The Structural Transformation of Transition Economies

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Abstract

This paper offers a comparative analysis of growth and structural transformation within the former-Soviet Union (FSU) countries. It introduces the Economic Transformation Database of Transition Economies, a new dataset comprising annual sectoral employment and value-added data for fourteen FSU countries spanning 1990 to 2019. The findings indicate that structural changes in the FSU countries has been growth reducing. About 0.8 percentage points of the annual aggregate productivity growth gap between the FSU countries and the formerly centrally planned economies of Central and Eastern Europe (CEE) can be attributed to differing patterns of structural change. While labor has shifted from low- to high-productivity sectors in CEE economies, the opposite trend is observed in FSU economies. We contend that the different contribution of structural change to growth can be attributed to the interplay of initial conditions, external factors, and reform strategies.

Keywords— Structural change, ETD-TE database, Productivity growth, former-Soviet Union countries
JEL codes: C80; N10; O10

1 Introduction

Both historically and in the present day, economic development is accompanied and facilitated by the large-scale reallocation of workers between sectors in the economy. Such structural transformation is a key driver of differential growth performance, both in theoretical models of development and in empirical examples of rapid economic growth from 19th-century Europe to present-day East Asia.[1] Different sectors operate with highly varied degrees of efficiency and modernity, and thus vary greatly in terms of labour productivity (McMillan et al., 2014). As a result, the movement of workers *en masse* from lower to higher productivity sectors can yield rapid increases to aggregate productivity growth and therefore to growth in income and economic welfare.

This interplay between inter-sectoral structural transformation and economic growth is long understood, and as a result analyses which document the contribution of structural change to growth, or lack thereof, have been performed for many developing regions. These include developing Asia, Latin America, sub-Saharan Africa, and Central and Eastern Europe (see e.g. de Vries et al. (2015), Foster-McGregor and Verspagen (2016), Havlik (2015), Landesmann (2000), McMillan et al. (2017), and McMillan et al. (2014), Mensah et al. (2022)). Nevertheless, there is as yet no such analysis of the countries which formerly comprised the Soviet Union, in terms neither of documenting structural change within this group of countries nor of comparison with other developing regions[2]. This is surprising given that these countries are important providers of critical inputs and raw materials in supply chains, span almost 20% of the globe, and that their recent history is by definition a period of rapid economic transformation.

A quantitative analysis of structural change in the countries of the former-Soviet Union [FSUs] is long overdue. The transition period from 1991 onwards was one of economic reform and transformation on an extraordinary scale (Estrin et al., 2009; Turley & Luke, 2010). The rapid dismantling of central planning, both in the FSUs and the other former-Warsaw pact countries of Central and Eastern Europe [CEEs], predicated and necessitated reform along a number of dimensions, including but not limited to systemic transformation and institutional

[1] See Herrendorf et al. (2014) for a recent review.

[2] With the exception of Russia, for which analysis of structural change has been performed on a single-country basis and compared with specific, non-FSU peer-economies (de Vries et al., 2012), and the Baltic republics of Estonia, Latvia, and Lithuania, which have been analyzed alongside the other former-centrally planned EU-ascension countries (Havlik, 2015; Havlik et al., 2012; Novák, 2020).

change, marketization and privatization, financial stabilization, and structural adjustment (Sachs, 1996). Structural adjustment explicitly required the reallocation of resources in the economy in response to marketization, whilst the other strands can reasonably be surmised to have at least implicitly impacted the structures of the transition economies.[3]

Despite commonalities between the reform strategies of all transition economies, and in their predicate structural conditions, there are nevertheless discernible differences between them both in approaches to reform and observable macroeconomic outcomes. Alternative policy paradigms for transition existed even before the Soviet break-up (Sachs et al., 1994; Turley & Luke, 2010), and systematic differences in economic performance and level of reform have been noted ever since. The most frequently observed variation in performance is between the FSUs and the CEEs (Beck & Laeven, 2006; Fischer & Sahay, 2000; Sachs, 1996; Svejnar, 2002). Beck and Laeven (2006) note that "a large literature has attempted to explain the divergent growth experience [between FSUs and CEEs] on the basis of differences in economic policies, initial conditions, and reform strategies", and themselves relate this difference in part to levels of institutional change.

In terms of drivers of heterogeneous transition experiences, the FSUs and the CEEs differ in two important ways. First, there were systematic differences in the initial conditions of the two sets of countries. Fischer and Sahay (2000) note that the CEEs were more geographically proximate to potential advanced economy trading partners, had less severe macroeconomic imbalances, and had experienced central planning for shorter periods of time prior to 1991. Furthermore, the FSUs had the additional burden of unwinding a common currency and fewer prior constitutions or sets of laws and private property rights to revert to (Dabrowski, 2022; Gomulka, 2000).[4] Also, many FSUs enjoyed much larger natural resource endowments than the CEEs, which Beck and Laeven (2006) suggest fundamentally determined elite behaviour and influenced it away from positive institutional

[3]Throughout this paper, the term 'transition economies' is used to denote the full set of countries which underwent transition from central planning to market economies beginning around 1991, whilst the terms former-Soviet Union [FSU] and Central and Eastern Europe [CEE] are used to denote the former-Soviet countries and other non-Soviet former-Warsaw pact countries respectively.

[4]The Baltic republics of Estonia, Latvia, and Lithuania fall in between the two groups in terms of initial conditions; they were members of the Soviet union and ruble currency-zone, but for a shorter period of time than the other eleven republics. However, in terms of the differences in reform strategy discussed in the next paragraph, they are generally considered much more comparable to the CEEs than the FSUs (Beck & Laeven, 2006; Gomulka, 2000; Svejnar, 2002).

reform and competitive privatization.

Second, the FSUs and CEEs differed systematically in reform strategies, and success in the implementation thereof. Svejnar (2002) highlighted this systematic difference in the success of implementing what he categorized as 'Type 1' reforms. These were reforms which were considered necessary in all of the transition economies, and include macro-stabilization, price liberalization and the dismantling of communist institutions, which were "much less successful [than the CEEs] in Russia, the other countries of the Commonwealth of Independent States and the Balkans" (Svejnar, 2002). In terms of 'Type 2' reforms - the building of new market-based laws, regulations, institutions and a reliable state apparatus in the aftermath of the post-communist dismantlement - the difference between the CEEs and the FSUs was not only in terms of successful implementation, but in whether such reforms were even fully attempted. Gomulka (2000) differentiates between 'strong' and 'weak' variants of transition reform strategy, stating that the former variant was attempted in the Baltics and CEEs, whilst the latter applied more to the FSUs. The 'weak' variant of the FSUs involved slower and more incomplete reallocation of capital and labour resources away from large, centralized, and non-competitive enterprises. Furthermore, in the 'weak' variant, institutional reform was less of a priority, and market-liberalization lagged behind privatization, leading to concentrated ownership as former state-owned enterprises were privatized on non-competitive terms (Gomulka, 2000; Turley & Luke, 2010). The aforementioned difference in elite behaviour highlighted by Beck and Laeven (2006) was a major reason for this systematic variation in reform strategies; and Sachs (1996), Svejnar (2002), and Falcetti et al. (2006) all make the explicit link between these heterogeneities in reform strategies between the CEEs and FSUs and subsequent differences in economic performance.

These differences between the two sets of transition economies have two major implications for the analysis of structural change in the FSUs. First, transition in the FSUs was sufficiently different from the CEEs such that findings from the existing literature on structural change in the CEEs (Havlik, 2015; Havlik et al., 2012; Landesmann, 2000) should not be expected to necessarily hold in the FSUs. Separate and explicit study of structural change in the FSUs in the period since transition is therefore necessary. Second, it is not clear *a priori* what to expect in terms of the contribution of structural change to productivity growth in the FSUs. Whilst many rapid and necessary macroeconomic changes occurred in all of the transition economies, it is clear that reforms in the FSUs were considerably less extensive than in the CEEs, and particularly those relating to the reallocation of capital and labour resources.

This paper offers a comparative analysis of growth and structural transformation within the former-Soviet Union (FSU) countries. Up to now, the major impediment to performing such analysis was the lack of a complete and consistent database of employment and value added by sector for the FSUs. This paper presents the Economic Transformation Database of Transition Economies [ETD-TE], which is built from scratch from primary and archive sources, and provides a balanced panel of annual sectoral employment and value added data for fourteen former-Soviet Republics across the period 1990-2019.[5] When combined with EU-KLEMS (Bontadini et al., 2023), there is data for a total of 22 transition economies for the period 1995-2018, including eight CEEs, three Baltic republics, and eleven non-Baltic FSUs. This combined dataset is used to compare the structural change contribution to growth between the FSUs and the CEEs as well as between the FSU and other developing regions such as developing Asia, sub-Saharan Africa, and Latin America since 1990.

The main result of this paper is that the contribution of structural change to labour productivity growth has been negative (growth-reducing) in the FSU countries across the three decades since transition, and that this stands in contrast with the CEEs, in which the contribution of structural change has been positive (growth-enhancing). About halve of the difference in aggregate productivity growth between the FSUs and the CEEs is accounted for by differences in the pattern of structural change – with labour moving from low- to high-productivity sectors in the formerly planned and Baltic economies, but in the opposite direction in transition economies. Additionally, the FSUs are the only set of developing countries to have experienced growth-reducing structural change when compared to the other developing regions of emerging Asia, sub-Saharan Africa, and Latin America, in a replication and extension of McMillan et al. (2014) incorporating the former-Soviet economies. These results are generated using a shift-share decomposition method in which aggregate labour productivity growth is decomposed into growth at the sector level and a reallocation (structural change) effect.

Accounting for heterogeneity within the set of FSUs shows that the finding of

[5]The fourteen FSUs are: Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Ukraine, and Uzbekistan. Turkmenistan is excluded. Whilst the original data contribution of the ETD-TE is for these 14 FSUs, from 1995 onwards it can be combined with EU-KLEMS (Bontadini et al., 2023) so as to additionally include data for eight CEEs - Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia - for a total combined dataset of 22 transition economies. The data is made publicly available and for free from www.ggdc.nl.

growth-reducing structural change is not driven by a specific subset of countries, but is common across the region in the Caucasus, Central Asia, and the 'Core' countries of Belarus, Moldova, Russia, and Ukraine. Growth-reducing structural change was concentrated in the first decade of transition for the FSUs as a whole, and for all sub-regions with the exception of the Core, which reverted to growth-reducing structural change also into the 2010s. By contrast, the Baltic experience more closely resembles that of the CEEs, with growth-enhancing structural change documented in every decade. Robustness checks and alternative specifications show that the results are not dependent on whether analysis starts before or after the transition recession, whether cross-country averages are weighted, whether natural resource rich economies are excluded, or the level of sectoral disaggregation used. A counterfactual analysis suggests that, had the FSUs experienced an identical pattern of inter-sectoral labour reallocation as that which occurred in the CEEs, their total increase in average labour productivity between 1995 and 2018 could have been 23% larger than what actually occurred, albeit with the strong assumption that such an alternative pattern of structural change could have been achieved without impacting within-sector productivity growth.

We do not claim that the different contribution of structural change to growth between the FSUs and the CEEs resulted solely from the aforementioned differences in reform strategy and implementation, nor do we suggest that the FSUs *could* have enjoyed a more positive structural change experience or replicated the CEE experience given the differences in initial conditions and other pre-determined factors.[6] It is noteworthy that the Baltics - the only former-Soviet countries which also joined the CEEs on the EU-ascension path - enjoyed a positive structural change experience comparable to the CEEs rather than the (other) FSUs, but in our analysis this remains no more than an association. Differences in initial conditions interacted with reform strategies and approaches - for example, the higher potential resource rents in FSU countries influencing elite behaviour away from stronger reforms as noted by Beck and Laeven (2006) - to the extent that

[6]In addition to differences in initial conditions, the end of the Soviet Union as a single state brought about rapid disruptions to long established internal production networks. For example, intermediate production in Soviet value chains taking place in the Caucasus or Central Asia upstream of final processing at factories in Belarus or Russia became suddenly external, and precisely at the moment of rapidly diminished demand, resulting in a large additional blow to various industries in new FSU countries (Turley & Luke, 2010). Whilst such disruptions also impacted CEE countries, which were also integrated into value chains with the Soviet Union and other centrally planned allies, they were likely less severe as these were already separate countries, albeit under a common political structure.

separating the impacts of the two on structural change and other aspects of the macroeconomy is a complex task which this paper leaves open for future research. Similarly, this paper is deliberately silent on the impact of specific features of transition on structural change - such as hyperinflations, specific reform strategies, policy packages, etc. - and opts instead to document key facts of structural change in the transition economies and bring the stark difference between the FSUs and the CEEs to the attention of the literature. This paper aspires to stimulate further research into unpicking and explaining these facts and differences and, in presenting the new ETD-TE, to provide an important tool with which to do so.

The remainder of this paper proceeds as follows. Section 2 presents the new ETD-TE database of employment and value added by sector for the former-Soviet countries and goes into detail of the construction sources, methods, and approach.[7] Section 3 presents the initial starting conditions, descriptive statistics, and a comparison of patterns and trends in the FSUs and CEEs. Section 4 uses a shift-share decomposition technique to quantify the contribution of structural change to growth in the FSUs and other developing regions for comparative purposes. Section 5 examines heterogeneity within the FSUs regarding the relation between structural change and growth. Section 6 performs a counterfactual exercise to benchmark the economic magnitude of the difference in structural change experience between the FSUs and the CEEs. Section 7 concludes.

2 The Economic Transformation Database of Transition Economies

To facilitate the analysis of inter-industry structural transformation in the former Soviet transition countries, this paper presents the Economic Transformation Database of Transition Economies [ETD-TE]. The ETD-TE is a new database of annual sectoral employment and value added [VA] data for fourteen former-Soviet Republics across the period 1990-2019[8]. The ETD-TE is built from scratch using primary and archive sources and provides a balanced panel of VA in national

[7] A detailed country-by-country description of sources and methods is provided in Appendix A.

[8] The full set of countries included in the ETD-TE is Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Ukraine, and Uzbekistan. For most of the sample period, Turkmenistan had an official nonreporting policy for macroeconomic statistics (World Bank, 2022a).

currencies at both real and nominal prices, and persons employed, across twelve main industrial sectors of the macroeconomy[9] . The real VA and persons employed data can be combined to create time series' of labour productivity by sector per annum. The twelve sectors follow International Standard Industrial Classification [ISIC] revision 4 across all countries and years.

This section describes the database in terms of construction principles, specific transition country data issues, consistency, reliability, and comparison with alternative datasets. Readers whose primary interest is in the analytical results may choose to skip the remainder of this section.

The ETD-TE can be used with the Economic Transformation Database [ETD] of the Groningen Growth and Development Centre and UNU-WIDER (de Vries et al., 2021; Kruse et al., 2022), whereby the variables and sector classifications match. The ETD contains data for 51 developing countries across Africa, Asia, and Latin America. Combining the ETD-TE with the ETD provides a set of 65 countries. This combined dataset can be used either to compare the structural transformation of transition economies with other developing countries or regions, as in this paper, or to perform broader analysis on a large, balanced panel of sectoral data which is now more representative of the world's developing regions[10].

The ETD-TE has been built from scratch[11] on the basis of detailed investigation into primary and archive statistical sources for each of the fourteen transition economies. The starting point is official data from the National Statistical Institutes [NSI], regional bodies such as the Commonwealth of Independent States [CIS], and reports or publications which preserve older NSI statistics as parts of statistical appendices, yearbooks, or country profiles. Many of these materials -

[9]The complete set of sectors included are agriculture [ISIC 4 code A], mining [B], manufacturing [C], utilities [D+E], construction [F], trade services [G+I], transport [H], business services [J+M+N], financial intermediate [K], real estate [L], public sector and government [O+P+Q], and other services [R+S+T+U]. Together these cover the full set of ISIC 4 classifications and the full macroeconomy.

[10]Additionally, the ETD-TE can be easily combined with the 2023 release of EU-KLEMS (Bontadini et al., 2023).

[11]A partial exception to this are the three Baltic countries of Estonia, Latvia, and Lithuania, which are EU-members and for which VA and employment data for the period 1995-2019 exists already as part of the EU-KLEMS project (Bontadini et al., 2023; Stehrer & Sabouniha, 2023; van Ark & Jäger, 2017). The EU-KLEMS data serves as a basis for the ETD-TE series' for these three countries, which is then subjected to normalization and extrapolated back to 1990 following procedures outlined in this section and elaborated in Appendix A.

especially those relating to the first decade of transition (1990s) - are available only in physical form and have been sourced and digitized for use in the ETD-TE. Where secondary sources have been used, such as UN Official Country Data, these figures are checked in terms of underlying metadata to ensure they are consistent with the concepts of the ETD-TE variables, and the figures are verified against primary sources[12].

A detailed description of the sources and methods on a country-by-country account is provided in Appendix A. The full database is publicly available at https://www.rug.nl/ggdc/structuralchange/etd/... and can be used for free provided appropriate attribution is made.

2.1 Construction and Consistency

The construction procedure was designed in order to best fulfil three consistency requirements which are established tests of largescale macroeconomic databases of this kind (de Vries et al., 2015; Kruse et al., 2022; Timmer et al., 2015). They are *intertemporal* consistency, *international* consistency, and *internal* consistency. This subsection outlines the construction procedure through the lens of intertemporal consistency and then explains how this procedure also ensures international and internal consistency.

Intertemporal consistency is obtained by ensuring the series' are complete over time and expressed in consistent units with no structural breaks or underlying conceptual shifts in the definition or construction of variables. The construction procedure for value added begins by taking data in levels for the most recent years of the sample by industrial sector according the the aforementioned sectoral disaggregation, either directly from the NSI National Accounts, or from UN Official Country Data verified against the National Accounts. All VA data is therefore expressed according to the most recent revision of the UN System of National Accounts (SNA), in current national currency units according to the most recent revaluation, and by ISIC sector classifications. All real VA data is converted to 2015 prices from previous year prices or whichever base year is used in the source data. Older NSI or UN data is then used to *backwards extrapolate* the series as

[12]For example, UN Official Country Data is often used as a source for sectoral VA, but always checked to ensure the numbers are consistent with those from the NSI and National Accounts. Verified UN Official Country Data might then be used in place of NSI VA data for the extrapolation of trends when it offers a higher level of disaggregation or covers a longer time period.

far as possible, usually to the mid-1990s. Finally, the data is backwards extrapolated to 1990 using VA or Net Material Product [NMP] data from archive sources according to a procedure detailed below. Where earlier data uses older revisions of the ISIC classification, it is converted to ISIC 4 using an official concordance (United Nations, 2007) when the older data is sufficiently detailed, or else assuming constant sub-sector ratios from the oldest available overlap year between the two classifications. When data is in Soviet-era classification, it is concorded to ISIC 4 using a procedure detailed below. The key aspect with regards to intertemporal consistency is that only the most recent official sectoral VA data is used in *levels*, all earlier data, once converted to ISIC 4, is used to generate growth-rate *trends* which are then applied to the most recent level data as a backwards extrapolation. This means that all data is automatically converted to the most recent SNA revision, currency and revaluation[13], and, in the case of the real VA data, 2015 base year, throughout the entire sample period[14]. This ensures intertemporal consistency in the VA data.

In the case of employment data, intertemporal consistency is again imposed as a result of the construction procedure. Employment throughout the database in all sectors, countries, and years of the sample is measured in thousands of *persons employed*; a definition which includes all persons aged 15+ and according to which each person employed is assigned to only one sector per year - that in which they primarily worked; whether in a formal, informal, or self-employed capacity. Employment statistics are not a standard part of the SNA. Where NSIs do provide

[13]This approach does come with one notable drawback in the case of the earliest years of nominal VA data. Many of the transition economies experienced hyperinflations throughout the post-Cold War sample period, sometimes repeatedly. These hyperinflations often ended with currency revaluations. For example, the current Belarussian ruble is in fact the 'third ruble', having replaced the second ruble in 2016 on the back of a hyperinflation episode, at a rate of one new ruble to 10,000 old rubles. The second ruble itself had replaced the first ruble in 2000 in a similar manner. The ETD-TE ensures intertemporal consistency by expressing Belarussian VA in 'third rubles' throughout, but the result is that the series' decline to extremely small numbers in the earliest years. This issue is present for most countries in the sample in the pre-1995 period, and this in conjunction with the lack of market prices in the first years of transition (as discussed later in section 2.1) implies that the early nominal VA data should be treated with a high degree of caution. The real VA data, and subsequent labour productivity calculations, are not subject to any such statistical issues resulting from these hyperinflations.

