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Abstract

This paper assesses the extent of structural or sectoral change and its importance for aggregate productivity growth during times of boom, bust and recovery. The analysis covers 10 EU countries from Central and Eastern Europe over the years 2001–2012. The reallocation of labour across sectors was substantial during the boom, very extensive in 2009 at the depth of the crisis and modest in the subsequent recovery period. The contribution of sectoral change to aggregate productivity growth is computed using various decomposition methods. Changes in labour productivity within sectors play the dominant role for aggregate productivity growth, while reallocation of labour between sectors is less important. This pattern is found through most of the sample period despite large differences in the extent of sectoral change during the boom, crisis and recovery.

JEL Codes: L16, E32, P23

Keywords: labour productivity, structural change, reallocation, productivity decomposition

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Non-technical summary

This paper assesses the extent of sectoral change and its importance for aggregate labour productivity growth in 10 EU countries from Central and Eastern Europe during times of boom, bust and recovery over the years 2001–2012. The extent of sectoral change is computed for both employment and value added. The contribution of sectoral reallocation of employment to aggregate productivity growth is computed using the decomposition methods of McMillan and Rodrik (2011) and Fagerberg (2000). The main contribution of the paper is the use of annual data, which allows a detailed analysis of the extent of sectoral change and its contribution to aggregate labour productivity growth at the business cycle frequency.

The empirical analysis provides several conclusions. The countries with the largest changes in their employment structure over the years 2001–2012 are the Baltic States and Romania followed by Bulgaria and Hungary, which are the countries in the sample with relatively low GDP per capita. The reallocation of labour across sectors was substantial in all countries during the boom, very extensive at the depth of the crisis in 2009 and modest in the subsequent recovery period.

The countries with the greatest sectoral change in value added over the years 2001–2012 are the Czech Republic, Slovakia and Romania. It is notable that there is little overlap between the group of countries with substantial sectoral change in employment and those with substantial sectoral change in value added, a feature resulting from the very different labour productivity growth across different sectors and different courses. The sectoral change in value added exhibits a similar pattern over time to that of the sectoral change in employment, though the decline in reallocation is less prevalent in the recovery period from 2010.

In terms of the contribution of sectoral change to aggregate productivity growth, the growth of productivity within sectors ("the within effect") clearly dominates over the growth of productivity stemming from the reallocation of labour between different sectors ("the between effect"). The upshot is that despite the large amount of sectoral change in the Central and Eastern European countries since 2001, sectoral reallocation has not led to substantial productivity gains. This applies for all the years within the sample 2001–2012, but less so during the height of the boom in 2005–2007 when the between effect was evident although still relatively modest. It is notable that the between effect was very small for most countries during the height of the crisis in 2009. The global financial crisis did not lead to a reallocation of labour from less to more productive sectors, so there is no indication of a "cleansing effect" of the crisis.

Contents

1. Introduction

This paper assesses the extent of labour reallocation across sectors and the contribution of this sectoral change to aggregate labour productivity growth during times of boom, bust and recovery. The analysis covers 10 countries from Central and Eastern Europe (CEE) over the years 2001–2012. These countries joined the EU in 2004 or 2007 and experienced a pronounced pattern of business cycle developments in the sample period.

The period from the turn of the century until the outbreak of the global financial crisis in 2008 was a period of strong economic growth and rapid convergence with West European income levels for most of the countries in the sample. The crisis affected the countries very differently; while Poland maintained positive rates of growth during the crisis, the Baltic countries experienced double-digit output declines in 2009. The period from 2010 has been a period of recovery, generally with positive but relatively low rates of growth in most of the CEE countries.

The business cycle developments in the 10 CEE countries have in large part been driven by demand factors aided by volatile external capital flows (Milesi-Ferretti (2012), Connolly (2012)). Capital inflows fuelled growth in the construction, real estate and retail sectors during the boom but to a varying degree across the countries. The global financial crisis meant a *sudden stop* in the capital inflows for many countries. The most dynamic sectors from the boom were hit hard by reduced demand and all the CEE countries except Poland experienced large output declines. The recovery starting from 2010 has been gradual in most countries due to the lack of demand from exports or domestic absorption.

The particular pattern of boom, bust and recovery together with the substantial variation across the 10 CEE countries makes it expedient to analyse developments at the sectoral level. Two main questions are analysed in this paper. First, to what extent did sectoral reallocation change over the business cycle from 2001 to 2012? Second, to what extent did the contribution of structural or sectoral change to aggregate productivity growth change over the business cycle?

The reallocation of labour across sectors may be driven by people moving into more productive sectors in search of higher pay, but it may also be due to shifts in the demand for the products of different sectors. The relative importance of supply and demand factors in the sectoral reallocation of labour may vary across the phases of the business cycle. It follows that the extent of sectoral reallocation and its contribution to growth over the business cycle are of major policy importance. A crisis may for instance have a “cleansing effect” if people who lose their jobs find new jobs in more productive sectors, but a

crisis may alternatively be aggravated if it leads to the reallocation of labour from productive to less productive sectors. Similar considerations apply to periods of boom and recovery.

The literature posits that structural change may be a significant source of economic growth, as labour in less productive sectors may be shifted to sectors with higher productivity (Maddison (1987)). This productivity enhancing reallocation was labelled a *structural bonus* by Baumol (1967). However, reallocations may also make a negative contribution to aggregate growth as economic branches with high productivity growth fail to maintain their share of employment and the labour reallocates toward sectors with low productivity causing a *structural burden*.

The importance of structural change and its contribution to aggregate growth has been examined in a number of studies. Most studies find that the growth of productivity within the different sectors (the "within effect") contributes much more to aggregate productivity growth than the productivity growth stemming from reallocation of labour between sectors (the "between effect").[1]

Only a few studies focus on the transition economies. Transition entails reorganisation of the economy and this may suggest that sectoral or structural change is particularly important for aggregate labour productivity growth in these countries, but this has not found very strong empirical support. Fagerberg (2000), Havlik (2005), Cörvers & Meriküll (2007), Memedovic & Iapadre (2009), Havlik et al. (2012) and Havlik (2013) have included transition economies in their samples. The analyses have usually shown that the within effect is dominating and that the reallocation effect is modest.

A small number of papers examine explicitly the pace of reallocation and its contribution to productivity growth across different stages of the business cycle and most use US manufacturing data. Davis & Haltiwanger (1990, 1999) and Barlevy (2003) have found that job reallocation in the US manufacturing sector is higher in recessions than in times of tranquillity or booms. The same conclusion is reached by Davis et al. (2012) and Foster et al. (2014) but not for the period after the outbreak of the global financial crisis. The upshot is that the recession after the crisis differs markedly from earlier

[1] The impact of structural reallocation on aggregate productivity has been examined by Olley and Pakes (1996) and Timmer and Szirmai (2000) for Asian economies, Carree (2003) for the OECD countries, Bartelsman et al. (2004) for several industrial and developing economies, Brown and Earle (2008) for the United Kingdom, Van Biesebroeck (2005) for seven African countries, Giannangeli and Gómez-Salvador (2008) for Belgium, Saccone and Valli (2009) comparing China and India, and Chansomphou and Ichihashi (2013) for the BRIC countries. Several papers have focused on examining the productivity gap between the USA and European countries in the light of structural change (Timmer et al. (2010), van Ark et al. (2012)).

downturns as there was no significant increase in reallocation and the reallocation that took place did not enhance productivity.

Havlik (2013) investigates the role of reallocation in productivity growth over the recent business cycle in the new EU economies. The paper uses broad sectoral categories and finds that the extent of labour reallocation is relatively stable in most of the countries and its contribution to aggregate growth is similarly little changed across the business cycle.

