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## Conference Paper

# Do housing costs eat up all regional income disparities?

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2019: 30 Jahre Mauerfall - Demokratie und Marktwirtschaft - Session: Income Distribution, Inequality and Poverty, No. C13-V3

### Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

*Suggested Citation:* Klick, Larissa; Schaffner, Sandra (2019) : Do housing costs eat up all regional income disparities?, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2019: 30 Jahre Mauerfall - Demokratie und Marktwirtschaft - Session: Income Distribution, Inequality and Poverty, No. C13-V3, ZBW - Leibniz-Informationszentrum Wirtschaft, Kiel, Hamburg

This Version is available at:

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## *Do housing costs eat up all regional income disparities?*

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This version: March, 01 2019

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### **ABSTRACT**

There exists empirical evidence for Germany that income inequality has increased. Further, development of housing prices is quite heterogeneous between regions. In this paper we analyze regional inequality regarding purchasing power per capita. By contrast to the existing literature we apply comprehensive data on the 1x1 km level. Consequently, this very precise delineation gives much better insights into regional disparities also below the level of administrative borders. In accordance with the existing literature we cannot observe increasing regional disparities. Further, first results indicate that there is a strong correlation between purchasing power and housing costs

The regional disparities will be described via inequality measurements and its decomposition. By a strong positive correlation between the price index for house purchases (RWI-GEO-REDX) and purchasing power, a dilution of regional purchase power can be found when taking real estate prices into account. Regional disparities vanish according to the analysis of the small-scale data.

JEL-Codes: **J31, R23, R31**

**Keywords: Regional Disparities, Housing prices**

## INTRODUCTION

There is empirical evidence that earnings inequality in Germany has increased, especially driven with increases at the top of the distribution and decreases at the bottom of the distribution (Dustmann et al. 2009, 2014). Not only earning inequality but also income inequality and household equalized income has increased (Fuchs-Schündeln et al. 2010, Biewen and Juhasz 2012).

Additionally, after the economic crisis housing prices has sharply increased (Bundesbank 2013; Schier and Voigtlaender 2015) while real income especially at the bottom of the distribution even decreased (Goebel and Grabka 2017). Both of these trends, the increase of housing prices as well as the increased wage and income inequality cannot give insights into the inequality in Germany after controlling for housing costs.

Housing costs are by far the largest part of all private spending. Further, the share of housing costs differs by income. Moretti (2013) analyzes the skill premium in the US. He observes an increase in wage inequality between high skilled and low skilled workers. However, when taking housing costs into account the inequality between skill groups have less increased. This effect is driven by the high-skilled workers that move to cities with high wages. For Germany as well as for the US it is observed that wages are higher in big cities (e.g. Suedekum 2006, Blien et al. 2008, Combes et al. 2008). Further, housing prices are the highest in the big cities (e.g. Klick and Schaffner 2019).

We aim at analyzing regional disparities in purchasing power and how they are related to regional disparities in housing prices. We analyze the development over time as well as spatial differences between regions. We apply a unique dataset on the 1x1km level for Germany (RWI-GEO-GRID) in combination with real estate data (RWI-GEO-RED) and regional housing price indices (RWI-GEO-REDX) for Germany. In our analysis we analyze the development of regional inequality. First results indicate that inequality of purchasing power is relatively low between neighborhoods. However, it can be seen that there is a strong correlation between purchasing power and housing prices.

## DATA

The analysis is based on the RWI-GEO-GRID data (microm and RWI 2017). RWI-GEO-GRID data covers socio-economic information of the residents for all populated 1x1km cells in Germany. The 1x1km cells are defined by the European INSPIRE regulation. The data can be obtained by the FDZ Ruhr at RWI: The data set includes information on the number of residents, households and cars of each cell. Further, the share of different age groups, ethnic groups and sexes are documented. For the cars there are the brands and classes available. Besides the characteristics of the residents also information on purchasing power as well as credit default risk classes are available. A detailed description of the data can be found in Breidenbach and Eilers (2018).

We apply the data of the scientific use file that covers all cells that are populated by at least 20 residents in the respective years. The years 2005 and 2009-2016 are available for all Germany. The data is not individual data but the respective shares, means or sums of the variable within the grid cell are available. That means that the sum of purchasing power in the 1x1km<sup>2</sup> cell as the share of residents in the lowest payment index class are available in the data. The data set covers between 209 thousand and 217 thousand populated cells per year.

