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A COMPARISON OF AGRICULTURAL PRODUCTIVITY IN THE EUROPEAN UNION REGIONS

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Abstract:

This paper presents a formulation of technical change that allows the decomposition of productivity scores obtained using intertemporal-DEA. The assumption is that the technology level in period t for each country is the maximum productivity index obtained until this period. The model assumes that improvements over earlier productivity levels are due to technical progress and that productivity scores below the earlier maximum productivity level are due to inefficiency. The methodology is applied to the analysis of agricultural productivity in the European Union regions in 1982-97. Outputs are aggregated in two categories: crops and animal products. Inputs are feedstuff, other materials, capital, labour and land. All output, intermediate input and depreciation data, originally reported in local currencies was converted into ECUs, using the 1990 exchange rates. There are some differences in the results with respect to those in earlier studies of EU agriculture. The periphery appears with high productivity level and the highest productivity rates of change. Productivity increase is related to developments in the crops sector, and to decreasing usage of intermediate inputs, suggesting a recessive way of increasing productivity.

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1. INTRODUCTION

Agriculture in the EU underwent major structural changes during the last quarter of the 20th century. In these recent decades, productivity growth was the major source of growth in farm output in EU regions. All EU countries experienced positive output growth, but the majority had small negative growth rates for total input use with a large decline in farm labor employment and a large increase in intermediate inputs and capital inputs used (OECD, 1995). In general, land shows no growth. Thus, input growth is wholly accounted for by the rapid increase in intermediate inputs and capital goods. Several studies (Bureau et al., 1995; Thirtle et al., 1995) highlighted the high rates of growth in Total Factor Productivity (TFP) for the agrarian sectors of the European Union (EU) countries. Differences in productivity growth emerge among countries, and among regions within each country.

It seems important to establish the relative position of each region in terms of potential agricultural production with respect to the whole EU agriculture. Thus, there is undoubted interest in comparing and explaining differences in productivity. It is obvious that the measure of TFP of regions is only significant when compared to their own past growth rates or the performance of other regions. TFP is essentially a condensed measure of the ratio between outputs and inputs. However, there is no single way of measuring this relationship in agriculture, a multiple-output multiple-input industry. Thus, the empirical analysis of productivity requires the imposition of strict assumptions concerning the structure of the technology.

In this paper a new technique is applied to the decomposition of productivity growth in technical and efficiency levels for the agricultural sectors of the European Union regions using intertemporal-DEA. It is a slight modification of the technique developed in Millán and Aldaz (2003). The DEA methodology is a useful tool for tackling the specific problems posed by agricultural productivity. It has been applied to the calculation of Malmquist indices and compared with some index number approaches in Bureau et al. (1995) for several European countries and the United States, and in Millán and Aldaz (1998) for the Spanish regions. However, there is a practical limitation in many applications of the Malmquist approach because of short samples. Thus, an approach to productivity analysis with panel data that uses the full set of observations could alleviate the short sample problem. The approach in this paper is simpler and computationally less demanding that the sequential-Malmquist used in Suhariyanto and Thirtle (2001). Moreover, the analysis is closer in spirit to the time series DEA approach in Lynde and Richmond (1999) than to the intertemporal-DEA or the sequential DEA approaches in Tulkens and Vanden Eeckaut (1995).

The methodology is explained in the following section. After this, the main results of the empirical analysis of the agricultural sectors of the European Union regions are presented and the main implications are discussed. The paper ends with several conclusions about methodology and results.

2. METHODOLOGY

Recently, linear programming techniques that envelop the data without specification of a restrictive functional form, and are also distribution free concerning errors, have been used. However, Lovell (1996) notes that the advantages of panel data are only fully exploited in a few instances, given that the technology is assumed to be unchanging. Tulkens and Vanden Eeckaut (1995) do not consider the possibility of technical change in 'intertemporal-DEA' (all observations in the sample), but only with 'contemporaneous-DEA' (a frontier is estimated for each period) or with 'sequential-DEA' (a frontier is estimated using contemporaneous and earlier observations).

Lovell remarks that the DEA-based Malmquist approach allows the calculation of technical progress and technical efficiency. Thus, recent research has used the measurement of adjacent period cross-distances for the calculation of Malmquist indexes. It is not necessary to assume that a country is operating at its production frontier. Therefore, improvements in total factor productivity can occur as a result of either improvement in technical efficiency (moving closer to the production frontier) or improvement in technology (outward shifts of the production frontier).

This paper presents a formulation of technical change that allows the decomposition of productivity scores obtained using linear programming methods (DEA) using intertemporal-DEA. The main assumption is the specification of monotonic non-decreasing technical progress. The model assumes that improvements over earlier productivity levels are due to technical progress and that productivity scores below the earlier maximum productivity level are due to inefficiency.

The following is an introduction to the methodology. To simplify the presentation, a balanced panel is assumed, but the methodology also applies to unbalanced panels as in the empirical application in this paper. Let $\mathbf{x}_{it} \in R^M$ the vector of M inputs used by the country i and time t to produce the P outputs $\mathbf{y}_{it} \in R^P$. The actual data set is the panel $S=\{(\mathbf{x}_{it}, y_{it}: i= N; t=1,..,T\}$, comprising NT observations.

We represent the input-oriented production technology

$$\mathbf{F}((\mathbf{y}_{it}+\mathbf{z}_{it}),\ E_{it}\ A_{it}\ (\mathbf{x}_{it}-\mathbf{s}_{it})) = 0 \qquad (1)$$

where E_{it} measures the efficiency of country i in time t, A_{it} measures the technology index of unit i in time t, $\mathbf{z}_{it}$ and $\mathbf{s}_{it}$ are vectors of output and input specific slacks, respectively, measuring non-radial inefficiencies of unit i in time t.

With the intertemporal-DEA approach E_{it} and A_{it} are not uniquely identifiable (Lovell, 1996). In fact, the usual linear programming methods can be used to identify a radial productivity index d_{it}

$$d_{it} = E_{it}\ A_{it} \qquad (2)$$

Then only the production frontier is fully determined as $\mathbf{F}((\mathbf{y}_{it}+\mathbf{z}_{it}),\ d_{it}\ (\mathbf{x}_{it}-\mathbf{s}_{it})) = 0$. Lovell (1996) and Tulkens and Vanden Eeckaut (1995) assume that the technology level is unchanged, and implicitly set to one. In this setting, $d_{it} = E_{it}$.

The approach in this paper is to obtain E_{it} and A_{it}, using the assumption of A_{it} non-decreasing in time. The assumption of monotonic technical progress has been usual in the non-parametric analysis of technology and producer behavior. This is a hypothesis maintained in Fawson and Shumway (1988) and Lim and Shumway (1992). More recently, Bar-Shira and Finkelshtain (1999) have accepted monotone technological progress and cost-minimizing behaviour for US agriculture, but not profit maximization and monotone technological progress. The way technical progress evolves has been modelled as additive or multiplicative translations, as in Chavas and Cox (1988), with problems criticized in Chalfant and Zhang (1997). In this paper, the simpler form of non-regressive change is used ($A_{i1} \leq \ldots \leq A_{iT} = A_{imax}$).

The methodology we are suggesting is an intertemporal-DEA model over all the observations in the panel. The productivity index d_{it} is calculated using non-parametric programming techniques. There are NT production units, each one using M inputs $\mathbf{x}_{it}$, to produce P outputs $\mathbf{y}_{it}$. Each combination {it} to be analysed is denoted with index 0. The constant returns to scale frontier in period t for region i is constructed as

$$\min_{d0,\, \lambda k} \; d_0$$

subject to

$$\sum_{k=1}^{NT} \lambda_k x_{jk} + s_{j0} = x_{j0} d_0 \qquad j=1,\ldots, M \qquad (3)$$

$$\sum_{k=1}^{NT} \lambda_k y_{pk} - z_{p0} = y_{p0} \qquad p=1,\ldots, P$$

$$\lambda_k, d_0 \geq 0$$

Thus a set $\mathbf{d}_0 = \{d_{it},\ i=1,\ldots N;\ t=1,\ldots,T\}$, of NT radial productivity indexes is calculated. In principle, A_{it} and E_{it}, which measure technology level and efficiency levels for each country i in the dimension t, cannot be determined separately, only their product $d_{it.}$ However, E_{it} and A_{it} can be given values in the interval (0,1] and analysed separately giving more structure to the evolution of A_{it}. Lynde and Richmond (1999) assumed non-regressive technical change, allowing the estimation of technical change and efficiency bounds. With the assumption of non-regressive technical change and the additional assumption that improvements over earlier productivity levels are due to technical change, E_{it} and A_{it} can be given point estimates. It is worth noting that productivity measures using intertemporal-DEA are calculated, but they are interpreted sequentially, only earlier periods for the same country being considered.

The efficiency level A_{it} is obtained by assuming the previous higher productivity level. Thus,

$$A_{it} = \max\{d_{it}, A_{i(t-1)}\} \qquad (4)$$

The first only period gives the maximum productivity score when d_{i1} is the maximum productivity level, and, given non-regressive technology level, all deviation from d_{it} is due to inefficiency. Related to this technical change level, the efficiency level is defined given (2):

$$E_{it} = d_{it}/ A_{it} \qquad (5)$$

As with Lynde and Richmond (1999), individual input efficiency is defined as the potential non-proportional reduction of each input due to slacks. Based on (1) and a given technology level A_{it}, the efficient usage of input j for observation {it} is given by

$$x_{jit}^* = E_{it} (x_{jit}-s_{jit}) \qquad (6)$$

The specific input efficiency indexes are measured as the ratio between efficient usage and real usage:

$$e_{jit} = E_{it} (x_{jit}-s_{jit})/x_{jit} \qquad (7)$$

It is worth noting that due to slacks, the time evolution of the efficiency of input j for observation {it}, e_{jit}, could differ greatly from the radial efficiency level E_{it}.

Output inefficiency is non-radial, given that an input oriented DEA is formulated. Specific output efficiency indexes e^{o}_{kit} are measured as the ratio between the real usage and efficient usage:

$$e^{o}_{kit} = y_{kit}/(y_{kit}+z_{kit}) \tag{8}$$

The specific output efficiency index e^{o}_{kit} measures the proportional reduction in potential output k due to technical inefficiency.

3. EMPIRICAL ANALYSIS

Annual data over the 1982-97 period was compiled for 119 European Union regions in Table 1, presented with codes and the actual time period. The final sample consists of 1594 observations. Austria, Denmark, Ireland and Luxembourg are analysed at the national level. The major source of data was the Agricultural Accounts in Regio (AGRI-R) from Cronos in Eurostat (1973-1997). This database is used to obtain the disaggregated outputs and intermediate inputs, in current and constant 1990 prices, and labour in annual work units (AWU). Capital is measured by depreciation, in constant terms using the deflator of gross investment or, when the former is not available, by the repair price index. When depreciation is not available by regions, as in Italy, the national data has been allocated proportionally to capital formation. Land is agricultural area in hectares. Interpolation has been used for completion of series in capital, land and labour.

