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Benchmarking European labour market performance with efficiency frontier techniques

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discussion paper

FS I 00 - 211

**Benchmarking European
Labour Market Performance
with Efficiency Frontier Techniques**

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Abstract

The issue addressed in this paper is how to obtain a composite measure of several indicators using benchmarking principles. While the exposition is only in two dimensions, and thus can be presented graphically, this is sufficient to capture the essence of the methodology and provide the basis for a critical examination of the assumptions. The data used is labour market statistics for the Member States of the European Union. The proposed approach comes from a technique originally used in production theory, namely efficiency frontiers. Here, however, we benchmark not efficiency but performance.

There are two main problems. First, related to composite measures, how does one compare (weigh) indicators that are not obviously comparable? Second, related to benchmarking, how does one benchmark countries that may differ considerably as regards the mix of the various indicators. Both these issues concern weights and require that the weighting system should be parsimonious as regards assumptions and flexible, in that not all countries should necessarily be awarded the same weights.

First we show how to construct the benchmark. It is constructed assuming only that the weights are positive, that we cannot discriminate between countries that are best in any single dimension and that a linear combination of these best performers is feasible, and also on the frontier. When benchmarking several indicators we arrive, not at a mark, but a frontier. The performance frontier is a multi-dimensional benchmark.

Next we show how to measure the distance of other countries from the performance frontier. This requires the assigning of weights. The weights are determined by the location of a particular country to a particular segment of the frontier. The countries off the frontier are weighted in accordance with the weights of the countries on the frontier that have a similar mix of indicators.

The essence of the method is presented by constructing a composite index of the unemployment and employment rates of the Member States in 1999. We then present an example in three dimensions using various measures of unemployment. Finally, we extend the cross-sectional approach, i.e. the Member States for a single year, to the construction of a pooled cross-sectional time series performance frontier. The pooled frontier is made up of the best performance of the best of countries at the best of times. In the final section we summarise the merits of this approach and comment on some possible criticisms

Zusammenfassung

In der Analyse wird gezeigt, wie ein Gesamtindikator aus Einzelindikatoren konzipiert werden kann, die auf der Basis von Benchmarking-Kriterien entwickelt worden sind. Obwohl sich der Ansatz auf (nur) zwei Parameter beschränkt - und er so graphisch darstellbar wird - ist dies ausreichend, um den Kern des methodischen Ansatzes erfassen und kritisch überprüfen zu können. Die verwendeten Daten sind Arbeitsmarktstatistiken der EU-Mitgliedstaaten. Der vorgeschlagene Ansatz wurde ursprünglich in der Produktionstheorie verwendet, insbesondere zur Ermittlung der „vordersten Effizienzgrenze“ (frontier). In der vorliegenden Analyse wird allerdings nicht die Effizienz, sondern die Leistung (performance) gemessen.

Es stellen sich hauptsächlich zwei Probleme. Das erste Problem hängt mit dem Charakter von Gesamtindikatoren zusammen: Wie sollen Indikatoren gewichtet und verglichen werden, die nicht auf den ersten Blick vergleichbar sind? Das zweite Problem bezieht sich auf das Benchmarking: Wie können sehr unterschiedliche Länder durch einen Mix sehr unterschiedlicher Indikatoren vergleichend gemessen werden? Beide Aspekte beziehen sich auf Gewichtungsprobleme und erfordern, in den Gewichtungsprozeß möglichst wenige (normative) Annahmen einfließen zu lassen und das „Gewichtungssystem“ so flexibel zu konzipieren, daß nicht allen Ländern automatisch das gleiche Gewicht zugemessen wird.

Im ersten Schritt wird die Konstruktion des Vergleichsmaßstabs dargestellt. Als Annahmen fließen nur ein: 1) die Gewichte haben einen positiven Wert, 2) die Festlegung der „Bestleistung“ der Länder erfolgt unabhängig von der jeweiligen dafür verantwortlichen Leistungskategorie, 3) die leistungsstärksten Länder können in einer linearen Kombination dargestellt werden.

Im zweiten Schritt wird gezeigt, wie der Abstand von der Leistungsspitze gemessen werden kann. Dies erfordert eine Zuordnung von Gewichten. Sie werden bestimmt durch die Zuordnung eines jeden Landes zu einem bestimmten Segment an der vordersten Leistungsgrenze. Die davon entfernten Länder werden entsprechend den Gewichten der am weitesten entwickelten Länder, die einen ähnlichen Indikatoren-Mix haben, gewichtet.

Die Quintessenz dieser Methode besteht darin, einen Gesamtindex, basierend auf den Arbeitslosigkeits- und Beschäftigungsdaten des Jahres 1999 der Mitgliedstaaten, zu konstruieren. Anschließend wird ein dreidimensionales Beispiel mit unterschiedlichen Kennziffern der Arbeitslosigkeit vorgestellt. Zum Schluß wird der Querschnittsvergleich der Mitgliedstaaten, der sich auf ein bestimmtes Jahr bezieht, dadurch erweitert, daß die „Spitzenleistung“ mittels gepoolter Zeitreihendaten für die Mitgliedsländer ermittelt wird. Der gepoolte „Verlauf der vordersten Leistungsgrenze“ ergibt sich aus der besten Leistung der besten Länder im besten Zeitraum. Im Schlußkapitel werden die Vorteile dieser Methode zusammengefaßt und mögliche Kritiken aufgegriffen.