A large amount of reallocation during a downturn may have a "cleansing effect" if it leads to less productive jobs being destroyed and labour moving into more productive uses (Mortensen and Pissarides (1994)). In this case reallocation is counter-cyclical, meaning that high-productivity plants or sectors on average decrease their share of employment in upturns and increase it in downturns. Reallocation may alternatively have a pro-cyclical effect if more efficient production units are also more vulnerable to a downturn due to credit constraints or other factors (Barlevy (2003)).

Baily et al. (2001) find using US data that the productivity of the average plant exhibits greater pro-cyclicality than aggregate productivity does, and this suggests that reallocation may contribute more to aggregate productivity growth during crises than during other phases of the business cycle. This kind of cleansing effect has also been observed by Osotimehin and Pappada (2013). Griliches and Regev (1995) and Foster et al. (2001) find weak counter-cyclical effects, meaning that reallocation contributes to productivity growth only slightly more during times of recession than at other times. Bresnahan and Raff (1991) and Schuh and Triest (1998) did not find even a weak positive effect.

It is clear from the literature review that only a few studies consider the contribution of structural change to aggregate productivity growth at different stages of the business cycle. The global financial crisis has led to deep recessions in many countries and may also have impacted the extent of structural change and its contribution to productivity growth. The role of the global financial crisis in sectoral change and the contribution of sectoral change to aggregate growth remain largely unresolved.

This paper computes the extent of labour reallocation across broad sectors and its contribution to aggregate productivity growth in times of boom, bust and recovery in 10 CEE countries. For this purpose we calculate structural change indices similarly to Havlik (2013) and decompose labour productivity growth following Fagerberg (2000) and McMillan and Rodrik (2011).

The paper extends the analysis in Havlik (2013) by broadening the scope and by carrying out the analysis on an annual basis instead of over longer time periods. Sectoral reallocation is typically analysed over longer periods

so that the demand factors of the business cycle do not influence the results, but the present analysis considers changes from year to year specifically to ascertain the effect of the particular pattern of the business cycle on labour reallocation and its contribution to aggregate productivity growth. The approach makes it possible to determine the reallocation from year to year, while a longer time interval may lead to an underestimation of the extent of the reallocation as some back and forth movement between sectors is possible.

The rest of the paper is organised as follows. Section 2 introduces the data and gives a brief overview of the dynamics of employment and labour productivity in the CEE countries. Section 3 analyses the extent of sectoral change from year to year. Section 4 presents the methodology used for analysing the role of sectoral change in productivity growth using different decomposition methods. Section 5 shows the results of the decomposition analysis, showing the relevance of sectoral change for productivity growth. Section 6 presents the conclusions.

2. Data and aggregate statistics

2.1. Data

The dataset consists of 10 EU countries from Central and Eastern Europe, i.e. Bulgaria, the Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia and Slovenia. For each country data are available on employment and value added for the broad one-digit or "letter" sectors in the NACE Rev 2 classification; see Appendix A for a list of the sectors. There are initially 21 sectors. Sector U is excluded for all countries due to data availability, leaving 20 broad sectors, while sector T is excluded for some countries, leaving 19 broad sectors.

The data are from the ESA95 version of the National Accounts published by Eurostat. The data cover the period 2000–2012; the years before 2000 are not included because the focus of the analysis is on the periods of boom, bust and recovery in the CEE countries, but also because data for several of the sample countries are available only from 2000. The final year is 2012 since sectoral data on value added using the ESA95 methodology are generally not available beyond this year.

The employment variable is total employment (Eurostat 2015, code: *nama_nace21_e*). This measure includes both employees and self-employed people working in the sector. The measure does not differentiate between full-time and part-time employment, which are both counted as one unit. This

may be a problem if the share employed part-time changes or the number of hours worked changes substantially over time. We have therefore included robustness analyses using working hours instead of total employment for the countries for which such data are available.

Value added is defined as gross value added at basic prices in chain-linked volumes with the reference year 2005 (Eurostat 2015, code: *nama_nace21_k*).

2.2. Aggregate employment and productivity dynamics

As a background for the sectoral analyses in Sections 3 and 5, this subsection briefly presents the employment and productivity dynamics for the entire economy in the 10 CEE countries. Figure 1 shows the growth in total employment, where total employment is calculated as the sum of employment in the 19 or 20 sectors for which data are available.

During the boom in 2001–2007, overall employment was stable or growing in most of the countries. The pattern for Poland is striking as large declines in employment at the turn of the century are reversed from around 2004. The large employment decline in Romania in 2002 is in all likelihood a reflection of the somewhat uneven quality of the data observed for many data series for this country.

A slight decrease in employment growth figures can be observed from 2008 for most of the countries, as the global financial crisis was already felt at the end of the year. The years 2009–2010, however, stand out with large declines in economy-wide employment, but there is substantial heterogeneity across the sample countries. The employment declines in the Baltic States are extremely large, while other countries saw more moderate declines. For most of the countries the employment decline was the largest in 2009, but for Lithuania and Poland the decline was largest in 2010.

The employment situation stabilised from 2011 but it is notable that the growth rates of employment have been modest with the main exception being the large employment growth in Estonia in 2011. Countries like Bulgaria and Slovakia saw continued declines in employment. The recovery was generally not strong enough for employment levels to return to their pre-crisis values by 2012.