[14]This procedure also considerably weakens the assumptions one has to make over the earlier data. For example, when ISIC 3 or Soviet-classification data is converted to ISIC 4, it is not necessary to assume that the concorded sectors precisely match the ISIC 4 series of the more recent data, merely that they *grew at the same rate*, in order for the database to be intertemporally consistent.

employment statistics, they are on the basis of Labour Force Surveys [LFS] and are sporadic, although in some cases there are regular annual figures for the most recent years. Most NSIs also conducted decennial Population Censuses [PC], which implicitly impose the 'persons employed' concept and are a full-population sample. These censuses are effectively a 'full population' LFS, and data from them can usually be tracked down in the form of summary publications and reports in cases when the figures are not directly provided by the NSI. Many NSIs also publish Statistical Yearbooks which collate LFS figures. Some NSIs and other (secondary) sources which collate employment data often compile data from methodologically disparate sources, such as surveys which cover only the formal sector or workers of larger enterprises and therefore do not impose the 'persons employed' concept, or household surveys not primarily designed to approximate the nationwide labour-market and therefore insufficiently large or stratified for reliable population-level inference.

The construction procedure overcomes these bars to intertemporal consistency in the following way. First, benchmark years are established whereby PCs and LFSs which verifiably utilized the persons employed concept and have broad and well-stratified population coverage are identified. For these years, of which there are typically many in the most recent decade of the sample but fewer in the first two decades, the persons employed by ISIC 4 sector is taken as *shares* of the total persons employed. In most cases, these shares are then applied to the persons employed totals from the Penn World Table [PWT] edition 10.0, to yield *levels* of employment by sector in each of the benchmark years[15]. Where data is not already in ISIC 4, the conversion to ISIC 4 is performed in the same way as for the VA data as described above. Sometimes, benchmark LFS data is taken from secondary sources, such as the UNECE Data Portal, when that data can be verified as having come from a reliable LFS which uses the persons employed concept. In between benchmark years, sectoral employment data is interpolated using growth rate *trends* from alternative labour force figures. These can include annual sectoral figures from statistical yearbooks, regional publications or country profiles, UN or UNECE figures, and ILO modelled estimates. For the very earliest years in the sample - usually pre-1995 - figures are then backwards extrapolated to 1990 using the trends from *employment registration* figures in Soviet era classification. More detail on this is provided below. The result of this construction procedure is that, throughout the sample, all employment by sector is in thousands of persons employed, according to the same employment concept and sector classification and

[15]In some cases, the PWT totals are adjusted to bring them in line with the totals from population censuses. Refer to Appendix A for details of such cases on a country-specific base, and any other specific deviations from the general procedure outlined in this section.

subject to the same normalizations. This ensures intertemporal consistency.

Much of the above described procedure for ensuring intertemporal consistency also ensures international consistency; i.e. that the data is the same across countries in the sample in terms of classifications, underlying concepts, base year, etc. The use of a standard guiding procedure as detailed above for all of the countries imposes international consistency. It results in a balanced panel; and therefore no deviations between countries in terms of which years are available, and data is presented in the aforementioned twelve ISIC 4 sectors across all countries. In the case of the real VA data, data for all countries is in 2015 prices, and in the case of the employment data, data for all countries utilizes the identical 'persons employed' concept. This methodology also imposes international consistency with the 51 countries of the Economic Transformation Database.

Finally, internal consistency requires that the variables within the database are consistent with each other; i.e. that the activities covered by the VA and employment data are the same. It is only when the variables are internally consistent that they can be meaningfully combined to produce, for example, labour productivity variables. The construction approach outlined above achieves internal consistency as closely as possible by recognising that the National Accounts based VA measures are whole economy measures, which seek to capture the full scope of production within an economy - including informal output, household production, etc. - and selecting the employment concept accordingly. The 'persons employed' definition is a whole economy concept which ensures that the labour input by sector of the entire economy is captured.

Within the National Accounts, calculations of VA involve certain approximations or imputations for production for which there is no market transaction. In most instances, this is fairly benign from the perspective of internal consistency. If, for example, the VA of agricultural production for home consumption is imputed, this is not inconsistent with the persons employed in agriculture variable as the latter includes home producers. There is however one major instance when this is not the case. In order to avoid an arbitrary distinction between owner-occupiers and renters from the perspective of the production of housing services, National Accounts routinely calculate imputed rents for those living in homes which they own; these can represent a sizeable addition to whole economy VA and do not have a meaningful employment equivalent. As a result, these imputed rents can lead to dramatic overstatement of labour productivity in the sector to which they are assigned, which is typically business services. The ETD-TE separates out these imputed rents into the sector 'Real Estate' so that they can easily be removed

from productivity calculates and other analysis. Other sectors for which the precise definitions of output remain subject to some debate, such as financial services (Inklaar & Wang, 2012), are also presented as separate in the ETD-TE.

2.2 Reliability

Potential concerns over the reliability of the ETD-TE as an accurate representation of the true evolving sectoral composition of the transition economies in the period since 1990 can be split into two categories: standard concerns over any such large-scale macroeconomic database which brings together primary sources from various time periods and NSIs, and specific concerns relating to the transition economies and the implications of transition for contemporary statistical sources.

The former concern is to a large extent addressed by the construction procedure outlined in the previous subsection, and especially by the research-approach of the ETD-TE which involved the collection and deep reading of a wide array of statistical materials and their accompanying metadata, with only reliable and verifiable sources used. An issue which has impacted work on such databases for other developing regions has been a lack of quality primary data for some countries (de Vries et al., 2015; Jerven & Johnston, 2015) which on occasion left compilers with no option but to use data from smaller-sample surveys or perform long interpolations. However, the transition economies generally offer a reasonable array of statistical materials, and are supplemented by regional agencies such as CIS Stat. Timmer and Voskoboynikov (2014) discuss some of the issues with the collection of statistics in the former-Soviet countries in the first half of transition, noting that the primary reliability concerns stem not from the frequency or breadth of statistical coverage, but from the fractured transition from one system of statistics to another, as will be discussed shortly. (Kudrov, 1998) describes the statistical capacity at the end of the Soviet era. The overarching Soviet superstructure implied that all republics inherited statistical capacities which were more sophisticated than those of other countries with similar per capita income levels. This trend appears to have persisted in the decades following the Soviet disolution. According to the statistical capacity index of (Cameron et al., 2021), twelve of the fourteen economies of the ETD-TE are in the top two global quintiles of state statistical capacity, and none are in the bottom quintile.

The latter concern, that of specific issues relating to the National Accounts and labour statistics of the transition economies, requires more detailed attention. These issues fall broadly into two catagories. First, the conceptual shift from the Soviet Material Product System [MPS], and accompanying statistical

approach and system of classification, to the international System of National Accounts [SNA] framework, has implications for the reliability of statistics in the earlier period (Entov & Lugovoy, 2013; Ivanov, 2009; Kudrov, 1998; Timmer & Voskoboynikov, 2014). Second, the process of price liberalization, during which prices took time to settle to new market price equilibria following the dismantling of the Soviet system of price controls and other distortions (Åslund, 1995; Entov & Lugovoy, 2013), raises questions of the reliability of nominal output measures during the earliest years of transition. A further issue of Soviet era statistics, that of systematic over-reporting of production on the basis of distorted incentives, likely diminished rapidly after 1991 as a result of market reforms[16] (Entov & Lugovoy, 2013).

The MPS differed from the SNA along several dimensions which stemmed from a fundamental ideological distinction between material and non-material production. This distinction had roots in Soviet ideological perspectives over the relative social importance of different types of labour (Holesovsky, 1961). Marer et al. (1993) provides a detailed explanation of the Soviet MPS, the differences between the MPS and the SNA, and contemporary approaches to conversion between the two systems. In brief, the major differences were as follows: a) the aforementioned material/non-material split and concomitant categorization implications; b) the use of official prices to estimate nominal values due to the lack of market prices in the Soviet system; and c) the prioritization of volume measures to evaluate production and output (Van Heijster & DeRock, 2020). The former conceptual split rendered the collation and measurement of non-material statistics a lower priority for Soviet statisticians.

As discussed by Timmer and Voskoboynikov (2014), officially Russia and the other former Soviet states adopted the SNA shortly after the Soviet dissolution in the early 1990s. In practice, however, statistical systems adapted at different paces, with elements of the MPS remaining in the Russian statistics until the early

[16]The market reforms and widespread privatization in the early 1990s may have replaced these Soviet era incentive based distortions with an opposite set; that is, before the Soviet break-up there was the incentive to over-report production to fulfil central targets, but after the break-up there was an incentive to under-report for reasons of tax evasion. This distortion, however, is much more common across national statistics generally and at least brings the transition economies in line with those of other comparison countries in terms of potential systematic biases (Slemrod, 2007) . According to Entov and Lugovoy (2013), the biggest issue stemming from these distortions is the structural break in incentives at the point of the Soviet break-up. By restricting the ETD-TE and the analysis of this paper to purely the transition period, this structural break is avoided.

2000s, and different transition economies fully converting to SNA at different times. In terms of output data, the MPS statistics use the Net Material Product [NMP] concept instead of the VA concept for expressing ouput by sector in the earliest years of transition. NMP is not an equivalent concept to GDP, although it is more similar to VA, as many of the adjustments required to convert NMP to GDP are in the dimension of depreciation, taxes, and margins (Kudrov, 1998; Marer et al., 1993). In terms of both output and employment data, the MPS statistics use a different set of sector classifications[17] which derive from the material/non-material split. Voskoboynikov (2012) provides a detailed concordance between MPS and ISIC sector classifications.

The construction procedure of the ETD-TE addresses these issues as follows. Data which retains any element of the MPS system is never used to provide level estimates of either VA or employment in the ETD-TE. Instead, growth-rate trends from such data are used to backwards extrapolate from the earliest years of purely SNA data. This imposes an assumption weaker than that MPS figures can be accurately concorded to, or can accurately proxy for, SNA figures. The assumption instead is that the growth rate of concorded MPS figures is a reasonable approximation of the growth rate of the equivalent SNA/ISIC 4 figures. Where figures are only available in Soviet-era classification, these are converted to ISIC 4 following the concordance of Voskoboynikov (2012) when the source data is sufficiently detailed to allow it, and the growth rate trends from these concorded figures are used for the backwards extrapolation. When the source data lacks this detail, the growth-rate trends from the broader MPS categories are applied to the relevant ISIC 4 sub-categories. For example, the growth rate of the MPS category 'Administration, banking and insurance' is sometimes applied to each of the ISIC 4 categories 'Business Services' and 'Financial Services' in the pre-1995 period. The fact that the smaller services sectors are often less well disaggregated in primary MPS data, combined with the aforementioned lesser priority of 'non-material' data for Soviet-era statisticians, implies that the levels and ratios of the smaller services sectors should be treated with caution for the pre-1995 period. This means that comparisons between these sectors - for example, comparing business services with financial services - should be made only from 1995 onwards, whereas comparisons of Services as a whole with other sectors can be reasonably made from 1990. Finally, in cases where VA figures are not available for the earliest years of the sample, the growth rate trends of the NMP figures are used instead.

The lack of market prices during the Soviet-era led to a widespread phe-

[17] Officially called the OKONH [Soviet National Economy Industries Classification System].

nomenon of *hidden inflation* with large deviations between official price indices and the actual cost of living (Nuti, 1986). The period of price liberalization therefore was not only a period of temporary deviation from market prices, as the official prices took time to adjust, but was also one of hyperinflation, as the hidden inflations of the 1980s came out from hiding in the early 1990s. Most of the post-Soviet literature on the price liberalization period focuses on Russia, but it has been suggested that prices settled and the general wave of hyperinflation ended by 1994 at the latest (Åslund, 1995). A broader implication of centrally managed prices is that Soviet statistical agencies placed a very low priority on conducting price surveys, deferring to the official price indices, and instead prioritizing the collection of volume measures (Entov & Lugovoy, 2013). Therefore, despite the aforementioned relative sophistication of Soviet statistical agencies in terms of frequency and breadth of coverage, the capacity to accurately compile nominal statistics remained underdeveloped for many years into transition[18].

The outcome of this discussion is that researchers should treat the pre-1995 nominal price VA data of the ETD-TE with caution. Whilst the ETD-TE uses primary statistical sources and makes few interpolations for this period, it relies on the price assumptions made in the source data. These price assumptions inherit the above described issues and are usually based on hybrid price indices, mixing price survey outcomes with adjusted official prices. The hyperinflations of this period also limit the usefulness of this data, particularly for intertemporal comparisons, due to the extremely rapid nominal growth rates. The real VA figures, which are based on volume measures of production, are not affected, and indeed may command increased confidence on account of the prioritization of such data collection by post-Soviet statistical agencies (Entov & Lugovoy, 2013).

Prior to the ETD-TE, there was to the best of our knowledge no complete panel database for the transition economies. Partial datasets containing both output and employment by sector are available for the period 1995 - 2019 for six of the transition economies from the World Bank Productivity Project[19], and for the period 2000 - 2019 for seven of the transition economies from the wiiw Handbook

[18]Besanov (2009) provides a comprehensive overview of the issues surrounding price indices in post-Soviet statistical agencies, but is available only in Russian.

[19]The countries in the World Bank Productivity Project are Azerbaijan, Estonia, Georgia, Latvia, Lithuania, and Russia. The data for the Baltic republics come directly from EU KLEMS and the data for Russia comes directly from Russia KLEMS.

of Statistics[20] (Borosak et al., 2020). These combine data from various different sources which use different methodologies and therefore impact international consistency[21].

Another possibility would be to assemble a panel dataset utilizing sectoral VA data from UN Official Country Data [UN OCD] and sectoral employment data from either the UNECE, which provides an unbalanced panel of sectoral employment data for many of the transition economies from around 2000, or from the ILO Modeled Estimates, which provides a balanced panel of sectoral employment data for most countries in the world, but on the basis of outcomes from a forecasting regression. The UN OCD does provide sectoral VA data for all countries in the sample which often goes back as far as the mid-1990s. However, this data is in a variety of different series' which are based on different SNA revisions, currencies, and sector classifications, and in the case of real VA data is frequently in previous year prices or at different base years which vary throughout the series'. The ETD-TE utilizes the UN OCD as an important source for sectoral VA data, but links the series through the procedures outlined above, and therefore improves intertemporal consistency. The most recent VA figures are always either directly from the National Accounts or verified against the National Accounts, and then the growth rate trends from UN OCD and other primary source figures are used to backwards extrapolate the data. This allows for smooth productivity calculations and time series trends as the data is rendered intertemporaily consistent. The procedures for incorporating archive statistics then bring the data back to 1990, which is not the case in the UN OCD figures.

In terms of the employment figures, the UNECE data portal collates sectoral employment figures from labour force, establishment, and household surveys. The amount of data held by the UNECE varies by country, but it has good coverage of many transition economies in the 2010s and somewhat more sporadic coverage for the 2000s. The data is unbalanced and all but the most recent years is in ISIC 3

[20]The countries in the wiiw Handbook of Statistics are Belarus, Estonia, Kazakhstan, Latvia, Lithuania, Russia, and Ukraine. The wiiw data archives also include older data for these countries; some of this data proved very useful as a check on figures in the ETD-TE. The wiiw Handbook of Statistics also contains a wide selection of data for former centrally planned EU countries and some Balkan nations.

[21]For example, the Russia KLEMS data applies a technique to impute hours spent on agricultural production at home beyond workers' primary employment (Voskoboynikov, 2012, 2021), resulting in figures for agricultural employment which are two to three times larger than those in the official labour statistics. EU KLEMS does not apply this adjustment to the Baltic countries, yet both datasets are combined in the World Bank Productivity Project.

classification and is disaggregated into six sectors. It compiles statistics from surveys with different methodologies or breadths of coverage; for example, combining data in levels from establishment surveys which cover only the formal sector and larger enterprises with data from full coverage labour force surveys. The following sub-section provides a comprehensive example of the construction procedure for one country in the sample - Georgia - which also illustrates by comparison some of the drawbacks of the UNECE figures.

2.3 Example of Construction Procedure: Georgia

To illustrate the construction procedure, we provide the example of Georgia. Sectoral labour statistics for the most recent years on the NSI website were establishment surveys and only covered the formal sector and employment in medium or large enterprises. Therefore, these figures were not used. Instead, microdata from comprehensive labour force surveys for the years 2017-2019 was located. This microdata contained sufficient detail to aggregate into ISIC 4 classification and check that the surveys were properly stratified. The employment shares of each sector from these microdata were applied to total employment for Georgia in the years 2017-2019 from the Penn World Table [PWT] version 10.1 (Feenstra et al., 2015) to yield benchmark employment levels by sector. Employment by sector for 2014 was drawn from a published report of the 2014 Population Census (Geostat, 2016). The employment shares of each sector were applied to the PWT employment total creating another benchmark year in 2014. Employment by sector in ISIC 3 classification for the years 1998-2007 was located in Statistical Yearbook publications (Geostat, 2007, 2009), with sufficient information to verify the quality of the underlying labour force surveys. The figures were disaggregated from ISIC 4 to ISIC 3 classification based on the assumption of constant sub-sector splits from the 2014 census data. The employment shares of each sector were then applied to the PWT employment totals creating benchmark years in 1998-2007.

In between the benchmark years, employment by sector was available from the UNECE data portal, but only across six broad sectors. The UNECE figures were drawn from the same LFS which underpinned the earlier Yearbook figures. These 6-sector UNECE figures were split to 12-sector ISIC 4 classification by application of sub-sector ratios from the ILO Modeled estimates. This yielded time series of employment by sector from 2007-2017 in ISIC 4 classification. The growth rate trends from these series were used to interpolate between the benchmark years; i.e. between 2007 and 2014, and between 2014 and 2017. For the period pre-1998, detailed data was found in two physical books: a Eurostat (1994) Country Profile Publication which contained detailed employment by sector in Soviet-era classification for the period 1990-1991, and a 1996 World Bank Former USSR Statistical Handbook (Duckett, 1997) which contained employment by sector in Soviet-era classification for the period 1990-1995 in slightly less detailed form. The data for 1990-1991 was concorded to ISIC 4 following Voskoboynikov (2012) which provides a concordance table in Appendix A[22]. This table lists all of the ISIC sectors at the

[22]The full table is Table A.T4 in Voskoboynikov (2012), pages 56-58, which can be downloaded from the 'Research Memoranda' section of the ggdc.net website; and is also reproduced in the sources and methods documentation (Hamilton et al., 2023).

one digit level and their closest equivalent sectors in the Soviet-era classification. From this table, it is possible to assemble the twelve sectors of the ETD-TE from the Soviet-era sectors, provided the source data is sufficiently disaggregated. The employment shares of each sector were applied to the PWT employment totals creating benchmark years in 1990-1991. These data were then forwards extrapolated to 1995 using the growth rate trends from the World Bank Data (Duckett, 1997). The ISIC 4 sectors use the trends of their closest equivalent Soviet-era sectors. As the Soviet-era data was not fully disaggregated, some ISIC 4 sectors share a common trend. For example, the growth-rate trend of the Soviet-era sector 'Industry' is used to interpolate all three of the ISIC 4 sectors 'Manufacturing', 'Mining', and 'Utilities' from 1991 to 1995. Finally, as there was no primary source data for the period 1996-1997, these years were interpolated using the growth rate trends from the ILO Modeled estimates in ISIC 4 classification.

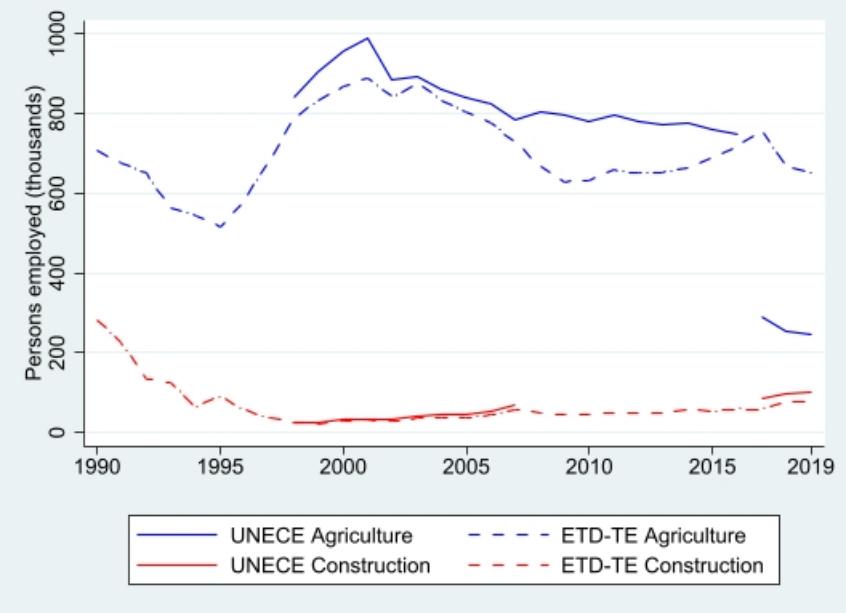
This construction approach yields a complete, balanced, and intertemporally consistent panel of sectoral employment for Georgia. Figure 1 shows the comparison with the unadulterated UNECE figures. This figure shows employment in the Agriculture and Construction[23] sectors for Georgia from both the ETD-TE and the UNECE. Whilst the UNECE series for Agriculture is complete as far back as 1998, there is a large gap in the series for Construction with no data between 2007 and 2017. There is a large structural break in the series for Agriculture in 2017 where employment drops by a factor of three. This is because the most recent years of UNECE data are drawn from the establishment surveys described above, which cover only formal employment in larger establishments. The Construction series does not show such a large deviation from the ETD-TE in these years because a smaller proportion of construction workers are informally employed. This indicates that not only are the employment levels within sectors impacted by the use of inconsistent LFS sources, but so are the ratios between sectors. Note that it is the *more recent* data which introduces the intertemporal inconsistency, therefore a strategy of assuming the accuracy of the most recent data and extrapolating backwards would have compounded rather than resolved the problem.

