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Abstract

When studying large countries, having access to infra-national, regional cost-of-living indicators is important (i) to be able to make (income- or expenditure-based) welfare comparisons across regions net of differences in prices, or (ii) to construct national welfare measures based on individual-level measures of welfare that reflect local variations in prices faced by households. Regional cost-of-living indices are however not always available or may not be updated as regularly as national CPI series. We therefore propose a simple approach for calculating regional cost-of-living deflators that does not require access to data on prices and that can be implemented directly from standard surveys on income and living conditions. We apply to the calculation of regional cost-of-living index methods that have been advocated for the similar problem of estimating equivalence scale parameters: we use subjective satisfaction data to capture indirect utility and adopt non-parametric matching methods to construct regional cost-of-living indices. As an illustration, we construct price indices for Russian regions from the Russian Longitudinal Monitoring Survey for the period 2000–2015 and compare our cost-of-living deflators with those from the Statistical Office of Russia (available from 2009 only). Over the years covered by both series, the indices correlate highly but not perfectly. Reassuringly, re-calculating inequality and poverty series for Russia over the whole period with application of regional price indices does not appear to alter broad trends.

Keywords — cost-of-living indices; regional deflators; income; subjective well-being; matching; Russia; RLMS

1 Introduction

To make meaningful welfare comparisons based on income (or expenditure) across individuals living in different places (or observed at different points in time), it is clearly important to adjust for differences in the prices faced by individuals. Determining how to make valid inter-temporal and international welfare comparisons is a whole field of research in itself (see, e.g., Almås (2012)). In large countries, prices may also vary substantially across different regions within the country. Being able to account for infra-national (regional) cost-of-living differences is important in at least two situations. First, and most obviously, it is critical to correct for the local price differences if one is interested in making direct welfare comparisons of regions based on income or expenditure data. Not doing so would lead to an overestimation of the welfare level of people living in 'expensive' regions and underestimate the welfare of people living in comparatively 'cheaper' regions. Second, one also need to account for regional prices differences when constructing aggregate, national series of social welfare indicators—such as inequality or poverty series—since such series should reflect heterogeneity of individual welfare across the country. To adequately reflect such heterogeneity in individual welfare, individual incomes need to be adjusted for differences in cost-of-living.

Income deflators used to adjust for differences in the prices faced by different individuals are typically based on price indices constructed from data on prices and consumption over time and/or across countries, such as the consumer price index or purchasing power parity series. While these are almost universally applied by practitioners, the construction of such series is complex, data demanding and not without conceptual and empirical problems—such as how to reflect individual differences in consumption baskets, the change in consumer behaviour, the introduction of new products and outlets, changes in the quality of goods, etc. (see, e.g., Diewert (1998)). The development of those series is therefore typically entirely conducted by specialist agencies and statistical offices.

Beyond potential concerns about the measurement and construction of price indices, a more pragmatic issue for practitioners is that regional price indices are not always available, or not released as frequently as national series by statistical offices in charge. This may practically limit the possibility to do adequate adjustments for regional cost-of-living differences in welfare analysis.

We therefore propose a simple approach for constructing regional cost-of-living deflators that does not require access to data on prices but that can be implemented directly from standard surveys on income and living conditions. This allows practitioners to generate their own regional income deflators in cases where regional prices indices are not readily available. Moreover, even when regional price indices do exist, it can be of interest to assess the robustness of one's results to the use of an alternative series of cost-of-living measures, especially in the light of the debates about the best way to construct prices deflators based on price data.

The proposed approach for the calculation of regional cost-of-living indices directly draws upon a methodology that has been advocated for the similar problem of estimating equivalence scale parameters. In a nutshell, we use subjective satisfaction data to capture indirect utility given income,

needs and local prices and then adopt a non-parametric matching method to assess 'counterfactual' indirect utility given income, needs and prices in a reference region and finally use those matched pairs to construct regional cost-of-living indices that equalize, in expectation, counterfactual indirect utility across regions for households of identical needs. The approach has two advantages. First, the data required for implementing these methods merely consist in income, household attributes that capture differences in needs (e.g., household composition, age of members, home ownership status, employment status, and possibly educational attainment, etc.) and, crucially, a variable that approximates household financial welfare. In the tradition of the 'Leyden school' and of more recent applications to the estimation of equivalence scale parameters, the latter can be assessed using self-reported, subjective variables of satisfaction with one's own financial situation ((Biewen & Juhasz (2017); Van Praag (1968); Melenberg & van Soest (1995); Bellemare et al. (2002))).[1] Many standard surveys on income and living conditions collect such variables. Second, the methodology is simple and involves no parametric assumptions.

Two key conditions must be satisfied for the approach to be valid. First and most obviously, the subjective variable of household financial welfare must accurately reflect differences in financial situations across responding households. This requires comparability of subjective responses across households sharing similar observable characteristics. It also requires that there is sufficient variation in the ordinal responses of households in the survey. Second, conditional independence between the unobserved, idiosyncratic component of (subjective) financial welfare and region of residence must hold conditionally on observable household characteristics, income and regional prices. This second condition means that the financial welfare of a household with a given income and observable characteristics can only vary across regions as a function of the regional cost-of-living differences. No other regional factor that should *not* be reflected in the cost-of-living index influence subjective financial welfare.

We illustrate our approach on Russian regions using data from the Russian Longitudinal Monitoring Survey and compare our cost-of-living deflator with official regional price indices provided by the Russian statistical office. Our cost-of-living indices are similar to the official figures in years where the two series co-exist. We also re-estimate inequality and poverty series using both deflators and provide evidence for a gap in inequality and poverty trends when not accounting for differences in prices. We find that Russia experienced an even larger decrease in inequality (driven by a decrease in between-region inequality estimates). The correction obtained with the two series are in the same direction but differ somewhat in magnitude. The overall trends are however reassuringly similar.

The reminder of the paper is organized as follows. In section 2, we briefly discuss the related literature, notably the Leyden school and the use of subjective equivalence scales. Section 3 introduces our approach and the estimation methods. Section 4 presents the data, estimates of cost-of-living indices for Russian regions and application to inequality and poverty analysis. Section 5 concludes.

[1] The use of a variable capturing financial welfare independently on income to construct price indices and equivalence scales also underlies early approaches based on the Engel curve where the food share in expenditures captures financial welfare.

2 Related Literature

We put special emphasis on the contributions of the Leyden school and the literature on subjective equivalence scale, because they build the theoretical framework of our approach. The Leyden approach was developed by Van Praag (1968) with the idea that cardinal utility can be measured by utilizing individuals' judgements of income they consider to be (i) very bad, (ii) bad, (iii) insufficient, (iv) sufficient, (v) good, and (vi) very good. Assuming a lognormal distribution of welfare function, every respondent is assigned to an individual welfare function that takes values from zero to one (for a detailed discussion of this assumption, see Van Praag (1968)). This allows a household equivalence scale to be constructed (see Kapteyn & Van Praag (1978); Van Praag & Warnaar (1997)), to measure poverty (see Goedhart et al. (1977); Van Praag et al. (1982); Hagenaars (2014)), to measure inequality (see Van Praag (1977)), and to estimate a climate equivalence scale (see Van Praag (1988); Frijters & Van Praag (1998)). The Leyden approach can also be applied to various economic issues including the construction of cost-of-living indices as carried out in this paper.

The Leyden approach is based on theoretical assumptions. We discuss the most relevant assumptions for our paper. First, every individual is able to evaluate his own situation and any hypothetical situation in relative terms. This implies that the Leyden school's welfare concept is derived from the income utility the individual has in mind. Additionally, the Leyden approach equalizes concepts of income utility, income satisfaction, and economic welfare. Second, individual's verbal evaluations can be transformed into a meaningful numerical evaluation. And finally, the same verbal response corresponds to the same feeling in every person. We address potential criticism of these assumptions in the following section. For further discussion on the Leyden approach and its validity see Van Praag & Kapteyn (1994); Van Praag & Frijters (1999).

