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# Analysis of the average exit age from the labour force

## Final report

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by
Kurt Vogler-Ludwig
Nicola Düll

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This study was launched by the European Commission to assess the dynamic and static exit age indicators regarding accuracy, timeliness, accessibility and clarity, comparability and coherence. Moreover, the working life expectancy indicator as suggested by Hytti and Nio was calculated on a pilot basis at national and European level. Calculations were based on the data provided by Eurostat for 31 countries.

The major critique addressed to the dynamic exit age indicator refers to the high variance over time, which can hardly be interpreted as “real” phenomena. The analysis shows that the use of activity rates from two LFS samples in subsequent years is the major source of exit age variation. The advantage of using a partial cohort approach for measuring exit age is more than compensated through the disadvantage, which arises from the comparison of two (mostly) independent samples. In the breakdown by countries, single ages and gender, the LFS is asked an accuracy for which it was not designed.

Moreover, the dynamic (and the static) exit age indicator is biased through two methodological constraints: firstly, the cut of activity rates relations between two ages at the maximum of 1 tends to underestimate the exit age. This data correction – which is a stringent requirement of the methodology – also limits the error correction process. Secondly, the maximum exit age of 70 – which is due to shrinking sample size with age – also distorts the estimates downwards (by 0.5 to 0.8 years compared to a working life span extended to 75).

The study comes to the conclusion that the working-life expectancy indicator has clear advantages compared to the static and dynamic indicators as regards accuracy, comparability, and interpretability of results. The advantages become particularly evident in comparison to the dynamic indicator. The working-life expectancy indicator is based on life tables, which are associated with activity rates to calculate the average working life expectancy of the labour force for a given year. This can be transformed into the required exit age indicator.

The working life expectancy indicator is characterised by a clear country and gender profile, which is equivalent to the other two indicators. Time series stability, however, is much higher. This is due to the internal error correction process involved in the methodology.

The implementation of the working life expectancy indicator requires the calculation of life tables on a country basis. This is already on the way in Eurostat. Regarding activity rates, LFS data remain the most important data input. However improvements of estimates for higher ages are required to reduce the effects of sampling errors and extend present age limits. It is therefore suggested to develop these estimates in parallel to the calculation of life tables.

Methodologically, this can be achieved through two approaches: (1) econometric estimates with logistic or spline functions which exploit the available time series. (2) Estimates based on LFS micro-data and making use of the great number of variables for the estimate of labour force participation. This would allow explaining participation through more variables than simply gender and age, and can be expected to provide more stable results.

# Kurzfassung

Diese Studie wurde von der Europäischen Kommission in Auftrag gegeben um die dynamischen und statischen Indikatoren für das Austrittsalter aus dem Arbeitsmarkt im Hinblick auf ihre Genauigkeit, Aktualität, Verfügbarkeit und Klarheit, Vergleichbarkeit und Kohärenz zu untersuchen. Darüber hinaus sollte der Indikator zur Arbeitslebenserwartung, wie er von Hytty und Nio vorgeschlagen wurde, im Rahmen von Pilotberechnungen auf nationaler und europäischer Ebene berechnet werden. Die Kalkulationen beruhen auf Eurostat-Daten für 31 Länder.

Die hauptsächliche Kritik am dynamischen Indikator für das Austrittsalter richtet sich auf die hohe Varianz im Zeitverlauf, die kaum mit „realen“ Phänomenen erklärt werden kann. Die Analyse zeigt, dass die Verwendung von Aktivitätsraten aus zwei aufeinander folgenden Jahren die wichtigste Ursache der Schwankungen im Austrittsalter. Der Vorteil aus der Verwendung eines partiellen Kohortenansatzes zur Messung des Austrittsalters wird mehr als kompensiert durch den Nachteil, der aus dem Vergleich zweier (überwiegend) unabhängiger Stichproben entsteht. In der Untergliederung nach Ländern, Altersjahrgängen und Geschlecht wird der Arbeitskräfteerhebung eine Genauigkeit abgefordert, für die sich nicht geschaffen worden war.

Darüber hinaus ist der dynamische Indikator (ebenso wie der statische) durch zwei methodische Vorgaben verzerrt: Erstens führt die Begrenzung der Relation der Aktivitätsraten auf das Maximum von 1 zu einer Unterschätzung des Austrittsalters. Diese Datenkorrektur – die methodisch zwingend vorgegeben ist – behindert auch den Fehlerausgleich. Zweitens, bewirkt die Festlegung des Höchstalters für eine aktive Beschäftigung auf 70 Jahre – die der mit steigendem Alter schwindenden Stichprobengröße geschuldet ist – ebenfalls zu einer Unterschätzung (etwa 0,5 bis 0,8 Jahre im Vergleich zu einem Höchstalter von 75 Jahren).

Die Studie kommt zu dem Schluss, dass der Indikator für die Arbeitslebenserwartung im Hinblick auf Genauigkeit, Vergleichbarkeit und Interpretierbarkeit klare Vorteile gegenüber dem dynamischen und dem statischen Indikator hat. Diese Vorteile werden besonders im Vergleich zum dynamischen Indikator sichtbar. Die Arbeitslebenserwartung wird auf der Basis von Sterbetafeln berechnet, die mit den Aktivitätsraten kombiniert werden um die „Überlebenswahrscheinlichkeit“ im Arbeitsmarkt für ein gegebenes Jahr zu berechnen. Dies kann in einen Indikator für das Austrittsalter aus dem Arbeitsmarkt umgeformt werden.

Der Indikator für die Arbeitslebenserwartung ist durch ein klares Länder und Geschlechtsprofil gekennzeichnet, das mit den anderen beiden Indikatoren vergleichbar ist. Die Zeitreihenstabilität ist jedoch wesentlich höher. Dies ist dem im methodischen Ansatz enthaltenen internen Fehlerausgleich zu verdanken.

Die Anwendung des Arbeitslebensindikators erfordert die Berechnung von Sterbetafeln auf der Länderebene. Diese Berechnungen werden von Eurostat gegenwärtig durchgeführt. Die Aktivitätsraten aus der Arbeitskräfteerhebung bleiben der wichtigste Dateninput. Allerdings sind verbesserte Schätzungen für hohe Altersjahrgänge erforderlich, um die Auswirkungen der Stichprobenfehler zu reduzieren und die Alterspanne der Berechnungen zu erweitern. Es wird daher vorgeschlagen, diese Schätzungen parallel zur Berechnung der Sterbetafeln durchzuführen.

Dies kann methodisch durch zwei Ansätze erreicht werden: (1) ökonometrische Schätzungen mit logistischen Ansätzen oder Spline-Funktionen, auf Basis der vorhanden Zeitreihen. (2) Schätzungen auf der Basis von Mikrodaten, die das große Potential an Variablen der Arbeitskräfteerhebungen ausschöpfen. Dies würde es erlauben, die Teilnahme am Arbeitsmarkt durch mehr Variable als nur Geschlecht und Alter zu erklären. Dies lässt stabilere Ergebnisse erwarten.

# Résumé

Cette étude a été lancée par la Commission Européenne pour évaluer l'indicateur dynamique et l'indicateur statique de l'âge moyen de sortie quant à son exactitude, son actualité, son accessibilité, sa clarté, sa comparabilité et sa cohérence. En outre, l'indicateur basé sur l'espérance de vie active construit par Hytti et Nio a été repris et développé pour en faire un indicateur au niveau national et Européen. Les calculs ont été effectués pour 31 pays à partir de données mises à disposition par Eurostat.

La critique majeure à l'adresse de l'indicateur dynamique de l'âge moyen de sortie se rap-porte sur sa grande variance au cours du temps, ce qui ne reflète point des phénomènes réels. L'analyse démontre que cette variation est due à l'utilisation des taux d'activité d'une année à l'autre de deux échantillons différents de la statistique de la population active. L'avantage d'utiliser une approche partielle de cohorte est anéanti par le désavantage suscité par la comparaison de deux échantillons (quasiment) indépendants. Pour la décomposition des données par pays, âge et gendre, les données EFT devraient pouvoir fournir une exactitude pour laquelle elle n'a pas été conçue.

Par ailleurs, autant l'indicateur statique que l'indicateur dynamique sont biaisés à cause de deux contraintes méthodologiques : premièrement, l'âge moyen de sortie est sous-estimé par le fait que la relation entre deux âges est plafonnée à la valeur « 1 ». Cette correction des données, qui est une demande stricte de la méthodologie appliquée, limite aussi le processus de correction d'erreurs. Deuxièmement, l'âge maximal de sortie est fixé à 70 ans, ce qui est lié au fait que la taille des échantillons par classe d'âge diminue avec l'âge, ce qui mène aussi à sous-estimer l'âge de sortie (de 0,5 à 0,8 années si l'on prend les classe d'âge jusqu'à 75 ans en considération).

