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Structural growth of employment in Europe

Balancing Absolute and Relative Trends

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Content

1	Introduction	1
2	Facing the problem	1
3	The development of a structural growth index.....	4
3.1	Small and large countries.....	4
3.2	Relative and absolute trends.....	4
3.3	Small and large sectors.....	6
3.4	Extending the formula	7
4	Structural growth in Europe between 2000 and 2007.....	8
5	Conclusions	9
6	Bibliography	11
7	Appendix.....	12

List of Tables

Table 1:	Relative growth of employment (EU-LFS, 2000-2007).....	3
Table 2:	Absolute growth of employment (EU-LFS, 2000-2007).....	3
Table 3:	Relative growth of the share in employment for the top five largest and top five smallest, growing sectors (EU-27 + Norway, 2000-2007)	7
Table 4:	Mean values and standard deviation of the BART Index (EU-LFS, 2000-2007).....	8
Table 5:	Correlations between the BART Index and Absolute and Relative trends in employment growth (AG-RG).....	9
Table 6:	The BART Index for NACE 1.1 sub-sectors at 2-digit level (EU-LFS, 2000-2007).....	12

List of Figures

Figure 1:	Real gross domestic product growth in the EU-15 and the New Member States (1995-2010, EUROSTAT).....	2
Figure 2:	Estimated distribution of the BART Index and the weighted relative and absolute trends (Epanechnikov kernels)	14

1 Introduction

The European Union has high ambitions for employment growth. The Europe 2020 agenda set the goal of an employment rate of 75% for the population aged 20-64 for each member state. Another key target is to raise investment in R&D and innovation to 3% of the EU's GDP. Hence, the former Lisbon goals aiming for 'more and better jobs' and 'to become the most dynamic and competitive knowledge-based economy in the world' are still present on the agenda. For research in the fields of employment growth and quality of work, it is important to understand the consequences of the job creation process. What are the jobs of the future? In what sectors will there be job growth and what will be the characteristics of these jobs? These questions will have to be addressed at different policy levels. To find the answers, a definition of employment growth is a key prerequisite. Conventional concepts are based on one of two measurement methods. Depending on the research question, one will either look at absolute (the number of additional jobs) or relative evolutions (the growth rate of the number of jobs). However, in order to understand employment growth better, both trends matter, especially when employment growth is to be broken down by sector and country. Relative employment growth by sector does not mean a lot in absolute terms when it takes place in a small niche only. At the same time, large sectors will show much higher absolute increases or decreases, even though in relative terms, it may be just a minor fluctuation. In order to take into account both aspects of employment growth, a growth concept may be advocated that gives more weight to relative growth for large sectors and more weight to absolute growth for small sectors.

The existing proposals to balance relative and absolute growth into an encompassing concept neglect the fact that absolute and relative growth are measured on a different scale, leading to unwanted results and scores that are difficult to interpret. Therefore, we propose the *Balanced Absolute and Relative Trend Index* (BART Index) for structural growth. The BART Index is characterised by a relative expression of sector size to allow for aggregation at the European level, equal dimensions for absolute and relative growth and weighted averaging, taking into account sector size. This method is applied to employment data from the 2000 and 2007 European Union Labour Force Surveys. The BART Index appears to be closest to the original absolute growth index, slightly adjusting ranks in case of conflicting relative growth figures. After transforming and weighting the relative growth index with the employment share, all measures are highly correlated.

