Czech Regional GDP: Challenges and Comprehensive Estimates[1)]

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Abstract

Statistical descriptions of regions or even cities are usually more popular with users than those at the national level. Users can more easily identify themselves with regional indicators such as the average wage. However, the production of regional indicators is more demanding in terms of data sources. National statistical institutes mostly do not officially publish all components of regional GDP, but rather select a few, such as gross value added or gross fixed capital formation, due to a lack of data. This paper aims at regional GDP in Czechia in particular to estimate missing components of regional GDP as well as analyse the results. It uncovers difficulties connected with the estimates. In addition, the effect of different regional price levels is assessed, regional indicators are adjusted accordingly. The findings indicate substantial differences in the regional GDP structure as well as notable variations of regional price levels. The analysis is conducted for the year 2020.

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Regional expenditures, GDP, national accounts, regional accounts, experimental estimates, NUTS 3 regions	*https://doi.org/10.54694/stat.2025.61*	*O11, R10*

INTRODUCTION

Attempts to estimate regional aggregates are pretty common and are spread throughout the world – e.g. Billé et al. (2023), Secondi (2021) in Italy, Gough (2017) in the UK, Rokicki and Hewings (2016)

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in Poland, or Aten and D'Souza (2008) in the USA. However, the difficulties are connected mainly with the limited data at the regional level (missing detailed structure as well as missing continual availability in time). It means that when researchers decide to do the estimation, it is usually just once or once in a longer time. In the meantime, there are often some methodological changes, which may be feasible to implement rather at the national level, but may bring more troubles at the regional level (e.g. scanner data or a change in household budget survey (hereinafter HBS) – from a quote to a random sample). This results in increased volatility of estimates at the regional level.

Our motivation is based on the fact that the topic of regional expenditure and regional price levels remains a subject of public interest, and there is a demand for updated results. The start of our research in this field dates back to 2009, when we began with the first estimates for 2007, using the expenditure approach to gross domestic product (hereinafter GDP) for 14 Czech NUTS[5] 3 regions. The regional price levels were estimated for the years 2012 and 2017, but regional expenditures are being updated now for the year 2020 within the current project.

The updates are not always straightforward, because many things are changing and improving over time, so it was necessary to make changes to many parts of the computation differently. The system of national accounts is dynamic and constantly evolving. It means that every further effort on our part involves particular changes in the methodology and calculations, which, on the one hand, brings a better approach to reality, but on the other hand, may result in less comparability of results. Each trade-off means some limitation elsewhere. In this research, we faced changes in data sources, classifications, methodologies and also in the entire economy.

At the national level, there is a detailed manual called the European System of Accounts or ESA 2010 (Eurostat, 2013a), a comprehensive methodological book exceeding 750 pages. This manual is regularly updated, and the adoption of new ESA 2028[6] is currently underway (see, e.g., Hronová, 2024), which means that our future estimates will again be connected with some methodological novelties. In (effective) ESA 2010, there is a methodological guide inside not only for estimates of aggregates on the national level, but for the whole system of national accounts. It should be noted that ESA 2010 is the Regulation of the European Parliament and of the Council, which is binding for all member states. Users benefit from a high level of comparability and harmonisation.

There are three different approaches to estimating GDP at the national level – the production method, the expenditure method, and the income method - that are briefly described e.g. in the methodology under the Czech Statistical Office (2025) or in Gough (2017, p. 2). The aim of this paper is to move to the regional level, i.e. to the 14 Czech NUTS 3 regions, and estimate regional GDP (RGDP) using all three approaches. We also discuss the main difficulties we encountered, the availability of data, and the need for some assumptions. At the regional level, there is officially published just part of the GDP components (e.g., gross value added – hereinafter GVA); as will be shown further in the paper, the rest are our experimental estimates. The availability of GVA at the regional level is quite common, e.g. Billé et al. (2023) work with data for 103 Italian provinces (NUTS 3 level) obtained from the National and Regional Accounts of the Italian National Institute of Statistics (ISTAT).

We decided to choose for this analysis the year 2020. There were more reasons for this. Firstly, when we started our effort, there was a new, semi-definitive version at the national level for the year 2022.

[5] Regional classification (Nomenclature of Territorial Units for Statistics) CZ-NUTS, for detailed structure see https://apl2.czso.cz/iSMS/en/klasstru.jsp?kodcis=80113

[6] In the meantime, it was decided that the manual would be entitled ESA 2030. "A draft legislative proposal for the ESA 2030 is being prepared, which includes the methodological framework as well as the revised data transmission programme. It is currently undergoing a thorough consultation process with EU countries and other stakeholders. The European Commission is expected to adopt the proposal once this process has been completed." (Eurostat, 2026).

However, the years 2021 and 2022 were extensively affected by COVID-19 disease (especially household and government expenditure, but to some extent the whole economy). In 2020, the first quarter was still under usual conditions, however it is clear that there was a significant influence of the COVID-19 pandemic in the rest of the year. What is important for this paper, the impact of the pandemic on all Czech regions was likely similar. This allows us to compare regions with each other as we intended. Of course, comparison with the previous analysis may be more difficult, as on one hand household expenditures were probably lower at the national level (especially on vacation or restaurant services) and on the other hand government expenditures were higher (especially in healthcare). The entire calculation is complicated and time-consuming, especially in terms of data sources therefore time – consuming. However, we plan to update the results to a more suitable year, 2023, in the future.

The detailed estimates of expenditure method in the Czech regions were published in 2013 (Kramulová and Musil, 2013); therefore, we aimed to carry out new estimates for the most recent possible year. National accounts are being regularly revised – the latest harmonised benchmark revision of the entire available time series of national accounts (1993–2024), was published in June 2024. Therefore, the year 2020 (after the revision) was chosen and it was necessary to consider new national numbers. The revision was aimed e.g. at imputed rent, paid rent, the incorporation of the new population census from 2021 and other data sources, the service life of buildings, or individual residential construction. Above that, the 2020 harmonised benchmark revision and the 2014 methodological revision have been published since our previous publication was issued. The latter changed concepts and definitions of national accounts indicators.