The inclusion of the pre-1998 period in the ETD-TE also introduces the immediate transition dynamics into the data; the Georgian economy suffered a deep depression in the immediate aftermath of the Soviet break-up which - coupled with outward migration of Russian-born Soviet citizens - manifested in rapid declines in employment (Kornai, 1994). This trend was reversed in 1996 when inflation was brought under control with a fixed exchange rate and tightening of fiscal and

[23]Employment in Manufacturing is not shown in Figure 1 because it is not separately distinguished in the UNECE data and is instead grouped with 'Mining' and 'Utilities'.

monetary policies (Dabrowski, 2022)[24]. However, the withdrawal of Soviet-era industrialized construction and housing policy meant employment in construction never returned to the very high levels of the Soviet period (Sillince, 2004). This illustrates the heterogeneous experiences of different sectors in the immediate aftermath of the transition recession.

Figure 1: Time series of level figures for employment in agriculture and construction in Georgia from the ETD-TE and UNECE.



Note: Solid lines show the levels of employment in agriculture and construction in each available year of data from the UNECE, dashed lines show the same from the ETD-TE. *Source:* ETD-TE and UNECE Statistical Database.

Data for constant and current price value added [VA] by ISIC 4 sector was taken directly from the UN Official Data Portal for the period 2010-2018 in levels. It was verified that this data matched the official NSI National Accounts. From 1995-2010, the UN Data is in ISIC 3 classification; it was therefore split to ISIC

[24]Dabrowski (2022) shows that Georgian GDP growth was 10.5 in both 1996 and 1997, following five consecutive years of negative growth from 1990-1994, and elaborates on the fiscal and monetary policy explanations for this reversal.

4 using the sub-sector ratios from the oldest overlap year, 2010. The growth rate trends from this data were then used to backwards extrapolate VA for each sector from 2010 back to 1995; by using the trend, data was automatically converted to the most recent revision and - in the case of the constant VA data - to the 2015 base year. For the pre-1995 period, current price VA data was available from the UNECE for the period 1992-1995, but only across six broad sectors. The growth rate trends from this data was used to extrapolate the current price VA data backwards to 1992, with ISIC 4 sub-sectors using the trends of their aggregated parent sectors. For constant price data, the sectoral VA was backwards extrapolated back to 1992 applying the same constant growth rates as between 1995 and 1996. Complete and well disaggregated Net Material Product [NMP] data was found only from 1990-1992, in Soviet-era Classification, in a physical copy of a World Bank (1993) country report. These data were converted to ISIC 4 using the concordance of Voskoboynikov (2012), yielding series of NMP in ISIC 4 classification for the period 1990-1992. The growth rate trends from this sectoral NMP data were then used to backwards extrapolate the sectoral VA data from 1992 back to 1990.

3 Starting Conditions and Sectoral Trends

This section presents descriptive statistics from the new ETD-TE in order to establish the initial conditions and changes over time in the structure of the transition economies. Figure 2 shows the sectoral structure of the transition economies in terms of employment shares and average sector labour productivity in 1995, as unweighted averages. The sample is the full set of former-Soviet republics including the Baltic states. The year 1995 comes at the end of the immediate transition recession and before the subsequent recovery in most countries (Dabrowski, 2022; Gomulka, 2000; Popov, 2007). The width of the bars shows employment in each sector as a share of total persons employed, and the height shows the ratio of sector labour productivity to average labour productivity across all sectors[25]. Labour productivity is calculated as constant VA per worker per annum in each sector, and then normalized to the average labour productivity in each country before taking the unweighted average across the fourteen transition countries.

[25]Real Estate sector is excluded because of the distortionary impact of imputed rent on productivity calculations as explained in section 2. For clarity of exposition, the remaining eleven sectors of the ETD-TE are grouped into nine. 'Finance and Business' contains 'Financial Services' and 'Communication and Business Services', 'Other Industry' contains 'Utilities' and 'Mining'.

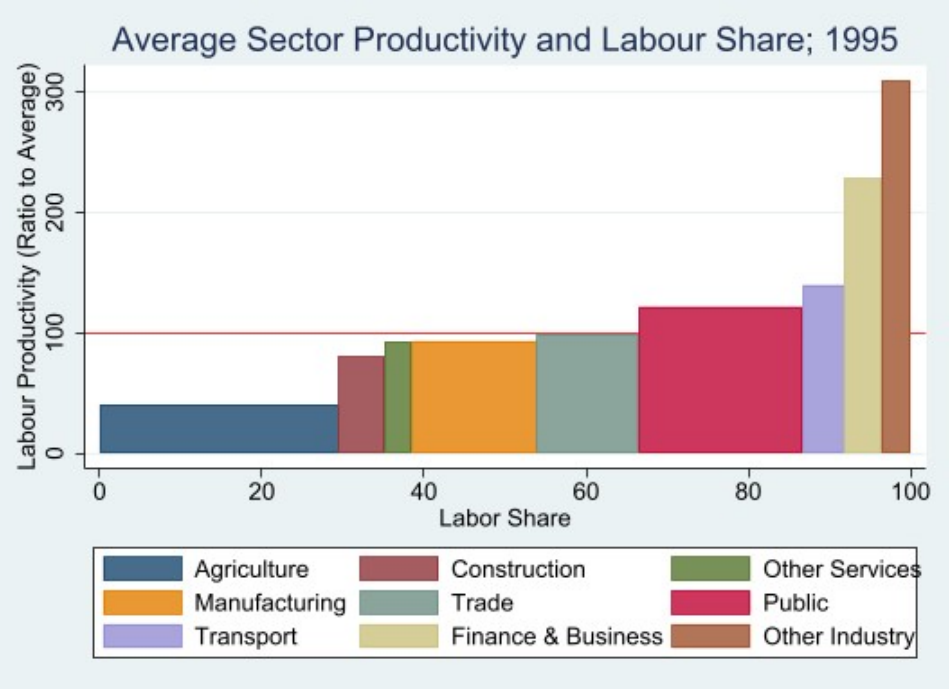
Figure 2 serves to establish the structural conditions at the beginning of the development arc of the former-Soviet countries as market-orientated economies. The lowest productivity sector on average was agriculture, the highest were other industry and finance & business. Other industry includes natural resource extraction, which is a major and capital-intensive source of value added in many former-Soviet economies (Horváth & Zeynalov, 2016). These most productive sectors are small in terms of their share of persons employed, and mining has a limited capacity to absorb labour. Agriculture was the largest sector, with just under 30% of persons employed in agriculture in 1995 in the average transition economy. This was followed by the public sector, with just over 20% of persons employed.[26] Manufacturing was the third largest sector, with just over 15% of persons employed in 1995 in the average country, and trade services - which comprises of wholesale and retail trade, accommodation, and food services - the fourth largest with 12.5%. Most notably, the manufacturing sector was producing at *below average* labour productivity; the average manufacturing worker was 7% less productive than the average worker in the economy as a whole[27]. A manufacturing sector which is already large and operating at below average labour productivity has limited potential to act as an engine of structural change based productivity growth. This supports the premise of Soviet over-industrialization which influenced the contemporary policy debate over the most appropriate form of post-Soviet development (Sachs et al., 1994)[28]. Additionally, the large public sector is atypical and demonstrates the legacy of the centrally-planned state superstructure (Schroeder & Pizer, 1983); Sachs et al. (1994) noted the large state sector as an additional impediment to structural adjustment.

[26]Public sector average labour productivity should be treated with caution due to the difficulty in estimating the value of outputs from a sector which produces primarily non-market services (Diewert, 2011).

[27]These structural conditions differ visibly from those in other parts of the developing world, and from those which underlie the theoretical assumptions of the Lewis (1954) model and subsequent multi-sector structural change based models of development (Diao & McMillan, 2018; Nelson & Pack, 1999). These models assume a large surplus of unproductive agricultural labour and a small but highly productive modern manufacturing sector with the capacity to absorb low skilled labour mcmillan2014driving.

[28]This pattern is also consistent with the former-centrally planned New Member States of the European Union which, according to Havlik (2015), "inherited a huge, oversized and inefficient industrial sector from the period of central planning".

Figure 2: Average Labour Productivity and Employment Share by Sector



Note: Bar heights show the (unweighted) average across countries of labour productivity by sector as a ratio of average labour productivity in 1995; bar widths show the share of persons employed in each sector in the average country in 1995. *Source:* Authors' calculation using the ETD-TE; full sample of 14 transition countries, *Real Estate* sector extracted.

Table 1: Average Sector Employment Shares and Labour Productivities in 1995, by Region.

	Baltics			**Former CP**		
	Share (Emp.)	*Productivity ($PPP)*	*Productivity (Mean Ratio)*	*Share (Emp.)*	*Productivity ($PPP)*	*Productivity (Mean Ratio)*
Agriculture	14.99	7.63	35.62	17.43	11.47	43.58
Manufacturing	19.12	16.41	76.64	24.14	17.27	65.62
Other Industry	3.24	56.03	261.62	3.66	66.24	251.78
Construction	6.21	21.22	99.09	6.37	32.05	121.81
Trade (W&R)	16.68	18.42	85.99	14.22	24.35	92.54
Transport	7.27	33.42	156.04	5.78	34.58	131.42
Public Sector	22.19	25.66	119.82	18.15	32.86	124.88
Finance & Business	7.04	34.44	160.81	7.38	54.74	208.06
Other Services	3.26	22.79	106.43	2.87	38.26	145.40
Total	100.00	21.42	100.00	100.00	26.31	100.00
Average		26.22			34.65	
	Transition Economies					
	Share (Emp.)	*Productivity ($PPP)*	*Productivity (Mean Ratio)*			
Agriculture	33.42	5.07	42.73			
Manufacturing	14.40	12.03	101.41			
Other Industry	3.70	39.54	333.40			
Construction	5.51	8.46	71.33			
Trade (W&R)	11.44	12.51	105.46			
Transport	4.56	15.64	131.86			
Public Sector	19.72	14.55	122.66			
Finance & Business	3.84	31.00	261.37			
Other Services	3.40	10.19	85.89			
Total	100.00	11.86	100.00			
Average		16.55				

Notes: Shares are the proportion of total employment in each sector, productivity is in PPP-adjusted constant 1995 US dollars per worker, productivity ratio is the ratio of sector productivity to total labour productivity. Unweighted averages across countries of three groups. Baltics: Estonia, Latvia, Lithuania; Former CP: Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia; Transition Economies: Armenia, Azerbaijan, Belarus, Georgia; Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Ukraine, Uzbekistan. *Source:* Authors' calculations from ETD-TE and EU-KLEMS.

Table 1 shows sectoral employment and productivity for three separate groups of former-centrally planned economies. The former-Soviet transition economies were not the only set of countries to undergo rapid market-oriented reforms in the aftermath of the Cold War. Many countries of Eastern Europe, whilst not Soviet republics, were members of the Warsaw Pact and followed a similar model of central planning until 1991. One might therefore expect similarities in their economic structure at the start of transition. Eight of these countries went swiftly on to the EU-ascension path as part of their transition, and sectoral data for these economies are therefore available as part of the EU-KLEMS project[29] (Bontadini et al., 2023). Table 1 shows the unweighted averages across countries of the sectoral employment shares, labour productivities in PPP-adjusted constant 1995 US dollars[30], and ratio to the economy-wide labour productivity of these eight former-centrally planned economies of Eastern Europe [FPEs] on the basis of EU-KLEMS data. The same information is presented for the group of eleven of the fourteen former-Soviet transition economies [TEs] on the basis of ETD-TE data, with the exclusion of the Baltics, the data for which are presented separately. The Baltics are separated because they conceivably belong in either group - they are former Soviet-republics, but also went on to the EU-ascension path during transition.

From Table 1 it can be seen that the FPEs also featured a large manufacturing share of employment, below-average manufacturing productivity, and a relatively small agricultural sector in 1995. In fact, in the average FPE, agriculture engaged a smaller share of employed persons than manufacturing, and manufacturing labour productivity was 35 percentage points below the economy-wide average. The FPEs also started transition with a large public sector in terms of share of employment. The noteworthy features of the TEs highlighted by figure 2 are present and extenuated in the FPEs, and also in the Baltics when considered as a separate group. Indeed, the exclusion of the Baltics from the TEs somewhat reduces these features, with table 1 showing above average labour productivity in manufacturing for the average non-Baltic transition economy, albeit only slightly. Finally, it should be noted that economy-wide labour productivity in the FPEs in 1995 was approximately double that of the TEs.

Table 2 shows the unweighted average for each of the above country groups

[29]The eight countries are Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia.

[30]PPP adjustment is made at the national level only and the exchange rate used is the same for all sectors within the country. In each country, the constant value added for each sector is converted to US dollars using the 1995 whole-economy PPP-adjusted exchange rate from the World Bank Development Indicators.

of the sector shares of output (constant VA) and employment in the years 1995 and 2018. Between the beginning and end of the sample period, all three country groups saw an increase in the manufacturing share of value added and a decrease in the share of employment. Nevertheless, in the transition economies, the relative decline in manufacturing employment share was larger than in the other two groups, whilst the relative increase in manufacturing output share was smaller, indicating a larger degree of deindustrialization. The agricultural share of both value added and employment has decreased in all three sample groups, but the relative magnitude of the decrease is considerably smaller in the TEs. The annual trends in agricultural employment share (not shown but available on request) show in fact that the agriculture sector of the transition economies initially expanded in the aftermath of transition and began to decline again only after 2005. The Soviet period, including the later years, was characterized by the consolidation of collective farms, top-down agronomic experiments, food subsidies, and price controls (Lerman et al., 2003; Pryor, 1992). Market-oriented reforms allowing for private agricultural production combined with a displacement of workers from more modern sectors during the transition recession may be the explanation for this return to agriculture in the period until 2005. Over the whole sample period in the TEs, there is very limited evidence of any widespread shift in employment away from agriculture as would feature in a Lewis-style model of structural change based development. By comparison, in the FPEs the share of persons employed in agriculture fell by almost half.

Several further points from table 2 are worthy of note. First, whilst the share of trade services in value added has increased in all three country groups, the Baltics and the FPEs have also experienced large increases in the value added share of the modern, high productivity service sectors of Finance and Business Services. By contrast, the combined share of value added of these sectors has actually decreased in the TEs. Second, the relative size of the public sector in terms of employment has remained very constant in all three groups. Although such persistence is a common feature of other emerging countries and regions, the fact that this sector in the formerly planned economies was so much larger initially has not impacted the tendency for its relative size to remain constant. Third, as with the starting conditions shown in table 1, the changes over time demonstrate that the Baltics generally more closely resemble the FPEs than the TEs in terms of their change in sectoral structure.

Table 2: Average sector real VA shares and employment shares, 1995 and 2018

	Baltics		Former CP		Transition	
	1995	2018	1995	2018	1995	2018
Real VA Share						
Agriculture	5.60	2.91	6.32	3.86	16.22	13.91
Manufacturing	14.29	17.72	16.67	23.28	15.34	16.47
Other Industry	8.42	4.25	9.06	5.15	11.26	10.35
Construction	6.18	7.69	7.07	6.08	4.63	8.80
Transport	11.10	11.73	7.31	7.02	6.74	6.88
Trade (W&R)	14.08	18.80	12.81	15.95	11.34	17.11
Public Sector	25.91	16.01	21.36	15.39	19.63	12.38
Fin & Bus	11.00	18.03	15.58	20.34	12.06	10.92
Other Services	3.42	2.85	3.81	2.93	2.79	3.19
Total	100	100	100	100	100	100
Employment Share						
Agriculture	14.99	6.00	17.43	9.34	33.42	27.87
Manufacturing	19.12	16.22	24.14	20.67	14.40	10.03
Other Industry	3.24	2.38	3.66	2.57	3.70	3.06
Construction	6.21	7.74	6.37	7.11	5.51	7.10
Transport	7.27	7.63	5.78	6.15	4.56	5.59
Trade (W&R)	16.68	19.12	14.22	18.23	11.44	16.12
Public Sector	22.19	21.98	18.15	18.80	19.72	19.55
Fin & Bus	7.04	14.11	7.38	13.60	3.84	6.25
Other Services	3.26	4.81	2.87	3.51	3.40	4.43
Total	100	100	100	100	100	100

Notes: Shares are the proportion of total constant VA in each sector and employment in each sector. Unweighted averages across countries of the three Baltic republics, eight former-centrally planned economies of Eastern Europe, and eleven non-Baltic transition economies. *Source:* Authors' calculations from ETD-TE and EU-KLEMS.

4 Structural Change and Economic Growth

This section quantifies the contribution of structural change to average labour productivity growth in the former-Soviet transition economies, and analyzes this contribution in comparison with a) the former-centrally planned economies of Eastern Europe, and b) other developing regions.

4.1 Quantifying Structural Change

A classic technique to establish the contribution of structural change to aggregate labour productivity growth is the shift-share decomposition originating from Fabricant (1942), which has in recent years become well established as the preferred method of the structural transformation literature in developing country contexts (Diao et al., 2017; Foster-McGregor & Verspagen, 2016; McMillan et al., 2017; McMillan et al., 2014). The shift-share decomposition technique decomposes changes over time in aggregate labour productivity into two components: the within- and between-effects. The within-effect captures the contribution of labour productivity growth within sectors to aggregate labour productivity growth. Broadly speaking, this is a proxy for technological progress or technical efficiency growth within sectors of the economy. The between-effect captures the contribution of workers reallocating to sectors with a higher or lower initial average productivity. A worker moving from a lower to a higher productivity sector will on average lead to an increase in aggregate labour productivity even when within-sector productivity growth is held constant. This is the structural change contribution to aggregate labour productivity growth. The formula used to perform the shift-share decomposition is as follows:

$$\Delta Y_t = \sum_{i=n} \theta_{i,t-k} \Delta y_{i,t} + \sum_{i=n} y_{i,t} \Delta \theta_{i,t} \tag{1}$$

where Y_t is aggregate labour productivity at time t, $y_{i,t}$ is labour productivity in sector i at time t, and $\theta_{i,t-k}$ is the employment share of sector i at time $t-k$. The Δ prefix denotes the change in a variable between time t and time k. The first term on the right-hand side of equation (1) captures the within-effect and the second term captures the between-effect. A positive within-effect term denotes that on average the sectors of the economy have become more productive per worker over the time period. A positive between-effect term denotes that on average labour has reallocated from less to more productive sectors over time period.