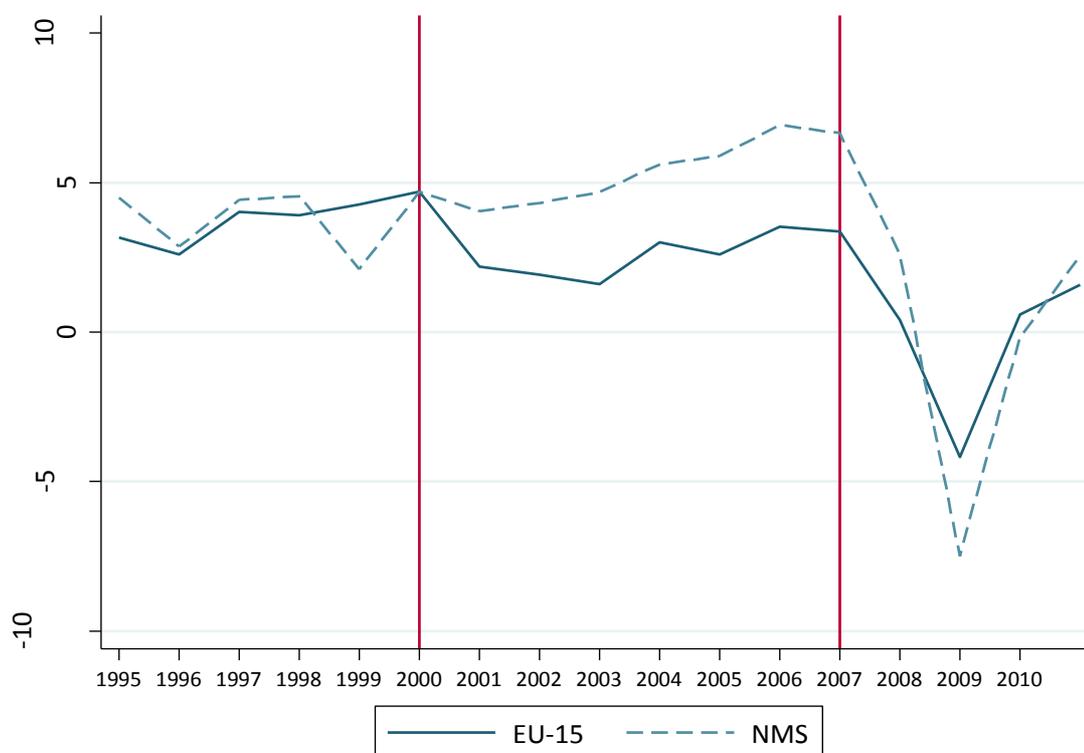
2 Facing the problem

Research on growth measures has its roots in applied economics, aimed at comparing the growth of companies. These statistics may be biased, depending on the choice implied by three fundamental methodological questions. First, the variable chosen to express growth: sales, profit, number of employees, etc. Second, the time span taken into consideration. Third, the measurement method, which can be absolute or relative (Weinzimmer,

Nystrom, & Freeman, 1998). The available literature examined these choices. In their meta-analysis, for instance, Shepherd and Wiklund (2009) looked at the differences between absolute and relative trends in different studies. For most variables under scope, the correlation was very weak. The main exception was employment growth, showing a moderate average correlation ($r = 0.450$).

Using data from the EU Labour Force Survey (EU-LFS), we compared the sectoral employment structure in 2000 and 2007.¹ The time span was chosen because business trends showed peaks in both Eastern and Western Europe in these years (Figure 1). This way we can detrend the evolution of the business cycle using actual data. Major depressions, such as the collapse of the IT bubble in 2001 and the mortgage crisis of 2009, as a consequence, have no impact on the trends observed. At the same time, some events such as the housing bubble in Spain could not be walked around. The difference between a real evolution and overconsumption is of course hard to define, as construction is quite clearly expected to continue to grow in Eastern Europe. Finally, selecting 2000 as the starting year makes sense from a political point of view because that was when the Lisbon Strategy set the goals of a labour participation of 70% and economic growth in knowledge-intensive industries by 2010.

Figure 1: Real gross domestic product growth in the EU-15 and the New Member States (1995-2010, EUROSTAT)



¹ For research interests, the data includes Norway. Poland is excluded due to the lack of available data for 2000.

In order to compile a ranking of growing sectors, two basic measurement methods are possible: either a relative trend (Table 1) or an absolute trend (Table 2). These figures are averaged over Europe, taking to account all employment in 62 NACE sectors, expressed as shares of total employment. Looking at the tables, we see that the two separate indices generate very different results indeed regarding the top ten growth sectors in Europe. In fact, only five sectors appear in both tables (Other business activities, Computer and related activities, Activities of households as employers of domestic staff, Real estate activities and Supporting and auxiliary transport activities & activities of travel agencies). Also, the fastest growing sector in relative terms does not appear in Table 2 and the strongest growth in absolute terms (Construction) falls outside the ten most growing sectors in relative terms. Based on these figures, it is hard to tell which sectors matter when describing employment growth in Europe. Both relative and absolute trends contribute to the concept of job growth, the first indicating change, the latter indicating impact. Therefore, we constructed an index that balances absolute as well as relative trends.