The paper is divided into several sections. The first one is aimed at concerning what is available in official statistics at the regional level and how the officially published regional GDP is compiled together with challenges that have to be faced. The second section is dedicated to the expenditure approach of GDP estimate at the regional level. The third section describes the income approach to regional GDP. Section 4 contains the discussion and the final one conclusion.

1 OFFICIAL REGIONAL ACCOUNTS STATISTICS IN CZECHIA

1.1 Which regional indicators are available in official statistics?

Official regional accounts in Czechia are limited to compiling only selected macroeconomic indicators: GVA, GDP in current and constant prices, gross fixed capital formation (GFCF), employment (employees, employed persons, hours worked, compensations of employees) and household sector accounts necessary for the allocation of disposable income (distribution of primary income account, secondary distribution of income account). The requirements for regional accounts statistics at the European level determine the scope of compiled regional indicators. Regional accounts in Czechia do not offer any additional indicators beyond those required by EU regulations.

Regional accounts are based on transactions of units resident in the territory of a region. If information for local units resident in the territory is not available, a distribution key close to the measured indicator is used to allocate data for a higher level (enterprise, total economy). Such approach is called either "top-down" (distribution of data from the level of total economy to regions) or "pseudo-bottom-up" (distribution of data from the enterprise or institutional unit level to regions), see Eurostat (2013b).

1.2 Compilation of the regional GVA and GDP in Czechia

Compilation of the regional GVA in Czechia is carried out on the basis of the production approach for sectors of non-financial corporations and enterprises in the sector of households (see Kahoun and Sixta, 2013 and Kahoun, 2009). Regional indicators of output and intermediate consumption are obtained from the same data sources used to calculate the national accounts. It means for the case of production,

collected data about sales of products and services, sales of goods for resale minus costs of goods sold, changes in inventories of own production and production for own final use. For intermediate consumption, it means collected data on material consumption, energy consumption and expenses for services incurred in making production. Both information on production and intermediate consumption is only available at the enterprise level in Czechia. The general problem in most countries is the valuation of output for the local units in case of multi-regional organisations (e.g. corporate headquarters, local units performing only administrative activity etc.).

The calculation is carried out at the level of divisions of NACE classification[7] and published at the level of sections. A special regionalisation approach is used for selected methodological adjustments in the national accounts, such as imputed rent, individual household construction, consumption of fixed capital in the general government sector (depreciation of roads, motorways, municipal roads and railways), capitalisation of research and development, geological exploration and part of illegal activities. In addition, FISIM[8], financial leasing, subsidies for mining reduction, and activities of households as employers of domestic personnel are also regionalised separately.

The predominant approach for the production method of regional GDP in Czechia is the "pseudo-bottom-up" method. This procedure is based on estimates of data on the activity of local units by disaggregating data from individual enterprises or companies. It is similar to the "top-down" method, but not at the national level, rather on aggregated data for a single multi-regional institutional unit. The obtained data are then aggregated into a total regional data in the same way as in the classic "bottom-up" method, which obtains the necessary information directly from the local units.

The method of "pseudo-bottom-up" is used for GVA of the most significant institutional sectors – non-financial corporations (S.11) and household entrepreneurs (S.14). The allocation of regional GVA for remaining institutional sectors (financial corporations, general government and non-profit institutions serving households (hereinafter NPISH) – S.12, S.13 and S.15) is carried out on the basis of wages and salaries broken down by types of statistical surveys and required regional and NACE breakdown. The regional structure of wages and salaries is used as the key for the "top-down" distribution of the remaining value of recorded GVA in the national accounts, i.e. for S.12, S.13 and S.15 (although this is still before methodological and conceptual adjustments that are made in the compilation of the national accounts). A pure "top-down" allocation based solely on wages and salaries was applied to 13.7% of the total national gross value added in 2020.

After adding up all the regional allocated values described above, there is still approximately 12% of GVA from national accounts that remains unallocated. These are mainly parts of the methodological adjustments of national accounts (except those mentioned above) and adjustments for the exhaustiveness of the economy, which includes intentional misrepresentation of most of the illegal activities, units that are not subject to identification, etc. These data are regionally allocated according to the structure of the regional GVA found in each NACE division separately. Estimates of these adjustments are usually made using models without the possibility of using currently available and sufficient quality regional data.

There are notable differences in the approaches to regional allocation of GVA among individual NACE industries, which are due to the different shares of institutional sectors in each NACE division and the different allocation approaches to institutional sectors. The 'top-down method' is used for the general government sector, financial corporations and NPISH sector, while the 'bottom-up method'

[7] Classification of Economic Activities CZ NACE or CZ NACE 2025, for detailed structure see https://apl2.czso.cz/iSMS/en/klaslist.jsp?fnazev=NACE

[8] Financial intermediation services indirectly measured.

is used for the non-financial corporations and entrepreneurs in households' sectors, as described above. So, while the 'bottom-up method' is used almost exclusively in manufacturing, mining and energy, as well as in trade and construction, the 'top-down method' is used almost exclusively in public administration and financial intermediation industry.

Location of corporate headquarters and central administrative activities is a key factor that affects data interpretation for capital cities or metropolitan areas in general. Regional accounts in Czechia assume that the value added created by corporate headquarters and individual workplaces can be allocated in the structure of wages and salaries (in accordance with available data sources). It is expected that the contributions of individual corporate workplaces or local units to the overall economic performance of the company are adequately reflected in the wages of their employees. Higher GDP in such regions is in this way neither overrated nor underrated by the presence of corporate headquarters, since wages correctly reflect the contribution of local units to overall economic performance at the company level.

Morillas-Jurado et al. (2026) propose to use more complex models for the analysis of the influence of the headquarters on GVA and GDP, for example input-output analysis, which would go beyond the scope of this article. However, the topic of regional input-output tables in Czechia has been addressed, for example, by Sixta and Vltavská (2016).

