Proposal for NBER Conference on Inflation: Frontiers of Research and Policy

Relative Prices and Inflation. Evidence from Micro Data of Consumer Prices in Norway 1975–2023

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Do changes in relative prices cause inflation? According to basic economic theory with flexible prices, there should be no such link, as relative prices are determined by sector-specific factors that are orthogonal to the determination of the aggregate price level. In the words of Friedman (1975): "*Why should the average level of prices be affected significantly by changes in the price of some things relative to others?*" Yet, theory suggests several reasons why such links may arise. Ball and Mankiw (1995) showed that if there are fixed (menu) costs of nominal price adjustments, implying that firms adjust prices to large shocks and not to small, aggregate inflation will increase if the distribution of price changes is skewed to the right. Greater skewness in price changes means greater movements in relative prices. With sectoral producer price data, they also show suggestive evidence that periods of higher skewness are associated with higher inflation. Since then, several papers have shown that relative price changes may affect aggregate inflation if price stickiness is heterogeneous across sectors (e.g. Aoki, 2001; Benigno, 2004). Afrouzi, Bhattarai and Wu (2024) show that the effect of relative price changes may be amplified if there are both production linkages and heterogeneous price stickiness. Specifically, they show how higher prices on energy and other raw materials may lead to higher aggregate inflation via higher input costs to downstream sectors with greater price stickiness.

The relationship between inflation and relative prices is also central in New Keynesian theory, in particular for the welfare costs of inflation (Woodford 2003; Nakamura et al 2018). There, inflation is costly because it causes relative price changes when prices are sticky. Luo and Villar (2020) shows that in menu cost models predict that the price change distribution will be skewed left when inflation is high. Thus, in menu cost models the distribution of price changes may be skewed both ways depending on the type of shocks.

We explore the link between relative price changes and inflation using a unique micro data set of consumer prices for Norway for the period 1975–2023. During the 1970s and 1980s inflation was high and volatile with an average inflation of 8.2 percent and standard deviation of 2.7 percent. Inflation peaked at around 15 percent in 1980. From the 1990s inflation

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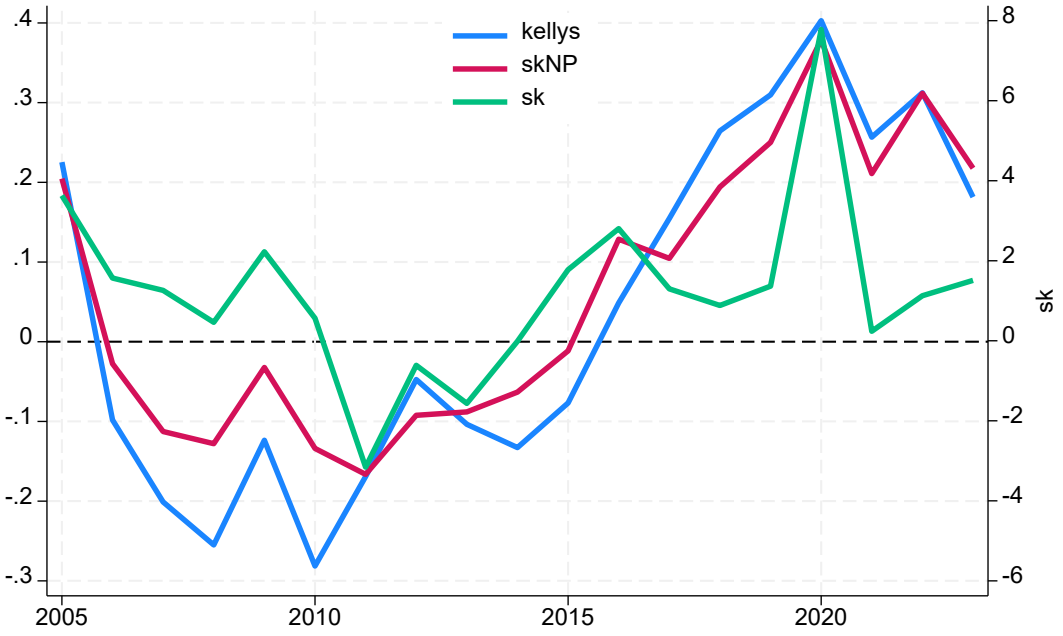
stabilized around an average of 2.2 percent with a standard deviation of 1.1 percent for three decades. Then, in 2021–2023 inflation increased as in other countries and peaked at 7.5 percent in 2022. On average inflation was 4.9 percent during this period with a standard deviation of 1.5 percent.

As a background, Wulfsberg (2016) documents the frequency and size of price changes for the period from 1975—2004, which are reported in the first two columns of the table below. The first column covers the high inflation period 1975—1989 and the second low inflation period 1990—2004. The two columns to the right show preliminary statistics for the low inflation period 2005—2020 and the post pandemic high inflation period 2021—2023. The frequencies and sizes of price changes are not constant over time.