L'étude conclu que l'indicateur d'espérance de vie active a de nets avantages comparé aux indicateurs statique et dynamique de l'âge moyen de sortie quant à son exactitude et sa comparabilité et peut plus facilement être interprété. Ces avantages sont particulièrement évidents quand on le compare avec l'indicateur statique. Ce nouvel indicateur est basé sur des tables de mortalité en prenant en compte les taux d'activité à fin de pouvoir calculer l'espérance de vie active de la population active pour une année précise. Il peut être transformé en indicateur de l'âge de sortie.

L'indicateur de l'espérance de vie active produit, tout comme les deux autres indicateurs, des profils clairs par pays et par genre. Par contre, la stabilité des séries dans le temps est nettement plus grande. Ceci est du au processus de correction interne inhérente à cette méthodologie.

La construction de l'indicateur de l'espérance de vie active nécessite un calcul à partir des tables de mortalité par pays. Eurostat a déjà pris les mesures nécessaires à cet effet. Quant aux taux d'activité, les données EFT sont utilisées. Néanmoins, les estimations pour les groupes d'âge plus avancé doivent être améliorées à fin de minimiser les erreurs d'échantillonnage et de repousser les limites d'âge utilisés. Il est donc suggéré d'effectuer ces estimations en même temps que les calculs des tables de mortalité.

Au niveau méthodologique cela peut être atteint par deux approches différentes: (1) par des estimations économétriques avec des fonctions logistiques et des fonctions « spline » appliquées aux séries longues disponibles ; (2) par l'utilisation des micro-données EFT en exploitant le grand nombre de variables pour estimer la participation de la population active. Ceci permettrait d'expliquer la participation avec plus de variables qu'uniquement l'âge et le genre et donc d'avoir des résultats plus stables.

# Summary

This study was launched by the European Commission to obtain an analysis of exit age indicators. Being part of the monitoring set for the European Employment Strategy, these indicators have an outstanding political relevance in the area of ageing policies, demanding for high standards of accuracy, timeliness, accessibility and clarity, comparability and coherence. It is the task of this study to evaluate the indicators by applying such criteria. Moreover, the view on alternatives was be opened through calculating and assessing the exit age indicator based on life-expectancy tables.

The study undertakes this analysis with a review of experts' opinions in Europe, a methodological and empirical assessment of the exit age indicators, and a sensitivity analysis. The suggestions of Hytti and Nio from the Finnish Ministry of Labour are further developed to a working life expectancy indicator at national and European level. The study draws conclusions from the findings and develops recommendations. Calculations were based on the data provided by Eurostat for 31 countries. Calculation methods were established with own resources.

*The expterts' assessment*

The survey among the EMCO working group and other statistical experts indicates that the exit age indicator calculated according to the dynamic or the static approach is not an ideal indicator for international comparisons. Although, some experts valued in particular the dynamic indicator rather positively most experts point to a number of technical and content-related problems: the small sample size for high age groups and the associated sampling errors, short and broken time series, definition of age brackets, definition of age span under consideration, sensitivity to cyclical variations, and finally the meaning of participation rates of older workers before and after retirement, as well as the definition of labour market participation (the one hour per week criteria). Overall, the literature survey pointed to a number of strength and weaknesses of the different indicators used. In particular by comparing the different concepts, the high volatility of the dynamic exit age indicator become clear.

As regards the database, a number of Member States prefer to use their administrative data. This, however, is not useful for international comparisons. The setting-up of the new longitudinal survey SHARE is very interesting, but also not usable at present for the calculation of the exit-age.

*Methodological and empirical assessment*

The (static or dynamic) exit age is the probability of single ages to withdraw from the labour market multiplied with the actual age and summed up over the age span from 50 to 70. In the static version the probability to withdraw is measured on the basis of consecutive ages for one observation year. The dynamic approach compares activity rates of the same age cohort between two consecutive years. The working life expectancy indicator combines the probability to be alive with the probability of being part of the labour force at the moment of observation. The weighted average of the working life expectancies over the ages 50 to 70 (or 74) is the exit age.

The indicators were calculated with the LFS dataset provided by Eurostat. It completely covers the 31 countries (27 EU countries and four NON-EU countries) with only a minor number of missing values. Life tables which are required to calculate the working life expectancy indicator will be established by Eurostat. For the purpose of this study interpolated WHO tables were used as a substitute.

Exit age calculations are undertaken on country level with single ages and separated by gender. As it is not suggested to reduce the degree of disaggregation, all approaches have to cope with the problem of sampling errors which rise considerably with age.

In the case of the static and dynamic approaches, sampling errors lead to a non-negligible share of "irregular" activity rates (14 to 18 % of all observations) which produce negative probabilities to withdraw from the labour market. As this would result in negative exit ages – and therefore is not allowed by the methodology – such irregular activity rates are corrected. This however leads to exit age estimates which are not fully consistent with LFS data.

The instability of the dynamic exit age indicator is clearly associated with the instability of the activity rates used. The correlation coefficient ($R^2$) between activity rates' changes and exit age changes over time is 0.81 for the dynamic approach but only 0.12 for the static approach. This indicates that the comparison of two different annual LFS samples creates the specific problem of volatility in the dynamic approach.

In principle, all approaches include error correction processes. However, this only works under the assumption of a pure random distribution of errors. If this is not the case, errors are multiplied in the static and dynamic approaches over all ages and are thus boosting biases. Moreover, the error correction mechanism of both approaches is limited by the correction of "irregular" probabilities. In the case of the working life expectancy approach, the error correction process is achieved by the additive aggregation of age-specific probabilities. There is no need to adjust "irregular" probabilities and thus the risks of the other approaches are avoided.

The analysis indicates that exit age indicators are sensitive to employment changes. On average of the EU27 countries about one third of the % change of employment is transferred into activity rates' changes. Exit age indicators therefore appear to be affected by cyclical variations of employment, even if the effect is partially absorbed.

*Sensitivity analysis*

The dynamic indicator shows high fluctuations between years which are not visible in the static and working life data. Even for the very short time series available, the variance of the dynamic indicator is three or even more times higher than for the other two indicators. The detailed view on country time series confirms these comparative results: on average over all countries maximum and minimum values range within a band of 5 % for the dynamic approach, but only 1.8 % for the static and 1.3 % for the working life approach.

The use of activity rates from two consecutive samples creates the major problem of the dynamic approach. As the Labour Force Survey is designed to measure cross-section distributions rather than time series, time comparison of single ages and gender asks too much from a survey with limited sample size. This is confirmed by the fact that the static approach is much more stable, using the same methodology and the same data inputs but only one observation year.

The static indicator is criticised because it reflects differences of labour market participation between ages rather than a cohort, and thus appears as a poor description of exit behaviour. However, the heterogeneity of participation behaviour between ages must be reflected to represent the behaviour of the 50 to 70 group. The composition of age cohorts with different participation behaviour and its changes over time therefore should be part of the observation. From this point of view it can be questioned whether a cohort approach is adequate, a partial cohort approach as used by the dynamic indicator in particular.

The working life expectancy indicator is not faced with the problems of the other two approaches. An important advantage is that survival functions are continuously decreasing, while the probabilities to be part of the labour force can decrease or increase. There is no restriction for activity rates changes and thus the method does not require altering empirical inputs.

In spite of the differences of time series behaviour, the three approaches come to similar results as regards the exit age differences by countries and gender.

The Eurostat calculations assume a maximum exit age of 70 at which all persons are assumed to have left the labour force. However, 10 % of the EU27 labour force is still active at the age of 65. Among women the share amounts to 7 % and 23 % for men. The assumption of a linear reduction of activity rates to zero until 70 therefore is very strong. Consequently, the extension of the age span to 75 raises exit age on average by 0.778 years in the case of the dynamic approach, by 0.457 for the static approach and 0.664 for the working life expectancy approach. This recommends extending the age span.

The smoothing of activity rates by 3-ages averages reduces the volatility of exit age values, of the dynamic approach in particular. It has no effects under the working life expectancy approach.

*Conclusions and recommendations*

The study comes to the conclusion that the working-life expectancy indicator has clear advantages compared to the static and dynamic indicators as regards accuracy, comparability, and interpretability of results. The advantages become particularly evident in comparison to the dynamic indicator which is actually used in the Commissions' indicator set for the assessment of the European Employment Strategy.