Table 1: Relative growth of employment (EU-LFS, 2000-2007)

Sector	Relative growth
Activities auxiliary to financial intermediation	3.07
Real estate activities	1.65
Recycling	1.64
Computer and related activities	1.59
Activities of households as employers of domestic staff	1.58
Other business activities	1.39
Renting of machinery and equipment without operator and of personal and household goods	1.36
Sewage and refuse disposal, sanitation and similar activities	1.25
Supporting and auxiliary transport activities; activities of travel agencies	1.25
Manufacture of rubber and plastic products	1.23

Table 2: Absolute growth of employment (EU-LFS, 2000-2007)

Sector	Absolute growth
Construction	1.41%
Other business activities	1.35%
Health and social work	0.68%
Computer and related activities	0.30%
Activities of households as employers of domestic staff	0.21%
Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.21%
Education	0.19%
Real estate activities	0.18%
Supporting and auxiliary transport activities; activities of travel agencies	0.17%
Hotels & restaurants	0.15%

In sum, this paper describes a methodology developed to construct a balanced list of growing sectors in the EU (including Norway). The challenges to build such an index are threefold and will be elaborated in the next section. First, we have to assign a relative importance to each member state's figures. Second, we want to balance the trend figures for absolute and relative growth. Third, we need to correct for the bias of growth figures due to sector size. In the final part of the paper we will apply this algorithm to the data and compare the new and old indices.

3 The development of a structural growth index

3.1 Small and large countries

We want to construct an aggregated index of structural growth for sectors in each country as well as averaged at the European level. The latter concept implies the question of whether (sectors from) all countries are equal. One option is to give countries a weight relative to their size, which can be either total population or total workforce. This has an important consequence: a small number of large countries (more precisely: Germany, France, Italy and the UK) will basically determine the overall results. The opposite approach argues that countries are the basic units of analysis. In each country, we can observe the consequences of one particular structural trend. Again, there are grounds for criticism. How relevant and lasting are trends observed in very small countries such as Cyprus or Malta? An intermediate weighting could therefore be considered in order to overcome this disadvantage.

Here, we will opt for the second approach without further weighting. To avoid scale biases to the statistics, we have divided employment numbers by the total national employment. Therefore, the share s_t of the employment within a sector i at moment t , denoted by n_{it} within total national employment at the same moment, n_t , will be used as a measure of employment (intensity) of the sector within the national economy, i.e. $s_{it} = \frac{n_{it}}{n_t}$. Because the shares may still be growing in shrinking economies, we reassure the readers that in the time span under consideration, employment grew in all but one member state (Romania). Either way, by comparing two peak periods it is not necessary to have employment growth in order to observe structural changes.

3.2 Relative and absolute trends

Concerning the second issue, we have defined structural growth as a combination of relative and absolute growth figures. A first solution to this problem was, to our knowledge, provided by Birch (1987, p. 36), who suggested multiplying relative and absolute growth. Next, cut-off points for three categories (strong, medium and absent growth) are defined arbitrarily. Scholten (2006) adjusted the original formula, making separate calculations in the case of growth and decline, always expressing trends in the positive way and taking the square root of the absolute growth. This way, the higher

absolute growth in employment, the more important is relative growth. Geurts (2008) sanctioned high absolute growth slightly less severely, using a power of $\frac{3}{4}$. In general, the idea is the following:

$$(1) \quad BIRCH = AG^p \cdot RG$$

With:

$$(2) \quad AG_{it} = n_{it} - n_{it-1} \quad (\text{absolute growth})$$

$$(3) \quad RG_{it} = \frac{n_{it}}{n_{it-1}} \quad (\text{relative growth})$$

$$(4) \quad p = \text{power} \quad (\text{Birch: } 1; \text{ Scholten: } \frac{1}{2}; \text{ Geurts: } \frac{3}{4})$$

We believe that it is not straightforward to use this formula when studying comparative trends in sectoral employment. As pointed out, sectors that make up the same share of the economy in different countries will have a different score on the Birch Index because absolute values are used. Also, the factors have different scales: RG has a minimum of zero, so its range is $[0, \infty]$, while AG is unlimited or between $[-\infty, \infty]$. This results in a very odd distribution, making it theoretically possible to have lower scores for a small decline than for a total disappearance (which would be zero due to the relative growth). Finally, because both factors have no upper limit, there is no clear interpretation of distances of the index.

