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Institute for the Protection and Security of the Citizen
Technological and Economic Risk Management Unit
I-21020 Ispra (VA) Italy

Internal Market Index 2002:

Technical details of the methodology

Prepared by

S. Tarantola, M. Saisana and A. Saltelli

(Applied Statistics Group)

http://www.jrc.cec.eu.int/uasa

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The JRC welcomes any feedback on this document. Please send your comments to Stefano.tarantola@jrc.it, Michaela.saisana@jrc.it or andrea.saltelli@jrc.it

Applied Statistics Group: http://www.jrc.cec.eu.int/uasa

1. EXECUTIVE SUMMARY

An attempt has been made to capture the development of the Internal Market in a single measurement – an Internal Market Index (IMI). This index looks at the impacts of the Internal Market on the ground for the 15 Member States throughout 1992-2001.

The Index has been developed through an open and interactive process, drawing on statistical, economical and analytical expertise from the European Union. It has been subjected to extensive peer review from DG MARKT and DG JRC and the methodology has been refined in response to a some comments received by DG ECFIN and ESTAT for a sound methodology underpinning a composite indicator development.

The Index integrates a significant amount of information on a number of different dimensions of Internal Market. It uses 12 sub-indicators, which were chosen through an extensive review of the economy literature, assessment of available data, and broad-based consultation and analysis. The Index is computed as a weighted sum of the 12 base indicators, whose relative importance was decided by canvassing the members of the Internal Market Advisory Committee (IMAC), the group of Member State officials who advise the Commission on Internal Market matters.

If a country has an IMI value of 120 for a given year, this implies that the country performs 20% better than its own state in 1992. At this point, the IMI scores do not allow ranking Member State's relative Internal Market performance in any way. A rapid increase in the index may simply indicate that a Member State started from a low level and a slow increase could easily be a sign that a Member State started from a level where there was little room for further improvement. But it is possible to see how much the index has increased in each Member State since 1992 – and to identify the indicators within the index responsible for the change.

The five countries whose index has grown faster than the EU index throughout the 10-year period are Finland, Spain, Italy, Sweden and Austria. These results show that the 'newest' Member States benefited rapidly from the Internal Market – this is a particularly welcome message in view of forthcoming EU enlargement.

No country has above average growth in each of the 12 indicators, nor is any country below average in all 12. Every country has room for improvement. The IMI in the current form (the IMI values are scaled considering that the IMI value for each country in 1992 is 100) does not permit cross-national comparisons in a systematic and quantitative fashion. However, the IMI enables:

- Tracking of Internal Market trends;
- Quantitative assessment of the success of policies and programs.

2. THE NEED FOR A REVISED INTERNAL MARKET INDEX

The Commission first published the Internal Market Index in the November 2001 Scoreboard (DG MARKT, 2001). The Commission promised that the index would be reviewed and revised. As a consequence, the 2002 index has been considerably revised compared to the 2001 edition.

The objective of the Internal Market Index is to provide some measure of the effects of Internal Market policy as defined in the broadest terms by the free circulation of goods, services, capital and workers within the European Union. It should be seen more as a reality check than as a precise scientific exercise.

The revised index focuses on a set of indicators, which are intended to measure Internal Market policy impacts. The objective of the revision was to make the new index a better measure of the 'core business' of the Internal Market. Variables linked to the Internal Market in a wider sense (greenhouse gas emissions for example, which were included in the 2001 index) were therefore excluded from the revised index.

To be useful, the Internal Market Index has been created in a systematic, transparent, and reproducible manner. It is faithful to the scientific literature as well as relevant to the major policy debates. It is applicable to a wide range of situations and conditions. And it makes use of what can actually be measured today while leaving room for movement toward what ought to be measured tomorrow.

3. THE INTERNAL MARKET INDEX 1992-2002: METHODOLOGY

Several steps have been followed to construct the Internal Market Index, according to the lines of the State-of-the-art report on composite indicators (Saisana and Tarantola, 2002). These steps are outlined in Table 1 and discussed in detail in the following sections.

Table 1. Steps for constructing the Internal Market Index

Issue	Approach
Defining the phenomenon to be measured	The effect of the Internal Market policy on the individual Member States.
Selection of sub-indicators	A clear political idea is needed about which sub-indicators are relevant to the phenomenon to be measured. DG MARKT, JRC and the IMAC members have worked together to select the relevant sub-indicators. A total of 12 indicators have been identified.
Assessing the quality of the data	The initial data availability was 73% (15 countries × 10 years × 12 indicators). After imputation using time-series analysis and correlation among indicators the availability was raised to 93%.
Pre-treatment of data	Expression of the indicators as percentage of GDP or per capita, or in monetary terms. Treatment of skewed data by considering the logarithmic value of the indicators.
Normalising the indicators	Use of the standardisation method based on z-scores (subtracting the mean and dividing by the standard deviation).
Assessing the relationships between the sub-indicators	Principal Components Analysis (PCA) has identified that 8 main Principal Components are needed to describe at least 90 percent of the variance in the full data set. This result confirms the expectation that the Internal Market is a multidimensional phenomenon, and thus it would benefit from the use of a composite indicator. PCA has been applied to the 1992-2001 series for all countries, after de-trending across time for each country and indicator.
Weighting of the indicators	A participatory method has been followed to define the relative importance of the sub-indicators, by canvassing the members of the Internal Market Advisory Committee (IMAC). The results show a plurality of perspectives on the issue.
Testing for Robustness and Sensitivity	Inevitably changes in the weighting system and the choice of sub-indicators will affect the results the Index shows. The degree of sensitivity of the country rankings has been tested and the values of the composite indicator are displayed in the form of confidence bounds.

3.1. Indicator treatment

3.1.1. Description of indicators

In order to build a new index to better measure the 'core business' of the Internal Market and to better focus on medium-term intermediate results with respect to the previous edition of the Scoreboard, DG MARKT decided to suppress some sub-indicators that were linked to the Internal Market Strategy in a wider sense, and selected a few relevant sub-indicators from the list of Structural Indicators, which are drawn up for use in the annual Synthesis Report and in the annual Communication from the Commission to consolidate and extend the Lisbon Strategy (COM(2002) 515 final).

The choice of indicators was driven by a consideration of a number of factors including: country coverage, the recency and time-series of the data, direct relevance to the phenomenon that the Index is intended to measure, and quality. This process led to retain a set of 12 sub-indicators, which have passed a quality control by JRC according to EUROSTAT guidelines. The list of the 12 sub-indicators with definitions and sources is given in Table 2.

Denominating the indicators facilitates fair comparison across countries. Most indicators were already expressed in monetary terms (Euro), or as percentage of GDP, or as ratios and therefore no country-specific adjustment was needed. The only indicator that needed to be adjusted was the 'Active population in a MS (aged 15-64 years) originally coming from other MS', which has been divided the population of the hosting country to permit international comparisons.