The working life expectancy indicator is characterised by a clear country and gender profile which is equivalent to the other two indicators. Time series stability, which is the major problem of the dynamic indicator, however, is much higher. This is due to the internal error correction process involved in the methodology.

The LFS data on labour force participation remain the most important input of the calculations for all approaches. The similarity of surveying methods, the homogeneity of definitions, and the structured timing of data provision makes it an indispensable data source which is comparable across countries. There is no alternative from other surveys. Even if the analysis showed that sampling errors are a problem for smaller countries, the strategy should be to solve these difficulties through adequate estimation procedures rather than changing the data source. This appears particularly important as the demand for the extension of the sample size cannot be achieved within a feasible time horizon.

The analysis showed that at the level of EU aggregates much of the sampling error disappears due to error balancing. If the indicator should only provide data at this level, no additional efforts appear to be necessary. However, data at the country level are required for the open process of coordination. Accuracy at the country level is needed. This can only be achieved through adequate estimation procedures for the activity rates of smaller countries in particular. One of the approaches which should be tested uses econometric estimates with logistic or spline functions. The other one is based on LFS micro-data exploiting the great number of variables for the estimate of labour market participation at high ages in particular. This would help extending the age limits.

The use of the working life indicator would require the calculation of life tables for all countries observed. The provisional data estimated on the basis of WHO tables with five-year age groups will not be sufficient. Therefore, the Eurostat calculations of life tables are particularly important for the further development of the exit age indicator.

# 1. Introduction

The exit age indicator is an important statistical measure for the impact of ageing policies in the European Union. As part of the indicator set for the assessment of the European Employment Strategy, it has a strong political relevance, which creates particular demands regarding the quality of statistical measurement. The European Commission therefore launched this study to obtain an analysis of the presently available indicators, assess their characteristics, and develop the approaches further.

The indicator presently used by the European Commission is the dynamic exit age indicator based on the probabilities of withdrawal from the labour market and applying a partial cohort approach. This up-to-date methodology however has some important drawbacks which can be attributed to the underlying methodology and the empirical data used.

This study therefore should provide a thorough evaluation of the existing exit age indicator, thereby assessing its relevance, accuracy, timeliness, accessibility and clarity, comparability across time, gender and country, and coherence. In addition, it should define, calculate and discuss the exit age indicator based on life-expectancy tables, and make an assessment of this indicator by applying the criteria mentioned before.

Economix submits the final report for this study with four parts: the following Section 2 provides a review of existing indicators. This is based on a broad literature review and a special survey undertaken among statistical experts in the national statistical offices and elsewhere. Section 3 undertakes the methodological and empirical assessment of the approaches. The sensitivity analysis is contained in Section 4. Finally, in Section 5 the study draws conclusions from the results which clearly recommend changing the methodology of exit age calculations.

# 2. Expert-based assessment of exit age indicators

This Chapter gives an overview of the main publications on methods of exit age calculation and makes a summary of the survey undertaken by this study to receive a broad assessment by users and producers of exit age statistics. The survey was conducted among the members of the EMCO Indicator Groups and experts from other national institutions (see Annex A). In addition experts in the fields of age management and employment analysis were interviewed. Finally, the discussion on alternative indicators and the data basis is reviewed in this Section.

## 2.1. Strengths and weaknesses of exit age indicators

Two ways have been developed to calculate exit age indicators on the basis of age-specific activity rates:

(1) The "static method" as developed by Latulippe (1996).
(2) The "dynamic method" as developed on the grounds of weaknesses of the "statistic indicator" that have been pointed to by Peter Scherer (2002). This indicator is used by the European Commission. Calculations are undertaken by Eurostat with Labour Force Survey Data.

Both indicators are based on changes of activity rates. In contrast to the "static" method, which compares activity rates of different ages or age groups within a specific year, the "dynamic method" is based on the logics of a cohort approach, although only two consecutive years of the same cohort are used by the analysis.[1]

The average exit-age from the labour force gives the most probable age at which people (who are at least 49 years old) leave the labour force. The measurement is based on probability models considering the changes of activity rates between ages in a specific year of observation (static concept) or from one year to another at a specific age (dynamic concept). It is assumed that at the maximum age of 70, everybody who is still in the labour force will withdraw. In order to obtain the average age of withdrawal, the specific ages are weighted by their probability to withdraw at these ages. Summing up the probabilities of being on the labour market and leaving during the year of observation over all ages leads to the average age of withdrawal from the labour market.

The probability rate is calculated on the basis of activity rates per age and year from the EU quarterly Labour Force Survey (LFS). The activity rates taken into consideration are the average over four quarterly observed rates in the year considered. The starting year is 2001 when most of the countries carried out quarterly LFS with a sufficient sample size. In a series of countries sampling errors in the age groups 50+ require the smoothing of activity rates linearly from age 65 to 70 so that at 70 the active population in terms of the model is zero. In such cases, it is also necessary not to take the actual activity rate at the age 65 but to consider the moving average over the ages 64 to 66 instead.[2]

The reliability of the exit age indicator has been questioned. Both the dynamic approach and the static approach have been in the focus of criticism. Some of the arguments are valid for both. In Finland the criticism put forward has led to the development of a new indicator based on activity rates and life expectancies (see below).

### 2.1.1. Dynamic exit age indicator

A series of criticism regarding the quality of the "dynamic indicator" was expressed in the survey and expert interviews. The main arguments and discussions can be summarised as follows:

#### 2.1.1.1. The quality of data

*Time series*
First of all the dynamic approach only makes sense if long time series are available, so the arguments of experts. This is not the case. Moreover, breaks in the time series cause problems, even in some of the large EU countries. Most importantly, in addition to problems linked to the collection of the data, structural breaks cause a problem.

*The data base: sampling problems and other biases*
According to our interviewee from Portugal, the main problem consists in the bias in the LFS sample. Sampling problems have been diagnosed in Portuguese LFS. Under-representation of older workers is one of those biases. Also in the case of Greece sampling problems have been reported. Hytti and Nio (2004) are pointing to sampling errors for Finland.

Our German interviewee stressed, that the self-reporting method used by LFS (in Germany, the *Mikrozensus*) causes a bias: The self-reporting about the activity status involves the problem that individual perception does in some cases not reflect reality. With regard to

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1 For the mathematical definition of the indicators see Section 3.1.

2 Detailed information regarding the dynamic exit-age indicator based on EU LFS is available on the Eurostat web-sitehttp://europa.eu.int/estatref/info/sdds/en/strind/emploi_ea_sm.htm

the transition between employment and exit of the labour market, it can be assumed that there is a systematic bias between the respondent's view and the administrative status. Thus an older unemployed might answer he is retired although he is not. Therefore the accuracy is rated as "good" and not "excellent". But as there are no more precise data in Germany, the data is nevertheless used for analysis.

*Age brackets*
The OECD uses a five years age span for defining the cohorts in order to reduce the volatility of single age data. Richard Wild (2006) argues that with a five year age band the implicit assumption is made that the withdrawal rates were uniform within each band in order to allow the average age of withdrawal to be the midpoint between each consecutive pair of groups. The UK experience shows that moving averages are helpful removing some of the age related volatility. Also in the Netherlands five year age brackets are used (see below).

One survey respondent has pointed out that some workers exit the labour market before the age of 50 and would therefore raise the question to open up the age period under consideration for the calculation. The availability of data for those older than 70 is also regarded as a limiting factor (Richard Wild, 2006).

*Gender differences*
A further problem consists in differences of participation rates between men and women. As Burniaux, Duval and Jaumotte argue (OECD, 2003), "increasing participation of women in the labour market has been the largest component of the increase of the aggregate participation rates over the past decades. By contrast, male participation has declined in many OECD countries". P. Scherer therefore criticises the static approach, as it will only measure net retirement rates correctly if participation rates are stable between one cohort and another so the argument. But substantial changes are taking place.

It is noteworthy to stress that most respondents have reported that comparability of the exit age indicators by gender is excellent. These statements, however, refer to the availability and quality of data by gender rather than the reflection of different labour market behaviour by gender.

The problem is also related to the question of the adequate age period for the exit age calculation. The 50 to 70 period implies continuous labour market participation until 50. This, however, does not coincide with the traditional pattern of female labour market participation – with child breaks between 20 and 40 and partial re-entry at later ages. In particular those women who left the labour market before 50 and did not return are not counted as exits.

#### 2.1.1.2. Instability and volatility of results

The results are rather instable and show in some years rather implausible outcomes. In the opinion of one of the experts the results are not plausible and not reliable. The survey reveals that a number of experts have problems with the interpretation of results and several experts point to the problem of plausibility.