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1. Introduction and Background¹

The background to our development of this methodology was to use benchmarking techniques to monitor the labour market performance, using the Basic Performance Indicators², in light of the new role awarded to the Commission in The Amsterdam Treaty. It was first proposed in Anxo and Storrie (1998) and implemented in Storrie and Bjurek (1999). Here we illustrate the methodology using updated data (up to 1999) and discuss some of the merits and possible criticisms of the method.

The efficiency frontier methodology was first developed by Farrell (1957) to obtain measures of productive efficiency, and this is still an excellent exposition of the topic.³ It is sometimes termed Data Envelopment Analysis (DEA) but the presentation here is more akin to its application to index theory. The methodology is perhaps best known for its application in studies of efficiency of public services. Bjurek (1994), and references within, demonstrate several such applications. The reason that this methodology has been so widely applied in the production of public services is due to the difficulty in weighing the value of the outputs of public services, as one generally lacks information on prices. This makes it difficult to arrive at a single (composite) measure for all different outputs. The weighting of several indicators to a single composite index is precisely the issue to be addressed in this paper. If this is to be performed in the benchmarking framework, then the efficiency frontier, which can be seen as a multi-dimensional benchmark, is a relevant and useful approach⁴

2. The Issue to be addressed

When benchmarking one indicator with a single statistic, the matter is, in principle, straightforward. The best performer (the benchmark) is identified and the degree to which others lie under the benchmark is a measure of their performance relative to the benchmark. However, when one has several measures of performance, as for example is the case with the Basic Performance Indicators, one must address the question of the relative value of each indicator.

The issue is to assign weights to the various indicators. The main difficulty is that practically every single indicator of labour market performance offers no suggestion as to how it should be evaluated in terms of other indicators. This is in contrast to, for example, the basic unit of national accounts, the Gross National Product. This is a composite indicator of all the different goods and services in the economy. In principle, the weights used are market prices to evaluate, however imperfectly, the relative value of guns, butter and other goods in the economy. This permits aggregation to a single measure. We have no natural choice of weights

¹ This paper was written when Donald Storrie was visiting fellow at the Social Science Research Centre Berlin. He would like to thank Professor Günther Schmid and other members of the Labour Market Policy and Employment Research Unit for not only making his stay enjoyable and stimulating but also for providing useful comments on an earlier version of this paper

² The Basic Performance Indicators are measures of labour market performance agreed upon by the European Union. They may be viewed as “official“ EU measures. The definitions have changed slightly over the years. See the latest Joint Employment Report for the current definitions.

³ The reason why it took so many years for Farrell’s method to be extensively applied is presumably due to the previous lack of computer power needed for its implementation.

⁴ To our knowledge efficiency frontier techniques have not been used in applications similar to this paper. However, Hartog et al. (1993) has proposed the use of efficiency frontiers, but did not develop further, the use of the production frontier approach as a more practical (and realistic) general criteria for labour market efficiency than the Pareto criteria.

or shadow prices to weigh together the Basic Performance Indicators and arrive at a single measure of labour market performance. Indeed in a number of contexts one may even question the feasibility of ascribing weights at all. Can one ever have the grounds for claiming, for example, that a 1 percentage increase in female participation rate is of equal value as a x percentage fall in youth unemployment ?⁵

Moreover, even if one could find appropriate weights, is it reasonable to consider that the weighting system would be the same in all countries? Weights may be seen as value judgements and different countries may have different preferences regarding, for example, the unemployment-inflation trade-off or gender equality. These country specific policy priorities cannot be expressed in any single weighting system.

The conclusion here is that due to intrinsic measurement difficulties and different political preferences, or other country specific factors, one must develop a very delicate and flexible means of weighing the indicators with so few value judgements as possible.

The efficiency frontier approach is extremely parsimonious as regards the weighting assumptions required to identifying the benchmark. When calculating a numerical value of the extent to which other countries fall short of the multi-dimensional benchmark, one cannot avoid weights. This is done not by explicitly assigning weights based on some value judgement but rather letting the data itself decide. More precisely, after the frontier is identified, the weighting depends upon on the location of the various countries relative to the countries that lie on the performance frontier and that exhibit a similar mix of the indicators.⁶

3. The indexing methodology

A fuller description of the methodology may be found in (Storrie and Bjurek, 1999). When working with only two indicators, the construction of the performance frontier and the measures of deviation from that frontier can be presented graphically. Thus, we present the essence of the method, including a description of the necessary assumptions, and their implications, by creating a composite index of the unemployment and employment rates of the member states in 1999.⁷

Section 3.2 presents an example in three dimensions. In the final subsection, we extend the cross-sectional approach, i.e. the member states for a single year, to the construction of a pooled cross-sectional time series performance frontier. It should be emphasised, however, that all the ideas can be grasped from the graphical presentation in two dimensions from Section 3.1.

