Nominal or Real? The Impact of Regional Price Levels on Life Satisfaction*

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Abstract

In this paper, we study the effect of real versus nominal income on life satisfaction. While according to standard economic theory real income, i.e., nominal income adjusted for purchasing power, should be the relevant source of life satisfaction, previous work has only studied the impact of nominal inome. We use a novel data set comprising about 7 million data points that are used to construct a price index at administrative district level in Germany. We use a fixed effects model that controls for local heterogeneity other than the price level. We find that higher price levels significantly reduce life satisfaction for individuals in the four lowest deciles of the income distribution. Furthermore, our findings suggest that people do not perceive money as neutral: the loss in life satisfaction caused by a higher price level is much larger than the gain in life satisfaction induced by a corresponding increase in nominal income. Our results provide a strong argument in favor of regional indexation of government transfer payments such as social welfare benefits and predict a higher job search intensity to prevail in more expensive regions.

Keywords: Life satisfaction, price index, neutrality of money, redistribution
JEL-Codes: D60, C23, D31

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1 Introduction

Among the determinants of life satisfaction, income is of fundamental interest and importance to economists. Studies on the effect of income on life satisfaction are abundant. They range from cross-country studies on the relationship between gross national product and average reported life satisfaction to analyses of the effect of individual income on individual life satisfaction. For survey articles see, e.g., Oswald (1997), Frey and Stutzer (2002), Di Tella and MacCulloch (2006), Kahneman *et al.* (2006), Clark, Frijters and Shields (2008), Dolan, Peasgood and White (2008), and Stutzer and Frey (2010). Besides studying absolute income, the role of relative income (e.g., Clark and Oswald (1996), Luttmer (2005), Ferrer-i Carbonell (2005)) and aspiration income (e.g., Stutzer (2004)) for individual life satisfaction has been explored. Lacking detailed data on purchasing power, all research on individual life satisfaction presented so far had to use nominal income as explanatory variable. According to standard microeconomic theory, however, individuals derive utility from consumption of goods that they can afford with their income. Therefore, real income, i.e., nominal income adjusted for purchasing power, is the appropriate instrument to measure the effect of income on life satisfaction that is often considered as a proxy for utility.

To take a step towards closing this gap, this paper studies whether differences in local price levels have an effect on individual life satisfaction once we control for nominal income. To this end, we match two sources of data: the first is a novel and very comprehensive data set on local price levels in Germany, a price index covering each of Germany's 393 administrative districts. The price index reveals substantial price differences within Germany (up to 37%) and is, to our knowledge, unique at such a disaggregated level. Information used to construct the price index comprises more than 7 million data points. We match the price index data and data from the German Socio-Economic Panel (GSOEP) that include a question on individual life satisfaction, a wide range of control variables, and district dummies. The GSOEP is a household panel survey which is representative of the German population. Around 22,000 individuals in 12,000 households participate each year. To explain life satisfaction, we use an individual fixed effects regression approach. Additionally, we include district dummies that capture district heterogeneity other than the price level.

Our first main finding is that there is a 'purchasing power effect': for a given nominal income, a higher price level reduces satisfaction with life. While the purchasing power effect is present in the population as a whole, it only becomes significant at conventional levels for the 45% poorest

individuals in our sample. The effect sizes are substiantial: consider an individual at the 25% income quantile with a fix nominal income. Moving from a district with the average German price level to a 10% more expensive district reduces life satisfaction by 0.58 points on a 11 point scale. This resembles the effect of having a full-time job instead of being unemployed which is about 0.6 points.

Our second main finding is evidence for non-neutrality of money. More precisely, we find that the effect of a 10% price increase exceeds the effect of a corresponding decrease in nominal income by a large amount. For example, a person at the 25% income quantile living in a district with the mean price level only looses 0.13 points on the life satisfaction scale for a 10% decrease in nominal income - compared to a loss of 0.58 points for a 10% increase in the price level. We also provide a formal test of neutrality of money and reject the null hypothesis of neutrality of money for the poorer half of our sample. Moreover, at most other quantiles of the income distribution the test statistic comes close to rejecting neutrality of money.

Our results provide new insights for the literature on individual life satisfaction and have important policy implications. Our first result that differences in the price level have a more pronounced effect on life satisfaction for poorer people adds to the well-established fact that life satisfaction is concave in nominal income. The modern literature on life satisfaction has documented the existence of diminishing marginal utility of nominal income by showing that reported life satisfaction is concave in nominal income.[1] For example, Layard, Mayraz and Nickell (2008) find that one extra pound brings only one tenth as much increase in life satisfaction for a rich person as it would bring to a person being one tenth as rich. Consequently, it seems reasonable to hypothesize that the effect of purchasing power on life satisfaction also depends on the location in the income distribution. Note that the decreasing marginal effect of income on life satisfaction implies that people with low income are located at the steepest part of the life satisfaction-income relation. Hence, we also expect a particularly strong sensitivity to price changes for people in the lower parts of the income distribution.

In terms of policy implications, our results provide a strong argument in favor of regional indexation of government transfer payments, in particular of those transfers that target low income groups such as unemployment and social welfare benefits. Our results also question country-wide uniform public sector or minimum wages. They show that not adjusting nation wide payments

[1] As Oswald (2008) points out, this claim implicitly assumes that reported life satisfaction is linear in actual life satisfaction.

to regional price differences treats equals unequally in terms of individual life satisfaction.

Additionally, our results promote the understanding of how people perceive real versus nominal terms. Economic theory usually assumes that people think and act in terms of real quantities and are not guided by nominal quantities. Fisher (1928) was the first to suggest that people exhibit money illusion, i.e., they think in nominal rather than real terms. Money illusion was then again banned from economic research until it was reintroduced by Shafir *et al.* (1997) who show compelling evidence in favor of money illusion using questionnaire and experimental data. Fehr and Tyran (2001) show that already a small extent of money illusion at the individual level may be sufficient to result in a large aggregate bias after a negative nominal shock. Weber *et al.* (2009) provide neuroeconomic evidence in favor of money illusion using functional magnetic resonance imaging. From an economic policy perspective, perception of real versus nominal terms is, for example, important for determining optimal inflation rates to be targeted by the central bank. Akerlof and Shiller (2009) argue that positive, but low inflation rates can help reducing unemployment: if people exhibit money illusion, people do not insist on indexing their labor contracts which reduces real wages over time. However, Akerlof and Shiller (2009) also argue that this will only hold up to a certain level of inflation beyond which workers are going to thrive for indexed contracts.