The credit default risk is a nine-category variable. For this variable the whole population is divided into nine evenly distributed risk classes of about 11 percent. Finally, for each cell the share of residents within each of the nine classes is calculated. The purchasing power is displayed as the overall sum within the grid cell. We calculated the purchasing power per capita by dividing this number by the number of residents in the respective year in the respective cell.

We further combine the data to data on private real estate and housing prices in Germany. First, we apply the RWI-GEO-RED data. It covers all private advertisements for sale and for rent for all Germany between 2007 and October 2017 on the real estate platform ImmobilienScout24. ImmobilienScout24 is the biggest real estate online platform in Germany. There are four different types of advertisements: houses for sale, apartments for sale, houses for rent and apartments for rent. For all of these advertisements the data covers characteristics like size (plot size and number of rooms), .... Further, there exist geo-coded address information. Unfortunately, for the first years the address was not mandatory. Therefore, not all advertisements have a proper address. From 2016 on all ads are geocoded. The addresses are assigned to the same 1x1km cells as the RWI-GEO-GRID data. This data is also provided by the FDZ Ruhr at RWI. A detailed description of the data can be found in Boelmann and Schaffner (2018).

Further, we also combine the data set with the RWI-GEO-REDX data as data on regional housing prices. These housing price indices are based on the RWI-GEO-RED data. The data covers the regional price indices that are based on a hedonic price regression. The price indices cover all German district (Landkreise and kreisfreie Städte) as well as information for most municipalities.

## EMPIRICAL STRATEGY

To accompany the small area data, indices from the Generalized Entropy class are applied to measure purchasing power inequality, afterwards the decomposition of purchasing power inequality follows and finally a functional interaction between price indices and Purchasing power will be analyzed.

First, we apply standard inequality measures for the purchasing power per capita on a regional level. We estimate the Theil1 inequality measure:

$GE(\alpha = 1) = I_{theil1}(y) = \frac{1}{N} \sum_{i=1}^N \frac{\bar{w}}{w_i} \log \left( \frac{\bar{y}}{y_i} \right)$  with  $y_i$  being the mean Purchasing power per capita of the 1x1km cell  $i$  at time  $t$ ,  $\bar{y}$  is the mean of Purchasing power over all  $N$  1x1km cells

Additionally, the Theil2 index is considered. It gives a more weight to the top of the income distribution and can be formulated as:

$$GE(\alpha = 2) = I_{theil2}(w) = \frac{1}{2N} \sum_{i=1}^N \left[ \left( \frac{\bar{y}}{y_i} \right)^2 - 1 \right].$$

. Above, the percentile ratio of the 90% to 50%-percentile as well as the 90% to 10%-percentile is evaluated. All these measurements aim at giving a comprehensive insight into the inequality of purchasing power in Germany measured on a very small regional scale.

In the second step a decomposition of the Theil index follows in a between and within component to describe the composition of power Purchasing inequality in Germany.

The within component can be described as  $GE_{within}(\alpha) = \sum_{k=1}^K \left( \frac{N_k}{N} \right)^{1-\alpha} \frac{y_k}{Y} GE(\alpha)$ ,