3.1 A two dimensional cross-sectional benchmark of employment and unemployment

The employment and unemployment rates are perhaps the most widely used of all labour market indicators and will serve to illustrate the methodology. While both measures have their

⁵ Economic theory would suggest weights related to opportunity costs

⁶ Mosley and Meyer (1998), who also benchmark the Performance indicators, using a Radar Chart approach, weigh all indicators equally for all countries.

⁷ Storrie and Bjurek (1999) present the similar illustrative examples but for 1998. Note that the data used in this paper are not just updates of the Storrie and Bjurek (1999). The definition of employment rate changed in 1999.

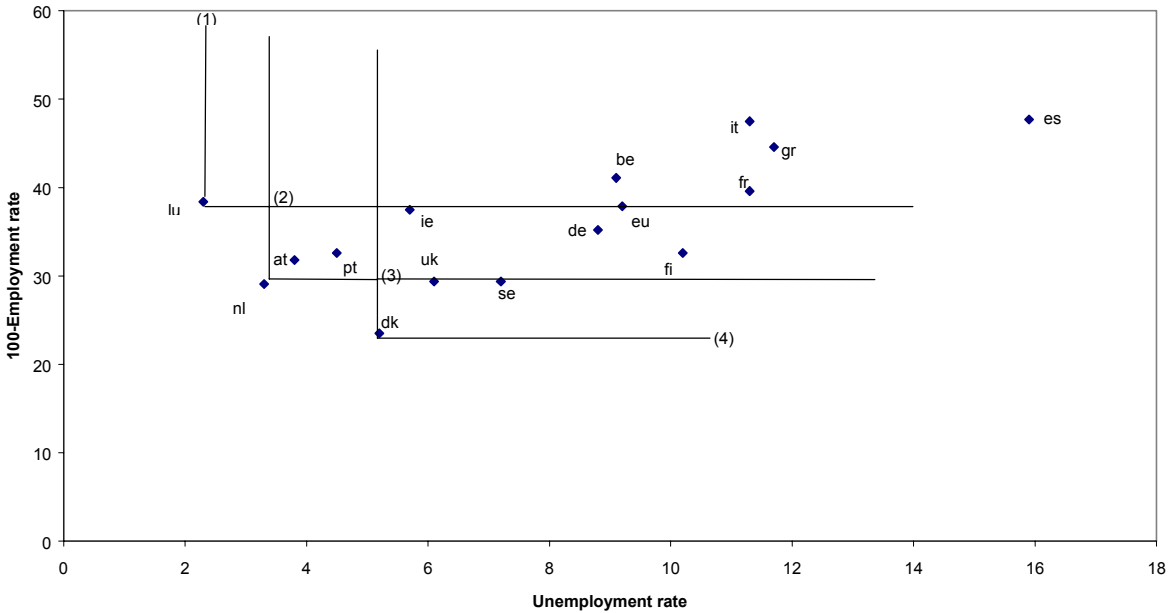
obvious rationale, rankings of countries by one or other of these measures do not yield identical rankings, see Table 1. For example, Denmark and, in particular, Luxembourg are ranked quite differently by the two measures. No country is unambiguously best, although Spain is clearly ranked last. Unemployment is lower in Ireland (5.7%) than in Sweden (7.2%), but the Swedish employment rate (70.6%) is higher than in Ireland (67.4%). On the basis of both these indicators, which of these two countries exhibits the best labour market performance?

Table 1
Employment and unemployment rates 1999

Unemployment		Employment	
2,3	lu	dk	76,5
3,3	nl	nl	70,9
3,8	at	se	70,6
4,5	pt	uk	70,6
5,2	dk	at	68,2
5,7	ie	fi	67,4
6,1	uk	pt	67,4
7,2	se	de	64,8
8,8	de	ie	62,5
9,1	be	lu	61,6
10,2	fi	fr	60,4
11,3	fr	be	58,9
11,3	it	gr	55,4
11,7	gr	it	52,5
15,9	es	es	52,3

Figure 1 plots the unemployment and 100 minus the employment rate. Best performance is to be found as we move towards the origin in both dimensions.⁸

Figure 1: The construction of a frontier
Unemployment rate and 100-Employment rate:1999.