In particular, the results of the "dynamic" method are highly sensible to cyclical variations as has been argued by several experts (see e.g. Hytti and Nio 2004). This is the reason why in Finland the static indicator is preferred to the dynamic one, although both indicators are criticised.

Richard Wild (2006) points to the problem of the dynamic approach that rising activity rates over time tend to bias the estimates due to the fact that the probability to stay in the labour market must not exceed 1. Otherwise not only the following probability not to stay but the resulting exit age will be negative (Section 3.1). Eurostat also pointed to this fact which became evident through Monte-Carlo simulation (Section 3.4).

Several respondents point to the problem that the dynamic exit age indicator has fallen recently, although labour market participation rates of older workers have risen. This has been a reason for rejecting the use of the dynamic exit age indicator. Hytti and Nio (2004) are putting the argument further that the dynamic approach is unsuited for predicting future trends.

Contradictory results have led to a debate on the quality of the indicator in the Netherlands. As a consequence the Dutch Statistical Office uses age brackets of 5 years. The resulting overlapping cohorts function as a moving average which may suppress volatility in the figures due to small samples and/or lack of panel data which allow following the labour force participation of individuals over their lifetime.

#### 2.1.1.3. Interpretation of the data

The LFS definition of a person employed uses the well-known one hour per week criteria. As the Swedish respondent pointed out, workforce participation among the higher age groups increasingly relates to temporary part-time work with a few hours per week: "As a result, calculations could be considered misleadingly high when it comes to drawing conclusions about the age at which the actual exit from working life takes place. To allow for this, an alternative calculation for Sweden halved labour force participation for all people over the age of 65. As a result, the exit age fell by 0.3 years." (Olsson 2006). In the Netherlands, the "dynamic" indicator is calculated by using a national database, which is comparable to the LFS, but with exclusion of jobs for less than 12 hours a week.

Richard Wild (2006) argues that in both cases – exit age following the static method or the dynamic approach – the presentation of withdrawal age estimates in isolation is incomplete: "As with every averaging technique, distributional features are disguised. One of the questions when analysing the data is, has the average withdrawal age risen because more people are remaining active beyond SPA (Statutory Pension Age), or because activity rates between age 50 and SPA have risen?". It is clear that the political implications would not be the same.

Hytti and Nio (2004) argue, that there is no basis for comparison, since the indicator does not take into account the differences in the level of activity rates of older people in different Member States. This weakness has also been stressed by some of the respondents in our expert survey.

### 2.1.2. Static exit age indicator

Peter Scherer (2002), who developed the dynamic indicator, points to a number of weaknesses of the "static" indicator:

- In particular there is a problem when there are important changes in the activity rates over the lifetime of a cohort, as in the case of women returning to the labour market. Latulippe's method only measures correctly net retirement age when participation rates are stable between one cohort and another.

- The static method needs to be based on the assumption that the labour force is not correlated with mortality (those in the labour force are as likely to die as those outside it). This is assessed to be unlikely.
- A further assumption would be that the labour force is not correlated with net migration (immigrants and emigrants are as likely to stay in the labour force as those who stay). Also this assumption is not very realistic.

In addition to these arguments, Richard Wild (2006) argues in his paper, that when applying the one-year cohort change (instead of age brackets of 5 years) in the static approach might not be a problem in most years, however it causes an important problem in case of a changing environment, e.g. in the area pensions policies, that would affect the decision to withdraw from the labour market from one year to the other (e.g. changes in eligibility rules for pensions). Those changes could generate both positive and negative bias, so the author. Further it is argued as a weakness of the static approach, that it makes the implicit assumption that people of consecutive ages (50 and 51 years old, etc) in a given year are equally affected by the prevailing labour market conditions, which is unlikely to be true. In addition, the static, like the dynamic model, are sensitive to changes in activity rates and age range specifications.

Despite these weaknesses, in three of the surveyed Member States the static indicator is preferred to the dynamic indicator e.g. in the UK, Sweden, and Finland. In the UK, the Office for National Statistics adopted the static indicator for reasons of stability. The indicator is now updated annually. The survey respondent from the UK explains that the accuracy of measurement, the clarity of interpretation and the comparability over time, the timeliness of updates as well as the coherence with other statistics are regarded as being "sufficient".

## 2.2. Literature relating to alternative indicators and data

In this sub-chapter an overview is given of further approaches which do not use the static or dynamic approach. This includes the working life expectancy approach which will be further investigated in Section 3, the setting-up of new databases, the use of administrative data sources in the national context, and working life. The objective of this section is to get a more comprehensive view of the advantages and pitfalls of alternative concepts and use of different data sources.

### 2.2.1. Survey on health, ageing and retirement in Europe

The Survey on Health, Ageing and Retirement (SHARE) was constructed and conducted for the first time in the context of the 5$^{th}$ framework programme. It was carried out as a research project in 11 Member States and included about 18,000 households with a family member being 50 and older. It is intended to become a longitudinal survey. The survey follows the approach of US survey "Health and Retirement Study" (HRS), which is carried out in the US since 1992 and involves 22,000 aged persons. It has been decided that the Survey is going to be continued, and important research Funds have been allocated to this Survey by the DG Research.

Based on random samples in all participating countries, SHARE represents the non-institutionalized population aged 50 and older. Spouses are also interviewed if they are younger than 50. Table 1 shows the breakdown of all 2004 samples by country, sex, and age. It also displays the household and individual response rates.

The survey gives a rather detailed picture of the employment situation. Questions concerning labour market participation include

- seasonal workers not working for the last 4 weeks,
- number of jobs,
- number of hours contracted,
- number of weekly hours worked,
- if work during last 4 weeks: was this exceptional or not,
- working biography,
- type of contract,
- main job or second job,
- number of months in the year during which you are employed in this job,
- net gross income of last paid job.

If the respondent states he or she is retired, then the main reasons for retirement are asked:
- pre-retirement,
- having reached statutory retirement age,
- having reached number of years entitling to pension,
- health status,
- dismissal,
- preference for leisure,
- how the person became unemployed,
- disability caused by work,
- reasons to stop working (health problems, working efforts, care resposibilities),
- sources of income,
- year at which pension was received for the first time
- other indicators.

Table 1 SHARE samples and response rates

| Country | Total | Male | Female | Under 50 | 50 to 64 | 65 to 74 | 75+ | Household Response Rate* | Individual Response Rate* |
|---|---|---|---|---|---|---|---|---|---|
| **Austria** | 1,893 | 782 | 1,111 | 44 | 949 | 544 | 356 | 55.6% | 87.5% |
| **Belgium** | 3,827 | 1,739 | 2,088 | 178 | 1,991 | 986 | 672 | 39.2% | 90.5% |
| **Denmark** | 1,707 | 771 | 936 | 92 | 916 | 369 | 330 | 63.2% | 93.0% |
| **France** | 3,193 | 1,386 | 1,807 | 155 | 1,648 | 759 | 631 | 81.0% | 93.3% |
| **Germany** | 3,008 | 1,380 | 1,628 | 65 | 1,569 | 886 | 486 | 63.4% | 86.2% |
| **Greece** | 2,898 | 1,244 | 1,654 | 229 | 1,458 | 712 | 499 | 63.1% | 91.8% |
| **Israel** | 2,598 | 1,139 | 1,459 | 142 | 1,416 | 690 | 347 | 60.1% | 83.9% |
| **Italy** | 2,559 | 1,132 | 1,427 | 51 | 1,342 | 785 | 381 | 54.5% | 79.7% |
| **Netherlands** | 2,979 | 1,368 | 1,611 | 102 | 1,693 | 713 | 459 | 61.6% | 87.8% |
| **Spain** | 2,396 | 994 | 1,402 | 42 | 1,079 | 701 | 573 | 53.0% | 73.7% |
| **Sweden** | 3,053 | 1,414 | 1,639 | 56 | 1,589 | 816 | 592 | 46.9% | 84.6% |
| **Switzerland** | 1,004 | 462 | 542 | 42 | 505 | 251 | 204 | 38.8% | 86.9% |
| ***Total*** | *31,115* | *13,811* | *17,304* | *1,198* | *16,155* | *8,212* | *5,530* | *61.6%* | *85.3%* |

*Weighted average for main sample (see Börsch-Supan & Jürges, 2005, for methodological details)

In our view, the longitudinal survey could be used in the long-run to analyse more precisely the transition between employment and exit from the labour market.

In this context it is noteworthy that the interviewed German expert stressed that for own researches about the German situation the longitudinal panel SOEP (*Sozio-ökonomisches Panel*) is used. Its disadvantage is the much smaller size as compared to LFS, but the data allows tracking employment behaviour of individuals over time. This data is used to analyse transition patterns at the end of working life.

