REGIONALIZATION OF THE CONSUMER PRICE INDEX IN THE CZECH REPUBLIC

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Abstract

The aim of the paper is to propose a possible methodology for calculating Regional Price Index (RPI) at the NUTS3 level based on Consumer Price Index (CPI). The fundamental application of RPI is mainly spatial price comparison and adjustment of nominal indicators such as nominal net disposable household income (NDHI), which are used in economic and political practice for the detection of interregional disparities. The fundamental hypothesis of the paper is that higher income tend to be compensated for by higher consumer prices. Therefore, the comparison of nominal values of indicators such as NDHI across regions does not reflect the real social-economic status of the region and its inhabitants. The article assesses the possibility of using the price probes of the Czech Statistical Office for regionalization of the CPI and calculates the RPIs for each NUTS3 region of the Czech Republic, which makes it possible to verify the fundamental hypothesis.

Key words: regionalization, CPI, real indicators.

JEL Code: C21, R13, R31

Introduction

The paper is aimed at the issue of regional price disparities in the context of assessment of the standard of living in the regions of the Czech Republic, or more specifically on the possible trade-off between the levels of prices and of nominal incomes in the regions. The main subject of the research lies in the construction of a Regional Price Index (RPI) based on the generally well-known and widely used Consumer Price Index (CPI). The RPI will be then applied as an instrument of rectification of nominal indicators used as measures of social-economic ranking of regions in the Czech Republic.

The fundamental research hypothesis claims, the higher levels of income of households (measured by the Net Disposable Household Income; NDHI) generally tend to be compensated for by higher consumer prices. Therefore, comparison of nominal values of

NDHI across regions does not illustrate the real social-economic position of the region's inhabitants.

The quantification and evaluation of regional disparities remains one of the most up-to-date topics of regional politics. According to Czech and foreign authors, the role of the supply side is often overestimated in the regional policy at the expense of the demand side, or more specifically of real income per Capita. The effect of the level of real living costs is perceived by the current theories of regional development as an impact of localization of corporations. It is presumed (to a great extent controversially) that the consumer prices are lower and the real estate prices are higher as a result of economies of agglomeration (Šimanová & Trešl, 2011). According to Viturka (2007), the price factors belong to the group of middle-important determinants of regional competitiveness. Kahoun (2011) considers the fact that the regional differences in price levels remain neglected, highly limiting for accountable regional comparison, especially because the difference in price levels between the Czech regions are significant. (Kahoun, 2011)

Following the EKS (Éltetö-Köves-Szulc) and PPS (purchase parity standard) method, Čadil, Mazouch, Musil, and Kramulová (2012) estimated the regional price levels in 2007 – 2009 for NUTS3 in the Czech Republic. The authors state rather high price homogenity across the regions of the Czech Republic in comparison to other member countries of the European Union. Nevertheless, they do not reflect other aspects of regional price levels, e.g. the impact on the real income disparities of inhabitants, real interregional disparities. (Čadil, Mazouch, Musil & Kramulová, 2012)

In the German NUTS3 regions, the regional price index was calculated in 1996 – 2004 on the basis of CPI and HRI (housing rent index). The spatial CPI patterns were found relatively stable in time. The real regional disparities were proved to diminish at a higher pace than the nominal ones, especially across East German regions. (Kostele & Eckey, 2008) (Kosfeld, Eckey & Lauridsen, 2010) (Schulze, 2003) In the United Kingdom, the issue of real regional disparities has been tackled by Overman and Gibbons, who focus solely on the prices of housing. During their research in 1998 – 2008, a significant trade-off between the level of wages and the costs of living was identified. Therefore, they recommend the economic policies should target the individual inhabitant and should attempt to improve his/her individual position, which will result in raising the situation of the whole region more efficiently than focusing on a geographically determined region. (Overman & Gibbons, 2012). In the USA, the researchers from the Bureau of Economic Analysis are deeply engaged in the issue of metropolitan and nonmetropolitan price indices among others also in the context of

real income of population. They discovered a higher variability in real incomes in the nonmetropolitan areas than in the metropolitan ones. (Aten, Bettina, Figuera & Martin, 2013)

1   Methodology

The consumer basket used for the CPI in the Czech Republic consists of nearly 800 items, segmented into 12 classes. Each item is assigned an individual weight so that the sum of all the weights gives 1000. The data on prices of all the representatives are probed in 35 districts regularly three times a month. The only exceptions to this rule are such commodities, prices of which are investigated centrally from one or a few data sources. These commodities are usually formed in sub-indices, but most of them are not relevant for calculation of RPI anyway (see presumption 2 and 3 below). The crucial role in spatial comparison of price levels will be most probably played by the immobile (local) services and by costs of living.

