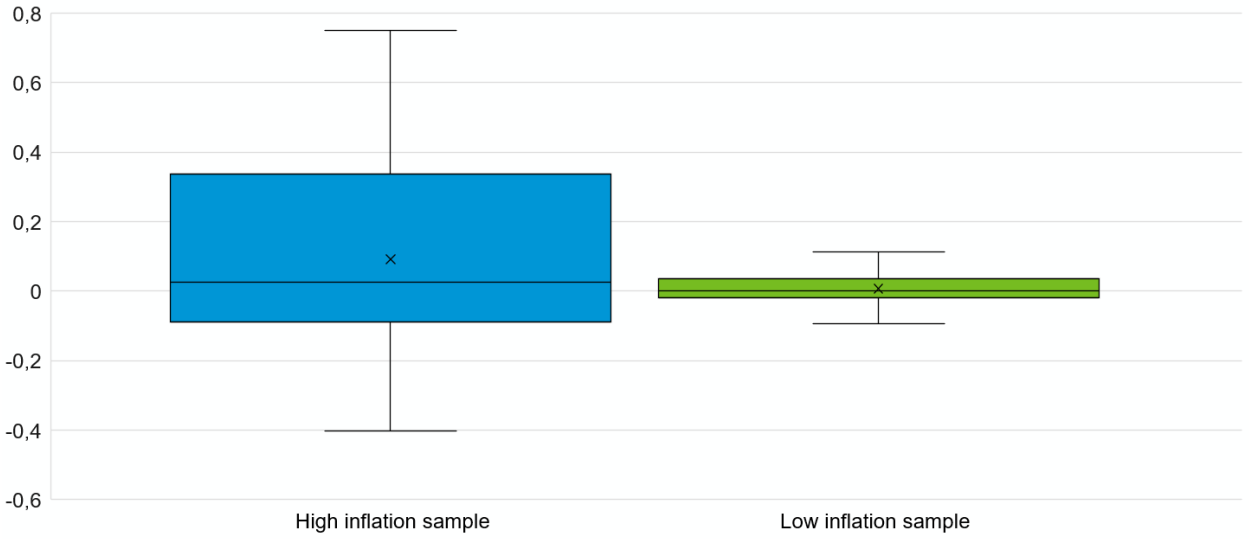

Figure 2: Distribution of estimated passthrough coefficients for each sample period

There are two main features to note: (1) the spread of passthrough coefficients is much larger in the high-inflation sample, and (2) the average passthrough is higher in the first sample. This suggests that relative price shocks tended to pass through more to future core inflation in the 1980s than during the 1990s and 2000s. In addition to average passthrough being higher, the spread also indicates higher variability of this spillover.

The average passthrough is given in table 2, specification (1). In the high-inflation sample average passthrough was approximately 0.09. This indicates that an average of ca. 9 percent of relative price shocks passed through to core inflation twelve months later. As shown by the P-value, the mean coefficient is significantly different from zero at the 5 percentage level.

Meanwhile, the mean coefficient for the low-inflation regime is just under 0.01, and not statistically different from zero. A test of the difference in mean across the two samples indicates that the means are statistically different from each other at a 10 percent significance level.

	(1)		(2)		(3)	
	Mean coeff.	P-value	Mean coeff.	P-value	Mean coeff.	P-value
High-inflation regime	0.092**	0.049	0.092**	0.049		
Low-inflation regime	0.007	0.236	-0.014	0.198		
1980-1999					0.085**	0.015
2000-2019					0.000	0.997
Difference in mean	0.084*	0.072	0.106**	0.028	0.085**	0.019

Significance levels: (*) 10 percent, (**) 5 percent, (***) 1 percent

Table 2: Average estimated passthrough coefficients[14]

In the above benchmark case, the sample split is motivated by producing samples with largely homogeneous inflation trends. However, this division results in a substantial sample size difference. The low-inflation sample is approximately double the size of the high-inflation sample.