Despite the common theoretical background, our approach is somewhat different to the Leyden approach in that it employs a direct question on subjective well-being, that is "*How satisfied are you with **your** economic conditions at present?*". In this way, our approach is related to studies on subjective equivalence scale (Melenberg & van Soest 1995; Bellemare et al. 2002; van den Bosch 1996). The subjective approach to the equivalence scale constructs a numeric ratio to equalize the utility assigned to income across heterogeneous households. It is defined as *subjective* because it is based on the concept of subjective welfare. In contrast to the Leyden approach, the literature on the subjective equivalence scale assumes that measuring the economic well-being of respondents by asking about their satisfaction with income is sufficient to learn about their welfare function. Equalizing incomes across heterogeneous households leads to equivalence scale estimates, while equalizing incomes across spaces generates cost-of-living indices. For a detailed discussion on the validity of the subjective approach to the equivalence scale see Biewen & Juhasz (2017).

This paper also contributes to the strand of studies on alternative approaches to price estimations (see Costa (2001); Hamilton (2001); Almås (2012); Coondoo et al. (2011)). The key concept of these studies, the so-called Engel Curve approach, is that any differences in household expen-

ditures of homogeneous households in two different countries are attributed to changes in prices. This approach requires information on quantities and prices of consumed goods. The Engel curve approach and the proposed matching approach are similar in their intention to account for bias in official price indies. However, the data on prices and quantities of consumer goods is often not available, and thus the method cannot be applied universally. We propose a method that is flexible and does not require data on prices.

3 Methods

Our approach to the construction of cost-of-living indices is 'direct' in the sense that it does not rely on the specification of a structural model. It consists in evaluating the monetary value of living in every region covered by the data relative to a reference region and use these monetary evaluations as cost-of-living indices.

The basic argument is that average income differences between any two observationally identical households who both reach the same level of financial welfare but who are randomly drawn from two different regions reflect cost-of-living differences between these two regions. Cost-of-living indices are thereby obtained non-parametrically by estimating average income differences in a sample of matched pairs of households where matching is based on two conditions: (i) matched households reach identical 'financial welfare' (defined shortly) and (ii) matched households have (approximately) identical characteristics on dimensions that reflect potential differences in needs (such as household size and composition, home-ownership status, etc.).

Definition of the cost-of-living index

To formalize this, let us consider a country with R regions, let S_{ir} denote the financial welfare of a household i residing in region $r \in \{1, ..., R\}$ and write S_{ir} as a function of income Y_i, observable characteristics Z_i, prices P_r and an idiosyncratic term ϵ_{ir}

$$S_{ir} = V(Y_i, Z_i, P_r, \epsilon_{ir}). \tag{1}$$

In a standard utility maximization perspective, V would be an indirect utility function for expenditure Y_i and prices P_r. In the absence of a structural model, we view it more directly as representing the level of subjective satisfaction that household i achieves given income, characteristics (that reflect needs) and prices in region r.

We define a cost-of-living index for region r to be a region-specific deflator d_r

$$Y_{ir}^* = \frac{Y_i}{d_r} \tag{2}$$

where Y_{ir}^* is the income needed for household i to achieve the same level of financial welfare it

achieves in region r if it was facing prices of a reference region 1:

$$V(Y_i, Z_i, P_r, \epsilon_{ir}) = V(Y^*_{ir}, Z_i, P_1, \epsilon_{ir}). \tag{3}$$

This is standard. Classic structural approaches would proceed from here by using demand functions to estimate the expenditure level Y^*_{ir} satisfying (3) and would recover d_r accordingly as Y_i/Y^*_{ir}. Using a direct measure of financial well-being instead, the deflator in (2) determines the income that would be required to leave household i with the same financial well-being in region 1 as it reaches in its region of residence r. The former, $V\left(Y^*_{ir}, Z_i, P_1, \epsilon_{ir}\right)$, is however unobserved so d_r cannot be determined yet.

The matching solution we propose is to substitute the unobserved $V\left(Y^*_{ir}, Z_i, P_1, \epsilon_{ir}\right)$ in (3) by $V\left(Y_j, Z_i, P_1, \epsilon_{j1}\right)$ where j is a household that resides in region 1, has $Z_i = Z_j$ and has the same level of financial welfare as household j, $S_{ir} = S_{j1}$. The deflator then becomes the solution to

$$\begin{aligned} V(Y_i, Z_i, P_r, \epsilon_{ir}) &= V\left(Y^*_{ir}, Z_i, P_1, \epsilon_{j1}\right) &(4)\\ &= V\left(Y_j, Z_i, P_1, \epsilon_{j1}\right) &(5)\end{aligned}$$

which holds by construction (since i and j are chosen such that $S_{ir} = S_{j1}$), and therefore

$$d_r = \frac{Y_i}{Y_j}. \tag{6}$$

Of course, such a solution is not unique: any pair of matched households $i \in \{1, ..., N^r\}$ and $j \in \left\{1, ..., N^1\right\}$ that satisfy the conditions $Z_i = Z_j$ and $S_{ir} = S_{j1}$ possibly determine a different deflator according to (6). We therefore finally redefine our cost-of-living index to be a region-specific constant such that (5) is satisfied in expectation over all $i \in \{1, ..., N^r\}$ and $j \in \left\{1, ..., N^1\right\}$ satisfying $Z_i = Z_j$ and $S_{ir} = S_{j1}$. The cost-of-living index is therefore the solution to

$$E\left(\frac{Y_i}{d_r} - Y_j\right) = 0. \tag{7}$$

Key assumptions

The approach rests on two key assumptions. The first key assumption for the matching argument to be valid—namely for unobserved $V\left(Y^*_{ir}, Z_i, P_1, \epsilon_{ir}\right)$ to be well captured by $V\left(Y_j, Z_i, P_1, \epsilon_{j1}\right)$ in expectation—is conditional mean independence of the idiosyncratic component in V:

$$E(\epsilon_{ir}|Y_i, Z_i, P_r) = E(\epsilon_{ir}|Y_i, Z_i).$$

This means that the idiosyncratic part of the financial satisfaction of household i in region r does not depend on regional characteristics. In another words, all regional characteristics that influence financial well-being are factored in the cost of living.

The second key assumption is independence of the idiosyncratic component on income Y

$$\epsilon_{jr} \perp Y_j \mid Z_j \qquad \forall j, r.$$

This second assumption means that the idiosyncratic components do not vary systematically with income (conditional on Z_j) – so Y_j is a valid proxy for Y_{ir}^* when matching is done on Z, but not on ϵ.

Implementation

Practically, the matching estimation can be implemented as follows.

Start with a sample of N households distributed across R regions where the data for each household consists of the tuples $\{Z_i, Y_i, S_{ir}, r\}$. Z_i is the vector of characteristics of household i: (i) demographic characteristics such as family size and composition (adults and children, etc.), age of spouses and children; (ii) variables that may impact the "needs" and cost of living (such as homeownership status, rural/urban area). Y_i is the household income. S_{ir} is the variable of satisfaction with financial situation (e.g., "Are you satisfied with your financial situation?", "how easy is it to make ends meet?", etc.) and r denotes the region of residence of household i.

For each household in the sample, find a matched household in each of the other regions. Denote by $m(i,s)$ the identifier of the household from region s matched to household i. The match is based on S_{ir} and X_i. The match should be exact on financial welfare, so $S_{ir} = S_{m(i,s)s}$ while the match can be approximate on household characteristics if the number of characteristics is large, so $Z_i = Z_{m(i,s)}$ or $Z_i \approx Z_{m(i,s)}$. Differences in the logarithm of income $(\ln Y_i - \ln Y_{m(i,s)})$ across all matched pairs should therefore reflect income differences for people of identical financial welfare and identical (or similar) characteristics, but living in different regions.