### 2.2.2. Studies on improving health and lengthening working lives

In the international literature, a focus is currently set on the debate whether increasing life expectancy and the trend towards better health of older workers is implying that people will withdraw later from the labour market.

In a recent article Munnel and Libby (2007) analyse for the US whether people will be healthy enough to work longer. As a starting point the median age of retirement is used as an indicator. Changes of this indicator over time are compared with changes in the health of older people. The health of older people (65 and older) is compared with those 50 to 64. The basic assumption is that health affects peoples' ability and desire to work. However, the authors write that self-reports on the health status are sensitive to some parts of the employment picture. "For example, people who like their work downplay their health problems and work longer, while those who dislike their work emphasize health issues and retire sooner. Also those who stopped working earlier might wish to justify this, by using bad health arguments. But both effects might outweigh each other."

According to the authors, one starting point for exploring the health of older workers is to look at trends in life expectancy at age 50. Although longer life spans generally imply improvements in health, keeping less healthy people alive could actually increase the percent of population with disabilities.

The authors show that health has globally improved, at least for those being now 50 to 65. The health status of the next generation is more doubtful as problems like obesity have risen which may reduce the health of the future older workers. But also if on average the health of older people rises this does not necessarily mean that people will be working longer: "... many of those who need to work longer – particularly low wage workers dependent on Social Security – are precisely the individuals who have onerous jobs that stress their health".

The paper written by Kalwij and Vermeulen (2005) shows that declining health conditions by age considerably account for the decline in participation rates with age. However, the paper does not show that as a general rule that improving health is leading automatically to increasing participation rates. In its Social Policy Studies series the OECD (1995) already argued that increasing life expectancy should not be mixed up with a sign of improved health and a general higher capacity to work longer.

### 2.2.3. Working life expectancy

Helka Hytti and Ilkka Nio (2004) propose in a paper published by the Finish Ministry of Labour to base the calculation of exit age on life expectancy and thus to base the new indicator on a life cycle perspective.

As will be shown in Section 3.1, the indicator is based on age-specific mortality and activity rates of the year of observation. The authors use the prevalence-based life table method (also called the Sullivan method). In calculating the expected period for belonging to the labour force, this method gives an expectancy figure which describes for each specific age x the expected average period of belonging to the labour force after attaining age x if the mortality and activity rates for the year observed apply.

### 2.2.4. Retirement age

The respondents to the questionnaires have in a number of cases pointed to the use of administrative pension data as an additional or even main information source. It has been stressed that retirement age is the indicator normally used in the public debate as pension reforms are of major concern. However, a number of problems arise according to the experts:

- Not the whole population is getting statutory pensions;
- The data is not released regularly in a number of countries and/or proves a poor timeliness;
- Economic activity of retirees cannot be measured.

Peter Scherer (2001) specifies in his paper that discussions of retirement trends in the OECD have been dominated by the trend to earlier retirement. A major problem for measurement and comparability consists in that “retirement” differs in its meaning from country to country, and also between types of pension arrangements within each country.

Withdrawal from the labour force can be hidden unemployment. Conversely, there are people who have “retired” from their main job but start a new career or find a new employment. This is particularly an important issue in the New Member States as the pension level is rather low. Companies use the retirees as a flexibility buffer (Lindley, Duell 2006). Further, there are difficulties to compare retirement rules and processes.

### 2.2.5. Employment rates

It is noteworthy, that a recent study prepared by the Centre for Analysis of Social Exclusion (London School of Economics by Asghar Zaidi, Mattia Makovec and Michael Fuchs; 2006) on the transition from work to retirement in the EU25 are in the first place considering employment rates of older workers, but do not use any exit age indicator.

### 2.2.6. Net withdrawal rate

In an earlier publication of the OECD (1995), employment rates have constituted the basis for a former OECD indicator (OECD 1995), the Net Withdrawal Rate. This indicator compares the employment rate of a group aged 55-59 with the employment rate of a group aged 60-64 five years later.

### 2.2.7. Determinants for withdrawal from the labour market

Although, we are not considering an indicator in this sub-section it needs to be stressed that a number of studies have analysed the incentives to retirement. One example of these analyses is a publication of the OECD from 1995 (Social Policy Studies). The study shows the main underlying determinants for retirement:

- Replacement rates and benefit levels: It is argued, that within any one country changes over time in the replacement rate are likely to have an impact on the number of beneficiaries. Further, the impact of replacement rates should be considered in conjunction with other factors such as duration of payment and benefit.

- Ruling of the pension systems and wealth effects, e.g. reduction and appreciation factors for leaving earlier or later for retirement.
- The value of leisure and the utility function.
- Conditionality of pension programmes.
- The economic situation (overall labour market situation, individual employment condition).
- The morbidity of the population (its overall state of health).
- The social climate (the acceptability of non-employment, policy priorities).

The study further analyses the employment conditions of those older workers who still are in the labour market.

### 2.2.8. Labour force projections

The paper prepared by Giuseppe Carone presents a methodology and results of labour force projections over the long term (until 2050). The projections show labour force changes through extrapolating recent trends in labour market behaviour (entry and exit rates from the labour market). For this the cohort approach, based on the methodology developed by P. Scherer (2002) and Burniaux et al. (2003) has been completed by a methodology to estimate the impact of recent pension reforms on the participation rates of older workers in 17 Member States.

## 2.3. Conclusions from the experts' perspectives

The survey among EMCO working group, the additional expert interviews as well as the literature review indicate that exit age indicators calculated according to the dynamic or the static approach are not an ideal indicator for international comparisons. Although, some experts valued in particular the dynamic indicator rather positively most experts point to a number of technical and content-related problems:

- sample size for high age groups and the associated sampling errors,
- short and broken time series,
- definition of age brackets,
- definition of age span under consideration,
- sensitivity to cyclical variations,
- and finally the meaning of participation rates of older workers before and after retirement, as well as the definition of labour market participation (the one hour per week criteria).

The still important use of "retirement age" as a main indicator in the national context underlines the concern to have an indicator reflecting "retirement". It is understandable in our view, that the policy implications of the number of persons working only few hours after retirement might be different from a general increase of participation rates before retirement.

Currently, there is a debate about the impact of health improvements for the exit age of workers. A number of studies indicate that neither increasing mortality rates nor improving health clearly lead to a potentially higher average exit age.

Overall, the literature survey has pointed to a number of strengths and weaknesses of the different indicators used. In particular by comparing the different concepts, the high volatility of the dynamic exit age indicator becomes clear. However, it is difficult to find indication in the literature on how to improve the calculation of the exit age indicator. As regards the database, a number of Member States prefer to use their administrative data. This, however, is not useful for international comparisons. The setting-up of the new longitudinal survey SHARE is very interesting, but actually not usable for the calculation of the exit-age.

# 3. Methodological and empirical assessment

After the review of external opinions, this Section undertakes the methodological and empirical assessment of three exit age indicators: the dynamic, static and working-life expectancy approach. It appears to be quite clear that only an approach based on a common data-set – like the European Labour Force Survey (LFS) – is able to accommodate the need for comparability of the indicator across countries and over time. This already excludes many suggestions to use national data or newly established surveys.

The Section defines the three indicators, analyses the statistical data-base of activity rates from the LFS, and undertakes a methodological assessment.

## 3.1. Definition of exit age indicators

### 3.1.1. Dynamic exit age indicator

The dynamic exit age indicator is calculated with activity rates by single ages and years. The model starts with the conditional probability of an age cohort to stay in the labour force at age a. This is given through

(1) $$p^{s}_{a,y} = r_{a,y} / r_{a-1,y-1} \qquad 0 \le p^{s}_{a,y} \le 1$$

$p^s$ *Probability to stay*
$r$ *activity rate*
$a$ *single age*
$y$ *year of observation*

In cases were relation (1) exceeds 1, a hundred percent probability to stay in the labour force is assumed. This avoids negative values of the reversal probability not to stay in the labour force. This is given through

(2) $$p^{ns}_{a,y} = 1 - p^{s}_{a,y}$$

$p^{ns}$ *Probability not to stay*

The probability still to be in the labour force at a certain age is equal to the overall probability to stay in the labour force from a starting age $a_0$ up to the age specified. As this is the probability at the entry to age a, the ages range from $a_0$ to a-1.

(3) $$p^{in}_{a,y} = \Pi_{\, j = a0..a-1} \; p^{s}_{j,y}$$

$p^{in}$ *Probability to be in the labour market*
$j$ *Index of age range $a_0$ to a-1*

In the Eurostat model $a_0$ is fixed to age 50. From this age onwards activity rates usually decline.