To overcome these problems with the Birch Index, we need to obtain equal dimensions for both growth measures. For absolute growth, this is already achieved by expressing employment, aggregated at sector level, as a fraction of total employment ($sAG_{it} = s_{it} - s_{it-1}$). The limit scenarios $[-1, 1]$ are easily demonstrated, occurring when a dominant sector disappears completely ($0 - 1 = -1$), or a new sector comes to take over all employment ($1 - 0 = 1$). To have the same dimensions for relative growth, the solution is more complicated and involves a transformation of the scale. The starting point is the conventional formula for (scaled) relative growth in sector i , indicated with one accent:

$$(5) \quad sRG'_{it} = \frac{s_{it}}{s_{it-1}}$$

The transformed scaled relative growth should approach 1 when sRG'_{it} approaches infinity. Therefore, we set the upper limit as 1 and subtract the inverse of the exponentiated sRG'_{it} . We then get the following formula, labelled with a double accent.

$$(6) \quad sRG''_{it} = 1 - \exp(-sRG'_{it})$$

Theoretically, when a sector originates, it will reach the upper limit of growth.² Since relative growth is always positive, the exponentiation in the lower limit will be 1 and the

² Because software does not like to divide by zero, in this case the upper limit should be defined in a previous statement.

transformed result will be 0. To obtain the wanted dimensions, we have to split up the range and rescale the transformation. We define the turning point as the non-growth scenario, when $sRG'_{it} = 1$. This point will need to be 0 in the transformed measure. Since the value in this case is about 0.63 (the correction term, formula 7), we subtract this from formula 6. To restore the limits, when sRG''_{it} is either 1 or 0, we divide by either the correction term or 1 minus the correction term. The final transformed relative growth term is thus given by the following expressions:

$$(7) \quad COR = 1 - \frac{1}{\epsilon}$$

$$(8) \quad sRG'_{it} \leq 1 \Rightarrow sRG_{it} = \frac{sRG''_{it} - COR}{COR}$$

$$(9) \quad sRG'_{it} > 1 \Rightarrow sRG_{it} = \frac{sRG''_{it} - COR}{1 - COR}$$

We have obtained the relative growth term with the same dimensions as the absolute growth term, i.e. [-1,1]. This transformation does respect rank order but it does not maintain distances in a strict sense. First of all, this is because the scale is broken in two, but, in general, because there is no absolute meaning to differences in ratios. Any transformation will impose a slope that defines how fast the asymptotic value is approached. Ideally, this fits the distribution of the conventional relative growth index, resulting in a normal distribution of the transformed scale.

3.3 Small and large sectors

We now have comparable indices for relative and absolute growth, which can, in a third step, be averaged or multiplied. In doing so, we want to weight the terms or factors for the effect of differences in sector size. It is known that small companies have a remarkable growth in relative terms because new companies are generally small (Picot & Dupuy, 1998) and because recruiting a small number of people will contribute much more to relative change than it does in large sectors. In the same vein, we suspect that small sectors will rather have a high relative growth and a low absolute growth, while the opposite is true for large sectors. Table 3 shows the difference in relative growth between large and small sectors. The five largest growing sectors grew by 15.03% over the seven-year time span under investigation, which is significantly lower than the average of the five smallest growing sectors (38.44%). At the same time, some large sectors do have high relative-growth figures, which means they should rank high on the balanced index.

Table 3: Relative growth of the share in employment for the top five largest and top five smallest, growing sectors (EU-27 + Norway, 2000-2007)

Sector	Employment share	Relative growth
Large sectors		15.03%
Construction	8.21%	21.74%
Other business activities	5.39%	38.91%
Public administration and defense; compulsory social security	7.04%	1.36%
Education	7.21%	3.68%
Health and social work	8.97%	9.44%
Small sectors		38.44%
Manufacture of rubber and plastic products	0.80%	23.23%
Real estate activities	0.76%	64.64%
Computer and related activities	1.09%	58.54%
Sewage and refuse disposal, sanitation and similar activities	0.49%	25.03%
Activities of membership organizations not elsewhere classified	0.66%	20.77%

Note: Employment share is measured as the average over the years. Poland was excluded because of lacking data for 2000, only sectors found in all countries are kept.

We have chosen the market share (i.e. the employment within a sector as a fraction of the total employment of a country, L_t) as the weight for relative growth and 1 minus the share as the weight for the absolute growth term. Summing both weighted growth figures, we obtain the BART Index, balancing absolute and relative trends.

$$(10) \text{BART}_{it} = s_{it-1} \cdot \text{sRG}_{it} + (1-s_{it-1}) \cdot \text{sAG}_{it}$$

3.4 Extending the formula

The formula elaborated in the previous section implies a perfect substitution of the growth indices. This means that for a sector that has a market share of 50% an increase of 1 point for relative growth is equal to an increase of 1 point for absolute growth. This can be seen as a special case of the constant elasticity substitution function, based on Arrow et al. (1961). An extended function (BART') would be:

$$(11) \text{BART}'_{it} = 2 \cdot \alpha \cdot \frac{\text{sRG}_{it+1}}{2}{}^r + (1-\alpha) \cdot \frac{\text{sAG}_{it+1}}{2}{}^r \frac{1}{r} - 1$$

Where:

$$(12) r = \frac{\sigma-1}{\sigma}$$

$$(13) \sigma = \text{substitution elasticity } [0; \infty]$$

When $\sigma = \infty$, we would obtain $\text{BART}' = \text{BART}$.

