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Alternative Measures of Price Inflation and the Perception of Real Income in Germany

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Abstract

Since the 1980s inflationary pressures seem to materialize overproportionately outside of the sectors of consumer goods and services. We combine the Harmonized Index of Consumer Prices with indices for asset prices, such as stocks and real estate, as well as the costs of public goods to develop alternative inflation measures in Germany since the introduction of the euro. Real economic growth as well as median wage developments are reexamined in light of the alternative inflation estimates. Both turn out to be negative over the past decade in the most pessimistic scenarios.

JEL-Codes: E310, E520, E580, O110.

Keywords: inflation, harmonized index of consumer prices, hidden inflation, assets prices, costs of public goods, inflation targeting, monetary policy, real wages, real economic growth, Germany.

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1. Introduction

It is a well-established position in modern macroeconomics that monetary policy's most important contribution to economic growth and prosperity is price stability (Bernanke & Mishkin, 1997; Fischer, 1996a, 1996b; Issing, 2000, 2003; Schwartz, 1995). Therefore, it has become the primary mandate of many central banks around the world to keep consumer price inflation low. In an attempt to operationalize this mandate, the European Central Bank (ECB) has adopted a quantitative definition of price stability in 1998 as "a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%." In 2003, the governing council of the ECB formulated this objective more precisely as maintaining consumer price inflation rates of "below, but close to, 2% over the medium term."²

Hence, the European System of Central Banks is a consumer price inflation targeting institution (Issing, 2004). The rationale for this target is based on the assumption that the consumer price index calculated by Eurostat accurately reflects the overall loss of purchasing power exerted by changes in the monetary base. It implicitly assumes that the transmission mechanism of monetary policy has remained stable and that consumer prices reliably respond to changes in monetary policy. However, this assumption has been challenged by empirical evidence (Andersson, 2011; Bruggeman, Camba-Méndez, Fischer, & Sousa, 2005).

One important indicator for a change in the transmission mechanism is the spread between consumer and asset price inflation that has occurred in developed countries since the 1980s. After the period of stagflation in the 1970s, consumer price inflation returned to a moderate and stable level, while asset prices rose quickly with strong pro-cyclical fluctuations along with gradually declining interest rates. Contrary to Alchian & Klein (1973), Goodhart (2001) and Cecchetti et al.

² See <https://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html>.

(2002), this has not been accepted as an argument for incorporating asset price inflation as part of the target variable of monetary policy, because *inter alia* it would render monetary policy unstable (Bernanke & Gertler, 1999, 2001). The focus continues to lie entirely on consumer prices which, at least over recent decades, are particularly rigid and hardly react to monetary policy shocks in the short to medium run (Andersson, 2011; Gerlach, 2004; Neumann & Greiber, 2004). This has allowed monetary policy authorities to pursue other goals such as financial stability (Smets, 2014) and business cycle stabilization without exceeding the policy target of 2% consumer price inflation (Stark, Mayer and Schnabl 2020) .

Moreover, Feldstein (2017) holds that inflation is still overestimated because quality improvements have not yet sufficiently been taken into account. In contrast, changes in the methods of calculating inflation concerning quality adjustments and substitution effects that were motivated by the findings of the Boskin commission (Boskin, Dulberger, Gordon, Griliches, & Jorgenson, 1996, 1997, 1998) and others (Hoffmann, 1998) have been argued to cause an understatement of price inflation and an overstatement of real economic growth in recent decades (Williams, 2013). In contrast, Komlos (2018) argues that there are unaccounted quality deteriorations of considerable proportion for example in publicly provided goods such as health care that are not accounted for in official inflation measurements. Tödter and Ziebarth (2020) highlight the underappreciated intertemporal aspect of inflation and measurement suggest that prices for future goods, such as stocks and real estate, have overproportionately increased.

The purpose of this paper is to take aspects of possibly hidden price inflation into account and to develop alternative measures of inflation using data for Germany from 1999 to the present.

2. Monetary expansion, measured consumer price inflation and inflation perceptions in the euro area

While being linked along many dimensions, the monetary and real spheres of the economy have parted ways in some important respects (Demirgüç-Kunt, Feyen, & Levine, 2012; Jayadev, Mason, & Schröde, 2018; Lazonick, 2014; Levine, 2005). As shown in Figure 1, monetary aggregates in the euro area, from M0 to M3, have increased much faster than real economic output (GDP) and consumer prices (HICP).

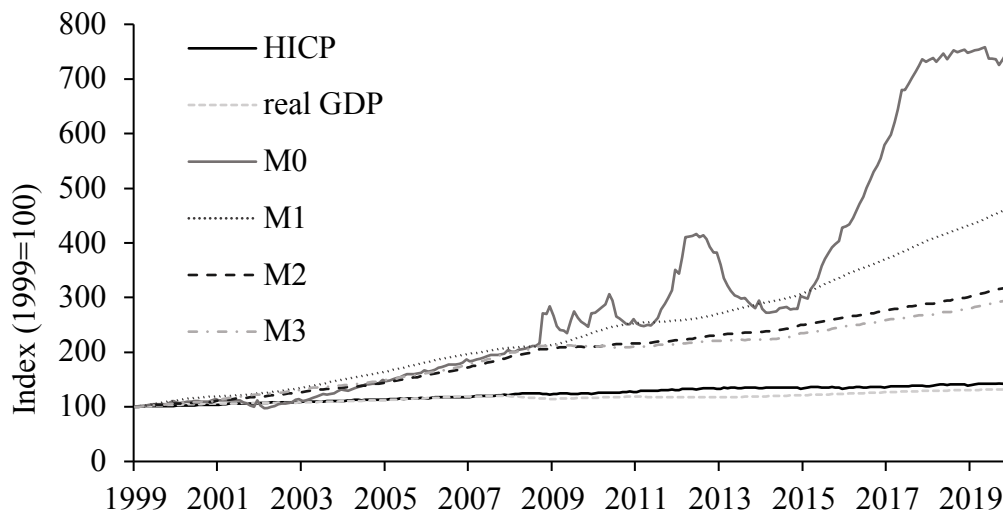


Figure 1: Monetary aggregates, real output and harmonized consumer prices in the euro area since 1999.
[Sources: ECB, IMF.]

The monetary base M0 of the euro area is under direct control of the ECB and its affiliated national central banks. It has increased by a factor of 7.4 from €426.6 bn. in February 1999 to €3,160.5 bn. in January 2020, that is, by an average annual rate of about 10.0%. The evolution of the monetary base exhibits relatively strong fluctuations when compared to the broader monetary aggregates. This indicates that monetary policy, through its management of M0, has stabilized the growth path of the broader monetary aggregates, for instance by preventing bank-credit deflation

and debt contraction that would have occurred during financial and economic crises (Bagus, 2015; Fisher, 1933). M1 is of particular interest. It consists of demand deposits as well as physical coins and notes in circulation, that is, *money* according to common understanding. According to Fisher (1935), it is the relevant monetary aggregate when analyzing the phenomena of price inflation and deflation. Since 1999, M1 has increased by an average annual growth rate of about 8.1%. M2 and M3 have increased by an annual average growth rate of about 5.8% and 5.4%

In contrast, the harmonized index of consumer prices has increased by an average annual growth rate of merely 1.7%. Real GDP of the euro area increased by about 1.6% annually. Assuming that the quantity equation provides a guideline for the inflation effects of monetary policy making one can calculate an explanatory gap by subtracting the average growth rates of the HICP and real GDP from the average growth rate of M1. The average explanatory gap in this case is 4.8 percentage points (Israel, 2020). Figure 2 shows the so calculated explanatory gaps for every year since 1999 as the distance between the two lines.