Our study adds to comprehending how people perceive nominal and real quantities by investigating the relationship between life satisfaction, nominal income, and real income. In particular, our results are based on yearly income data, i.e., large stakes for an individual. We do not find evidence for money illusion, but in contrast for non-neutrality of money in the opposite direction of what is usually thought of as money illusion. Especially the life satisfaction of people with a lower income tends to react much stronger to changes in the price level than to corresponding changes in nominal income. The only other study on subjective well-being (concerning satisfaction with income) and price levels we are aware of is Boes, Lipp and Winkelmann (2007). They focus on whether people exhibit money illusion and do not investigate the impact of real as opposed to nominal income on life satifsaction. Using GSOEP data, they study the effect of price levels on income satisfaction and use much more aggregate data on price levels, i.e., price levels for 13 out of the 16 German federal states instead of all 393 districts. Boes, Lipp and Winkelmann (2007) do not find evidence for money illusion either and their results point in a similar direction as ours (although the authors do not indicate this explicitly). Depending on the specification the estimated coefficients of the log of the price level are 23% to 43% higher than the coefficients of

the log of nominal income. These differences are, however, not statistically significant.

Finally, our results offer a possible explanation for the fact that unemployment rates are usually lower in richer and more expensive regions. Theoretical job search models (see, e.g., McCall (1970)) predict that lower unemployment payments (in real terms) will result in higher search effort. Our results show that people are less satisfied with their life when receiving a given nominal level of unemployment benefit in a more expensive region. Thus, our findings would predict a higher search intensity of the unemployed in more expensive regions.

The remainder of the paper is organized as follows: section 2 describes both sources of data, section 3 explains our empirical strategy, and section 4 presents our results and several robustness checks. We discuss implications of our results and conclude in section 5.

2 Data

This paper uses information on price levels in all 393 German districts ('Kreise') to obtain a precise measure of individual real income. The districts constitute administrative units comprising one or more cities and their surroundings. The districts are the smallest division of Germany for which it is feasible to collect detailed price data, because in smaller units some of the products contained in the price index will not be available. The data on prices at district level have been collected by the German Administrative Office for Architecture and Comprehensive Regional Planning. Kawka, Beisswenger, Costa, Kemmerling, Müller, Pütz, Schmidt, Schmidt and Trimborn (2009) describe the data set, its collection and first descriptive results on price levels in great detail.

The price index is constructed based on the basket of commodities used by the German Federal Statistical Office to calculate the German inflation rate. Table 1 lists the most important classes of goods that this basket of commodities contains. In terms of classes of goods, the price index covers 73.2% of this basket. More precisely, more than 7 million data points on prices of 205 commodities have been collected at the district level. Prices included in the calculation range from obvious candidates such as rental rates, electricity prices, or car prices to such detailed ones as dentist fees, prices for cinema tickets, costs for private English lessons, or entry fees for open air pools. We are not aware of any other data source from any other country that provides such a comprehensive price index for similarly fine geographical units.

With these data, a price index is constructed that provides an overall price level for each district. When constructing a price index, a weight needs to be attached to each individual

Table 1: Main components of the basket of commodities

Commodity group	‰ of whole basket
Rent for dwellings (including rental value for owner-occupied dwelling)	203.30
Comestible goods	89.99
Goods and services for privately used vehicles	75.57
Electricity, gas, and other fuels	59.82
Clothing	39.42
Purchase of vehicles	37.50
Water supply and other dwelling related services	33.04
Food services	32.12
Leisure and cultural services	28.99
Telecommunication	27.12
Furniture, interior equipment, carpeting, and other floor coverings	26.50
Insurance services	24.88
Tobacco products	22.43
Personal hygiene	21.54
Leisure products, garden products, pets	21.53
Audiovisual, photographic, and information-processing devices and related equipment	19.01

Reproduced from the German Federal Statistical Office (2005) (see http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Statistiken/Preise/Verbraucherpreise/WarenkorbWaegungsschema/Waegungsschema,property=file.pdf). Displayed commodity groups account for about 750 ‰ of the whole basket of commodities.

commodity measuring its share of the whole basket of commodities. The price index is based on the weights used by the German Federal Statistical Office. These weights are inferred from a household survey with 53,000 participating households that are asked about their income and consumption habits. With these weights, the price index is constructed as an arithmetic mean. The weighting is the same for each individual and each district, i.e., it does not adjust for different consumption habits of rich and poor people, men and women, families and singles, young and old people or, more generally, for different individual or regional preferences for consumption. Such an approach certainly introduces some measurement error, but is, mainly due to feasibility constraints, the standard approach in economics concerning price indeces and also inflation rates. A clear advantage of this approach is that it allows for a direct comparison of different regional price levels and for a straightforward interpretation of the price index: the question addressed by the price index is what 'an average individual traveling through Germany' would need to pay for

its consumption in each district.

Since collecting such comprehensive data cannot be managed in a single year, the data were gathered in the years 2004 to 2009, with most of the data, roughly 85%, being collected from 2006 to 2008. The data are used to build a single time-invariant price level for each district. Such a procedure implicitly assumes that the relative price level of each district remains constant over the period of study. This assumption seems to be quite realistic: the correlation coefficient of rental prices at district level in 2004 and 2008 is 0.989. With a share of about 20%, rents are by far the most influencial component of the price index.

The original price index uses the district of the former German capital Bonn as baseline (100 points). The cheapest district is Tirschenreuth in the federal state of Bavaria with 83.37 points, while Munich, with 114.40 points the most expensive district, also lies in Bavaria. Hence, the most expensive district is 37% more expensive than the cheapest, showing a substantial price differential within Germany. Figure 1 shows a map of Germany indicating the relative price level of each district. Three observations are worth mentioning: price levels are generally lower in East than in West Germany and lower in Northern than in Southern Germany. Moreover, urban areas are more expensive than rural ones.