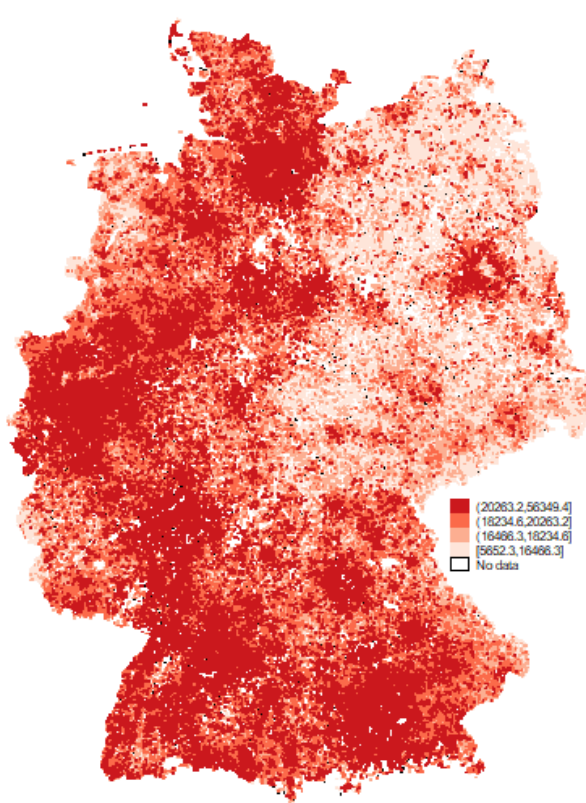
With  $N_k$  being the numbers of members in subgroup  $k= 1, \dots, K$  resp. the number all the grids belong to the respective subgroup and  $y_k$  being the mean purchasing power in group  $k$  relative to the total purchasing power in all grids  $Y$ . While the between component is therefore:

$GE_{between}(\alpha) = GE(\alpha) - GE_{within}(\alpha)$ , so that they add to the Generalized Entropy index.

Thirdly, the connection between purchasing power and regional price levels is analyzed. While purchasing power increase on absolute terms, a decrease in real terms might still be vital. When cost

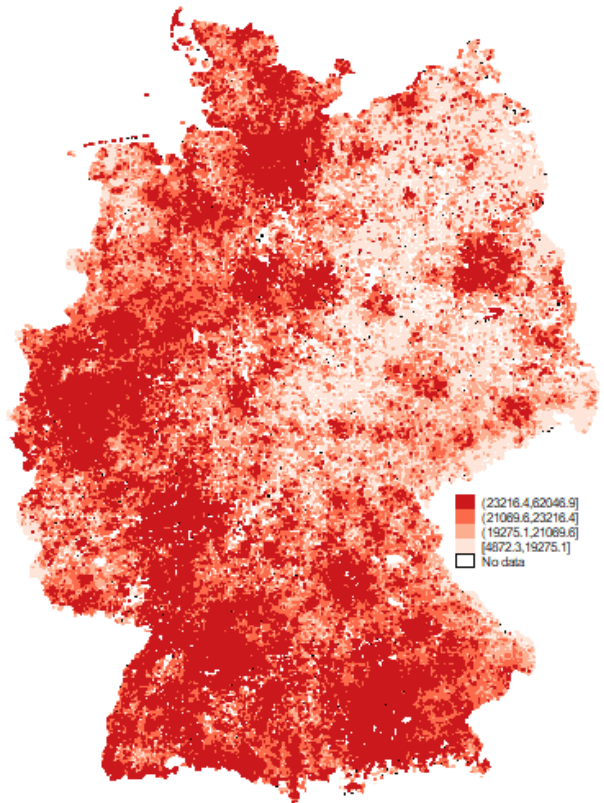
of living – in the here referred context real estate prices – increase proportionally to the Purchasing power, effects of high Purchasing power might even out between regions. Very new Price index unique data set, Eat up Income?

## FIRST RESULTS



2009

Figure 1: Purchasing Power on 1x1km level



2016

Figure 2: Purchasing Power in Germany on 1x1km level

Figure 1 presents the distribution of purchasing power on the 1km<sup>2</sup> level. The purchasing power per capita is the highest in big cities as well as in Baden-Wurttemberg and Bavaria.

There already exists evidence that inequality in Germany is relatively low. However, there is evidence of increasing inequality in the most recent decades. Table 1 presents the different measures of inequality for purchasing power on the 1x1km level. All measures are very low. However, it has to be taken into account that it is the inequality between neighborhoods and their mean purchasing power per capita. Theil 1 and Theil 2 index are quite similar indicating that the structure is quite similar in the upper and the lower part of the distribution. All inequality measures sharply decreased between 2005 and 2009. Afterwards inequality is further decreasing.

Further, we analyze the regional inequality by urbanization. Therefore, we estimate inequality only between all rural cells separately. The same is done for peri-urban and urban regions. The definition of rural and urban areas is implemented on the district level taken from BBSR (BBSR INKAR 2018). Inequality is somewhat higher between urban regions, while there are almost no differences between peri-urban and rural grids. However, the differences between urban and rural areas are relatively small. Further, the development is similar to the overall development.