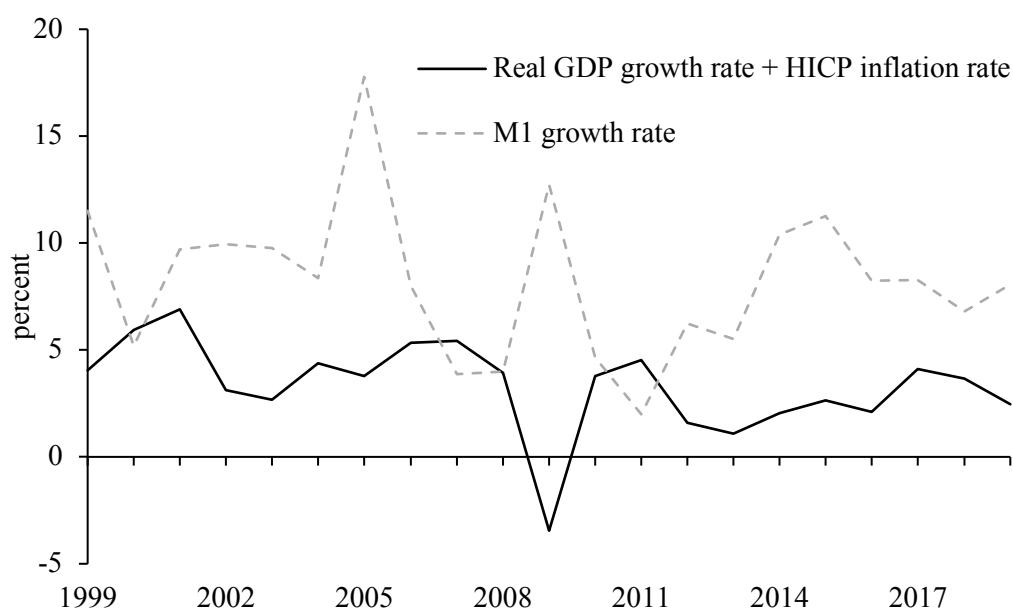


Figure 2: Year-on-year percentage change of M1 compared to the sum of the growth rates of the HICP and real GDP in the euro area. [Sources: ECB, Eurostat.]

Among the possible explanations for the persistent gap are changes in the reservation demand³ for money, or changes in the velocity of money, systematic biases in the measurement of the consumer price level,⁴ and unaccounted and overproportionate inflationary developments in other parts of the economy, outside of consumer goods industries. A combination of these causes is most likely at work.

Estimates of the velocity of money that are based on the quantity equation ($MV = PY$), which define the velocity of money as a residual of the other three variables (Dreger & Wolters, 2008) have little information content. Other reliable and independent estimates of the velocity of money in the euro area, which are for instance based on changes in the payment habits, are scarce (Morgan, 2007).

If it is assumed that payment habits are widely unchanged,⁵ systematic downward biases in the measurement of consumer price inflation and overproportionate inflationary pressure outside of consumer goods industries, have to explain the gap. Survey data since 2004 on inflation perceptions by the public from the business and consumer survey database of the European Commission suggest that the overall inflationary perceptions of a representative household in the euro area are by no means captured by the HICP.

³ The reservation demand for money is sometimes also referred to as cash balance demand or retention demand for money (Israel, 2018, pp. 386-387). It can be defined as “the demand for money to hold by those who already hold it” (Rothbard, 2004, p. 756). It is akin to the idea of liquidity preference or indeed hoarding (Keynes, 1936, ch. 13, part V), but avoids the negative connotation of the term.

⁴ Real GDP is calculated on the basis of the GDP deflator, rather than the HICP. This implies that an estimation bias identified in the HICP does not generally affect the assessment of real GDP to the same extent.

⁵ When formulating its monetary policy strategy in 1998, the ECB assumed a small decline of the velocity of money of 0.5% per year as economic agents were assumed to gradually shift payment habits to electronic money.

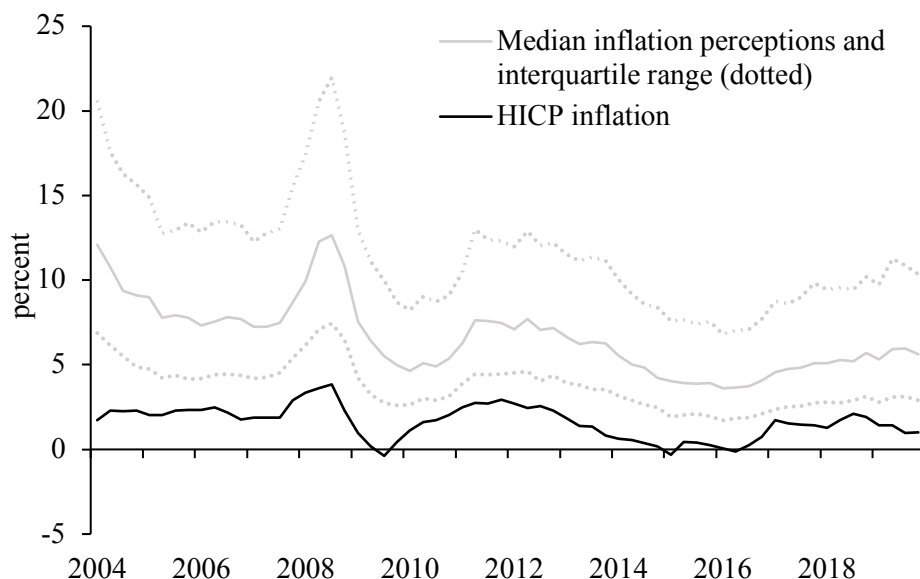


Figure 3: Officially measured HICP inflation rates and the interquartile range of inflation perceptions in the euro area since 2004. [Source: European Commission - Business and consumer survey database.]

Figure 3 shows that the interquartile range of perceived inflation in the euro area lies entirely above the officially measured HICP inflation rates. The average annual rate of the median⁶ perceived inflation since 2004 is 6.6%, which is 5 percentage points above the measured average HICP inflation rate (which is 1.6% since 2004). While inflation perceptions themselves are likely to be distorted, they may not miss the mark entirely. Notice that our average explanatory gap of 4.8 percentage points is remarkably close to the difference between median perceptions and measured inflation.⁷ Therefore, we explore more closely where potential downward biases in the HICP lie and how an alternative measure of price inflation can be constructed.

⁶ The average rate of the average (instead of the median) of perceived inflation is 9.1% since 2004, indicating that the distribution is right-skewed with outliers towards extremely high inflation perceptions. Hence, the median seems to be the more meaningful summary statistic as it is not as sensitive to outliers.