4 Structural growth in Europe between 2000 and 2007

When we take sector sizes into account and compute the average of the absolute and relative trends, a new list of growth sectors can be compiled (Table 4 below and Table 6 in the Appendix). We first calculated the BART Index by country and then took the European average. As mentioned earlier, each country has the same weight in the construct. The resulting numbers are rather close to zero, indicating that change in this period was moderate. Since structural change is a zero sum game, about half of the sectors are growing and the other half show a decline.

We should note that mean values always hide variation, in this case between countries. Some strongly growing sectors are rather concentrated in a few countries and may even be declining in other countries. Education and Construction, for instance, are clear examples of this scenario. In the aggregated BART Index, they score high despite the uneven distribution. Other sectors, such as IT and Travel, managed to evolve steadily in most or all countries. The smaller standard deviation indicates that the national scores are close to the average.

Table 4: Mean values and standard deviation of the BART Index (EU-LFS, 2000-2007)

Sector	BART	St. Dev.
Construction	2.45%	2.99%
Other business activities	2.38%	1.11%
Health and social work	1.30%	1.75%
Computer and related activities	0.51%	0.37%
Education	0.44%	1.77%
Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.38%	1.34%
Activities of households as employers of domestic staff	0.36%	0.82%
Hotels and restaurants	0.34%	1.49%
Supporting and auxiliary transport activities; activities of travel agencies	0.31%	0.62%
Real estate activities	0.30%	0.28%

How does the BART Index relate to the underlying trend figures? At first glance, the top ten consist entirely of sectors found in the original list ordered by absolute growth. The impact of the relative growth of sectors is limited to reordering this list. The four sectors with the strongest absolute growth keep their position, followed by Education, which skips over Wholesale Trade and Household Employers. Finally, Real Estate and Hotels & Restaurants trade places. We might conclude from this that it seems that the influence of the relative growth index is rather limited.

To examine the relation more closely, we compared the weighted and scaled relative and absolute trend with the final index for each country. The average correlation for the weighted absolute trend is $r = 0.998$ and for the weighted relative trend $r = 0.997$ (Table 5). Unsurprisingly, both trends themselves are highly correlated ($r = 0.989$). This is, however, at odds with the starting point of this paper: the observation that the two trends

are not equivalent. To check the correlations with the conventional indices, i.e. before transformation, unscaled and unweighted, we need to rely on a rank correlation. Note that rank correlations after transformation will be exactly the same because of the ordinal equivalence of the transformation. So while all columns in Table 5 show correlations with the weighted or unweighted scaled *transformed* trends, the extreme right column would not be different using unscaled and untransformed trends. Setting the BART Index side to side with the unweighted absolute trend, we notice a nearly perfect rank correlation ($r = 0.999$) while correlation for the unweighted relative trend is less than perfect but still very high ($r = 0.824$).

With the construction of the BART Index, these differences seem to disappear. This is not due to the transformation of the relative growth variable, since this only returns moderately strong correlations (on average $r = 0.491$). The biggest difference is observed after the weighting: while absolute growth is highly correlated in all settings, it is only with weighted indices that we find equality between absolute and relative growth.³ This illustrates the point that some major growing sectors in a relative sense catch the eye because of their small size. After correcting for this, absolute and relative trends are highly comparable.

Table 5: Correlations between the BART Index and Absolute and Relative trends in employment growth (AG-RG)

	Pearson		Spearman	
	Weighted	Unweighted	Weighted	Unweighted
BART x AG	0.998	0.998	0.999	0.999
BART x RG	0.997	0.491	0.998	0.824
AG x RG	0.989	0.492	0.995	0.823

5 Conclusions

This methodology stems from the need to find a way to include both absolute and relative employment trends in one index for structural growth in a comparative perspective. We addressed three issues: first, an agreement on the way to aggregate country level statistics; second, equalizing the dimensions of absolute and relative growth and third, controlling for biases in the figures due to the size of a sector. To construct the BART Index, we therefore expressed sector sizes relative to the size of the economy (as shares of the labour market), and weighted all countries equally. Next, the relative growth measure was transformed to get the proper dimensions, and finally a weighted average between the trends was calculated in order to downplay the impact of relative growth to the final index for small sectors.