Some researchers prefer to analyze structural change via a three-part decomposition, as opposed to the two-part decomposition shown in equation (1). These

include de Vries et al. (2015) and Havlik (2015), the latter of which analyzes structural change in a subset of the FPEs. This three-part decomposition accounts for the fact that average sector productivity levels change over the sample period, whilst the two-part decomposition of equation (1) considered structural change only on the basis of differential sector productivity levels. The three-part decomposition divides the between-sector structural change component of aggregate productivity growth into two further parts, commonly referred to as the *static* and *dynamic* components. The static component captures the effect on aggregate productivity growth of the reallocation of workers to sectors with different initial average productivity levels, whereas the dynamic component captures the effect of the reallocation of workers to sectors with different *average productivity growth rates* across the sample period. The formula for the three-part decomposition is as follows:

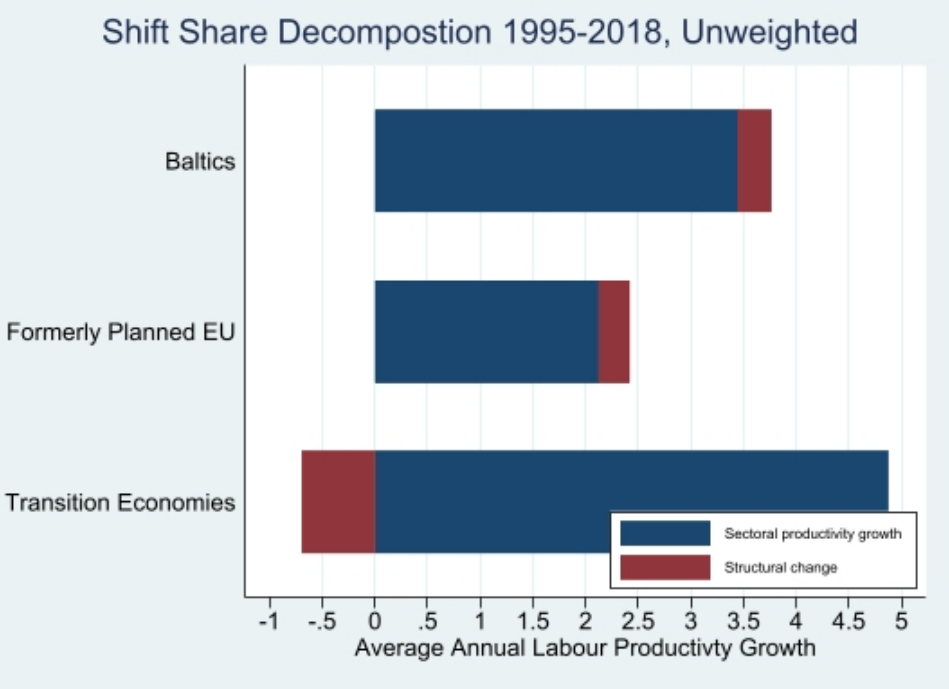
$$\Delta Y_t = \sum_{i=n} \theta_{i,t-k} \Delta y_{i,t} + \sum_{i=n} y_{i,t-k} \Delta \theta_{i,t} + \sum_{i=n} \Delta y_{i,t} \Delta \theta_{i,t} \tag{2}$$

where Y_t is aggregate labour productivity at time t, $y_{i,t}$ is labour productivity in sector i at time t, $y_{i,t-k}$ is labour productivity in sector i at time $t-k$, $\theta_{i,t}$ is the employment share of sector i at time t, and $\theta_{i,t-k}$ is the employment share of sector i at time $t-k$. The Δ prefix denotes the change in a variable between time t and time k. The first term on the right hand side of equation (2) is the within-effect which is identical to that of equation (1), both mathematically and in interpretation. The second term captures the static between-effect; i.e. the effect of workers reallocating to sectors with a higher or lower initial average productivity level. The third term captures the dynamic between-effect, i.e. the effect of workers reallocating to sectors which are growing or declining in terms of average labour productivity across the time period between t and k. A positive static term implies that on average workers moved to sectors with a higher initial productivity level, whereas a positive dynamic term implies that on average workers moved to sectors where productivity growth was more rapid than the economy-wide average. Negative terms imply the opposites.

4.2 The Transition Economies and Formerly-Planned Eastern Europe

Figure 3 shows graphically the results from performing the shift-share decomposition of equation (1) on i) the three Baltic countries, ii) the FPEs, and iii) the eleven former-Soviet TEs across the time period 1995-2018.

Figure 3: Decomposition results for Baltic, former-centrally planned, and transition economies; 1995-2018



Note: Bars show separately the within- and between-sector components of labour productivity growth as per equation (1) for three sets of countries: transition economies, former-centrally planned economies of Eastern Europe, and Baltics. *Real Estate* sector extracted. Unweighted averages across countries. *Source:* Authors' calculations using the ETD-TE and EU-KLEMS.

The results shown are the unweighted averages of the within- and between-sector contributions across the countries in each region sample. The bar lengths depict the average annual contribution of each component to the annual rate of labour productivity growth in percentage points. For example, the final bar shows that within-sector productivity growth contributed 3.8 percentage points, and structural change contributed -0.50 percentage points, to the average annual labour productivity growth rate of 3.3 percentage points per annum in the transition economies.

From figure 3 it can be seen that in the transition economies, the average contribution of structural change to aggregate labour productivity growth has been negative across the twenty-five years since the end of the transition recession. The transition economies have experienced *growth-reducing structural change* during this period. This finding is robust to using the average across countries weighted by population size, to including the Baltics in the set of TEs, and to considering the full 1990-2019 sample period as is shown in the next subsection[31]. This implies that, on average, workers reallocated from sectors with higher to sectors with lower initial productivity levels. Within-sector productivity growth is positive and of considerably larger magnitude than the structural change component, resulting in a positive rate of average annual labour productivity growth on aggregate.

This result stands in stark contrast with that of the Eastern European FPEs, for which the average contribution of structural change to aggregate labour productivity growth has been positive across the same time period - *growth enhancing structural change*. In the FPEs, structural change on average contributed 0.3 percentage points to the annual rate of labour productivity growth. The within sector contribution was also positive but smaller than that of the TEs, as the FPE sectors started from higher initial productivity levels. The Baltics closely resemble the FPEs, with a positive structural change contribution of almost identical magnitude. Within sector productivity growth in the Baltics was faster than the FPEs but slower than the TEs, indicative of their in-between levels of initial sector productivity, as was seen in table 2. The overall pattern of within sector productivity growth across the three regions is indicative of convergence. Clearly, however, structural change in the transition economies what opposite to that in the former-centrally planned economies of Easter Europe, with a total average between-sector contribution gap of 0.8 percentage points per annum.

[31]The results of these robustness checks can be seen in figure 6 of the appendix. Appendix figure 7 also shows the decomposition results for each of the transition economies individually for the full sample period.

Appendix figure X shows the results from the three-part decomposition of equation (2) for the full set of transition economies and each of the geographic sub-regions for the period 1995-2018. The dynamic contribution of structural change to growth is negative in both the TE and FPE samples, whilst the static contribution is positive and of similar magnitude in both. This means that on average, workers reallocated to sectors which were at a higher level of initial productivity, but to sectors which experienced below average productivity growth. The driver of the aggregate difference is that dynamic structural change, whilst negative in the FPEs, was much smaller. The positive static contribution of structural change was more than enough to mitigate the negative dynamic contribution in the FPEs, but not in the TEs. Although it is not possible to draw conclusions as to the exact economic explanations for this statistical decomposition result, these results are consistent with a situation where sectors which are expanding in terms of labour share are unable to absorb this new labour without relative productivity loss. This occurred in both the TEs and the FPEs, but to a much greater extent in the former. Unlike the two other groups, the Baltics experienced a small but positive dynamic contribution of structural change, which supplemented the positive static contribution.

4.3 The Transition Economies and other developing regions

Having established the stark contrast in structural change experiences between the transition economies and the other former-centrally planned economies of Eastern Europe, this section now extends the georegional comparison and places it in a global context. McMillan et al. (2014) established patterns of structural change and the contribution to labour productivity growth in three geographically distinct world developing regions using data[32] which ran until 2009. The three regions were sub-Saharan Africa [SSA], developing Asia [ASIA], and Latin America [LA]. Their analysis does not include any of the former-Soviet transition economies, either separately or as units in the aforementioned country samples.

Figure 4 shows graphically the results from performing the shift-share decomposition of equation (1) on i) the full set of transition economies across the full time period 1990-2019 using the ETD-TE data, and ii) three other world developing regions across the time period 1990-2018 using the ETD data: SSA, ASIA,

[32]McMillan et al. (2014) use data from the GGDC 10-Sector Database (de Vries et al., 2015), which was a precursor database to the ETD and included a smaller set of countries.

and LA. These three developing regions match those analyzed by McMillan et al. (2014), although the country samples for each region are larger reflecting the broader coverage of the ETD. As in McMillan et al. (2014), high-income countries are excluded from the sample according to the World Bank (2022b) classification. It can be seen that the transition economies are the only developing region which experienced growth-reducing structural change in this period. Both SSA and ASIA experienced structural change which added a substantial positive contribution to their aggregate productivity growth rate, and the contribution of structural change in LA was non-negative[33]. Within-sector productivity growth in the transition economies was almost as large as in ASIA, and larger than in SSA. To the extent that within-sector productivity can be considered a proxy for technological progress, this implies the transition economies may have been less far behind the technological frontier than the aggregate productivity figures would suggest. Had the transition economies not experienced growth-reducing structural change, they would be the region with the second-highest rate of labour productivity growth.

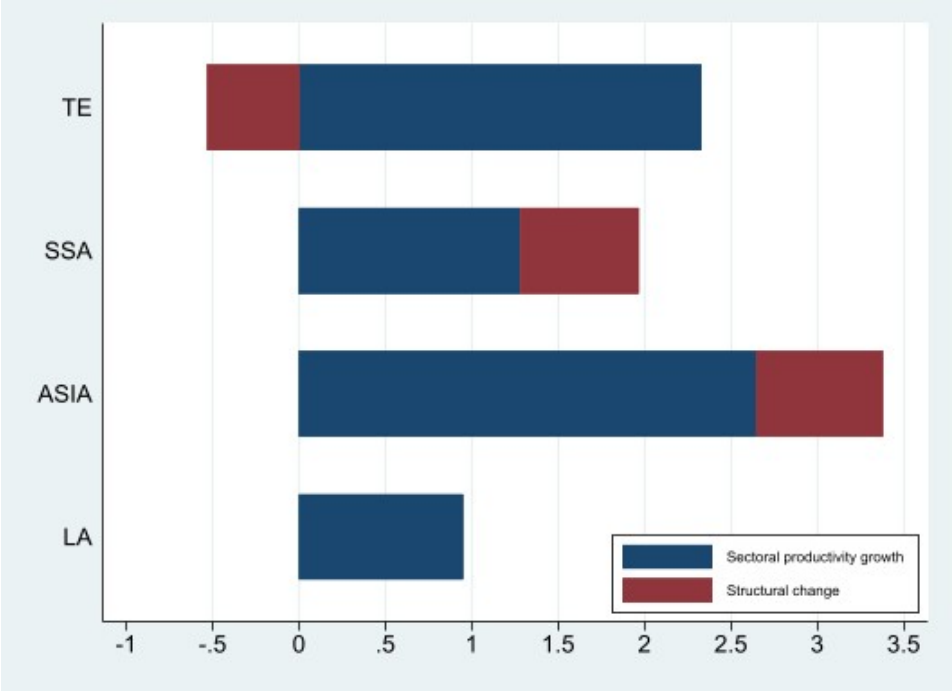
5 Structural change by sub-region and decade

The analysis of the previous section demonstrated that the transition economies as a group experienced growth-reducing structural change across the period 1990-2019; and that it was the only developing region to do so. This section looks inside the country group and sample period in order to explore heterogeneities between the structural change experiences of the transition economies, and shows that the results of the previous section are not driven by a smaller sub-group of the transition economies, but that they are concentrated in the first decade of transition. Figure 5 shows the decomposition results of equation (1) for four distinct geographic sub-regions within the transition economies. The Core are the four countries in the Soviet-centre: Belarus, Moldova, Russia, and Ukraine. The Baltics are the three countries on the Baltic coast: Estonia, Latvia and Lithuania. The Caucasus are the South Caucasus region of Armenia, Azerbaijan, and Georgia. Central Asia are the former Soviet countries located entirely on the Asian

[33]The results for SSA, ASIA, and LA also serve as a replication and extension of McMillan et al. (2014) on larger country samples and with an updated sample period, and broadly support the findings therein. McMillan et al. (2014) found a positive between-sector component for ASIA and, whilst their overall between-sector component for SSA was negative, they presented evidence that it had turned positive in the period since 2000. The results of figure 3 confirm that this trend continued in the most recent years and was sufficient to turn the overall average structural change experience of SSA positive for the period since 1990.

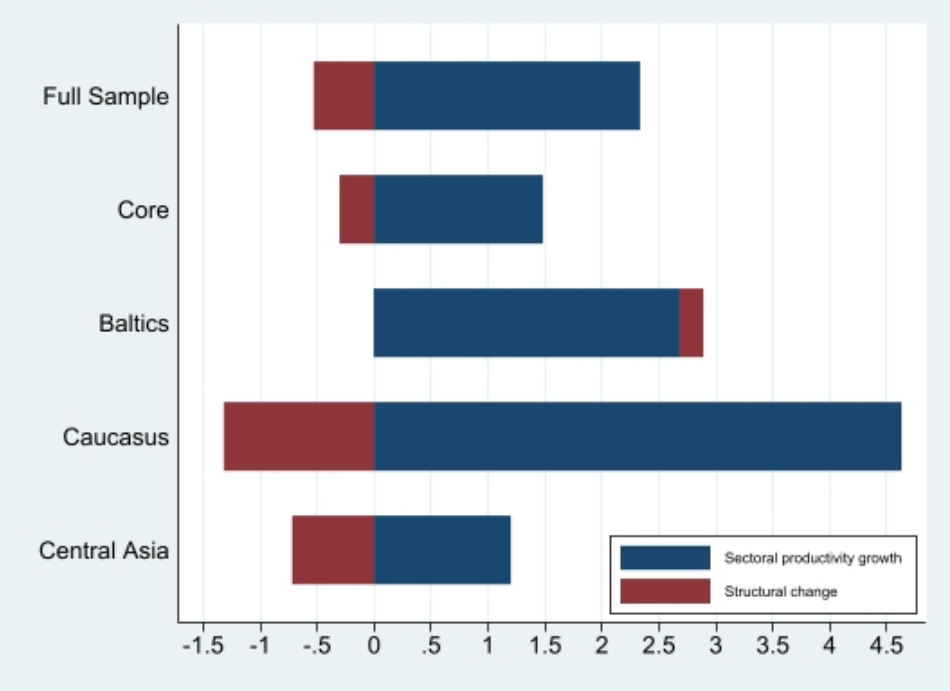
continent: Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan. The results are unweighted averages across the countries in each sub-region.

Figure 4: Decomposition results for transition economies and other developing regions



Note: Bars show separately the within- and between-sector components of labour productivity growth as per equation (1) for four sets of countries: transition economies (1990-2019), sub-Saharan Africa, developing Asia, and Latin America (all 1990-2018). Unweighted averages across countries. *Source:* Authors' calculations using the ETD-TE and ETD. *Real Estate* sector extracted.

Figure 5: Decomposition results for transition economies by geographic sub-region.



Note: Bars show separately the within- and between-sector components of labour productivity growth as per equation (1) for the whole sample of transition economies and four sub-regions across the full sample period 1990-2019. Core: Belarus, Moldova, Russia, Ukraine; Baltics: Estonia, Latvia, Lithuania; Caucasus: Armenia, Azerbaijan, Georgia; Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan. Unweighted averages across countries. *Source:* Authors calculations using the ETD-TE. *Real Estate* sector extracted.

Figure 5 shows that growth-reducing structural change characterized all sub-regions of the transition economies over the period 1990-2019, with the exception of the Baltics as explored in the previous section. This demonstrates that the general finding of growth-reducing structural change was not driven exclusively by specific countries or regions. The Core does not have the most negative structural change contribution; both the Caucasus and Central Asia demonstrate a higher degree of growth-reducing structural change which aligns with the return-to-agriculture observed in the descriptive trends, as agriculture is the sector with the lowest average productivity in all sub-regions. The Core did however experience a smaller degree of within-sector productivity growth than all sub-regions other than Central Asia. Central Asia, the lowest-income sub-region on average, experienced the lowest within-sector productivity growth and the lowest overall labour productivity growth[34].

In order to illustrate the productivity impact of structural change in different decades of the post-Soviet period, table 3 presents the results of the equation (1) shift-share decomposition by decade, both for the full ETD-TE sample and each of the geographic sub-regions. From table 3 it can be seen that growth-reducing structural change was concentrated in the first decade of transition. Only the 1990s saw a negative between-sector contribution to aggregate productivity growth for the full sample, during which time within-sector productivity growth was also negative. Both the within- and between-sector contributions were positive for the full sample in the 2000s and in the 2010s, but are of smaller magnitude in the most recent decade. The within- is much larger then the between-sector contribution in both of these decades. Whilst growth-reducing structural change in the transition economies was a 1990s phenomenon, the reversal in the 2000s was small, and even smaller in the 2010s - not sufficient to mitigate the 1990s decline, which is why the average structural change contribution to productivity growth is negative across the full sample period.

[34] Appendix Figure x repeats the geographic sub-region comparison of figure 5, but utilizing the three-part decomposition of equation (2). The dynamic contribution of structural change to growth is negative and the static contribution is small but positive in every sub-region. In all sub-regions other than the Baltics, the negative dynamic effect was substantially larger than the positive static effect, resulting in a negative overall contribution of structural change as per the two-part decomposition.

Table 3: Shift-share decomposition results by decade and sub-region.

	1990-1999	2000-2009	2010-2019
Whole Sample			
Within	-1.55	4.74	2.15
Between	-1.33	0.41	0.19
Total	-2.88	5.15	2.35
Core			
Within	-5.04	4.21	2.44
Between	-0.06	0.31	-0.07
Total	-5.10	4.53	2.37
Baltics			
Within	0.66	3.56	2.03
Between	0.60	0.43	0.09
Total	1.26	3.99	2.13
Caucasus			
Within	-0.01	8.50	2.63
Between	-2.61	0.45	0.40
Total	-2.63	8.95	3.03
Central Asia			
Within	-0.87	3.34	0.98
Between	-3.08	0.46	0.49
Total	-3.94	3.79	1.47

Notes: Rows show separately the within- and between-sector components of labour productivity growth as per equation (1) and aggregate labour productivity growth for the whole sample of transition economies and four sub-regions in each decade since 1990 (columns). *Real Estate* sector extracted. Unweighted averages across countries. *Source:* Authors' calculations using the ETD-TE.

Comparing between sub-regions, table 3 shows that only the Core has experienced a reversion to growth-reducing structural change in the most recent decade. Furthermore, whilst the contribution of structural change was positive in the 2000s in all sub-regions, it was of smaller magnitude in the Core. These figures combined suggest that the Core former-Soviet countries of Belarus, Moldova, Russia, and Ukraine have experienced greater difficulty in reversing the 1990s trend of growth-reducing structural change then the other sub-regions. The Core is also characterized by a deeper 1990s within-sector productivity recession than the other sub-regions. The Causcasus and Central Asia are quite similar to each other. Both saw structural change act as a particularly severe drag on aggregate productivity growth in the 1990s, consistent with the shift of workers from manufacturing to low-productivity agriculture. This was followed by a 2000s of strong within-sector productivity growth and modest growth-enhancing structural change in both sub-regions, and culminates in a 2010s of more modest but still positive within-sector productivity growth, and persistent growth-enhancing structural change.

6 Counterfactuals

Section 4 demonstrated that, despite a common need to transition rapidly from command to market economies, the transition economies experienced a markedly different structural change experience from the former-centrally planned economies of Eastern Europe. In the TEs, structural change contributed negatively to aggregate productivity growth, whereas in the FPEs it contributed positively. This raises the question as to what productivity gains could have been achieved had the TEs followed a pattern of structural change more similar to that of the FPEs.

In order to provide a rough approximation of this potential gain, this section conducts a thought experiment to explore a counterfactual scenario in which inter-sectoral reallocation of labour between 1995 and 2018 in each of the transition economies matches that of the average FPE, with no change to the rates of within-sector productivity growth. This would imply a larger degree of deagrarianization, a smaller degree of deindustrialization, a smaller increase in the share of trade services, and a much larger increase in business services than actually took place. The average changes in sectoral employment shares in the FPEs and TEs can be seen and compared in the lower half of table 2. For example, the average FPE saw the agricultural share of employment decrease by approximately 8.1 percentage points between 1995 and 2018. In the counterfactual, the agricultural employment share of each transition economy would therefore have decreased by

8.1 percentage points, holding constant initial and final agriculture sector productivity levels at their actual values. The counterfactual therefore assumes these alternative changes in employment patterns could have been achieved without impacting within-sector productivity growth. The counterfactual can be expressed mathematically as follows:

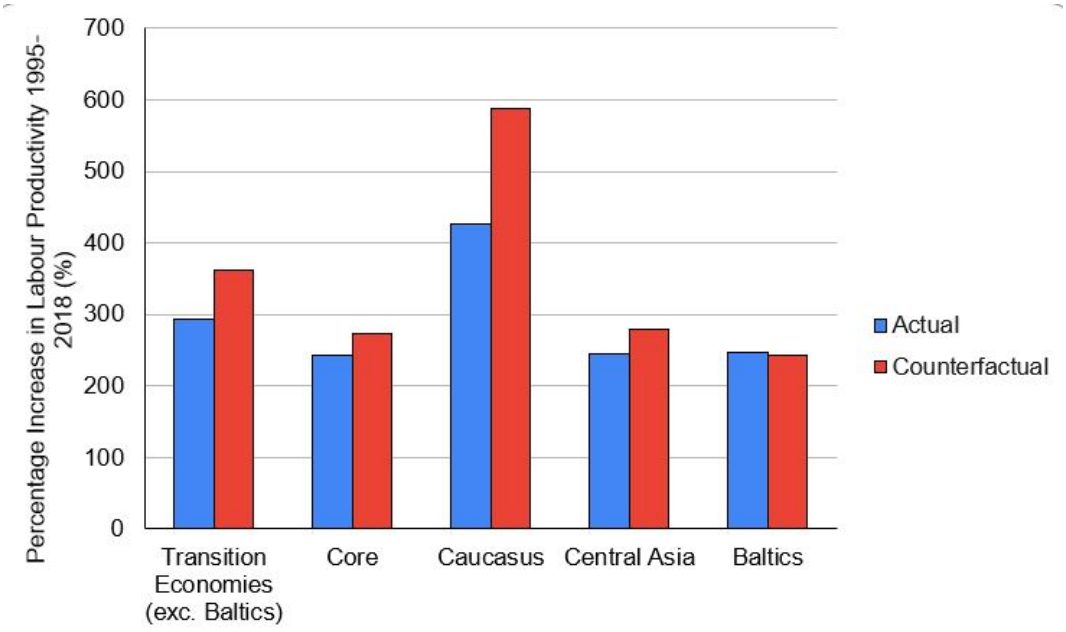
$$\Delta Y_t^{CF} = \sum_{i=n} \theta_{i,t-k} \Delta y_{i,t} + \sum_{i=n} y_{i,t} \Delta \hat{\theta}_{i,t} \tag{3}$$

which is the same as the shift-share decomposition equation (1), except now $\Delta \hat{\theta}_{i,t}$ represents the change in employment share of sector i in the average FPE, rather than the actual change in employment share which occurred. That within-sector productivity growth is unchanged can be seen from the fact that the first term on the RHS of equation (3) is identical to that of equation (1). Once the average FPE changes in sector employment shares are substituted into equation (3) along with the other, actually realized RHS variables for each transition economy, the outcome of the function is ΔY_t^{CF} - the hypothetical change in aggregate labour productivity which each transition economy would have achieved under the counterfactual scenario. This can then be compared with ΔY_t - the actually realized change in aggregate labour productivity - to examine the degree to which productivity may have increased if the TEs had followed an identical pattern of inter-sectoral structural change as that of the FPEs. It is important to stress that this does not represent the productivity-optimizing hypothetical pattern of structural change in the transition economies, and in some economies following the FPE pattern of structural change may have actually been less conducive for productivity growth than what actually occurred. It is also by no means implied that each of the transition economies *could* have followed this pattern, instead this exercise serves more as an approximate quantification of the impact of the different structural change performance of the TEs and the FPEs.