⁷ More precisely, the average explanatory gap from 2004 to 2019, that is, the period for which data on price inflation perceptions are available, is 4.9 percentage points.

3. Deficiencies of the harmonized index of consumer prices

Since 1997, the EU member states have been pursuing a harmonized method with uniform standards and definitions for calculating price inflation, as laid down by the guideline of the EU Commission (Nierhaus, 2006). In the euro area, all member states calculate a national harmonized index of consumer prices (HICP). Compliance with the standards is monitored by Eurostat.

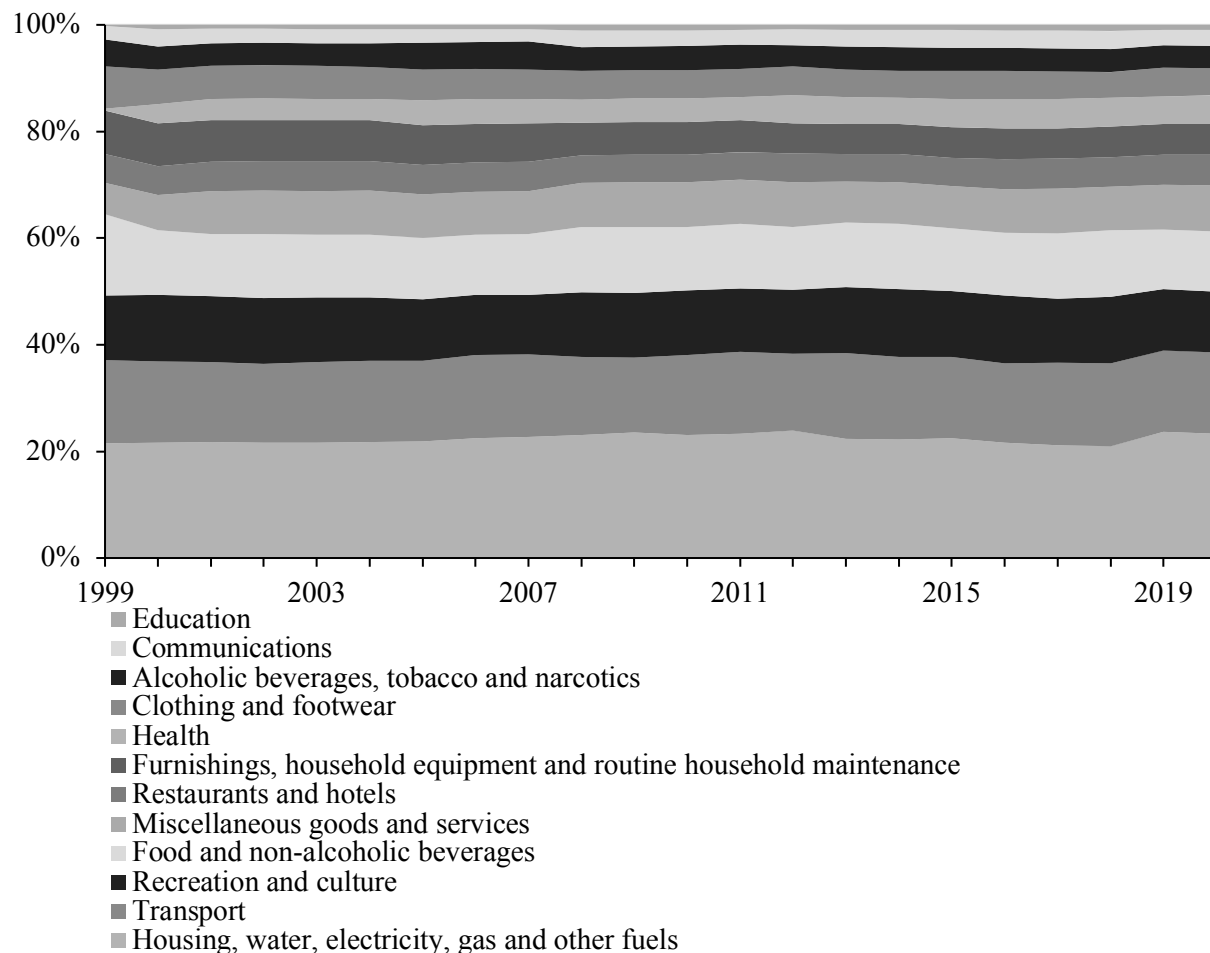


Figure 4: The evolving weights of sub-indices of the HICP for Germany since 1999 [Source: Eurostat.]

The national HICP statistics are aggregated into a weighted average for the euro area by Eurostat and published on a monthly basis. The country weights in the aggregated index are based

on the volume of monetary consumption expenditures of private households. Formally, the euro-zone HICP is a Laspeyres-type chain index. Yet the weights of current price changes of individual goods in the basket correspond to the real turnover shares of the respective goods and are subject to changes.

The HICP consists of 12 sub-indices whose weights in the overall index for Germany are shown in Figure 4. The weights have changed moderately over time taking account of changes in consumption habits. The sub-index with the highest weight of 23.3% covers “Housing, water, electricity, gas and other fuels.” A first systematic bias emerges in this sub-index. Relatively heavily regulated rents are included in the inflation calculation, but purchase prices for real estate are not. Real estate serves not only as an asset (i.e. future consumption), but also as a long-term consumer good in the case of owner-occupied housing (present consumption). Hence, if real estate prices rise sharply relative to rents, there can be a downward distortion of the official inflation measurement (Moebert, 2017). In the case of sharply falling real estate prices, as in the years of the great recession of 2008/2009, there can be a systematic upward distortion (Ambrose, Coulson, & Yoshida, 2018). The ECB itself has presented evidence in this respect for the euro area before and during the European financial and debt crisis showing that an inclusion of real estate prices would substantially alter inflation measures (ECB, 2010, pp. 49-53; Mersch, 2020).

The fact that weights are adjusted over time can cause a systematic bias, which is not detectable on the level of the 12 sub-indices. Rather, it might be found on the level of prices and weights for individual items, where substitutable goods and services with different rates of price inflation exist. Goods and services with relatively high price inflation rates are likely to be replaced by substitutes with more favorable price developments from the consumer’s perspective (compare Boskin et al., 1996 and Hoffmann, 1998). This will lead to a downward bias in inflation measurement when

weights are adjusted accordingly. The bias increases when cheap goods have lower inflation rates than more expensive goods.⁸ The weights and price indices for individual goods and services are however not available on Eurostat or the website of the German national statistical bureau, which makes a detailed analysis of this potential bias impossible.⁹

Another important but nontransparent source for biases are quality adjustments (Schnabl & Sepp, 2020). In particular, since 2002 hedonic quality adjustments are implemented in all EU countries, which systematically leads to lower measures of price inflation rates (Linz & Eckert, 2002). In hedonic quality adjustments, an average price for any given quality change is estimated in a linear regression over a range of similar products. For example, one can estimate the average price differential that is caused by an increase in computing power from, let us say 3.4 to 3.6 GHz, over a range of notebooks, tablets and computers. The average price equivalent for that quality change is then subtracted from the observed price of a given product in the basket for which the quality improvement occurred.