When constructing the RPI (based on the CPI) on the level of NUTS3 in the Czech Republic, it is necessary to take into account the following simplifying presumptions:

1) With respect to a small area and low differentiation of the surface of the Czech Republic, the consumer behavior and practice will be considered homogenous across all the regions of the Czech Republic. Thus, the weights in the consumer basket for RPIs will be identical with the weights of the total CPI.

2) Some of the items in the consumer basket have demonstrably and unequivocally null price variation across the regions of the Czech Republic (such as stamps, newspapers, journals, cigarettes, public administration services, train connections, etc.) and can be with no risk disqualified from the RPI consumer basket.

3) Other commodities (mostly services) prices of which are generally investigated centrally and consumption of which usually runs across regions (such as accommodation in hotels, recreation or leisure centers, purchase of a car, services of travel agencies, etc.) can be also disqualified from the RPI consumer basket.

4) Prices of representative goods and services are mostly probed in regional or district centers (in approx. 45 % of all district centers in the Czech Republic), consequently they are incapable of regarding the sub-regional price.

1.1   Methodology of CPI Regionalization

Following the presumptions 2 and 3 above, the list of price representatives was reduced by 123 items, the regional price variability of which was found negligible. These items together

create 19.2 % of the total CPI consumer basket (e.g. telephone services, cigarettes, financial services, etc.). The overview of disqualified representatives summed up by their classes and the total of their weights provides the following fig. 1.

Fig. 1: Price Representatives Disqualified from the RPI Consumer Basket
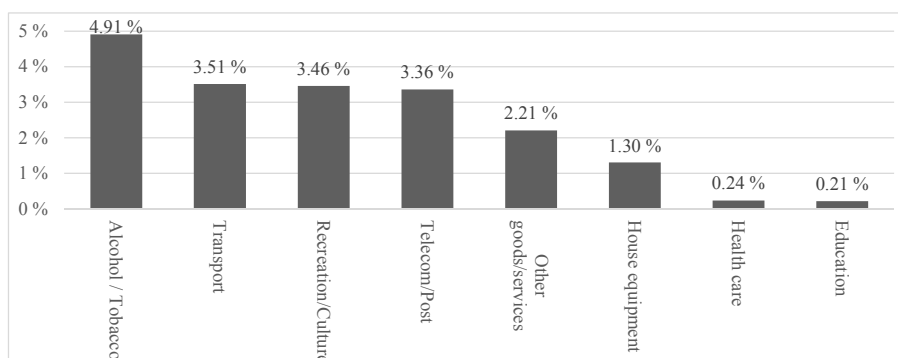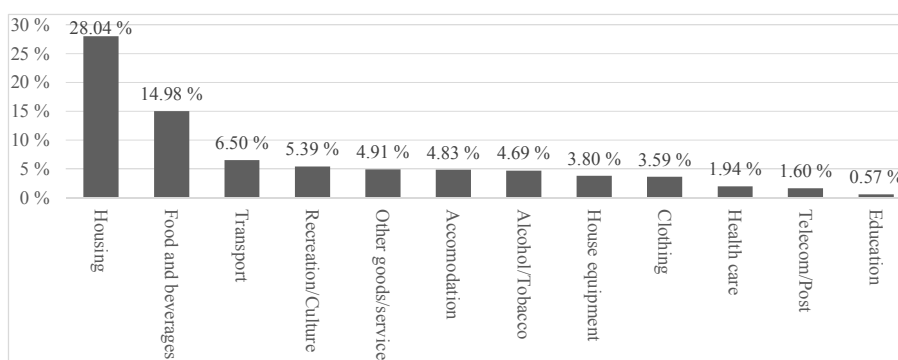

Source: authors' calculations

All other items of the consumer basket form the base set of price representatives for calculation of RPIs. Their aggregated listing including the share of the weights of the classes on the total CPI basket illustrates the fig. 2. The sum of their shares has naturally the value of 80.8 %.