To ease the interpretation of the estimates of our model (for details see section 3) we rescale the price index: we let the cheapest district be the base of 1 and rescale the other price levels accordingly. We match the rescaled price index data and data from the GSOEP using district identifiers. The GSOEP is a representative panel study of German households that started in 1984. For this study we use the five waves 2004 to 2008. In addition to information at the household level, individual information is available. In each wave, about 22,000 individuals in 12,000 households are interviewed. Data cover a wide range of topics such as individual attitudes and health status, job characteristics, unemployment and income, family characteristics and living conditions. Wagner, Burkhauser and Behringer (1993) and Schupp and Wagner (2002) provide an in-depth description of the GSOEP.

Since the first wave in 1984 people are asked about their life satisfaction on an eleven point Likert scale, which constitutes our dependent variable. More precisely, as a proxy for life satisfaction we use the answer to the question: "How satisfied are you with your life, all things considered?". Life satisfaction is often used as a measure for individual welfare or utility.[2] It

[2]For a detailed discussion on the relationship between happiness and utility see, for example, Clark *et al.* (2008) and Oswald (2008).

Figure 1: Regional Price Index

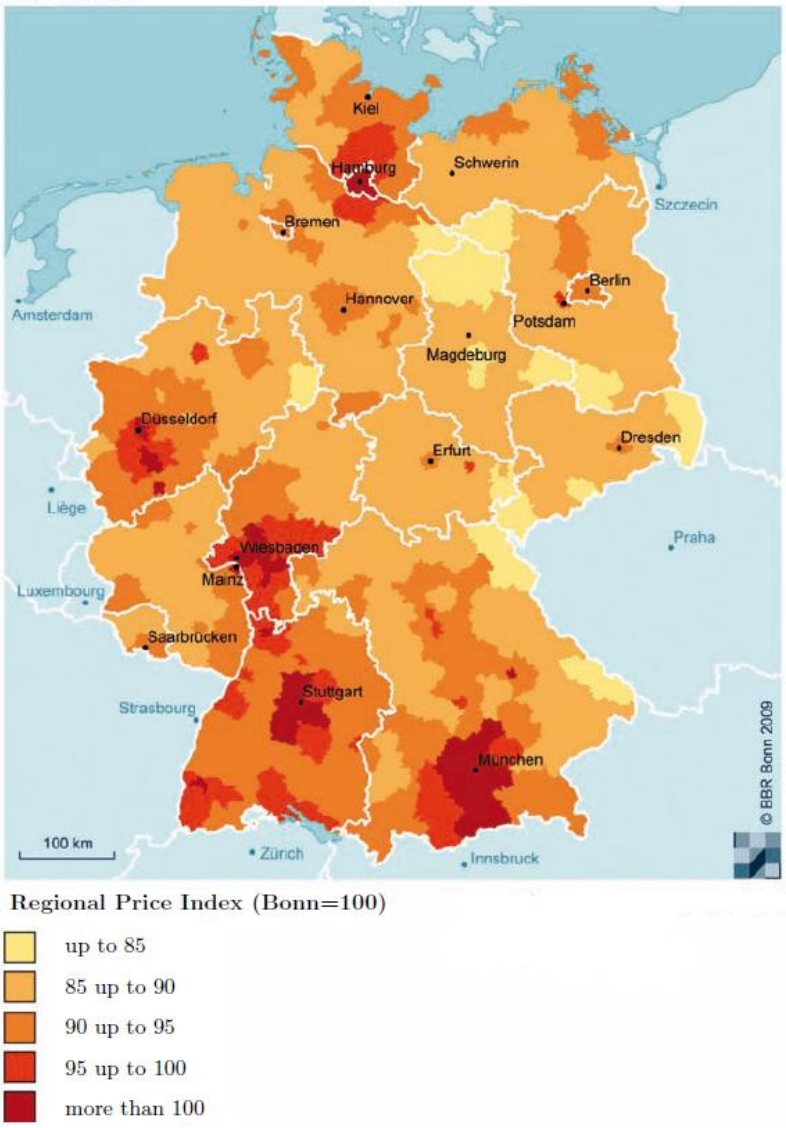


Figure reproduced from Kawka *et al.* (2009), page 60. The cities are the capitals of the 16 German federal states.

is also gaining importance as an evaluation tool for economic policy. In 2008, French President Nicholas Sarkozy asked a commission of economists to come up with better measures for social progress than, for example, GDP. In their report, the so called 'Sarkozy commission' notes on page 12 that "... the time is ripe for our measurement system to shift emphasis from measuring economic production to measuring people's well-being." (Stiglitz *et al.* (2009)).

Since we are interested in the effect of purchasing power on life satisfaction, our explanatory variable of interest is real income. The goal of our real income measure is to capture purchasing

power of a given nominal income as precisely as possible: we start with household disposable nominal income, i.e., after tax household income including all kinds of government transfer income.[3] We then form the corresponding per person equivalence income as suggested by the OECD, see Grabka (2008) for an application to GSOEP data. The idea of the equivalence income is to assign each household member the income that corresponds to the disposable income the household member would have if he were single. The equivalence income corrects household income for the number of household members by dividing through a factor. The factor takes a value of 1 for the first household member, 0.7 is added for each additional adult and 0.5 for each child. Last, to obtain our measure of real income, we divide the nominal equivalence income by the rescaled, district specific price level.

In our regressions of life satisfaction on income we use a well established set of control

Table 2: Summary Statistics

Variable	Obs	Mean	Std. Dev.
Life satisfaction	104,474	6.90	1.84
Price index	104,474	1.11	0.07
Nominal equivalence income (adjusted for inflation)	104,474	18,512	28,657
Real equivalence income (adjusted for inflation)	104,474	16,633	27,426
Number of children	104,474	0.55	0.92
Single	104,474	0.24	0.43
Married	104,474	0.60	0.49
Separated	104,474	0.02	0.13
Divorced	104,474	0.08	0.27
Widowed	104,474	0.07	0.25
Level of disability	104,474	7.15	21.03
Invalid in household	104,474	0.04	0.20
Unemployed	104,474	0.06	0.24
Employed full time	104,474	0.39	0.49
Employed part time	104,474	0.15	0.36
Maternity leave	104,474	0.02	0.12
Non-participant	104,474	0.39	0.49

variables. These control variables are dummies for marital status (Married, Separated, Divorced,

[3]We adjust all income measures for inflation using 2004 as the baseline year. We use the national inflation rate since there are no comprehensive data on inflation rates at lower levels, not even for all 16 federal states.