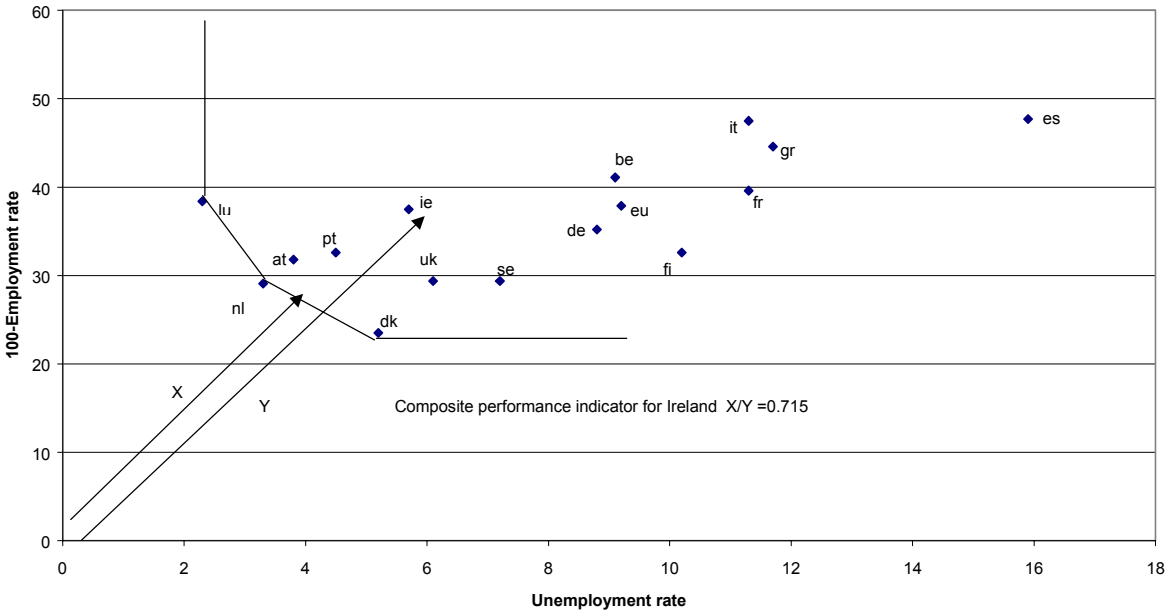
⁸ In this paper we express all the indicators so that they are to be minimised.

We say that a country dominates another when it is best in both indicators. If one country dominates another it is ranked higher than the other. This is the first assumption of the methodology. It means that “more is better” or, more formally, that the single indicators have weights greater than zero. Dominance is illustrated graphically by drawing an L-shape with the country in question at the intersection of the L. The country dominates all countries above and to the right of the L.

From Figure 1 we see that Denmark dominates ie, uk, se, de, fi, be, fr, it, gr and es. Luxembourg dominates fr, be, gr, it and es. The Netherlands dominates all countries except Luxembourg and Denmark. These three countries are not dominated by any other. As we have no means of discriminating between them, without assuming something about how we weigh the employment rate relative to the unemployment rate, we award them the equal, top ranking. They all constitute the frontier or the multi-dimensional benchmark. The performance frontier follows the steps passing through (1)-lu-(2)-nl-(3)-dk-(4).

We then make the further assumption that a linear combination of two countries on the frontier is also on the frontier, i.e. convexity. This joins the edges of the steps together. The frontier is now as drawn in Figure 2.⁹

Figure 2: The Performance Frontier
Unemployment rate and 100-Employment rate:1999.



It remains now to measure the extent to which the other countries deviate from the frontier. We exemplify the procedure with Ireland, see Figure 2. We measure the length of the ray from the origin to Ireland and denote it equal to Y . We then measure the distance from the origin in the direction of Ireland up to the frontier and denote this distance X . The composite indicator for Ireland is equal to $X/Y = 0.715$. We see that for countries on the frontier the composite measure is equal to one. The same procedure is performed for all countries. Table 2 presents the results of these calculations.¹⁰ On the basis of these results we can provide an

⁹ Convexity is not a vital assumption. In some applications a step-like frontier may be used.
¹⁰ In two dimensions this can be calculated using Pythagoras’ theorem. For dimensions higher than two, linear programming techniques may be used.

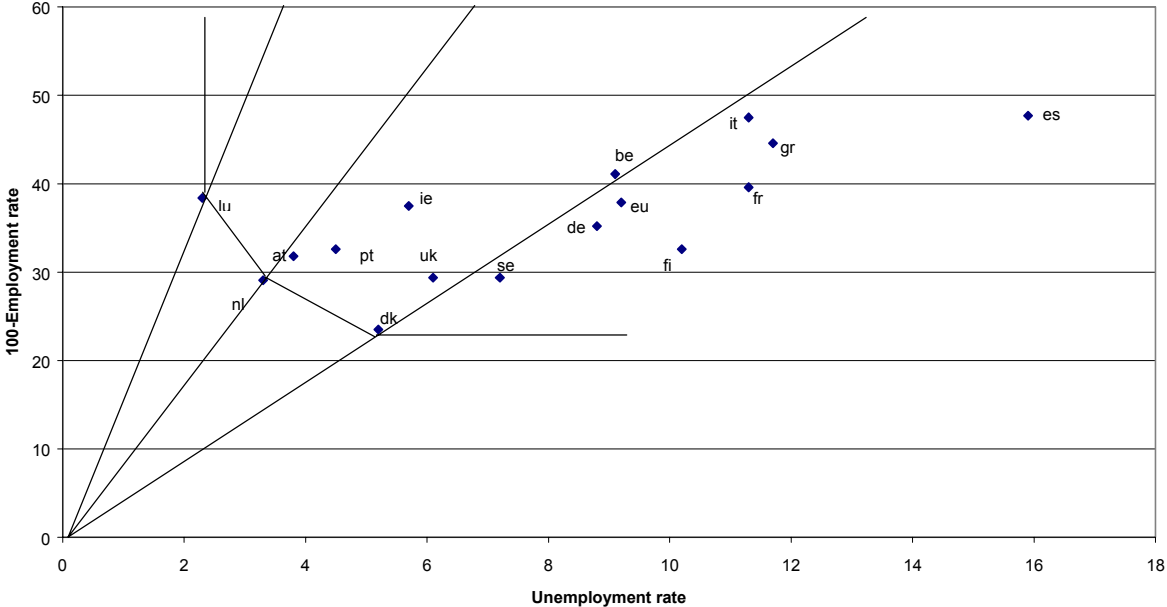
answer to the question posed above. Does Ireland or Sweden exhibit the better labour market performance? Table 2 gives an answer – Sweden.