1.3. Challenges of other regional accounts indicators beyond GDP

In addition to regional GDP, which is the subject of this paper, regional accounts also face challenges with other officially published indicators, especially disposable income of households and GFCF. When regionally allocating disposable income of households, one needs to allocate all household income according to their place of residence (more precisely, mid-period population published by the Czech Statistical Office by regions), while, for example, wages are monitored in statistical surveys according to the place of work, possibly also the headquarters of the institutional unit. The distribution of households' income from the place of work to the place of residence thus requires the application of estimates and the linking of multiple data sources, which are usually not combined in other statistics.

In the case of regional GFCF, one is mainly confronted with the problem of correct territorial recording. First, there is the problem of central purchases of multi-regional units in the headquarters residence, when later the distribution of individual fixed assets to other regions may occur, which accounting units will not properly record in statistical surveys. Then there is also a problem of correct allocation in the case of large infrastructure projects that are carried out in several regions from one workplace (local unit) located in a single region. In this case, instead of statistical surveys for local units, information is provided directly by the transport infrastructure companies (Railway Administration or Road and Motorway Directorate) about actually implemented construction projects in the territory of individual regions. At this point, it is also worth noting that the GFCF does not enter into the calculation of officially published regional GDP (since it is not calculated by the expenditure approach).

Eurostat publishes also primary income of households and household disposable income by NUTS 2 regions for EU countries. Regional population is taken over from demographic statistics that is on one hand based on usual residency concept (census), on the other hand migration, births and deaths follow a permanent residency concept. The difference between the concepts is not negligible in several regions (Czech Statistical Office, 2021). With respect to the new EU Regulation on European statistics on population and housing (for details see EUR-Lex Document 52023PC0031), the upcoming census will be likely based on the permanent residency concept which may cause some differences between the count of people registered in and actually living in the region. Regional incomes by place of residence rely mainly on Statistics on Income and Living Conditions (SILC) that is a sample survey carried out by the Czech Statistical Office. Single Monthly Employer Report, which is being implemented nowadays,

represents a new administrative data source that may substantially improve various statistical domains including regional accounts. Data on each single employee will be collected that allow detailed analysis of the labour market. In particular, information about employees' places of work, places of residence and paid salaries and wages may improve quality of regional GVA as well as regional household incomes. Above all, the new data source may represent a significant improvement in the regional allocation of wages and salaries as the most important component of disposable income of households (the limitations of which were mentioned above).

2 EXPENDITURE APPROACH TO REGIONAL GDP

2.1 General introduction to chapter

Expenditure approach to GDP is very well known in Economics as a sum of consumption (C), investment (I), government spending (G) and net exports (NX):

$$GDP = C + I + G + NX \tag{1}$$

In statistical language, the GDP by expenditure approach is defined as the sum of final consumption expenditure made by households, the government, and NPISH, plus gross capital formation and net exports (total exports minus total imports), see e.g. Gough (2017). Nevertheless, the above-mentioned approach is not the primary one, as most National Statistical Offices (hereinafter NSOs) rely primarily on the production approach to GDP at the national level, including the Czech Statistical Office[9]. Pursuant to ESA 2010 Regulation (Eurostat, 2013a), the NSO is obliged to publish GDP by production, expenditure, and income approaches for a respective member state, while regional indicators are limited to the production approach, employment, household income, and gross fixed capital formation. The lack of relevant data sources, particularly for foreign trade and capacities, prevents statistical authorities from compiling regional GDP using all approaches (Gough, 2017). It should be noted that international and interregional exports and imports would have to be distinguished, including travel (purchases in other regions).

Nevertheless, various users need that regional data for analysis. A team of researchers of the University of Economics and Business estimated the first results a decade ago (Kramulová and Musil, 2013). Several methods could be reused, while others have been replaced due to changes in the economy, data collection, and other improvements.

The expenditure method of GDP includes, from the point of view of national accounts, three main parts:

- Final consumption expenditure (Households, General Government, NPISH),
- Gross capital formation (Gross fixed capital formation, Changes in inventories, Acquisition of valuables less disposals) and
- External balance of imports and exports of goods and services.

Regionalisation of final consumption expenditure is based on our research. All expenditure groups of households need to have their regionalisation keys.

2.2 Final household consumption expenditures

Final household consumption expenditures form approximately 2/3 of total final consumption expenditures at the national level. They are divided into 13 divisions according to the COICOP[10] classification

[9] Detailed description of national accounts compilation in Czechia can be found on dedicated webpage: https://csu.gov.cz/gdp-national-accounts-reports-on-quality

[10] CZ-COICOP or CZ-COICOP 18 – Classification of Individual Consumption According to Purpose, for detailed structure see https://apl2.czso.cz/iSMS/en/klaslist.jsp?fakronym=CZ-COICOP

and further categorised into 52 groups. We use the version COICOP 18, which is valid as of January 1, 2024. It is slightly different from the previous version. National accounts are already compiled in this classification, whereas HBS – one of our main data sources – is published in the previous ECOICOP classification. Therefore, we had to transform the data into the new classification using a correspondence table between ECOICOP and COICOP 18. In the previous classification, there were 12 divisions; now there are 13 divisions for households' expenditures and newly also one for NPISH and one for general government. These divisions are hierarchically split into groups, which is the level we are using for our computations. Instead of the previous 47 groups, there are now 52 for households. Some have just moved, some are new, one has been removed, and some are nested under a different division. Households' expenditures can be recorded either in the national or domestic concept. The former refers to all expenditures spent by a resident household whereas the latter refers to all spending in a given territory by resident and non-resident households. The national concept is used in sector accounts allowing a comparison of income expenditures and a calculation of savings. As regards regional accounts, the 'national' concept consists of spending in a particular region, spending in other regions of Czechia and abroad. Following the choice of the concept of households' expenditures the coherent concept of foreign trade, in particular tourism, is applied. For instance, expenditures of citizens of Středočeský kraj in Hlavní město Praha are booked as imports and households' expenditures in Středočeský kraj while as output and exports in Hlavní město Praha.