In addition, data has been corrected according to the Structure of Agricultural Holdings Surveys (1987, 1990, 1993, 1995, 1997).

--- TABLE 1 ---

The database covers 40 outputs that were grouped into two major categories, crops and animal products. Intermediate inputs are grouped into two major categories: feeds and other materials (fertilizer, energy and other intermediate consumption). It is assumed that all intermediate inputs purchased were used within the year. Using constant 1990 values and values for the individual items at the national level, translog price indexes are estimated for crop output, animal output, feed and other materials. Thus, the different compositions of inputs and outputs are instrumental in obtaining different price indices at the regional level, although national prices are used for each item. Quantities in 1990 terms for the two outputs and the two intermediate inputs are calculated, deflating current values by the price indices. All output, intermediate input and depreciation data, originally reported in local currencies was converted into ECUs, using the 1990 exchange rates.

There are differences in the size and relative importance of agricultural inputs and products for the EU countries. Of course, there were important changes in agricultural production in the EU countries over the period considered, too. To illustrate these, Table 2 presents the mean quantities of each input and output. There are important differences in size and orientation among regions.

--- TABLE 2 ---

Animal production is higher than crop production in average (crop production is 69% of animal production. However, crop production is higher than animal production for 65 regions. This means that larger regions are oriented to animal production. The largest crop producer is Andalusia in Spain. The largest animal producer is Luxembourg, followed by Britain in France and Bavaria in Germany. Britain is the main feed consumer and Bavaria is the largest user of other intermediate consumptions. The largest use of agricultural labour is in Northern Portugal. The region with largest agricultural area is Castile-Leon in Spain.

--- TABLE 3 ---

Table 3 shows the correlations between outputs and inputs. It is remarkable the high correlation between animal production and intermediate consumptions, not only feed, and the relatively low correlation between labour and animal production. The low correlations between feed and agricultural production and feed and agricultural area are unsurprising.

--- TABLE 4 ---

Table 4 shows the average annual growth rates for outputs and inputs. Crop production increases for 85 regions. The largest growth is for the relatively unimportant producer Övre Norland in Sweden, but very important rates of growth are given in several French and Spanish regions. Animal output decreases slightly in average and for 59 regions. The greater variability in rates of animal production growth is in Greece.

There are small decreases in the consumption of feed, other materials and capital. The decrease in labour use is remarkable, with only 3 regions in Italy increasing labour (Trentino-Alto Adige, Molise and Calabria). Agricultural land increases for 59 regions and in average.

--- TABLE 5 ---

Table 5 shows the correlations between rates of growth. The high correlation between animal production and feed is expected, but the high correlations between the rates of growth of labour and feed and other materials are remarkable.

Next, the methodology explained in section 2 is applied. The analytical approach implemented is based on the assumption that technologies are evolving in time non-regressively, meaning that the analysis is able to capture productivity increases as improvements in technology, and productivity decreases as inefficiencies. Table 6 presents a summary of the results of the productivity analysis. As can be observed, it is easy to deal with unbalanced panels. The period of the analysis is reproduced for comparison purposes. The productivity measure for the beginning period, the year of higher productivity, the higher and lower productivity levels, and the years supporting the reference frontier follow.

---TABLE 6 ---

Sixty-two observations out of 1594 (3.9%) support the intertemporal reference technology. There are several regions in Greece, France, Italy, Portugal, Spain, all regions in The Netherlands, Luxembourg, and Berlin. Given non-regressive technical change, the assumption of unchanged technology is binding in eight regions with the higher productivity in the first period, with other eleven regions with higher productivity in the second year. We can observe the relatively good productivity scores of the Southern regions and the islands.

An important issue is the evolution of productivity. A measure of average productivity, composite of efficiency and technical change, is given by the logarithm of the ratio of the final to the beginning productivity measure divided by the number of years. There is a pattern for the evolution of the indices of productivity according to orientation, and related to geographical criteria. Productivity growth is positively related to the rate of crop production (correlation coefficient is 0.22) but not to the rate of growth of animal production (correlation -0.03) and negatively related to the rate of growth of feed (correlation -0.25) and more important other materials (correlation -0.46) and labour (correlation -0.50).

The former results mean, firstly, that the Southern regions and the regions belonging to the former Democratic Republic of Germany are among those with larger productivity gains. In a certain sense, it is evidence of greater productivity increases in the ‘periphery’ that in the ‘centre’. This finding contradicts previous analysis at a national level as in Schimmelpfennig and Thirtle (1999) that are accepted as ‘established facts’ of the evolution of productivity in the European agricultures. Secondly, the above results support the idea of productivity increases related to de-intensification, an evolution of agricultural productivity growth in a ‘recessive’ instead of a ‘progressive’ way, just opposite to the evolution analysed in Bureau et al. (1991) for a former period.

It must be taken into account that the regions that begin with a low level of productivity and reach the maximum toward the end of the period of analysis exhibit a higher growth rate for the technology index. The detailed evolution of the productivity measures for the different is presented in Table A1 and the evolution of the non-decreasing technical change element in Table A2.

Radial efficiency measures give only a particular form of inefficiency that can be explained by a proportional contraction in input usage. There are other inefficiencies associated with the use of some inputs that can be reduced beyond a radial decrease, measured by the slacks in the linear programming results. The DEA-panel methodology imposes the most restrictive conditions on achieving efficiency, and this leads to the identification of those countries or years presenting inefficiency in specific outputs or inputs. This means an advance in non-radial productivity, which the usual Malmquist approach can hardly identify. Note that the use of the Russell non-radial measure for the measurement of productivity, an interesting alternative productivity estimate, leaves particular output specific inefficiency unexplained.

-- TABLE 7 ---

Table 7 presents a summary of slacks, because this kind of inefficiency occurs frequently. Crop slacks appear more frequently than animal slacks for three countries (Austria, Denmark and Ireland), but there is no specific animal output inefficiency.

Specific inefficiency in the use of feedstuff is not very frequent, and specific inefficiency in other materials usage is uncommon. Specific inefficiency in capital and in land, mainly, is pervasive. The detailed estimates of particular efficiencies are available, although they are not presented here.

4. CONCLUSIONS

This study estimates the agricultural productivity of the European Union regions using a DEA methodology applied to panel data. Decomposition in efficiency and technical change elements is accomplished by means of restrictions on the general structure of the technology indices. Productivity measures are calculated using the full sample consisting of pooled cross sections of time series for the regions of the European Union from 1982 to 1997. In the intertemporal DEA approach, the productivity results appear as a consequence of the comparison between all available units, so it has a higher discriminatory capacity.

There are some differences in the results with respect to those in earlier studies of EU agriculture. The periphery appears with high productivity level and the highest productivity rates of change. Productivity increase is related to developments in the crops sector, and to decreasing usage of intermediate inputs. It suggests a 'recessive' way of increasing productivity. There are major differences with data and methodology used in previous studies of productivity in EU agriculture. In particular, differences in regional aggregation and in time periods analysed, in addition to the use of intertemporal DEA, could explain the emergence of new results.

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Table 1. Regions

Code	Region	Period
at	**Austria**	82-97
	Belgique	
be2	Vlaams Gewest	82-95
be3	Région Wallonne	82-95
	Germany	
de1	Baden-Württemberg	82-97
de2	Bayern	82-97
de3	Berlin	82-97
de4	Brandenburg	90-97
de7	Hessen	82-97
de8	Mecklenburg-Vorpommern	90-97
de9	Niedersachsen	82-97
dea	Nordrhein-Westfalen	82-97
deb	Rheinland-Pfalz	82-97
dec	Saarland	82-97
ded	Sachsen	90-97
dee	Sachsen-Anhalt	90-97
def	Schleswig-Holstein	82-97
deg	Thüringen	90-97
dk	**Denmark**	82-97
	España	
es11	Galicia	82-95
es12	Principado de Asturias	82-95
es13	Cantabria	82-95
es21	Pais Vasco	82-95
es22	Comunidad Foral de Navarra	82-95
es23	La Rioja	82-95
es24	Aragón	82-95
es3	Comunidad de Madrid	82-95
es41	Castilla y León	82-95
es42	Castilla-la Mancha	82-95
es43	Extremadura	82-95
es51	Cataluña	82-95
es52	Comunidad Valenciana	82-95
es53	Illes Balears	82-95
es61	Andalucia	82-95
es62	Murcia	82-95
es7	Canarias	82-95
	Finland	
fi13	Itä-Suomi	92-97
fi14	Väli-Suomi	92-97
fi15	Pohjois-Suomi	92-97
fi16	Uusimaa	92-97
	France	
fr1	Île de France	82-96
fr21	Champagne-Ardenne	82-96
fr22	Picardie	82-96
fr23	Haute-Normandie	82-96
fr24	Centre	82-96
fr25	Basse-Normandie	82-96
fr26	Bourgogne	82-96
fr3	Nord - Pas-de-Calais	82-96
fr41	Lorraine	82-96
fr42	Alsace	82-96
fr43	Franche-Comté	82-96
fr51	Pays de la Loire	82-96
fr52	Bretagne	82-96
fr53	Poitou-Charentes	82-96
fr61	Aquitaine	82-96
fr62	Midi-Pyrénées	82-96
fr63	Limousin	82-96
fr71	Rhône-Alpes	82-96
fr72	Auvergne	82-96
fr81	Languedoc-Roussillon	82-96
fr82	Provence-Alpes-Côte d'Azur	82-96
fr83	Corse	82-96

Code	Region	Period
	Greece	
gr11	Anatoliki Makedonia, Thraki	83-94
gr12	Kentriki Makedonia	83-94
gr13	Dytiki Makedonia	83-94
gr14	Thessalia	83-94
gr21	Ipeiros	83-94
gr22	Ionia Nisia	83-94
gr23	Dytiki Ellada	83-94
gr24	Sterea Ellada	83-94
gr25	Peloponnisos	83-94
gr3	Attiki	83-94
gr41	Voreio Aigaio	83-94
gr42	Notio Aigaio	83-94
gr43	Kriti	83-94
ie	Ireland	82-97
	Italia	
it11	Piemonte	82-96
it13	Liguria	82-96
it2	Lombardia	82-96
it31	Trentino-Alto Adige	82-96
it32	Veneto	82-96
it33	Friuli-Venezia Giulia	82-96
it4	Emilia-Romagna	82-96
it51	Toscana	82-96
it52	Umbria	82-96
it53	Marche	82-96
it6	Lazio	82-96
it71	Abruzzo	82-96
it72	Molise	82-96
it8	Campania	82-96
it91	Puglia	82-96
it92	Basilicata	82-96
it93	Calabria	82-96
ita	Sicilia	82-96
itb	Sardegna	82-96
lu	Luxembourg	87-97
	Nederland	
nl1	Noord-Netherland	82-93
nl2	Oost-Nederland	82-93
nl3	West-Nederland	82-93
nl4	Zuid-Nederland	82-93
	Portugal	
pt11	Norte	86-97
pt12	Centro	86-97
pt13	Lisboa e Vale do Tejo	86-97
pt14	Alentejo	86-97
pt15	Algarve	86-97
pt2	Açores	86-97
pt3	Madeira	86-97
	Sverige	
se01	Stockholm	88-97
se02	Östra Mellansverige	88-97
se04	Sydsverige	88-97
se06	Norra Mellansverige	88-97
se07	Mellersta Norrland	88-97
se08	Övre Norrland	88-97
	United Kingdom	
uke	Yorkshire and The Humber	82-95
ukf	East Midlands	82-95
ukg	West Midlands	82-95
ukk	South West	82-95
ukl	Wales	82-95
ukm	Scotland	82-95
ukn	Northern Ireland	82-95