Following these steps, we made a new list of structurally growing sectors using European Labour Force Survey data. Because this index represents structural change, about half of the sectors are growing and the other half are declining. The index was deconstructed to

³ See also the overlapping kernel distributions in Figure 2 in the Appendix.

assess the effects of the relative and absolute trends. We found that absolute growth contributed most to the index while the procedure of balancing essentially brought the relative trend to comparable levels. The reason for this is the weighting, which effectively corrected the impact of sector size. The result is a slightly corrected index which bears most resemblance with absolute growth.

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7 Appendix

Table 6: The BART Index for NACE 1.1 sub-sectors at 2-digit level (EU-LFS, 2000-2007)

Rank	Sector	BART
1	Construction	2.45%
2	Other business activities	2.38%
3	Health and social work	1.30%
4	Computer and related activities	0.51%
5	Education	0.44%
6	Wholesale trade and commission trade, except of motor vehicles and motorcycles	0.38%
7	Activities of households as employers of domestic staff	0.36%
8	Hotels and restaurants	0.34%
9	Supporting and auxiliary transport activities; activities of travel agencies	0.31%
10	Real estate activities	0.30%
11	Recreational, cultural and sporting activities	0.28%
12	Manufacture of fabricated metal products, except machinery and equipment	0.20%
13	Manufacture of motor vehicles, trailers and semi-trailers	0.17%
14	Activities auxiliary to financial intermediation	0.16%
15	Public administration and defence; compulsory social security	0.14%
16	Other service activities	0.12%
17	Activities of membership organizations not elsewhere classified	0.11%
18	Sewage and refuse disposal, sanitation and similar activities	0.07%
19	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	0.07%
20	Manufacture of medical, precision and optical instruments, watches and clocks	0.07%
21	Renting of machinery and equipment without operator and of personal and household goods	0.05%
22	Financial intermediation, except insurance and pension funding	0.04%
23	Recycling	0.04%
24	Research and development	0.02%
25	Manufacture of rubber and plastic products	0.01%
26	Extra-territorial organizations and bodies	0.00%
27	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	0.00%
28	Collection, purification and distribution of water	-0.01%

Continued overleaf.

Continued from previous page.

Rank	Sector	BART
29	Manufacture of electrical machinery and apparatus not elsewhere classified	-0.02%
30	Other mining and quarrying	-0.03%
31	Mining of uranium and thorium ores	-0.04%
32	Manufacture of tobacco products	-0.06%
33	Mining of metal ores	-0.06%
34	Fishing, fish farming and related service activities	-0.06%
35	Water transport	-0.06%
36	Manufacture of other transport equipment	-0.07%
37	Manufacture of coke, refined petroleum products and nuclear fuel	-0.07%
38	Forestry, logging and related service activities	-0.09%
39	Air transport	-0.10%
40	Manufacture of other non-metallic mineral products	-0.10%
41	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction	-0.11%
42	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting	-0.12%
43	Manufacture of office machinery and computers	-0.12%
44	Manufacture of chemicals and chemical products	-0.18%
45	Publishing, printing and reproduction of recorded media	-0.18%
46	Manufacture of pulp, paper and paper products	-0.18%
47	Mining of coal and lignite; extraction of peat	-0.19%
48	Manufacture of radio, television and communication equipment and apparatus	-0.20%
49	Land transport; transport via pipelines	-0.20%
50	Manufacture of furniture; manufacturing not elsewhere classified	-0.23%
51	Insurance and pension funding, except compulsory social security	-0.23%
52	Manufacture of machinery and equipment not elsewhere classified	-0.26%
53	Electricity, gas, steam and hot water supply	-0.27%
54	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	-0.34%
55	Manufacture of basic metals	-0.35%
56	Post and telecommunications	-0.35%
57	Manufacture of textiles	-0.53%
58	Manufacture of wearing apparel; dressing and dyeing of fur	-0.58%
59	Manufacture of food products and beverages	-0.98%
60	Agriculture, hunting and related service activities	-3.33%

Figure 2: Estimated distribution of the BART Index and the weighted relative and absolute trends (Epanechnikov kernels)