	1975–1989	1990–2004	2005–2020	2021–2023
Frequency of price increases	12.8	8.3	6.2	8.9
Frequency of price decreases	3.5	4.5	4.8	7.2
Frequency of price changes	15.6	12.8	11.5	15.8
Size of price increases	7.6	9.9	16.4	18.7
Size of price decreases	–7.8	–10.2	–14.9	–17.2

We calculate different measures of skewness used in the literature and explore to what extent these measures can contribute to explain the post pandemic surge in inflation. For asymmetric distributions the mean and the median (and the mode) differ. The difference between the mean and the median of the distribution of price changes (the nonparametric median skew) is well suited to explore the effect of skewness on CPI inflation, as it is directly linked to the mean growth of consumer prices. It is also linear and has the same scale which helps interpretation. Other common measures, such as the third order moment skewness (Pearson, 1895) is highly sensitive to large price changes which are quite frequent in the data. Quantile based measures (Bowley, 1901) like the popular Kelly skewness, disregard the tails of the price change distribution and is thus robust to large price changes. However, large price changes are an important empirical part of price change distributions so important information on skewness may be lost by the Kelly skewness. Lastly, a fourth measure of skewness is to compare the mass of the upper tail of the distribution to the corresponding lower tail (Ball and Mankiw), e.g. beyond the first and third quartiles or the extreme deciles. This is also based on quantiles but compare the mass of the tails instead of omitting them.

The preliminary figure below shows that the nonparametric skew (skNP), the moment skewness coefficient, and the Kelly skewness of price changes for the period 2005–2023. The nonparametric skew and Kelly skewness are mostly negative from 2006 until 2015 and then positive peaking in 2020 (left hand scale). The moment coefficient of skewness is usually positive except for 2011–13 and spikes in 2020 (right hand scale). It is more volatile than the nonparametric skew and Kelly skewness. The Kelly skewness is highly correlated with the nonparametric skew. How does this compare to the skewness in the price change distribution during the great inflation period in the 1970s and 1980s?

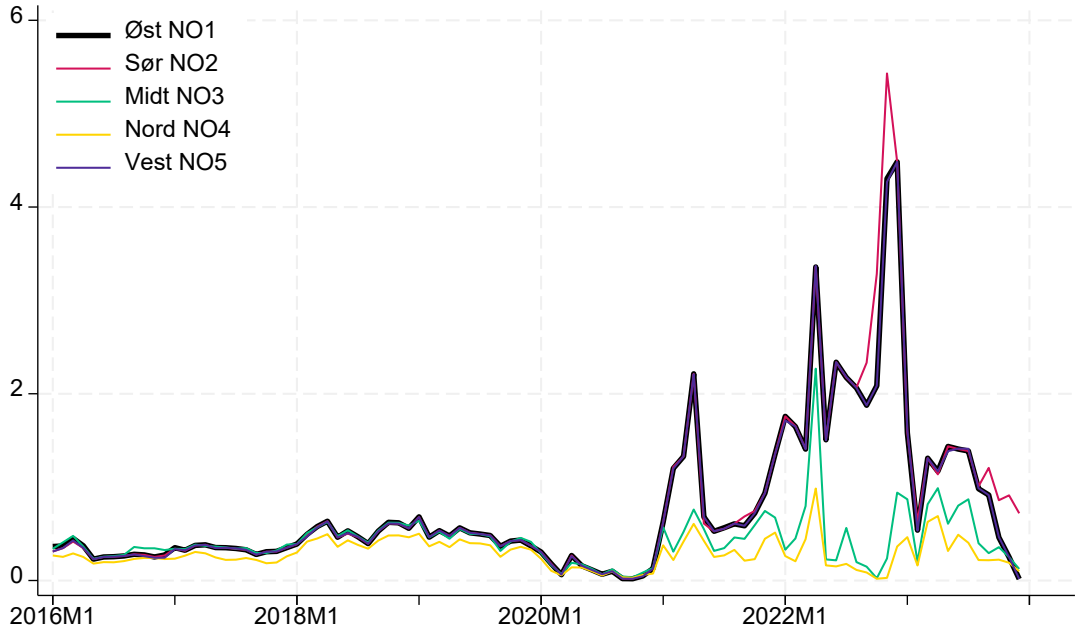


We decompose the skewness of the price change distribution into the mean price change above and below the weighted median. This decomposition will distinguish between skewness arising from high price growth for some goods, or few goods with especially low or large negative price changes.

Furthermore, the skewness of price changes may be due to both skewness in the frequency and in the size of price changes. The linearity of the nonparametric skew allows us to easily decompose the skewness into frequencies and sizes of price changes to investigate at what margin the skewness of price changes arise.

We also exploit divergent prices of electricity in 2021–2023 to compare differences in price changes between regions for the same products. Electricity is an important input in retail. The price of electricity in Norway is divided into 5 regions, see chart of price per kWh in NOK below. Due to the energy crises in Europe before and after Russia's invasion of Ukraine, electricity prices soared in the southern part of Norway (NO1, NO2, and NO5) as these

regions are connected to Europe while NO3 and NO4 is less connected to the south. We investigate if these regional differences led to systematic variation in skewness of price changes between regions.



We also explore to what extent higher price growth for goods that also are important input in the production of other goods, like energy, may contribute to explaining changes in inflation over the sample period.

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