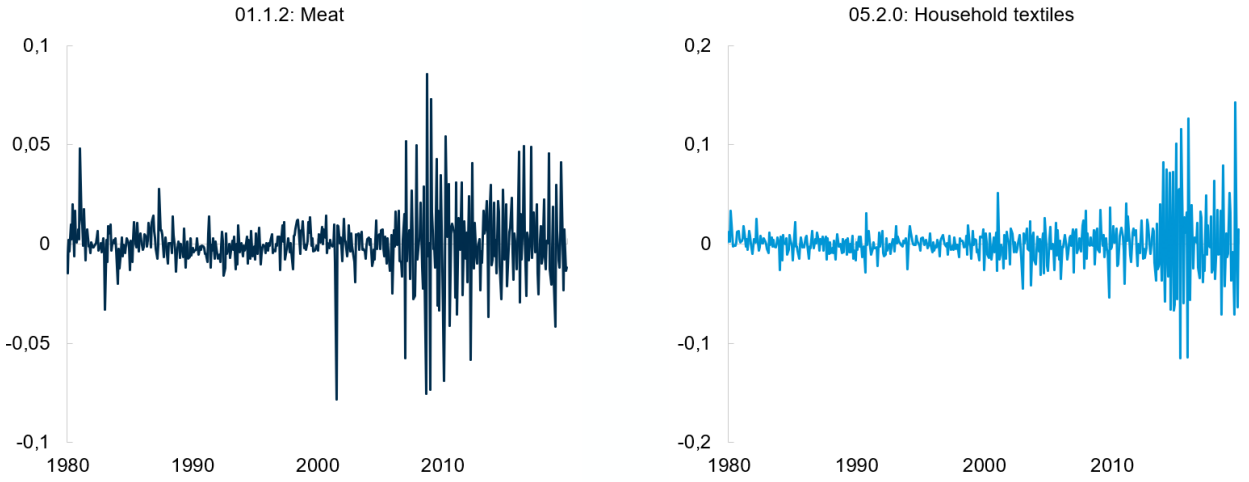

Figure 3: Examples of estimated relative price shock series. Monthly growth. Percent.

There are two ways of remedying this problem. Firstly, we can reduce the sample size of the low-inflation period. There are some good reasons for doing this, as discussed below. Secondly, given that we are constrained to starting in 1980, when data on sub-indices are available, we can split the full sample more evenly, breaking in 2000. In this case, the sample split does not capture high versus low inflation periods. However, it does align with other important shifts, discussed below.

We firstly consider the possibility of reducing the size of our second sample, by comparing the high-inflation period with a low-inflation period spanning January 1993 to December 2006. Now,

[14]P-value reported for one-sample t-test for both regimes' average coefficient, with null hypothesis that average coefficient is zero. P-value for difference in mean is reported for a two-sample t-test with null that the two averages come from populations with different means.

the low-inflation sample is closer in size to the high-inflation sample. The drawback is that we no longer utilize the most recent data.

A benefit with checking our benchmark results with this shorter second sample is that it helps resolve issues with the underlying data. A meaningful portion of the price subindices we use appear to have a break in the volatility of data in the mid-2000s or early 2010s, see two examples in figure 3. This difference likely arises from innovations to the collection and reporting of price data over this period. The change is potentially concerning, as it makes comparing price indices from four decades ago with the 2000s nontrivial.

It is thus important to check whether results are being conflated by these changes in the data by considering results with a shorter low-inflation period. Below, we do so with a low-inflation sample spanning from January 1993 only to December 2006.[15] Results are reported in specification (2) in table 2 and shown in figure 4.