Calculation of the second term of equation (3) - the counterfactual *between*-sector effect - shows that, if the transition economies had each followed an identical inter-sectoral reallocation pattern as the average FPE, the contribution of structural change to aggregate labour productivity growth would indeed have been positive in the average transition economy. The average TE would have experienced an additional 0.72 percentage points of labour productivity growth per annum compared to their actual rate of labour productivity growth, i.e. the baseline case. Figure 6 shows the actual and counterfactual increases in total labour productivity across the sample period, with the counterfactual changes calculated using equation (3), whereby total labour productivity is normalized to 100 in each country in 1995. The result of this normalization is that the height of the bars

represent the percentage increase in the total productivity *level* of the average economy in each country group between 1995 and 2018.

Figure 6: Actual vs counterfactual percentage increase in total labour productivity 1995-2018.



Note: Blue bars show the actual percentage increase in total labour productivity in the full set of transition economies excluding the Baltics and in each of the geographic sub-regions; red bars show the hypothetical increases in total labour productivity if each country had followed the same pattern of structural change as the average FPE, calculated as per equation (3). Unweighted averages across countries. *Source:* Authors' calculations using the ETD-TE.

From figure 6 it can be seen that the increase in total productivity in the average transition economy is 67 percentage points, or around 23%, larger in the counterfactual case. This demonstrates the potentially large cumulative effect that a pattern of structural change more in line with that of the FPEs may have had on the TEs. In each of the three sub-regions, the counterfactual is larger than the actual productivity increase, with the Caucasus demonstrating the most sizeable

difference of almost 40%. The Baltics are excluded from the transition economies sample for the same reasons as in section 4.1. Nevertheless, the final columns show the comparison also for the Baltics - the fact that there is so little change between the actual and counterfactual case is further evidence that the pattern of structural change in the Baltics was already quite similar to that of the FPEs.

7 Conclusion

This paper has studied inter-industry structural change in the countries of the former-Soviet Union and quantified the contribution of such structural transformation to aggregate productivity growth. These results were contrasted first with those for the other non-Soviet transition economies in the aftermath of central planning, and second with other major world emerging regions in the style of McMillan et al. (2014). Heterogeneity analysis further unpicked the results across different geographic sub-groups of FSU countries, and different decades of the transition and post-transition period. Finally, a counter-factual exercize benchmarked the potential economic magnitude of the differing structural transformation experiences between the FSUs, the Baltics, and the CEEs. In order to make these analyses possible, this paper constructed and presented a new database - the ETD-TE - which provides a balanced panel of sectoral employment and value added data for fourteen former-Soviet republics across the three-decade period 1990-2019.

The findings indicate that structural change contributed negatively to growth in the FSU countries. In the average FSU country across the period 1990-2019, the pattern of structural change which occurred reduced aggregate productivity growth by 0.5 percentage points per annum. This is in contrast with the CEE countries, where structural change was growth-enhancing. In total, around 0.8 percentage points of the difference in annual aggregate productivity growth between the FSUs and the CEEs is accounted for by differences in the patterns of structural change. The other developing regions of emerging Asia, sub-Saharan Africa, and Latin America also all experienced growth-enhancing structural change across the period 1990-2019, implying that the negative structural change experience of the FSUs stands out in a global as well as regional context. The Baltics much more closely resembled the CEEs rather than the FSUs in terms of structural transformation. Heterogeneity analysis showed that the the finding of growth-reducing structural change in the FSUs was concentrated in the first decade of transition, but was present across the geographic sub-regions of the Caucasus, Central Asia, and the Core. The Core countries of Belarus, Moldova, Russia, and Ukraine also saw a reversion to growth-reducing structural change in the decade 2010-2019. The

counter-factual exercise indicated that the hypothetical gains to the FSUs if they had followed an identical pattern of structural change to the CEEs could have been on average a 23% larger increase in aggregate productivity between 1995 and 2018.

There are of course several caveats to the above results. First, the shift-share decomposition method assumes constant returns to scale. There is however no body of sectoral studies which indicate increasing or decreasing returns to scale. Second, the shift-share methodology is primarily a static approach. A more dynamic analysis would acknowledge the endogeneity of structural changes influenced by various factors such as productivity growth within sectors, demand elasticities, trade patterns, and shifts in global prices. The primary objective in this paper has been to assess the direct contribution of sectors using a straightforward model, without making claims about causality. Third, the analysis does not incorporate sectoral investment data. Consequently, it is not possible to separate the changes in labor productivity into variations in capital intensity and total factor productivity. Further investigation into sectoral investment flows would be required to address this limitation. Fourth, certain sectors such as agriculture, trade, and transportation services may exhibit a disparity between marginal and average productivity due to the prevalence of informal activities, particularly in developing countries. While ideally this should be considered, data on informal activities at the sectoral level is scarce and incomparable across countries. This remains an essential area for future research. Fifth, the counter-factual exercize assumes that a different pattern of structural change could have been achieved without influencing within-sector productivity growth. Any such influence would have the potential to either exacerbate or mitigate these results.

This paper introduced the ETD-TE database, which provides time series data on value added and employment figures for the twelve broad sectors of the economy in fourteen former-Soviet republics across the period 1990-2019. Whilst several adjustments have been made to ensure consistency over time and across countries, there still exist significant statistical challenges. The future likely holds improvements in the availability of measures for both current and historical periods. The ETD-TE Database serves as a valuable initial resource and will undergo updates to incorporate these advancements; it should also serve as a useful benchmark for any researcher constructing country-specific data for any of the FSUs. Many of the methods used the extrapolate the data between 1990-1995 involve compromises and assumptions as pre-1995 statistical systems in these countries were very different to those of today. Although the key results of this paper hold also for the post-1995 period, future studies should keep these compromises in mind when working with the pre-1995 data.

Within the ETD-TE, labour input is quantified in terms of persons engaged rather than hours worked. This is a necessary compromise due to the limitations of the primary data, and is standard in such sectoral databases for developing countries (de Vries et al., 2015; Kruse et al., 2022; Mensah & Szirmai, 2018; Timmer et al., 2015). Nevertheless, it implies that actual time in hours allocated to each activity is not captured. Hence, for example, the measurement of agricultural labour input might result in an overestimation, while output could be underestimated due to inadequate coverage of home production intended for personal consumption. Moreover, market services industries - such as finance and business services - are known to have inherent difficulties in measuring output accurately, which impact all cross-sector comparative analyses. Additionally, many non-market services rely on input-based volume indices to measure output, resulting in zero productivity growth by design.

Whilst there is no reason to suppose these issues would impact the formerly-planned economies differentially from other developing economies - thereby rendering the comparisons of this paper internationally consistent - it is still the case that future data improvements should allow for the further honing of key results. Some transition economies have started collecting time-use data in hours for the most recent years, and as more time elapses it should in future be possible to compile such data for a reasonable length of time. It is, however, beneficial that the ETD-TE fits in consistently with a broader family of datasets including the ETD and EU-KLEMS, allowing for consistently generated benchmark results to serve as a point of reference for any future studies if and when more nuanced data becomes available. There is no reason to suppose that the key results of this paper regarding the role of structural change in accounting for the differences in aggregate productivity growth should fail to hold with such additional data. Beyond striving to make data advances, future research should now seek to understand how initial conditions, reform strategies, and other determinants account for the observed patterns of structural change in the transition economies, and where the most likely explanations for the stark differences in the growth-performance of structural change may lie.

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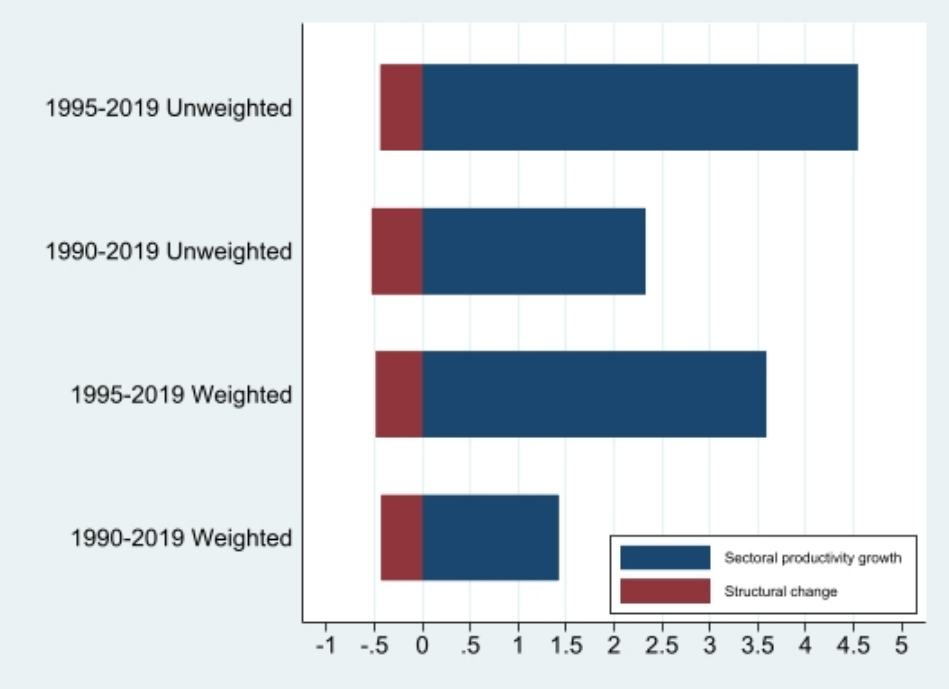
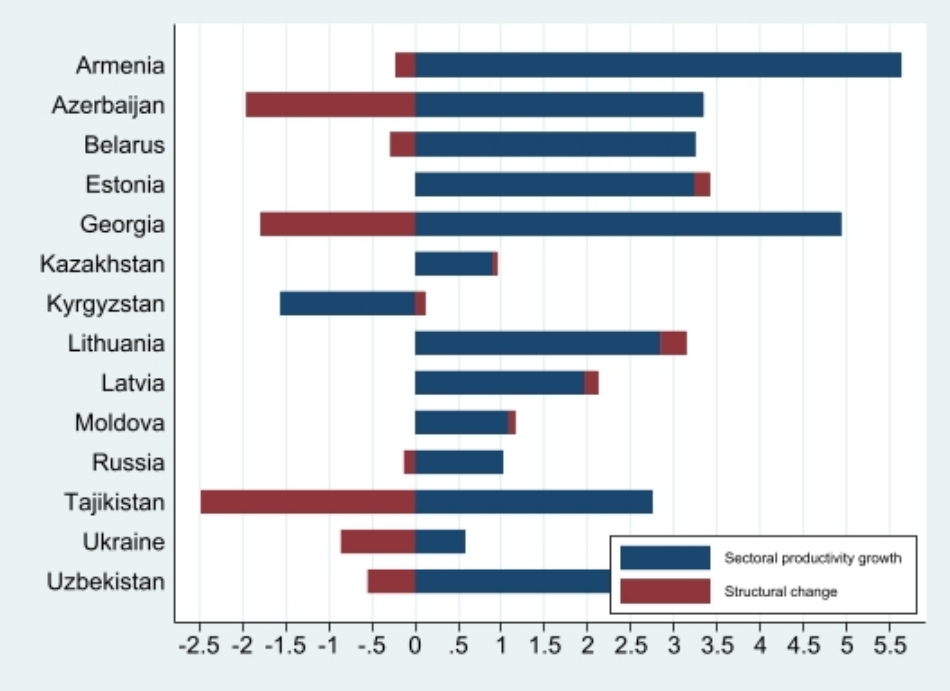
Appendix: Supplementary Tables and Figures

Figure 7: Decomposition results for transition economies full sample; weighted averages and post-transition recession sample period.



Note: Bars show separately the within- and between-sector components of labour productivity growth as per equation (1) for each country of the full sample of transition economies across; demonstrating robustness to a) the use of (population) weighted averages, and b) only the (post-transition recession) 1995-2019 sample period. *Source:* Authors calculations using the ETD-TE. *Real Estate* sector extracted.

Figure 8: Decomposition results for transition economies by country.



Note: Bars show separately the within- and between-sector components of labour productivity growth as per equation (1) for each country of the full sample of transition economies across the full sample period 1990-2019. *Source:* Authors calculations using the ETD-TE. *Real Estate* sector extracted.

Table 4: Average sector real VA shares, employment shares, and labour productivity growth rate, by period.

	Core				
	1990	1995	2005	2015	2019
Real VA Share					
Agriculture	8.54	10.81	10.61	10.28	10.57
Manufacturing	17.59	16.07	21.52	21.49	21.68
Other Industry	15.28	13.88	9.68	8.48	7.91
Construction	7.23	5.32	8.02	7.64	8.22
Transport	10.86	8.04	6.88	6.85	6.98
Trade (W&R)	13.14	10.69	13.64	16.95	16.98
Public Sector	22.15	25.98	16.61	13.30	12.03
Fin & Bus	3.13	7.15	11.15	13.02	13.63
Other Services	2.08	2.06	1.90	1.98	2.01
Total	100	100	100	100	100
Employment Share					
Agriculture	20.78	24.93	21.15	18.33	14.14
Manufacturing	24.82	20.80	16.68	14.22	14.28
Other Industry	4.36	4.36	4.07	3.73	3.69
Construction	9.54	6.73	5.85	6.51	6.68
Transport	5.00	4.96	5.57	6.11	6.42
Trade (W&R)	9.89	11.53	16.33	18.75	20.16
Public Sector	18.79	18.93	20.43	21.09	20.83
Fin & Bus	3.93	4.89	6.27	7.53	8.84
Other Services	2.89	2.87	3.66	3.73	4.97
Total	100	100	100	100	100
Labour Productivity Growth (Annual Average)					
Agriculture	-	-8.30	5.91	5.16	9.90
Manufacturing	-	-8.54	9.14	4.96	3.83
Other Industry	-	-12.07	0.58	3.16	2.27
Construction	-	-11.05	14.36	1.93	5.50
Transport	-	-18.76	3.48	4.63	1.83
Trade (W&R)	-	-17.47	3.15	2.79	3.04
Public Sector	-	-8.18	-1.93	1.56	1.52
Finance & Business	-	7.65	6.70	3.91	-0.26
Other Services	-	-10.47	1.14	3.78	-1.51
Aggregate	-	-11.18	3.95	3.64	3.84

Notes: Shares are the proportion of total constant VA in each sector and employment in each sector, productivity growth is the average rate of sector labour productivity growth per annum in the preceding period. Unweighted averages across countries of the full sample of transition economies. *Source:* Author calculations from ETD-TE.

Table 5: Average sector real VA shares, employment shares, and labour productivity growth rate, by period.

	Baltics				
	1990	1995	2005	2015	2019
Real VA Share					
Agriculture	5.52	5.60	3.73	4.09	3.35
Manufacturing	21.30	14.29	16.38	17.27	17.49
Other Industry	10.72	8.42	5.36	4.52	3.73
Construction	11.84	6.18	8.26	7.22	7.41
Transport	7.71	11.10	10.75	10.99	11.96
Trade (W&R)	12.87	14.08	18.16	18.42	18.93
Public Sector	18.09	25.91	18.29	17.18	15.71
Fin & Bus	8.37	11.00	15.74	17.42	18.63
Other Services	3.58	3.42	3.34	2.89	2.78
Total	100	100	100	100	100
Employment Share					
Agriculture	18.53	14.99	9.74	7.06	5.72
Manufacturing	22.79	19.12	18.83	16.00	16.14
Other Industry	3.84	3.24	2.84	2.34	2.24
Construction	11.38	6.21	8.28	7.82	7.91
Transport	5.58	7.27	7.34	7.91	7.60
Trade (W&R)	11.86	16.68	18.56	19.17	18.99
Public Sector	17.24	22.19	22.02	22.33	22.24
Fin & Bus	6.07	7.04	8.20	12.71	14.27
Other Services	2.70	3.26	4.19	4.65	4.90
Total	100	100	100	100	100
Labour Productivity Growth (Annual Average)					
Agriculture	-	2.37	7.48	6.08	3.31
Manufacturing	-	-4.44	7.57	4.03	3.48
Other Industry	-	-3.04	2.97	1.90	-0.44
Construction	-	2.57	6.21	1.12	3.78
Transport	-	-5.48	7.77	1.70	4.33
Trade (W&R)	-	0.20	5.74	1.27	6.27
Public Sector	-	0.63	2.78	1.17	1.04
Finance & Business	-	0.08	7.85	-1.35	2.02
Other Services	-	-3.65	3.27	-0.69	0.62
Aggregate	-	-1.44	6.10	1.95	3.35

Notes: Shares are the proportion of total constant VA in each sector and employment in each sector, productivity growth is the average rate of sector labour productivity growth per annum in the preceding period. Unweighted averages across countries of the full sample of transition economies. *Source:* Author calculations from ETD-TE.

Table 6: Average sector real VA shares, employment shares, and labour productivity growth rate, by period.

	Caucasus				
	1990	1995	2005	2015	2019
Real VA Share					
Agriculture	14.51	20.38	15.46	12.25	10.35
Manufacturing	14.16	11.24	10.70	9.80	10.95
Other Industry	13.61	14.98	14.93	15.14	15.67
Construction	8.57	2.63	10.94	10.55	8.40
Transport	5.24	3.33	5.19	5.73	5.89
Trade (W&R)	17.54	11.05	14.49	15.61	17.75
Public Sector	15.53	19.99	14.76	14.88	13.61
Fin & Bus	6.94	10.93	9.13	11.47	11.82
Other Services	3.90	5.47	4.40	4.58	5.56
Total	100	100	100	100	100
Employment Share					
Agriculture	26.07	31.74	46.75	40.49	35.43
Manufacturing	15.14	11.81	6.86	5.75	7.04
Other Industry	4.23	3.31	2.14	2.38	2.58
Construction	8.79	5.53	3.67	5.29	7.43
Transport	4.06	4.06	3.61	3.79	4.45
Trade (W&R)	8.50	11.61	12.93	13.55	14.49
Public Sector	23.19	23.71	17.19	19.79	19.02
Fin & Bus	4.87	3.72	3.21	4.66	5.16
Other Services	5.15	4.50	3.64	4.30	4.40
Total	100	100	100	100	100
Labour Productivity Growth (Annual Average)					
Agriculture	-	-6.88	1.43	3.78	4.76
Manufacturing	-	-7.50	13.42	5.57	1.23
Other Industry	-	5.16	11.35	4.69	2.90
Construction	-	0.62	28.85	1.52	-11.16
Transport	-	-21.11	8.94	6.06	4.75
Trade (W&R)	-	-16.12	12.66	5.62	-1.04
Public Sector	-	-3.71	7.88	3.80	1.99
Finance & Business	-	4.09	7.04	3.75	2.03
Other Services	-	-0.56	7.90	3.45	5.94
Aggregate	-	-8.99	7.83	5.34	3.11

Notes: Shares are the proportion of total constant VA in each sector and employment in each sector, productivity growth is the average rate of sector labour productivity growth per annum in the preceding period. Unweighted averages across countries of the full sample of transition economies. *Source:* Author calculations from ETD-TE.