Widowed; Single as omitted category), dummies for employment status (Employed full time, Employed part time, Maternity leave, Non-participant; Unemployed as omitted category), the level of disability (Level of disability), the number of children in the household (Number of children), a dummy for whether a disabled person is living in the household (Invalid in household), and district dummies. Summary statistics of all variables can be found in Table 2. Moreover, we include year dummies. Our analysis is based on a representative sample of the German population. We use all subsamples of the GSOEP data and use the cross-sectional weights provided in the GSOEP data, since the GSOEP oversamples certain population groups.

3 Empirical Strategy

Our research question is to figure out whether, for a given nominal income, differences in purchasing power affect individual satisfaction with life.

Our measure of purchasing power is based on the price index that offers a price level for each of the 393 German districts. To ensure that the price index only captures the purchasing power effect and not the effect of other unobserved district characteristics, such as infrastructure or natural beauty, on satisfaction with life our specification includes a dummy variable for each district.[4]

We choose a specification that is easy to compare to existing studies. The main difference to standard life satisfaction regressions is that, besides nominal income, we include an additional regressor: the difference between real and nominal income, $(R-N)$. Real income is nominal income N divided by the price index P. A coefficient of $(R-N)$ that is significantly different from zero implies that former studies using nominal instead of real income did indeed suffer from omitted variable bias. In contrast, a non-significant coefficient of $(R-N)$ would imply that former studies that did not use information on real income did not suffer from substantial omitted variable bias. $(R-N)$ is always smaller than or equal to zero and is decreasing in P since $R-N=(\frac{1}{P}-1)\times N$ and P is rescaled to be larger than or equal to 1. Thus, a positive coefficient of $(R-N)$ indicates that there is a purchasing power effect: for a given nominal income, a higher price level reduces satisfaction with life.

More precisely, we estimate the following linear individual fixed effects specification for indi-

[4]To be able to identify the effect of the price index one additional district dummy is dropped.

vidual i's life satisfaction in district j in year t, H_{ijt}:

$$H_{ijt} = \alpha_0 + \alpha N_{ijt} + \gamma N_{ijt}^2 + \delta(R_{ijt} - N_{ijt}) + x_{ijt}\beta + c_i + d_j + h_t + \epsilon_{ijt}.$$

N is nominal equivalence income adjusted for inflation, which we simply call nominal income throughout the paper. R is real income, x includes all further control variables as described in section 2, c is an individual fixed effect, d is a district dummy, h is a year dummy, α_0 a constant term, and ϵ the error term. To avoid having inconsistent estimates because of unobserved time-invariant individual characteristics that are correlated with the explanatory variables and satisfaction with life we use a fixed effects estimator.[5] Doing so, any time-invariant regressor is dropped. The rescaled price index, P, is time-invariant. With P as a separate regressor, we would identify the potential purchasing power effect on individual life satisfaction only via the relatively small number of movers in our sample, about 1.4% of all individuals. In our specification, identification of the effect of time-invariant P through the $(R-N)$ term rests on sufficient variation in individual nominal income over time. We decide to use both sources of identifying variation (movers and changes in nominal income).

Usually, regressions with life satisfaction as dependent variable use the logarithm of income because a concave relationship between satisfaction with life and income is a robust finding of the previous empirical literature and the standard assumption in microeconomic utility theory. However, applying the logarithm to real income R the time-invariant price index would drop out in our fixed effects specification.[6] To be able to directly compare the size of coefficients of nominal income N and the $(R - N)$ term, we do not use the logarithm of nominal income. We add the square of nominal income as regressor to still allow for concavity.

A further implication of the concave relationship between life satisfaction and nominal income is that we also expect the price level to have a larger effect on life satisfaction for less affluent people. Consequently, we will first present results of our specification for the sample as a whole and then proceed by cutting the sample from above according to nominal income quantiles.

At first sight, it might seem natural to simply estimate a specification typically used in the literature on life satisfaction and just substitute nominal by real income. Due to district differences in price levels, an individual's position in the German distribution of nominal income

[5] Ferrer-i-Carbonell and Frijters (2004) show that using a fixed-effects estimator is of substantial importance when estimating life satisfaction regressions. In the same paper, they show that estimating an ordinal instead of a linear model only marginally changes results.

[6] $\log(R) = \log(\frac{N}{P}) = \log(N) - \log(P)$

may well differ from the same individual's position in the distribution of real income. Still, the overall distributions of nominal and real income that determine coefficient estimates are very similar, e.g., the corresponding correlation coefficient is 0.997. The reason is that differences in nominal income (that ranges from close to zero to about 3.6 million Euros) are tremendously larger than differences in regional price levels that range from 1 to 1.37 using our rescaled price index. Any coefficient estimate of real income would, to the largest share, be driven by differences in nominal income and not by differences in price levels. Consequently, just substituting nominal by real income would not deliver meaningful insights on the effect of purchasing power on life satisfaction.

4 Results

Table 3 displays the estimation results of the specification described in the previous section. Different columns show results for different partitions of the income distribution. The results for the whole population in the leftmost column are well in line with findings from the previous literature. Being disabled oneself and the obligation to take care of an invalid in the household have a strongly significant, negative influence on life satisfaction. Compared to being unemployed, we find significant positive effects (all at the 1% level) of being employed full or part time, of maternity leave, and of being a non-participant in the labor market. Compared to being single, people are more satisfied if they are married and less satisfied if they are separated or widowed. The number of children has only a marginally significant and small positive influence on life satisfaction. Finally, for the sample as a whole, we find a significant positive, but decreasing marginal effect of nominal income on life satisfaction. The coefficient of $(R - N)$ is positive, but not significant at conventional levels (p-value=0.16). The positive sign points in the direction of a purchasing power effect, but for the population as a whole this effect is not strong enough to significantly affect individual satisfaction with life.