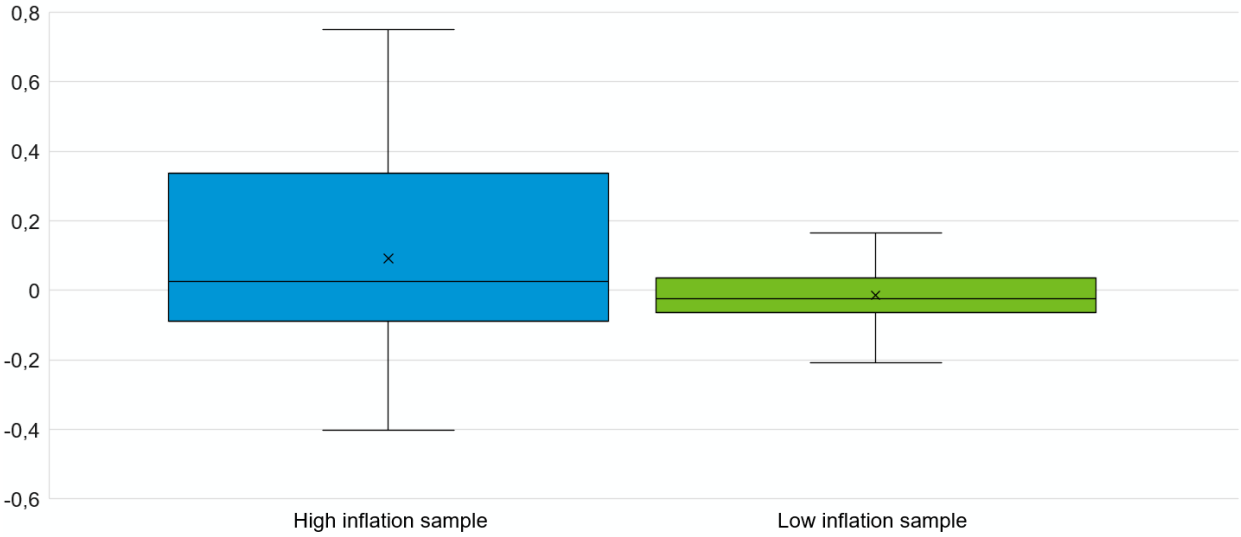

Figure 4: Distribution of estimated passthrough coefficients. Shorter low inflation sample.

Given that the sample is the same, the distribution of the high-inflation coefficients is unchanged. The low-inflation sample now has a lower average passthrough coefficient, see table 2. As with the full sample, the average coefficient is not statistically different from zero. The spread of the estimated coefficients has increased slightly. This is unsurprising given the smaller sample size.

As in the benchmark, a two-sample t-test rejects the hypothesis that the samples come from populations with the same mean, see table 2. That is, the means remain statistically different from each other. Hence, reducing the second sample to a period with more comparable data does not meaningfully change our finding that relative price passthrough appears to have declined after the 1980s.

[15] Cut-off date chosen based on when there is a break in the estimated principal components

A second alternative for balancing the samples is to change the sample break date from December 1992 to December 1999. This balances the size of the samples. Repeating the exercise above with these new samples produces the distribution of estimated passthrough coefficients illustrated in figure 5.

As reported in the third specification in table 2, the average passthrough of the earlier sample is somewhat lower than in the previous two specifications but remains significantly different from zero. The average passthrough coefficient of the second sample remains statistically indistinguishable from zero, and the difference between the two means is significant at the 5 percent level.