For calculation of RPI in this paper only the selection of 113 price representatives was used. They form 47 % of the weight of the base set of CPI consumer basket and their structure corresponds to the distribution of commodity classes in the CPI basket. The highest share show the price representatives associated with the costs of living (nearly 30 % – see fig. 2).

Fig. 2: Structure of the Consumer Basket for RPI

Source: authors' calculations

Laspeyres modified price index will be used for calculation on RPI (Roos, 2006):

$$RPI_r = \frac{\sum_{i=1}^{N} p_i^r q_i}{\sum_{i=1}^{N} p_i^a q_i} = \sum_{i=1}^{N} \frac{p_i^r}{p_i^a} \frac{p_i^a q_i}{\sum_{i=1}^{N} p_i^a q_i} = \sum_{i=1}^{N} \frac{p_i^r}{p_i^a} w_i \qquad (1)$$

where p_i is the price and q_i is the quantity of good or service i consumed in a region r, a stands for the regional average, in this case the average price of the whole Czech Republic used in CPI calculation. As can be seen in (1), Laspeyres index is the sum of all relative prices between the region of interest and the national average price, weighted by the expenditure shares w_i of each individual item of the consumer basket of the Czech Republic (see presumption 1). (Roos, 2006)

The prices of individual representatives are calculated using moving average for each year and region in the years 2009 – 2012 (the original probe has been carried out by the Czech Statistical Office in the framework of national price investigation for CPI). The data on costs of living originate from the same source, specifically from the regional sample survey of the Czech Statistical Office in 2009 – 2012. The individual weights in the consumer basket are – following the presumption 1 – constant for all the years and originate from the revision of consumer basket performed by the Czech Statistical Office in 2010.

Using these data, the RPIs will be calculated and the hypothesis of potential trade-off between the regional level of consumer prices and the regional level of nominal net disposable household income (NDHI) will be tested by instruments of correlation analysis.

1.2   Methodology of Regional Disparities Assessment

In the second step, the authors are about to test the variability of the regional real NDHI and the regional nominal NDHI and to prove the application of RPIs on the nominal NDHIs significantly rectifies the regional differences on the given 5% level of significance.

Since the data seem to be heavily skewed, Brown-Forsythe test on homoscedasticity based on median will be applied rather than Levene's variance check based on arithmetic mean. (Maršíková & Kocourek, 2012) (Brown & Forsyte, 1974)

The test statistic W has the following form:

$$W = \frac{(N-k)}{(k-1)} \frac{\sum_{i=1}^{k} N_i (Z_i - Z_{..})^2}{\sum_{i=1}^{k} \sum_{j=1}^{N_i} (Z_{ij} - Z_{i.})^2} \qquad (2)$$

where W is the result of the test, k is the number of groups (in our case 2 – nominal NDHI and real NDHI), N is the count of all cases in all groups (in our case 112), N_i is the number of

cases in the *i*-th group (in our case 56), Y_{ij} is the value of the NDHI for the *j*-th case in the *i*-th group, $Z_{ij} = \left| Y_{ij} - \tilde{Y}_{i.} \right|$, $\tilde{Y}_{i.}$ is the median of *i*-th group, $Z_{..} = \dfrac{1}{N} \sum\limits_{i=1}^{k} \sum\limits_{j=1}^{N_i} Z_{ij}$, and $Z_{i.} = \dfrac{1}{N_i} \sum\limits_{j=1}^{N_i} Z_{ij}$. The significance of *W* statistic is tested against $F(\alpha, i-1, N-i)$, where $\alpha = 0.05$.

2. Results

The resultant values of RPIs for each region and year are shown in fig. 3. As expected, the highest RPIs are recorded for Prague region, while the lowest values are reached by region Vysočina, South Bohemian, Pardubice and Olomouc region. The fig. 3 also demonstrates, the differences among the individual regions are rather stable and do not change much over time (although the time series is too short for making any definitive conclusions).

In the following step of the analysis, the results of RPIs were confronted with the regional values of nominal NDHIs per Capita (shown in fig. 4). Both figures suggest there might me some trade-off between the regional NDHI per Capita and the RPI, the higher nominal NDHI per Capita seems to be compensated for by the higher values of RPI.