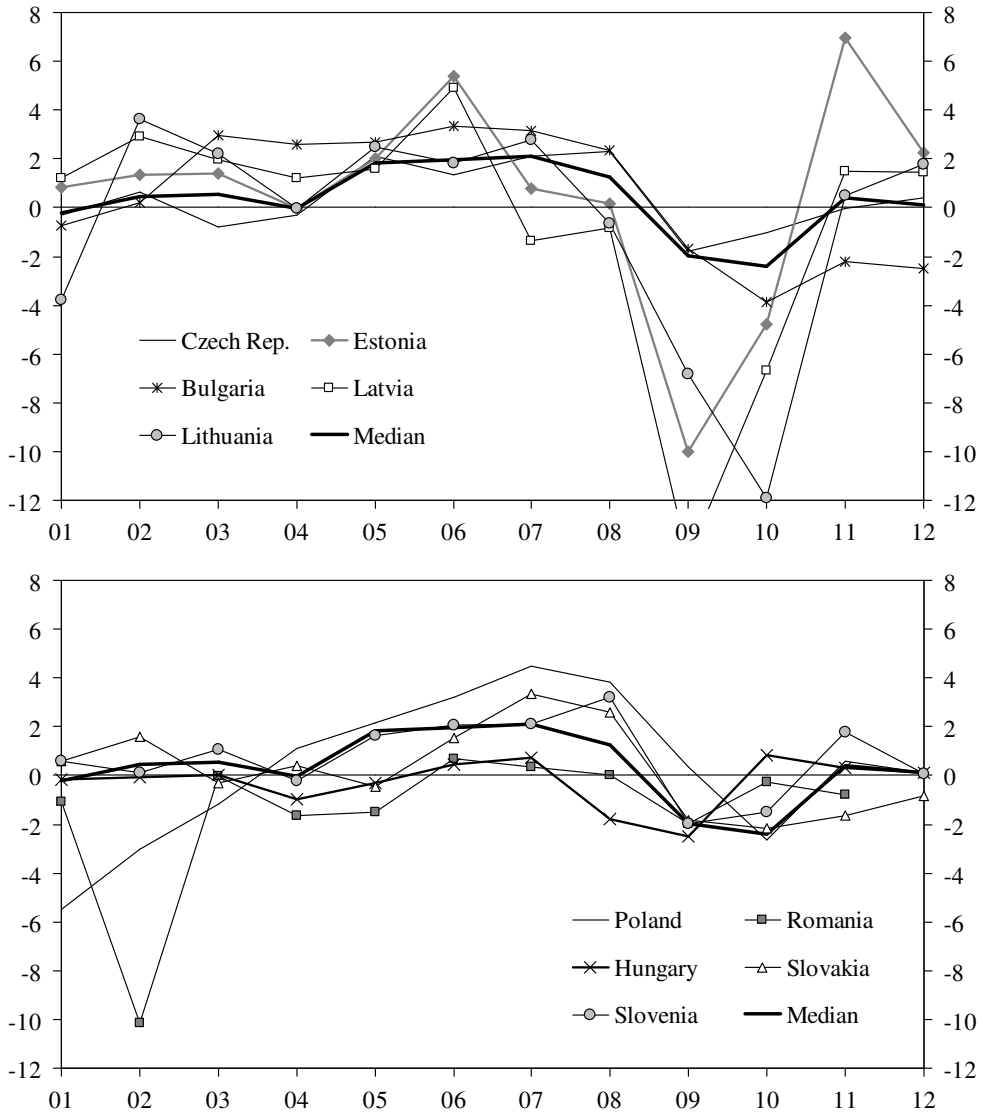

Figure 1: Growth rate of employment in the total economy for 10 CEE countries, 2001–2012, per cent per year

Source: Own calculations based on Eurostat (2015, code: *nama_nace21_e*).

Figure 2 shows the growth rate of labour productivity in the entire economy in the 10 CEE countries in 2001-2012. The aggregate productivity is computed as the weighted average over the productivity level of the sectors using total employment shares as weights.[2] Productivity in each sector is defined as the value of gross value added over total employment.

[2] The same sectors are used as in the calculations of employment growth; sector U is always excluded and sector T is excluded for the countries for which data are not available.

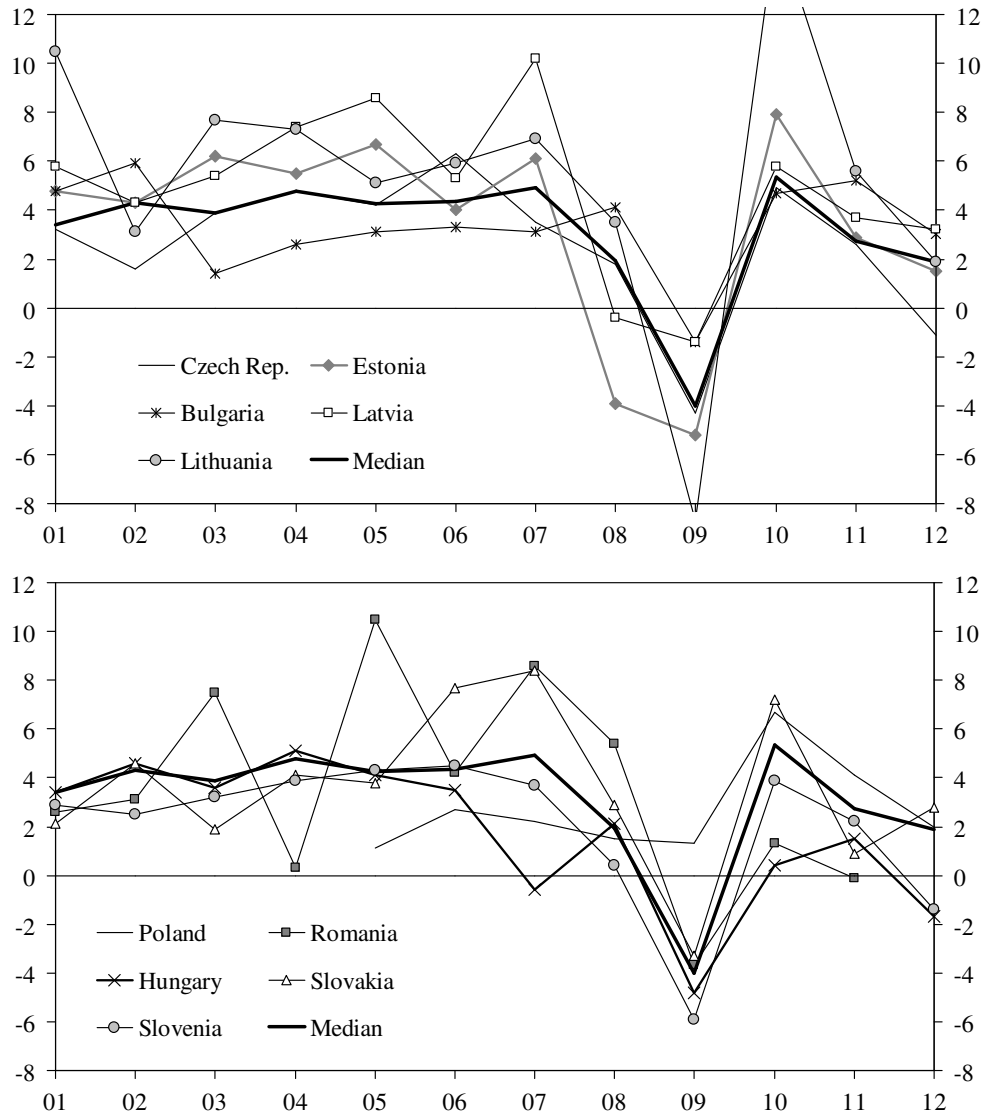

Figure 2: Growth rate of labour productivity in the total economy for 10 CEE countries, 2001–2012, per cent per year

Source: Own calculations based on Eurostat (2015, codes: *nama_nace21_k and nama_nace21_k*).

For most of the CEE countries, aggregate labour productivity grew steadily over the boom years 2001–2007. The median growth rate in the sample countries was around four per cent per year with a slight upward trend. The rates of productivity growth were particularly high in the Baltic States and in Romania and Slovakia towards the end of the boom phase. The large variability in the growth rate for Romania may be a sign of data reliability problems.

As with employment, some signs of crisis are already apparent in 2008 with the median productivity growth rate decreasing, though still positive. In 2009 the bottom of the business cycle was reached and labour productivity decreased in all the CEE countries except Poland; the decline was substantial in many countries.

The recovery period exhibited very high rates of productivity growth in 2010, essentially representing a bounce back from 2009 as the countries with the largest declines in 2009 typically saw the largest increases in 2010. The growth rates of labour productivity generally remained positive in 2011 and 2012.

Figures 1 and 2 make it clear that the pattern of boom, bust and recovery is clearly reflected in the growth rates of employment and aggregate labour productivity. There is, however, noticeable heterogeneity across the 10 CEE countries. Some, such as the Baltic States, saw a very pronounced pattern of boom, bust and recovery, while Poland saw a less pronounced pattern. The timing of the infliction points similarly varies across the countries.

3. Sectoral change

The structural change indicator (SCI) in Havlik (2013) provides an aggregate measure of the shifts in sectoral shares of employment or value added. The SCI is computed as the square root of the sum of squared changes in shares *weighted* by the initial shares. The indicator, measuring change from year to year, can be expressed as:

$$\mathrm{SCI}_t = \sqrt{\sum_i (\Delta s_{i,t})^2 (s_{i,t-1}/100)} \qquad (1)$$

Subscript i denotes the sector and subscript t the year. The term s_i is the percentage share of sector i in total employment or value added. The operator Δ denotes change in s_i in percentage points from year $t-1$ to year t. The SCI can take values from 0 to 100 and a higher value means more shifts in sectoral shares. The SCI is constructed for the purpose of comparison; a single value of the SCI without any comparison is not readily interpretable.