One reason for a downward bias is that quality improvements tend to be easily recognizable and are often advertised. Quality improvements are thus relatively easy to assess and are often quantifiable, such as increases in computing power. On the other hand, quality deteriorations are typically made along other dimensions of the product that are harder to observe and assess, for example, the quality of the cabling and casing of computers.¹⁰ This implies that quality adjustments

⁸ This could be the case for instance when inequality is growing.

⁹ Eurostat only provides complete data down to the third level of sub-indices. For example, one can download data on the sub-index “Food and non-alcoholic beverages” (CP01; first level), the sub-sub-index “Food” (CP011, second level), as well as the sub-sub-sub-index “Bread and cereals” (CP0111; third level), but at the next level, for example, for the sub-category “Rice” (CP01111) the data are incomplete, in particular the weights are partially missing. Also, there are no data for particular kinds of rice. However, we would expect systematic biases from substitution effects to occur within the lowest levels of sub-categories, where goods are typically more substitutable than between higher-order categories.

¹⁰ For instance, when metal is substituted by plastic.

in inflation measurement tend to be biased towards quality improvements and tend to leave out possible deteriorations which would in turn require to increase prices in the statistics.

Unfortunately, there is no data publicly available on the extent to which quality adjustments reduce the measured rates of price inflation. The raw price data prior to quality adjustments is not published by any of the statistical service providers involved.¹¹

Moreover, substitution effects in combination with quality adjustments can lead to a downward bias in inflation measurement. When higher-quality products enter the market, they exert an independent deflationary pressure on the prices of lower-quality - i.e. less technologically advanced - substitutes as the demand for the latter decreases shifting towards the new product. Regardless of how the quality improvement in the new product is quantified and priced as such, there is a downward pressure in the index due to the substitution effect. Assume that we were able to accurately subtract the quality improvement from the list price of the new product in the official statistics. There would then still be an independent downward pressure on the prices of less technologically advanced substitutes which leads to an additional downward bias in the statistics. In a sense, one can argue that the quality improvement of the new product is partially accounted for already in the downward pressure on the prices of lower-quality substitutes that remain in the basket. Yet, in addition a full quality adjustment in the list price of the improved product is made.

Indeed, there are different opinions on the extent and even the direction of the bias that emanates from changes in the quality of products and the adjustments that are made in response. Originally, the Boskin commission estimated an upward bias on price inflation measures of about

¹¹ Upon request at the German *Statistisches Bundesamt*, we were informed that the raw data are generally not available for public use.

0.4 percentage points annually in the US prior to 1996 stemming from insufficient adjustments to quality improvements (Boskin et al., 1996, 1997, 1998).¹² This led to a more widespread implementation of hedonic quality adjustments not only in the US but also in Europe.

For West Germany from 1980 to 1996, Hoffmann (1998) estimated a quality bias of about 0.45 percentage points annually. More recently, Feldstein (2017) argued that quality improvements and technological advances are still vastly underestimated even after the wide-spread adoption of hedonic quality adjustments. Hence, he concludes that real economic growth and wage developments are still systematically underestimated. In contrast, Komlos (2018) disapproves of this assessment and emphasizes aspects in which the quality of life has arguably decreased over the past decades and which are not accounted for by corresponding increases in the consumer price index, such as incarceration rates, suicide rates, and the opioid epidemic.¹³

4. Alternative Measures of Inflation

Tödter (2019) argues that quality changes are today more or less adequately accounted for in those goods contained in the basket, but he identifies other blind spots in the official statistics, such as, in particular, the intertemporal aspect of price developments. Future consumption, which is financed via savings, is systematically excluded in the official statistics.

¹² The commission identified three other biases, all of which contributed to a potential overestimation of consumer price inflation. All of these other biases are related to substitution effects. The so-called *substitution bias* was estimated to be 0.4 percentage points annually. It occurs because individuals substitute products that become relatively more expensive by relatively cheaper substitutes, which is not taken into account if the basket and the weights of products remain the same over time. This bias is today taken into account by adjusting the basket and changing the weights according to changes in the real turnover shares of goods and services. However, as we have argued above, this may lead to a reverse downward bias. The *outlet substitution bias* emerges when consumers buy identical products from cheaper outlets (discounter, online stores). The *new product bias* emerges when new products are not included in the basket of goods, or are only included after a relatively long time-lag. The latter biases were estimated to be relatively small, 0.1 and 0.2 percentage points, respectively.

¹³ On the importance of these and similar aspects see also Case & Deaton (2015, 2020). While these aspects are particularly pronounced in the US, they are also observable in other countries.

Tödter & Ziebarth (2018, 2020) develop an intertemporal cost of living index based on the concept of effective prices which are defined as present values of prices for future consumption. The authors show that effective inflation has developed more or less synchronously to the official consumer price inflation in Germany between 1980 and 2009. However, since 2010 effective inflation has increased relative to consumer price inflation, which reflects the fact that prices of future goods, such as real estate and other assets, have overproportionately increased in response to the low-interest rate policies of central banks in response to the Great Recession.

Missing items in the HICP statistics are important parts of present or future consumption of the average household. Most households are directly or indirectly affected by the developments in asset markets, especially real estate and stock markets, or changing costs for the government's provision of public goods, such as infrastructure, defense, safety, social security, health care and education. "Education" (CP10) and "Health" (CP06) are two sub-indices of the HICP, but these indices only cover additional expenses for health and education services apart from public sector spending. This explains the small weights in the overall index - currently 0.93% for education and 5.38% for health (see Figure 4). The lion share for education, health and other public goods is paid for by taxes and does not appear in the consumer price index. But taxes and social security contributions reduce the disposable income and the purchasing power of households.

Figure 5 shows the development of the HICP as well as the core HICP that excludes energy and food prices along with the German stock index DAX, the residential property price index compiled by the Bundesbank and total tax revenues for Germany since 1999. Total taxes can be

seen as a measure of the overall cost of provision of public goods and therefore can serve as a proxy for their corresponding market prices.¹⁴