Concerning the regionalisation keys, some are derived from regional national accounts, but most of them are from HBS. From our last estimates, there is a substantial change that HBS switched from a quote sample to a random sample in the year 2017 (Czech Statistical Office, 2017). The majority of countries use for HBS random sample as well, from the EUROSTAT quality report in 2015 it is evident that in European Union "*[e]xcept for CZ and DE (which resort to quota sampling) all the HBS samples were selected according to a probability sampling scheme*. " (Eurostat, 2015, p. 9). Now, the only country with a quota sample in the EU remains Germany. Ayyash and Sek (2020) investigating Malaysian household consumption expenditure also used data from Household Expenditure Survey based on a probability sampling design. The switch to a random sample presents some challenges for us, as it introduces new attributes and pros and cons. The regional data (for NUTS 2 regions, which we must transform to the NUTS 3 regional level) we used are also no longer publicly available; earlier, it was available for download. Together with the change to a random sample, the regional structure may be less reliable. This is quite common, e.g. in Italy there are regional HBS data available for NUTS 1 and NUTS 2 levels, however no more for NUTS 3 or LAU 1 administrative level due to low reliability (Marchetti and Secondi, 2017). Other data sources such as health statistics or ministry data remain more or less the same.

After applying the keys to each of 52 groups of household expenditure, we obtained the weights, that were used to regionalise the national values. As we already mentioned above, some groups are completely new – e.g. groups 01.3 Services for processing primary goods for food and non-alcoholic beverages, 02.2 Alcohol production services, 06.4 Other health services, 07.3 Passenger transport services, 09.5 Cultural goods or 09.6 Cultural services requiring new keys to be assigned. For some groups, we tried to adjust previously assigned keys to better reflect economic reality. One example – for the groups 07.1 Purchase of vehicles and 7.2 Operation of personal transport equipment, data from the Ministry of Transport's yearbook on registered cars and motorcycles was previously used, but because there were doubts about the consistency of data on the region of registration, region of purchase and region of subsequent operation, this time we used data from HBS, which we consider more relevant. Some slight additional corrections were used. The results are in Table A1 in the Annex.

2.3 Government consumption expenditure

Government consumption expenditure can be divided into collective and individual parts. The former is sourced from government non-market output, while the latter is sourced from either government non-market output or purchased market production. Consequently, government consumption expenditure is regionalised consistently with the production approach, i.e., compensations of employees, assuming that other non-market components (intermediate consumption, consumption of fixed capital, and net taxes on production) are distributed alike (Kahoun and Sixta, 2013). Regarding purchased market production, the most important element is health, including health services and pharmaceutical products. The latter is allocated to regions using value of prescriptions and vouchers that is an improvement compared to the previous estimate where hospital consumption of pharmaceutical products was used. The former is allocated according to hospital revenues. As Lequiller and Blades (2007, p. 248) say, social benefits in kind (D.631) "*include repayments from the health sector of social security payment of household and medical assistance in the home and housing allowances*". The remaining part (less than 20%) is distributed pro rata, assuming the same consumption per capita.

2.4 Consumption expenditure of NPISH

Consumption expenditure of NPISH represents a negligible component of GDP. Similarly to government consumption expenditure it consists of non-market output produced by NPISH and purchased market output. Regionalisation is carried out analogously.

2.5 Foreign trade

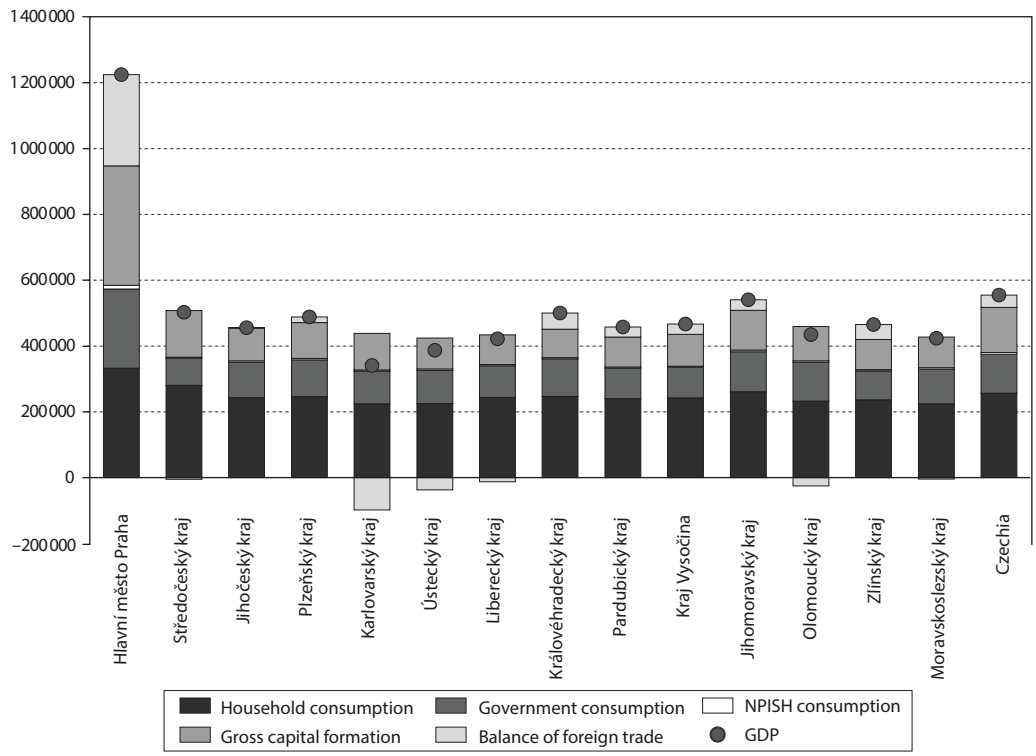
Exports of a region consists of international exports of goods and services and intraregional exports of trade and services. Those components can be hardly estimated as international trade is realised also by foreign companies and traders located in other countries or regions. Additionally, trade in services includes also international and intraregional tourism. Total imports can be divided similarly. Consequently, the balance of foreign trade is calculated as the difference between the official regional GDP published by the Czech Statistical Office and all other expenditure components. Net exports are therefore derived residually rather than estimated directly. Potential further disaggregation is discussed by Holý and Šafr (2022).