Table 3: Fixed Effects Regression

	Bottom Quantiles				
	100%	99%	75%	50%	25%
	(-)	(53,406€)	(19,594€)	(14,247€)	(10,456€)
$N/1000$	0.004^{**}	0.025^{***}	0.062^{***}	0.097^{**}	0.182^{**}
	(0.002)	(0.007)	(0.021)	(0.043)	(0.071)
$N^2/1000$	-0.0000009^{*}	-0.0002407^{*}	-0.0013970^{*}	-0.0026480	-0.0047730
	(0.0000005)	(0.0001314)	(0.0007476)	(0.0020050)	(0.0045470)
$(R-N)/1000$	0.017	0.058	0.068	0.249	0.668^{**}
	(0.012)	(0.036)	(0.099)	(0.170)	(0.282)
Number of children	0.052^{*}	0.063^{**}	0.058^{*}	0.018	-0.009
	(0.027)	(0.028)	(0.032)	(0.037)	(0.060)
Married	0.201^{***}	0.186^{**}	0.251^{**}	0.276^{*}	0.078
	(0.075)	(0.075)	(0.097)	(0.141)	(0.192)
Separated	-0.271^{**}	-0.269^{**}	-0.177	-0.056	-0.206
	(0.124)	(0.124)	(0.148)	(0.198)	(0.293)
Divorced	0.157	0.156	0.166	0.159	-0.027
	(0.123)	(0.123)	(0.156)	(0.193)	(0.275)
Widowed	-0.253^{*}	-0.262^{*}	-0.195	-0.118	-0.297
	(0.147)	(0.147)	(0.188)	(0.238)	(0.340)
Level of disability	-0.004^{***}	-0.004^{***}	-0.005^{***}	-0.006^{***}	-0.006^{**}
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)
Invalid in household	-0.632^{***}	-0.632^{***}	-0.633^{***}	-0.647^{***}	-0.866^{***}
	(0.091)	(0.091)	(0.104)	(0.135)	(0.226)
Employed full time	0.646^{***}	0.633^{***}	0.658^{***}	0.629^{***}	0.470^{***}
	(0.058)	(0.059)	(0.066)	(0.078)	(0.100)
Employed part time	0.435^{***}	0.431^{***}	0.420^{***}	0.391^{***}	0.328^{***}
	(0.062)	(0.062)	(0.069)	(0.079)	(0.101)
Maternity leave	0.456^{***}	0.462^{***}	0.427^{***}	0.392^{***}	0.409^{**}
	(0.099)	(0.098)	(0.110)	(0.127)	(0.181)
Non-participant	0.383^{***}	0.380^{***}	0.352^{***}	0.334^{***}	0.204^{**}
	(0.059)	(0.059)	(0.064)	(0.075)	(0.089)
Observations	104,474	102,739	72,618	46,697	21,978

Dependent variable is individual life satisfaction. *, **, and *** indicate significance at the 10%, 5%, and 1% level. Robust standard errors, clustered at district level, are shown in parentheses. For each partition, the highest nominal equivalence income is displayed in parentheses. Omitted category for marital status is being single, and for employment being unemployed. Year dummies are included. Ceteris paribus, a positive coefficient of (R-N) implies lower individual life satisfaction the higher the price level.

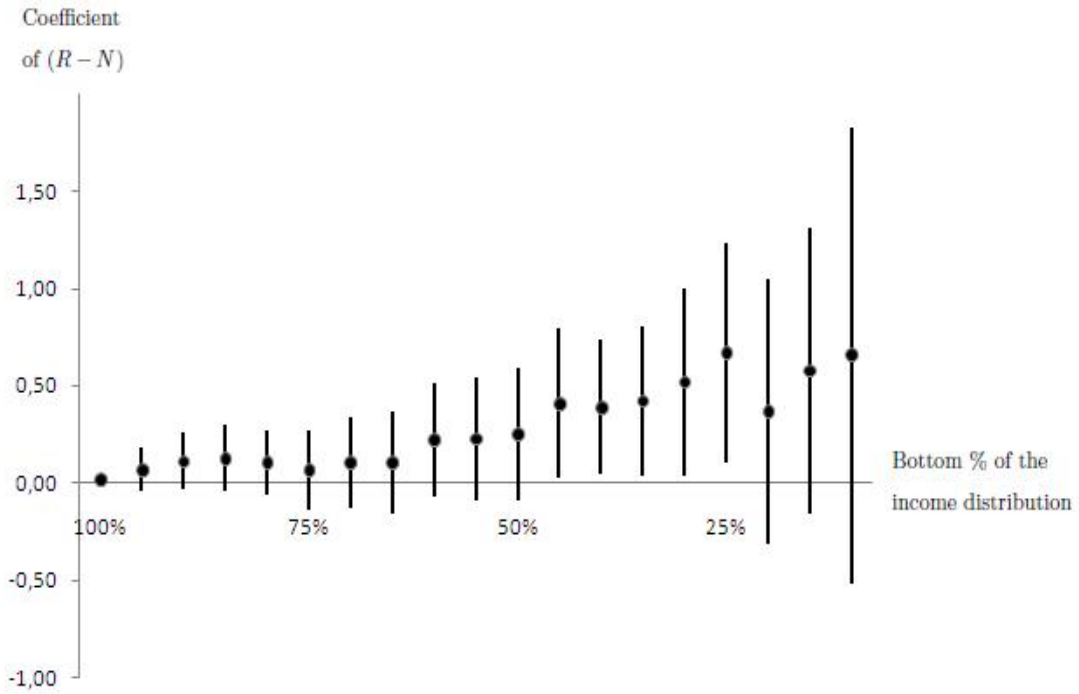
Since we do not use the log of income and the income distribution is very skewed, in a linear specification, high incomes have an especially large influence on the estimated coefficients of income. To avoid that just a few observations have a strong impact on the estimated coefficients we also look at the regression excluding the 1% richest individuals. The second column displays the corresponding estimation results that exclude nominal incomes above 53,406 Euros. As one would expect, all three coefficients of the income variables are substantially larger. We still find a significant positive, but decreasing effect of income on life satisfaction. The purchasing power effect increases substantially, but is still not significant (p-value=0.11).