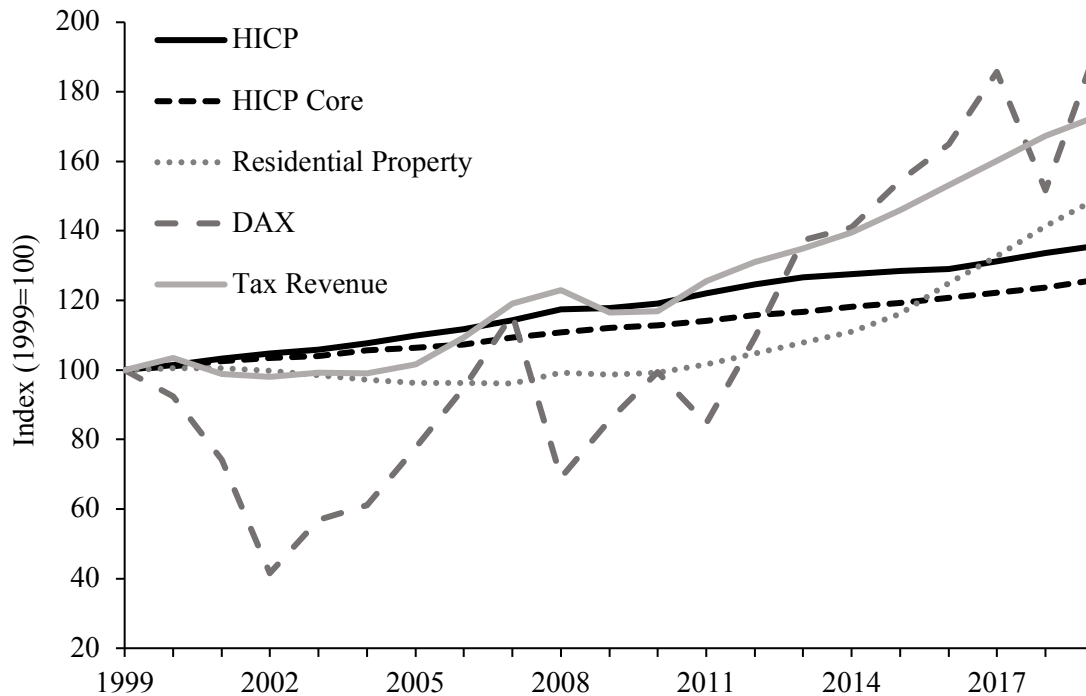


Figure 5: HICP, HICP core index without food and energy, residential property price index of the Deutsche Bundesbank, DAX and total German tax revenues [Source: Deutsche Bundesbank.]

It can be seen from Figure 5 that the price indices of all the excluded items have increased faster than the HICP. The DAX exhibits strong fluctuations but has on average increased by 4.7% per year. Residential property prices have been stagnating for most of the period, but they started to increase rapidly in recent years. Since 2012, they have grown at an average annual rate of 5.2%. The index corresponds to a weighted average of real estate prices in Germany as a whole, with price developments diverging significantly between rural and urban areas. For example, the

¹⁴ The prices of public goods are unobservable, since public goods are not traded on markets, which is why their cost of provision is considered instead. An alternative proxy are total government expenditures, which lead to similar results.

corresponding index for the seven largest cities in Germany¹⁵ has increased by an average rate of 8.7% per year since 2012.¹⁶

Overall tax revenues of the German government had a local maximum in 2000 which coincides with the height of the dotcom bubble. Tax revenues afterwards increased synchronously with the HICP. In 2007, tax revenues reached another local maximum. During the crisis they have decreased again, but since 2010 they have increased at a substantially higher rate than the HICP. The HICP has increased at an average rate of 1.4% per year since 2010, while total tax revenues grew at 4.4% annually over the same period. Table 1 summarizes the average annual growth rates of all indices for different periods.

The proxy for the prices of government provided public goods as well as for asset prices (i.e. future consumption) can be combined into a weighted average with the standard HICP in order to obtain an alternative measure of price inflation. With respect to the treatment of public goods, this approach differs from Nordhaus's (1999) *augmented cost of living index* (ACOLI) that also incorporates public goods. Nordhaus focuses on government regulations that tend to increase selling prices, such as mandatory environmental and safety regulations. For example, a carbon tax would fit in that category.

The increase in prices due to such measures is directly reflected in the HICP, but they possibly add a benefit that is not taken into account, i.e. more safety and environmental protection. Nordhaus (1999) argues that the resulting increase in the consumer price index has to be interpreted as a quality improvement. Without an adequate adjustment, the increase in the cost of living resulting

¹⁵ These are Berlin, Hamburg, Munich, Cologne, Frankfurt, Stuttgart and Düsseldorf.

¹⁶ Germany has not experienced sharply rising real estate prices prior to the Great Recession of 2008 as some of the Southern European countries have. However, the recent developments raise the question of whether something like a real estate bubble has emerged in Germany since then.

from the tax would be overestimated. However, today such quality adjustments are in fact made for the calculation of the HICP. New safety features and increased fuel efficiency in automobiles, for example, are interpreted as quality improvements and lead to a downward adjustment of the prices.

Table 1: Average annual growth rates of the HICP, the HICP core, residential property prices, the DAX and overall tax revenue in Germany for selected periods [Source: German Bundesbank.]

| Period | HICP | HICP core | Residential Property | DAX | Tax revenue |
|------------------|-------------|------------------|---------------------------------|------------|--------------------|
| 1999-2019 | 1.49% | 1.12% | 1.92% | 4.75% | 2.97% |
| 1999-2010 | 1.53% | 1.05% | -0.06% | 2.73% | 1.89% |
| 2010-2019 | 1.45% | 1.22% | 4.61% | 7.49% | 4.43% |
| 2012-2019 | 1.21% | 1.19% | 5.16% | 8.24% | 4.02% |
| 2018-2019 | 1.44% | 1.73% | 5.26% | 25.48% | 3.11% |

The overall tax burden, that is, how much income is siphoned away from the private sector to finance government provision of public goods and services is overlooked in Nordhaus's approach.¹⁷ However, the tax burden has as such an impact on the purchasing power. An increased absolute tax burden can come along with improvements in the quality of public goods and services, but this is not necessarily the case.

The quality of public goods and services can deteriorate over time, in spite of a growing tax burden, as one would expect from public choice considerations (Tullock, Seldon & Brady, 2002), or Mises's (1944) and Niskanen's (1971) theories of bureaucracy. The reason is that the incentive

¹⁷ Nordhaus (1999, p. 184) explicitly states that "income taxes do not drive a wedge between market-factor costs and product prices, so no adjustment in the ACOLI is necessary for income taxes."

structure that prompts private businesses to operate efficiently are often lacking in public and bureaucratic management, leading to decreasing efficiency in the public sector over time. For example, evidence has been provided on the stagnating and even decreasing quality of public education in developed countries (Altinok, Angrist, & Patrinos, 2018).

What weights should be given to the prices of real estate, stocks, and public goods? Because expenditure patterns differ depending on age, education, occupation, location and various other factors, there is no one-size-fits-all solution. We develop different alternatives by calculating different weighted averages based on the data shown in Figure 5.