An estimate of the 'pairwise' cost-of-living deflator for any pair of regions (r, s), $\hat{d}_{r,s}$, is then such that scaling Y_i by $\hat{d}_{r,s}$ eliminates differences in average log income for the matched pairs between region r and s. A simple pairwise deflator could be obtained as

$$\frac{1}{N_r} \sum_{i=1}^{N_r} \left(\ln \frac{Y_i}{\hat{d}_{r,s}} - \ln Y_{m(i,s)} \right) = 0 \tag{8}$$

$$\hat{d}_{r,s} = \exp\left(\frac{1}{N_r} \sum_{i=1}^{N_r} (\ln Y_i - \ln Y_{m(i,s)}) \right) \tag{9}$$

If $\hat{d}_{r,s}$ is about 1, then this indicates that there is no systematic cost of living difference between the regions r and s. This can be done for all pairs of regions. However, to obtain an overall cost-of-living deflator some further normalization is required.

A simpler and more efficient estimation is feasible however. First stack all matched log income differences $D_{is} = \left(\ln Y_i - \ln Y_{m(i,s)}\right)$ for all households i and regions s in a long vector (of size $N \times R$). Define two sets of dummy variables – one for region r in which household i resides (the

origin set) and one for the region s of the matched value (the matched set). Reference region 1 is omitted from both sets of dummy variables. Finally apply a constrained OLS regression of D_{is} on the two sets of dummy variables, constraining the coefficients on the dummy variables for the matched set to be equal to minus the coefficient of the dummy variable of the same regions in the origin set. Denoting by $\hat{\beta}_r$ the resulting coefficients for region r and setting $\hat{\beta}_1 = 0$ (for the omitted, reference, region), our final estimate of the cost-of-living deflator is

$$\hat{d}_r = \exp\left(\hat{\beta}_r\right).$$

where $\hat{d}_1$ is equal to 1 for the reference region. The cost-of-living deflators $\hat{d}_r$ can then be used to adjust household incomes or expenditures to adjust for regional cost-of-living differences. Note that confidence intervals for the estimated deflators can be derived from the regression coefficients by applying the standard delta method on exponentiated coefficients.

The procedure is easy and flexible. Modern statistical software have packaged routines for forming matched pairs and running constrained regression. It allows the cost-of-living deflators to be estimated for different geographical units (cities, regions, countries etc.) without imposing specific utility functions or other structural parameters and without data on prices.

There is no free lunch however: the validity of the approach hinges on the key assumptions described above to be satisfied. In particular such assumptions in the context of using subjective financial satisfaction variables imply the following. First, we must assume that every respondent is able to evaluate her financial situation (e.g., on a scale from one to five). Second, we must assume that verbal responses to subjective questions across respondents are comparable, implying that verbal labels signify the same welfare experience to every respondent – at least among respondents with similar observable characteristics. Such assumptions are similar however to those made in the derivation of subjective equivalence scales which are now routinely estimated.

In fact the procedure bears much similarity with the subjective approach to the construction of equivalence scales (see, e.g.,Biewen & Juhasz (2017)). To see the similarity, just change the label r for regions to denote instead different household composition classes and much of the procedure carries over. However, whereas we estimate separate unconstrained cost-of-living measures for each different region r, the literature on equivalence scale typically imposes a functional form onto the resulting d_r, such as, e.g, $d_r = e(n_a, n_c) = (1 + \alpha(n_a - 1) + \beta n_c)^\theta$ where n_a and n_c would denote the number of adults and children in the household respectively. Non-linear regression methods are then be applied to estimate parameters α, β and θ. No such second step is needed in the context of regional cost-of-living delfators.

4 Application to Regions in Russia

We illustrate the proposed framework on the real-world data. First, using the household survey data we estimate price indices for Russian regions. Then, we compare these indices to the official

price indices from the Russian Statistical Office.

4.1 Household Survey Data

The RLMS-HSE is an annual survey that collects information on socio-demographic characteristics, employment, satisfaction measures, and income sources. The survey is conducted in 32 out of 85 regions, covering 96% of the whole Russian population (see Kozyreva et al. (2016)). Our dataset includes 16 waves covering 2000-2015. RLMS-HSE is the only household survey that collects information on subjective well-being and, therefore, we have chosen it as the source of evidence.

In order to estimate price indices with the matching approach, we need information on income, material needs and welfare level. All of this information is provided by the survey. Income is defined as nominal household income, which is the sum of all private sources of income of every household member, including state transfers, minus taxes. We adjust it by the OECD equivalence scale. Material needs are captured by household and individual characteristics. These include: age and gender of respondents, household size, household composition, number of children, number of pensioners, number of employed household members, type of residence (owned, rented, or dormitory) and place of residence (urban or rural). Welfare is captured by satisfaction with income. We use answers to the question "*How satisfied are you with **your** economic conditions at present?*"-, on a scale from one to five. The phrasing of this question in Russian aims at capturing a respondent's satisfaction with his living conditions, material well-being and purchasing power, which is not reflected in translation to English. As our approach is based on equalizing the utility assigned to economic well-being, this subjective measure effectively captures the satisfaction of the respondent's material needs and is the best fit for our approach. Table 1 in the Appendix provides summary statistics of the pooled sample.

Given the fact that satisfaction with economic conditions is a subjective measure, we address potential obstacles related to its use (for a detailed discussion, see Bertrand & Mullainathan (2001)). Answers to subjective questions might be shaped by various factors including question ordering, question phrasing, scale design and survey framing. Furthermore, they might be subject to measurement error correlated to observable characteristics of respondents. We claim that the RLMS-HSE survey is a nationally representative household survey and, therefore, we exclude any bias resulting from surveying particular demographic groups. Second, despite the fact that this question includes a five and not commonly used ten-point Likert scale, we stress that this scale is appropriate for our approach as the five-point scale is used in the educational system, and is thus a common scale of evaluation for Russians. Third, the question regarding well-being does not involve negative wording. Fourth, a question about satisfaction with financial well-being comes after a satisfaction with life question, which is preceded by a general section on employment. Thus, reported answers are not affected by non-related matters (for example, no questions on health or political attitudes are asked before a financial satisfaction question). Finally, Krueger & Schkade (2008) shows evidence for the reliability of subjective measures, especially if the question is part of a repeated sample, sufficiently specific, or if comparison between socio-demographic groups is the purpose of the study.

Summing up, we are confident about using the subjective question on satisfaction for the purpose of the study.

4.2 Federal State Statistics Data

Since 2009 the Russian Federal Statistical Office (Rosstat) has published cost-of-living indices across cities in Russia (Federal State Statistical Agency of Russia (2020)). These indices shows how much more or less expensive the same basket of goods and services is in different regions. The basket consists of 275 items which are consumed by a majority of the local population. Every item is weighted according to its share of total consumer expenditures from the yearly household budget survey conducted by Rosstat. We convert these indices from city-level to region-level by re-weighting them according to the share of population in the region. We uses prices in Moscow as the reference level, and thus normalize price indices accordingly.