Table 2
A composite measure of labour market performance
Employment and unemployment rates 1999

Country	lu	nl	dk	at	pt	uk	se	fi	ie	de	eu15	fr	be	gr	it	es
index	1,000	1,000	1,000	0,903	0,847	0,819	0,799	0,721	0,715	0,668	0,620	0,593	0,572	0,527	0,495	0,493

As we have now calculated a numerical measure, we must have made some weighting assumptions. In fact it is the data that makes the assumptions for us. For Ireland the weights are those represented by the slope of the line between the Netherlands and Denmark. The weights are thus determined by the location of Ireland relative to the countries on a particular segment of the frontier, namely the segment that is determined by countries that have a similar mix of employment and unemployment as Ireland. The weighting of unemployment and employment in Ireland is in accordance with the weights or “price line” that that occur in the real world by countries located on the benchmark. Thus, this methodology takes the benchmarking concept further than before in that it is the benchmark countries that determine the weights. We emphasise that different countries will be weighted differently depending upon where they are located in relation to the frontier. Countries off the benchmark are being compared to those on the benchmark that most closely resemble their own mix of the two indicators. Figure 3 indicates which segment of the frontier is relevant for every country.

Figure 3: The weighing of the performance indicator
Unemployment rate and 100-Employment rate:1999.

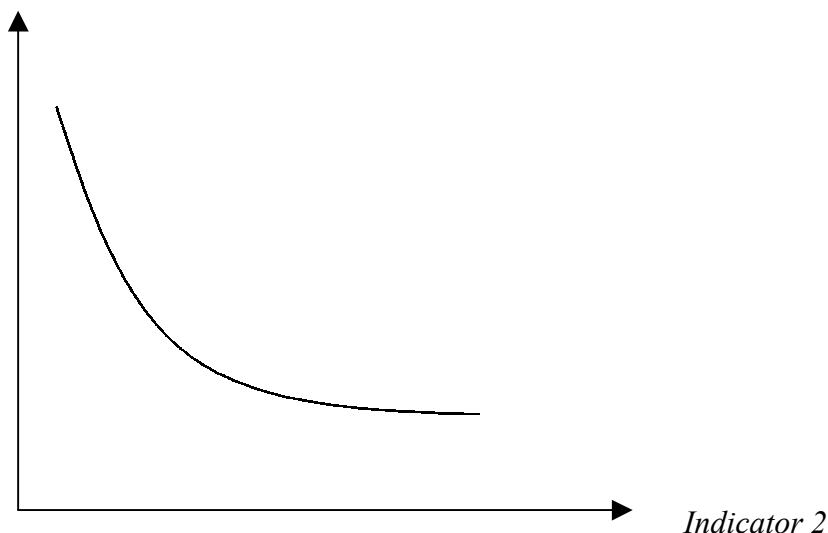


The first two assumptions lead to a frontier shaped like a typical convex indifference curve or isoquant common in microeconomics, see Figure 4. The slope of the frontier determines the weights, which vary as we move along the frontier. Out to the right of the figure, at high levels of *Indicator 2*, the relative weight for *Indicator 2* is low. For countries in that area more

weight will be placed on *Indicator 1*. As we move leftwards the weights converge until *Indicator 1* is weighed more than *Indicator 2*.

Figure 4: A stylised performance frontier

Indicator 1



3.2 A three dimensional cross-sectional benchmark of unemployment

The idea, illustrated graphically in the previous section in two dimensions, may be extended in principle to any number of dimensions. The basic idea of a frontier, and the distance to a particular segment, remains. In this section an example in three dimensions is presented.

Three measures of unemployment from the Commission's Basic Performance Indicators are benchmarked. The three single indicators are; the unemployment rate, the long-term unemployment rate and the youth unemployment ratio. See Table 3 for the data and the results.¹¹

As the Netherlands had the lowest unemployment rate, Austria the lowest youth unemployment rate and Denmark the lowest long-term unemployment rate, these three countries are on the frontier. As no other country is better than a linear combination of these three, they alone constitute the frontier. In Storrie and Bjurek (1999), we have used perhaps more appropriate combinations of three and higher dimensions, with special focus on the youth and gender.

As more and more dimensions are added to the analysis, the discriminatory power of the technique may diminish if more countries constitute the frontier.¹² However, I argue in Section 4.2 that this is not necessarily a disadvantage of the technique, but may rather be a reflection of the paucity of the data.

¹¹ As Luxembourg dominates in all three dimensions, and may be viewed as a somewhat unusual country, it is excluded from the analysis.

¹² Note that the discriminatory power does not necessarily diminish.