Table 2: Average annual growth rates of the HICP, the HICP core, and alternative indices of general price inflation

| Period | HICP | HICP core | Index 1 | Index 2 | Index 2* | Index 2** | Index 3 |
|------------------|-------|-----------|---------|---------|----------|-----------|---------|
| 1999-2019 | 1.49% | 1.12% | 1.56% | 2.19% | 2.43% | 1.97% | 2.57% |
| 1999-2010 | 1.53% | 1.05% | 1.30% | 1.45% | 1.67% | 1.25% | 1.58% |
| 2010-2019 | 1.45% | 1.22% | 1.90% | 3.19% | 3.46% | 2.93% | 3.91% |
| 2012-2019 | 1.21% | 1.19% | 1.77% | 2.99% | 3.27% | 2.74% | 3.84% |
| 2018-2019 | 1.44% | 1.73% | 2.04% | 2.75% | 3.25% | 2.25% | 5.84% |

[Calculation based on indices shown in Figure 7: Index 1 = 0.85*HICP + 0.15*Residential Property; Index 2 = 0.45*HICP + 0.15* Residential Property + 0.4*Taxes; Index 2* = Index 2 with 0.5 percentage point decrease per year as quality adjustment for public goods; Index 2** = Index 2 with 0.5 percentage point increase per year as quality adjustment for public goods; Index 3 = 0.35*HICP + 0.15* Residential Property + 0.4*Taxes + 0.1*DAX]

Index 1 combines the HICP at a weight of 85% with the property price index of the Bundesbank at a weight of 15%. Many households spent a large share of their income over an extended period of time on acquiring a house or an apartment, while others rent housing, or inherit real estate. The chosen weight targets some middle ground. Index 2 combines the HICP at a weight of 45%, residential property prices at 15% and tax revenues at 40%. Once again, the effective tax burden is

very different between households depending on wealth, income and occupation, but a recent OECD study found the average tax burden of a German household to lie at 39.7% (OECD, 2019). Index 3 adds stock prices to the mix: the HICP is weighted at 35%, property prices at 15%, taxes at 40% and the DAX at 10%. The underlying assumption is that on average 10% of household income are saved in stocks to finance future consumption.

Table 2 provides a summary of the average inflation rates over different periods. For Index 2, we have included two alternative scenarios, as individual perceptions of the quality of public goods differ widely. Index 2* follows a scenario, where the quality of public goods is assumed to have gradually improved, so that the measured price inflation rate of public goods is 0.5 percentage points lower per year reflecting Feldstein's (2017) perception. Index 2** describes the more pessimistic view of Komlos (2018) in which the quality of public goods is assumed to have systematically decreased,¹⁸ so that the measured price inflation rate of public goods is increased every year by 0.5 percentage points. For Index 3, we abstain from such quality adjustments.

As shown in Figure 6, Index 1 has only surpassed the HICP since 2012 when the increase of real estate prices in Germany has accelerated. Over the entire period, Index 1 has merely increased by 1.9 percentage points more than the HICP. Incorporating tax revenues makes a substantial difference. Over the entire period since 1999, Index 2 has increased by 21.2 percentage points more than the HICP. This means that the average annual growth rate of Index 2 was 0.7 percentage points higher than that of the HICP.

¹⁸ In Germany, there have been controversial discussions concerning a deteriorating quality of school education, public rail transport, streets, defense, data transmission and health care.

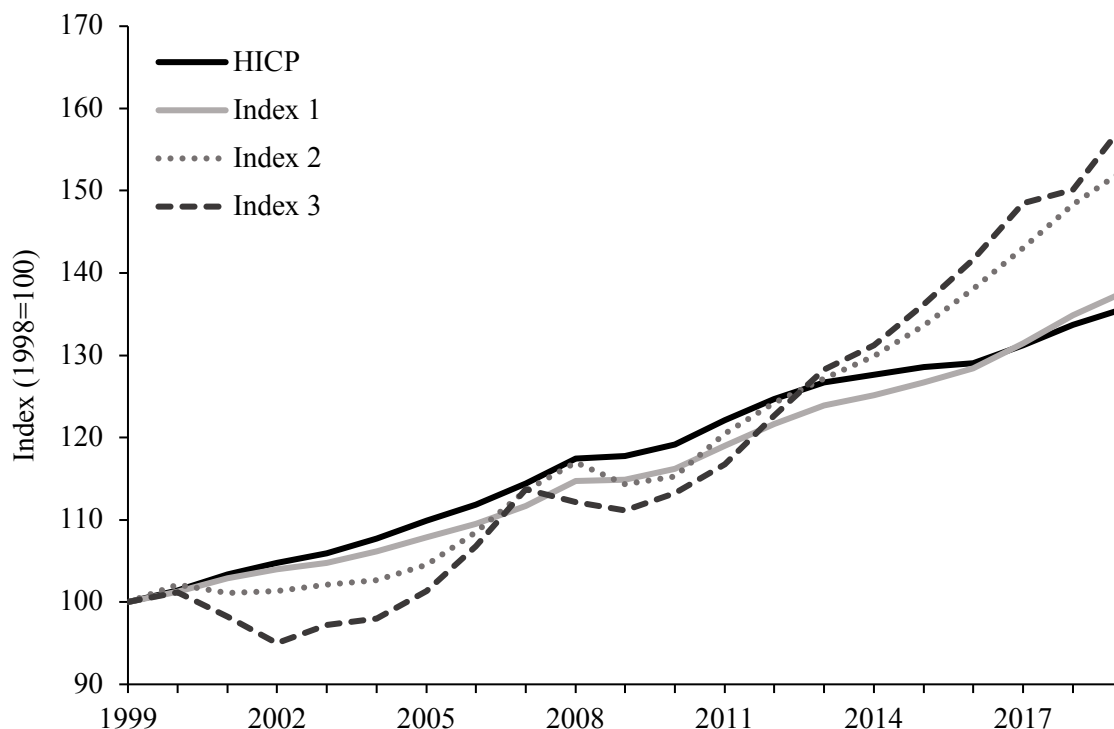


Figure 6: Generalized alternative indices of price inflation
 [Calculation based on indices shown in Figure 6: Index 1 = $0.85 \cdot \text{HICP} + 0.15 \cdot \text{Residential Property}$;
 Index 2 = $0.45 \cdot \text{HICP} + 0.15 \cdot \text{Residential Property} + 0.4 \cdot \text{Taxes}$; Index 3 = $0.35 \cdot \text{HICP} + 0.15 \cdot$
 $\text{Residential Property} + 0.4 \cdot \text{Taxes} + 0.1 \cdot \text{DAX}$]

The highest general rate of price inflation is exhibited by Index 3. It has increased by 34.0 percentage points more than the HICP since the introduction of the euro. The average annual growth rate of Index 3 was more than 1 percentage point higher than the official rate of consumer price inflation. Hence, according to that measure, the HICP underestimates the general rate of price inflation by more than 1 percentage point per year. The divergence has increased in recent years. Since 2010, the average growth rate of Index 3 is almost 2.5 percentage points higher than the HICP inflation rate.

Figures 6 and Table 2 show that measured price inflation rises as additional items enter the generalized index. The effect is especially pronounced for the period after 2010 which marks the

advent of unconventional monetary policies in the euro area. In contrast, the HICP has remained rather stable. There are no significant changes in its average growth rate for the different periods considered in Table 2. However, prices for real estate, stocks and public goods have surged.

5. Real economic developments in light of alternative inflation measures

Depending on what measure of price inflation rate is taken as the baseline, the evaluation of real macroeconomic developments changes. Real economic growth is officially estimated on the basis of nominal GDP measures discounted by the GDP deflator, whose average annual growth rates are close to those of the core HICP over the considered time period. Nominal GDP in Germany has increased by 2.6% annually since 1999.

According to official estimates, real economic growth has been 1.4% per year, or 33.1% over the entire period. If we were to take the HICP instead of the GDP deflator, the estimated average annual rate of real economic growth would be merely 1.1%. Of course, the higher the estimated rate of price inflation, the lower will be the rate of real economic growth. Table 3 contains a summary of average GDP growth rates on the basis of different price inflation rates for various periods.