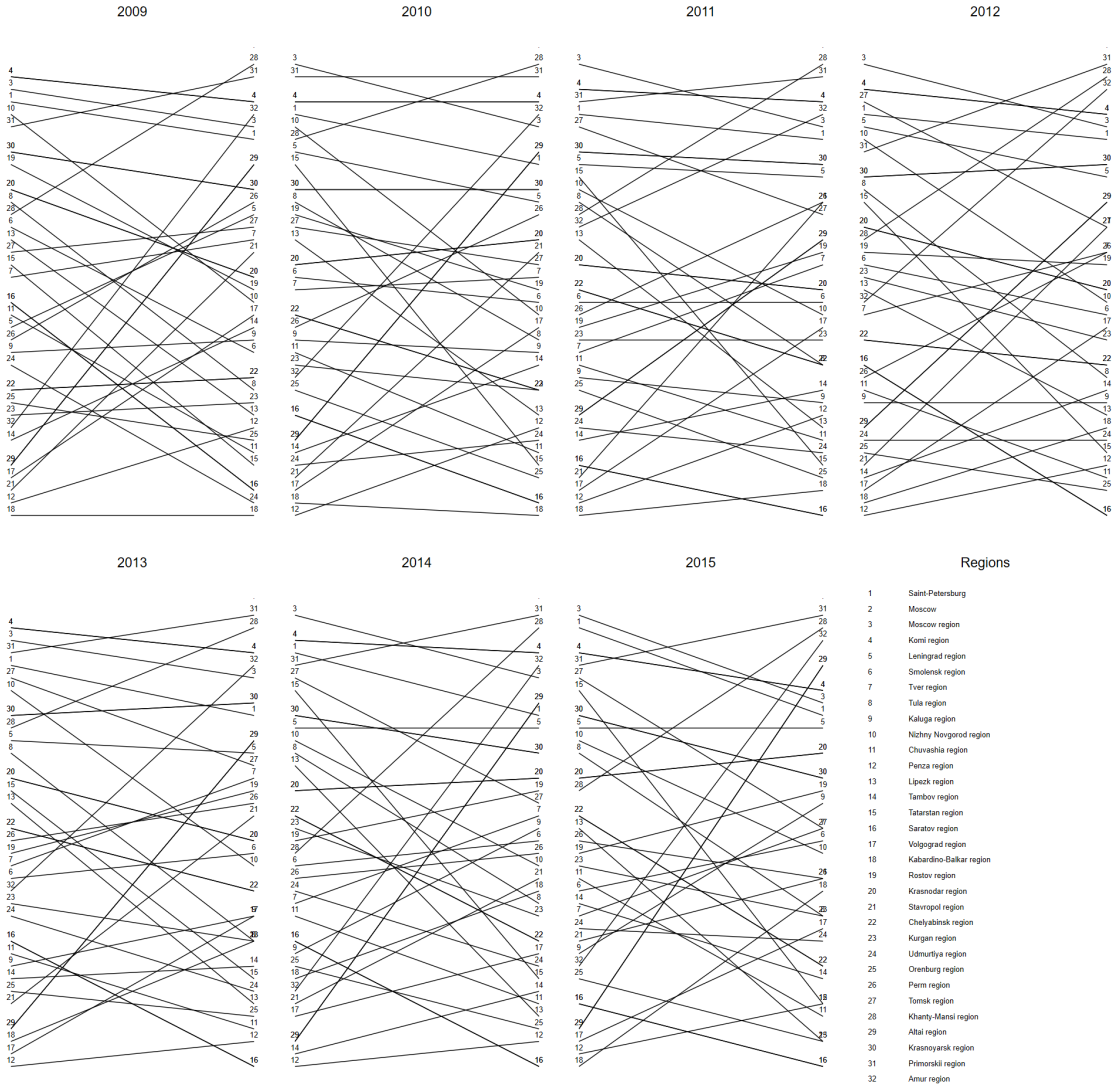
4.3 Price Indices Estimates

Using the household survey data, we estimate price indices for 38 regions in Russia over the years 2000-2015. We compare price indices with the official indices from the Rosstat over the period 2009-2015. Price indices are normalized to the price level in Moscow. Price estimates are shown in Figure A in the Appendix and the correlation is shown in Table 2 in the Appendix .

We find that for some regions the price indices are almost identical (see, for example, Chuvashia region, Saratov region, Chelyabinsk region, Krasnoyarsk region), while others are more expensive according to the matching approach (see, fore example, Komi region, Leningrad region, Saint-Petersburg). The price indices in some regions are cheaper (see, for example, Tver region, Penza region, Rostov region). Importantly, even when the two indices differ, we find that they follow similar trends. This indicates that the conceptual gap between the matching approach and the official state figures is constant. Correlation estimates confirm the results that the two price indices are very similar.

We also analyze price indices in relative terms by ranking the regions from the most expensive to the cheapest over the years 2009-2015. Figure 1 shows the results. The regions on the left-hand side are ranked according to the matching approach, and those on the right-hand side according to the Rosstat. The most expensive and the cheapest regions are depicted at the top and the bottom respectively. Over the years 2009-2015, Moscow is the most expensive region according to the two approaches. The majority of the regions remain in their relative positions according to the two approaches. For some regions we document a tendency for the relationship to be reversed: the more expensive regions from the Rosstat data tend to be cheaper in the matching approach, while the cheaper regions from the Rosstat data tend to be more expensive in the matching approach. In particular, all regions from the Far-East Federal district range from average-expensive to very expensive according to the matching approach, while some regions from the Central, Southern and Volga Federal districts range from average-expensive to cheaper.

Figure 1: Ranking of the Russian regions according to the cost-of-living



Source: RLMS-HSE (2020); Federal State Statistical Agency of Russia (2020), own calculations.

Note: Rosstat ranking is on the left-hand side; Non-parametric matching approach ranking is on the right-hand side.

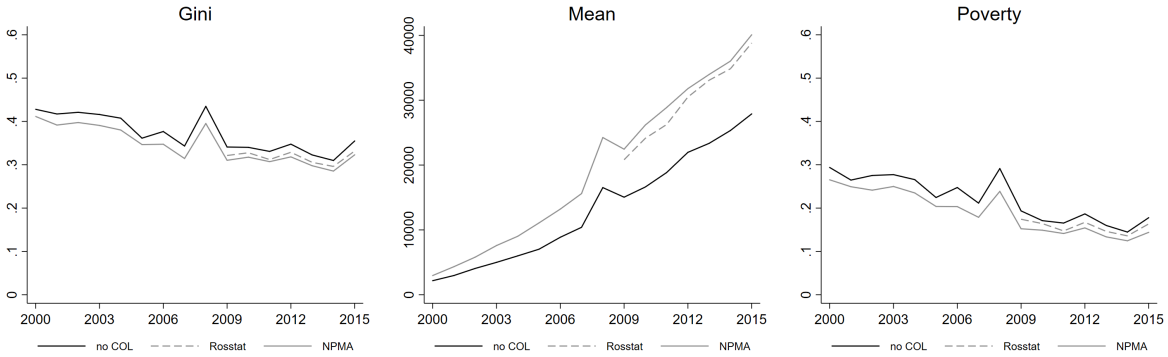
4.4 Implications for Inequality and Poverty

As prices play an important role in inequality and poverty analysis, we investigate the impact of price adjustments on inequality and poverty. Therefore, we compute the Gini index, average income and poverty rate with and without price adjustments. Figure 2 shows the estimates under three scenarios: without price adjustments (black line), with price adjustments from the Rosstat (dashed gray line), and with price adjustments from the matching approach (solid gray line).

Overall, there was a decrease in income inequality and poverty over the years 2000-2015, but the decrease is even larger once price changes are accounted for. Inequality accounting for price changes

follows similar trends but different levels as inequality not accounting for price changes inequality. Income levels differ substantially once price changes are accounted for: an increase from 28,000 Rubles in 2000 to 41,000 Rubles in 2015 compared to an increase from 20,000 Rubles in 2000 to 28,000 Rubles in 2015. We also document that incomes adjusted by the Rosstat and the matching approaches yield very similar trends in inequality, poverty and average income levels. Therefore, we conclude that inequality and poverty estimates differ when adjusted for price changes, and, more importantly, that price indices from the matching approach show very similar results to price indices from the Rosstat.