**Table 1: Inequality measures for purchasing power in Germany, analyzed on 1x1km level**

year	Theil2	Theil1	p90p50	p90p10
2005	0.0395	0.0379	1.4009	1.9962
2009	0.0144	0.0139	1.2408	1.5009
2010	0.0172	0.0162	1.2375	1.5139
2011	0.0142	0.0135	1.2335	1.4812
2012	0.0145	0.0137	1.2395	1.4847
2013	0.0142	0.0134	1.2350	1.4763
2014	0.0145	0.0137	1.2395	1.4847
2015	0.0128	0.0123	1.2279	1.4563
2016	0.0123	0.0118	1.2228	1.4420

Source: RWI-GEO-GRID data, own calculation; Inequality measures on 1x1km level

**Table 2: Inequality measures by level or urbanization**

year	urban		peri-urban		rural	
	Theil1	Theil2	Theil1	Theil2	Theil1	Theil2
2005	0.033	0.031	0.030	0.029	0.040	0.038
2009	0.016	0.016	0.011	0.010	0.012	0.012
2010	0.018	0.017	0.013	0.012	0.017	0.015
2011	0.016	0.015	0.011	0.011	0.012	0.011
2012	0.016	0.016	0.012	0.011	0.012	0.011
2013	0.016	0.015	0.011	0.011	0.012	0.011
2014	0.016	0.016	0.012	0.011	0.012	0.011
2015	0.015	0.014	0.010	0.010	0.011	0.010
2016	0.015	0.014	0.010	0.009	0.010	0.010

Source: RWI-GEO-GRID data, own calculation; Inequality measures on 1x1km level.

Based on these first measures of inequality the Theil1- and Theil2- indices are decomposed into the between and the within component as described in the previous section. As a first step groups are defined by rural, peri-urban and urban. Therefore, inequality between groups covers the inequality between rural, peri-urban and urban regions. Inequality within a group similarly covers the inequality within all urban areas etc. Table 2 already indicates that the inequality between the levels of urbanization are relatively low. This finding is confirmed by the decomposition displayed in Table 3. Inequality between the regions is negligible. Most of the measured inequality is driven by inequality within each of the levels of urbanization.

**Table 3: Decomposition of Inequality in Between and Within Component by Level of Urbanization**

year	$GE_{between} (2)$	$GE_{between} (1)$	$GE_{within} (2)$	$GE_{within} (1)$
2005	0.0051	0.0050	0.0344	0.0329
2009	0.0018	0.0018	0.0126	0.0121
2010	0.0017	0.0017	0.0155	0.0145
2011	0.0016	0.0016	0.0126	0.0119
2012	0.0016	0.0016	0.0129	0.0121
2013	0.0016	0.0015	0.0126	0.0118
2014	0.0016	0.0016	0.0129	0.0121
2015	0.0014	0.0014	0.0114	0.0109
2016	0.0013	0.0013	0.0110	0.0105