Table 2. List of the 12 sub-indicators with definitions and sources (cf. final Scoreboard version)

Name of indicator and definition	Explanation	Source
1. Sectoral and ad hoc state aid [% of GDP] It includes (a) State aid given by way of schemes/programs that specifically promote sectoral objectives and (b) State aid granted ad hoc to individual companies.	Proxy for fair competition	Eurostat*
2. Value of published public procurement [% of GDP] The value of public procurement which is openly advertised and estimated annually from the contract award notices submitted for publication in the Official Journal.	Proxy for transparency and market access	Eurostat*
3. Telecommunication costs [Euro] Sum of prices in Euro (including VAT) of 10 min calls for (a) local call (3 km), (b) national call (200 km), (c) international call to USA.	Proxy for market opening in telecommunications sector	Eurostat*

4. Electricity prices [Euro] Sum of products of energy consumption × energy prices in Euro without taxes for household and industry. (a) medium industry user annual consumption = 2 GWh (b) medium household user annual consumption = 3.5 MWh	Proxy for market opening in electricity sector	Eurostat*
5. Gas prices [Euro] Sum of products of gas consumption × gas prices in Euro without taxes for household and industry (a) medium industry user annual consumption = 41860 GJ (b) medium household user annual consumption = 83.7 GJ	Proxy for market opening in gas sector	Eurostat*
6. **Relative price level of private final consumption including indirect taxes** It is measured as ratio between Purchasing Power Parity and the market exchange rate [EU average = 100]. The higher the value, the more expensive the country as compared to the EU average.	Proxy for price divergence by Member State from EU average	Eurostat*
7. Intra-EU Foreign direct investment inward flows [% of GDP]	Proxy for free movement of capital between Member States	Eurostat
8. Intra-EU trade [% of GDP]	Proxy for free movement of goods between Member States	Eurostat
9. Active population in a MS (aged 15-64) originally coming from other MS [per capita]	Proxy for free movement of workers between Member States	Eurostat
10. Value of pension fund assets [% of GDP]	Proxy for movement from pay-as-you-go to funded pension schemes	European Commission, Internal Market DG
11. Retail lending interest rates over savings interest rates ratio	Proxy for efficiency of the banking sector	European Central Bank: http://www.ecb.int/stats/
12. Postal tariffs (20g standard letter) [Euro]	Proxy for market opening in postal services	European Commission, Internal Market DG

Notes: Prices and values are always measured in euro.
Freely available on the Eurostat website on structural indicators at:
http://europa.eu.int/comm/eurostat/Public/datashop/print-product/EN?catalogue=Eurostat&product=1-structur-EN&mode=download

3.1.2. Imputation of missing data for the sub-indicators

Missing data are an endemic problem for anyone working with indicators. There is not a single country that is covered by each of the 12 sub-indicators and for all 10 years used in the IMI. Ten countries are missing between 25-42 percent of the indicators-years, and the remaining 5 countries miss less than 25 percent of the data (Table 3). The indicators with the minimum coverage are Sectoral and ad hoc state aid, telecommunication costs and Pension fund assets, which have 50 percent valid data across all countries and years (Table 4). Altogether, this means that 27 percent of the 1,800 data points in our database were missing.

We estimated missing values for all the indicators, countries and years, based on a *sequential imputation* procedure. We first imputed missing values for a given indicator and country across the ten years applying second-order polynomial fitting. The condition for imputation was that the polynomial would account for at least 80% of the variance of the original data at a 95% confidence level. We then calculated bivariate correlations among the indicators for a given country. Where correlations were high (at least 80% variance explained) and there was a plausible justification for presuming the indicators to be related, we estimated missing values using those indicators. Had we not imputed missing data some countries would lack values for more than six indicators. We then calculated the Index values assuming that all indicators receive equal weight, as a first estimation, so as to explore whether our imputation procedure introduced any bias. The correlation of determination between the Index values with and without imputation is 0.81.

Table 3. Data coverage per indicator before and after imputation

(15 Member States, years 1992-2001)

	Before imputation (%)	**After imputation (%)**
Sectoral and ad hoc State aid	50	99
Public procurement openly advertised	79	100
Telecommunication costs	50	100
Electricity prices	91	96
Gas prices	73	79
Relative price levels	90	98
Intra-EU FDI inward flows	62	71
Intra-EU trade	91	95
Active population in MS	81	99
Pension fund assets	50	99
Retail lending interest rates/savings interest rates	70	75
Postal tariffs	90	100
Total	*73*	*93*

By imputation we were able to generate reliable measures on each of the 12 indicators for each of the 15 countries (Table 3 and Table 4). The countries have now 93 percent data on average. The minimum coverage is noticed for Greece (73%) and the maximum coverage for Germany, Spain, Italy, the Netherlands and Sweden (almost 100%). After imputation, nine indicators have more than 95 percent valid data. The indicator with the least coverage is the Intra-EU FDI inward flows with 71 percent.

Table 4. Data coverage per country before and after imputation (12 indicators, years 1992-2001)

Member State	Code	Before imputation (%)	After imputation (%)
Austria	A	67	95
Belgium	B	73	90
Germany	D	82	99
Denmark	DK	68	86
Spain	E	83	100
Finland	FIN	73	94
France	F	74	91
Greece	EL	58	73
Ireland	IRL	76	93
Italy	I	82	99
Luxembourg	L	68	85
Netherlands	NL	82	99
Portugal	P	72	90
Sweden	S	67	100
United Kingdom	UK	76	94
Total		*73*	*93*

3.1.3. Accounting for skewed distributions

We then converted the skewed distribution of the indicator “Intra-EU FDI inward flows” (skewness measure of 2.7) to a base-10 logarithmic scale. In the absence of such a conversion these indicator scores typically generated high positive values for two countries (Finland and United Kingdom) and smaller, identical values for each of the remaining countries. Such distribution failed to convey useful information in aggregating across indicators. Similar approach has been followed in the past by the World Economic Forum for several indicators composing the Environmental Sustainability Index (World Economic Forum, 2001).

3.1.4. Normalisation

Before computing the Index, the sub-indicators were converted to a unitless scale by standardising them. We chose the z-score, which has desirable characteristics when it comes to aggregation and has been widely used in other composite indicators (e.g.

Environmental Sustainability Index (World Economic Forum, 2001) and Technology Achievement Index (United Nations, 2001). In particular, the fact that the z-score has an average of zero means that it avoids introducing aggregation distortions stemming from differences in the indicator means. The formula to calculate the z-score is the value of an indicator minus the mean of the indicator across countries, divided by the standard deviation. For indicators in which high observed values correspond to low performance of Internal Market, we multiplied the normalised values by minus one to preserve this ordinal relationship. These indicators are listed in Table 5.

Table 5. Sub-indicators for which high observed values correspond to low performance of Internal Market

Sectoral and ad hoc state aid
Telecommunication costs
Electricity prices
Gas prices
Relative price level
Retail lending/savings interest rates
Postal tariffs

With a view to allow comparisons between years, we normalised each indicator for each year using the values of the EU mean and standard deviation for the reference year 1992, as given by Eq.1 (for indicators in which high observed values correspond to high performance of Internal Market) and Eq.2 (for indicators in which high observed values correspond to low performance of Internal Market, shown in Table 5),

$$y_{ji}^{t} = \frac{x_{ji}^{t} - x_{jEU}^{1992}}{s_{j}^{1992}} \tag{1}$$

$$y_{ji}^{t} = -\frac{x_{ji}^{t} - x_{jEU}^{1992}}{s_{j}^{1992}} \tag{2}$$

where x_{ji}^{t} is the raw value for sub-indicator *j* at year *t* for country *i*,

$x_{jEU}^{1992} = \frac{1}{15}\sum_{i=1}^{m} x_{ji}^{1992}$ is the raw value for sub-indicator *j* at the reference year *1992* for the European Union, and

s_{j}^{1992} is the standard deviation for sub-indicator *j* at the reference year *1992* across the Member States.

For the standardised indicator values, zero indicates the EU mean for 1992, +1 and –1 representing one standard deviation above and below that mean, +2 and –2 representing two standard deviations above and below the mean, and so on. In a “normal” bell-shaped distribution 68 percent of the scores fall within one standard deviation of the mean, 95

percent within two standard deviations, and 99.7 percent within three standard deviations. The actual distributions vary among the indicators.