2.6 Results

The highest GDP per capita is registered in the capital city, where economic performance per capita is more than two times higher than the national average, while differences among other regions are substantially smaller. This is a typical picture of many countries where GDP per capita is the highest in the region including the capital city. Alves et al. (2021) suggest that cities generate wealth with the help of their own population and the population of workers attracted from neighbouring cities. GDP per capita of regions may suffer from inconsistency of nominator and denominator of the indicator (see also Dunnell, 2009). GDP in a given region may be produced using 'domestic' resources, in particular people living in a region in question, but also commuters from other regions. Likewise, residents encompassed in denominator may contribute to other regions' GDP. The balance of commuting to work of Hlavní město Praha is about 180 thousand people mainly with Středočeský kraj (surroundings of the capital city, Czech Statistical Office, 2023). Assuming the same productivity of commuters and residents, the contribution of employed persons commuting to Hlavní město Praha is estimated as GDP per employed person in the place of work multiplied by the number of commuting persons. The estimate should be interpreted as illustrative, as it relies on the simplifying assumption that commuters and residents exhibit the same average productivity. Differences in occupational structure, industry composition, or skill levels between the two groups may affect the resulting values. The result suggests that about ¼ GDP is created by commuters while negative contribution of residents working in other regions is about 3%. 'Modified'

GDP generated with 'domestic' resources exhibits lower variability among regions. The highest value is still observed in Hlavní město Praha, where GDP per capita is 73% above the national average. Besides the level of GDP, the structure of GDP varies across Czech regions. Household consumption expenditure represents only 27% GDP in Hlavní město Praha while it constitutes 2/3 of GDP in Karlovarský kraj. In other regions, the share of household consumption fluctuates around half of GDP. Government consumption expenditure constitutes about one fifth of GDP in Czech regions, nevertheless the amount in nominal term is two times higher in Hlavní město Praha than national average. Net exports are positive in most regions, but several regions registered deficits, with the highest deficit in Karlovarský kraj. The leading net exporter is Hlavní město Praha. It may be assumed that expenditures by foreign tourists as well as Czech tourists and commuters notably contribute to net exports in the capital city.

Figure 1 Regional GDP by expenditure approach per capita (in CZK)



Source: Czech Statistical Office, own calculations.

3 INCOME APPROACH TO REGIONAL GDP

The income method represents the aggregation of variables of the income generation account: compensations of employees, gross operating surplus and net taxes on production and imports (excluding subsidies) at the regional level. Information on compensations of employees by industry is obtained from official regional accounts statistics. Compensations of employees are concurrently used in combination with the production method indicators to estimate regional gross value added. However, the availability of information on gross operating surplus and mixed income is the biggest weakness of the regional GDP calculation by income method. Operating surplus is not directly calculated at the national level let alone broken down by region, thus complicating the use of the full income method for estimating regional

GDP. There is not only the issue of data availability, but also the issue of where actual operating surplus or profit is created (if it is only in the headquarters of companies or individual local units in regions, and what is the share of local units on company operating surplus).

Net taxes on production and imports consist of *net taxes on products* (such as VAT) and *net other taxes on production* (such as income from sales of emission trading permits). An allocation of *net taxes on products* is made in official regional accounts for GDP compilation according to the regional structure of total regional GVA. For *net other taxes on production,* the allocation into the regions can be done in the same way, i.e. in the proportion of total regional GVA.

3.1 Regional allocation of individual GDP components of the income approach

The calculation of regional GDP for Czechia is mostly carried out using the production method at the Czech Statistical Office. However, the regional structure of GVA in the case of multi-regional organisations (bodies with operations in several regions) is based on the regional structure of wages and salaries paid by these organisations. The production method of calculation is thus combined with the compensations of employees as a key indicator of the income method. The reason is that compensations of employees is easily ascertainable by region and, while indicators characterising the production method, i.e. production and intermediate consumption, are easily available by enterprises from business survey. Therefore, the regional structure of wages serves as a key for the regionalisation of GVA (output minus intermediate consumption) for multi-regional organisations.

For the calculation of regional GVA directly by the income approach, it is necessary to work beside compensations of employees as well as with reliable data on regional consumption of fixed capital (CFC) and data on regional net operating surplus (OS), which is another essential part (the most difficult to detect) of the income components of GVA.

The experimental calculation of the income components of regional GVA is made below on the example of data from the regional accounts of Czechia for the year 2020. It follows the same experimental calculation for 2011 carried out last time in 2013 (see Kahoun and Sixta, 2013).

Assuming that the results of production and income approaches must be balanced, the operating surplus and mixed income is equal to the difference between the total GVA and the remaining components of the income approach (compensations of employees, consumption of fixed capital and net other taxes on production and imports). The formula for the regional calculation of operating surplus and mixed income is so determined:

$$OS = GVA - W - CFC - (T - S) \tag{2}$$

where:

OS – *regional net operating surplus and mixed income*
GVA – *regional gross value added (available in regional accounts)*
W – *compensations of employees paid by local units (available in regional accounts)*
CFC – *regional consumption of fixed capital (to be estimated)*
T – S – *regional other taxes on production and imports less subsidies (to be estimated)*

Regional GVA is known from regional accounts, as well as compensations of employees, but there is also necessary to make estimates for regional consumption of fixed capital and regional net taxes on production and imports.