Table 2. Outputs and inputs. Means. (1)

Code	crop	animal	feed	other	capital	labour	area
at	1475.7	3034.1	385.2	2054.9	1197.9	251.2	3471.8
be2	1739.6	2783.3	1263.8	1256.2	309.7	65.9	609.1
be3	627.8	1057.6	270.7	541.0	150.2	30.4	753.0
de1	1664.4	1907.3	395.6	1207.2	769.0	122.4	1479.6
de2	1699.4	4931.2	996.7	2579.4	1783.5	260.6	3386.8
de3	42.6	5.4	1.5	19.0	9.8	5.2	26.9
de4	499.2	799.3	231.7	486.9	166.6	38.8	1283.0
de7	573.9	890.5	173.5	622.8	336.1	50.4	774.6
de8	622.7	714.6	200.5	533.1	162.4	34.0	1315.9
de9	2056.0	4747.1	1355.1	2095.1	916.4	124.5	2711.7
dea	1572.3	3075.9	908.5	1657.4	720.8	99.1	1574.2
deb	1144.5	608.0	121.0	656.8	328.8	60.3	717.7
dec	50.0	67.9	14.5	45.2	25.4	3.5	68.7
ded	531.1	747.3	184.5	431.2	170.2	32.9	885.8
dee	690.5	636.9	179.0	517.8	168.4	31.5	1088.4
def	828.1	1482.9	504.9	794.3	332.1	40.3	1080.0
deg	434.9	581.5	161.3	367.3	135.6	31.8	784.7
dk	2052.9	4670.7	1601.9	1672.4	887.0	127.9	2787.6
es11	470.6	1231.6	319.7	342.4	205.2	252.7	657.7
es12	49.9	350.7	107.6	67.2	40.4	60.5	385.3
es13	19.0	223.3	62.5	37.9	17.0	28.8	213.6
es21	174.0	220.3	103.6	75.2	31.4	34.4	218.9
es22	298.0	251.0	122.9	128.8	50.3	21.9	561.0
es23	311.7	98.6	43.1	84.2	30.8	16.2	196.7
es24	789.2	833.4	528.6	463.6	192.8	66.4	2392.9
es3	119.6	180.7	95.5	61.0	38.9	10.3	363.3
es41	1431.9	1675.4	560.8	902.8	418.8	159.6	5218.3
es42	1436.4	816.8	355.9	601.5	322.8	94.7	4330.1
es43	686.1	506.7	185.9	260.9	109.5	64.4	2925.6
es51	1201.0	1927.2	1443.5	594.3	218.9	96.5	1124.2
es52	1941.7	425.8	281.7	580.7	100.7	90.5	751.4
es53	188.0	104.2	60.4	64.2	29.6	16.3	227.0
es61	4450.3	855.0	349.0	1089.0	317.3	252.1	4603.6
es62	949.8	309.1	226.1	342.7	44.5	44.3	522.6
es7	536.8	133.5	46.3	241.1	13.3	39.5	80.5
fi13	46.4	648.7	136.3	224.1	145.3	28.2	371.8
fi14	233.9	829.2	181.0	355.0	204.6	34.6	540.0
fi15	37.4	415.7	96.5	146.5	104.5	15.9	247.0
fi16	230.9	132.2	26.3	122.4	69.1	59.1	1202.7
fr1	987.3	88.7	39.6	403.4	98.5	17.9	584.4
fr21	2463.2	447.0	98.7	828.4	245.7	48.6	1552.4
fr22	1758.6	612.8	186.7	837.1	201.3	39.5	1345.3
fr23	613.3	577.2	107.1	406.6	113.1	28.8	807.8
fr24	2383.9	696.7	193.8	1079.2	301.4	71.2	2435.8
fr25	411.9	1533.7	267.1	575.9	180.2	66.2	1310.7
fr26	1395.1	770.4	140.7	625.6	219.5	54.1	1766.8
fr3	1046.1	898.8	256.6	640.9	161.7	44.7	855.6
fr41	425.6	695.0	119.3	356.1	142.5	31.7	1105.5
fr42	559.6	248.3	61.3	208.5	90.8	25.7	338.5
fr43	170.4	577.2	114.5	215.5	74.1	24.7	664.7
fr51	1380.9	3117.0	883.6	1087.9	312.5	119.4	2250.9
fr52	776.8	4954.9	2113.8	1172.9	437.5	122.2	1769.2
fr53	1301.9	980.0	300.7	735.1	257.6	68.7	1770.4
fr61	2274.7	1060.8	281.0	955.0	306.0	115.3	1494.4
fr62	1427.3	1350.8	304.4	937.0	325.3	115.0	2355.3
fr63	87.2	524.7	89.8	243.9	82.7	36.9	876.5
fr71	1399.3	1342.6	379.3	660.5	254.2	104.5	1596.4
fr72	288.2	942.8	192.3	360.3	159.2	55.8	1505.4
fr81	1789.1	199.6	65.5	472.9	181.9	76.9	1013.4
fr82	1873.1	155.8	59.9	593.0	188.7	64.7	624.0
fr83	92.8	39.1	7.3	45.5	8.7	5.4	109.5

Table 2. Outputs and inputs. Means. (2)

Code	crop	animal	feed	other	capital	labour	area
gr11	569.4	182.2	35.7	134.4	45.0	74.3	359.5
gr12	1238.4	423.3	120.3	350.5	100.9	137.3	603.1
gr13	181.3	114.7	24.4	63.3	17.8	26.7	198.6
gr14	815.7	293.2	57.8	179.8	74.9	85.6	424.7
gr21	188.7	213.9	58.1	53.8	7.1	46.7	126.0
gr22	130.9	41.8	7.1	20.5	4.0	22.7	80.8
gr23	626.9	226.2	34.3	119.7	27.1	92.3	284.9
gr24	548.5	259.7	58.7	144.5	34.5	72.4	374.7
gr25	758.6	244.1	38.8	127.2	28.9	108.2	411.8
gr3	160.2	130.7	38.9	47.3	5.9	16.3	56.3
gr41	96.2	62.0	8.1	17.5	2.4	23.8	157.7
gr42	88.8	74.3	7.2	17.5	3.3	18.5	134.1
gr43	595.3	194.1	39.9	92.0	12.0	78.3	381.5
ie	520.1	3546.3	711.6	1096.0	435.9	249.3	4596.6
it11	1431.9	1395.2	522.4	436.2	634.0	156.8	1299.6
it13	587.4	89.6	34.5	60.1	101.1	46.8	98.6
it2	1232.9	3446.3	1242.4	633.2	725.1	130.5	1237.6
it31	568.3	301.1	112.4	84.6	240.6	50.3	456.2
it32	1984.5	1817.1	690.6	533.0	749.2	165.1	978.6
it33	386.5	310.8	116.7	118.5	179.8	38.3	288.7
it4	2615.0	2313.2	883.3	647.3	820.7	153.2	1362.7
it51	1096.6	491.0	184.3	244.5	444.6	107.3	1060.9
it52	377.3	273.1	99.9	103.6	162.1	41.4	452.5
it53	673.2	375.6	144.8	172.8	231.4	61.6	635.6
it6	1402.0	650.5	242.0	254.5	401.0	129.1	923.2
it71	732.3	283.3	105.1	125.7	265.1	70.3	573.5
it72	159.4	121.2	46.0	40.6	118.6	24.4	274.6
it8	2170.0	593.3	223.5	289.3	489.8	228.8	722.1
it91	3013.3	326.3	117.1	429.1	456.5	203.1	1623.7
it92	341.9	143.9	52.2	79.0	200.5	48.7	677.6
it93	1076.8	286.6	109.8	126.7	355.2	117.8	736.2
ita	2982.8	512.6	191.2	355.9	690.4	178.5	1768.3
itb	469.2	613.5	217.5	114.8	350.9	73.8	1515.6
lu	1432.0	6456.1	906.3	2204.1	1233.7	5.8	126.3
nl1	550.3	1535.5	456.4	488.8	234.4	33.5	570.7
nl2	736.2	3239.5	1526.5	762.0	362.2	65.1	563.2
nl3	3401.5	1157.1	349.5	1280.1	489.4	78.1	493.4
nl4	1039.9	2992.6	1651.7	780.3	334.6	56.8	389.2
pt11	587.5	488.3	148.4	297.6	43.9	282.9	733.6
pt12	452.6	551.3	256.8	249.2	39.4	232.4	641.0
pt13	618.3	562.5	320.9	319.3	40.2	112.1	500.9
pt14	362.8	356.6	102.9	246.5	21.8	51.2	1654.3
pt15	135.6	42.7	19.8	44.0	6.1	24.5	136.2
pt2	31.2	158.4	30.7	26.1	3.5	18.7	117.5
pt3	55.0	24.8	12.6	11.9	1.7	18.6	7.6
se01	61.4	51.3	20.0	45.9	23.5	2.5	108.0
se02	390.7	481.1	151.1	379.8	182.9	17.6	837.1
se04	496.2	614.5	199.8	387.4	151.6	17.6	591.4
se06	66.5	206.9	56.7	122.1	62.7	8.4	288.1
se07	4.0	123.4	30.4	46.5	22.9	4.9	118.6
se08	7.2	164.7	39.0	62.5	29.6	4.5	121.2
uke	782.6	952.4	395.1	565.7	220.0	38.4	1108.7
ukf	1208.5	859.7	344.2	708.5	258.7	41.5	1226.0
ukg	605.4	1034.9	375.4	539.8	204.0	39.1	914.7
ukk	580.2	1935.4	680.6	825.2	310.4	70.5	1758.2
ukl	66.8	1010.6	271.6	452.5	173.6	48.8	1448.0
ukm	593.1	1303.8	314.4	804.1	328.3	60.9	5158.6
ukn	97.2	1019.7	336.4	378.5	186.0	42.7	996.7
mean	865.5	961.3	303.5	479.9	243.7	73.0	1055.1

Table 3. Outputs and inputs. Correlations.

	crop	animal	feed	other	capital	labour	area
crop	1	0.35	0.34	0.59	0.57	0.57	0.47
animal		1	0.87	0.85	0.79	0.38	0.44
feed			1	0.66	0.59	0.33	0.35
other				1	0.83	0.43	0.58
capital					1	0.54	0.49
labour						1	0.53
area							1

Table 4. Outputs and Inputs rates of growth. Correlations.

	crop	animal	feed	other	capital	labour	area
crop	1	-0.12	-0.03	0.13	0.17	0.04	0.09
animal		1	0.66	0.24	0.07	0.27	0.06
feed			1	0.25	-0.12	0.53	-0.12
other				1	0.34	0.64	0.17
capital					1	0.07	0.48
labour						1	0.21
area							1

Table 5. Outputs and inputs rates of growth (1).