3.2. Principal Components Analysis

Once it is proved that the set of 12 sub-indicators is relevant to what is being measured, the next step is to prove that the dimensionality of the phenomenon that is being measured by these sub-indicators is large enough. Indeed, the sub-indicators might be all consistent to what is being measured, but they might be reflecting similar characteristics of the phenomenon, thus not covering as many features as possible (this is the objective of a composite indicator). In this case we say that the sub-indicators are partially/ consistently *overlapping*.

The correlation analysis is the first step to be carried out, followed by a more comprehensive principal component analysis (PCA). Before calculating the correlation among the indicators we de-trended the values of one sub-indicator for a given country across time (e.g. public procurement for Austria over 1992-2001). This 10-point time series is de-trended by subtracting its regression E(Y|t) from the original data. This procedure is repeated 180 times, i.e. for all the 12 sub-indicators and for all the 15 Member States. The correlation values between original data and the corresponding regressions are higher than 0.7 for 119 cases out of 180. In spite of this, all the series have been de-trended.

De-trending is necessary to have stationary series for a subsequent correlation analysis. A 12×12 correlation-matrix has been estimated to obtain the correlation coefficients between all the pairs of sub-indicators. Each correlation coefficient is estimated using the sub-indicator values for all the 10 years and the 15 countries, for a total of 150 individuals. The correlation matrix is shown in Table 6.

Table 6. Correlation coefficients for the 12 indicators

(15 Member States, 1992-2001, de-trended values)

	Sectoral	*Public*	*Tele*	*Elec.*	*Gas*	*Relative*	*FDI*	*Trade*	*Active*	*Pension*	*Ratio*
Sectoral and ad hoc state aid											
Public procurement	0.14										
Telecommunication costs	-0.14	0.13									
Electricity prices	0.12	-0.01	0.05								
Gas prices	0.09	-0.06	0.25	0.38							
Relative price levels	0.32	-0.03	-0.21	0.60	0.25						
Intra-EU FDI inward flows	0.06	0.07	0.02	0.00	0.06	0.00					
Intra-EU trade	-0.03	0.24	-0.05	-0.37	-0.05	-0.47	0.03				
Active population in MS	0.10	0.06	0.16	0.38	0.18	0.18	0.00	-0.08			
Pension fund assets	0.05	-0.15	-0.65	0.00	-0.08	0.10	-0.03	0.05	-0.01		
Ratio of interest rates	-0.26	-0.06	-0.10	-0.06	-0.19	-0.08	-0.70	0.12	-0.10	0.05	
Postal tariffs	0.17	-0.09	0.12	0.23	-0.04	0.06	0.00	-0.05	0.31	0.08	0.02

The main finding of this analysis is that only two indicators display a large negative correlation: *Retail lending interest rates over savings interest rates ratio* and *Log-Flow of Direct Investments*. This result represents a partial overlap in the information provided by the two sub-indicators. All the other indicators can be considered non-correlated. This aspect is relevant as it shows that the set of sub-indicators cover different portions of the phenomenon that the index is aimed at measuring. In other words, there is no double-counting resulting from including two closely related indicators in the composite indicator.

After the correlation analysis, the PCA has been performed on the de-trended indicators using, as a basis, the 15 countries and the entire time range 1992-2001 (150 points). Of course, not all the individuals could be used due to missing data. A measure of the dimensionality of the phenomenon is the number of principal components (PCs) that are necessary to explain a given fraction of the variance in the indicators with respect to the total number of indicators. Table 7 shows the results of the PCA. The eigenvalue for a principal component indicates the variance that the PC accounts for out of the total variance of the original sub-indicators. The principal component with the highest eigenvalue is the first PC. The PCA produces eigenvalues ranked in decreasing order (see Table 7). Note that the first three principal components explain 50% of the information contained in the set of 12 sub-indicators. The first five PCs are needed to reach the 70% threshold, and that the first 8 PCs explain 90% of the phenomenon. The measure mentioned above is hence 8/12, which is quite high if compared to other cases that can be found in the literature (Ogwang and Abdou, 2000).

Table 7. Eigenvalues of the Principal Components

(1992-2001, 15 countries, de-trended data)

	Eigenvalue	% total variance	Cumulative Eigenvalue	Cumulative variance (%)
1	2.5	20.7	2.5	20.7
2	1.9	15.8	4.4	36.5
3	1.7	13. 9	6.1	50.4
4	1.3	10.6	7.3	61.0
5	1.1	9.3	8.4	70.4
6	1.0	8.0	9.4	78.3
7	0.8	6.8	10.2	85.1
8	0.6	4.9	10.8	90.0
9	0.5	3.8	11.3	93.8
10	0.3	2.4	11.6	96.3
11	0.2	2.0	11.9	98.3
12	0.2	1.7	12.0	100.0

An additional analysis consists in executing the so-called *normalized varimax rotation* of the components (Kaiser, 1958), which are thus transformed in order to find new components that are easier to interpret. The new components are orthogonal, like the old

ones. The ease of interpretation is due to the fact that with the rotation we obtain factor loadings for the new components which are either close to zero or very different from zero. Varimax is recommended as the standard approach (Manly, 1994).
The results are shown in Table 8. The high values of the loadings are highlighted in gray. Interesting to note that each sub-indicator is now loaded on a single new component (this does not happen so often). This means that one rotated component is mainly responsible for one sub-indicator. A confirmation is given by the fact that the rotated components have almost equal eigenvalues (see penultimate row in Table 8).

Table 8. Loadings of the Principal Components, rotation method: varimax normalised. Marked loadings are >0.70

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	PC11	PC12
State aid	0.13	-0.02	0.03	0.09	0.08	0.04	0.97	0.04	0.00	0.03	0.07	0.09
Public procurement	0.00	0.07	0.04	-0.05	0.98	-0.04	0.08	0.03	0.12	0.01	-0.05	0.01
Telecom. costs	-0.12	0.41	0.00	0.09	0.07	0.15	-0.09	0.09	-0.04	0.01	-0.87	0.04
Electricity prices	0.28	0.01	0.00	0.12	0.01	0.20	0.03	0.19	-0.19	0.89	-0.01	0.00
Gas prices	0.10	0.03	0.04	-0.04	-0.04	0.97	0.04	0.07	0.00	0.16	-0.11	0.06
Relative price level	0.88	-0.05	0.00	0.00	0.00	0.12	0.18	0.07	-0.26	0.29	0.12	0.01
Intra EU-FDI	0.00	0.01	0.98	0.01	0.03	0.02	0.00	-0.01	0.03	0.00	0.01	0.19
Intra EU-trade	-0.20	-0.03	0.01	-0.01	0.13	0.00	0.00	-0.02	0.95	-0.15	0.03	-0.05
Active population	0.06	0.00	0.00	0.15	0.04	0.07	0.04	0.97	-0.02	0.15	-0.06	0.03
Pension fund assets	0.03	-0.95	-0.02	0.05	-0.07	-0.02	0.01	0.00	0.03	0.00	0.28	-0.01
Ratio of interest rates	-0.01	-0.01	-0.56	0.03	-0.02	-0.10	-0.16	-0.05	0.09	-0.01	0.06	-0.80
Postal tariffs	0.01	-0.04	0.00	0.97	-0.05	-0.04	0.09	0.15	-0.01	0.09	-0.06	-0.02
Expl.Var	*0.95*	*1.09*	*1.28*	*1.01*	*1.01*	*1.04*	*1.04*	*1.02*	*1.04*	*0.95*	*0.88*	*0.69*
Prp.Totl	*0.08*	*0.09*	*0.11*	*0.08*	*0.08*	*0.09*	*0.09*	*0.09*	*0.09*	*0.08*	*0.07*	*0.06*

3.3. Weighting approach

A common practical problem in building composite indicators is how to assess properly the plurality of perspectives about the relative importance of the sub-indicators. Cox et al. (1992) summarise the difficulties that are commonly encountered when proposing weights to combine indicators to a single measure, and conclude that many published weighting schemes are either arbitrary (e.g. based upon too complex multivariate methods) or unreliable (e.g. have a little meaning to society).