Table 1 shows the structural change index for employment shares for the 10 CEE countries for the years 2001–2012. Data are not available for Poland for 2001–2004 and for Romania in 2012. Sector A is excluded from the analysis for Romania as data for this sector exhibit unreasonable dynamics.[3]

[3] The Romanian data for sector A show for instance a decrease in the number of employed of 1.3 million or 28 per cent in 2002.

Table 1: Employment structural change index, 2001–2012

	BUL	CZE	EST	LAT	LIT	HUN	POL	ROM[a]	SVK	SLV	*Median*
2001	0.27	0.17	0.51	0.30	0.73	0.46	..	0.18	0.29	0.19	*0.30*
2002	0.18	0.22	0.54	0.41	0.69	0.14	..	0.61	0.53	0.57	*0.53*
2003	0.51	0.27	0.51	0.67	0.32	0.77	..	0.14	0.30	0.30	*0.50*
2004	0.45	0.24	0.70	0.53	1.01	0.41	..	0.54	0.29	0.20	*0.45*
2005	0.48	0.19	0.50	0.81	0.77	0.53	0.32	0.68	0.36	0.28	*0.49*
2006	0.50	0.17	0.92	0.34	0.98	0.15	0.68	0.72	0.29	0.45	*0.48*
2007	0.45	0.14	0.88	1.14	0.86	0.35	0.55	0.74	0.21	0.41	*0.44*
2008	0.34	0.20	0.59	0.34	0.82	0.41	0.35	0.88	0.19	0.45	*0.38*
2009	0.91	0.99	1.19	0.97	1.00	0.58	0.60	1.15	1.08	0.88	*0.94*
2010	0.43	0.30	0.70	0.54	0.63	0.29	0.34	0.64	0.27	0.49	*0.46*
2011	0.20	0.33	0.67	0.64	0.22	0.42	0.13	0.28	0.27	0.30	*0.32*
2012	0.33	0.13	0.62	0.42	0.23	0.31	0.16	..	0.18	0.19	*0.23*
Median	*0.44*	*0.21*	*0.65*	*0.54*	*0.75*	*0.41*	*0.35*	*0.86*	*0.29*	*0.36*	..

Notes: No data are available for Poland for 2001–2004 and for Romania for 2012. For individual countries SCI values in the interval 0.41–0.80 are indicated with light shading and SCI values above 0.81 with dark shading.
[a] Sector A is excluded from the analysis.

The development of the employment SCI over the 12 years from 2001 to 2012 reflects the whole the business cycle pattern for the period. The median SCI was around 0.5 in most years during the boom period, although larger in the CEE countries with the highest rates of economic growth. The median employment SCI was around 0.94 at the height of the crisis in 2009, clearly exceeding the median for any other year. The SCI for 2009 was either the highest or the second highest observed for all the sample countries, indicating that a lot of labour reallocation took place in the crisis year of 2009. The increase in the employment SCI in 2009 was the smallest for Poland and Hungary. It is notable that Poland was little affected by the global financial crisis and saw total employment increase in 2009. Finally, the median SCI fell markedly in 2010 and was around 0.3 in the last two years of the recovery for which data are available.

The results exhibit a pattern of substantial reallocation of employment across sectors during the boom, extreme reallocation at the peak of the crisis and very modest reallocation in the post-crisis recovery. The finding that there was more sectoral change in the CEE countries during the deep recession than in other phases of the business cycle is arguably the result of shifts in demand across sectors as the construction and financial sectors contracted while other sectors were faring better. In Baltic States and Hungary the construction sector experienced the largest declines in 2009, while in the Czech

Republic, Romania, Slovenia and Slovakia the manufacturing sector saw the largest declines. In 2010 construction continued to decline with double digits in Baltic States whereas in other CEE countries the decline was close to zero.

The substantial reallocation during the crisis is in contradiction to the results in Foster et al. (2014), who found that the intensity of reallocation in the US economy fell during the global financial crisis. It is notable that recessions in the CEE countries generally were deeper than in the USA after the global financial crisis. The result for the CEE countries is however in line with Davis and Haltiwanger (1990, 1999), who observed higher reallocation in US manufacturing during recessions before the global financial crisis.

Table 2 shows the sectoral change index for value added. The pattern is more or less the same as for the employment SCI. In almost all the countries the highest or second highest SCI for value added occurs in 2009. This once again shows that some sectors were hit much more severely by the crisis than others. Some sectors lost a large amount of their share of value added while some other sectors gained some share. The clearest difference between the employment and value added SCIs is that while the employment SCI figures went down in 2010, back to their 2008 levels, the value added SCI figures remained high in 2010 and in some cases even in 2011. So while most of the labour reallocation took place within one year in 2009, severe value added reallocation still continued in 2010.

Table 2: Value added structural change index, 2001–2012

	BUL	**CZE**	**EST**	**LAT**	**LIT**	**HUN**	**POL**	**ROM**[a]	**SVK**	**SLV**	***Median***
2001	0.47	0.33	0.52	0.36	0.62	0.28	..	0.98	1.02	0.24	*0.47*
2002	0.24	0.45	0.46	0.46	0.30	0.41	..	0.51	0.86	0.26	*0.45*
2003	0.57	0.18	0.31	0.42	0.42	0.49	..	0.26	1.22	0.33	*0.42*
2004	0.48	0.55	0.39	0.34	0.46	0.36	..	0.62	1.33	0.17	*0.46*
2005	0.71	1.35	0.43	0.60	0.34	0.27	0.16	0.96	0.87	0.15	*0.52*
2006	0.36	1.27	0.38	0.83	0.51	0.34	0.75	0.58	0.72	0.24	*0.55*
2007	1.07	0.34	0.22	0.46	0.73	0.76	0.59	0.90	0.34	0.28	*0.53*
2008	0.90	1.04	0.82	0.68	0.19	0.46	0.31	0.92	0.49	0.34	*0.59*
2009	0.70	1.70	1.17	1.47	1.46	1.52	0.53	0.52	1.34	1.16	*1.26*
2010	0.91	1.17	1.35	0.98	0.71	1.17	0.39	0.82	2.07	0.71	*0.95*
2011	0.73	0.99	0.74	0.47	0.48	0.16	0.73	1.27	0.57	0.33	*0.65*
2012	0.43	0.21	0.58	0.36	0.37	0.23	0.13	..	0.35	1.68	*0.36*
Median	*0.64*	*0.77*	*0.49*	*0.47*	*0.47*	*0.39*	*0.46*	*0.82*	*0.87*	*0.31*	..

Notes: No data are available for Poland for 2001–2004 and for Romania for 2012. For individual countries SCI values in the interval 0.41–0.80 are indicated with light shading and SCI values above 0.81 with dark shading.

[a] Sector A is excluded from the analysis.

Tables 1 and 2 reveal a substantial increase in sectoral reallocation during the deepest crisis in 2009, while Havlik (2013) and Foster et al. (2014) do not find a similar increase in reallocation after the global financial crisis. The difference is in all likelihood due to those studies analysing change over periods of several years, which may see sectors contracting and subsequently reverting, while we consider change from year to year.[4] An analysis of reallocation year by year can thus provide information on sectoral reallocation that remains disguised when longer time periods are considered.

In the study by Havlik (2013) there seems to be a pattern that structural change is more pronounced in employment than in value added. In our study there is no such pattern. The results for individual countries in Havlik (2013) and this study are quite similar, with Romania and Bulgaria seeing the most structural change and Estonia and Hungary the least. There are, however, also differences as Havlik (2013) finds that the Czech Republic is the country with the most stable value added structure, while we find a lot of structural change. The reason is again that Havlik considers longer time periods, while we consider each year separately.