Table 3
Three measures of unemployment and a composite measure

	Unemployment			
	Total rate	Youth ratio	Long-term rate	Composite index
at	3,8	2,9	1,2	1,000
dk	5,2	7,1	1,1	1,000
nl	3,3	4,7	1,3	1,000
pt	4,5	4,3	1,7	0,809
ie	5,7	4,2	2,7	0,690
uk	6,1	8,6	1,7	0,689
de	8,8	4,7	4,5	0,617
se	7,2	6,6	2,1	0,563
fi	10,2	10,8	2,9	0,406
be	9,1	8,5	5,2	0,402
eu15	9,2	8,5	4,2	0,398
fr	11,3	8,5	4,4	0,341
it	11,3	12,5	6,9	0,312
gr	11,7	12,9	5,9	0,301
es	15,9	12,5	7,3	0,238

3.3 A two dimensional pooled cross-section time series benchmark of unemployment and employment.

Pooled data is cross-sectional data of the type used earlier in this paper, but for several years. The pooled frontier is comprised of the best performance of the best of countries at the best of times. The composite index measures the distance from each country for each year to the pooled frontier. Again to facilitate presentation we perform the construction of the frontier for two single indicators, the unemployment and employment rate. The data to be benchmarked, from 1995 to 1998, are plotted in Figure 5.

The frontier and distance from it are calculated precisely as in two dimensional cross-section case. We see that all the best performances were from 1999 and were Luxembourg, the Netherlands and Denmark. The frontier has thus moved downwards in 1999.¹³ The composite indexes of all countries, for every year since 1995, from the frontier are presented in Table 4. The countries with the highest average level are placed on the top rows. The countries exhibiting the largest improvement are placed to the right of the rows. The figure in the appendix shows the development of unemployment and employment rates for each member state over time. We observe appreciable movement towards the frontier for Ireland, Finland, The Netherlands and Spain.

¹³ The index based on the pooled frontier is transitive. By this we mean that the change between t_0 and t_2 can be derived from (is consistent with) the two changes between t_0 and t_1 and t_1 and t_2 . This is a very desirable characteristic of any temporal index. It should be noted that some common indexes do not have this property. This means that if the performance indicators were to be benchmarked using pooled data in the future the calculation may then result in different index values than those presented for previous years in Table 4. This would occur if the 2000 data found a country on the pooled frontier. This is not an undesirable characteristic and indeed is inherent in the benchmarking approach, which entails the measurement with reference to best performance.

**Figure 5: The pooled performance frontier
employment and unemployment rates 1995-1999**

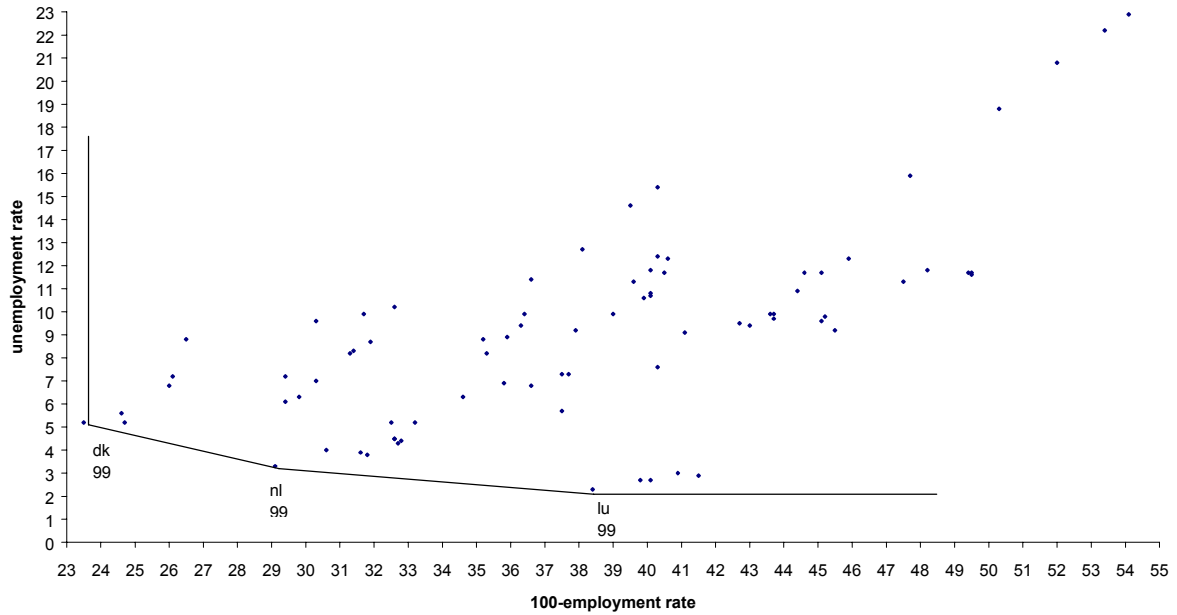


Table 4
Pooled benchmark EU member states 1995 to 1999 - employment and unemployment rates