Regional CFC (K.1 according to ESA 2010) based on local units is not directly calculated in Czechia and its regional values are not available anywhere. Therefore, it is necessary to find a suitable key

for a regional distribution of national values using the top-down method. The available statistical indicator of regional accounts regularly published is gross fixed capital formation (GFCF). Between 2002 and 2004, the Structural Business Survey in Czechia included a specific section on stocks of fixed assets by region. Data on fixed assets since 2004 and their regular update on the new GFCF and estimated depreciation of assets until 2020 can therefore serve as a basis for an experimental calculation of the CFC. Only total assets acquired can be depreciated and the regional structure of total fixed assets should therefore be close to the regional structure of the estimated indicator. The estimated structures of regional fixed assets in 2020 are used as weights for the regional top-down distribution of CFC from national accounts for 2020. It should be noted that the estimates rely on historical information on regional fixed assets updated by subsequent investment flows, which may not fully capture all structural changes in the regional distribution of assets over time.

A relatively small remaining item is the indicator of net other taxes on production and imports (D.29 minus D.39 according to ESA 2010). Similarly to the case of net taxes on products (D.21 minus D.31), regional allocation can be made according to the regional structure of total gross value added. However, the regional allocation of net other taxes on production is made for each two-digit NACE separately, which allows considering the different meanings of subsidies in each NACE – e.g. a significant part of subsidies is concentrated in energy or agriculture. The remaining value to total gross value added represents net operating surplus (including mixed income).

While the methodology of regional allocation and the data sources used in the current calculation were the same, the interpretation of items slightly changed due to the inclusion of indicators, which were revised with the revisions of national accounts since 2013. Compensations of employees and net taxes on production and imports changed only very little in official statistics after the national accounts' revisions. More significant methodological changes occurred in the consumption of fixed capital, which mainly reflected the new valuation of fixed assets in the national accounts. The revision in 2014 represented the transition to the updated standard ESA 2010. In fixed assets there were reflected mainly the changes in capitalisation of research and development or capitalisation of small tools previously not included. The revisions of the national accounts in 2020 and 2024 had an impact on the valuation of dwellings and other buildings and structures.

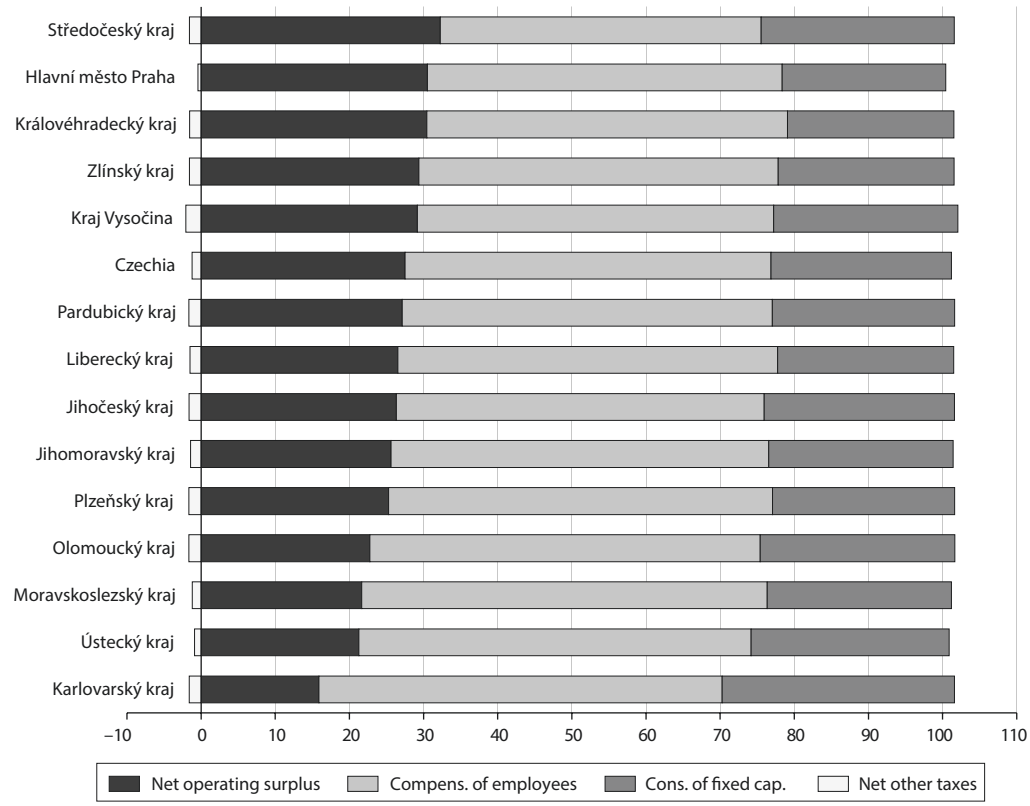
In regional weights used for this experimental calculation, the revisions of national accounts are reflected in the form of data on the regional GFCF applied into the distribution of regional total fixed assets, and therefore indirectly also in the allocation of CFC.

3.2 The resulting regional allocation of the operating surplus

Figure 2 illustrates the structure of GVA, broken down by individual components, ranked by the share of operating surplus in gross value added in 2020. The results logically indicate a relatively higher share of net operating surplus in regions with a lower share of compensations of employees or a lower share of CFC on GVA (Středočeský kraj, Hlavní město Praha and Královéhradecký kraj). In particular, a historically lower level of wages and salaries may strengthen the share of operating surplus, if the region is currently developing economically. On the other hand, a historically higher level of wages and salaries may currently be limiting for the operating surplus (Moravskoslezský, Ústecký), especially if the region is in a phase of economic slowdown.

Compared to the calculations made in 2013 for 2011, the share of the regions on national net operating surplus decreased significantly for Karlovarský kraj (–0.8 p.p.), Ústecký kraj (–2.3 p.p.) and Moravskoslezský kraj (–3.8 p.p.). On the other hand, the share increased in Hlavní město Praha (+ 5.2 p.p.) and Středočeský (+ 1.9 p.p.) kraj.