Figure 2: Inequality and Poverty Trends in Russia



Source: RLMS-HSE (2020); Federal State Statistical Agency of Russia (2020), own calculations.

Note: NPMA is non-parametric matching approach estimate. Poverty line is defined as 50% of the average income.

Additionally, we address the question of which drivers decrease inequality and poverty by decomposing inequality into two components: within-region and between-region. The results are given in Figure 2 in the Appendix. We find that accounting for price changes decreases inequality between regions. Furthermore, between-region inequality accounting for price changes from the matching approach is very close to zero, which means that the price indices from the matching approach equalize regions in term of cost-of-living. This allows for better income comparison across regions. The larger decrease in inequality is driven by a reduction in between-region inequality.

5 Conclusion

Regional price indices are not always available or may not be released as regularly as standard national CPI series. They are however potentially important to account for differences in cost of living across regions when income or expenditure data are used for welfare comparisons in large countries. We therefore propose a simple approach for calculating regional cost-of-living deflators that do not require access to data on prices and that can be implemented directly from standard surveys on income and living conditions. To do so, we apply to the calculation of regional cost-of-living index methods that have been advocated for the similar problem of estimating equivalence scale parameters: we use subjective satisfaction data to capture financial welfare instead of relying on calculation of indirect utility and adopt non-parametric matching methods to construct regional cost-of-living indices.

The proposed approach makes cost-of-living indices easily available since it does not require data on prices and quantities. We focus on regional deflators, but it allows income deflators to be estimated more generally for countries and regions as well as over time if more classic price indices are not readily available.

Using the matching approach we estimate cost-of-living indices for various Russian regions over the years 2000–2015. We also compare the matching indices with the official price indices from the Russian Statistical Office. We find that the two series are similar: they are almost the same for some regions, while they differ in levels but not in trends for other regions. When levels differ, the gap between the two indices remains unchanged over time. We find the comparison reassuring and suggestive that the matching approach can be a feasible means of estimating cost-of-living deflators.

We also assess the impact of applying regional cost-of-living adjustments on inequality and poverty. We find that when cost-of-living differencses are accounted for, Russia experienced a larger decrease in inequality and poverty and a larger increase in average income levels. Income levels adjusted by regional cost-of-living indices differ substantially from non-adjusted levels. However, income levels adjusted by different cost-of-living indices are similar. We also decomposed inequality into between- and within-region inequality and found that application of the matching cost-of-living indices leads to zero between-region inequality.

Application to real work data stresses the importance of acknowledging existing regional differences in prices and their impact on inequality and poverty estimates. The application also demonstrates the feasibility of our approach as a viable alternative when price estimates are absent.

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A Appendix

Table 1: Descriptive Statistics of the pooled sample, 2000-2015 years

	Mean	SD
Age	43.60	18.68
Female	0.57	0.50
Urban	0.73	0.44
Children	0.73	0.91
Employed	0.55	0.50
Retired	0.62	0.78
Family size	3.33	1.64
Family type 1	0.07	0.25
Family type 2	0.08	0.28
Family type 3	0.03	0.16
Family type 4	0.33	0.47
Family type 5	0.03	0.16
Family type 6	0.46	0.50
Home ownership	0.91	0.29
Renting	0.06	0.24
Living in dormitory	0.03	0.16
Income	15202.58	32882.55
Fully satisfied	0.03	0.17
Fully unsatisfied	0.26	0.44

Source: RLMS-HSE (2020), own calculations.

Note: Income is defined as nominal household disposable income adjusted by the OECD equivalence scale. We consider individuals to be employed if (a) they are currently working; or (b) they are on paid leave; or (c) they are on unpaid leave; or (d) they are self-employed; or (e) they are farmers. Household composition: type 1 - single pensioner, type 2 - multiple pensioners, type 3 - single adult without children, type 4 - multiple adults without children, type 5 - single adult with children, type 6 - multiple adults with children.

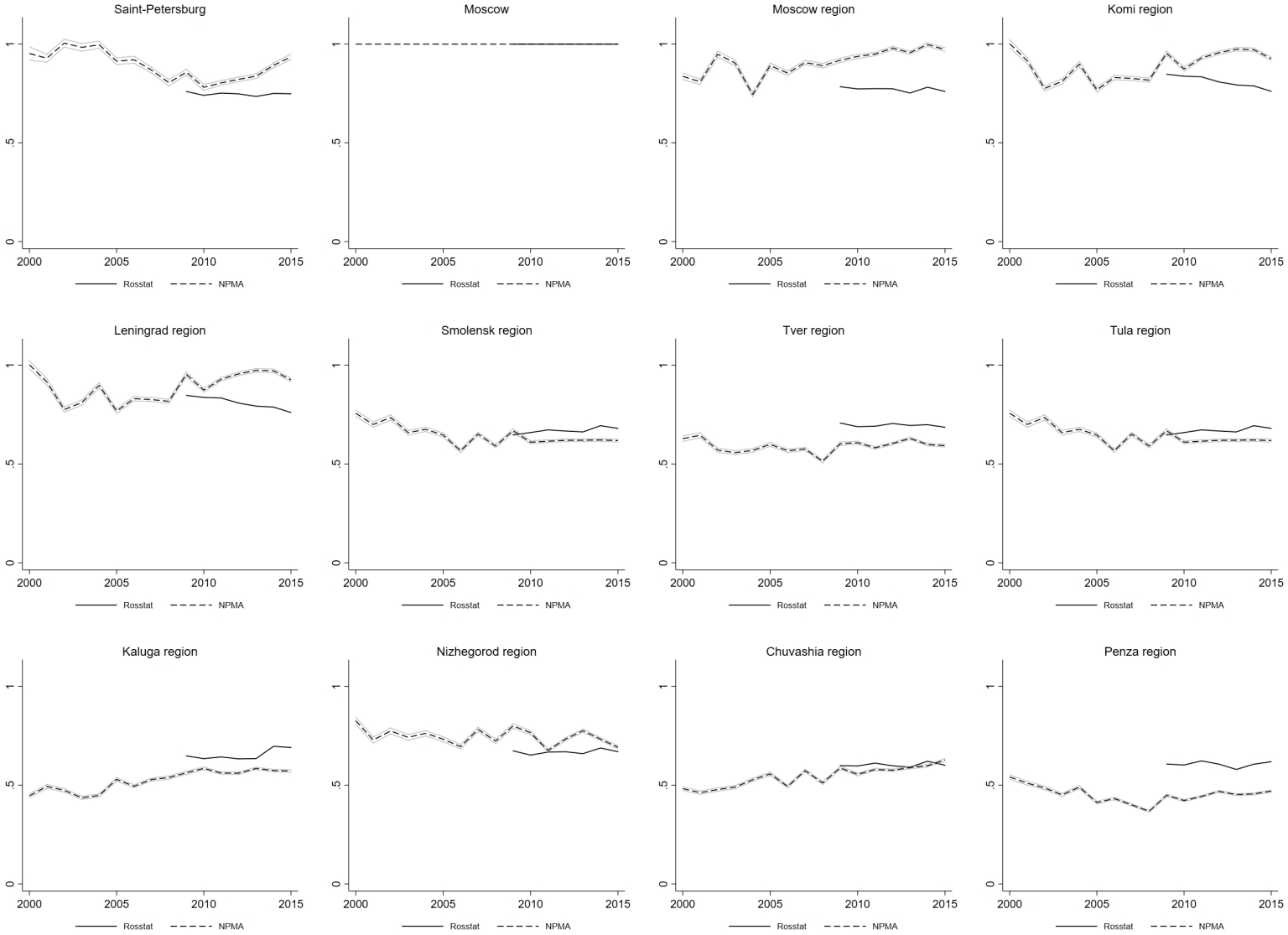
Table 2: Correlation between Rosstat and Non-parametric matching approach cost-of-living indices