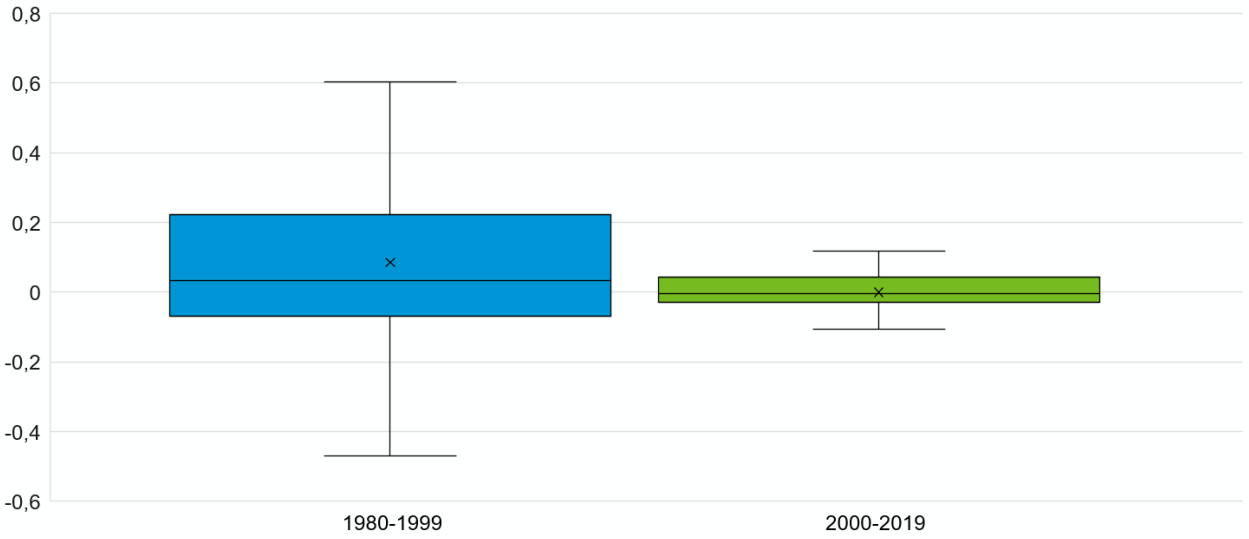

Figure 5: Distribution of estimated passthrough coefficients. Alternative sample-break.

A concern with this sample split is that the first sample is no longer strictly a high-inflation period. It now also covers the entire 1990s, which had very low and stable inflation after 1992, see table 1. Despite having less homogeneous inflation trends, the break point could make sense to study for other reasons. For example, Norges Bank formally began targeting inflation in 2001, meaning most of the latter sample is within a single monetary policy regime. Secondly, other important secular trends, such as globalization, are regarded as becoming more important from the 2000s onwards. This check underscores that there could be different drivers of the observed decline in relative shock passthrough, not exclusively related to the high-inflation environment. For example, monetary policy credibility could plausibly play an important role, as could greater global competition.

It is difficult to directly draw on this analysis to understand if inflation dynamics are returning to a higher passthrough environment. Most importantly, there are yet too few observations of this higher inflation period to analyse. However, we can use the method for estimating relative price shocks to consider how they have evolved from 2020 to today, see figure 6.[16] The share of subindices

[16]Due to the break in some of the price index series described above, it is not possible to construct a perfectly comparable share back to the 1980s.

experiencing substantial price increases began rising around the middle of 2021. Though there have been fluctuations in this share over the last decade, during the last year it reached its highest level in this period. Though this does not tell us whether inflation dynamics have changed, a large increase in the number of relative price shocks could indicate that there is more uncertainty about how persistent heightened inflation will be.

Figure 6: Share of CPI subindices with substantial price increases. Twelve-month moving average. Percent. January 2009 - December 2022.

4 Conclusion

This exercise finds evidence that relative price shocks have largely been transient when inflation has been low and stable. That is, they have had limited effects on the core inflation rate twelve months ahead. Meanwhile, evidence from the 1980s suggests that these relative price shocks have tended to spill over more to core inflation in a high inflation regime, causing both higher and more persistent price growth. The evidence is in line with Borio et al. (2021)'s analogous exercise for the US.

The study is intentionally simple and of limited scope. The analysis is not in structural form and does not show causality, nor does it posit which channel the passthrough of relative prices occurs through. However, it draws on the dynamics observed in a high-inflation period to help illustrate that empirical relations based on the 1990s and 2000s could be missing out on crucial shifts occurring only once inflation is high and contributes to making price growth more persistent. It is also in line with the idea of self-reinforcing inflation, which has recently been discussed by the likes of the ECB as an upside risk of ongoing inflation developments.[17]

[17] See, for example, European Central Bank meeting minutes 7-8 September 2022.

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