Figure 2 Structure of GVA by NUTS 3 regions, items of the income approach in %, year 2020



Note: Ranking by the share of the estimated net operating surplus on GVA.
Source: Czech Statistical Office, own calculations.

In Table 1, the last column shows the regional structure of net operating surplus, which is based on the assumption of equilibrium of total GVA known from regional accounts and sum of individual components of the income method. However, it should be mentioned that the calculation of regional GVA for multiregional organisations in regional accounts is based on the regional structures of wages and salaries of individual companies. This means that the remaining components of the income calculation of GDP are also distributed for multiregional organisations in the structure of wages and salaries (including their operating surpluses). Therefore, the experimental calculation is relatively simplified and carried out only with regard to the absence of the necessary regionally broken-down data. At the same time, it can be assumed that operating surpluses are more important in the cases of multiregional organisations (energy companies, financial intermediaries, telecommunications companies etc.).

The main challenge for the regional allocation of income components of GVA remains in finding a suitable key for the regional distribution of operating surplus. This is what mainly complicated further progress towards the full use of the income method, and therefore, the calculation of regional GDP in this way is not implemented in most countries, or only for a selected part of GVA.

Table 1 Regional estimated structures of the income components of GDP in %, 2020

Regions of Czechia, 2020	Compensations of employees	Consumption of fixed capital	Net other taxes	GVA	Net operating surplus
ESA codes	**D.1**	**K.1**	**D.29-D.39**	**B.1g**	**B.2n**
Hlavní město Praha	25.8	24.1	9.4	26.6	29.6
Středočeský kraj	10.4	12.7	15.5	11.9	14.0
Jihočeský kraj	5.0	5.2	6.7	5.0	4.8
Plzeňský kraj	5.1	4.9	6.6	4.8	4.4
Karlovarský kraj	1.8	2.1	2.2	1.7	1.0
Ústecký kraj	5.7	5.8	3.9	5.3	4.1
Liberecký kraj	3.3	3.1	3.9	3.2	3.1
Královéhradecký kraj	4.6	4.3	5.9	4.7	5.2
Pardubický kraj	4.1	4.1	5.5	4.0	4.0
Kraj Vysočina	3.9	4.1	6.9	4.0	4.3
Jihomoravský kraj	11.3	11.2	12.9	11.0	10.2
Olomoucký kraj	5.0	5.0	6.4	4.7	3.9
Zlínský kraj	4.5	4.5	5.9	4.6	4.9
Moravskoslezský kraj	9.5	8.8	8.4	8.6	6.8
Czechia	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Czech Statistical Office, own calculations.

4 DISCUSSION – WHY IS THIS TOPIC IMPORTANT?

GDP is one of the most important indicators of national accounts; however, it is sometimes misused. Users should keep in mind that GDP is an indicator of economic performance, but not of the wealth or well-being of households, which is rather measured by household consumption expenditure (see Secondi, 2021, p. 652). Stiglitz et al. (2009) pointed out that other indicators focused on households should be promoted or developed. The highest GDP per capita in purchase power standard (PPS) in the EU was recorded in Luxembourg (242% EU average in 2023) and Ireland (213%). The latter is mainly caused by operations of globally active firms in Ireland (Lane, 2017). The former case is very well known, as the headquarters of many financial corporations and EU institutions are seated in Luxembourg, a very small country. In addition, commuters from neighbouring countries contribute to Luxembourg's GDP. Such cities as e.g. Luxembourg, Basel, Geneva, Vienna are attracting qualified foreign labour (for details see Decoville et al., 2013). In these cities, the issue of the different structure of cross-border consumption expenditure also arises (Math*ä* et al., 2014). However, this is probably not the case of Hlavní město Praha (and Czechia) in such extent, also due to the language or common consumption expenditure habits of commuters from neighbouring countries (e.g. Slovakia).

Therefore, a headline indicator of international comparison published by Eurostat is actual individual consumption expressing amount of goods and services actually consumed by households. The highest value is likewise the highest in Luxembourg (140% of the EU average in 2023), which is substantially lower than the GDP. Similarly, the highest regional GDP per capita in PPS is recorded in regions, where large companies are located: South-West (Ireland), Dublin or Wolfsburg. GDP per capita in PPS is more than three times higher than the EU average in these areas. Obviously, GDP in small areas can be affected by local circumstances that are not necessarily reflected in household consumption.

Above mentioned cases pose challenges to interpretation of GDP in Ireland or Luxembourg to users that might not be familiar with those phenomena. Regional GDP may be affected to a large extent. Various public policies have been introduced to support so called structurally affected regions or in general to diminish regional differences. Progress could be assessed using a wide range of indicators, nevertheless

regional national accounts fail in providing a complete macroeconomic picture of regions. The results presented in the paper may help policy makers to target public support to appropriate regions and area of funding. In particular, programmes focused on households may benefit from a consistent picture of regional incomes, expenditures and savings depicting living standards.

It should be noted that indicators have conceptual limits that are negligible at the national level but relevant at the regional level. Firstly, ESA 2010 stipulates that non-market output is consumed by government and NPISH and cannot be exported. Ministries and other government agencies are mainly located in Hlavní město Praha where non-market output as well as government consumption expenditure are booked even though citizens in other regions also benefit from their activities. Notwithstanding, the next ESA may allow to record international trade in government services.

Regional indicators published by NSOs and Eurostat are valued either in national currency/Euro or in PPS, i.e. no adjustment for a difference in regional prices levels is made. Gough (2017) pointed out that an assumption of the same price level in a given country is not held in many countries. Čadil et al. (2014) proved that this is also the case in Czechia. The updated estimates are presented below in Table 2. Regional price levels are based on final household consumption expenditure; considerable differences are recorded in housing, personal and restaurant services. Unsurprisingly, the highest prices were recorded in Hlavní město Praha, Středočeský kraj (a region surrounding Hlavní město Praha) and Jihomoravský kraj, including the second largest city Brno. Nominal household expenditure is revalued to the regional purchase power standard (RPPS), eliminating variation in prices among Czech regions. Differences in consumption in RPPS are substantially smaller than for nominal indicators.