AT		LU		DK		NL			
99	0,903	99	1,000	99	1,000	99	1,000		
98	0,847	98	0,921	98	0,970	98	0,916		
97	0,848	97	0,917	97	0,955	97	0,812		
96	0,856	96	0,869	96	0,904	96	0,730		
95	0,901	95	0,873	95	0,900	95	0,692		
SE		UK		PT					
99	0,799	99	0,819	99	0,847				
98	0,748	98	0,803	98	0,800				
97	0,741	97	0,776	97	0,685				
96	0,776	96	0,751	96	0,656				
95	0,887	95	0,737	95	0,658				
DE		FR		BE		FI		IE	
99	0,668	99	0,593	99	0,572	99	0,721	99	0,715
98	0,647	98	0,586	98	0,550	98	0,642	98	0,619
97	0,646	97	0,579	97	0,549	97	0,617	97	0,539
96	0,655	96	0,583	96	0,538	96	0,595	96	0,521
95	0,666	95	0,580	95	0,538	95	0,583	95	0,512
GR		IT		ES					
99	0,527	99	0,495	99	0,493				
98	0,529	98	0,488	98	0,467				
97	0,524	97	0,475	97	0,452				
96	0,529	96	0,476	96	0,440				
95	0,535	95	0,475	95	0,434				

*Note: Vertically, the table is sorted by average levels
and horizontally by absolute change from 1995 to 1999.*

We note that one could also benchmark a single country over time. The frontier would then be comprised of the years during which the combinations of single indicators dominated other years. This may be a way to evaluate a country with reference to its particular circumstances, and thus possibly more politically acceptable for the member state in question. However, obviously, the results will largely be driven by the business cycle.

4. A critique of the methodology

4.1 Advantages

(1) The main advantage of benchmarking generally is that it provides a measure of performance based on observation of the real world. Best performance is not a theoretical, and possibly abstract concept, it is defined by merely observing the best performer. The observance of best performance when there are several indicators was the issue dealt with in this paper. Performance frontiers are multi-dimensional benchmarks.

(2). It is extremely parsimonious as regards weighting assumptions. We list once again the assumptions. A critical discussion of the assumptions follows in Section 4.2

(a) The construction of the frontier

- Positive weights, i.e. that “more is better”.
- We cannot discriminate between countries that are not dominated by any other country and thus rank them to be equal.
- Convexity, i.e. that a linear combination of the best countries is feasible and also on the frontier.

The assumptions imply a frontier similar in shape to the text book isoquant or indifference curve.

(b) To measure the performance of countries off the frontier

Here numerical weights must be applied. Without some information on how this should be done, this will always be a somewhat arbitrary matter. However, we believe the way in which we let the data decide this is the best method available. This was explained in detail towards the end of Section 3.1

4.2 Issues of debate

(1) The first advantage listed above, i.e. that all benchmarking methodologies are only based on observing the real world, can also be seen as a disadvantage as it provides no theoretical grounds for the measures of performance. It is said to be measurement without theory. While this may indeed be a valid criticism of many benchmarking techniques, and certainly the frontier approach in this paper is not based on any theory of the labour market, the frontier approach does have some inherent theoretical merit. Efficiency frontiers, in their original application, are based in the microeconomic theory of production. This lies behind the “diminishing returns” characteristic, which we believe to be an attractive quality of the method also in this application. Moreover, the exercise performed above may only be the first

step in a research process that first obtains measures of performance and then proceeds to explain them by conventional theoretically based empirical research.

(2) If a country is best in any single indicator then it is judged to be on the frontier. This is a consequence of the parsimony of value judgements. In the construction of the frontier, the methodology does not assume that any single indicator should be awarded greater weight than any other. For example, we have no reason to believe that a low unemployment rate is better than a high employment rate. This feature would definitely be a weakness if trivial single indicators were used, for example, the percentage of redheads in the labour force! With relevant indicators it is difficult to see how one could suggest a better alternative than what is done here. Of course, if other information is available, on the relative importance of the indicators, this should be incorporated into the analysis.

(3) If the line measuring a country's distance from the frontier crosses a horizontal or vertical segment of the frontier, this implies that one of the single indicators is awarded a zero weight. Again this is a consequence of our refusal to assume anything more than non-negative weights. There are two responses to viewing this as a weakness of the methodology. The first response is best phrased in the pooled context. A country that is far out along the X-axis has low employment, see Figure 5. With low employment it should be rewarded much less for increasing its employment than a country further to the left with higher employment. This is an analogy to the feature of diminishing marginal returns/utility for convex production/utility functions. Second, one may tilt the vertical or horizontal segment of the frontier towards the axis (the X or Y axis as the case may be). Our *feeling* is that one should be loath to perform such *ad hoc* adjustments to a method that is otherwise free from all such tinkering and letting only the data itself decide the weights. Perhaps a less *ad hoc* method, but still not fully theoretically sound, would be to extend the frontier after Luxembourg, with the same slope as the Netherlands Luxembourg segment. Two measures could be calculated: the one suggested above and the one used in this paper (a sort of upper and lower bound). A further possibility is to impose a Cobb-Douglas type isoquant, see Figure 4, passing through the counties on the frontier and converging asymptotically towards the axis. Finally, any empirical analysis should always be careful to ensure the identification of outliers that may be inappropriately treated.