A commonly used method is the assignment of weights to sub-indicators based on expert judgement (Puolamaa et al., 1996). It was essential to bring together experts that have a wide spectrum of knowledge, experience and concerns, so as to ensure that a proper weighting system is found for the IMI. ***Budget allocation*** (Moldan *et al.* 1997) has been used for the assessment of the relative importance of the sub-indicators that compose IMI. The experts of the Internal Market Advisory Committee originating from each of the Member States were given a "budget" of 100 points, to be distributed over seven of the twelve sub-indicators, "paying" more for those indicators whose importance they want to stress. Allocating a certain budget over a too large number of indicators can give serious

cognitive stress to the experts, as it implies circular thinking. For this reason, the experts were requested to allocate the budget over seven indicators (number tested in other case studies).

Table 9 presents the weights given by the IMAC experts of 14 Member States (Luxembourg did not provide weights) and their average across countries. All indicators have been voted, at least once, by a Member State. Pension funds and Postal tariffs have received the lowest weights, while Intra EU trade, Sectoral & ad hoc state aid and Published Public Procurement have received the highest weights.

Table 9. Weights provided by the IMAC members for the sub-indicators composing the IMI

Name of indicator	A	B	D	DK	E	FIN	F	EL	IRL	I	L	NL	P	S	UK	Mean
State aid	10	0	20	30	15	10	0	20	20	30	-	10	0	15	10	13.6
Public procurement	0	25	20	0	10	0	10	18	10	35	-	20	15	15	10	13.4
Telecom. costs	15	10	0	10	10	10	15	8	15	10	-	0	5	15	10	9.5
Electricity prices	15	20	5	10	15	20	20	4	15	15	-	0	15	15	0	12.1
Gas prices	15	15	0	10	10	10	10	0	10	0	-	2	10	0	0	6.6
Relative price level	20	0	0	15	0	0	25	20	0	0	-	8	15	15	20	9.9
Intra-EU FDI	15	10	20	0	15	15	0	15	10	10	-	20	20	0	20	12.1
Intra-EU trade	10	10	20	0	25	20	0	15	20	0	-	20	20	15	20	13.9
Active population	0	10	5	0	0	0	0	0	0	0	-	20	0	10	0	3.2
Pension fund assets	0	0	0	0	0	0	0	0	0	0	-	0	0	0	10	0.7
Ratio of interest rates	0	0	10	15	0	15	10	0	0	0	-	0	0	0	0	3.6
Postal tariffs	0	0	0	10	0	0	10	0	0	0	-	0	0	0	0	1.4

Note: The sum of weights provided by each IMAC member equals 100

3.4. Calculation of IMI values

The IMI z-scores were calculated by taking the weighted average of the standardised values (z-scores) for each indicator,

$$IMI^{t}_{i,z-score} = \sum_{j} w_j y^{t}_{ji} \qquad (3)$$

where w_j is the average weight for sub-indicator *j* obtained from the IMAC survey and y^{t}_{ji} is the standardised sub-indicator as calculated by Eq.1 or Eq.2. All Member States had equal weight in the overall average and in the Index. In cases in which an indicator was missing it was simply not included in the weighted average and the weights of the remaining indicators were scaled to sum up to 1.

With this definition, the IMI z-score in 1992 for EU is equal to 0. The countries with negative IMI z-scores perform worse than EU in 1992, the countries with positive IMI z-scores perform better than EU in 1992.

With the view to track the relative performance of each country with respect to its own state in 1992 (target date of the Internal Market Programme), the IMI z-scores have been scaled as follows.

The IMI value of country *i* at time *t* is given by:

$$\overline{IMI}_i^t = 100 \cdot \left(\frac{IMI_{i,z-score}^t + IMI_{EU}^{1992}}{IMI_{i,z-score}^{1992} + IMI_{EU}^{1992}} \right) \tag{4}$$

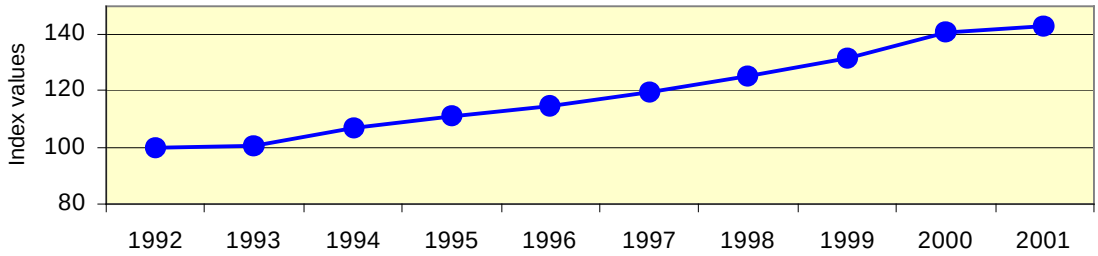
where $IMI_{EU}^{1992} = \sum_j w_j \frac{x_{jEU}^{1992}}{s_j^{1992}}$.

Therefore if a country has an IMI value of 120 for a given year, this implies that the country performs 20% better than its own state in 1992. At this point, the IMI z-scores do not allow ranking Member State's relative Internal Market performance in any way. A rapid increase in the index may simply indicate that a Member State started from a low level and a slow increase could easily be a sign that a Member State started from a level where there was little room for further improvement. But it is possible to see how much the index has increased in each Member State since 1992 – and to identify the indicators within the index responsible for the change.

4. THE INTERNAL MARKET INDEX 1992-2002: SCOREBOARD NO. 11

The Internal Market Index appears to reflect steady progress towards the desired impacts of Internal Market policy since the target year 1992. The overall score for the EU has improved by some 40%.

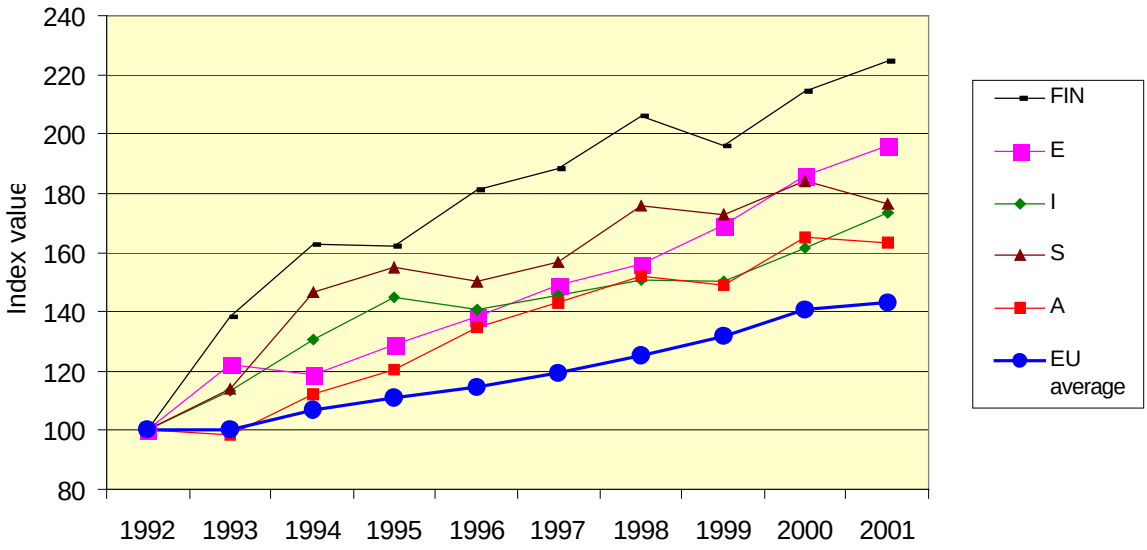
Figure 1: Considerable progress since 1992