Table 7: Average sector real VA shares, employment shares, and labour productivity growth rate, by period.

	Central Asia				
	1990	1995	2005	2015	2019
Real VA Share					
Agriculture	13.10	18.51	17.96	19.95	18.77
Manufacturing	21.95	17.67	16.80	13.92	15.70
Other Industry	4.77	5.85	8.95	7.63	8.47
Construction	6.90	5.44	6.48	9.48	10.45
Transport	7.81	8.00	4.91	7.74	7.60
Trade (W&R)	13.60	12.19	11.26	16.90	17.42
Public Sector	16.46	13.01	11.14	11.76	11.02
Fin & Bus	14.54	17.81	20.01	9.73	7.83
Other Services	0.86	1.51	2.50	2.89	2.75
Total	100	100	100	100	100
Employment Share					
Agriculture	35.68	43.16	45.32	34.64	29.89
Manufacturing	13.43	9.93	7.37	6.98	8.49
Other Industry	4.24	3.34	2.88	3.05	3.04
Construction	7.98	4.29	5.20	7.95	8.27
Transport	5.28	4.54	4.23	5.57	6.01
Trade (W&R)	7.86	11.22	10.68	13.91	15.15
Public Sector	19.55	17.52	16.47	17.84	18.87
Fin & Bus	3.12	2.89	2.73	4.53	5.02
Other Services	2.85	3.11	5.13	5.52	5.26
Total	100	100	100	100	100
Labour Productivity Growth (Annual Average)					
Agriculture	-	-9.88	4.24	6.18	7.17
Manufacturing	-	2.57	10.58	1.82	1.35
Other Industry	-	-2.25	12.04	1.30	7.58
Construction	-	-10.77	5.39	3.12	4.69
Transport	-	-21.65	4.11	4.52	2.55
Trade (W&R)	-	-12.36	1.60	5.49	0.62
Public Sector	-	-13.04	9.08	2.23	0.68
Finance & Business	-	-5.24	9.30	-9.51	-5.61
Other Services	-	-8.82	13.10	3.07	7.62
Aggregate	-	-14.76	5.04	2.33	3.66

Notes: Shares are the proportion of total constant VA in each sector and employment in each sector, productivity growth is the average rate of sector labour productivity growth per annum in the preceding period. Unweighted averages across countries of the full sample of transition economies. *Source:* Author calculations from ETD-TE.

Table 8: Average Sector Employment Shares and Labour Productivities in 1995, by sub-region.

	Core			**Baltics**		
	Share (Emp.)	*Productivity ($PPP)*	*Productivity (Mean Ratio)*	*Share (Emp.)*	*Productivity ($PPP)*	*Productivity (Mean Ratio)*
Agriculture	24.93	7.62	39.34	14.99	7.63	35.62
Manufacturing	20.80	16.18	83.53	19.12	16.41	76.64
Other Industry	4.36	73.07	377.25	3.24	56.03	261.62
Construction	6.73	11.11	57.38	6.21	21.22	99.09
Trade (W&R)	11.53	19.83	102.38	16.68	18.42	85.99
Transport	4.96	25.19	130.07	7.27	33.42	156.04
Public Sector	18.93	26.33	135.93	22.19	25.66	119.82
Finance & Business	4.89	23.22	119.88	7.04	34.44	160.81
Other Services	2.87	14.41	74.42	3.26	22.79	106.43
Total	100	19.37	100	100	21.42	100
Average		24.11			26.22	
	Caucasus			**Central Asia**		
	Share (Emp.)	*Productivity ($PPP)*	*Productivity (Mean Ratio)*	*Share (Emp.)*	*Productivity ($PPP)*	*Productivity (Mean Ratio)*
Agriculture	31.74	4.36	63.53	43.16	3.05	37.63
Manufacturing	11.81	6.21	90.52	9.93	12.24	151.06
Other Industry	3.31	31.82	464.06	3.34	11.81	145.70
Construction	5.53	3.31	48.29	4.29	9.67	119.29
Trade (W&R)	11.61	6.74	98.30	11.22	9.51	117.39
Transport	4.06	7.09	103.44	4.54	12.49	154.17
Public Sector	23.71	6.66	97.13	17.52	8.68	107.16
Finance & Business	3.72	22.13	322.77	2.89	45.43	560.57
Other Services	4.50	8.19	119.48	3.11	7.45	91.98
Total	100	6.86	100	100	8.10	100
Average		10.72			13.37	

Notes: Shares are the proportion of total employment in each sector, productivity is in PPP-adjusted constant 1995 US dollars per worker, productivity ratio is the ratio of sector productivity to total labour productivity. Unweighted averages across countries of four sub-regions. Core: Belarus, Moldova, Russia, Ukraine; Baltics: Estonia, Latvia, Lithuania; Caucasus: Armenia, Azerbaijan, Georgia; Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan. *Source:* Author calculations from ETD-TE.

Table 9: Average sector real VA shares and employment shares, 1995 and 2018

	Baltics		Former CP		Transition	
	1995	2018	1995	2018	1995	2018
Real VA Share						
Agriculture	5.60	2.91	6.32	3.86	16.22	13.91
Manufacturing	14.29	17.72	16.67	23.28	15.34	16.47
Other Industry	8.42	4.25	9.06	5.15	11.26	10.35
Construction	6.18	7.69	7.07	6.08	4.63	8.80
Transport	11.10	11.73	7.31	7.02	6.74	6.88
Trade (W&R)	14.08	18.80	12.81	15.95	11.34	17.11
Public Sector	25.91	16.01	21.36	15.39	19.63	12.38
Fin & Bus	11.00	18.03	15.58	20.34	12.06	10.92
Other Services	3.42	2.85	3.81	2.93	2.79	3.19
Total	100	100	100	100	100	100
Employment Share						
Agriculture	14.99	6.00	17.43	9.34	33.42	27.87
Manufacturing	19.12	16.22	24.14	20.67	14.40	10.03
Other Industry	3.24	2.38	3.66	2.57	3.70	3.06
Construction	6.21	7.74	6.37	7.11	5.51	7.10
Transport	7.27	7.63	5.78	6.15	4.56	5.59
Trade (W&R)	16.68	19.12	14.22	18.23	11.44	16.12
Public Sector	22.19	21.98	18.15	18.80	19.72	19.55
Fin & Bus	7.04	14.11	7.38	13.60	3.84	6.25
Other Services	3.26	4.81	2.87	3.51	3.40	4.43
Total	100	100	100	100	100	100

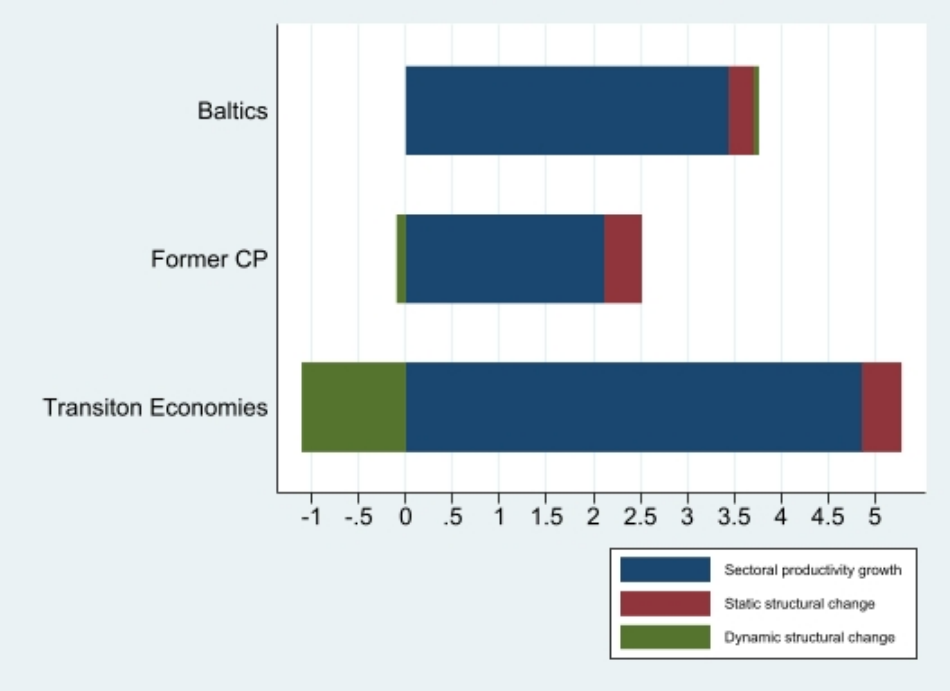
Notes: Shares are the proportion of total constant VA in each sector and employment in each sector, productivity growth is the average rate of sector labour productivity growth per annum in the preceding period. Unweighted averages across countries of the full sample of transition economies. *Source:* Author calculations from ETD-TE.

Table 10: Average sector real VA shares, employment shares, and labour productivity growth rate.

	Whole Sample				
	1990	1995	2005	2015	2019
Real VA Share					
Agriculture	10.48	13.94	12.27	12.14	11.32
Manufacturing	18.89	15.11	16.75	15.92	16.77
Other Industry	10.94	10.65	9.67	8.81	8.84
Construction	8.41	4.96	8.25	8.70	8.72
Transport	8.11	7.68	6.78	7.75	7.99
Trade (W&R)	14.16	11.92	14.11	16.96	17.69
Public Sector	18.24	20.98	15.01	14.03	12.87
Fin & Bus	8.33	11.83	14.23	12.69	12.65
Other Services	2.45	2.92	2.92	2.99	3.15
Total	100	100	100	100	100
Employment Share					
Agriculture	25.69	29.47	31.10	25.32	21.40
Manufacturing	19.06	15.41	12.38	10.72	11.47
Other Industry	4.18	3.60	3.05	2.95	2.95
Construction	9.33	5.66	5.72	6.94	7.56
Transport	5.00	5.14	5.14	5.84	6.13
Trade (W&R)	9.43	12.56	14.46	16.34	17.26
Public Sector	19.62	20.25	18.95	20.15	20.18
Fin & Bus	4.36	4.53	5.01	7.17	8.12
Other Services	3.33	3.37	4.19	4.56	4.92
Total	100	100	100	100	100
Labour Productivity Growth (Annual Average)					
Agriculture	-	-6.16	4.81	5.35	6.61
Manufacturing	-	-4.26	10.13	3.99	2.49
Other Industry	-	-3.64	6.67	2.69	3.34
Construction	-	-5.55	13.16	2.01	1.33
Transport	-	-17.24	5.75	4.28	3.20
Trade (W&R)	-	-11.93	5.30	3.84	2.16
Public Sector	-	-6.72	4.32	2.15	1.28
Finance & Business	-	1.58	7.76	-1.09	-0.81
Other Services	-	-6.42	6.46	2.55	3.15
Aggregate	-	-9.65	5.55	3.27	3.53

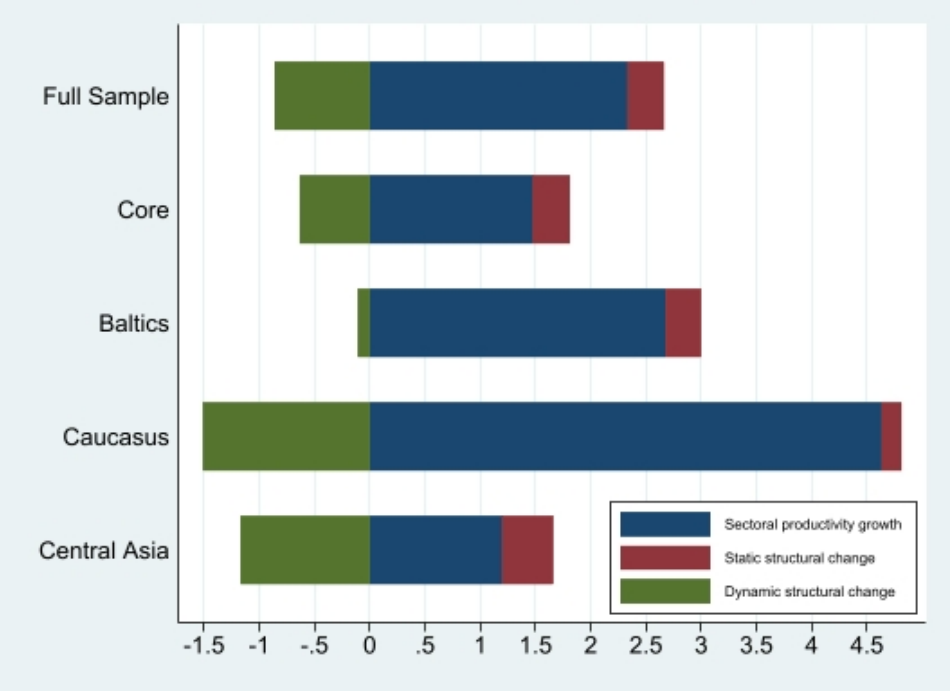
Notes: Shares are the proportion of total constant VA in each sector and employment in each sector, productivity growth is the average rate of sector labour productivity growth per annum in the preceding period. Unweighted averages across countries of the full sample of transition economies. *Source:* Author calculations from ETD-TE.

Figure 9: Three-part decomposition results for transition economies, former-centrally planned Europe, and Baltics; 1995-2018



Note: Bars show separately the within-, static between-, and dynamic between-sector components of labour productivity growth as per equation (2) for three sets of countries: transition economies, former-centrally planned economies of Eastern Europe,and Baltics. Unweighted averages across countries. *Source:* Authors calculations using the ETD-TE and EU-KLEMS. Real Estate sector extracted.

Figure 10: Three-part decomposition results for transition economies and geographic sub-regions.



Note: Bars show separately the within-, static between-, and dynamic between-sector components of labour productivity growth as per equation (2) for the whole sample of transition economies and four sub-regions across the full sample period 1990-2019. Core: Belarus, Moldova, Russia, Ukraine; Baltics: Estonia, Latvia, Lithuania; Caucasus: Armenia, Azerbaijan, Georgia; Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan. Unweighted averages across countries. *Source:* Authors calculations using the ETD-TE. *Real Estate* sector extracted.

Appendix: Country Specific Sources and Methods

Acronyms

ILO = International Labour Organization
IMF = International Monetary Fund
ISIC = International Standard Industrial Classification
LFS = Labour Force Survey
NMP = Net Material Product
NSI = National Statistical Institute
PC = Population Census
PWT = Penn World Table
SEC = Soviet Era Classification

Armenia

Employment

Period	Sectoral data sources
1990 - 1995	Former USSR Statistical Handbook 1996 (in Soviet era classification)
1995-2000	Armenia Statistical Yearbooks in ISIC 3
2001	Armenian Population Census in ISIC 3
2002-2010	Armenian Statistical Yearbooks in ISIC 3
2011	Armenian Population Census in ISIC 3
2012-2017	Armenian Statistical Yearbooks (in ISIC rev. 3/4 classification)
2018-2019	UN Official Country Data in ISIC 4

- Benchmark years from population censuses in 2001 and 2011, in shares; ISIC3-4 split using constant shares from. Shares applied to PWT ver 10 employment total.
- Post-2001 - 2017, excluding census years, employment data from various Armenian statistical yearbooks, in shares; ISIC3-4 split using constant shares from nearest ISIC 4 benchmark. Shares applied to PWT ver 10 employment total.

- Post- 2017 employment data from UN Official Country Data, in shares. Shares applied to PWT ver 10 employment total.
- 1995 - 2000 employment data from various Armenian statistical yearbooks, in trends; backwards extrapolated from 2001 census benchmark. ISIC4 Sub-sectors use ISIC3 parent sector trend.
- 1990 - 1994 employment data from Former USSR Statistical Handbook Publication (World Bank 1996) used as trends; backwards extrapolated from 1995. ISIC4 sectors use SEC equivalent sectors according to broad concordance.

Nominal Value Added

Period	**Sectoral data sources**
1990 - 1993	Former USSR Statistical Handbook 1995 (NMP classification) and IMF (1993) Economic Review (NMP classification)
1994-2004	UN Official Country Data in ISIC 3; UNECE data for Agriculture
2005-2008	Armenian Statistical Yearbooks in ISIC 3
2009-2019	UN Official Country Data in ISIC 4

- 2009-2019 sectoral VA in ISIC 4 from UN Official Country Data, in levels.
- 2005 - 2008 sectoral VA from Armenian Statistical Yearbooks, trends backwards extrapolated; ISIC4 Sub-sectors use ISIC3 parent sector trend.
- 1994 - 2004 sectoral VA from UN Official Country Data and UNECE, trends backwards extrapolated; ISIC4 Sub-sectors use ISIC3 parent sector trend.
- 1990 -1993 sectoral NMP from World Bank (1995) and IMF (1993) Armenia Economic Review trends backwards extrapolated; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Constant Value Added

Period	Sectoral data sources
1990 - 1993	Former USSR Statistical Handbook 1995 (NMP classification) and IMF (1993) Economic Review (NMP classification).
1994-2014	UN Official Country Data in ISIC 3
2015	UN Official Country Data base year in ISIC 4
2016-2019	UNECE Data in ISIC 4

- 2016 - 2019 sectoral constant VA from UNECE data portal, trends forwards extrapolated from 2015 benchmark year.
- 2015 is base year, uses current price sectoral VA from UN Official Country Data in levels.
- 1994 - 2019 sectoral constant VA from UN Official Country Data, trends backwards extrapolated from 2015 benchmark year.
- 1990 -1993 sectoral NMP from World Bank (1995) and IMF (1993) Armenia Economic Review, ISIC 4 sectors use trends from closest NMP equivalent sectors. Converted from previous year prices to constant base year prices in combination with current price NMP data.

Azerbaijan

Employment

Period	Sectoral data sources
1990 - 1992	World Bank (1993) Azerbaijan Country Report (in Soviet era classification)
1993 - 1996	Former USSR Statistical Handbook 1996 (in Soviet era classification)
1996 - 1999	ILO Modeled Estimates in ISIC 3
2000 - 2004, 2006 - 2009, 2011- 2015, 2016	UNECE Data in ISIC 4
2005, 2010, 2015, 2017-2019	NSI Employment Data (from LFS; in ISIC rev. 4 classification).

- For the benchmark years 2005, 2010, 2015, and 2017-2019, sectoral employment data in ISIC 4 classification is available directly from the NSI on the

basis of Labour Force Surveys. These are converted to shares and then applied to PWT ver 10 employment total.

- For the periods 2000 - 2004, 2006 - 2009, 2011- 2015, and 2016, sectoral employment data from UNECE data portal in ISIC 4 classification is used as trends interpolated between the benchmark years.
- For the period 1990-1992, World Bank (1993) Azerbaijan Country Report provides sectoral employment by sector in Soviet Era Classification, converted to ISIC 4 using sector concordance and service subsector splits according to ratios in ILO Modelled Estimates. These are converted to shares and then applied to PWT ver 10 employment total.
- For 1993 - 1995, employment data from Former USSR Statistical Handbook Publication (World Bank 1996) in Soviet Era classification used as trends; forwards extrapolated from 1993 using parent/equivalent sector trends for smaller sectors where appropriate.
- For 1996 - 1999, employment data from ILO Modeled Estimates in ISIC 3 used as trends, interpolated between 1995 and 2000 benchmark years. ISIC4 Sub-sectors use ISIC3 parent sector trend.