Code	crop	animal	feed	other	capital	labour	area
at	-0.007	-0.001	-0.003	-0.011	-0.038	-0.039	-0.004
be2	0.031	0.024	0.026	0.053	0.033	-0.025	-0.001
be3	0.013	0.006	-0.004	0.018	0.010	-0.025	-0.003
de1	-0.016	-0.006	-0.009	0.002	-0.014	-0.041	-0.003
de2	0.021	-0.007	-0.003	-0.007	-0.007	-0.038	-0.002
de3	-0.025	-0.033	-0.034	-0.006	0.012	-0.062	-0.014
de4	0.010	0.035	0.106	0.097	0.012	0.137	-0.008
de7	0.008	-0.015	-0.018	-0.005	-0.034	-0.046	0.000
de8	-0.035	0.046	0.134	0.062	-0.007	0.151	-0.003
de9	0.010	0.003	0.008	0.001	-0.016	-0.038	-0.001
dea	0.011	-0.005	-0.010	0.003	-0.021	-0.039	-0.004
deb	-0.005	-0.019	-0.025	-0.021	-0.045	-0.048	-0.002
dec	-0.033	-0.016	-0.029	-0.022	-0.040	-0.043	0.006
ded	-0.025	0.032	0.108	0.079	-0.019	0.138	-0.007
dee	-0.014	0.048	0.132	0.078	-0.009	0.142	-0.013
def	-0.003	-0.010	-0.031	-0.001	-0.010	-0.036	-0.004
deg	-0.041	0.030	0.103	0.078	-0.016	0.148	-0.001
dk	0.014	0.012	0.010	-0.006	-0.028	-0.033	-0.005
es11	0.016	0.014	-0.015	0.011	0.028	-0.046	-0.008
es12	0.006	-0.006	-0.007	0.020	0.028	-0.016	-0.005
es13	-0.006	0.034	-0.035	0.052	0.003	-0.034	0.009
es21	0.016	-0.017	0.007	0.012	0.022	-0.058	0.005
es22	-0.006	0.031	0.027	0.007	0.020	-0.026	0.008
es23	0.041	-0.003	-0.026	-0.008	0.004	-0.038	0.018
es24	-0.005	0.026	0.033	0.014	0.017	-0.047	0.007
es3	-0.019	-0.048	-0.039	-0.013	-0.038	-0.037	-0.019
es41	0.017	0.021	0.015	0.004	0.003	-0.057	0.000
es42	-0.026	-0.001	-0.003	-0.001	-0.002	-0.030	0.009
es43	-0.012	0.031	0.061	-0.005	-0.015	-0.018	-0.006
es51	0.000	0.016	0.003	0.019	-0.005	-0.036	-0.002
es52	0.010	0.022	0.052	-0.011	0.004	-0.023	-0.011
es53	0.050	-0.031	-0.015	-0.026	-0.010	-0.036	-0.004
es61	0.017	0.016	0.027	0.017	-0.001	-0.011	0.001
es62	0.047	0.006	0.035	0.048	-0.030	-0.026	-0.003
es7	-0.002	0.010	-0.008	-0.028	0.005	-0.047	-0.029
fi13	-0.007	0.002	0.011	0.000	-0.055	-0.041	-0.059
fi14	0.013	0.021	0.024	0.004	-0.058	-0.034	-0.030
fi15	-0.035	-0.008	-0.010	0.002	-0.062	-0.046	-0.037
fi16	0.028	0.010	0.017	-0.032	-0.060	-0.033	-0.031
fr1	-0.008	-0.008	-0.011	-0.023	-0.002	-0.041	0.000
fr21	0.006	-0.011	-0.004	-0.018	0.003	-0.028	0.002
fr22	0.015	-0.003	-0.005	-0.019	0.005	-0.034	0.001
fr23	0.024	-0.007	0.008	-0.018	-0.010	-0.044	-0.001
fr24	0.004	-0.006	0.010	-0.018	-0.002	-0.046	-0.002
fr25	0.036	0.004	0.016	-0.008	-0.005	-0.046	-0.003
fr26	0.016	-0.002	0.030	-0.018	-0.001	-0.041	0.001
fr3	0.023	-0.006	0.004	-0.019	0.000	-0.037	0.000
fr41	0.042	-0.002	0.016	-0.007	-0.010	-0.045	0.002
fr42	0.007	-0.009	0.017	-0.007	0.002	-0.039	0.000
fr43	0.040	0.002	-0.005	-0.024	-0.005	-0.040	0.001
fr51	0.020	0.014	0.031	-0.015	-0.004	-0.042	-0.004
fr52	0.053	0.019	0.027	-0.015	-0.003	-0.047	0.000
fr53	0.014	-0.001	0.028	-0.013	-0.006	-0.039	0.001
fr61	0.035	0.010	0.028	-0.008	-0.006	-0.033	0.001
fr62	0.022	0.001	0.019	-0.016	-0.008	-0.038	-0.001
fr63	0.027	-0.002	0.046	-0.014	-0.003	-0.036	0.000
fr71	0.005	0.003	0.003	-0.026	-0.004	-0.043	-0.001
fr72	0.038	0.001	0.030	-0.019	0.000	-0.041	0.002
fr81	-0.007	0.010	0.021	-0.016	-0.004	-0.043	0.001
fr82	0.000	-0.011	-0.005	-0.016	-0.005	-0.032	0.001
fr83	-0.015	0.026	0.045	-0.025	-0.043	-0.045	0.001

Table 5. Outputs and inputs rates of growth (2).

Code	crop	animal	feed	other	capital	labour	area
gr11	0.021	0.023	0.087	-0.025	-0.005	-0.030	0.004
gr12	0.021	0.029	0.056	0.017	-0.005	-0.025	0.000
gr13	0.031	-0.039	0.051	0.008	-0.005	-0.011	-0.001
gr14	0.024	0.015	0.009	-0.009	-0.005	-0.022	0.002
gr21	0.015	-0.110	-0.077	0.031	-0.005	-0.020	-0.006
gr22	-0.010	0.014	-0.014	0.013	-0.005	-0.013	-0.003
gr23	-0.012	0.013	0.022	-0.004	-0.005	-0.025	0.006
gr24	0.020	-0.002	0.002	0.032	-0.005	-0.024	-0.005
gr25	0.017	0.036	0.021	0.004	-0.005	-0.035	-0.008
gr3	0.037	-0.061	-0.088	0.083	-0.005	-0.035	0.022
gr41	0.020	-0.053	-0.042	0.005	-0.005	-0.024	-0.018
gr42	0.045	-0.071	-0.008	0.005	-0.005	-0.023	0.000
gr43	-0.001	0.016	-0.040	0.023	-0.005	-0.040	-0.012
ie	0.003	0.020	0.022	0.021	0.007	-0.023	-0.009
it11	0.013	0.012	-0.001	0.006	0.020	-0.019	0.046
it13	0.024	-0.002	-0.010	0.021	0.045	-0.055	0.035
it2	0.045	0.014	0.003	0.015	-0.001	-0.028	0.051
it31	0.026	0.017	0.008	0.019	0.021	0.002	0.051
it32	0.016	0.014	0.003	-0.002	0.023	-0.033	0.053
it33	0.035	-0.004	-0.014	0.000	0.015	-0.023	0.053
it4	-0.004	-0.002	-0.013	0.003	0.020	-0.020	0.053
it51	0.005	-0.017	-0.030	0.003	0.010	-0.018	0.045
it52	0.017	-0.012	-0.027	0.007	0.026	-0.025	0.052
it53	0.017	-0.020	-0.034	0.005	0.018	-0.033	0.046
it6	-0.008	0.002	-0.008	0.009	0.030	-0.018	0.050
it71	0.008	-0.012	-0.025	0.017	0.021	-0.009	0.056
it72	0.005	0.029	0.017	0.020	0.014	0.003	0.053
it8	-0.008	0.003	-0.008	0.006	0.028	-0.023	0.056
it91	0.020	0.003	-0.008	0.028	-0.008	-0.009	0.050
it92	0.016	-0.008	-0.022	0.009	-0.012	-0.010	0.052
it93	0.032	-0.020	-0.033	0.018	0.054	0.000	0.050
ita	0.006	0.017	0.004	0.015	0.018	-0.019	0.052
itb	0.006	0.019	0.007	0.023	0.018	-0.006	0.053
lu	-0.022	0.005	0.000	0.010	0.016	-0.024	0.001
nl1	0.034	-0.004	-0.020	0.031	0.050	-0.011	-0.001
nl2	0.055	0.007	-0.009	0.069	0.053	-0.011	0.002
nl3	0.067	-0.010	-0.037	0.055	0.053	-0.001	-0.001
nl4	0.044	0.023	-0.001	0.082	0.058	-0.007	0.000
pt11	-0.029	0.014	0.036	-0.013	0.043	-0.060	0.003
pt12	0.000	0.023	0.044	0.001	0.011	-0.070	0.001
pt13	0.024	0.027	0.032	0.006	-0.023	-0.053	-0.012
pt14	0.001	0.025	0.012	-0.012	-0.033	-0.025	0.035
pt15	0.023	-0.017	-0.027	0.024	-0.001	-0.079	-0.006
pt2	-0.014	0.027	-0.014	0.043	0.001	-0.042	-0.002
pt3	-0.043	-0.035	-0.023	-0.043	0.011	-0.023	-0.012
se01	0.005	-0.004	-0.005	-0.014	-0.044	-0.023	-0.016
se02	-0.009	0.006	0.005	-0.008	-0.037	-0.029	-0.010
se04	-0.008	-0.004	-0.011	-0.028	-0.047	-0.030	-0.010
se06	0.005	-0.009	-0.005	-0.016	-0.048	-0.025	-0.018
se07	0.034	-0.024	-0.011	-0.024	-0.040	-0.031	-0.012
se08	0.106	-0.024	-0.011	-0.026	-0.044	-0.016	-0.004
uke	0.013	0.004	0.003	0.003	-0.003	-0.032	-0.006
ukf	0.009	-0.002	0.028	-0.001	-0.026	-0.034	0.005
ukg	0.007	0.003	-0.001	0.004	0.002	-0.034	-0.011
ukk	0.008	0.007	-0.010	0.012	0.006	-0.042	-0.010
ukl	-0.015	0.000	0.018	0.017	0.011	-0.031	-0.002
ukm	0.024	0.005	0.022	-0.002	-0.007	-0.025	-0.006
ukn	0.027	0.017	0.021	0.014	0.018	-0.031	-0.001
mean	0.013	-0.001	-0.003	-0.001	-0.002	-0.036	0.005

Table 6. Intertemporal DEA. Statistical summary (1).