Source: RWI-GEO-GRID data, own calculation; Inequality measures on 1x1km level

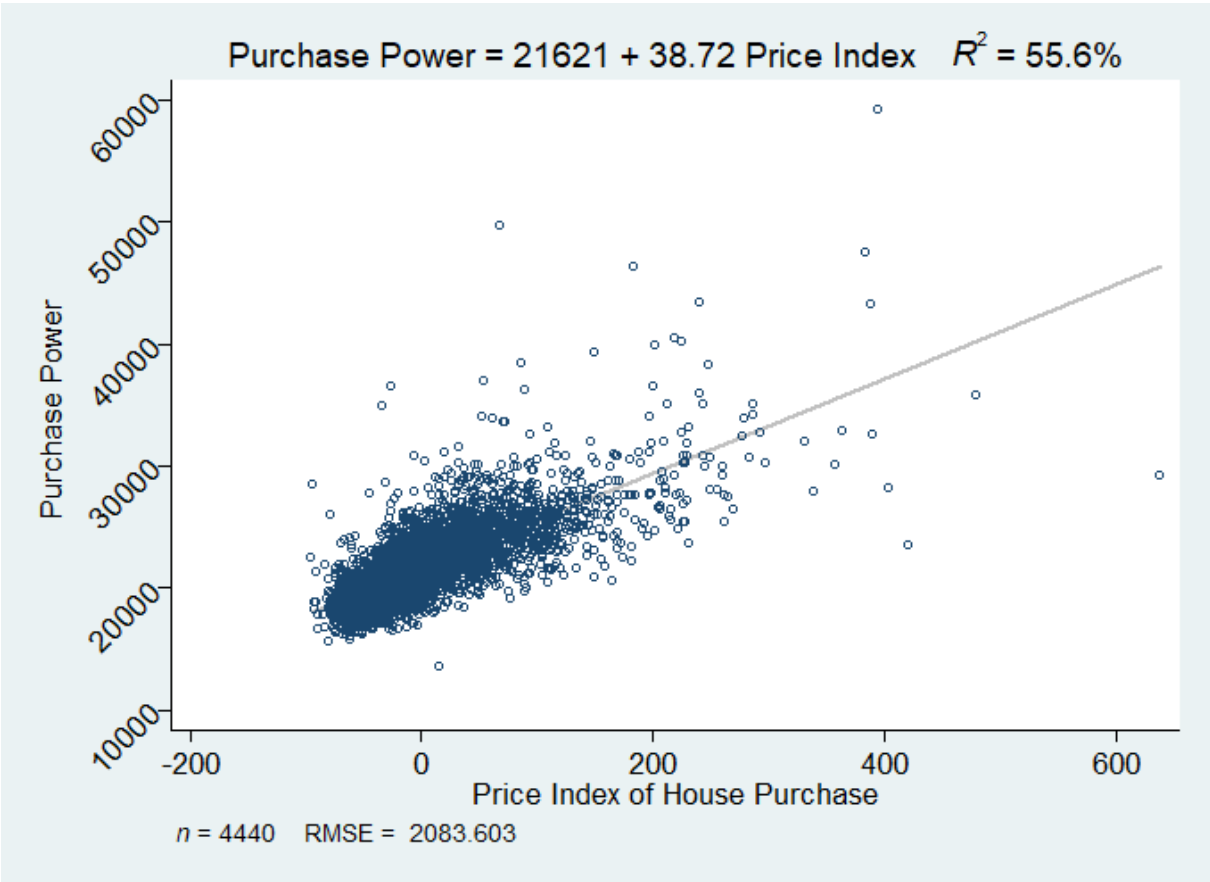


Figure 2: Correlation between Regional Price Index and Purchasing Power aggregated on municipality level in 2016

Beyond the component of A high explanatory value of house purchase prices on municipality level can be found on Purchasing power aggregated on municipality level in 2016, comparing Figure 4. It implies a statistical relationship and a strong interaction between the two variables.

The further plan is to deflate the income by the regional Price Index for Real estate and get insights in the importance of prices for inequality measurement on the 1x1km level.