The probability of withdrawing from the labour force at a certain age is equal to the probability of still being in the labour market at age a combined with the probability not to stay.

(4) $$p^{w}_{a,y} = p^{in}_{a,y} \; p^{ns}_{a,y}$$

$p^{w}$ *Probability to withdraw*

The sum of all probabilities to withdraw between $a_0$ and $a_{max}$ is 1. The Eurostat model assumes that $a_{max}$ is 70. From this age onwards all persons withdrew from the labour force. $p^w$ is zero at this and the following ages.

The average exit age (*e*) is calculated as the average of all ages weighted by the probabilities to withdraw.

(5) $$e_y = \sum_{j = a0..amax} p^{w}_{j,y} \, j$$

### 3.1.2. Static exit age indicator

The static exit age indicator substitutes equation (1) by

(6) $$p^{s}_{a,y} = r_{a,y} \, / \, r_{a-1,y} \qquad 0 \leq p^{s}_{a,y} \leq 1$$

It uses the relation of activity rates between ages of the same observation year as measure of net exits from the labour market.

The subsequent calculation of probabilities and exit age is exactly the same as for the dynamic indicator (Equations 2 to 5). The only difference is that the dynamic indicator applies a partial cohort approach, which uses the activity rates of the same age cohort in two different years, while the static approach applies a cross-section approach taking the changes of activity rates between ages as the adequate description of labour market exit behaviour.

### 3.1.3. Working life expectancy indicator

Hytti and Nio suggested an alternative approach measuring working life expectancy and non-working life expectancy (Hytti, Nio 2004). This approach is used by this study to calculate the average exit age through adequate weighting of the working life expectancies.

Based on the demographic life expectancy calculated with survival functions, the approach multiplies survival rates with activity rates and thus achieves estimates for the "survival in the labour market". The sum over the age groups 50 to 70 (or a higher age) then provides the working life expectancy. The difference between life expectancy and working life expectancy then is the non-working life expectancy.

It is suggested here to calculate the exit age by adding working life expectancy of single ages between 50 and 70 to the actual age. The exit age then is the weighted sum over these ages, with the number of "survivors" in the labour market as weight. The number of "survivors" in the labour market is the product of the number of years lived by the standardised birth cohort and the activity rate at age a.

The indicator uses two data inputs, life expectancy and activity rates by ages. It is constructed in the following way:

Life expectancy is calculated through

(7) $\varepsilon_a = T_a \,/\, l_a$ *life expectancy at age a*

with

(7a) $T_a = \sum_{j=a..\infty} L_j$ *the number of future living years expected at age a*

and

(7b) $L_a = (l_a + l_{a+1}) \,/\, 2$ *the average number of persons of the birth cohort alive at age a*

| | |
|---|---|
| $\varepsilon_a$ | *Life expectancy at age a in years* |
| $l_a$ | *Number of survivors of the birth cohort at age a* |
| $T_a$ | *Sum of living years expected at age a* |
| $L_a$ | *Interpolated survival function between a and a+1* |

This represents the usual life expectancy formula which gives the number of years a person at age *a* can expect to live if the mortality rates of a given year are assumed to persist in future.

The working life expectancy is calculated accordingly through the use of age-based activity rates:

(8) $\varepsilon^w_a = T^w_a \,/\, l_a$ *working life expectancy at age a*

with

(8a) $T^w_a = \sum_{j=a..70} L^w_j$ *the number years in the labour force which can be expected at age a*

and

(8b) $L^w_a = L_a\, r_a$ *the average number of active persons in the birth cohort at age a*

| | |
|---|---|
| $\varepsilon^w_a$ | *Working life expectancy at age a in years* |
| $T^w_a$ | *Sum of working years expected at age a* |
| $L^w_a$ | *Number of active persons in the birth cohort at age a* |
| $r_a$ | *Activity rate at age a* |

In the Finnish example the sums are counted up to the age of 74. For comparability reasons with the calculation of dynamic and static exit age, this was adjusted here to 70.

The non-working life expectancy – or the number of years outside the labour force – is the difference between life and working life expectancy:

(9) $\varepsilon^{nw}_a = \varepsilon_a - \varepsilon^w_a$

The average exit age for a single country can now be calculated as a weighted average of the actual age and the working life expectancy. The (standardised) number of active persons at age *a* are used as weights.

$$(10) \qquad e^w = \left(\sum_{a=50..70} (a + \varepsilon^w{}_a)\ L^w{}_a\right) / \sum_{a=50..70} L^w{}_a$$

As this is the exit age for one country, aggregates for EU country groups can be calculated as averages weighted with the active population between 50 and 70. This weighting scheme corresponds to the weighting of single ages in equation 10.

$$(11) \qquad \bar{e}^w = \left(\sum_{c=1..n} (e^w)\ A_c\right) / \sum_{c=1..n} A_c$$

$\bar{e}^w{}_a$ *Average exit age in year y*
$A_c$ *Active population at age 50 to 70 in country c and year y*

## 3.2. Data sources

### 3.2.1. Eurostat dataset

The dataset provided by Eurostat for this study in order to calculate the average exit age is from the Labour Force Survey. It includes the data for

- the years 2000 to 2005;
- 31 countries (25 Member States and CH, HR, IS, NO), and 5 country aggregates (EU-15, EU-25, EUR11, EUR12, NMS)[3];
- separation by gender (male, female, male and female);
- single ages from 49 to 71.

It contains the indicators

- Original activity rates as provided by the LFS;
- Adjusted activity rates;
- Population;
- Active population;
- Employed population;
- Employment rate.

The data is organised as databank containing 14,697 records for each country/gender/–age/year combination.

The initial idea to undertake calculations until 2006 could not be put into practice as data for 2006 were not available from Eurostat.

The attached CD-ROM includes this dataset in file EXITAGE_RAWDATA.XLS. Morevover, the CD-ROM contains the data files for activity rates, the calculated exit age, the life tables, and parts of the programming code (see Annex D).

### 3.2.2. Life tables

The survival functions for the years 2000 to 2005 were taken from the World Health Organisation's statistical database[4]. The WHO tables cover all 31 countries of this study, and

[3] For the definition of country aggregates see Table D2, Annex D.
[4] EUROSTAT is actually developing life tables for EU countries.

allow retrieving data by five-year age groups. Standardised life tables are constructed on the basis of official death registrations and population figures (WHO 2001).

As only five-year age groups are published, single age values had to be linearly interpolated between the middle ages of each group (Table 2). Comparisons to Austrian and German survival functions for single ages showed only minor deviations.

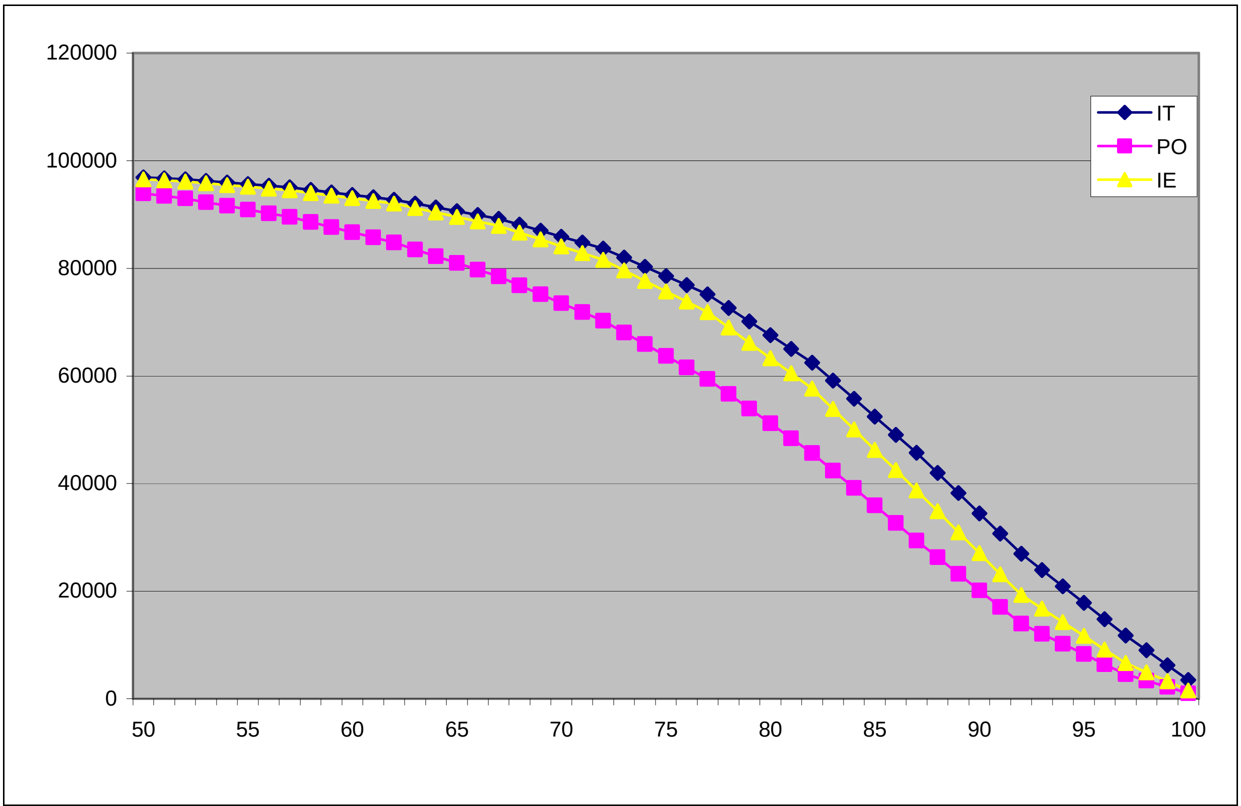
The use of the WHO life tables is a substitute until EUROSTAT finished the work under way. Chart 1 shows the life table values for three selected countries.