We can usefully look at some of the factors, which affect the rate at which the index grows. The two indicators, which have the most positive influence on the growth of the index, are foreign direct investment (FDI) and the value of published procurement. The influence results from both the weight of the indicator and its development over time. The indicators on gas prices and intra EU trade have the least positive influence on the index. This quantitative indication fits with an intuitive view of the development of the Internal Market over the last decade. Legislation on public procurement has lead to Member States publishing openly a larger proportion of contracts. The high levels of intra EU trade which already existed in 1992 have increasingly been complimented by the increasing emphasis which business puts on investing in a European production base. And there have been different trends in opening up certain utilities markets – more progress has been made in telecommunications for example than in energy markets:

	Has driven index up	**Has slowed index down**
EU	FDI, public procurement	Gas prices, intra-EU trade

Figure 2: The index for Finland, Spain, Italy, Sweden and Austria grew significantly more than the EU index

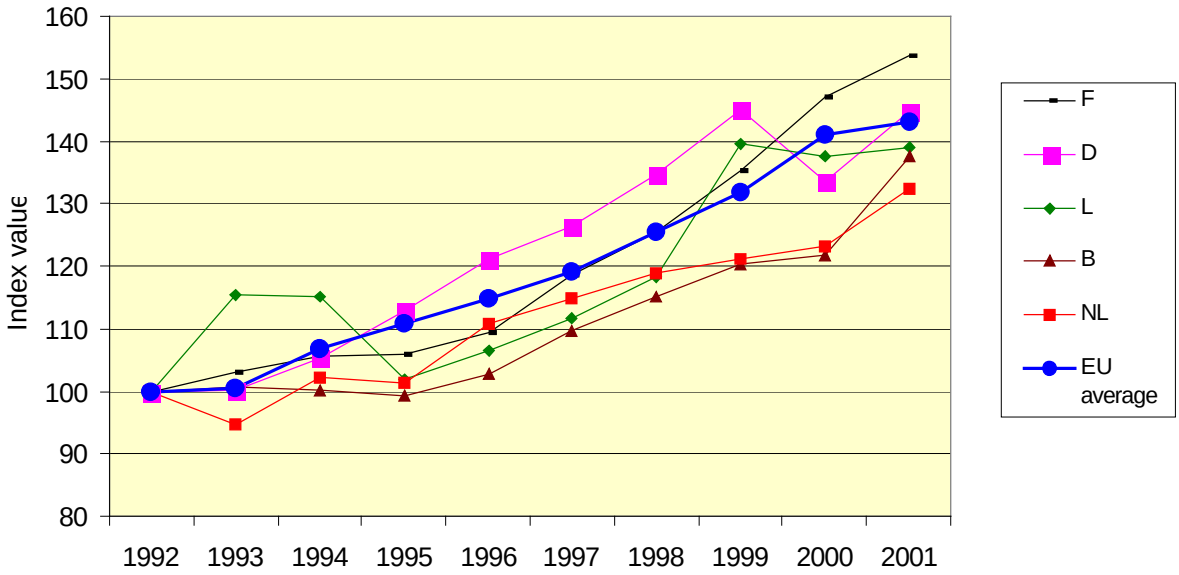


Note: Index measuring percentage change compared to the base year 1992 (=100 for each country).

Four of the 5 Member States whose index grew the fastest over the last decade are relatively new Member States. 3 joined in 1995 and Spain in 1986. The faster growth in their indices could reflect on the one hand their rapid integration on an economic level and on the other the introduction and compliance with certain EU legislation (state aid, public procurement) which was not applicable prior to membership. The above average growth in the Italian index seems to be the result of the key drivers in the table below and a reduction in telecommunications costs.

	Has driven index up	**Has slowed index down**
Finland	FDI, state aid	Intra-EU trade, telecommunications costs
Spain	FDI, public procurement	Gas prices, relative price level
Italy	State aid, public procurement	Gas prices, electricity prices
Sweden	Public procurement, electricity prices	Telecommunications costs, relative price level
Austria	Public procurement, telecommunications costs	Relative price level, state aid

Figure 3: The growth rates of the indices for France, Germany, Luxembourg, Belgium and the Netherlands are clustered around the rate for the EU index

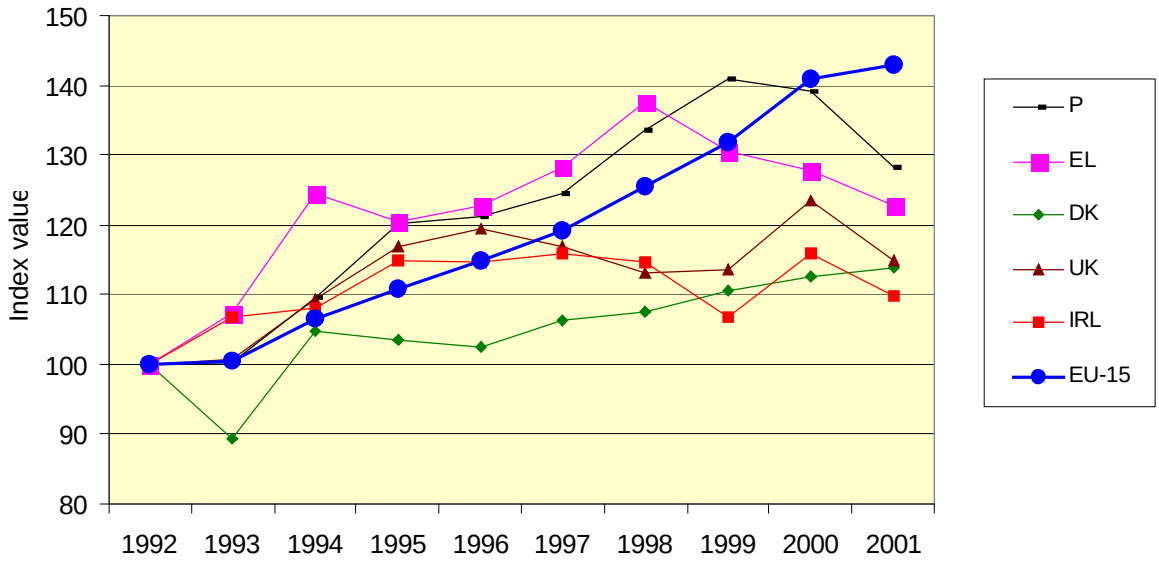


Note: Index measuring percentage change compared to the base year 1992 (=100).

These Member States are all founder members of the EU and it does not seem unusual that their indices grow at a rate close to the EU index, since they had already implemented many Internal Market rules before 1992. Utility prices seem to have played a very significant role in the development of these countries' indices.

	Has driven index up	**Has slowed index down**
France	Public procurement, FDI	Gas prices, relative price level
Germany	Telecommunication costs, electricity prices	Gas prices, intra-EU trade
Luxembourg	Telecommunication costs, public procurement	Gas prices, relative price level
Belgium	Public procurement, intra-EU trade	Electricity prices, gas prices
Netherlands	Telecommunication costs, public procurement	Electricity prices, gas prices

Figure 4: The index for Portugal, Greece, Denmark, UK and Ireland has grown significantly less than the EU index



Note: Index measuring percentage change compared to the base year 1992 (=100).