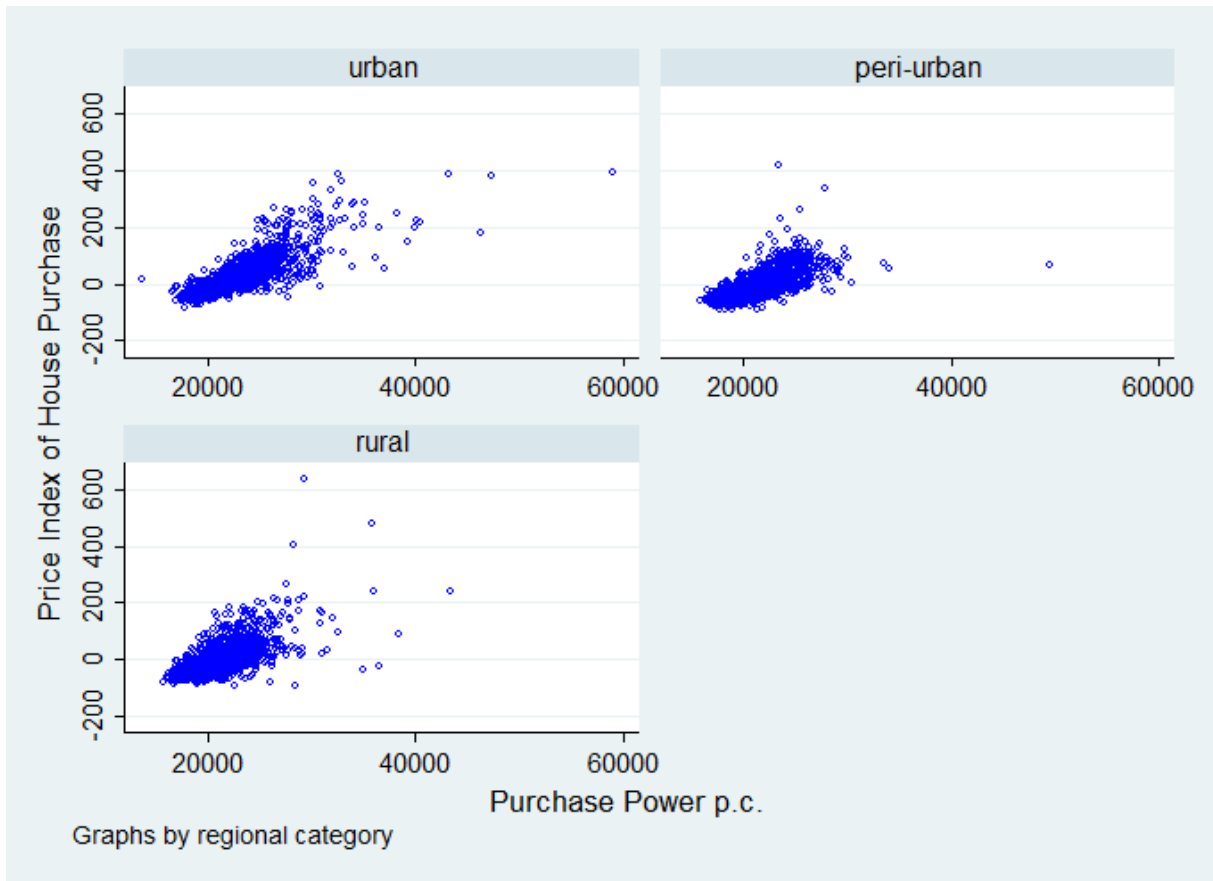
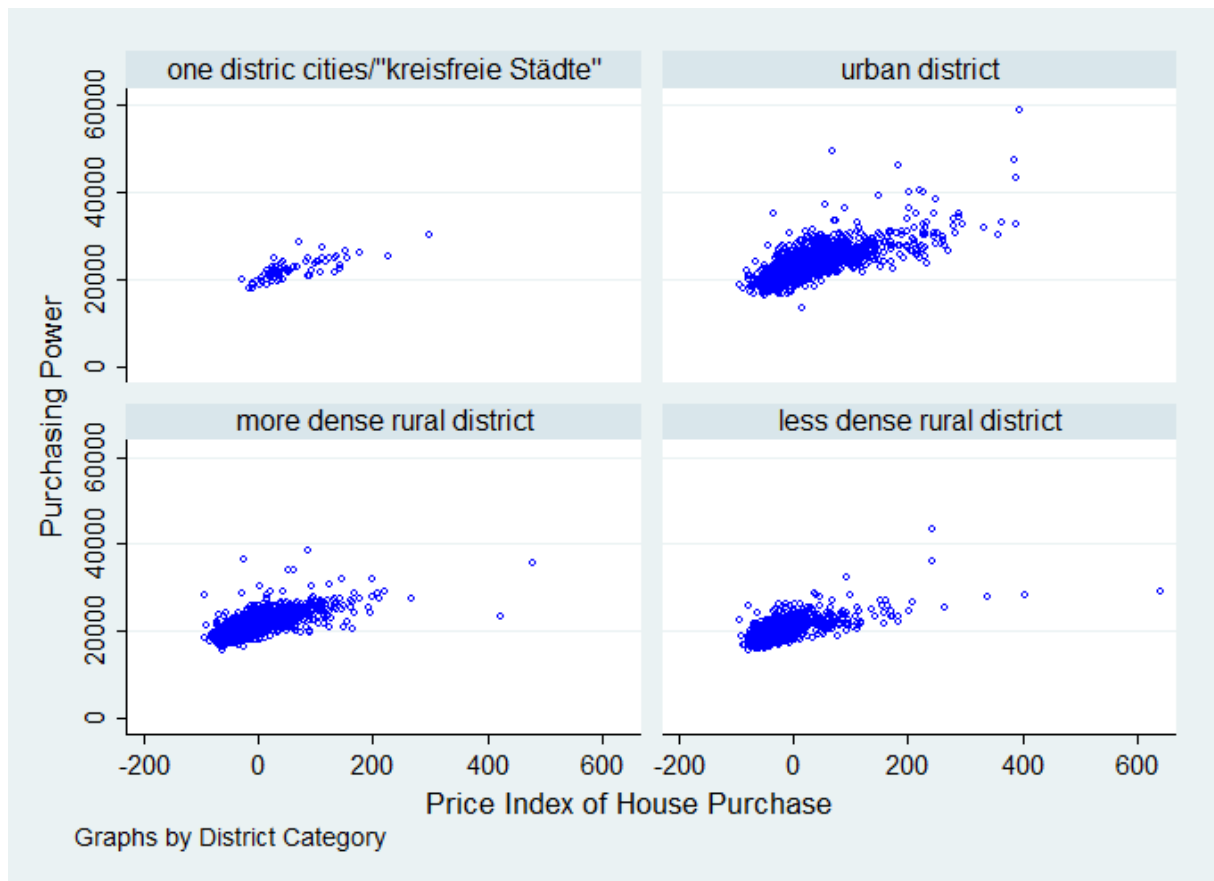