Fig. 3: RPIs in NUTS3 Regions of the Czech Republic, 2009 – 2012
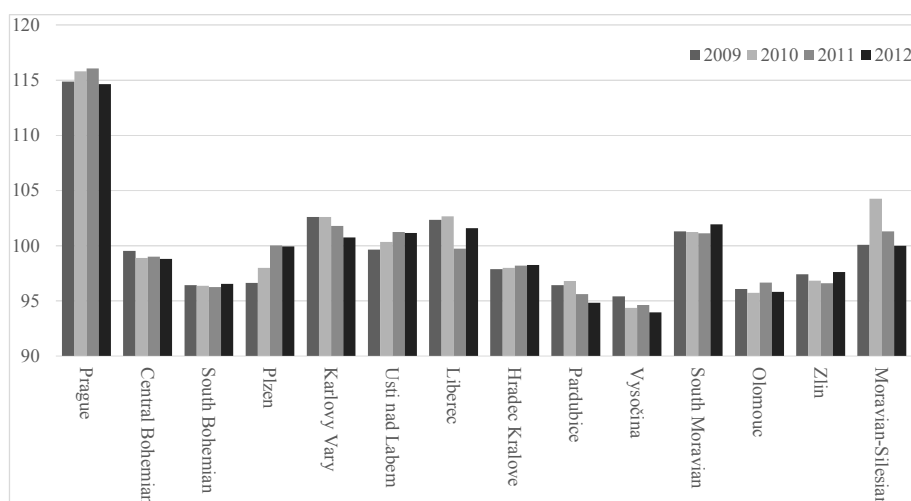
Source: authors' calculations

The outcomes of the correlation analysis are summarized in fig. 5. The left part of the figure demonstrates a rather strong and significant direct trade-off, but also shows a group of extreme outliers formed by the results of Prague region. Due to these outliers the data set does not conform to the requirement of normal distribution (presumption of correlation analysis) and the results therefore cannot be accepted.

**Fig. 4: NDHIs in NUTS3 Regions of the Czech Republic, 2009 – 2012**
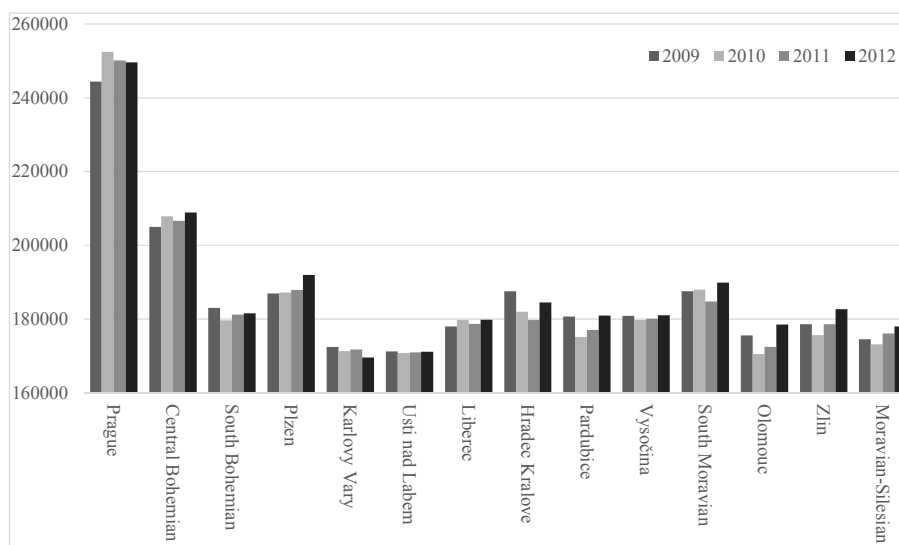
Source: authors' calculations

After excluding Prague region from the data set, significant trade-off between the regional RPIs and NDHIs was not proved at the 5% level of significance. The slope of the correlation line in the right part of the fig. 5 does not differ significantly from zero (*P*-value = 0.7126).