Code	Period	First d	Final d	Year max	Max d	Min d	Supporting reference set
at	82-97	0.575	0.685	90	0.798	0.574	
be2	82-95	0.816	0.788	83	0.816	0.704	
be3	82-95	0.697	0.704	93	0.754	0.674	
de1	82-97	0.617	0.612	90	0.689	0.586	
de2	82-97	0.606	0.647	82	0.651	0.571	
de3	82-97	0.718	0.971	88	1.000	0.432	88
de4	90-97	0.409	0.634	93	0.663	0.409	
de7	82-97	0.575	0.627	96	0.636	0.543	
de8	90-97	0.424	0.643	93	0.679	0.424	
de9	82-97	0.664	0.774	97	0.774	0.644	
dea	82-97	0.602	0.674	97	0.674	0.565	
deb	82-97	0.579	0.724	92	0.736	0.526	
dec	82-97	0.567	0.634	96	0.668	0.545	
ded	90-97	0.418	0.647	93	0.648	0.614	
dee	90-97	0.425	0.659	96	0.672	0.425	
deg	82-97	0.410	0.677	96	0.677	0.410	
def	90-97	0.634	0.661	97	0.673	0.575	
dk	82-97	0.647	0.895	97	0.895	0.645	
es11	82-95	0.622	0.755	95	0.755	0.554	
es12	82-95	0.873	0.644	82	0.873	0.606	
es13	82-95	0.797	0.868	92	0.982	0.711	
es21	82-95	0.582	0.627	92	0.652	0.524	
es22	82-95	0.567	0.663	92	0.786	0.567	
es23	82-95	0.532	1.000	95	1.000	0.532	95
es24	82-95	0.470	0.556	89	0.648	0.470	
es3	82-95	0.746	0.626	91	0.774	0.558	
es41	82-95	0.451	0.638	93	0.721	0.451	
es42	82-95	0.542	0.514	92	0.707	0.514	
es43	82-95	0.528	0.615	92	0.785	0.494	
es51	82-95	0.695	0.785	95	0.785	0.600	
es52	82-95	0.655	0.884	93	0.945	0.604	
es53	82-95	0.466	1.000	95	1.000	0.466	95
es61	82-95	0.655	0.752	92	0.911	0.655	
es62	82-95	0.577	0.728	92	0.896	0.568	
es7	82-95	0.596	0.845	92	0.881	0.501	
fi13	92-97	0.738	0.760	97	0.760	0.668	
fi14	92-97	0.623	0.672	95	0.693	0.609	
fi15	92-97	0.742	0.738	95	0.786	0.607	
fi16	92-97	0.384	0.461	97	0.461	0.367	
fr1	82-96	0.806	1.000	96	1.000	0.762	96
fr21	82-96	0.835	1.000	90	1.000	0.759	90,96
fr22	82-96	0.597	0.956	96	0.956	0.580	
fr23	82-96	0.680	0.860	96	0.860	0.657	
fr24	82-96	0.604	0.775	96	0.775	0.595	
fr25	82-96	0.768	0.892	96	0.892	0.768	
fr26	82-96	0.766	0.959	96	0.959	0.683	
fr3	82-96	0.610	0.863	96	0.863	0.582	
fr41	82-96	0.729	0.832	96	0.832	0.684	
fr42	82-96	0.738	0.858	96	0.858	0.642	
fr43	82-96	0.653	0.928	96	0.928	0.647	
fr51	82-96	0.708	0.998	96	0.998	0.708	
fr52	82-96	0.747	1.000	96	1.000	0.747	96
fr53	82-96	0.584	0.741	94	0.753	0.535	
fr61	82-96	0.575	0.905	96	0.905	0.555	
fr62	82-96	0.578	0.726	96	0.726	0.547	
fr63	82-96	0.813	0.669	82	0.813	0.583	
fr71	82-96	0.627	0.924	96	0.924	0.582	
fr72	82-96	0.715	0.809	96	0.809	0.634	
fr81	82-96	0.985	0.946	82	0.985	0.784	
fr82	82-96	0.891	0.979	89	1.000	0.848	89,95
fr83	82-96	0.643	0.752	92	1.000	0.494	92

Table 6. Intertemporal DEA. Statistical summary (2).

Code	Period	First d	Final d	Year max	Max d	Min d	Supporting reference set
gr11	83-94	0.674	0.837	94	0.837	0.580	
gr12	83-94	0.614	0.697	88	0.801	0.555	
gr13	83-94	0.656	0.665	84	0.696	0.502	
gr14	83-94	0.639	0.881	91	0.900	0.618	
gr21	83-94	1.000	0.906	83	1.000	0.598	83,88,91
gr22	83-94	0.966	0.811	88	1.000	0.628	88
gr23	83-94	0.891	0.815	85	1.000	0.680	85
gr24	83-94	0.666	0.732	88	0.815	0.602	
gr25	83-94	0.770	1.000	94	1.000	0.635	94
gr3	83-94	1.000	0.866	83	1.000	0.711	83,84,88,89,91
gr41	83-94	0.949	0.952	88	1.000	0.755	88,91
gr42	83-94	0.809	0.970	88	1.000	0.728	88,91
gr43	83-94	1.000	0.975	83	1.000	0.705	83,85,89
ie	82-97	0.668	0.742	88	0.775	0.668	
it11	82-96	0.663	0.814	96	0.814	0.654	
it13	82-96	0.856	0.941	84	1.000	0.796	84,90,93,94,95
it2	82-96	0.894	1.000	93	1.000	0.894	93-96
it31	82-96	0.861	0.963	96	0.963	0.739	
it32	82-96	0.717	0.939	96	0.939	0.717	
it33	82-96	0.584	0.758	96	0.758	0.584	
it4	82-96	0.896	0.926	83	0.938	0.782	
it51	82-96	0.624	0.660	83	0.665	0.587	
it52	82-96	0.621	0.703	96	0.703	0.594	
it53	82-96	0.610	0.703	96	0.703	0.586	
it6	82-96	0.749	0.739	83	0.771	0.667	
it71	82-96	0.744	0.692	83	0.781	0.624	
it72	82-96	0.591	0.645	86	0.657	0.563	
it8	82-96	0.794	0.692	83	0.864	0.665	
it91	82-96	0.694	0.919	94	0.971	0.694	
it92	82-96	0.489	0.536	94	0.591	0.454	
it93	82-96	0.695	0.784	85	1.000	0.589	85
ita	82-96	0.772	0.853	83	0.981	0.669	
itb	82-96	0.913	0.934	83	1.000	0.716	83
lu	87-97	0.993	1.000	87	1.000	0.973	87,89,90,92,93,96,97
nl1	82-93	0.934	1.000	90	1.000	0.708	90,91,93
nl2	82-93	0.969	1.000	84	1.000	0.729	84,90,93
nl3	82-93	0.824	1.000	93	1.000	0.678	93
nl4	82-93	0.935	1.000	84	1.000	0.752	84,90,93
pt11	86-97	0.434	0.361	87	0.457	0.328	
pt12	86-97	0.368	0.433	96	0.447	0.363	
pt13	86-97	0.367	0.558	97	0.558	0.354	
pt14	86-97	0.498	0.687	97	0.687	0.497	
pt15	86-97	0.448	0.672	97	0.672	0.403	
pt2	86-97	0.876	1.000	94	1.000	0.829	94
pt3	86-97	0.968	0.812	87	1.000	0.801	87,89,90,92,95
se01	88-97	0.478	0.561	97	0.561	0.478	
se02	88-97	0.467	0.515	93	0.528	0.467	
se04	88-97	0.573	0.705	97	0.705	0.573	
se06	88-97	0.470	0.507	93	0.528	0.470	
se07	88-97	0.631	0.622	96	0.714	0.622	
se08	88-97	0.665	0.656	96	0.751	0.656	
uke	82-95	0.564	0.648	94	0.671	0.517	
ukf	82-95	0.550	0.648	82	0.682	0.495	
ukg	82-95	0.595	0.659	82	0.683	0.557	
ukk	82-95	0.634	0.696	82	0.696	0.571	
ukl	82-95	0.591	0.529	82	0.631	0.529	
ukm	82-95	0.542	0.565	82	0.590	0.532	
ukn	82-95	0.579	0.637	82	0.705	0.552	

Table 7. Slacks (Non radial inefficiency) occurrences (1).

Code	crop	animal	feed	other	capital	labour	area
at	10	0	0	2	16	0	16
be2	0	0	4	0	0	0	2
be3	0	0	0	0	0	0	14
de1	0	0	0	0	6	0	16
de2	8	0	0	0	16	0	16
de3	0	9	0	7	13	0	10
de4	0	0	0	0	0	0	8
de7	0	0	0	0	16	0	16
de8	0	0	0	0	0	0	8
de9	0	0	0	0	0	0	16
dea	0	0	0	0	0	0	12
deb	0	0	0	0	16	0	0
dec	0	0	0	0	5	0	16
ded	0	0	0	0	0	0	6
dee	0	0	0	0	0	0	8
deg	0	0	0	0	0	0	8
def	0	0	0	0	0	0	16
dk	0	0	0	0	1	0	16
es11	14	0	0	0	14	13	0
es12	14	0	8	0	14	1	14
es13	14	0	5	0	14	2	14
es21	0	0	0	0	1	0	14
es22	0	0	0	0	0	0	14
es23	0	0	1	0	0	0	2
es24	0	0	0	0	0	0	14
es3	0	0	0	0	0	0	14
es41	0	0	0	0	0	0	14
es42	0	0	0	0	0	0	14
es43	0	0	0	0	0	0	14
es51	0	0	10	0	0	0	12
es52	0	7	12	0	0	0	2
es53	0	0	0	0	0	0	13
es61	0	9	0	0	0	0	14
es62	0	1	12	0	0	0	3
es7	0	5	6	2	5	14	0
fi13	6	0	0	0	6	0	6
fi14	0	0	0	0	5	0	6
fi15	6	0	0	0	6	0	6
fi16	0	0	0	0	4	0	6
fr1	0	14	0	13	9	0	3
fr21	0	2	0	6	7	0	12
fr22	0	0	9	0	0	0	15
fr23	0	0	0	0	0	0	15
fr24	0	0	0	0	0	0	15
fr25	9	0	0	0	0	0	15
fr26	0	0	0	0	7	0	15
fr3	0	0	0	0	0	0	8
fr41	1	0	0	0	2	0	15
fr42	0	0	0	0	0	0	0
fr43	6	0	0	0	0	0	15
fr51	0	0	0	0	0	0	15
fr52	13	0	0	0	0	0	5
fr53	0	0	0	0	0	0	15
fr61	0	0	0	0	0	0	0
fr62	0	0	0	0	0	0	15
fr63	13	0	0	0	5	0	15
fr71	0	0	0	0	0	0	15
fr72	4	0	0	0	1	0	15
fr81	0	12	0	0	7	0	13
fr82	0	5	0	4	8	0	3
fr83	0	0	0	0	4	0	11

Table 7. Slacks (Non radial inefficiency) occurrences (2).