The index for Greece and Portugal grew slightly faster than the EU index until 1998. Since then the index for these two countries has fallen both relative to the EU index and in absolute terms. The index for the UK and Ireland grew more or less in line with the EU index until 1997 and from then on grew significantly more slowly. This is primarily because price indicators are used in the index as proxies to measure Internal Market progress on utilities and to measure relative price levels. All of these prices are measured in Euro. The UK index is therefore heavily affected by the appreciation in the value of the pound whilst the Irish index is affected by Ireland's differential inflation rate compared to the rest of Euroland.

	Has driven index up	**Has slowed index down**
Portugal	Electricity prices, telecommunication costs	State aid, public procurement
Greece	State aid, public procurement	Intra-EU trade, relative price level
Denmark	Public procurement, FDI	Electricity prices, state aid
UK	FDI, public procurement	Relative price level, gas prices
Ireland	Public procurement, telecommunications costs	Relative price level, gas prices

5. ROBUSTNESS ASSESSMENT OF THE INDEX

With a view to estimate the uncertainty in the IMI values due to the plurality of perspectives about the importance of the indicators, we calculated the IMI as the weighted average of the 12 indicators, considering different sets of weights **Error! Reference source not found.**]. The probability density function (pdf) of the weights was set-up according to the outcome of the IMAC survey (all the weights provided by IMAC are given in Table 9). The pdf is therefore discrete with probability values proportional to the frequency the weight received by the experts, as shown in Figure 5. With a view to include all the sub-indicators in the calculation of the Index, in the cases where a sub-indicator has received zero weight by an expert, this weight has been considered as 1 instead of 0.

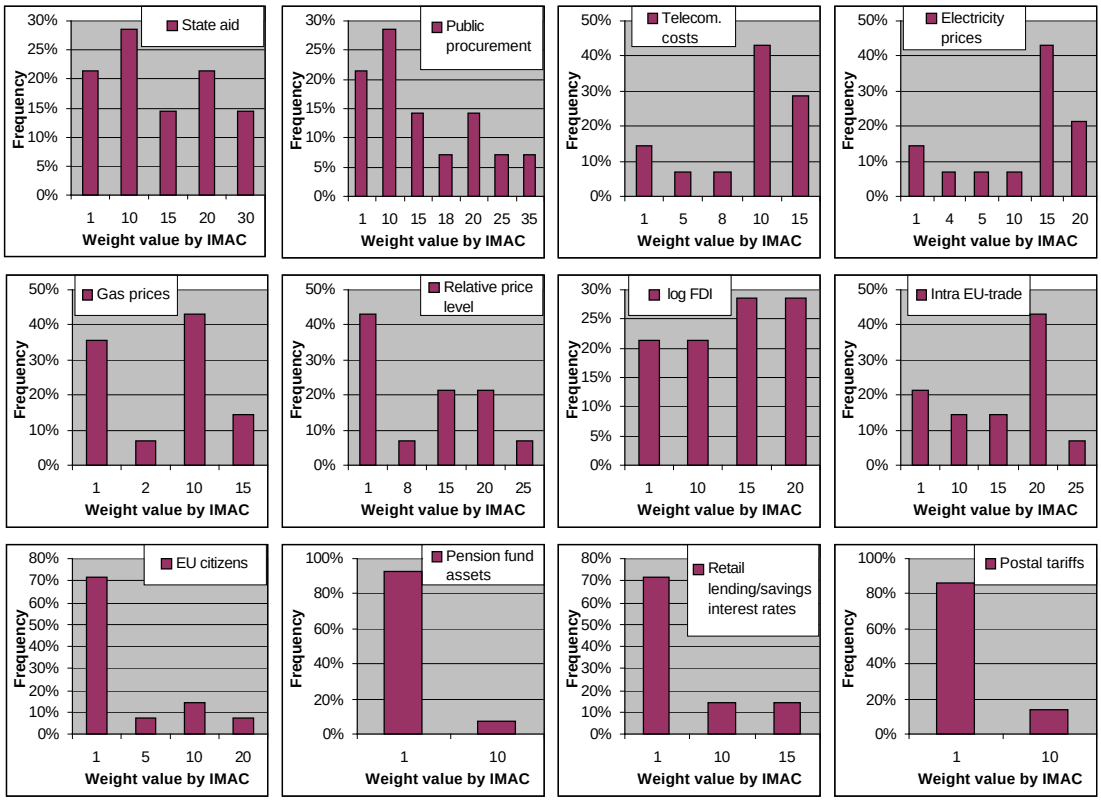


Figure 5: Probability distribution functions for the weights as provided by the IMAC experts

5.1. Set-up of the analysis

A sample of 5,000 random points has been generated from the pdf's of the weights. Each point is a realisation of a set of weights and the IMI has been calculated for this realisation. The calculation of the IMI is then repeated for each realisation and a set of 5,000 IMI values is obtained for each country and year. These values are a sample from

the empirical distribution of the IMI and we can estimate a number of statistics (median, dispersion, percentiles, etc.).

5.2. Results of the Uncertainty Analysis

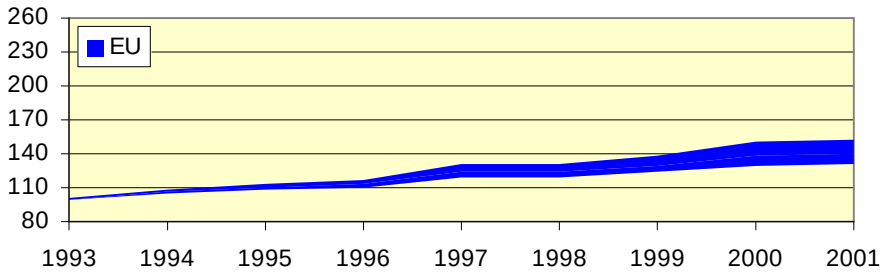
In the uncertainty analysis all the weights assigned by the IMAC members are considered, not only their average values. In this way, 100% of the information offered by IMAC is acknowledged, and its effect on the Internal Market Index (IMI) is estimated.

The results from the uncertainty analysis (UA) are reported in Figure 6-9 (the same scales have been used in all the graphs). The uncertainty bounds of the IMI values for EU and the 15 Member States are shown. These bounds are expressed as the 20^{th} and 80^{th} percentiles of the distributions. Usually, the 10^{th} and the 90^{th} percentiles are reported in the analyses. However, the sampling from the pdf's given in Figure 5 produces a consistent number of samples with null values for most of the weights. This implies that in 40% of the cases the IMI is calculated using less than six sub-indicators, yielding either very small or very large values for the IMI. Therefore, these outliers were removed from the distribution by considering the 20^{th} and 80^{th} percentiles.

By acknowledging uncertainty, the figures show that the EU as a whole is growing over time. This is particularly marked in Finland, Spain, Italy, Sweden and Austria. Note that the IMI for EU is 100 in 1992, the reference year, and around 140 in 2001.

Graphical representations of time-dependent variables, especially indicators, with their uncertainty bounds are still not a standard procedure, because it requires extra information to characterise the sources of uncertainty that is not always available. However, uncertainty analysis is gaining credit in the scientific arena, mostly thanks to the better understanding that this yields on the behaviour of the phenomenon under study. Above all, uncertainty analysis is useful to assess the reliability and quality of the results obtained. That is the main reason why we propose its use here.

Figure 6: The progress of the index for EU considering the uncertainty bounds



Note: Index measuring percentage change compared to the base year 1992 (=100 for each country).