Table 3: Average annual growth rates of GDP for different price inflation rates and periods in Germany

| Period | Nominal GDP | Real GDP | Real GDP (Index 1) | Real GDP (Index 2) | Real GDP (Index 3) |
|------------------|------------------------|-----------------|-------------------------------|-------------------------------|-------------------------------|
| 1999-2019 | 2.58% | 1.37% | 1.00% | 0.37% | 0.00% |
| 1999-2010 | 2.03% | 1.11% | 0.72% | 0.57% | 0.44% |
| 2010-2019 | 3.30% | 1.72% | 1.38% | 0.11% | -0.58% |
| 2012-2019 | 3.26% | 1.59% | 1.46% | 0.26% | -0.56% |
| 2018-2019 | 2.73% | 0.56% | 0.68% | -0.01% | -2.93% |

If GDP is understood as a measure of aggregate income of the economy as a whole, then real GDP gives us an indication of how much this income can buy relative to some base year. If Index 3 that combines prices for real estate, stocks and public goods with consumer prices is taken as the benchmark for general price inflation, then there has been no real income growth in Germany since 1999. For the period since 2010, for which official real growth numbers have been relatively high (1.7% per year), the adjusted growth numbers based on Index 3 are even negative (-0.6%). Hence, according to this measure, real economic growth has been overestimated by 2.3 percentage points per year since 2010.

This is not waterproof evidence that Germany has become poorer overall. It merely is an indication that the overall income generated in a year worth of economic activity may not buy as much in real terms as it used to 10 years ago. This is in large part due to asset price inflation, which is not harmful to everyone. Those who already possesses assets tend to benefit, because asset price inflation in that case comes along with a positive wealth effect (Duarte & Schnabl, 2019; Hülsmann, 2014; Israel, 2017). In contrast, for those strata of the population that do not already possess assets, it becomes harder to obtain any given level of real wealth. The problem may become even more evident when the development of labor income as a subset of overall income is considered.

The individual gross labor income data of the German Socio-Economic Panel (SOEP) draws a rather grim picture, even when the standard HICP is used to deflate the nominal values. The median gross labor income in real terms has on average decreased by 0.5% annually between 1999 and 2017.¹⁹ For the alternative measures of price inflation, the values change accordingly pointing to even larger negative income effects. Table 4 summarizes the results.

¹⁹ The most recent data available in the survey is from 2017.

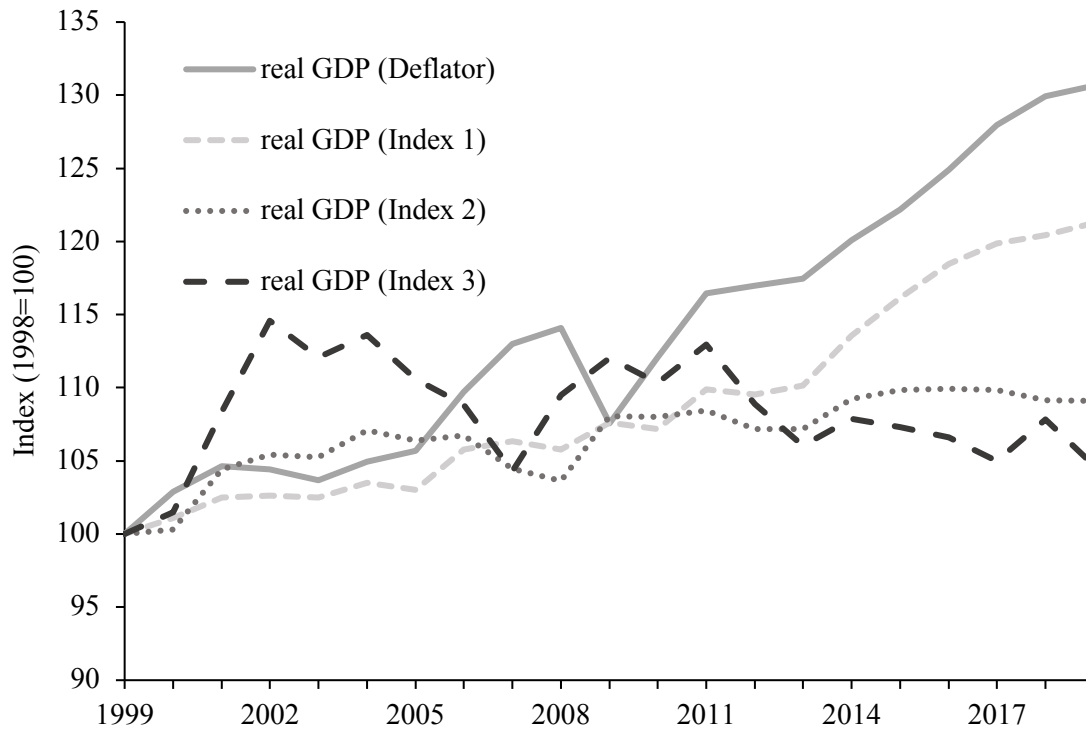


Figure 7: Real economic growth in Germany since 1999 in light of alternative inflation measures

If Index 3 is used to deflate the nominal wages, the average annual growth rate is -1.6% between 1999 and 2017. This means that real median gross labor income has diminished by 25.9% over the entire period. This indicates that for households that primarily live on labor income, it has become increasingly difficult to acquire real estate and stocks. Figure 9 shows the development of the corresponding indices over time.²⁰

²⁰ Taking the average gross wage calculated from the national accounts of the German Federal Statistical Service over the same period yields quantitatively different but qualitatively similar results. If deflated by Index 3, the average wage decreases by about 14.2% between 1998 and 2017 (instead of 25.9% for the median wage retrieved from the SOEP). On the basis of the HICP the average real wage from the national accounts has increased by 5.8% between 1998 and 2017, or by about 0.3% annually (instead of -0.49% for the median wage retrieved from the SOEP; see Table 4).

Table 4: Average annual growth rates of the nominal and real median gross labor income for different price inflation rates and periods in Germany [Source: SOEP and own calculations]

| Period | Nominal Wage | Real Wage (HICP) | Real Wage (Index 1) | Real Wage (Index 2) | Real Wage (Index 3) |
|-----------|--------------|------------------|---------------------|---------------------|---------------------|
| 1999-2017 | 0.98% | -0.49% | -0.49% | -1.08% | -1.56% |
| 2010-2017 | 0.69% | -0.69% | -1.07% | -2.40% | -2.87% |
| 2016-2017 | 0.16% | -1.51% | -2.13% | -3.34% | -3.80% |

The findings on real wage developments have to be qualified to some extent, because labor time has not remained constant. Part of the decrease in individual labor income is due to a reduction in average labor time per worker.