Code	crop	animal	feed	other	capital	labour	area
gr11	0	0	0	0	2	0	3
gr12	0	0	2	0	0	0	0
gr13	0	0	0	0	1	0	7
gr14	0	0	0	0	0	0	1
gr21	2	1	5	0	0	8	0
gr22	0	1	0	0	0	11	1
gr23	0	0	0	0	0	3	0
gr24	0	0	0	0	0	0	0
gr25	0	0	1	0	0	4	0
gr3	0	0	2	0	0	1	2
gr41	0	0	1	0	0	10	9
gr42	3	0	2	0	2	5	9
gr43	0	0	0	0	0	2	6
ie	16	0	0	0	12	0	16
it11	0	0	0	0	15	0	2
it13	0	0	1	0	7	3	1
it2	0	0	0	0	11	0	0
it31	0	0	0	0	15	0	15
it32	0	0	0	0	12	0	2
it33	0	0	0	0	15	0	3
it4	0	0	0	0	7	0	2
it51	0	0	0	0	15	0	15
it52	0	0	0	0	15	0	15
it53	0	0	0	0	8	0	15
it6	0	0	0	0	8	0	14
it71	0	0	0	0	15	0	15
it72	0	0	0	0	15	0	15
it8	0	0	0	0	12	1	2
it91	0	14	0	0	2	0	15
it92	0	0	0	0	15	0	15
it93	0	0	2	0	12	8	10
ita	0	0	2	0	6	0	15
itb	0	0	0	0	14	0	14
lu	1	0	0	1	4	1	3
nl1	1	0	0	0	0	2	8
nl2	7	0	2	0	0	3	0
nl3	3	0	0	1	6	4	3
nl4	1	0	8	0	1	4	0
pt11	0	0	0	0	0	7	0
pt12	0	0	0	0	0	4	4
pt13	0	0	3	0	0	0	11
pt14	0	0	0	0	0	0	12
pt15	0	0	7	0	0	1	4
pt2	7	0	6	0	1	3	6
pt3	0	1	3	0	0	6	0
se01	0	0	0	0	5	0	10
se02	0	0	0	0	0	0	10
se04	0	0	0	0	0	0	10
se06	0	0	0	0	4	0	10
se07	10	0	0	0	7	0	10
se08	10	0	0	0	5	0	10
uke	0	0	0	0	0	0	14
ukf	0	0	2	0	0	0	6
ukg	0	0	0	0	0	0	14
ukk	0	0	0	0	0	0	14
ukl	14	0	0	0	4	0	14
ukm	0	0	0	0	0	0	13
ukn	14	0	0	0	0	0	14

Table A1. Productivity measures d. (1)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
at	0.575	0.574	0.625	0.605	0.624	0.619	0.614	0.629	0.798	0.645	0.649	0.665	0.656	0.678	0.692	0.685
be2	0.816	0.816	0.810	0.785	0.758	0.713	0.747	0.735	0.704	0.720	0.766	0.795	0.789	0.788		
be3	0.697	0.687	0.731	0.718	0.737	0.694	0.674	0.702	0.729	0.738	0.752	0.754	0.708	0.704		
de1	0.617	0.619	0.610	0.586	0.630	0.610	0.633	0.660	0.689	0.606	0.652	0.636	0.639	0.622	0.629	0.612
de2	0.606	0.626	0.597	0.590	0.600	0.571	0.575	0.588	0.590	0.631	0.612	0.610	0.595	0.615	0.651	0.647
de3	0.718	0.833	0.826	0.771	0.877	0.724	1.000	0.509	0.487	0.432	0.754	0.779	0.873	0.747	0.866	0.971
de4									0.409	0.509	0.655	0.663	0.632	0.646	0.592	0.634
de7	0.575	0.557	0.574	0.561	0.569	0.543	0.579	0.584	0.615	0.607	0.595	0.611	0.606	0.609	0.636	0.627
de8									0.424	0.510	0.638	0.679	0.612	0.643	0.587	0.643
de9	0.664	0.651	0.683	0.660	0.692	0.644	0.644	0.652	0.664	0.682	0.681	0.694	0.687	0.707	0.764	0.774
dea						0.568	0.576	0.589	0.608	0.582	0.608	0.622	0.595	0.581	0.631	0.674
deb	0.579	0.526	0.580	0.577	0.585	0.541	0.569	0.643	0.650	0.660	0.736	0.720	0.729	0.713	0.727	0.724
dec	0.567	0.545	0.589	0.583	0.643	0.627	0.640	0.579	0.592	0.582	0.588	0.592	0.601	0.610	0.668	0.634
ded									0.418	0.507	0.631	0.648	0.615	0.624	0.614	0.647
dee									0.425	0.485	0.639	0.656	0.605	0.615	0.672	0.659
deg									0.410	0.509	0.656	0.651	0.615	0.631	0.644	0.677
def	0.634	0.622	0.634	0.617	0.622	0.575	0.606	0.594	0.578	0.629	0.613	0.632	0.612	0.626	0.673	0.661
dk	0.647	0.645	0.680	0.697	0.735	0.699	0.730	0.733	0.737	0.733	0.734	0.808	0.795	0.833	0.845	0.895
es11	0.622	0.619	0.554	0.584	0.631	0.654	0.647	0.633	0.560	0.668	0.630	0.607	0.706	0.755		
es12	0.873	0.862	0.712	0.608	0.799	0.747	0.808	0.794	0.626	0.606	0.693	0.665	0.642	0.644		
es13	0.797	0.821	0.724	0.711	0.895	0.919	0.848	0.876	0.818	0.829	0.982	0.945	0.750	0.868		
es21	0.582	0.557	0.527	0.524	0.533	0.556	0.536	0.577	0.561	0.604	0.652	0.616	0.606	0.627		
es22	0.567	0.594	0.642	0.595	0.604	0.626	0.588	0.647	0.615	0.713	0.786	0.701	0.726	0.663		
es23	0.532	0.729	0.756	0.713	0.754	0.716	0.722	0.787	0.718	0.803	0.807	0.849	0.850	1.000		
es24	0.470	0.508	0.549	0.514	0.472	0.514	0.588	0.648	0.519	0.593	0.573	0.580	0.547	0.556		
es3	0.746	0.739	0.700	0.714	0.684	0.585	0.558	0.636	0.608	0.774	0.684	0.622	0.749	0.626		
es41	0.451	0.505	0.474	0.540	0.485	0.575	0.575	0.554	0.577	0.575	0.575	0.721	0.629	0.638		
es42	0.542	0.527	0.603	0.569	0.555	0.585	0.579	0.586	0.641	0.664	0.707	0.618	0.554	0.514		
es43	0.528	0.494	0.623	0.636	0.550	0.585	0.601	0.585	0.711	0.781	0.785	0.690	0.775	0.615		
es51	0.695	0.679	0.624	0.647	0.600	0.667	0.715	0.757	0.706	0.729	0.767	0.770	0.779	0.785		
es52	0.655	0.708	0.718	0.693	0.604	0.759	0.709	0.771	0.838	0.886	0.927	0.945	0.895	0.884		
es53	0.466	0.497	0.470	0.541	0.629	0.631	0.597	0.624	0.631	0.587	0.628	0.545	0.748	1.000		
es61	0.655	0.710	0.785	0.852	0.733	0.769	0.901	0.746	0.844	0.878	0.911	0.890	0.827	0.752		
es62	0.577	0.568	0.592	0.785	0.620	0.589	0.654	0.735	0.856	0.803	0.896	0.784	0.723	0.728		
es7	0.596	0.561	0.501	0.535	0.635	0.722	0.697	0.811	0.797	0.650	0.881	0.817	0.834	0.845		
fi13											0.738	0.668	0.731	0.746	0.748	0.760
fi14											0.623	0.630	0.609	0.693	0.660	0.672
fi15											0.742	0.607	0.689	0.786	0.743	0.738
fi16											0.384	0.371	0.367	0.444	0.429	0.461
fr1	0.806	0.762	0.853	0.902	0.829	0.849	0.905	0.858	0.853	0.932	0.960	0.946	0.940	0.941	1.000	
fr21	0.835	0.759	0.777	0.788	0.852	0.858	0.868	0.922	1.000	0.966	0.976	0.918	0.895	0.948	1.000	
fr22	0.597	0.580	0.628	0.646	0.642	0.598	0.694	0.640	0.690	0.718	0.779	0.787	0.784	0.822	0.956	
fr23	0.680	0.657	0.705	0.715	0.702	0.671	0.689	0.688	0.687	0.695	0.729	0.719	0.805	0.785	0.860	
fr24	0.604	0.595	0.669	0.663	0.602	0.635	0.654	0.641	0.627	0.664	0.708	0.706	0.700	0.735	0.775	
fr25	0.768	0.782	0.813	0.820	0.808	0.780	0.772	0.773	0.803	0.801	0.828	0.814	0.839	0.819	0.892	
fr26	0.766	0.683	0.744	0.773	0.726	0.740	0.726	0.731	0.742	0.717	0.770	0.818	0.890	0.891	0.959	
fr3	0.610	0.611	0.602	0.617	0.633	0.582	0.636	0.609	0.649	0.658	0.721	0.765	0.807	0.803	0.863	
fr41	0.729	0.684	0.719	0.751	0.739	0.697	0.701	0.701	0.719	0.730	0.762	0.751	0.775	0.779	0.832	
fr42	0.738	0.642	0.658	0.672	0.673	0.681	0.718	0.706	0.697	0.733	0.823	0.815	0.816	0.787	0.858	
fr43	0.653	0.647	0.691	0.787	0.745	0.727	0.732	0.764	0.780	0.779	0.820	0.829	0.880	0.890	0.928	
fr51	0.708	0.711	0.734	0.763	0.745	0.752	0.727	0.735	0.767	0.806	0.882	0.891	0.952	0.944	0.998	
fr52	0.747	0.780	0.769	0.791	0.801	0.783	0.798	0.801	0.828	0.857	0.894	0.919	0.960	0.990	1.000	
fr53	0.584	0.563	0.584	0.589	0.557	0.582	0.535	0.589	0.608	0.595	0.719	0.701	0.753	0.704	0.741	
fr61	0.575	0.560	0.555	0.629	0.633	0.650	0.597	0.626	0.648	0.614	0.833	0.786	0.781	0.873	0.905	
fr62	0.578	0.577	0.581	0.586	0.575	0.584	0.547	0.571	0.587	0.612	0.641	0.641	0.671	0.698	0.726	
fr63	0.813	0.771	0.734	0.739	0.693	0.638	0.650	0.583	0.623	0.624	0.648	0.612	0.640	0.735	0.669	
fr71	0.627	0.582	0.596	0.617	0.606	0.638	0.616	0.678	0.706	0.717	0.780	0.802	0.871	0.896	0.924	
fr72	0.715	0.711	0.687	0.667	0.634	0.649	0.668	0.651	0.678	0.700	0.730	0.739	0.783	0.799	0.809	
fr81	0.985	0.914	0.956	0.898	0.915	0.921	0.794	0.844	0.835	0.784	0.835	0.807	0.958	0.938	0.946	
fr82	0.891	0.903	0.964	0.920	0.936	0.965	0.999	1.000	0.948	0.848	0.992	0.984	0.964	1.000	0.979	
fr83	0.643	0.626	0.494	0.497	0.557	0.589	0.720	0.619	0.588	0.661	1.000	0.738	0.772	0.773	0.752	