The results in Tables 1 and 2 are largely consistent with business cycle developments during the years 2001 to 2012 (Milesi-Ferretti (2012), Connolly (2012)). The boom was characterised by some structural change as resources were gradually moved into construction, trade and finance: This process was reversed abruptly in 2009 as all three sectors came under severe pressure. Very little sectoral change was found for the period 2010–2012, essentially reflecting the sluggish recovery in the region and an absence of sectors exhibiting notable dynamic developments.

4. Decomposition methodology

This section presents the methodology used to compute the contribution of sectoral change to aggregate productivity growth. We apply shift-share analysis for the decomposition of aggregate productivity growth into the contribution from within the sector and changes from the sectoral composition in the economy.

Aggregate productivity P_t is the share-weighted mean of the productivity of the individual sectors:

[4] Beyond the analysis on an annual basis, we also examined longer time periods, distinguishing between the boom period 2000–2007, the bust period 2008–2009 and the recovery period 2010–2012 (results available upon request). In this analysis the bust period does not stand out as clearly as in the analysis where the SCI is calculated for every year.

$$P_t = \sum_i s_{i,t} p_{i,t} \tag{2}$$

The share of sector i employment in total employment is $s_{i,t}$ and $p_{i,t}$ is the productivity of sector i, i.e. gross value added per person employed as defined in Subsection 2.1. We use labour productivity and not total factor productivity due to the difficulties of computing a reliable measure of total factor productivity; the same argument is used by Fagerberg (2000), Bartelsman et al. (2004) and Foster et al. (2001). Total employment is used instead of working hours due to data availability, but robustness checks are provided for the countries for which the working hours are available.

By tracking the productivity levels of individual sectors and the corresponding employment shares over time, the change in share-weighted total productivity can be decomposed into two or more components. We use decompositions proposed by McMillan and Rodrik (2011) and Fagerberg (2000) to find the contribution of sectoral labour reallocation to aggregate productivity growth.

The decomposition method applied by McMillan and Rodrik (2011) and McMillan et al. (2014) is the sectoral level equivalent of the plant level method used by Baily et al. (1992) in their seminal study. When applied to annual changes the McMillan and Rodrik (2011) decomposition can be expressed as follows:

$$\frac{\Delta P_t}{P_{t-1}} = \frac{\sum_i s_{i,t-1} \Delta p_{i,t}}{P_{t-1}} + \frac{\sum_i p_{i,t} \Delta s_{i,t}}{P_{t-1}} \tag{3}$$

The operator Δ denotes the change in productivity or employment share from year $t-1$ to year t. The first component on the right hand side in equation 3 is referred to as the "MR within effect" and it captures the share of aggregate productivity growth stemming from growth within the sectors. Using an analogue from index theory, this effect shows the sum of productivity changes over sectors when the employment shares are held constant. The second component is called the "MR between effect" and it captures the share of aggregate productivity growth stemming from changing labour shares weighted by the productivity of each sector in the same year, hence capturing the contribution of the labour reallocation between the sectors. This effect can be thought of as the sum of employment share changes over sectors when the productivity of each sector is held constant.

Our second decomposition method comes from Fagerberg (2000) and Timmer and Szirmai (2000), which is the sectoral level analogue to the

methodology used by Foster et al. (2001) for plant level analysis. This approach has been used frequently, e.g. by de Vries et al. (2012), Havlik (2013) and others. In this decomposition, referred to as the Fagerberg or F decomposition, productivity growth is divided into three components instead of two:

$$\frac{\Delta P_t}{P_{t-1}} = \frac{\sum_i s_{i,t-1}\Delta p_{i,t}}{P_{t-1}} + \frac{\sum_i p_{i,t-1}\Delta s_{i,t}}{P_{t-1}} + \frac{\sum_i \Delta p_{i,t}\Delta s_{i,t}}{P_{t-1}} \quad (4)$$

The first term on the right hand side is the F within effect which is the same as the MR within effect. The second term represents Fagerberg's static effect, the F between static effect, and it is calculated by summing the changes in employment shares over all sectors, weighted by the relative productivity of the sectors in the previous year. The effect is positive if sectors with an initially high level of labour productivity increase their share in total employment, i.e. if labour has shifted from lower to higher productivity sectors. The third term represents Fagerberg's dynamic effect, the F between dynamic effect, which is an interaction or covariance term that is calculated as the sum of pairwise changes of employment shares and relative labour productivity in individual sectors. The effect is positive if sectors with growing productivity increase their share in total employment and negative if sectors with growing productivity do not maintain their share in total employment.

The within effect is per definition the same in the two decomposition methods. The only difference refers to the between effect, which in the decomposition in Fagerberg (2000) is divided into two counterparts, the sum of which equals the between effect in McMillan and Rodrik (2011). We include both methods to see whether Fagerberg's method, which distinguishes between different sources of structural change, provides additional insights. The length of the time series warrants attention; rather than analysing longer-term structural change and its contribution to productivity growth, we investigate the effect of short-term sectoral changes to ascertain the role of the business cycle.

5. Decomposition results

This section presents the results when the different shift-share decomposition methods discussed in the previous section are applied to the sample of 10 CEE countries. The large number of countries complicates the presentation of the results. To obtain an overall picture of the decomposition results, we start

by averaging the results across the sample countries and then present the results for individual countries.

5.1. Average effects

Table 3 shows the results of the labour productivity decomposition averaged over the sample countries for which data are available in any given year. *Productivity change* is the percentage change in aggregate labour productivity compared to the previous year. *MR/F within* shows what the aggregate productivity change would have been if no reallocation of employment across sectors had taken place (the within effect, cf. equations 2 and 3). *MR between* shows what the aggregate productivity change would have been with no productivity change inside sectors, i.e. how much can be attributed to the reallocation (the between effect, cf. equation 2). The sum of *MR/F within* and *MR between* is the aggregate productivity change although small differences may occur due to rounding. The decomposition into *F between static* and *F between dynamic* effects provides a more detailed picture of the contribution of labour reallocation to aggregate productivity growth. Their sum is equal to MR between although small differences may occur due to rounding.[5]

Table 3: Decomposition of labour productivity growth, unweighted averages over 10 CEE countries

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	4.5	3.8	4.5	4.6	5.2	4.7	5.2	1.7	−3.7	5.8	2.9	1.1
MR/F within	4.6	3.2	4.5	4.6	4.4	4.1	4.5	1.4	−3.8	5.7	2.8	1.2
MR between	−0.2	0.6	0.0	0.0	0.7	0.6	0.7	0.4	0.0	0.2	0.1	−0.1
F between static	0.2	1.4	0.4	0.4	0.9	1.0	1.0	0.8	0.2	0.5	0.3	0.0
F between dynamic	−0.3	−0.8	−0.4	−0.3	−0.2	−0.3	−0.4	−0.5	−0.1	−0.2	−0.2	−0.1

Note: Productivity change in per cent, other measures in percentage points. No data are available for Poland for 2001–2004 and for Romania for 2012.

During the economic boom in 2001–2007 the average annual productivity growth across the sample countries was four to five per cent per year. In 2008 the average productivity growth was less than two per cent and in 2009 at the depth of the crisis, the average productivity growth was clearly negative. The recovery from the crisis is visible as average productivity growth bounced

[5] The F between static effect is positive if labour shifts from lower to higher productivity industries and the F between dynamic effect is positive if labour has shifted towards sectors with growing labour productivity.

back in 2010 and remained positive in 2011 and 2012 although at a lower level than during the boom.