Nominal Value Added

Period	**Sectoral data sources**
1990 - 1991	World Bank (1993) Azerbaijan Country Report (NMP classification)
1992 - 2004	UN Official Country Data in ISIC 3; various series'.
2005 - 2019	UN Official Country Data in ISIC 4

- 2005-2019 sectoral VA in ISIC 4 from UN Official Country Data, in levels.
- 1992-2004 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2005; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1990 -1991 sectoral NMP from World Bank (1993) Azerbaijan Country Report, trends backwards extrapolated; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Constant Value Added

Period	Sectoral data sources
1990 - 1991	World Bank (1993) Azerbaijan Country Report (NMP classification)
1992 - 2005	UNECE Data in ISIC 3
2006 - 2019	UN Official Country Data in ISIC 4

- 2015 is base year, uses current price sectoral VA from UN Official Country Data in levels.
- 2006 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards and backwards extrapolated from 2015 base year.
- 1992 - 2005 sectoral VA in ISIC 3 from UNECE Data Portal, converted to base year 2015, trends backwards extrapolated from 2006; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1990 -1991 sectoral constant price NMP from World Bank (1993) Azerbaijan Country Report, trends backwards extrapolated; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Belarus

Employment

Period	Sectoral data sources
1990	UN Official Country Data (in ISIC rev. 2 classification)
1991 - 1992	World Bank (1997) Belarus Country Report (NMP classification)
1994 - 1999	IMF (1999) Belarus Staff Country Report in ISIC 3
2001 - 2004, 2006 - 2007	UN Official Country Data in ISIC 3
2000, 2005, 2008-2009	Belarus Statistical Yearbooks in ISIC 3
2010-2018	Belarus Statistical Yearbooks in ISIC 4
2019	UN Official Country Data in ISIC 4

- For the benchmark years 2010-2018, sectoral employment data in ISIC 4 classification taken directly from NSI Statistical Yearbooks. These are converted to shares and then applied to PWT ver 10 employment total.
- 2019 sectoral UN Official Country Data in ISIC 4 classification, trend extrapolated forward from 2018.
- 2000, 2005, 2008-2009, sectoral employment data in ISIC 3 classification taken directly from NSI Statistical Yearbooks, converted to ISIC 4 by applying sub-sector shares of closest benchmark years. These are converted to shares and then applied to PWT ver 10 employment total.
- 2001 - 2004, 2006 - 2007 sectoral UN Official Country Data in ISIC 3 classification, trends interpolated between the above benchmark years, ISIC 4 sub-sectors use ISIC 3 parent sector trend.
- 1994 - 1999 , sectoral employment data in ISIC 3 classification taken from IMF (1999) Belarus Staff Country Report, converted to ISIC 4 by applying sub-sector shares of closest benchmark years. These are converted to shares and then applied to PWT ver 10 employment total.
- 1991 - 1992, sectoral employment data in Soviet Era Classification from World Bank (1997) Belarus Country Report, trends backwards extrapolated from 1993 pairing to closest ISIC 4 equivalent sector.
- 1990, sectoral UN Official Country Data in ISIC 2 classification (broad primary sectors), trend backwards extrapolated from 1991 using common primary sector trend for all ISIC 4 subsectors.

Nominal Value Added

NOTE: Belarus has experienced multiple currency revaluations in the sample period, as a result of hyperinflations. The latest 'third ruble' revaluation took place in 2016. All Current and Constant VA is expressed in 'third ruble' value so as to allow for inter-temporarily consistent productivity calculations. This means that current price VA in earlier years appears very small. Multiplying Constant VA values by 10,000 will yield a good approximation to 'second ruble' VA, as the 2015 base year is close to the 2016 revaluation year.

Period	Sectoral data sources
1990 - 1995	World Bank (1997) Belarus Country Report (GDP conversion, in Soviet era classification)
1995 - 2010	UN Official Country Data in ISIC 3; various series'.
2010 - 2015	Belarus 2017 Statistical Yearbook in ISIC 4; 'second rubles'
2015 - 2019	Belarus 2021 Statistical Yearbook in ISIC 4; 'third rubles'

- 2015-2019 sectoral VA in ISIC 4 from Belarus Statistical Yearbook 2021 edition, in levels, in 'third rubles' (see note above).
- 2010-2015 sectoral VA in ISIC 4 from Belarus Statistical Yearbook 2017 edition, trends backwards extrapolated from 2015, source data in 'second rubles', trend extrapolation converts to 'third rubles' (see note above).
- 1995-2010 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2010; ISIC 4 sub-sectors split from ISIC 3 parent sectors according to 2010 (overlap year) ratios. Trend extrapolation converts to 'third rubles' (see note above).
- 1990 - 1995 sectoral GDP (conversion from NMP to GDP had been performed already in the source material) in detailed Soviet-era classification from World Bank (1997) Belarus Country Report, trends backwards extrapolated from 1995; ISIC 4 sectors use trends from closest Soviet-era equivalent sectors, detailed disaggregation allowed for accurate matching.

Constant Value Added

Period	Sectoral data sources
1990 - 1995	World Bank (1997) Belarus Country Report (GDP conversion, in Soviet era classification)
1995 - 2010	UN Official Country Data in ISIC 3; various series', 'second rubles', converted from previous year prices.
2010 - 2019	UN Official Country Data in ISIC 4; various series', 'third rubles', converted from previous year prices.

- 2015 is base year, uses ISIC current price sectoral VA from UN Official Country Data in levels, converted from 'second rubles' to 'third rubles' (see note above).
- 2010 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards and backwards extrapolated from 2015 base year. Maintains consistent 'third rubles' denomination.
- 1995 - 2010 sectoral VA in ISIC 3 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends backwards extrapolated from 2010, ISIC 4 sub-sectors use ISIC 3 parent sector trend.
- 1990 - 1995 sectoral GDP (conversion from NMP to GDP had been performed already in the source material) in detailed Soviet-era classification from World Bank (1997) Belarus Country Report, trends backwards extrapolated from 1995; ISIC 4 sectors use trends from closest Soviet-era equivalent sectors, detailed disaggregation allowed for accurate matching. Source data is in constant 1990 (Russian) rubles, application of growth rate trend converts automatically to 2015 (Belarusian) 'third rubles'.

Estonia

Employment

Period	Sectoral data sources
1990 - 1995	Arro et al. (2001) ILO Employment Report, ILO LFS statistics in ISIC 3.
1995 - 2019	EU-KLEMS in ISIC 4, normalized to PWT ver 10.

- 1995 - 2019 sectoral employment data in ISIC 4 classification from EU-KLEMS in shares. Shares applied to PWT ver 10 employment total.
- 1990 - 1995 sectoral employment data in ISIC 3 classification from Arro et al. (2001), an ILO employment report which contains extensive ILO primary LFS data for Estonia, trends backwards extrapolated from 1995. ISIC 4 sub-sectors follow ISIC 3 parent sector trends.

Nominal Value Added

Period	Sectoral data sources
1990 - 1992	IMF (1994) Estonia Country Report (NMP, in Soviet era classification)
1992 - 1993	World Bank (1999) Estonia Country Report (GDP conversion, in ISIC 3)
1993 - 1995	UNECE Data in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4

- 1995 - 2019 sectoral current VA data in ISIC 4 classification from EU-KLEMS in levels. Denominated in euros throughout.
- 1993 - 1995 sectoral current VA data in ISIC 3 classification from UNECE data portal, trends backwards extrapolated from 1995. ISIC 4 parent sectors follow ISIC 3 equivalent sector trends.
- 1992 - 1993 sectoral GDP (conversion from NMP to GDP had been performed already in the source material) in ISIC 3 classification from World Bank (1999) Estonia Country Report, trends backwards extrapolated from 1992; ISIC 4 parent sectors follow ISIC 3 equivalent sector trends. Source data is in Kroons but application of trends automatically converts to Euros.
- 1990 - 1992 sectoral NMP from IMF (1994) Estonia Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Constant Value Added

Period	Sectoral data sources
1990 - 1992	IMF (1994) Estonia Country Report (NMP, in Soviet era classification)
1992 - 1993	Interpolated from Current Price VA assuming linear growth in price index between 1991 and 1993.
1993 - 1995	UNECE Data in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4

- 1995 - 2019 sectoral constant VA data in ISIC 4 classification from EU-KLEMS in levels. Source data is already in constant 2015 prices. Denominated in euros throughout.
- 1993 - 1995 sectoral current VA data in ISIC 3 classification from UNECE data portal, trends backwards extrapolated from 1995. ISIC 4 parent sectors follow ISIC 3 equivalent sector trends; source data in constant 2010 euros but application of trends automatically converts to 2015 euros.
- 1992 no constant price sectoral VA data found for this year. Therefore, the average of the 1991 and 1993 price indices are calculated for each sector, and then applied to the 1992 current price VA levels.
- 1990 - 1992 sectoral NMP from IMF (1994) Estonia Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors; source data in constant 1990 (Russian) rubles but application of trends automatically converts to 2015 euros.

Georgia

Employment

Period	Sectoral data sources
1990 - 1991	Eurostat (1996) Georgia Country Profile (in Soviet era classification)
1991 - 1995	Former USSR Statistical Handbook 1996 (in Soviet era classification)
1995 - 1998	ILO Modeled Estimates in ISIC 4
1998 - 2007	Georgia Statistical Yearbooks in ISIC 4, normalized to PWT ver 10.
2007 - 2014	ILO Modeled Estimates in ISIC 4; UNECE sectoral data in Broad Aggregates.
2014	Georgia Population Census in ISIC 3
2014 - 2017	ILO Modeled Estimates in ISIC 4; UNECE sectoral data in Broad Aggregates.
2017 - 2019	LFS Microdata from NSI, ISIC 4, normalized to PWT ver 10.

- 2017 - 2019 detailed LFS microdata from NSI aggregated to ISIC 4 and sectoral shares calculated, shares applied to PWT ver 10 employment totals.
- 2014 sectoral employment data from Population Census, ISIC 4 shares calculated and applied to PWT ver 10 employment total.
- 1998 - 2017 sectoral employment data from Georgia Statistical Yearbooks in ISIC 3; converted to ISIC 4 assuming constant 2014 subsector ratios; shares calculated and applied to PWT ver 10 employment totals.
- 1990 - 1991 sectoral employment data from Eurostat (1996) Georgia Country Profile in detailed Soviet era classification, concorded to ISIC using concordance from Voskoboynikov (2012), used as levels.
- 1991 - 1995 employment data from Former USSR Statistical Handbook Publication (World Bank 1996) used as trends; forwards extrapolated from 1991. ISIC4 sectors use SEC equivalent sectors according to broad concordance.
- 2014 - 2017, 2007 - 2015, and 1995 - 1998; no quality/verifiable primary source data found for these periods; therefore trends interpolated using ILO Modeled Estimates in ISIC 4 classification. In the later periods, where possible ILO data was normalized to UNECE sectoral employment data in broad aggregates prior to the application of trends.

Nominal Value Added

Period	Sectoral data sources
1990 - 1992	World Bank (1993) Georgia Country Report (NMP classification)
1992 - 1995	UNECE Data in ISIC 3
1995 - 2010	UN Official Country Data in ISIC 3
2010 - 2019	UN Official Country Data in ISIC 4

- 2010-2019 sectoral VA in ISIC 4 from UN Official Country Data, in levels.
- 1995-2010 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2010; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1992-1995 sectoral VA in ISIC 3 from UNECE Data Portal, trends used for backwards extrapolation from 1995; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1990 -1992 sectoral NMP from World Bank (1993) Georgia Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Constant Value Added

Period	Sectoral data sources
1990 - 1992	World Bank (1993) Georgia Country Report (NMP classification)
1992 - 1995	Interpolation assuming constant growth rate.
1995 - 2010	UN Official Country Data in ISIC 3
2010 - 2019	UN Official Country Data in ISIC 4

- 2010-2019 sectoral VA in ISIC 4 from UN Official Country Data, in levels, source data already in constant 2015 prices.
- 1995-2010 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2010; ISIC 4 sub-sectors follow ISIC 3 parent sector trends, source data in constant 1996 prices but application of trend automatically converts to 2015 base year.

- 1992-1995; no quality constant price sectoral VA data found. Series' are backwards extrapolated from 1995 using constant 1995-96 growth rate.
- 1990 -1992 sectoral NMP from World Bank (1993) Georgia Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors, source data in constant 1987 prices but application of trend automatically converts to 2015 base year

Kazakhstan

Employment

Period	Sectoral data sources
1990 - 1995	World Bank (1997) Kazakhstan Country Report (in Soviet era classification)
1995 - 1999	ILO Modeled Estimates in ISIC 4
1999 - 2008	Kazakhstan Statistical Yearbooks in ISIC 3
2008 - 2019	Kazakhstan Statistical Yearbooks in ISIC 4

- 2008-2019, sectoral employment data in ISIC 4 classification taken directly from NSI Statistical Yearbooks. These are converted to shares and then applied to PWT ver 10 employment total.
- 1999-2008, sectoral employment data in ISIC 3 classification taken directly from NSI Statistical Yearbooks; these are concorded to ISIC 4 using constant subsector ratios from 2008. These are converted to shares and then applied to PWT ver 10 employment total.
- 1995 - 1999, no quality/verifiable primary source data found for these periods; therefore trends backwards extrapolated from 1999 using ILO Modeled Estimates in ISIC 4 classification.
- 1990 -1995 sectoral employment in Soviet era classification from World Bank (1997) Kazakhstan Country Report, trends backwards extrapolated; ISIC 4 sectors use trends from closest SEC equivalent sectors.

Nominal Value Added

Period	Sectoral data sources
1990 - 1992	World Bank (1993) Kazakhstan Country Report (NMP classification)
1992 - 2010	UN Official Country Data in ISIC 3, various series (verified against Statistical Yearbooks)
2010 - 2019	Kazakhstan Statistical Yearbook 2020 in ISIC 4

- 2010-2019 sectoral VA in ISIC 4 from Kazakhstan Statistical Yearbook 2020, in levels
- 1992-2010 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2010; ISIC 4 sub-sectors split from ISIC 3 parent sectors according to 2010 (overlap year) ratios; in the more recent years UN data is verified as matching various editions of Kazakhstan Statistical Yearbook.
- 1990 -1992 sectoral NMP from World Bank (1993) Kazakhstan Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Constant Value Added

Period	Sectoral data sources
1990 - 1992	World Bank (1993) Kazakhstan Country Report (NMP classification)
1992-2010	UN Official Country Data in ISIC 3, various series (verified against Statistical Yearbooks), converted from previous year prices.
2015	Kazakhstan Statistical Yearbook 2020 in ISIC 4
2010-2019	UN Official Country Data in ISIC 4, various series (verified against Statistical Yearbooks), converted from previous year prices.

- 2015 is base year, uses ISIC current price sectoral VA from Kazakhstan Statistical Yearbook 2020 in levels.
- 2010 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards and backwards extrapolated from 2015 base year.
- 1992 - 2010 sectoral VA in ISIC 3 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends backwards extrapolated from 2010, ISIC 4 sub-sectors use ISIC 3 parent sector trend.
- 1990 -1992 sectoral NMP from World Bank (1993) Kazakhstan Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors. NMP is in constant 1987 prices, application of trend converts automatically to 2015 prices.

Kyrgyzstan

Employment

Period	Sectoral data sources
1990 - 1999	UN Official Country Data (based on LFS) in ISIC 3
1999	Kyrgyzstan Population Census in ISIC 3
1999 - 2009	UN Official Country Data (based on LFS) in ISIC 3
2009	Kyrgyzstan Population Census in ISIC 3
2009 - 2012	Kyrgyzstan Statistical Yearbooks in ISIC 3
2012 - 2019	Kyrgyzstan National Accounts (based on LFS) data in ISIC 4

- 2012-2019, sectoral employment data in ISIC 4 classification taken directly from National Accounts Data from NSI Website; these are based on Labour Force Surveys which were checked for comprehensive coverage. These are converted to shares and then applied to PWT ver 10 employment total.
- 2009 and 1999 are additional benchmark years using sectoral employment data from Population Census reports; ISIC 3 to ISIC 4 split assumes constant subsector ratios. These are converted to shares and then applied to PWT ver 10 employment total.
- 2009 - 2012; in between these two benchmark years, data is interpolated using trends from Kyrgyzstan Statistical Yearbook sectoral employment data in ISIC 3; whereby ISIC4 sub-sectors use their parent sector trends.
- 1999 - 2009; in between these two benchmark years, data is interpolated using trends from UN Official Country Data sectoral employment data in ISIC 3, which is stated as being drawn from primary Labour Force Surveys; whereby ISIC4 sub-sectors use their parent sector trends.
- 1990 - 1999, data is backwards extrapolated from 1999 using trends from UN Official Country Data sectoral employment data in ISIC 3, which is stated as being drawn from primary Labour Force Surveys; whereby ISIC4 sub-sectors use their parent sector trends.

Nominal Value Added

Period	**Sectoral data sources**
1991 & 1995	CIS (2021) Statistical Abstract in Broad ISIC 3 Sectors
1990 - 2010	UN Official Country Data in ISIC 3, various series.
2010 - 2019	UN Official Country Data in ISIC 4

- 2010-2019 sectoral VA in ISIC 4 from UN Official Country Data, in levels.
- 1990-2010 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2010; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.

- 1991 1995; CIS (2021) 30 1991-2021 [Statistical Abstract: 30 years of the Commonwealth of Independent States] publication provides benchmark GDP shares for broad ISIC 3 sectors in 1991 and 1995; UN Data shares are verified against these and normalized where appropriate.

Constant Value Added

Period	Sectoral data sources
1990 - 2010	UN Official Country Data in ISIC 3, various series, converted from previous year prices.
1990 - 2019	UN Official Country Data Agriculture VA in 2015 Prices.
2010 - 2019	UN Official Country Data in ISIC 4, various series, converted from previous year prices.

- 2015 is base year, uses ISIC current price sectoral VA (see above section) in levels.
- 2010 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards and backwards extrapolated from 2015 base year.
- 1990 - 2010 sectoral VA in ISIC 3 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends backwards extrapolated from 2010, ISIC 4 sub-sectors use ISIC 3 parent sector trend.
- 1990 - 2019; the exception to the above is Agriculture. UN OCD also provides sectoral VA data in broad (three sector) aggregates in constant 2015 prices; as Agriculture series from previous year prices exhibits extreme jumps, it is replaced with the Agriculture series from the constant 2015 price data.

Lithuania

Employment

Period	Sectoral data sources
1990 - 1995	UNECE Data in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4, normalized to PWT ver 10.

- 1995 - 2019 sectoral employment data in ISIC 4 classification from EU-KLEMS in shares. Shares applied to PWT ver 10 employment total.
- 1990 - 1995 sectoral employment data in ISIC 3 classification from UNECE data portal, trends backwards extrapolated from 1995. ISIC 4 parent sectors follow ISIC 3 equivalent sector trends.

Nominal Value Added

Period	Sectoral data sources
1990 - 1995	UN Official Country Data (SNA 1993 series 100) in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4

- 1995 - 2019 sectoral current VA data in ISIC 4 classification from EU-KLEMS in levels. Denominated in euros throughout.
- 1990 - 1995 sectoral VA in ISIC 3 from UN Official Country Data; trends from SNA 1993 series 100 data used for backwards extrapolation from 1995; ISIC 4 sub-sectors follow ISIC 3 parent sector trends. Source data is in Lithuanian litas but application of growth rate trend converts automatically to euros.

Constant Value Added

Period	Sectoral data sources
1990 - 1992	IMF (1993) Lithuania Country Report (NMP, in Soviet era classification)
1992 - 1994	Lithuania 1996 Statistical Yearbook in ISIC 3
1994 - 1995	UN Official Country Data (SNA 1993 series 100) in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4

- 1995 - 2019 sectoral constant VA data in ISIC 4 classification from EU-KLEMS in levels. Source data is already in constant 2015 prices. Denominated in euros throughout.
- 1994 - 1995 sectoral constant VA in ISIC 3 from UN Official Country Data; trends backwards extrapolated from 1995, ISIC 4 sub-sectors use ISIC 3 parent sector trend. Source data is in constant 1995 Lithuanian litas but application of growth rate trend converts automatically to 2015 euros.
- 1992 - 1994 sectoral constant VA in ISIC 3 from 1996 Lithuania Statistical Yearbook NSI publication; trends backwards extrapolated from 1994, ISIC 4 sub-sectors use ISIC 3 parent sector trend. Source data is in constant 1993 Lithuanian litas but application of growth rate trend converts automatically to 2015 euros.
- 1990 - 1992 sectoral NMP from IMF (1993) Lithuania Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors; source data in constant 1990 (Russian) rubles but application of trends automatically converts to 2015 euros. Smaller services sectors (ISIC 4 J-U) are not included in the source data, so the trend applied to these sectors is that of the aggregate of the services sectors which are included in the report.

Latvia

Employment

Period	Sectoral data sources
1990 - 1991	IMF (1993) Latvia Country Report (in Soviet era classification)
1991 - 1995	UNECE Data in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4, normalized to PWT ver 10.

- 1995 - 2019 sectoral employment data in ISIC 4 classification from EU-KLEMS in shares. Shares applied to PWT ver 10 employment total.
- 1991 - 1995 sectoral employment data in ISIC 3 classification from UNECE data portal, trends backwards extrapolated from 1995. ISIC 4 parent sectors follow ISIC 3 equivalent sector trends.

- 1990 - 1991 sectoral employment data in Soviet Era Classification from IMF (1993) Latvia Country Report, trends backwards extrapolated from 1991 pairing to closest ISIC 4 equivalent sector.

Nominal Value Added

Period	Sectoral data sources
1990 - 1995	UNECE Data in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4

- 1995 - 2019 sectoral current VA data in ISIC 4 classification from EU-KLEMS in levels. Denominated in euros throughout.
- 1990 - 1995 sectoral current VA data in ISIC 3 classification from UNECE data portal, trends backwards extrapolated from 1995. ISIC 4 parent sectors follow ISIC 3 equivalent sector trends.