Figure 3: Purchasing Power to Price Index for House Purchase on Municipality Level in 2016 by regional category

When connecting the local Purchasing power in the grid with the regional price index for house prices the positive correlation can be found in all different region categories. In rural municipalities the positive outliers with high prices for house purchase meet a medium Purchasing Power compared to the high house prices due to the high Bavarian Municipalities close to Starnberg and Munich.





**Table 3: Decomposition of Inequality in Between and Within Component by District Category**

year	$GE_{between} (2)$	$GE_{between} (1)$	$GE_{within} (2)$	$GE_{within} (1)$
2005	0.0072	0.0070	0.0320	0.0307
2009	0.0024	0.0024	0.0120	0.0114
2010	0.0024	0.0024	0.0148	0.0138
2011	0.0023	0.0023	0.0119	0.0112
2012	0.0025	0.0024	0.0121	0.0112
2013	0.0023	0.0023	0.0118	0.0110
2014	0.0025	0.0024	0.0121	0.0112
2015	0.0021	0.0021	0.0107	0.0102
2016	0.0019	0.0019	0.0104	0.0098

## CONCLUSION

In this study we analyze regional inequality regarding purchasing power in Germany. Regional inequality reported in other sources is debated by the analysis. While we do not find regional inequality when comparing all 1x1km grids neither do we find them between region types or district categories. The importance of functional areas of labor does not seem to foster the inequality. Although the functions of urban areas as economic center of interest and the average lower economic importance of rural regions does not explain the variation of regional income inequality.

This leads to the assumption that the inequality lies within smaller areas and cannot be captured with small scale data on a national level.

A further look inside regions becomes a vital interest as Germany as a whole is not equal in income and regional disparities possibly evens out national wide. Define additional regions to have a closer look into developments.

When going into regional developments and inequalities the local price level becomes a crucial factor in the purchasing power of households. A relevant correlation between income and real estate price index can be shown and needs to be used in further analysis to draw a full picture of economic possibilities of households. A high income household can afford a house on an expensive local housing market while a low-income household might have to evade the market.

The motivation to do the analysis on 1x1km level is that there is much to discover below the level of districts, that is most commonly used in regional analysis on Germany, and even beyond the municipality level regions, towns and even villages are not homogenous. Especially, if one can detect high power purchase differences in a small radius or even the nearby neighborhood grids, and regional income inequality may be problematic for the low-income households as they share a local consumer basket and prices with high income households that give the lead for regional prices. E.g. low-income households searching a house on a high demand/low supply real estate market fall behind against higher-income households. Individuals with higher purchasing power determine the formation of prices on the regional real estate market.

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