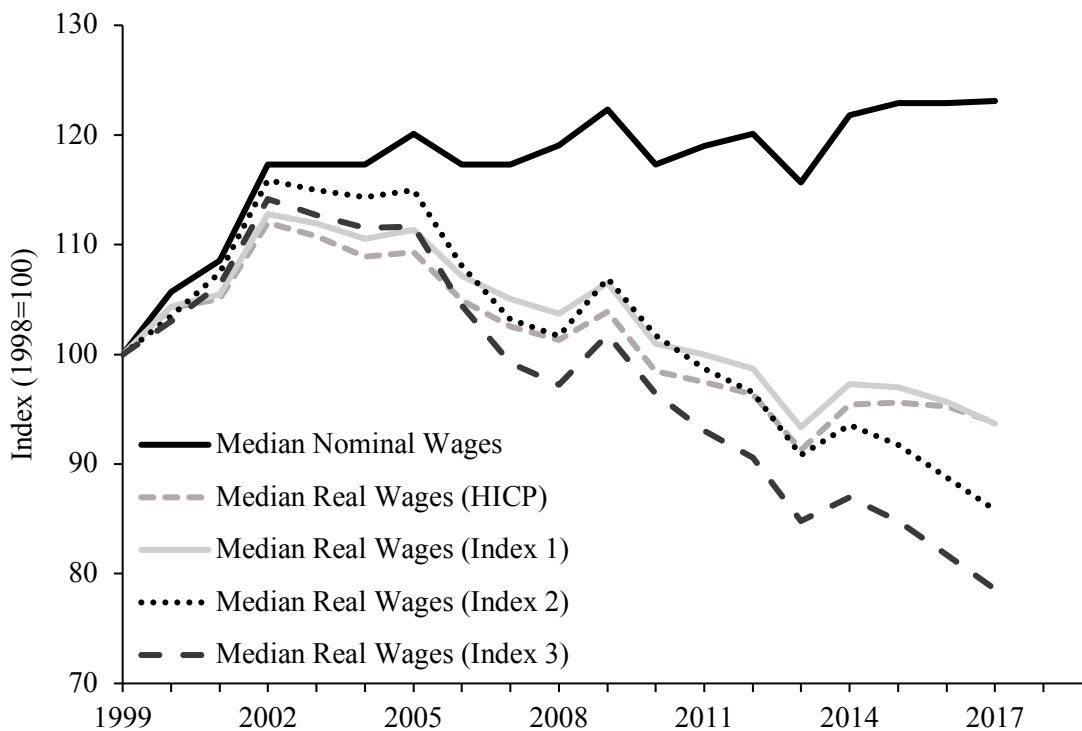


Figure 8: Individual median gross labor income in Germany between 1999 and 2017
[Source: SOEP; calculation based on indices shown in Figure 7: Index 1 = $0.85 \cdot \text{HICP} + 0.15 \cdot \text{Residential Property}$; Index 2 = $0.45 \cdot \text{HICP} + 0.15 \cdot \text{Residential Property} + 0.4 \cdot \text{Taxes}$; Index 3 = $0.35 \cdot \text{HICP} + 0.15 \cdot \text{Residential Property} + 0.4 \cdot \text{Taxes} + 0.1 \cdot \text{DAX}$]

Real median gross labor income per hour, when calculated on the basis of the HICP, has increased by 0.1% per year, or 2.2% in total between 1999 and 2017. When the alternative measures of price inflation are used instead, the growth rates turn negative. Again, the effect is especially strong for the period from 2010 to 2017, which coincides with unconventional monetary policies that have propped up asset prices. Taking Index 3 as the baseline, the average annual growth rate of the median of real individual gross labor income per hour has been -2.1% between 2010 and 2017.

Independent from the inflation measure, how can the fact that the growth rate of individual labor income per hour has been higher (or less negative) than the growth rate of individual labor income irrespective of working time be interpreted? The optimist might argue that living standards have improved and therefore the opportunity costs of labor in terms of leisure foregone have increased.²¹ Hence, workers have decided to work fewer hours. This would be in line with long-term trends in growing and prosperous economies.

Table 5: Average annual growth rates of the nominal and real median gross labor income per hour for different price inflation rates and periods in Germany [Source: SOEP and own calculations]

| Period | Nominal Wage | Real Wage (HICP) | Real Wage (Index 1) | Real Wage (Index 2) | Real Wage (Index 3) |
|------------------|--------------|------------------|---------------------|---------------------|---------------------|
| 1999-2017 | 1.59% | 0.12% | 0.11% | -0.48% | -0.97% |
| 2010-2017 | 1.46% | 0.07% | -0.31% | -1.66% | -2.13% |
| 2016-2017 | 2.94% | 1.23% | 0.59% | -0.65% | -1.13% |

²¹ According to the *Institut für Arbeitsmarkt- und Berufsforschung* (IAB) average working time has diminished by 6.6% between 1998 and 2019.

The skeptic might point out that the total number of full-time employees has remained rather stable,²² whereas the total number of part-time employees has increased by 68.0%. The share of part-time employees in the workforce has grown from 27.3% to 38.6%, while the German population has remained more or less constant during that time. Hence, many people started to work part-time, who did not or would not have worked before. This reduces the average working time per employee but increases the overall workload for the population. The widespread transition from single to dual-earner households is probably at the root of this development, which means that more time is spent on paid labor and less time is available for unpaid housework and leisure per household.²³ This can be seen as an additional loss of welfare from an individual household's perspective.

The latter interpretation is in line with the hypothesis of diminishing real labor income that we have estimated on the basis of alternative measures of price inflation. From a household perspective, a transition from single to dual-earner, often one full-time and one part-time employee, is a way to compensate the decrease in real labor income per labor hour. The household as a whole can even have a higher real income, but it requires a sacrifice in terms of less time spent outside of the workplace.

6. Conclusion

There exists a notable gap between perceived price inflation and officially measured price inflation in terms of the HICP in the euro area. Beyond distorted perceptions concerning rising inflation, two possible causes of the gap are systematic downward biases in the HICP measurement procedure and overproportionate price inflation outside of the HICP basket. We have combined the

²² It has increased by 0.6% between 1999 and 2019.

²³ Note that full-time employees have spent only 2% less time at work in 2019 compared to 1998, whereas part-time employees, besides having grown in absolute numbers, have increased their average working time by 16.7%.

HICP with price indices for assets and public goods in order to calculate a range of alternative inflation measures for Germany since the introduction of the euro. The annual growth rate of our most general alternative measure (Index 3) is on average about 1.1 percentage points higher than the HICP inflation rate over the entire period and about 2.5 percentage points higher since 2010 (Table 1). This suggests that overall inflationary pressures in a broader interpretation are not fully captured by the HICP.

Real economic growth assessed on the basis of the most general alternative measure of inflation has been zero overall in Germany since 1999 and even negative since 2010 (Table 3). Real labor income has been on an even weaker trajectory. It has risen very slowly or even declined for all inflation measures and sub-periods considered here.

The primary driver of this result is high asset price inflation that has been fueled by unconventional monetary policies over the past decade. Households that primarily live on labor income and do not possess assets are most severely affected by these trends. While there is no one true rate of price inflation in a diverse and complex world, the alternative measures presented in this paper suggest that the official assessment of real economic developments in Germany might have been overly optimistic and needs careful revision.

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