The decompositions reveal that the within effect dominates over the between effect over the entire business cycle. In most years the average within effect accounts for most of the productivity change, and the between effect from reallocation of labour is modest in most cases. The between effect is very small in the beginning of the boom phase but reached its highest levels of 0.6–0.7 percentage points in 2005–2007. This suggests indeed the presence of a modest structural bonus from the rapid reallocation of employment resources at the height of the boom. The average between effect during the crisis in 2008–2009 was very small, which suggests that no cleansing effect of the crisis can be observed. Finally, the between effect is also negligible during the recovery phase 2010–2012, which may be consistent with the modest rates of structural change in this period.

Fagerberg's decomposition reveals that there has on average been some, although very little, movement into the sectors with higher initial productivity levels as indicated by positive values for F between static. This holds for all phases of the business cycle and is particularly prevalent during the later stage of the boom in 2005–2007. The finding supports the structural bonus hypothesis (Baumol (1967), Timmer and Szirmai (2000)). On the other hand, sectors with faster productivity growth over the year have on average had a declining employment share as indicated by the negative values for F between dynamic. This again is true for the boom, as well as for the bust and the recovery phase of the business cycle. The latter finding is in accordance with the structural burden hypothesis. The hypotheses have previously found supporting evidence in studies of relatively long time periods, but this evidence is corroborated in this analysis of sectoral change from year to year.

5.2. Individual countries

The decomposition results are quite similar across the 10 CEE countries in spite of their very different aggregate developments. Table B.1 in Appendix B shows the results for the countries individually. The growth rates of labour productivity vary substantially across the countries, but in almost all cases most of the productivity change comes from the within effect. The between effect for most countries remains close to zero over the time sample and usually consists of positive static and negative dynamic sectoral change effects.[6] As the between effect did not increase in hardly any of the countries during

[6] Bulgaria and Slovenia may be considered unusual, as the between effect is never negative in these countries and the static effect is always positive in all the sample years.

the crisis years, with the slight exception of Latvia, no cleansing effect can be observed.

The similarity of the results of the decomposition analyses may be illustrated by a comparison of the results for Lithuania and Hungary, the countries with the highest and the lowest aggregate productivity growth over the sample period. Table 4 shows the decomposition results for Lithuania and Table 5 the decomposition results for Hungary.

Table 4: Decomposition of labour productivity growth, Lithuania

Lithuania	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	10.5	3.1	7.7	7.3	5.1	5.9	6.9	3.5	−8.7	15.6	5.6	1.9
MR/F within	11.4	0.2	9.7	6.7	3.1	3.2	6.8	2.0	−8.1	14.9	5.2	1.5
MR between	−0.9	2.9	−2.0	0.6	2.0	2.6	0.2	1.5	−0.6	0.7	0.4	0.4
F between static	−0.2	7.2	−1.3	1.3	2.6	3.3	1.1	2.8	−0.9	1.4	0.7	0.6
F between dynamic	−0.7	−4.3	−0.7	−0.7	−0.7	−0.6	−0.9	−1.4	0.3	−0.7	−0.3	−0.2

Note: Productivity change in per cent, other measures in percentage points.

Table 5: Decomposition of labour productivity growth, Hungary

Hungary	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	3.4	4.6	3.6	5.1	4.1	3.5	−0.6	2.1	−4.8	0.4	1.5	−1.7
MR/F within	2.4	4.3	3.7	4.3	3.9	2.7	−1.0	0.9	−4.5	0.8	2.0	−1.2
MR between	1.0	0.2	−0.1	0.8	0.2	0.8	0.4	1.2	−0.2	−0.4	−0.5	−0.4
F between static	1.2	0.2	0.6	1.2	0.3	0.9	0.6	1.7	−0.1	−0.2	−0.2	−0.3
F between dynamic	−0.2	0.0	−0.7	−0.4	−0.1	−0.1	−0.2	−0.6	−0.2	−0.3	−0.2	−0.1

Note: Productivity change in per cent, other measures in percentage points.

The within effect clearly dominates in both countries in most years, while the between effect from sectoral reallocation is small over the entire period. Reallocation had a slight productivity-enhancing effect during the boom, while its effect on productivity was negative during the deepest crisis year 2009. The recovery period has not seen between effects as productivity enhancing as they were during the boom and for Hungary the structural change effects have remained negative. In sum, even if the aggregate productivity developments vary substantially across countries, the contributions from different sources are fairly similar.

5.3. Discussion

As a robustness analysis we produced the decomposition using working hours instead of total employment, which was possible for nine countries but not Hungary due to data availability. The results are shown in Table C.1 in Appendix C. For the boom and the recovery the results for both methods are very similar. During the crisis the productivity growth is higher when working hours are used as the employment variable instead of total employment. This signifies that the working hours of many employed people were reduced due to the recession, which signifies that the adjustment to the crisis occurred via both the hours and the number of employed. It is notable, however, that the relative importance of the within and the between effects in any case is close to that found in the baseline analysis.

The findings in this section generally align with the previous literature, but several new insights are evident. Our finding that the within effect is much more important than the structural change effect is also found in most papers within the field; see e.g. Timmer and Szirmai (2000), Havlik (2013) and McMillan and Rodrik (2011). It is often presumed that reallocation and the impact of structural change are particularly important for transition economies (Foster et al. (2001)), but our study shows that the reallocation effects are quite modest at best.

Our findings are in line with those of Davis and Haltiwanger (1990), showing that job reallocation is higher in times of recession. However, this intensified reallocation seems to have nothing to do with the cleansing effect, as was suggested by Mortensen and Pissarides (1994). It was not only less productive jobs that were destroyed after the global financial crisis as employment seems to have reallocated to both more and less productive sectors. Bresnahan and Raff (1991) and Schuh and Triest (1998) have come to the same conclusion by investigating some earlier crisis episodes.

6. Final comments

This paper assesses the extent of sectoral change and its importance for aggregate labour productivity growth in 10 EU countries from Central and Eastern Europe during times of boom, bust and recovery over the years 2001–2012. The extent of sectoral change is computed for both employment and value added. The contribution of sectoral reallocation of employment to aggregate productivity growth is computed using the decomposition methods of McMillan and Rodrik (2011) and Fagerberg (2000). The main contribution of the paper is the use of annual data, which allows a detailed analysis of the

extent of sectoral change and its contribution to aggregate labour productivity growth at the business cycle frequency.

The empirical analysis provides several conclusions. The countries with the largest changes in their employment structure over the years 2001–2012 are the Baltic States and Romania followed by Bulgaria and Hungary, which are the countries in the sample with relatively low GDP per capita. The reallocation of labour across sectors was substantial in all countries during the boom, very extensive at the depth of the crisis in 2009 and modest in the subsequent recovery period.

The countries with the greatest sectoral change in value added over the years 2001–2012 are the Czech Republic, Slovakia and Romania. It is notable that there is little overlap between the group of countries with substantial sectoral change in employment and those with substantial sectoral change in value added, a feature resulting from the very different labour productivity growth across different sectors and different courses. The sectoral change in value added exhibits a similar pattern over time to that of the sectoral change in employment, though the decline in reallocation is less prevalent in the recovery period from 2010.

In terms of the contribution of sectoral change to aggregate productivity growth, the growth of productivity within sectors ("the within effect") clearly dominates over the growth of productivity stemming from the reallocation of labour between different sectors ("the between effect"). The upshot is that despite the large amount of sectoral change in the Central and Eastern European countries since 2001, sectoral reallocation has not led to substantial productivity gains. This applies for all the years within the sample 2001–2012, but less so during the height of the boom in 2005–2007 when the between effect was evident although still relatively modest. It is notable that the between effect was very small for most countries during the height of the crisis in 2009. The global financial crisis did not lead to a reallocation of labour from less to more productive sectors, so there is no indication of a "cleansing effect" of the crisis.