Table A1. Productivity measures d. (2)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
gr11		0.674	0.748	0.737	0.657	0.580	0.707	0.643	0.639	0.791	0.734	0.717	0.837			
gr12		0.614	0.705	0.619	0.607	0.637	0.801	0.662	0.555	0.673	0.672	0.595	0.697			
gr13		0.656	0.696	0.695	0.575	0.502	0.691	0.558	0.546	0.672	0.664	0.591	0.665			
gr14		0.639	0.665	0.740	0.742	0.618	0.841	0.788	0.709	0.900	0.815	0.865	0.881			
gr21		1.000	0.901	0.926	0.898	0.691	1.000	0.598	0.946	1.000	0.850	0.841	0.906			
gr22		0.966	0.775	0.887	0.774	0.803	1.000	0.890	0.628	0.813	0.782	0.751	0.811			
gr23		0.891	0.865	1.000	0.825	0.831	0.861	0.843	0.680	0.809	0.798	0.765	0.815			
gr24		0.666	0.718	0.708	0.645	0.602	0.815	0.648	0.614	0.765	0.706	0.697	0.732			
gr25		0.770	0.747	0.831	0.864	0.687	0.834	0.813	0.635	0.835	0.921	0.951	1.000			
gr3		1.000	1.000	0.976	0.806	0.891	1.000	1.000	0.942	1.000	0.759	0.711	0.866			
gr41		0.949	0.812	0.954	0.865	0.946	1.000	0.755	0.857	1.000	0.920	0.919	0.952			
gr42		0.809	0.844	0.986	0.933	0.752	1.000	0.728	0.927	1.000	0.930	0.912	0.970			
gr43		1.000	0.997	1.000	0.792	0.736	0.932	1.000	0.705	0.892	0.874	0.936	0.975			
ie	0.668	0.679	0.736	0.737	0.700	0.754	0.775	0.673	0.758	0.760	0.763	0.741	0.696	0.700	0.714	0.742
it11	0.663	0.699	0.687	0.694	0.696	0.687	0.700	0.678	0.689	0.654	0.702	0.704	0.725	0.770	0.814	
it13	0.856	0.851	1.000	0.867	0.796	0.814	0.874	0.935	1.000	0.834	0.968	1.000	1.000	1.000	0.941	
it2	0.894	0.923	0.944	0.930	0.914	0.895	0.909	0.898	0.919	0.968	0.982	1.000	1.000	1.000	1.000	
it31	0.861	0.846	0.837	0.889	0.835	0.876	0.846	0.739	0.884	0.845	0.827	0.822	0.935	0.880	0.963	
it32	0.717	0.768	0.758	0.758	0.768	0.783	0.770	0.759	0.791	0.765	0.825	0.838	0.832	0.925	0.939	
it33	0.584	0.597	0.676	0.671	0.677	0.710	0.654	0.662	0.661	0.632	0.679	0.652	0.696	0.726	0.758	
it4	0.896	0.938	0.906	0.880	0.906	0.890	0.900	0.855	0.883	0.782	0.901	0.900	0.889	0.892	0.926	
it51	0.624	0.665	0.619	0.587	0.624	0.616	0.602	0.618	0.628	0.614	0.614	0.606	0.632	0.657	0.660	
it52	0.621	0.637	0.594	0.689	0.598	0.627	0.641	0.679	0.680	0.648	0.689	0.673	0.674	0.698	0.703	
it53	0.610	0.636	0.586	0.610	0.621	0.640	0.645	0.648	0.635	0.621	0.661	0.649	0.678	0.694	0.703	
it6	0.749	0.771	0.743	0.746	0.727	0.706	0.723	0.708	0.685	0.667	0.720	0.701	0.714	0.728	0.739	
it71	0.744	0.781	0.719	0.756	0.715	0.686	0.655	0.674	0.624	0.638	0.655	0.660	0.673	0.678	0.692	
it72	0.591	0.606	0.645	0.655	0.657	0.622	0.652	0.629	0.607	0.601	0.598	0.563	0.582	0.632	0.645	
it8	0.794	0.864	0.781	0.745	0.742	0.757	0.793	0.806	0.776	0.747	0.732	0.700	0.665	0.724	0.692	
it91	0.694	0.955	0.834	0.875	0.879	0.879	0.926	0.830	0.701	0.940	0.935	0.907	0.971	0.921	0.919	
it92	0.489	0.524	0.545	0.545	0.532	0.506	0.514	0.478	0.454	0.527	0.537	0.547	0.591	0.548	0.536	
it93	0.695	0.982	0.676	1.000	0.711	0.837	0.688	0.825	0.589	0.765	0.597	0.805	0.649	0.789	0.784	
ita	0.772	0.981	0.826	0.914	0.877	0.813	0.808	0.726	0.669	0.772	0.798	0.962	0.862	0.832	0.853	
itb	0.913	1.000	0.973	0.940	0.878	0.814	0.793	0.716	0.727	0.752	0.773	0.830	0.909	0.899	0.934	
lu						1.000	0.993	1.000	1.000	0.985	1.000	1.000	0.973	1.000	1.000	1.000
nl1	0.934	0.939	0.972	0.950	0.880	0.708	0.721	0.980	1.000	1.000	0.977	1.000				
nl2	0.969	0.988	1.000	0.989	0.904	0.729	0.753	0.955	1.000	0.999	0.976	1.000				
nl3	0.824	0.821	0.844	0.830	0.793	0.678	0.763	0.926	0.965	0.996	0.982	1.000				
nl4	0.935	0.942	1.000	0.990	0.921	0.752	0.794	0.943	1.000	0.986	0.991	1.000				
pt11					0.434	0.457	0.385	0.409	0.438	0.426	0.420	0.328	0.357	0.357	0.373	0.361
pt12					0.368	0.390	0.363	0.384	0.406	0.395	0.415	0.385	0.413	0.444	0.447	0.433
pt13					0.367	0.392	0.354	0.433	0.459	0.476	0.553	0.510	0.542	0.547	0.557	0.558
pt14					0.498	0.517	0.503	0.497	0.505	0.513	0.561	0.514	0.565	0.622	0.650	0.687
pt15					0.448	0.478	0.403	0.457	0.470	0.445	0.489	0.475	0.506	0.540	0.521	0.672
pt2					0.876	0.857	0.899	0.933	0.928	0.840	0.829	0.847	1.000	1.000	1.000	1.000
pt3					0.968	1.000	0.889	1.000	1.000	0.849	1.000	0.801	0.923	1.000	0.940	0.812
se01							0.478	0.512	0.534	0.488	0.508	0.537	0.520	0.533	0.536	0.561
se02							0.467	0.503	0.526	0.516	0.496	0.528	0.508	0.526	0.509	0.515
se04							0.573	0.612	0.652	0.624	0.625	0.689	0.592	0.621	0.658	0.705
se06							0.470	0.484	0.512	0.522	0.499	0.528	0.522	0.517	0.527	0.507
se07							0.631	0.640	0.647	0.675	0.663	0.691	0.714	0.685	0.714	0.622
se08							0.665	0.670	0.680	0.717	0.694	0.721	0.736	0.721	0.751	0.656
uke	0.564	0.517	0.601	0.607	0.630	0.620	0.592	0.587	0.619	0.645	0.658	0.643	0.671	0.648		
ukf	0.550	0.495	0.629	0.616	0.618	0.638	0.581	0.635	0.646	0.676	0.682	0.674	0.660	0.648		
ukg	0.595	0.557	0.606	0.594	0.613	0.598	0.578	0.579	0.605	0.634	0.683	0.658	0.640	0.659		
ukk	0.634	0.610	0.600	0.620	0.621	0.594	0.571	0.596	0.621	0.614	0.668	0.626	0.638	0.696		
ukl	0.591	0.554	0.615	0.581	0.585	0.582	0.599	0.610	0.631	0.622	0.589	0.581	0.576	0.529		
ukm	0.542	0.534	0.575	0.567	0.548	0.569	0.539	0.554	0.590	0.576	0.562	0.532	0.554	0.565		
ukn	0.579	0.552	0.604	0.601	0.599	0.631	0.627	0.684	0.651	0.705	0.697	0.653	0.646	0.637		