We find a concave relationship between life satisfaction and nominal income. Consequently, at some sufficiently low income level, the marginal effect of income on life satisfaction may well become large enough for the difference between real and nominal income to significantly affect life satisfaction. Thus, the next step of our analysis in columns 3-5 of Table 3 is to cut the sample from above according to nominal income.[7] A first observation is that the coefficients of the control variables, especially those of the significant ones, display stable patterns for all different subsamples. As expected, this is not the case for the coefficients of the income variables. While for the bottom 75% quantile the marginal effect of nominal income is still significantly decreasing at the 10% level, this is no longer the case for the bottom 50% and 25% quantiles. Moreover, for the bottom 25% quantile the positive coefficient of $(R - N)$ becomes significant at the 5% level which implies that there is a significant purchasing power effect: people with a low nominal income fare significantly better when living in a cheaper district.

To investigate for which share of the population differences in the price level significantly influence satisfaction with life, we construct finer partitions of the income distribution by cutting it from above. Figure 2 shows the coefficient of $(R - N)$ for different partitions of the income distribution in steps of 5 percentage points. For the 45% poorest, the coefficient of $(R-N)$ starts being significant at the 5% level. Overall, our results show that price differences at district level significantly affect individual satisfaction with life for a large share of the population: for a given nominal income, a higher price level reduces individual satisfaction with life. There are three further observations when looking at Figure 2: No matter how the income distribution is partioned, the coefficient of $(R-N)$ is positive, indicating a purchasing power effect. Furthermore, the coef-

[7] An alternative would be to construct standard income quantiles that are not overlapping. However, the identification of the purchasing power effect rests on sufficient within-subject variation of income which is substantially lower in smaller and poorer income groups (with the exception of the very poorest).

Figure 2: Coefficient of $(R - N)$



This Figure shows the coefficient of $(R - N)$ for different partitions of the income distribution cutting it from above. Black dots denote the point estimates, while the adjoining lines indicate the 95% confidence intervals. The coefficient is significant (at the 5% level) from the bottom 45% to the bottom 25% quantile. Generally, both the estimated coefficient and the standard errors increase for lower parts of the income distribution.

ficient of $(R-N)$ has an upward trend from richer to poorer partitions of the income distribution. This corroborates our observation that the effect of purchasing power on life satisfaction is much stronger for poorer people. Finally, standard errors of $(R - N)$ increase substantially in poorer subsamples of the income distribution. This is due to a lower number of observations and a lower within variation in nominal income that is used to identify the coefficient of $(R - N)$.[8] For these reasons, we do not find a significant coefficient of $(R-N)$ from the bottom 20% quantile onwards. However, we think that the price level affects life satisfaction in the very lowest part of the income distribution. With the data at hand, it is just not possible to identify the purchasing power effect for the poorest 20% at conventional significance levels.

As a next step we try to quantify the effect of a change in the price level on a person's

[8]For example, the within-subject standard deviation of nominal income drops by 25% from 1352 to 1015 when going from the bottom 50% quantile to the bottom 20% quantile.

life satisfaction ceteris paribus. That is we take the point estimates of $(R - N)$ and for a given nominal income, we let P vary. The results are as follows: Given a yearly nominal income of 10,450 (13,400) Euros (corresponding to the bottom 25% and 45% quantile, respectively), moving from a district with the mean price level of 1.1 to a 10% more expensive district reduces life satisfaction by 0.58 (0.45) points on a 11 point scale. These effects are huge: For example, the effect of having a full-time job instead of being unemployment increases life satisfaction by about 0.6 points. Furthermore, the effect of a 10% price increase exceeds the effect of a corresponding change in nominal income by a large amount. For example, a person living in a district with the mean price level of 1.1 with an income of 10,450 (13,400) Euros only looses 0.13 (0.14) points for a 10% decrease in nominal income. Hence, at least for people in the lower part of the income distribution, there is substantial divergence between the estimated change in life satisfaction caused by a change in the price level and the one caused by the corresponding change in nominal income.

This is in contrast to standard economic theory which assumes neutrality of money at the macroeconomic level and people thinking and acting in terms of real quantities at the microeconomic level. Fisher (1928) was the first to deviate from that view by suggesting that people exhibit money illusion, i.e., they think in nominal rather than real terms. In our application, the presence of money illusion would imply a larger effect of a, for example, 10% decrease in nominal income than a 10% increase in the price level. Interestingly, the results presented so far point in the opposite direction.

To allow for a formal test of neutrality of money (i.e., the absence of any deviation from evaluation in real terms), we also estimate our specification including the additional term $(R^2 - N^2)$. We test the null hypothesis that money is neutral, i.e., that the coefficients of N and $(R - N)$ are not significantly different from each other and at the same time, the ones of N^2 and $(R^2 - N^2)$ are not significantly different from each other either. To this end we perform a joint F-test on these two restrictions. Rejecting the null hypothesis implies rejecting neutrality of money. Table 4 contains the results of the estimation and the F-tests. We reject the null hypothesis of neutrality of money for the lower half of the income distribution. Thus, we reject neutrality of money exactly for the poorer part of the population that experiences a significantly lower satisfaction with life if prices are higher. Again we find that the non-neutrality is driven by a too strong reaction to changes in prices compared to changes in income, which is exactly the opposite of what is typically thought of as money illusion.

Table 4: Fixed Effects Regression Including $(R^2 - N^2)$

	Bottom Quantiles				
	100%	99%	75%	50%	25%
	(-)	(53,406€)	(19,594€)	(14,247€)	(10,456€)
$N/1000$	0.004^{*}	0.040^{***}	0.130^{***}	0.187^{***}	0.120
	(0.002)	(0.014)	(0.039)	(0.072)	(0.141)
$N^2/1000$	-0.0000009^{*}	-0.0005965^{**}	-0.0044290^{***}	-0.0079180^{**}	-0.0000226
	(0.0000005)	(0.0002992)	(0.0015310)	(0.0039680)	(0.0103300)
$(R-N)/1000$	0.011	0.196	0.775^{**}	1.224^{*}	-0.004
	(0.016)	(0.121)	(0.344)	(0.697)	(1.229)
$(R^2 - N^2)/1000$	0.0000044	-0.0017510	-0.0167600^{**}	-0.0302700	0.0273800
	0.0000053	0.0013170	0.0072150	0.0216200	0.0488300
F-Test (p-value)	0.6067	0.1531	0.1115	0.0990	0.0471
Observations	104,474	102,739	72,618	46,697	21,978

Dependent variable is individual life satisfaction. *, **, and *** indicate significance at the 10%, 5%, and 1% level. Robust standard errors, clustered at district level, are shown in parentheses. For each partition, the highest nominal equivalence income is displayed in parentheses. Explanatory variables are the same as in Table 3.