Figure 7: The growth rates of the indices for Finland, Spain, Italy, Sweden and Austria considering the uncertainty bounds

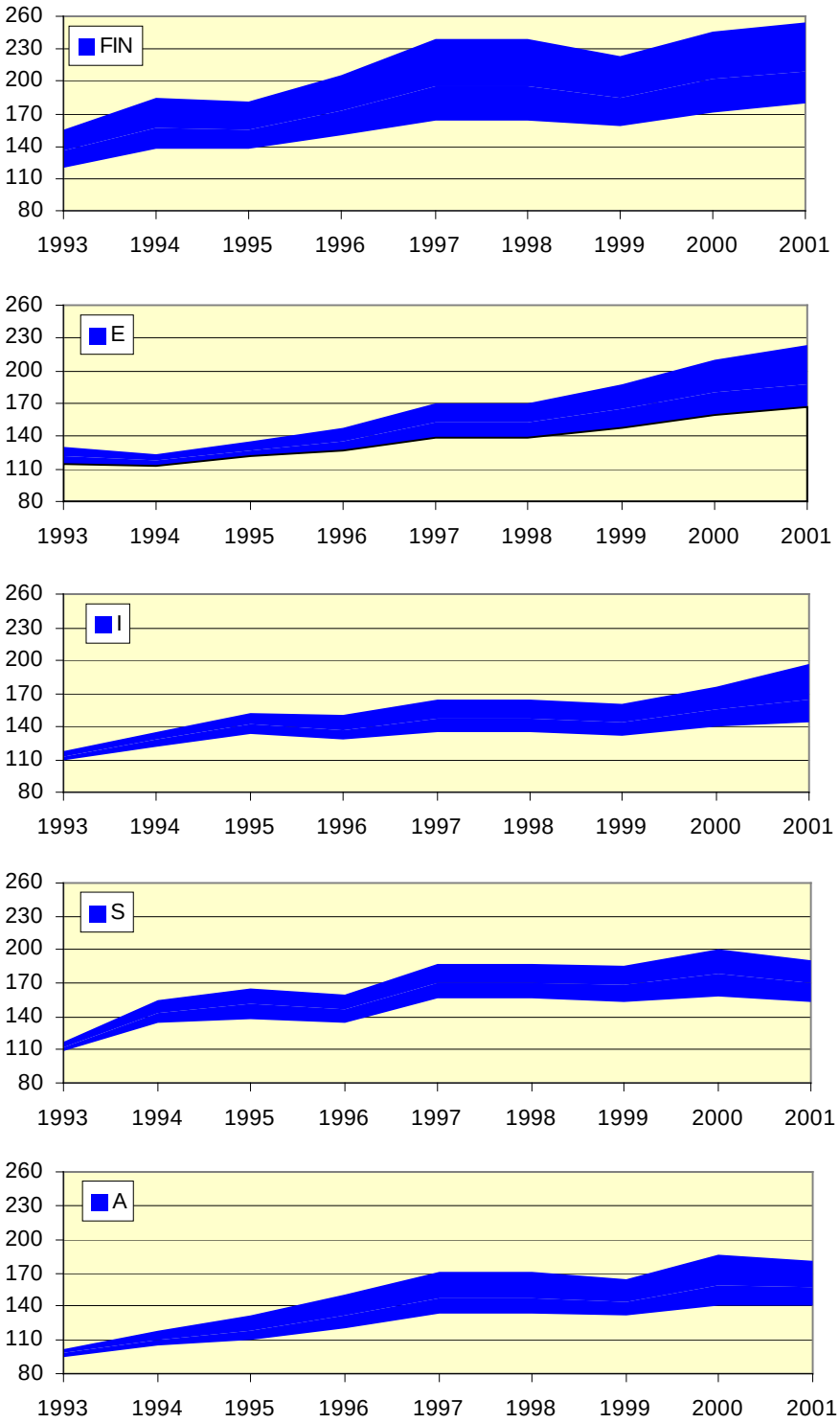


Figure 8: The growth rates of the indices for France, Germany, Luxembourg, Belgium and the Netherlands considering the uncertainty bounds

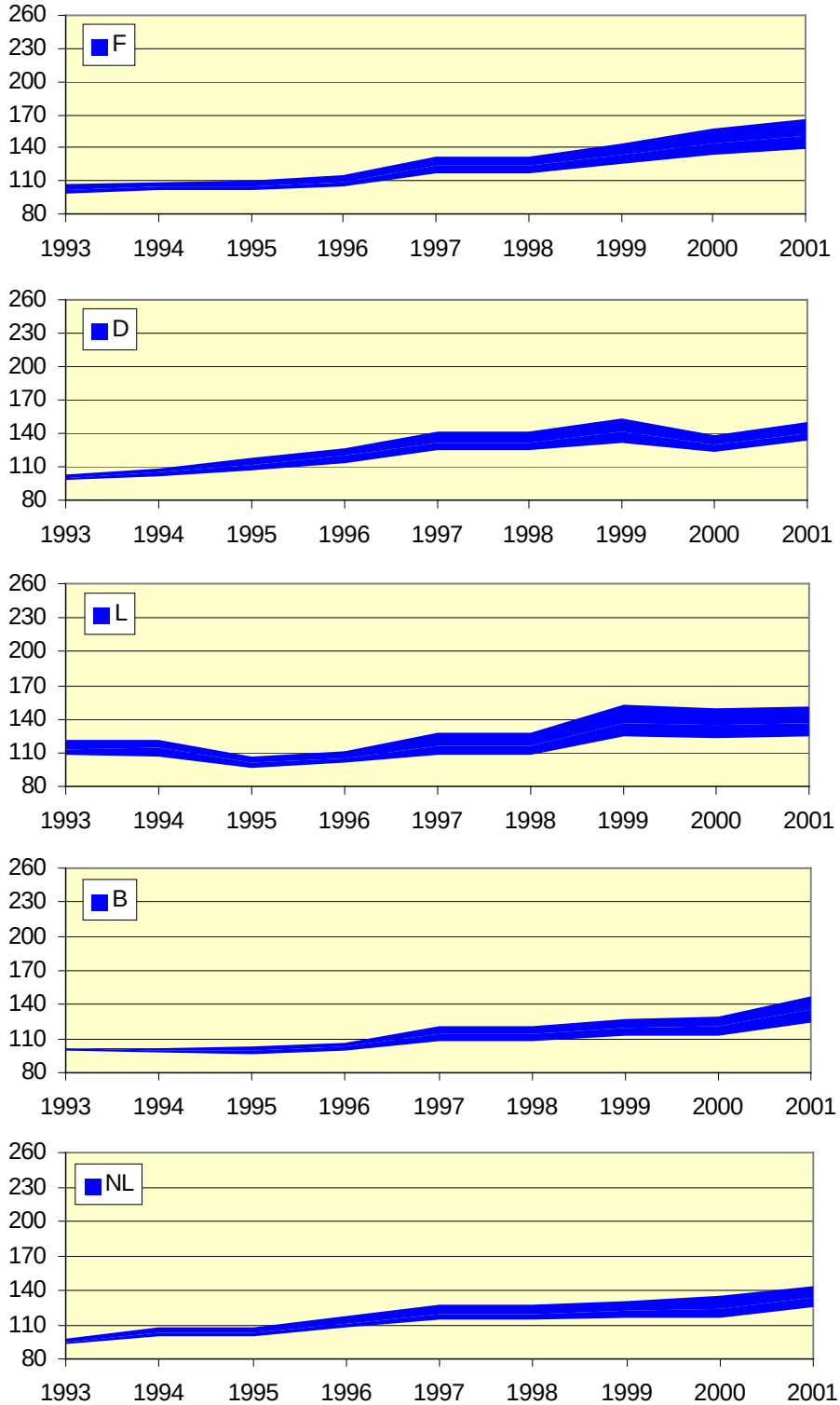
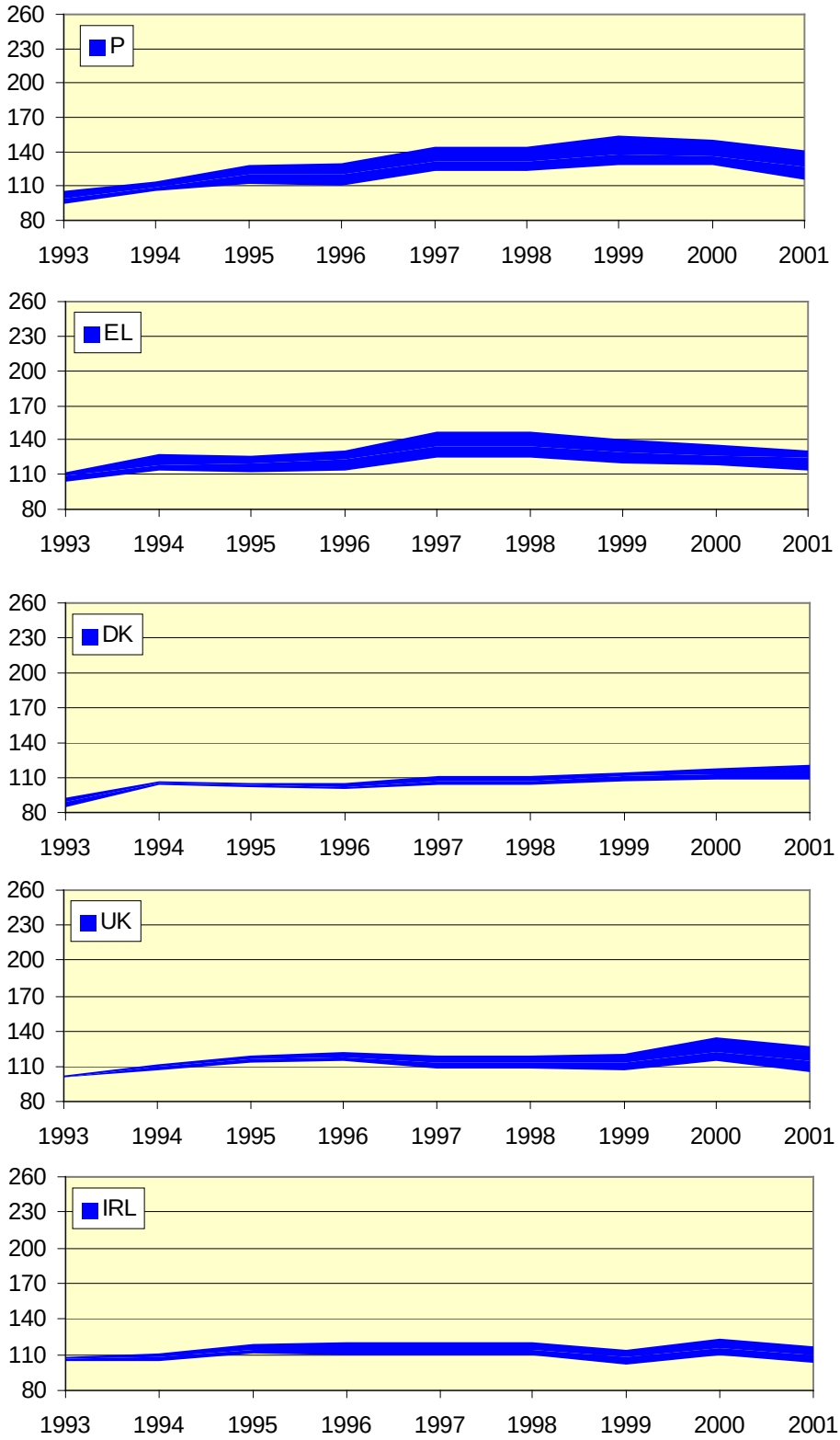