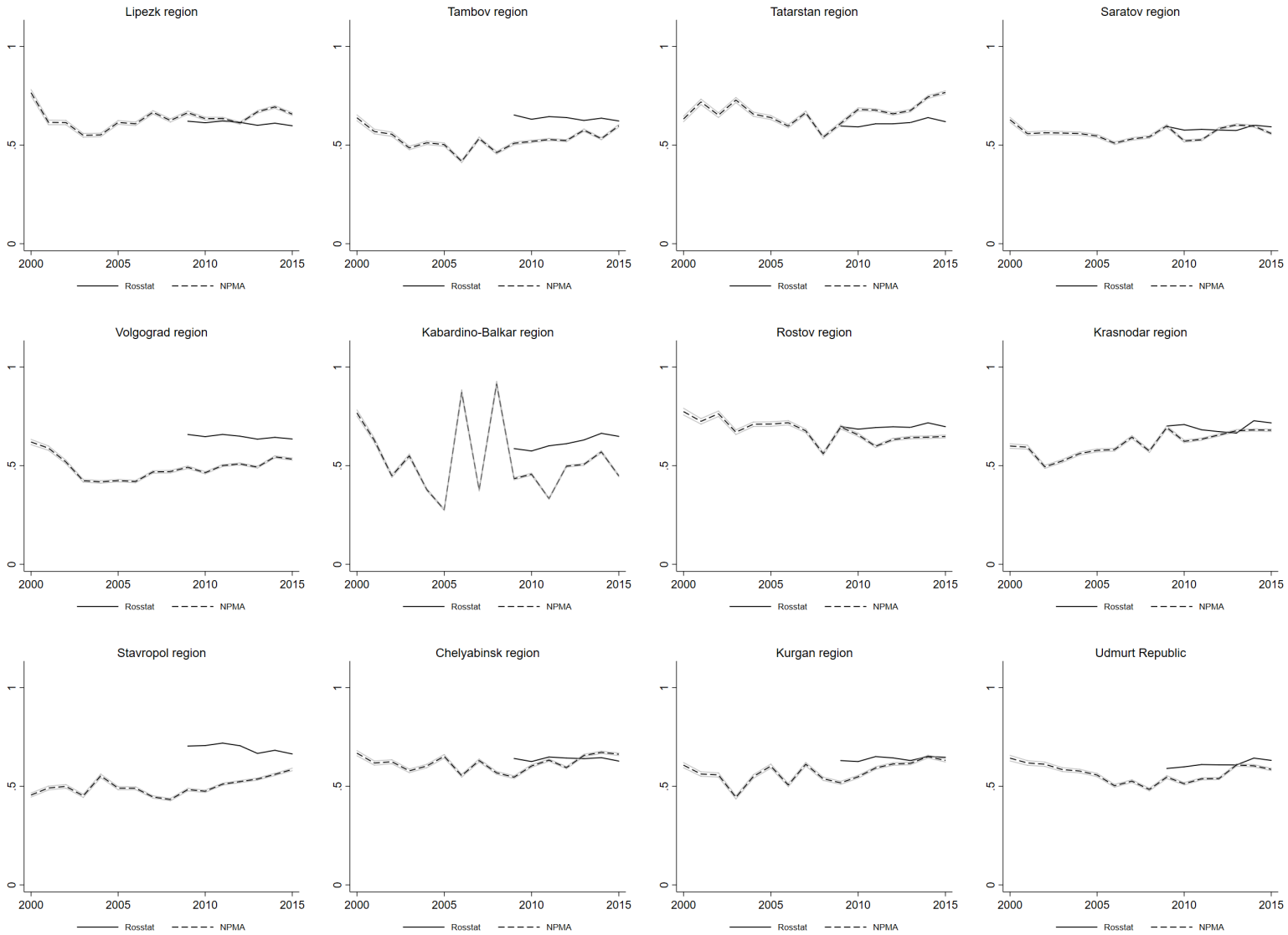
	2009	2010	2011	2012	2013	2014	2015
Spearman correlation	0.580***	0.584***	0.758***	0.727***	0.669***	0.554***	0.563***
Pearson correlation	0.748***	0.684***	0.817***	0.791***	0.780***	0.709***	0.706***

Source: RLMS-HSE (2020); Federal State Statistical Agency of Russia (2020), own calculations.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 1: Price indices for Russian regions, 2000-2015




Lipezk region
Tambov region
Tatarstan region
Saratov region
Volgograd region
Kabardino-Balkar region
Rostov region
Krasnodar region
Stavropol region
Chelyabinsk region
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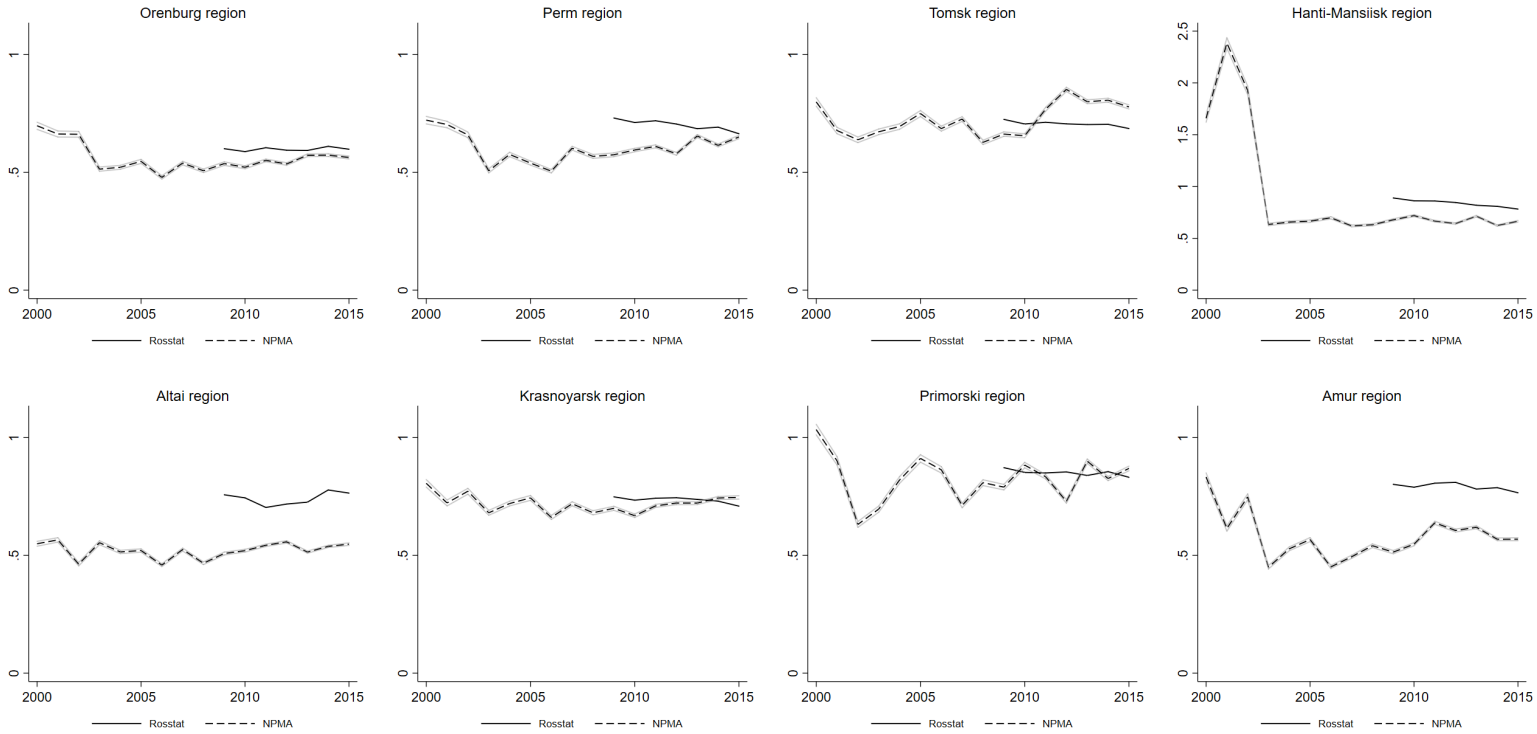
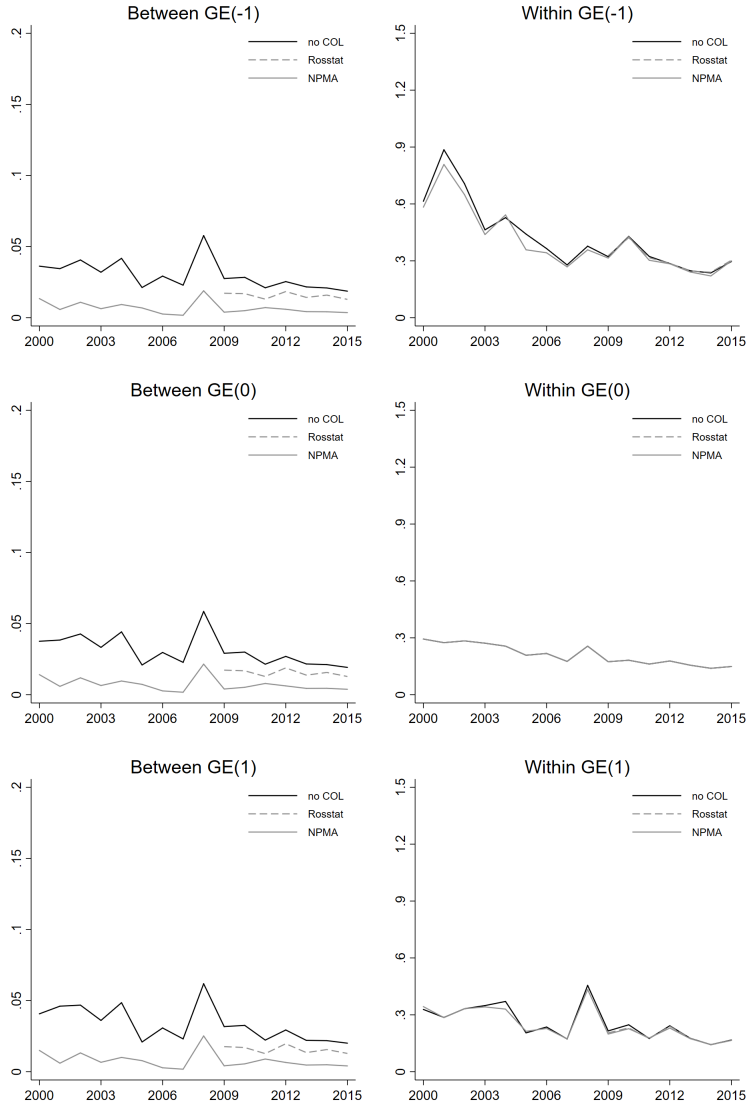
Rosstat
NPMA