Boes *et al.* (2007) present a related finding: they compare the effect of nominal income and a price index at the level of 13 out of 16 federal states in Germany on income satisfaction (while we use overall life satisfaction as dependent variable and have a substiantially more detailed price index covering 393 districts). Depending on the specification the estimated coefficients of the log of the price level are 23% to 43% higher than the coefficients of the log of nominal income. These differences are, however, not statistically significant. A possible overreaction to price levels can also be made visible when splitting our sample at the median of P. The resulting mean nominal income in the more expensive half of the sample is 26.1% higher than in the cheaper half (20.734 against 16.443 Euros). In contrast, the mean price level is only 8.5% higher (1.15 against 1.06) showing a pronounced overcompensation in nominal income for price levels.

Finally, we run two kinds of robustness checks: First, we estimate our baseline specification as presented in Table 3, but exclude the N^2 term. The rationale is to ensure that multicollinearity due to a high correlation of N and N^2 is not affecting our results. While using a variable and its square as separate regressors is a very common approach, the two are usually highly correlated. With the data at hand, the correlation coefficient of N and N^2 ranges between 0.84 and 0.98. In

contrast, the correlation coefficients of $(R-N)$ and N or $(R-N)$ and N^2 are much lower, ranging between -0.36 and -0.73 or -0.08 and -0.72 depending on the bottom quantiles. The estimated coefficients of the income variables and the corresponding F-tests for neutrality of money are displayed in Table 5. As one would expect, without a negative N^2 term, the cofficients of nominal income are smaller. Reassuringly, the coefficients of $(R-N)$ are very similar to our baseline estimates - especially in the bottom half of our sample in which the effect of nominal income on life satisfaction is non-decreasing. Similar to the tests results in Table 4, we reject the null hypothesis of neutrality of money for the 45% to 25% poorest individuals in our sample. Taken together, these results do not indicate that the precision of the baseline estimates and those in Table 4 is affected by multicollinearity.

Table 5: Fixed Effects Regression Excluding N^2

	Bottom Quantiles				
	100%	99%	75%	50%	25%
	(-)	(53,406€)	(19,594€)	(14,247€)	(10,456€)
$N/1000$	0.00082	0.01603***	0.02979***	0.04867***	0.11657***
	(0.00065)	(0.00436)	(0.01062)	(0.01777)	(0.03121)
$(R-N)/1000$	−0.00164	0.06954**	0.07697	0.24671	0.65913**
	(0.00682)	(0.03528)	(0.09213)	(0.09781)	(0.28186)
F-Test (p-value)	0.7038	0.0923	0.5955	0.2017	0.0348
Observations	104,474	102,739	72,618	46,697	21,978

Dependent variable is individual life satisfaction. *, **, and *** indicate significance at the 10%, 5%, and 1% level. Robust standard errors, clustered at district level, are shown in parentheses. For each partition, the highest nominal equivalence income is displayed in parentheses. Explanatory variables are the same as in Table 3.

As a second robustness check, we exclude all individuals who have moved at least once during the period under study. Consequently, the within-subject variation of nominal income over time remains as the only source of identifying variation of the purchasing power effect. The results in Table 6 are very close to those of our baseline specification. This is reassuring since movers could be a very peculiar subset of the population, experiencing especially strong shocks to life satisfaction caused by shocks to unobserved hetrerogeneity.

Table 6: Fixed Effects Regression Excluding Movers

	Bottom Quantiles				
	100%	99%	75%	50%	25%
	(-)	(53,406€)	(19,594€)	(14,247€)	(10,456€)
$N/1000$	0.004^{*}	0.025^{***}	0.061^{***}	0.100^{**}	0.189^{**}
	(0.002)	(0.008)	(0.022)	(0.046)	(0.076)
$N^2/1000$	-0.0000009^{*}	-0.0001958	-0.0013850^{*}	-0.0028630	-0.0051550
	(0.0000005)	(0.0001445)	(0.0007862)	(0.0021460)	(0.0048760)
$(R-N)/1000$	0.015	0.074^{*}	0.061	0.236	0.641^{**}
	(0.012)	(0.042)	(0.104)	(0.176)	(0.301)
Observations	98,191	96,551	68,326	43,860	20,405

Dependent variable is individual life satisfaction. *, **, and *** indicate significance at the 10%, 5%, and 1% level. Robust standard errors, clustered at district level, are shown in parentheses. For each partition, the highest nominal equivalence income is displayed in parentheses. Explanatory variables are the same as in Table 3. Ceteris paribus, a positive coefficient of (R-N) implies lower individual life satisfaction the higher the price level.

5 Discussion

Income is the determinant of satisfaction with life that has received most attention in economic research. Economic theory predicts that real income, i.e., nominal income adjusted for purchasing power, should be used as predictor of life satisfaction. However, lacking appropriate data, all research presented so far had to use nominal income as explanatory variable. Using a novel and very comprehensive data set on local price levels in Germany this paper aimed at closing this gap.

Our results show that information on price levels adds explanatory power when analyzing satisfaction with life. In Germany, the poorest 45% of the population are significantly less satisfied with their life when living in a more expensive region. For them, the effect of a 10% increase in the price level on life satisfaction is substantial: its size is comparable to the effect of having a full-time job instead of being unemployed. While the purchasing power effect (i.e., higher prices reduce satisfaction with life) is also present for the population as a whole, it is not significant at conventional levels. Both results are compatible with the well established empirical fact that the relationship between satisfaction with life and nominal income is concave.