Table A2. Technical change measure A. (1)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
at	0.575	0.575	0.625	0.625	0.625	0.625	0.625	0.629	0.798	0.798	0.798	0.798	0.798	0.798	0.798	0.798
be2	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816		
be3	0.697	0.697	0.731	0.731	0.737	0.737	0.737	0.737	0.737	0.738	0.752	0.754	0.754	0.754		
de1	0.617	0.619	0.619	0.619	0.630	0.630	0.633	0.660	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689
de2	0.606	0.626	0.626	0.626	0.626	0.626	0.626	0.626	0.626	0.631	0.631	0.631	0.631	0.631	0.651	0.651
de3	0.718	0.833	0.833	0.833	0.877	0.877	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
de4									0.409	0.509	0.655	0.663	0.663	0.663	0.663	0.663
de7	0.575	0.575	0.575	0.575	0.575	0.575	0.579	0.584	0.615	0.615	0.615	0.615	0.615	0.615	0.636	0.636
de8									0.424	0.510	0.638	0.679	0.679	0.679	0.679	0.679
de9	0.664	0.664	0.683	0.683	0.692	0.692	0.692	0.692	0.692	0.692	0.692	0.694	0.694	0.707	0.764	0.774
dea						0.568	0.576	0.589	0.608	0.608	0.608	0.622	0.622	0.622	0.631	0.674
deb	0.579	0.579	0.580	0.580	0.585	0.585	0.585	0.643	0.650	0.660	0.736	0.736	0.736	0.736	0.736	0.736
dec	0.567	0.567	0.589	0.589	0.643	0.643	0.643	0.643	0.643	0.643	0.643	0.643	0.643	0.643	0.668	0.668
ded									0.418	0.507	0.631	0.648	0.648	0.648	0.648	0.648
dee									0.425	0.485	0.639	0.656	0.656	0.656	0.672	0.672
deg									0.410	0.509	0.656	0.656	0.656	0.656	0.656	0.677
def	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.673	0.673
dk	0.647	0.647	0.680	0.697	0.735	0.735	0.735	0.735	0.737	0.737	0.737	0.808	0.808	0.833	0.845	0.895
es11	0.622	0.622	0.622	0.622	0.631	0.654	0.654	0.654	0.654	0.668	0.668	0.668	0.706	0.755		
es12	0.873	0.873	0.873	0.873	0.873	0.873	0.873	0.873	0.873	0.873	0.873	0.873	0.873	0.873		
es13	0.797	0.821	0.821	0.821	0.895	0.919	0.919	0.919	0.919	0.919	0.982	0.982	0.982	0.982		
es21	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.604	0.652	0.652	0.652	0.652		
es22	0.567	0.594	0.642	0.642	0.642	0.642	0.642	0.647	0.647	0.713	0.786	0.786	0.786	0.786		
es23	0.532	0.729	0.756	0.756	0.756	0.756	0.756	0.787	0.787	0.803	0.807	0.849	0.850	1.000		
es24	0.470	0.508	0.549	0.549	0.549	0.549	0.588	0.648	0.648	0.648	0.648	0.648	0.648	0.648		
es3	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.746	0.774	0.774	0.774	0.774	0.774		
es41	0.451	0.505	0.505	0.540	0.540	0.575	0.575	0.575	0.577	0.577	0.577	0.721	0.721	0.721		
es42	0.542	0.542	0.603	0.603	0.603	0.603	0.603	0.603	0.641	0.664	0.707	0.707	0.707	0.707		
es43	0.528	0.528	0.623	0.636	0.636	0.636	0.636	0.636	0.711	0.781	0.785	0.785	0.785	0.785		
es51	0.695	0.695	0.695	0.695	0.695	0.695	0.715	0.757	0.757	0.757	0.767	0.770	0.779	0.785		
es52	0.655	0.708	0.718	0.718	0.718	0.759	0.759	0.771	0.838	0.886	0.927	0.945	0.945	0.945		
es53	0.466	0.497	0.497	0.541	0.629	0.631	0.631	0.631	0.631	0.631	0.631	0.631	0.748	1.000		
es61	0.655	0.710	0.785	0.852	0.852	0.852	0.901	0.901	0.901	0.901	0.911	0.911	0.911	0.911		
es62	0.577	0.577	0.592	0.785	0.785	0.785	0.785	0.785	0.856	0.856	0.896	0.896	0.896	0.896		
es7	0.596	0.596	0.596	0.596	0.635	0.722	0.722	0.811	0.811	0.811	0.881	0.881	0.881	0.881		
fi13											0.731	0.746	0.748	0.760	0.760	0.760
fi14											0.609	0.693	0.693	0.693	0.693	0.693
fi15											0.689	0.786	0.786	0.786	0.786	0.786
fi16											0.367	0.444	0.444	0.461	0.461	0.461
fr1	0.806	0.806	0.853	0.902	0.902	0.902	0.905	0.905	0.905	0.932	0.960	0.960	0.960	0.960	1.000	
fr21	0.835	0.835	0.835	0.835	0.852	0.858	0.868	0.922	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fr22	0.597	0.597	0.628	0.646	0.646	0.646	0.694	0.694	0.694	0.718	0.779	0.787	0.787	0.822	0.956	
fr23	0.680	0.680	0.705	0.715	0.715	0.715	0.715	0.715	0.715	0.715	0.729	0.729	0.805	0.805	0.860	
fr24	0.604	0.604	0.669	0.669	0.669	0.669	0.669	0.669	0.669	0.669	0.708	0.708	0.708	0.735	0.775	
fr25	0.768	0.782	0.813	0.820	0.820	0.820	0.820	0.820	0.820	0.820	0.828	0.828	0.839	0.839	0.892	
fr26	0.766	0.766	0.766	0.773	0.773	0.773	0.773	0.773	0.773	0.773	0.773	0.818	0.890	0.891	0.959	
fr3	0.610	0.611	0.611	0.617	0.633	0.633	0.636	0.636	0.649	0.658	0.721	0.765	0.807	0.807	0.863	
fr41	0.729	0.729	0.729	0.751	0.751	0.751	0.751	0.751	0.751	0.751	0.762	0.762	0.775	0.779	0.832	
fr42	0.738	0.738	0.738	0.738	0.738	0.738	0.738	0.738	0.738	0.738	0.823	0.823	0.823	0.823	0.858	
fr43	0.653	0.653	0.691	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.820	0.829	0.880	0.890	0.928	
fr51	0.708	0.711	0.734	0.763	0.763	0.763	0.763	0.763	0.767	0.806	0.882	0.891	0.952	0.952	0.998	
fr52	0.747	0.780	0.780	0.791	0.801	0.801	0.801	0.801	0.828	0.857	0.894	0.919	0.960	0.990	1.000	
fr53	0.584	0.584	0.584	0.589	0.589	0.589	0.589	0.589	0.608	0.608	0.719	0.719	0.753	0.753	0.753	
fr61	0.575	0.575	0.575	0.629	0.633	0.650	0.650	0.650	0.650	0.650	0.833	0.833	0.833	0.873	0.905	
fr62	0.578	0.578	0.581	0.586	0.586	0.586	0.586	0.586	0.587	0.612	0.641	0.641	0.671	0.698	0.726	
fr63	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	
fr71	0.627	0.627	0.627	0.627	0.627	0.638	0.638	0.678	0.706	0.717	0.780	0.802	0.871	0.896	0.924	
fr72	0.715	0.715	0.715	0.715	0.715	0.715	0.715	0.715	0.715	0.715	0.730	0.739	0.783	0.799	0.809	
fr81	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	0.985	
fr82	0.891	0.903	0.964	0.964	0.964	0.965	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
fr83	0.643	0.643	0.643	0.643	0.643	0.643	0.720	0.720	0.720	0.720	1.000	1.000	1.000	1.000	1.000	

Table A2. Technical change measure A. (2)

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
gr11		0.674	0.748	0.748	0.748	0.748	0.748	0.748	0.748	0.791	0.791	0.791	0.837			
gr12		0.614	0.705	0.705	0.705	0.705	0.801	0.801	0.801	0.801	0.801	0.801	0.801			
gr13		0.656	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696	0.696			
gr14		0.639	0.665	0.740	0.742	0.742	0.841	0.841	0.841	0.900	0.900	0.900	0.900			
gr21		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
gr22		0.966	0.966	0.966	0.966	0.966	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
gr23		0.891	0.891	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
gr24		0.666	0.718	0.718	0.718	0.718	0.815	0.815	0.815	0.815	0.815	0.815	0.815			
gr25		0.770	0.770	0.831	0.864	0.864	0.864	0.864	0.864	0.864	0.921	0.951	1.000			
gr3		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
gr41		0.949	0.949	0.954	0.954	0.954	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
gr42		0.809	0.844	0.986	0.986	0.986	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
gr43		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
ie	0.668	0.679	0.736	0.737	0.737	0.754	0.775	0.775	0.775	0.775	0.775	0.775	0.775	0.775	0.775	0.775
it11	0.663	0.699	0.699	0.699	0.699	0.699	0.700	0.700	0.700	0.700	0.702	0.704	0.725	0.770	0.814	
it13	0.856	0.856	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
it2	0.894	0.923	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.968	0.982	1.000	1.000	1.000	1.000	
it31	0.861	0.861	0.861	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.935	0.935	0.963	
it32	0.717	0.768	0.768	0.768	0.768	0.783	0.783	0.783	0.791	0.791	0.825	0.838	0.838	0.925	0.939	
it33	0.584	0.597	0.676	0.676	0.677	0.710	0.710	0.710	0.710	0.710	0.710	0.710	0.710	0.726	0.758	
it4	0.896	0.938	0.938	0.938	0.938	0.938	0.938	0.938	0.938	0.938	0.938	0.938	0.938	0.938	0.938	
it51	0.624	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	0.665	
it52	0.621	0.637	0.637	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.689	0.698	0.703	
it53	0.610	0.636	0.636	0.636	0.636	0.640	0.645	0.648	0.648	0.648	0.661	0.661	0.678	0.694	0.703	
it6	0.749	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	0.771	
it71	0.744	0.781	0.781	0.781	0.781	0.781	0.781	0.781	0.781	0.781	0.781	0.781	0.781	0.781	0.781	
it72	0.591	0.606	0.645	0.655	0.657	0.657	0.657	0.657	0.657	0.657	0.657	0.657	0.657	0.657	0.657	
it8	0.794	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	0.864	
it91	0.694	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.971	0.971	0.971	
it92	0.489	0.524	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.545	0.547	0.591	0.591	0.591	
it93	0.695	0.982	0.982	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
ita	0.772	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	
itb	0.913	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
lu						1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
nl1	0.934	0.939	0.972	0.972	0.972	0.972	0.972	0.980	1.000	1.000	1.000	1.000				
nl2	0.969	0.988	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
nl3	0.824	0.824	0.844	0.844	0.844	0.844	0.844	0.926	0.965	0.996	0.996	1.000				
nl4	0.935	0.942	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
pt11					0.434	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457
pt12					0.368	0.390	0.390	0.390	0.406	0.406	0.415	0.415	0.415	0.444	0.447	0.447
pt13					0.367	0.392	0.392	0.433	0.459	0.476	0.553	0.553	0.553	0.553	0.557	0.558
pt14					0.498	0.517	0.517	0.517	0.517	0.517	0.561	0.561	0.565	0.622	0.650	0.687
pt15					0.448	0.478	0.478	0.478	0.478	0.478	0.489	0.489	0.506	0.540	0.540	0.672
pt2					0.876	0.876	0.899	0.933	0.933	0.933	0.933	0.933	1.000	1.000	1.000	1.000
pt3					0.968	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
se01							0.478	0.512	0.534	0.534	0.534	0.537	0.537	0.537	0.537	0.561
se02							0.467	0.503	0.526	0.526	0.526	0.528	0.528	0.528	0.528	0.528
se04							0.573	0.612	0.652	0.652	0.652	0.689	0.689	0.689	0.689	0.705
se06							0.470	0.484	0.512	0.522	0.522	0.528	0.528	0.528	0.528	0.528
se07							0.631	0.640	0.647	0.675	0.675	0.691	0.714	0.714	0.714	0.714
se08							0.665	0.670	0.680	0.717	0.717	0.721	0.736	0.736	0.751	0.751
uke	0.564	0.564	0.601	0.607	0.630	0.630	0.630	0.630	0.630	0.645	0.658	0.658	0.671	0.671		
ukf	0.550	0.550	0.629	0.629	0.629	0.638	0.638	0.638	0.646	0.676	0.682	0.682	0.682	0.682		
ukg	0.595	0.595	0.606	0.606	0.613	0.613	0.613	0.613	0.613	0.634	0.683	0.683	0.683	0.683		
ukk	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.634	0.668	0.668	0.668	0.696		
ukl	0.591	0.591	0.615	0.615	0.615	0.615	0.615	0.615	0.631	0.631	0.631	0.631	0.631	0.631		
ukm	0.542	0.542	0.575	0.575	0.575	0.575	0.575	0.575	0.590	0.590	0.590	0.590	0.590	0.590		
ukn	0.579	0.579	0.604	0.604	0.604	0.631	0.631	0.684	0.684	0.705	0.705	0.705	0.705	0.705		