Constant Value Added

Period	Sectoral data sources
1990 - 1995	UNECE Data in ISIC 3
1995 - 2019	EU-KLEMS in ISIC 4

- 1995 - 2019 sectoral constant VA data in ISIC 4 classification from EU-KLEMS in levels. Source data is already in constant 2015 prices. Denominated in euros throughout.
- 1990 - 1995 sectoral constant VA data in ISIC 3 classification from UNECE data portal, trends backwards extrapolated from 1995. ISIC 4 parent sectors follow ISIC 3 equivalent sector trends. Source data is in constant 2010 prices but application of growth rate trend converts automatically to 2015 prices.

Moldova

Note: There are considerable disparities between different sources regarding Moldovan employment statistics for the following reason. As a result of the 2014 population census, the full results of which were not

published until a year or two later, it emerged that outward migration from Moldova in the ten years since the previous census had been much larger than expected, manifesting in large scale population and labour force decline. Labour Force Surveys had been normalized to overall employment on the basis of a trend from the 2004 census, and as a result were much too high. Recent LFS are adjusted to the 2014 census. Some sources have applied backward revisions to the earlier LFS and others have not. Furthermore, some secondary sources continued to extrapolate aggregate population and employment totals on the basis of earlier figures and growth rates and are inaccurate as a result. In this data, for the post-2004 period we use adjusted sources where available, and perform our own adjustments where not, so as to accurately capture the Moldovan population and employment declines. The procedures for this are outlined below. The result is that the sums over sectoral employment will seem considerably lower than the employment totals presented by some alternative sources in the more recent years.

Employment

Period	**Sectoral data sources**
1990 - 1992	World Bank (1994) Moldova Country Report in Soviet era classification.
1992 - 1994	Former USSR Statistical Handbook 1996 in Soviet era classification.
1994 - 1995	ILO Modeled Estimates in ISIC 4
1996 - 2014	Moldova Statistical Yearbook 2017 in ISIC 3; normalized to adjusted employment total.
2004, 2014	Moldovan Population Censuses; employment totals used to initiate adjusted total employment series uses for normalizations.
2014 - 2019	Moldova Statistical Yearbook 2020 in ISIC 4; normalized to adjusted employment total.

- 2004 - 2019; for the reasons discussed in the above note, a total employment series is created. This series is benchmarked from the 2004 and 2019 population censuses, where the total employment levels are taken directly from these censuses. In between the benchmark years, the series is interpolated using the growth rate of total employment from the 2017 statistical

yearbook, which is based on labour force surveys. After 2014, the series is forwards interpolated using the growth rate of total employment from the 2020 statistical yearbook, which is based on labour force surveys. The result is a series which follows as closely as possible the year to year dynamics uncovered in the LFS whilst matching the long-term trends uncovered by the population censuses.

- 2014 - 2019, sectoral employment data in ISIC 4 classification from 2020 Moldova Statistical Yearbook, converted to shares which are then applied to the above described total employment series.
- 1996 - 2014, sectoral employment data in ISIC 3 classification from 2017 Moldova Statistical Yearbook, first concorded to ISIC 4 assuming constant 2014 sub-sector ratios, then converted to shares which are then applied to the above described total employment series.
- 1994 - 1996, no quality/verifiable primary source data found for 1995; therefore trend interpolated for this one year using ILO Modeled Estimates in ISIC 4 classification.
- 1992 - 1994, employment data from Former USSR Statistical Handbook Publication (World Bank 1996) used as trends; backwards extrapolated from 1995. ISIC4 sectors use SEC equivalent sectors according to broad concordance.
- 1990 - 1992, sectoral employment data from World Bank (1994) Moldova Country Report in detailed Soviet era classification, concorded to ISIC using concordance from Voskoboynikov (2012), used as trends; backwards extrapolated from 1992.

Nominal Value Added

Period	Sectoral data sources
1990 - 1992	World Bank (1994) Moldova Country Report (NMP, in Soviet era classification)
1992 - 1995	UN Official Country Data (series 200) in ISIC 3
1995 - 2004	Moldova Statistical Yearbooks in ISIC 3, various editions.
2010 - 2019	UN Official Country Data in ISIC 4; verified against Statistical Yearbook Data

- 2010-2019 sectoral VA in ISIC 4 from UN Official Country Data, verified against Statistical Yearbook Data, in levels.
- 1995-2010, sectoral VA in ISIC 3 from various editions of the Moldovan Statistical Yearbook; trends used for backwards extrapolation from 2010; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1992-1995 sectoral VA in ISIC 3 from UN Official Country Data; trends from series 200 used for backwards extrapolation from 1995; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1990-1992 sectoral NMP from World Bank (1994) Moldova Country Report, trends backwards extrapolated from 1992; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Constant Value Added

Period	Sectoral data sources
1990 - 1993	World Bank (1994) Moldova Country Report (NMP, in Soviet era classification), in previous year prices with current price data used for conversion.
1993 - 1995	Interpolation based on linear price deflator growth.
1995 - 2005	UN Official Country Data in ISIC 3, various series, converted from previous year prices.
2005 - 2019	UN Official Country Data in ISIC 4, various series, converted from previous year prices.

- 2015 is base year, uses ISIC current price sectoral VA (see above section) in levels.
- 2005 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards and backwards extrapolated from 2015 base year.
- 1995 - 2005 sectoral VA in ISIC 3 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends backwards extrapolated from 2010, ISIC 4 sub-sectors use ISIC 3 parent sector trend.

- 1990 - 1993, sectoral constant NMP from World Bank (1994) Moldova Country Report in previous year prices. This is first converted to data in constant 1990 prices by combining with current price NMP from the same report. Then, the trends are backwards extrapolated from 1993, which ensures the data is converted to constant 2015 prices. ISIC 4 sectors use trends from closest NMP equivalent sectors.
- 1993 - 1995, no quality/verifiable primary source data found for 1994, therefore an interpolation is performed whereby a price deflator is calculated for each sector in 1994 as the average of the 1993 and 1995 price deflators, this is then applied to the 1994 current price VA data.

Russia

Employment

Period	Sectoral data sources
1990, 1992, 1995	Rosstat Labour Force Surveys (Population Survey on Employment Issues) in Soviet Era Classification
1991, 1993, 1994	Linear Interpolations
1995 - 2004	Rosstat 'Russia in Numbers' publications (based on LFS) in Soviet Era Classification
2004 - 2012	Rosstat Labour Force Surveys (Population Survey on Employment Issues) in ISIC 3
2012 - 2017	Rosstat Labour Force Surveys (Population Survey on Employment Issues) in detailed ISIC 3
2017 - 2019	Rosstat (NSI) Labour Force Surveys in ISIC 4

- For the benchmark years 2017-2019, sectoral employment data in ISIC 4 classification taken directly from NSI (Rosstat) LFS data archive. These are converted to shares and then applied to PWT ver 10 employment total.
- 2012-2017, sectoral employment data in detailed ISIC 3 classification taken directly from NSI (Rosstat) LFS data archive; data is sufficiently detailed/disaggregated that it can be reassembled to ISIC 4 without requiring assumptions. These are converted to shares and then applied to PWT ver 10 employment total.

- 2004-2012, sectoral employment data in ISIC 3 classification taken directly from NSI (Rosstat) LFS data archive; converted to ISIC 4 by applying subsector shares from 2012, the earliest year of disaggregated data. Trends used to backwards extrapolate from 2012.
- 1995-2004, sectoral employment data in Soviet-era classification taken directly from NSI (Rosstat) 'Russia in Numbers' publications which are based on LFS data; concorded to ISIC 4 using the concordance tables of Voskoboynikov (2012). Trends used to backwards extrapolate from 2004.
- 1990, 1992, 1995, sectoral employment data in Soviet-era classification taken directly from NSI (Rosstat) LFS data archive; concorded to ISIC 4 using the concordance tables of Voskoboynikov (2012). Gaps (1991, 1993, 1994) filled using linear interpolations to create a full series 1990-1995. Trends used to backwards extrapolate from 1995.

Nominal Value Added

Period	Sectoral data sources
1990 - 2013	UN Official Country Data in ISIC 3, various series, later years verified against Rosstat National Accounts Publications.
2013 - 2019	Rosstat (NSI) National Accounts Publication in ISIC 4

- 2013-2019 sectoral VA in ISIC 4 from Rosstat National Accounts 2013-2020 (2013-2020) publication, in levels.
- 1990-2013 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2013; ISIC 4 subsectors split use ISIC 3 parent sector trends. Earlier versions of the above National Accounts publication from 2007 are qualitatively similar; UN data is preferred for the trends as it may in some cases have been subjected to more recent revisions (the NA publications are roughly contemporary). Pre-2007 National Accounts publications are in Soviet Era classification.

Constant Value Added

Period	Sectoral data sources
1990 - 2011	UN Official Country Data in ISIC 3, various series, later years verified against Rosstat National Accounts Publications.
2011 - 2019	Rosstat (NSI) National Accounts Publication in ISIC 4

- 2011-2019 constant sectoral VA in ISIC 4 from Rosstat National Accounts 2013-2020 (2013-2020) publication, converted from 2016 to 2015 prices and then used in levels.
- 1990-2011 constant sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2011; ISIC 4 sub-sectors split use ISIC 3 parent sector trends. Different series utilize different base years but application of trend automatically converts to 2015 prices. Earlier versions of the above National Accounts publication from 2002 are qualitatively similar; UN data is preferred for the trends as it may in some cases have been subjected to more recent revisions (the NA publications are roughly contemporary). Pre-2002 National Accounts publications are in Soviet Era classification.

Tajikistan

NOTE: Tajikistan Labour Statistics have historically been slow in updating sector classification systems. Data collection and reporting switched from NMP to NACE classifications only in 2010, and ISIC revision 4 was adopted only in 2019. Whilst most countries in this dataset involve by necessity some classification concordance in the earliest years, and some assumptions over the ISIC3 to ISIC4 split in the middle period, these carry much later in the case of Tajikistan and are therefore stronger assumptions. Users should therefore treat employment ratios in the smaller services sectors (the 'non-material sphere') with caution in the case of Tajikistan.

Employment

Period	Sectoral data sources
1990 - 1991	World Bank (1994) Tajikistan Country Report in Soviet Era Classification
1991 - 2010	NSI 'Tajikistan in Figures' Publications in Soviet Era Classification
2010	CIS (2021) Statistical Abstract in ISIC 3
2011 - 2019	NSI 'Tajikistan in Figures' Publications in ISIC 3
2019	NSI 'Tajikistan in Figures 2019' Publication in ISIC 4

- For the benchmark year 2019, sectoral employment data in ISIC 4 classification taken directly from NSI 'Tajikistan in Figures 2019', which is based on LFS. These are converted to shares and then applied to PWT ver 10 employment total.
- 2011-2019, sectoral employment data in ISIC 3 classification taken directly from various editions of the NSI 'Tajikistan in Figures' Publications, which are based on LFS, and converted to ISIC 4 by applying the sub-sector shares 2019. These are converted to shares and then applied to PWT ver 10 employment total.
- 2010, sectoral employment data in ISIC 3 classification taken directly from CIS (2021) 30 1991-2021 [Statistical Abstract: 30 years of the Commonwealth of Independent States] publication and converted to ISIC 4 by applying the sub-sector shares 2019. These are converted to shares and then applied to PWT ver 10 employment total.
- 1991-2010, sectoral employment data in Soviet era classification taken directly from various editions of the NSI 'Tajikistan in Figures' Publications, which are based on LFS, and concorded to ISIC 3 using the concordance of Voskoboynikov (2012). Trends from these series are then used to backwards extrapolate sectoral employment from 2010, whereby ISIC 4 sub-sectors follow their ISIC 3 parent sector trends.
- 1990 - 1991 sectoral employment data in Soviet era classification from World Bank (1994) Tajikistan Country Report, trends backwards extrapolated from 1991; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Nominal Value Added

Period	Sectoral data sources
1990 - 1994	UN Official Country Data in ISIC3 (series 100)
1994 - 2000	UNECE Data in ISIC 3
2000 - 2017	UN Official Country Data in ISIC3 (series 400)
2017 - 2019	UN Official Country Data in ISIC4

- 2017-2019 sectoral VA in ISIC 4 from UN Official Country Data, verified against NSI National Accounts, in levels.
- 2000-2017, sectoral VA in ISIC 3 from UN Official Country Data (series 400); trends used for backwards extrapolation from 2010; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1994-2000 sectoral VA in broad ISIC 3 from UNECE Data Portal, trends backwards extrapolated from 2006; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1990-1994 sectoral VA in ISIC 3 from UN Official Country Data (series 100, in Russian rubles but application of trends converts automatically to Tajik somoni); trends used for backwards extrapolation from 1994; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.

Constant Value Added

Period	Sectoral data sources
1990 - 2000	UN Official Country Data in ISIC3 (various series)
2000 - 2015	UNECE Data in ISIC 3
2015 - 2019	UN Official Country Data in ISIC4

- 2015 is base year, uses ISIC current price sectoral VA (see above section) in levels.

- 2015 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards extrapolated from 2015 base year.
- 2000 -2015 sectoral constant VA in broad ISIC 3 from UNECE Data Portal, trends backwards extrapolated from 2015; ISIC 4 sub-sectors follow ISIC 3 parent sector trends. Source data is in constant 2010 prices but application of trend converts automatically to 2015 prices.
- 1990-2000 sectoral constant VA in ISIC 3 from UN Official Country Data (various series which are first linked); trends used for backwards extrapolation from 2000; ISIC 4 sub-sectors follow ISIC 3 parent sector trends. Source data already in 2015 prices.

Ukraine

NOTE: Following the 2014 annexation of Crimea and parts of the Donbass, post-2014 primary source data exclude those regions. We follow this convention. This results in jumps in the series levels and, to a much lesser extent, in labour productivity calculations.

Employment

Period	Sectoral data sources
1990 - 2001	UN Official Country Data (based on LFS) in ISIC 2
2001	2001 Population Census in ISIC 3
2001 - 2008	UN Official Country Data (based on LFS) in ISIC 3
2008 - 2012	ILO Modeled Estimates in ISIC 4
2012 - 2019	Ukraine Statistical Yearbook 2020 in ISIC 4

- 2012-2019, sectoral employment data in ISIC 4 classification taken directly from NSI Statistical Yearbooks. These are converted to shares and then applied to PWT ver 10 employment total.
- 2008 benchmark year constructed from most recent year of UN Official Country Data sectoral employment in ISIC 3, split to ISIC 4 using 2012 sub-sector rations, converted to shares and then applied to PWT ver 10 employment total.

- 2001 benchmark year constructed from 2001 Population Census sectoral employment in ISIC 3, split to ISIC 4 using 2012 sub-sector rations, converted to shares and then applied to PWT ver 10 employment total.
- 2008-2012, no quality/verifiable primary source data found for this period; therefore trends interpolated using ILO Modeled Estimates in ISIC 4 classification.
- 2001-2008, trends interpolated between benchmark years using UN Official Country Data sectoral employment in ISIC 3, whereby ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1990 - 2001, trends backwards extrapolated using UN Official Country Data sectoral employment in ISIC 2, whereby ISIC 4 sub-sectors follow ISIC 2 parent sector trends. Note that this data did not include the public sector, so public sector trend is that of the 'employees not classified' category. This is not an unreasonable assumption as public sector employees form the vast majority of this residual category.

Nominal Value Added

Period	Sectoral data sources
1990 - 2000	UN Official Country Data in ISIC3, various series.
2000 - 2019	UN Official Country Data in ISIC4

- 2000-2019 sectoral VA in ISIC 4 from UN Official Country Data, in levels.
- 1990-2000 sectoral VA in ISIC 3 from UN Official Country Data; trends from various series' used for backwards extrapolation from 2010; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.

Constant Value Added

Period	Sectoral data sources
1990 - 2000	UN Official Country Data in ISIC3, various series, converted from previous year prices.
2000 - 2019	UN Official Country Data in ISIC4, converted from previous year prices.

- 2015 is base year, uses ISIC current price sectoral VA from UN Official Country Data in levels.
- 2000 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards and backwards extrapolated from 2015 base year.
- 1990 - 2000 sectoral VA in ISIC 3 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends backwards extrapolated from 2000, ISIC 4 sub-sectors use ISIC 3 parent sector trend.

Uzbekistan

Employment

Period	Sectoral data sources
1990 - 1991	World Bank (1993) Uzbekistan Country Report in Soviet era classification.
1995 - 2000	CIS (2021) Statistical Abstract in broad aggregates.
2005 - 2007, 2000, 1995, 1991	CIS (2021) Statistical Abstract in ISIC 3
2008 - 2009, 2001 - 2004, 1992 -1994	ILO Modeled Estimates
2010 - 2019	UNECE Data in ISIC 4
2010 - 2019	Uzbekistan NSI Labour Force Surveys in ISIC 4

- 2010-2019, sectoral employment data in ISIC 4 classification taken directly from NSI Labour Force Survey data. The data provided by the NSI does not disaggregate the smaller services sector. Therefore, these are unpicked using sectoral employment data in ISIC 4 from the UNECE data portal. The UNECE data is from the same source LFS but includes more detail. These are converted to shares and then applied to PWT ver 10 employment total.
- 2005-2007, 2000, 1995, 1991; benchmark years, sectoral employment data in ISIC 3 classification taken directly from CIS (2021) 30 1991-2021 [Statistical Abstract: 30 years of the Commonwealth of Independent States] publication and converted to ISIC 4 by applying the sub-sector shares of 2010. These are converted to shares and then applied to PWT ver 10 employment total.

- 1995-2000, sectoral employment data from CIS (2021) in broad aggregates (Agriculture, Industry, Construction, Services), split to ISIC 4 using rations from ILO Modeled Estimates, trends applied to interpolation between the 1995 and 2000 benchmark years.
- 2008 - 2009, 2001 - 2004, 1992 -1994; no quality/verifiable primary source data found for these years; therefore trends interpolated using ILO Modeled Estimates in ISIC 4 classification.
- 1990 - 1991, sectoral employment data in Soviet era classification from World Bank (1993) Uzbekistan Country Report, trends backwards extrapolated from 1991; ISIC 4 sectors use trends from closest NMP equivalent sectors.

Nominal Value Added

Period	**Sectoral data sources**
1990 - 1994	Former USSR Statistical Handbook 1996 (in Soviet era classification)
1994 - 2000	UN Official Country Data in ISIC 3, series 200
2000 - 2010	NSI National Accounts Data in ISIC 3
2010 - 2019	UN Official Country Data in ISIC 4

- 2010-2019 sectoral VA in ISIC 4 from UN Official Country Data, in levels.
- 2000-2010, this period is missing from UN data. Therefore, contemporary National Accounts data from the NSI is used as trends to backwards extrapolate from 2010. This data does not separately distinguish the smaller services sectors (ISIC 4 K-U). Therefore, these sectors all use the trends from boshqa xizmatlar sohalari (other branches of services).
- 1994-2000 sectoral VA in ISIC 3 from UN Official Country Data; trends from series 200 used for backwards extrapolation from 2000; ISIC 4 sub-sectors follow ISIC 3 parent sector trends.
- 1990 - 1994 sectoral VA from Former USSR Statistical Handbook Publication (World Bank 1996) used as trends; backwards extrapolated from 1995. ISIC4 sectors use SEC equivalent sectors according to broad concordance.

Constant Value Added

Period	Sectoral data sources
1990 - 1994	Former USSR Statistical Handbook 1996 (in Soviet era classification), converted from previous year prices.
1995 - 1998	Interpolation assuming constant growth rate of price deflator.
1999 - 2010	UNECE Data in ISIC 3
2010 - 2019	UN Official Country Data in ISIC4, converted from previous year prices.

- 2015 is base year, uses ISIC current price sectoral VA from UN Official Country Data in levels.
- 2010 - 2019 sectoral VA in ISIC 4 from UN Official Country Data; converted from previous year prices to base year 2015 prices, trends forwards and backwards extrapolated from 2015 base year.
- 1999 - 2010 sectoral constant VA data in ISIC 3 classification from UNECE data portal, trends backwards extrapolated from 1995. ISIC 4 parent sectors follow ISIC 3 equivalent sector trends; source data in constant 2010 euros but application of trends automatically converts to 2015 euros.
- 1990 - 1994 sectoral VA from Former USSR Statistical Handbook Publication (World Bank 1996) used as trends; backwards extrapolated from 1995. ISIC4 sectors use SEC equivalent sectors according to broad concordance. Source data is in previous year prices, converted to constant 1993 prices using current VA data in same publication, application of trend therefore imposes conversion to 2015 prices.
- 1995 - 1998; no quality/verifiable primary source data found for these years; therefore an interpolation is made by applying the 1999-2000 growth rates of price deflators as constant price deflator growth rates, and then combining with the concording sectoral VA data.