Table 2 Example of survival function
Austria, selected ages

| Age group | Age | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| 45-49 | 47 | 96609 | 96717 | 96826 | 96934 | 97043 | 97151 |
| | 48 | 96345 | 96460 | 96576 | 96691 | 96807 | 96922 |
| | 49 | 96082 | 96204 | 96326 | 96449 | 96571 | 96693 |
| | 50 | 95818 | 95947 | 96077 | 96206 | 96336 | 96465 |
| | 51 | 95555 | 95691 | 95827 | 95964 | 96100 | 96236 |
| 50-54 | 52 | 95291 | 95434 | 95577 | 95721 | 95864 | 96007 |
| | 53 | 94845 | 95001 | 95157 | 95314 | 95470 | 95626 |
| | 54 | 94398 | 94567 | 94737 | 94906 | 95076 | 95245 |
| | 55 | 93952 | 94134 | 94316 | 94499 | 94681 | 94863 |
| | 56 | 93505 | 93700 | 93896 | 94091 | 94287 | 94482 |
| 55-59 | 57 | 93059 | 93267 | 93476 | 93684 | 93893 | 94101 |
| | 58 | 92441 | 92652 | 92862 | 93073 | 93283 | 93494 |
| | 59 | 91822 | 92035 | 92248 | 92461 | 92674 | 92887 |
| Original WHO values | | | | | | | |

Source: WHO, Economix

Chart 1 Interpolated WHO life tables for selected countries
2005




Source: WHO, Economix.

## 3.3. LFS activity rates

With the exemption of Croatia the dataset is complete covering all classification variables and indicators for all countries, years, sexes and ages. The Croatian data series start in 2002.

### 3.3.1. Missing values

For original activity rates the dataset contains a limited number of zero values (Tables 3 to 5). Out of the 12,834 data entries for all ages, gender and 31 countries, only 84 activity rates are zero. These values are concentrated on countries (LU and MT), upper ages (above 65) and females. It can be assumed that this is due to insufficient representation of ages in the sample. Zero values can therefore be interpreted as missing values. In Luxembourg e.g. activity rates above 65 are below 5 %. In Malta this starts already at 61. This means that the number of active persons in the sample becomes very small. For Sweden the original activity rates for year 2000 are constant from 64 onwards for all gender groups.

The missings are partly corrected by Eurostat estimates. Following the methodological description the sample sizes in higher ages in some countries (BE, DK, IE, LU, NL, AT, FI, SE, IS, NO, CH, BG, CY, EE, HU, LV, LT, SI and SK) makes it necessary to artificially smooth the decline of activity rates linearly from age 65 to age 70 so that at the age of 70 the active population in terms of the model is zero (linear "melt-away" hypothesis). In such cases, it is also necessary not to take the actual activity rate at age 65 but to consider the moving average over the ages 64 to 66 instead (Eurostat).

Table 3 Missing values among original activity rates by countries
Number of zero values

| Country | All | Female | Male |
|---|---|---|---|
| LU | 6 | 22 | 9 |
| MT | 3 | 28 | 4 |
| DK | 3 | 3 | 3 |
| SK | 0 | 2 | 0 |
| CY | 0 | 1 | 0 |

Table 4 Missing values among original activity rates by year
Number of zero values

| Year | All | Female | Male |
|---|---|---|---|
| 2000 | 5 | 14 | 5 |
| 2001 | 2 | 11 | 5 |
| 2002 | 0 | 7 | 0 |
| 2003 | 1 | 7 | 1 |
| 2004 | 1 | 7 | 2 |
| 2005 | 3 | 10 | 3 |

Table 5 Missing values among original activity rates by age
Number of zero values

| Age | All | Female | Male |
|---|---|---|---|
| 62 | 0 | 3 | 0 |
| 63 | 0 | 3 | 0 |
| 64 | 0 | 2 | 1 |
| 65 | 0 | 2 | 0 |
| 66 | 0 | 6 | 0 |
| 67 | 2 | 5 | 3 |
| 68 | 1 | 4 | 1 |
| 69 | 4 | 10 | 5 |
| 70 | 2 | 11 | 3 |
| 71 | 3 | 10 | 3 |

### 3.3.2. Variance of activity rates

Excluding missing values, the analysis shows a clear picture: with rising age the calculated coefficients of variation among the original activity rates rise continuously from 10 % at the age of 49 to 96 % at the age of 71 (Chart 2). For females the coefficient starts at 20 % moving up to 120 %, and for males it ranges between 5 and 80 %.

### 3.3.3. Sampling errors

Eurostat estimated the sampling errors by age groups, based on the coefficient of variation. The estimate uses information on the coefficients of variation for the employment and unemployment rate provided by Member States. The details of the calculation are given in Annex E. The results are presented in Table E1.

The estimates confirm that the coefficients of variation are higher for females and increase with age (Table 6). For females the coefficients are on average 1.5 times higher than for males. They range from 2.6 % for the age group 50-54 to 18.9 % for the age group 65-69. For males the coefficients lie between 1.6 % and 13.1%. There are, however, big differences among countries.

Table 6 Estimated coefficients of variation for activity rates
(30 countries, 2006)

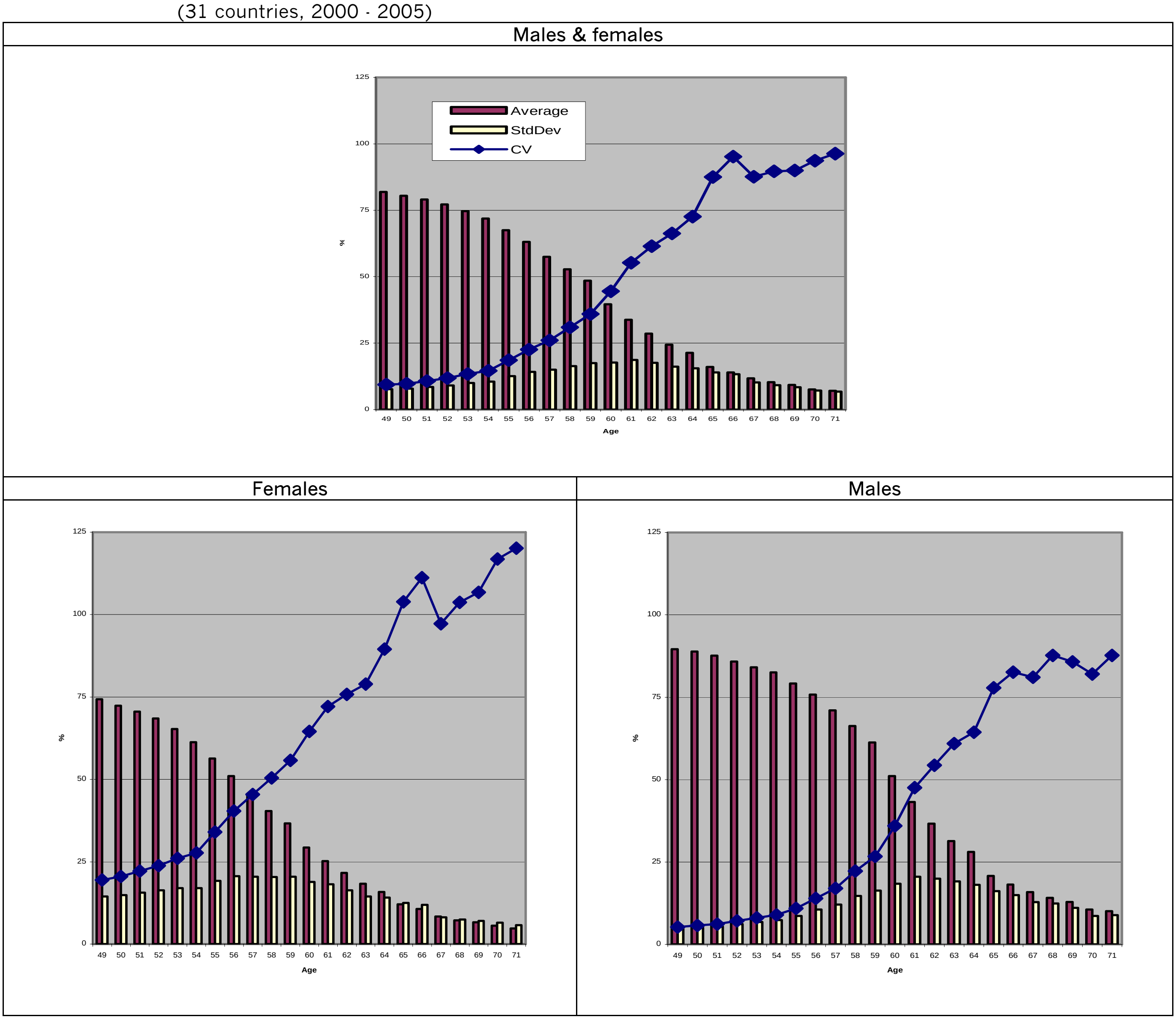
| Age group | Male | | Female | |
|---|---|---|---|---|
| | Average Activity rate | CV (%) | Average Activity rate | CV (%) |
| 50-54 | 87.0 | 1.6 | 71.7 | 2.5 |
| 55-59 | 73.3 | 2.5 | 52.7 | 4.0 |
| 60-64 | 41.7 | 5.8 | 25.4 | 9.3 |
| 65-69 | 17.2 | 13.1 | 9.6 | 18.9 |
| All ages | 67.3 | 0.7 | 52.2 | 0.9 |