Source: RLMS-HSE (2020); Federal State Statistical Agency of Russia (2020), own calculations.

Note: Grey lines are confidence intervals. NPMA is non-parametric matching approach estimate.

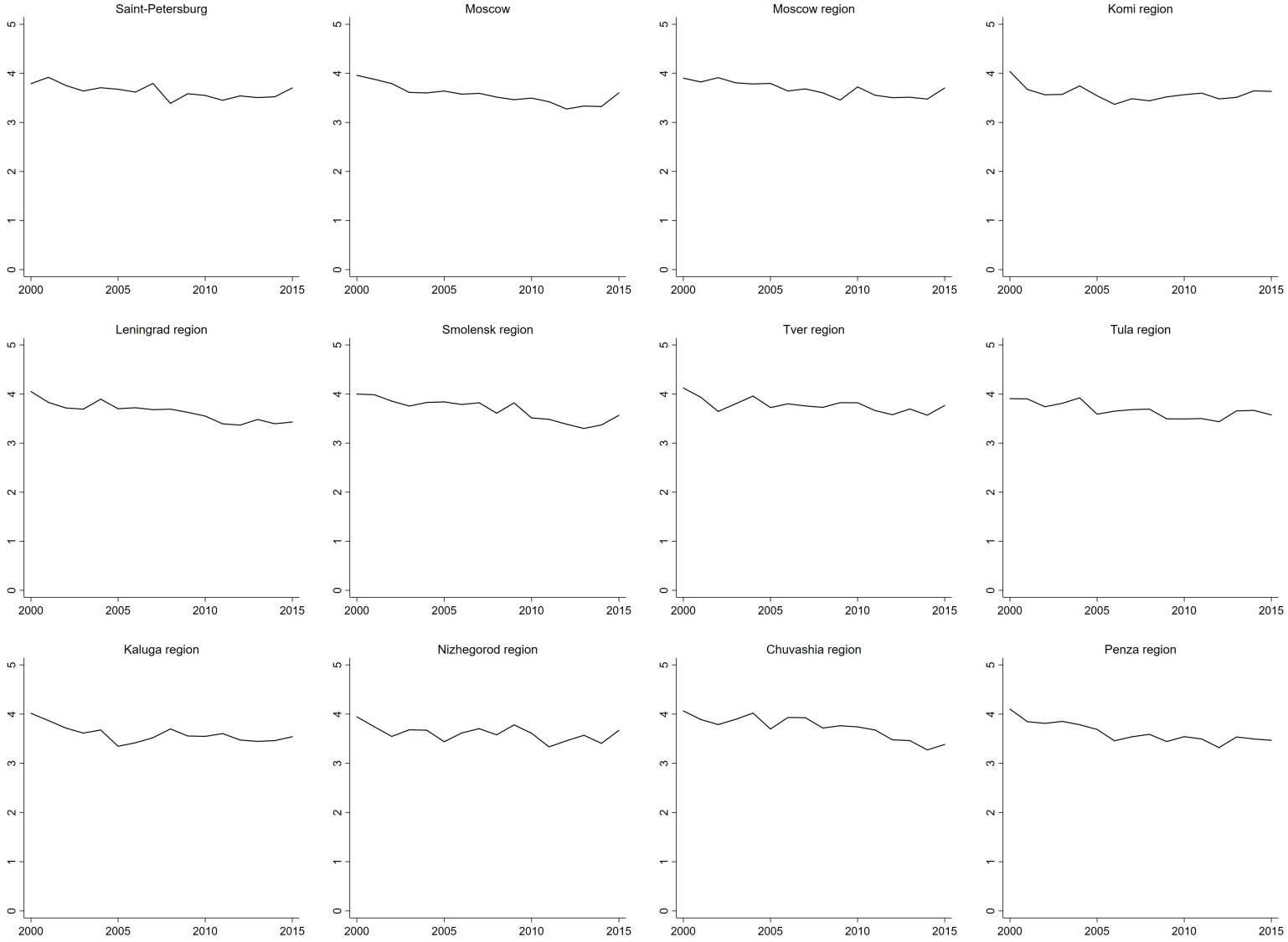
Figure 2: Between- and within-regions decomposition of inequality