Some additional dynamics are revealed when the decomposition distinguishes between three components. The results of Fagerberg's decomposition support simultaneously the hypothesis of a structural bonus and the hypothesis of a structural burden. In most of the CEE countries there has been some labour transfer into sectors with relatively higher initial productivity, whereas sectors with faster productivity growth over the year have on average seen lower employment shares. Nevertheless, given the relatively small size of the sectoral change effects, the contributions from the structural bonus and the structural burden are indeed very modest.

The main contribution of this paper is the analysis of the extent of sectoral change and its contribution to productivity growth using annual data. Analyses using longer time intervals are unable to capture changes in sectoral shares at the business cycle frequency, especially during episodes of boom and bust where changes in opposite directions may cancel each other out. The results in this paper show clear connections between business cycle developments at the aggregate level, aggregate labour productivity growth and the extent of sectoral change. A deeper analysis of these connections using additional data and econometric methods would undoubtedly reveal interesting results. This avenue of inquiry is left for future research.

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Appendix A

Table A.1: List of NACE Rev 2 main categories

Code	Sector description
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air-conditioning supply
E	Water supply, sewerage, waste management and remediation
F	Construction
G	Wholesale and retail trade, repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technological activities
N	Administrative and support service activities
O	Public administration and defence. Compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other services
T	Activities of households as employers and for own use
U	Activities of extraterritorial organisations and bodies

Appendix B

Table B.1: Decomposition of labour productivity growth, 10 CEE countries

Bulgaria	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	4.8	5.9	1.4	2.6	3.1	3.3	3.1	4.1	–1.4	4.7	5.2	3.0
MR/F within	3.6	5.8	1.1	1.4	2.0	1.9	1.4	3.8	–2.6	2.5	4.5	3.0
MR between	1.2	0.1	0.3	1.2	1.2	1.3	1.8	0.3	1.2	2.3	0.7	0.0
F between static	1.4	0.3	0.7	1.3	1.1	1.4	1.7	0.8	1.5	2.5	0.8	0.1
F between dynamic	–0.1	–0.1	–0.4	0.1	–0.1	0.1	–0.6	–0.2	–0.2	–0.1	–0.1	–0.2

Czech Republic	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	3.2	1.6	3.9	4.8	4.2	6.3	3.5	1.8	–4.3	4.9	2.6	–1.1
MR/F within	3.8	0.9	4.2	5.2	3.6	6.0	3.2	1.8	–4.0	5.1	3.0	–1.5
MR between	–0.5	0.7	–0.4	–0.4	0.7	0.2	0.3	0.0	–0.3	–0.2	–0.4	0.4
F between static	–0.4	0.8	–0.2	–0.4	0.6	0.3	0.3	0.1	–0.4	–0.2	–0.4	0.4
F between dynamic	–0.2	–0.1	–0.1	–0.1	0.0	–0.1	0.0	–0.1	0.0	–0.1	0.0	0.0

Estonia	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	4.8	4.3	6.2	5.5	6.7	4.0	6.1	–3.9	–5.2	7.9	2.9	1.5
MR/F within	6.7	3.0	7.5	7.6	6.4	5.4	6.9	–5.0	–5.8	7.2	1.9	1.5
MR between	–2.0	1.2	–1.3	–2.1	0.3	–1.3	–0.8	1.2	0.6	0.6	1.0	0.0
F between static	–0.9	2.6	–0.3	–0.7	1.0	–0.1	0.3	1.7	0.7	1.7	1.7	0.2
F between dynamic	–1.0	–1.4	–1.0	–1.4	–0.7	–1.3	–1.1	–0.6	–0.1	–1.0	–0.7	–0.2

Latvia	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	5.8	4.3	5.4	7.4	8.6	5.3	10.2	–0.4	–1.4	5.8	3.7	3.2
MR/F within	7.2	4.2	4.8	7.4	7.4	4.5	7.6	–0.9	–1.8	5.5	4.3	4.2
MR between	–1.4	0.1	0.7	0.0	1.1	0.9	2.6	0.6	0.4	0.3	–0.6	–1.0
F between static	–0.8	0.3	0.9	0.3	1.2	0.9	3.3	0.9	0.4	0.2	–0.4	–0.6
F between dynamic	–0.6	–0.2	–0.2	–0.2	0.0	–0.1	–0.7	–0.4	0.0	0.1	–0.2	–0.4

Lithuania	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	10.5	3.1	7.7	7.3	5.1	5.9	6.9	3.5	–8.7	15.6	5.6	1.9
MR/F within	11.4	0.2	9.7	6.7	3.1	3.2	6.8	2.0	–8.1	14.9	5.2	1.5
MR between	–0.9	2.9	–2.0	0.6	2.0	2.6	0.2	1.5	–0.6	0.7	0.4	0.4
F between static	–0.2	7.2	–1.3	1.3	2.6	3.3	1.1	2.8	–0.9	1.4	0.7	0.6
F between dynamic	–0.7	–4.3	–0.7	–0.7	–0.7	–0.6	–0.9	–1.4	0.3	–0.7	–0.3	–0.2

Hungary	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Productivity change	3.4	4.6	3.6	5.1	4.1	3.5	–0.6	2.1	–4.8	0.4	1.5	–1.7
MR/F within	2.4	4.3	3.7	4.3	3.9	2.7	–1.0	0.9	–4.5	0.8	2.0	–1.2
MR between	1.0	0.2	–0.1	0.8	0.2	0.8	0.4	1.2	–0.2	–0.4	–0.5	–0.4
F between static	1.2	0.2	0.6	1.2	0.3	0.9	0.6	1.7	–0.1	–0.2	–0.2	–0.3
F between dynamic	–0.2	0.0	–0.7	–0.4	–0.1	–0.1	–0.2	–0.6	–0.2	–0.3	–0.2	–0.1

Poland	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Productivity change	..	..	..	..	1.1	2.7	2.2	1.5	1.3	6.7	4.1	2.0
MR/F within	..	..	..	..	1.2	2.1	0.6	1.2	0.3	6.4	4.0	2.1
MR between	..	..	..	..	–0.1	0.6	1.6	0.3	1.0	0.3	0.1	–0.2
F between static	..	..	..	..	0.0	0.9	1.9	0.5	1.4	0.5	0.1	0.0
F between dynamic	..	..	..	..	–0.1	–0.2	–0.2	–0.3	–0.4	–0.2	0.0	–0.1

Romania	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Productivity change	2.6	3.1	7.5	0.3	10.5	4.2	8.6	5.4	–3.7	1.3	–0.1	..
MR/F within	2.6	3.0	5.9	–0.1	10.4	4.1	8.3	6.4	–1.6	3.6	0.2	..
MR between	0.1	0.1	1.6	0.3	0.1	0.0	0.4	–1.0	–2.1	–2.4	–0.2	..
F between static	0.1	0.2	1.8	0.6	0.2	0.8	0.5	–0.7	–0.9	–1.4	–0.4	..
F between dynamic	0.0	–0.1	–0.2	–0.3	–0.1	–0.8	–0.1	–0.3	–1.2	–0.9	0.2	..