Fig. 5: Correlation of RPIs and NDHIs in the NUTS3 Regions, 2009 – 2012

(including Prague Region left, excluding Prague Region right)
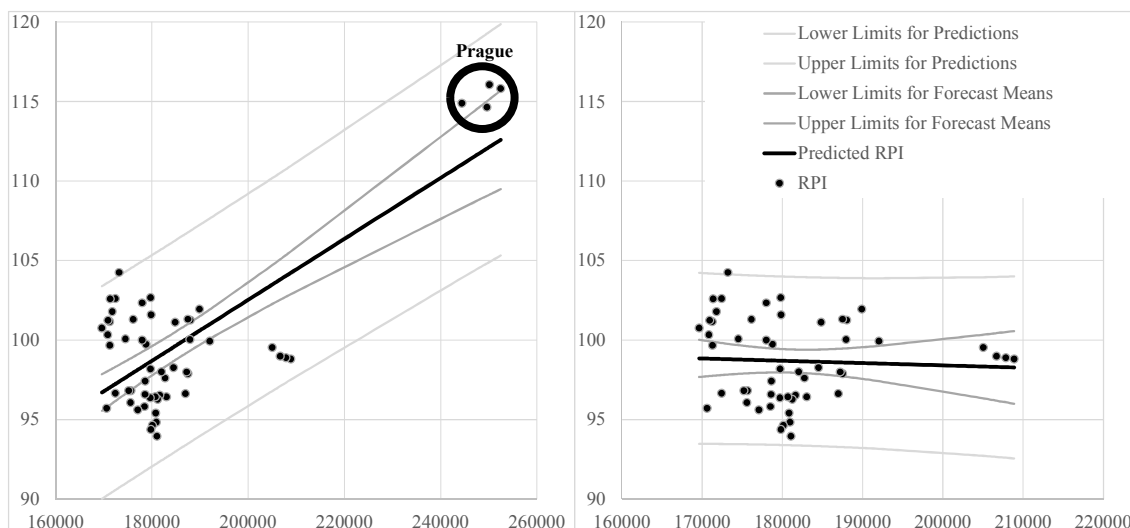
Source: authors' calculations

The second hypothesis of this article is focused on validations of the statistically significant influence of regional price levels on the extent of recorded interregional social-economic disparities. For this purpose, the nominal values of regional NDHIs per Capita were

refined by the RPIs. The resultant values of real NDHIs per Capital were calculated for all regions and years 2009 – 2012. The results of Brown-Forsythe test on homogeneity of variance are summed up in the table 1. Since the *P*-value exceeded the 5% level, the null hypothesis of homogeneity of variances was rejected. Thus, we can conclude the RPI significantly reassess the regional disparities as measured by NDHI. In fact, the interregional differences measured by nominal NDHI per Capita are wider than the real disparities.

Table 1: Results of the Brown-Forsythe test on homoscedasticity

Nominal NDHI variance	385,616,928.63	Real NDHI variance	173,538,524.26
Statistic *W*	0.191053	Critical *F* (0.05, 1, 110)	3.927394
P-value	0.662898	Alpha	0.050000

Source: authors' calculations

Conclusion

The correlation analysis across all regions of the Czech Republic verified the statistically significant trade-off between the RPIs and NDHIs, when higher NDHIs imply higher RPIs. This finding is, however, fundamentally biased by the outliers of Prague region. Following the requirement of normal distribution of the data, the outlying records were removed and in the statistical sample of 13 regions of the Czech Republic (excluding Prague), the hypothesis of significant trade-off among NDHI and RPI was **not confirmed**. In other words, the regions of the Czech Republic do not show any strong linkage between the levels of NDHI per Capita and the regional levels of prices (at the 5% level of significance).

In the second step of the analysis, the variability of the statistical set of regional nominal NDHIs per Capita was tested against the variability of the regional real NDHIs per Capita. The significant impact of application of RPI was verified at the 5% level of significance. The nominal indicator of social-economic position of an average individual in the NUTS3 region of the Czech Republic recorded significantly higher variability than the real indicator. Thus, the differences in prices across regions decrease the interregional disparities and to some extent improve the social-economic situation of inhabitants of problematic regions of the Czech Republic.

More precise definition of localities as well as methods of assessing the real economic and social disparities (using the regional price index) is desirable for increasing the efficiency of applied instruments of regional policies. It seems more suitable to focus the policies of regional development more on the social-economic situation of the individuals and implicitly

the position of geographically determined region. Taking into account the instruments of economic policies acting as stimuli of wealth resources allocation, it is obviously crucial which subject will receive the support. (Kraft, & Kraftová, 2009)

Spatial assessment of the relative regional price differences has the potential of improving the understanding of some of the market problems and represents an important mean of more precisely targeted interventions of economic policy. The regional price levels play a crucial role in consumers' decision making, in localization of economic subjects, and as such can influence the extent of regional disparities.

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