Figure 9: The growth rates of the indices for Portugal, Greece, Denmark, United Kingdom and Ireland considering the uncertainty bounds



5.3. Sensitivity analysis

We assessed the effect of the uncertainty in the weights upon the growth rates of the IMI values for each country and for each year. Given that the relationship between the weights and the growth rates for the IMI is non linear, we used a technique for global sensitivity analysis called *extended FAST* (see Saltelli et al., 2000). If such relationship were linear, then other simpler techniques, such as Standardised Regression Coefficients (SRC), could have been employed.

Table 10 shows the sensitivity indices estimated with the extended FAST for year 2001, averaged across the 15 Member States. These sensitivity indices are called *first order effects*, as they quantify the influence of a given weight, taken singularly, upon the growth rate of the IMI. There are also *second order effects*, *third order effects* etc, which measure the effects of interactions among groups of weights upon the IMI.

The highest first order effects are obtained for the weights of the sub-indicators *relative price levels*, *electricity prices* and *public procurement*. This information is useful: we know which direction we should focus efforts on, in order to reduce the uncertainty bounds of the IMI in the next editions of the Scoreboard. IMAC members are invited to meet and to focus their discussion on the weights for the three sub-indicators mentioned above. If more consensus will be found on the relative merit of such three sub-indicators, more accurate estimates of IMI could be obtained.

Table 10. Average Sensitivity Indices across all Member States for 2001.

Indicator	**First order Effects (*extended FAST*)**
State aid	0.05
Public procurement	0.12
Telecommunication costs	0.05
Electricity prices	0.15
Gas prices	0.04
Relative price level	0.19
Intra-EU FDI	0.07
Intra-EU trade	0.03
Working foreigners in a MS	0.03
Pension fund assets	0.00
Ratio of interest rates	0.03
Postal tariffs	0.01

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ANNEX – Table A1. Questionnaire given to the Internal Market Advisory Committee for assigning weights for the indicators.

Name of indicator and source	**Explanation**	**Step 1** (relevant indicators)	**Step 2** (points allocated)
1. Sectoral and ad hoc state aid as % of GDP, (2001 Structural Indicators / EUROSTAT)	Sectoral and ad hoc state aid distorts the level playing field and should be avoided if possible.	**X**	**20 (example!)**
2. Value of published public procurement as % of GDP, (2001 Structural Indicators / EUROSTAT)	Publication of procurement enables market access and leads to more competition.	**X**	**20 (example!)**
3. Telecommunication costs [Sum of a 10 min local call + 10 min national call + 10 min call to USA], (2001 Structural Indicators / EUROSTAT)	Liberalisation of utilities and technical progress should lead to lower prices.		
4. Electricity prices [Sum of products of energy consumption × energy prices for household and industry], (2001 Structural Indicators / EUROSTAT)	Liberalisation of utilities and technical progress should lead to lower prices.	**X**	**5 (example!)**
5. Gas prices [Sum of products of gas consumption × gas prices for household and industry], (2001 Structural Indicators / EUROSTAT)	Liberalisation of utilities and technical progress should lead to lower prices.	**X**	**10 (example!)**
6. Relative price level measured as ratio between PPP and the market exchange rate [EU average = 100], (2001 Structural Indicators / EUROSTAT)	More competition, economies of scale etc. should eventually lead to lower prices.		
7. Intra-EU Foreign direct investment inward flows as % of GDP, (EUROSTAT)	Measures free movement of capital.	**X**	**10 (example!)**
8. Intra-EU trade as % of GDP, (EUROSTAT)	Measures free movement of goods.	**X**	**25 (example!)**
9. Active population in a MS originally coming from other MS [divided by population], (EUROSTAT)	Measures free movement of workers.		
10. Value of pension fund assets as % of GDP., (EUROSTAT)	As a measure of movement from pay-as-you-go to funded pension schemes it indicates the speed of pension reform in the EU.		
11. Retail lending interest rates over savings interest rates ratio, (EUROSTAT)	Measures the efficiency of the banking sector.		
12. Postal tariffs [20g standard letter], (DG MARKT)	Liberalisation of utilities and technical progress should lead to lower prices.	**X**	**10 (example!)**
SUM of allocated points			**100**