Slovakia	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Productivity change	2.1	4.6	1.9	4.1	3.8	7.7	8.4	2.9	–3.3	7.2	0.9	2.8
MR/F within	2.3	5.7	1.8	4.7	3.1	7.5	8.6	4.0	–2.9	7.1	0.5	2.9
MR between	–0.2	–1.2	0.2	–0.5	0.7	0.2	–0.2	–1.1	–0.4	0.1	0.4	–0.1
F between static	–0.2	–0.9	0.5	–0.4	0.9	0.4	0.1	–0.9	–0.4	0.3	0.5	–0.1
F between dynamic	0.0	–0.2	–0.4	–0.1	–0.1	–0.1	–0.3	–0.2	0.1	–0.2	–0.1	0.0

Slovenia	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Productivity change	2.9	2.5	3.2	3.9	4.3	4.5	3.7	0.4	–5.9	3.9	2.2	–1.4
MR/F within	1.6	1.2	2.2	3.8	3.2	3.6	3.0	–0.5	–6.5	3.6	2.0	–1.4
MR between	1.3	1.3	1.0	0.1	1.1	0.9	0.7	0.9	0.6	0.2	0.2	0.0
F between static	1.4	2.0	1.1	0.2	1.1	1.0	0.8	1.0	0.6	0.3	0.2	0.1
F between dynamic	–0.1	–0.7	–0.1	0.0	–0.1	–0.1	–0.1	0.0	–0.1	0.0	0.0	–0.1

Note: Productivity change in per cent, other measures in percentage points. No data are available for Poland for 2001–2004 and for Romania for 2012.

Appendix C

Table C.1: Labour productivity growth decomposition, working hours, nine CEE countries

Bulgaria	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	4.1	5.9	2.0	1.2	3.4	3.5	3.1	1.7	1.4	4.8	5.3	2.9
MR/F within	3.0	5.4	2.8	–0.2	2.5	2.6	1.6	1.4	0.3	2.5	4.5	2.9
MR between	1.1	0.6	–0.8	1.4	0.9	0.9	1.5	0.2	1.2	2.4	0.8	0.0
F between static	1.3	0.7	–0.3	1.5	0.9	1.0	1.5	1.1	1.5	2.6	0.9	0.1
F between dynamic	–0.2	–0.1	–0.5	–0.1	0.0	–0.1	0.1	–0.9	–0.4	–0.2	–0.1	–0.1

Czech Republic	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	7.6	1.7	4.4	4.1	4.3	7.4	4.3	1.4	–3.1	3.0	2.6	–0.6
MR/F within	8.2	0.9	4.8	4.6	3.5	7.1	3.9	1.5	–2.7	3.0	3.1	–1.2
MR between	–0.6	0.8	–0.4	–0.5	0.8	0.2	0.4	–0.1	–0.5	0.0	–0.5	0.6
F between static	–0.4	0.9	–0.3	–0.4	0.8	0.3	0.4	0.0	–0.4	0.0	–0.5	0.6
F between dynamic	–0.2	–0.1	–0.1	–0.1	0.0	–0.1	0.0	–0.1	0.0	0.0	0.0	0.0

Estonia	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	5.2	4.1	6.0	4.9	5.9	4.5	6.3	–2.4	1.8	5.2	0.5	3.3
MR/F within	6.4	2.0	8.6	7.8	5.2	5.8	7.7	–3.9	1.0	4.9	–0.1	4.1
MR between	–1.2	2.1	–2.5	–3.0	0.7	–1.3	–1.4	1.6	0.8	0.3	0.6	–0.7
F between static	–0.4	3.9	–1.2	–1.2	1.4	0.1	–0.3	2.3	1.0	1.0	1.4	–0.5
F between dynamic	–0.7	– 1.8	–1.4	–1.8	–0.7	–1.4	–1.1	–0.7	–0.2	–0.7	–0.8	–0.3

Latvia	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	6.3	6.4	6.1	9.3	6.7	5.7	17.7	–0.5	1.2	6.8	2.8	4.2
MR/F within	8.3	5.7	6.0	9.3	5.4	5.7	16.9	–1.7	–0.2	6.4	3.8	5.2
MR between	–2.0	0.7	0.2	–0.1	1.4	0.0	0.8	1.2	1.3	0.4	–0.9	–1.0
F between static	–1.2	0.9	0.6	0.1	1.4	0.1	2.2	2.0	1.7	0.3	–0.6	–0.6
F between dynamic	–0.9	–0.3	–0.4	–0.2	0.0	–0.2	–1.4	–0.8	–0.4	0.1	–0.3	–0.4

Lithuania	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	11.6	4.8	8.8	5.8	1.8	6.5	5.8	1.9	–6.7	14.3	7.2	2.0
MR/F within	12.6	1.7	10.5	5.2	0.8	4.0	6.0	1.3	–7.0	13.7	7.1	1.0
MR between	–1.1	3.1	–1.7	0.6	0.9	2.5	–0.2	0.5	0.3	0.6	0.1	1.0
F between static	–0.6	7.1	–1.1	1.3	1.6	3.0	0.8	1.6	0.2	1.1	0.3	1.2
F between dynamic	–0.5	–4.1	–0.6	–0.8	–0.7	–0.5	–0.9	–1.1	0.1	–0.5	–0.2	–0.3

Poland	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	..	..	..	..	1.3	2.6	2.4	1.9	2.1	7.0	4.4	2.2
MR/F within	..	..	..	..	1.5	1.9	1.2	2.0	1.2	6.7	4.5	2.7
MR between	..	..	..	..	–0.1	0.7	1.2	–0.1	0.9	0.3	–0.1	–0.5
F between static	..	..	..	..	0.0	0.9	1.3	0.1	1.3	0.5	–0.1	–0.3
F between dynamic	..	..	..	..	–0.1	–0.2	–0.1	–0.2	–0.4	–0.2	0.0	–0.2

Romania	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	6.3	16.6	7.0	9.4	5.3	6.2	6.1	8.0	–3.6	–0.9	1.5	..
MR/F within	5.4	6.6	5.7	4.8	6.7	4.9	5.7	7.6	–0.7	3.2	–0.7	..
MR between	1.0	9.9	1.3	4.6	–1.5	1.3	0.4	0.4	–2.9	–4.1	2.2	..
F between static	1.0	10.4	1.4	5.5	–1.0	1.9	0.5	0.7	–1.6	–3.0	2.3	..
F between dynamic	0.0	–0.5	–0.2	–0.9	–0.4	–0.6	–0.1	–0.3	–1.3	–1.0	–0.1	..

Slovakia	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	2.9	1.6	3.1	2.7	8.5	10.2	7.9	2.6	2.8	7.2	5.9	5.1
MR/F within	1.2	0.2	1.7	2.0	7.6	9.2	7.5	2.1	3.0	6.8	6.0	5.6
MR between	1.8	1.4	1.5	0.7	0.9	0.9	0.4	0.5	–0.2	0.4	–0.1	–0.5
F between static	2.0	1.9	1.9	0.9	0.9	1.0	0.5	0.6	–0.1	0.5	0.0	–0.3
F between dynamic	–0.2	–0.5	–0.4	–0.2	–0.1	0.0	–0.1	–0.1	–0.1	0.0	–0.1	–0.1

Slovenia	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Productivity change	3.7	6.8	5.3	1.9	0.6	3.6	3.9	–0.4	–5.1	1.6	–0.4	–2.0
MR/F within	3.6	8.0	4.1	2.5	–0.1	3.5	3.4	0.8	–4.9	0.8	–1.1	–2.3
MR between	0.1	–1.3	1.1	–0.6	0.7	0.1	0.5	–1.2	–0.2	0.8	0.7	0.3
F between static	0.1	–0.9	1.3	–0.3	1.0	0.2	0.7	–0.8	–0.1	0.9	0.8	0.4
F between dynamic	0.0	–0.4	–0.1	–0.3	–0.4	–0.1	–0.1	–0.4	–0.2	–0.1	–0.1	–0.1

Note: Productivity change in per cent, other measures in percentage points. No data are available for Poland for 2001–2004 and for Romania for 2012. For Hungary no data on working hours are available.

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No 1
Lenno Uusküla. Firm Turnover and Inflation Dynamics