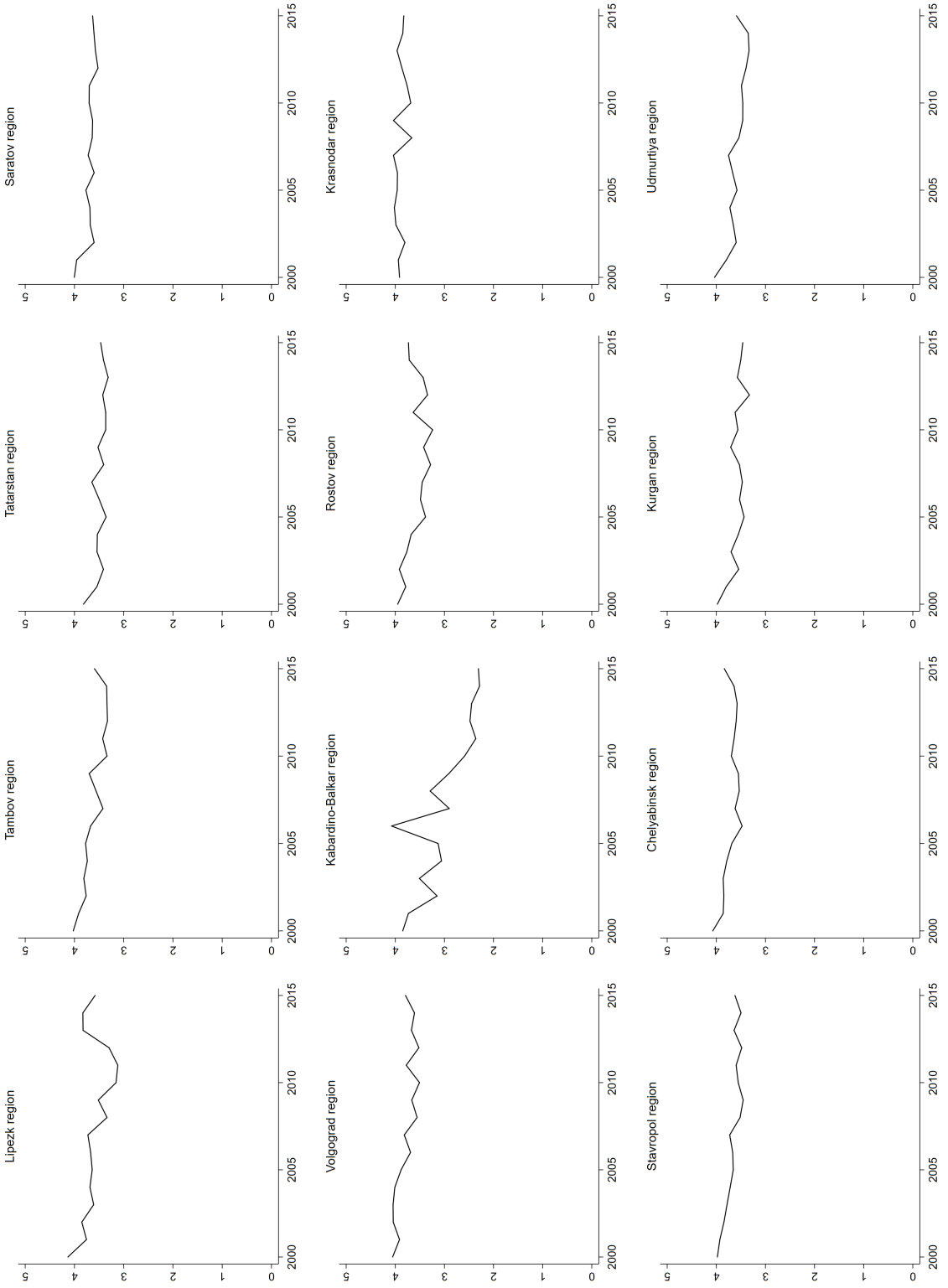


Source: RLMS-HSE (2020); Federal State Statistical Agency of Russia (2020), own calculations.

Note: GE(α) is a General Entropy Family measure. The larger the α is, the more sensitive GE(α) to changes in incomes at the top. NPMA is non-parametric matching approach estimate.

Figure 3: Average satisfaction with economic conditions across Russian regions, 2000-2015




Lipezk region
Tambov region
Tatarstan region
Saratov region
Volgograd region
Kabardino-Balkar region
Rostov region
Krasnodar region
Stavropol region
Chelyabinsk region
Kurgan region
Udmurtiya region
0
1
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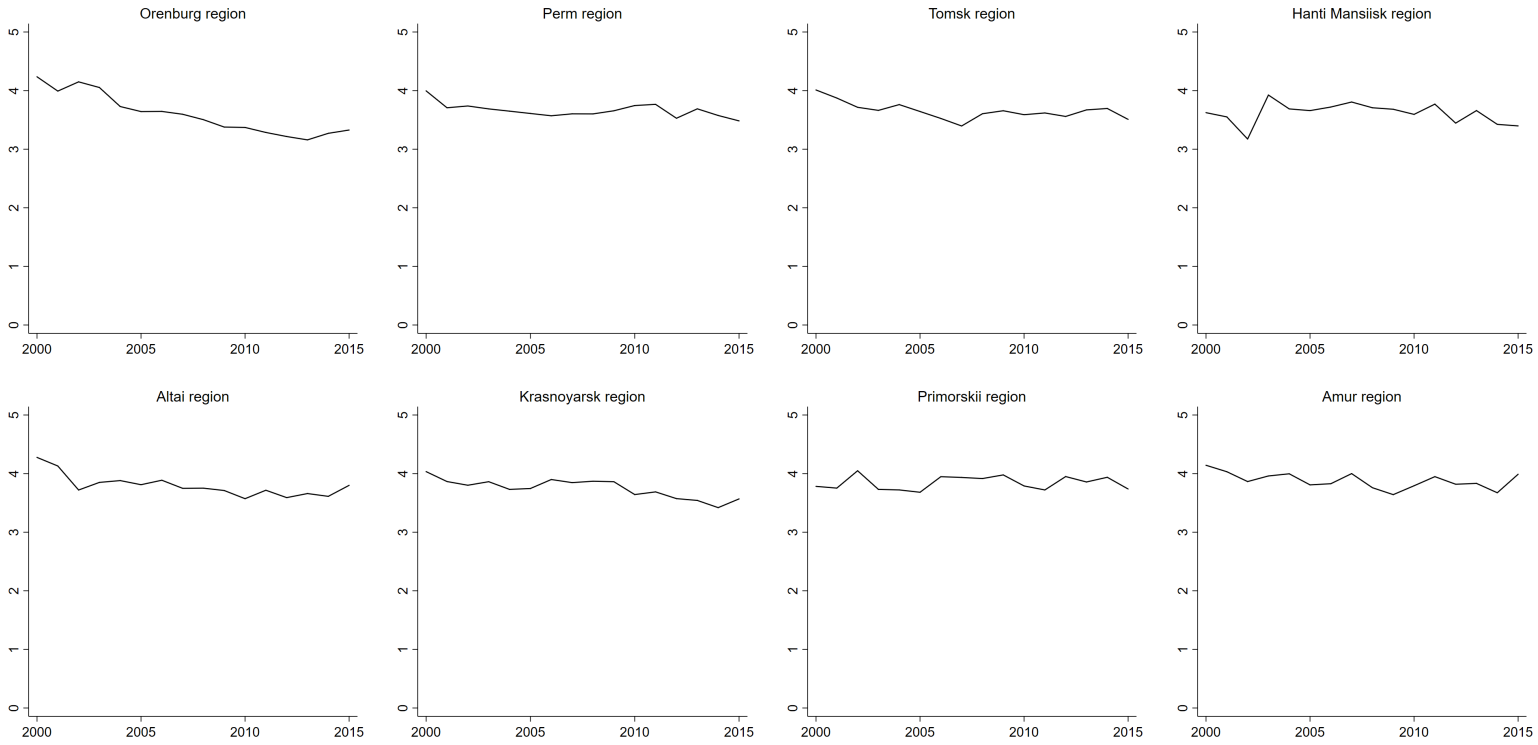
2000
2005
2010
2015



Source: RLMS-HSE (2020); Federal State Statistical Agency of Russia (2020), own calculations.