Our results are of obvious relevance for advising policy. Policy usually aims at treating equals

equally. The price index data provide insights on whether equal treatment is met when granting people the same nominal or when granting them the same real payment. Our results imply that real income predicts individual satisfaction with life more precisely than nominal income does, especially in the lower half of the income distribution. This finding has important policy implications in many domains: it provides a strong argument in favor of regional indexation of government transfer payments, in particular of those transfers which target low income groups such as the US Supplemental Security Income (SSI), unemployment benefits, or social welfare benefits. Our results also put country-wide uniform public sector or minimum wages into question. In all examples, not adjusting nation wide payments to regional price differences treat equals unequally in terms of individual satisfaction with life.[9]

Furthermore, for the lower half of the income distribution, we reject the hypothesis that money is neutral. More precisely, a change in the price level seems to have a stronger effect on life satisfaction than a corresponding change in nominal income. Kahneman *et al.* (2006) argue that the salience of (nominal) income is particularly high when being confronted with the task to evaluate one's satisfaction with life. At least for people in the lower half of the income distribution, we find that the salience of the price level seems to be even higher. A possible explanation is that prices are experienced virtually every day, at every instance of buying anything. In contrast, for the vast majority of people, income is paid only monthly and often simply accrues to a bank account without being experienced explicitly before consumption.

A promising avenue for future research might be the use of the price index data to test the predictions of theoretical job search models, see, e.g., McCall (1970). Job search models predict that the length of an unemployment spell depends on the level of unemployment benefits. In particular, search intensity is predicted to be higher the lower the unemployment benefit. Different price levels introduce exogenous variation in real unemployment benefits across Germany. Given our result that price differences are large enough to reduce life satisfaction of the poorest 45% of the population, we expect the search intensity in the labor market to be higher in more expensive regions. We think this phenomenon deserves further study in future work.

[9] Of course, the validity of these arguments rests on a ceteris paribus assumption, i.e., groups who get compensated for differences in the price level are assumed to be small enough for a change in their nominal income not to affect the local price level.

References

Akerlof G, Shiller R. 2009. *Animal Spirits: How Human Psychology Drives the Economy, and Why it Matters for Global Capitalism*. Princeton: Princeton University Press.

Boes S, Lipp M, Winkelmann R. 2007. Money Illusion under Test. *Economics Letters* **94**: 332–337.

Clark AE, Frijters P, Shields MA. 2008. Relative Income, Happiness, and Utility: An Explanation for the Easterlin Paradox and Other Puzzles. *Journal of Economic Literaturel* **46**: 95–144.

Clark AE, Oswald AJ. 1996. Satisfaction and comparison income. *Journal of Publich Economics* **61**: 359–381.

Di Tella R, MacCulloch R. 2006. Some uses of happiness data in economics. *The Journal of Economic Perspectives* **20**: 25–46.

Dolan P, Peasgood T, White M. 2008. Do We Really know What Makes Us Happy? A Review of the Economic Literature on the Factors Associated with Subjective Well-Being. *Journal of Economic Psychology* **29**: 94–122.

Fehr E, Tyran JR. 2001. Does money illusion matter? *The American Economic Review* **91**: 1239–1262.

Ferrer-i Carbonell A. 2005. Income and Well-Being: An Empirical Analysis of the Comparison Income Effect. *Journal of Public Economics* **89**: 997–1019.

Ferrer-i-Carbonell A, Frijters P. 2004. How important is methodology for the estimates of the determinants of happiness? *The Economic Journal* **114**: 641–659.

Fisher I. 1928. *The Money Illusion*. New York: Adelphi.

Frey BS, Stutzer A. 2002. What Can Economists Learn from Happiness Research? *Journal of Economic Literature* **40**: 402–435.

Grabka MM. 2008. *Data Documentation 34*. DIW, Berlin.

Kahneman D, Krueger AB, Schkade D, Schwarz N, Stone AA. 2006. Would you be happier if you were richer?A focusing illusion. *Science* **312**: 1908–1910.

Kawka R, Beisswenger S, Costa G, Kemmerling H, Müller S, Pütz T, Schmidt H, Schmidt S, Trimborn M. 2009. *Regionaler Preisindex, Berichte Band 30*. Bundesinstitut für Bau-, Stadt- und Raumforschung.

Layard R, Mayraz G, Nickell S. 2008. The Marginal Utility of Income. *Journal of Public Economics, Special Issue: Happiness and Public Economics* **92**.

Luttmer EFP. 2005. Neighbors as negatives: Relative earnings and well-being. *The Quarterly Journal of Economics* **120**: 963–1002.

McCall J. 1970. Economics of Information and Job Search. *Quarterly Journal of Economics* **84**: 113–126.

Oswald A. 1997. Happiness and economic performance. *The Economic Journal* **107**: 1815–1831.

Oswald A. 2008. On the curvature of the reporting function from objective reality to subjective feelings. *Economic Letters* **100**: 369–372.

Schupp J, Wagner GG. 2002. Maintenance of and Innovation in Long-Term Panel Studies The Case of the German Socio-economic panel (GSOEP). *Allgemeines Statistisches Archiv* **86**: 163–175.

Shafir E, Diamond P, Tversky A. 1997. Money illsuion. *The Quarterly Journal Of Economics* **112**: 341–374.

Stiglitz J, Sen A, Fitoussi JP, Agarwal B, Arrow KJ, Atkinson AB, Bourguignon F, Cotis JP, Deaton AS, Dervis K, Fleurbaey M, Folbre N, Gadrey J, Giovannini E, Guesnerie R, Heckman JJ, Heal G, Henry C, Kahneman D, Krueger AB, Oswald AJ, Putnam RD, Stern N, Sunstein C, Weil P. 2009. *Report by the Comission on the Measurement of Economic Performance and Social Progress*. www.stiglitz-sen-fitoussi.fr.

Stutzer A. 2004. The role of income aspirations in individual happiness. *Journal of Economic Behavior and Organization* **54**: 89–109.

Stutzer A, Frey BS. 2010. Recent Advances in the Economics of Individual Subjective Well-Being. *Social research: An International Quarterly* **77**: 679–714.

Wagner GG, Burkhauser RV, Behringer F. 1993. The English Language Public Use File of the German Socio-Economic Panel. *The Journal of Human Resources* **28**: 429–433.

Weber B, Rangel A, Wibral M, Falk A. 2009. The medial prefrontal cortex exhibits money illusion. *PNAS* **106**: 5025–5028.