Table 2 Impact of regional price levels on household consumption expenditures, 2020

Region	Household consumption expenditures per capita, %	RPPP	Household consumption expenditures per capita in RPPS, %
Hlavní město Praha	129.9	124.6	104.3
Středočeský kraj	109.6	108.2	101.3
Jihočeský kraj	94.9	98.1	96.8
Plzeňský kraj	96.2	98.3	97.8
Karlovarský kraj	87.7	97.6	89.8
Ústecký kraj	87.9	95.8	91.8
Liberecký kraj	95.1	100.5	94.7
Královéhradecký kraj	96.3	98.1	98.2
Pardubický kraj	93.6	97.0	96.5
Kraj Vysočina	94.5	95.4	99.0
Jihomoravský kraj	102.0	103.1	98.9
Olomoucký kraj	90.8	95.5	95.1
Zlínský kraj	92.3	96.9	95.3
Moravskoslezský kraj	87.7	94.5	92.8
Czechia	**100.0**	**100.0**	**100.0**

Source: Own calculations.

CONCLUSION

The Czech Statistical Office publishes just the required set of regional accounts' indicators specified in the ESA 2010 Transmission Program. The aim of this paper was to extend and complement regional indicators, in particular RGDP using all three methods – production, expenditure and income. The results show that despite Czechia being a relatively small country, the differences among regions are quite substantial. It is evident that regions surrounding or containing the capital city perform differently from remote regions. The distinction occurs in the expenditure approach (e.g., a share of housing costs or food and non-alcoholic beverages), and disparities also exist in the structure of income components of GVA. The officially published data on GDP suggest that economic performance in Hlavní město Praha is more than twice as high as in other relatively homogeneous regions. The presented results shed light on economic reasoning, especially the demand side of economy.

All the calculations were done for the year 2020 that was partly affected by COVID-19 pandemic; however, it is intended to update the results for the more suitable year 2023. Especially the expenditures were probably highly influenced (e.g. lockdowns and related government containment measures). In the case of the income method, the biggest challenge remains in the choice of an appropriate key for regional allocation of operating surplus for multiregional companies.

Finally, it is necessary to emphasize and remind that most of the values of RGDP are not recalculated to respective regional price levels, which worsens the right interpretation. Table 2 shows, that after taking regional price levels into account, the results may significantly differ. Household consumption expenditures variance among Czech NUTS 3 regions decreased considerably and the same could be naturally in the case of RGDP. Use of the real RGDP can help to consecutively assess the tendency of convergence or divergence of regions and to take political decisions in order to improve the economic performance of the territories. However, the vast topic of regional price levels and the broad consequences of this recalculation exceeds this paper and will be part of our further research and discussed and published thereafter.

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ANNEX / APPENDIX **Table A1** Final household consumption expenditures in % according to NUTS 3 region and COICOP18 classification

ANNEX / APPENDIX	Hlavní město Praha	Středo-český kraj	Jiho-český kraj	Plzeň-ský kraj	Karlo-varský kraj	Ústecký kraj	Libe-recký kraj	Králové-hradecký kraj	Pardu-bický kraj	Kraj Vysočina	Jiho-moravský kraj	Olomoucký kraj	Zlínský kraj	Moravsko-slezský kraj	Czechia
01 – Food and non-alcoholic beverages	12.88	15.97	17.50	17.27	17.41	17.37	16.48	16.28	16.74	17.40	16.65	17.74	17.46	17.55	**16.31**
02 – Alcoholic beverages, tobacco and narcotics	7.06	7.63	8.24	8.21	8.54	8.72	8.45	8.27	8.43	7.76	7.51	8.76	8.62	9.88	**8.13**
03 – Clothing and footwear	3.33	3.19	3.70	3.65	3.60	3.60	3.26	3.22	3.31	3.59	3.52	3.50	3.45	3.48	**3.43**
04 – Housing, water, electricity,gas and other fuels	38.03	38.34	32.66	32.50	31.25	31.63	32.78	32.84	31.75	31.58	33.93	30.92	31.62	29.90	**33.86**
05 – Furnishings, household equipment and routine household maintenance	4.44	4.23	5.26	5.21	4.86	4.85	5.34	5.35	5.48	5.76	5.49	5.72	5.63	4.97	**5.02**
06 – Health	1.97	1.61	2.13	2.19	2.61	2.25	2.12	2.33	2.13	2.19	2.20	2.55	2.54	2.49	**2.15**
07 – Transport	8.21	7.64	8.83	8.90	8.80	8.61	8.50	8.62	8.71	8.86	8.09	8.03	7.82	7.98	**8.26**
08 – Information and communication	4.11	4.17	4.86	4.95	5.60	5.53	4.98	4.82	4.80	4.56	4.52	5.09	4.78	5.38	**4.72**
09 – Recreation, sport and culture	5.76	5.95	5.07	5.00	5.54	5.68	5.89	5.86	6.02	5.82	5.65	5.60	5.51	5.67	**5.68**
10 – Education services	0.81	0.51	0.41	0.36	0.36	0.37	0.37	0.39	0.40	0.45	0.40	0.42	0.42	0.44	**0.48**
11 – Restaurants and accommodation services	5.77	4.15	3.94	3.88	3.74	3.73	4.82	4.79	4.92	4.92	4.71	4.34	4.27	5.02	**4.64**
12 – Insurance and financial services	4.20	2.66	3.82	4.32	3.78	3.48	3.73	3.86	3.81	3.41	3.76	3.34	3.98	3.38	**3.63**
13 – Personal care, social protection and miscellaneous goods and services	3.43	3.95	3.59	3.54	3.92	4.18	3.29	3.36	3.50	3.71	3.56	3.99	3.91	3.86	**3.70**
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source: Czech Statistical Office, own calculations.