(4) It is sometimes said that the measure of performance, i.e. the distance from the frontier, is not a measure that has any intuitive or real world meaning. This is not the case. While some indexes only provide the basis for a meaningful ordinal interpretation, the numbers generated above can be interpreted. The performance index is the percentage proportional decrease of all indicators required for a country to move down to the frontier. This is most easily illustrated with reference to Figure 3. We see that Belgium and Denmark have the same mix of employment and unemployment rates. Thus, movement from Belgium to Denmark represents a proportional decrease in all indicators. If we multiply the two Belgian indicators by its performance measure from Table 2, we arrive at the same rates as for Denmark, and on the frontier.

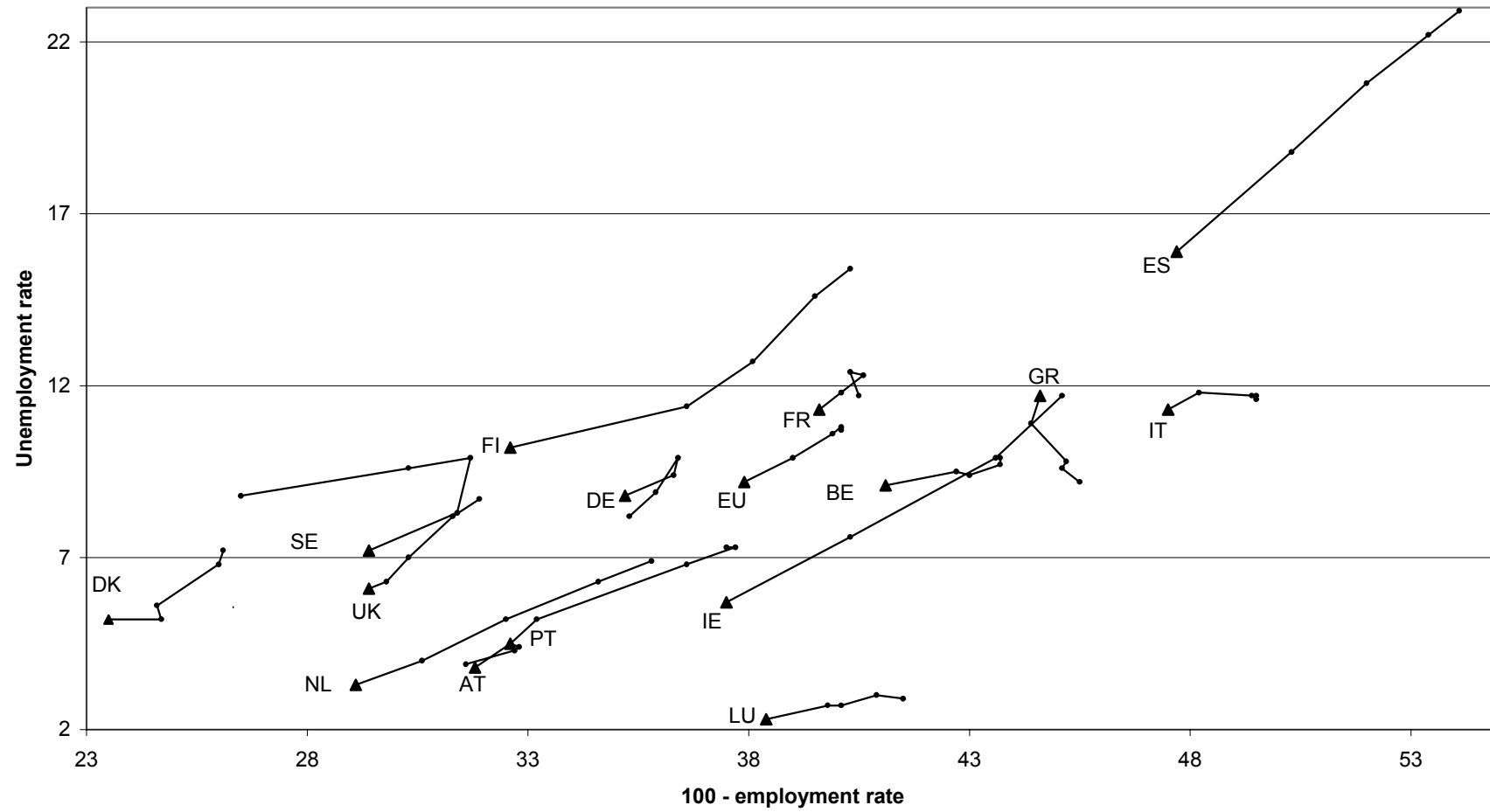
(5) If many indicators are used then one may find that most of the countries constitute the frontier and thus the technique has little power to discriminate between countries. However, one may wonder whether it is really credible that any composite indicator, comprised of say five indicators, even should be able to provide us with a unique ranking of the fifteen member states. Here one is reminded of the comment of Keynes regarding some of the sophisticated calculations in economics emerging after the second world war that "it is better to be roughly right than exactly wrong".

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Appendix

Figure A1: Employment and Unemployment rates: 1995-1999



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