Source: Eurostat

It was intended to use sampling errors for single age groups and individual countries in order to have a clear measure for the error boundaries of the exit age indicators. This however was not possible as the information on sampling errors appears to be one of the secrets of national statistics. Even overall sample size is not published by all statistical offices.

The analysis of activity rates nevertheless found sufficient indication for the size of sampling errors with age. This is presented in the following Sections.

Chart 2 Variance of original activity rates by age
(31 countries, 2000 - 2005)




## 3.4. "Irregular" probabilities to stay

Exit age indicators are calculated with the rule that activity rates for a specific age must not exceed activity rates of the preceding age.[5] This has the mathematical reason to avoid negative values for the probability not to stay and the exit age. But it is also based on the interpretation of activity rates as "survival rates" in the labour market. From the age of 49 onwards individual workers are only expected to stay in or leave the labour market. Re-entries into the labour market or inflows through migration are not assumed to happen.

5 See equation 1 and 6

It is certainly correct that a rise of activity rates has a low probability from the age of 50 onwards. As far as this assumption is correct, such "irregular" probabilities to stay can be taken as a partial measure of the sampling error: if the measurement of activity rates for single ages is correct, no irregularities appear, and the number of such irregularities and their size can then be taken as an indirect indication of the sampling error.

### 3.4.1. Number of "irregularities"

In the original data, the theoretical rule is violated in a considerable number of cases, indicating that the irregularity of the probabilities to stay $(p^s > 1)$ is far from being unlikely.[6]

Table 7 $P^s > 1$

| | Dynamic approach | | | Static approach | | |
|---|---|---|---|---|---|---|
| | All | Female | Male | All | Female | Male |
| All countries | | | | | | |
| $P^s > 1$ (observations on country level) | 574 | 780 | 675 | 554 | 791 | 781 |
| % of all observations (n = 3213; 3864)* | 17.86 | 24.28 | 21.01 | 14.34 | 20.47 | 20.21 |
| Mean deviation (% points)** | 1.61 | 2.02 | 2.27 | 2.02 | 2.32 | 2.64 |
| EU27 countries | | | | | | |
| $P^s > 1$ (observations on country level) | 483 | 665 | 574 | 444 | 655 | 633 |
| % of all observations (n = 2793; 3360)* | 17.29 | 23.81 | 20.55 | 13.21 | 19.49 | 18.84 |
| Mean deviation (% points)** | 1.49 | 1.78 | 2.14 | 1.83 | 1.97 | 2.44 |
| EA13 countries | | | | | | |
| $P^s > 1$ (observations on country level) | 202 | 324 | 217 | 144 | 255 | 222 |
| % of all observations (n = 1365; 1638)* | 14.80 | 23.74 | 15.90 | 8.79 | 15.57 | 13.55 |
| Mean deviation (% points)** | 1.15 | 1.34 | 1.49 | 1.08 | 1.28 | 1.53 |
| NMS12 | | | | | | |
| $P^s > 1$ (observations on country level) | 254 | 315 | 315 | 276 | 370 | 373 |
| % of all observations (n = 1218; 1470)* | 20.85 | 25.86 | 25.86 | 16.85 | 22.59 | 22.77 |
| Mean deviation (% points)** | 1.81 | 2.28 | 2.68 | 2.24 | 2.47 | 3.04 |
| NON-EU countries | | | | | | |
| $P^s > 1$ (observations on country level) | 91 | 115 | 101 | 110 | 136 | 148 |
| % of all observations (n = 420; 504)* | 21.67 | 27.38 | 24.05 | 21.83 | 26.98 | 29.37 |
| Mean deviation (% points)** | 2.27 | 3.44 | 2.97 | 2.79 | 4.02 | 3.48 |

* *first n for dynamic approach; second n for static approach*
** *dynamic approach:* $1/n \sum (r_{a,y} - r_{a-1,y-1})$ *for all observations* $p^s > 1$
*static approach:* $1/n \sum (r_{a,y} - r_{a-1,y})$ *for all observations* $p^s > 1$

Applying the calculation method of the dynamic approach, in 17.9 % of the cases $p^s$ is greater than one (out of the 3213 observed figures for males & females)[7]. For females the share is 24.3 % and for males 21 % (Table 7). The mean deviation of $(r_{a,y} - r_{a-1,y-1})$ for all

6 For details see Annex C
7 31 countries, 5 years and 21 ages; as Hungary is missing two years the number of observations is 2*21 less than 31*5*21.

observations with $p^s > 1$ is 1.61 percentage points for males and females, 2.02 for females and 2.27 for males.

In the static approach, in 14.3 % of the available 3864 observations[8] $p^s$ is greater than 1. For females the share is 20.5 % and for males 20.2 %. The mean deviation ($r_{a,y} - r_{a-1,y}$) is 2.02 for males and females, 2.32 for females and 2.64 for males.

This means that the static approach generally performs slightly better regarding the number of "irregularities" calculated with original activity rates, however, the mean deviation is bigger.

The greater number of irregular probabilities to stay for the dynamic approach might be explained through the additional variation of activity rates caused by the comparison of two annual samples. The lower mean deviation of the dynamic approach might be due to the fact that it filters out the cohort effect of labour market participation while the static approach includes behavioural changes between ages. The dynamic approach therefore seems to better reflect labour market exit behaviour, but is burdened with stronger sample variation.

"Irregular" probabilities to stay can be observed in all years with similar numbers (Table 8). This is particularly visible for the static approach, while figures for the dynamic approach show singular leaps. The change of sampling design between years might be an explanation for this.

Table 8 $P^s > 1$ by country groups and years
Number of observations for all ages and gender groups*

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Sum | Mean deviation |
|---|---|---|---|---|---|---|---|---|
| **Dynamic approach** | | | | | | | | |
| EU27 countries | | 84 | 89 | 105 | 97 | 108 | 483 | 1.485 |
| EA13 countries | | 37 | 34 | 42 | 45 | 44 | 202 | 1.154 |
| NMS12 countries | | 46 | 47 | 55 | 55 | 51 | 254 | 1.811 |
| EU15 countries | | 38 | 42 | 50 | 42 | 57 | 229 | 1.123 |
| NON-EU countries | | 19 | 18 | 21 | 14 | 19 | 91 | 2.268 |
| ALL countries | | 103 | 107 | 126 | 111 | 127 | 574 | 1.609 |
| **Static approach** | | | | | | | | |
| EU27 countries | 80 | 74 | 75 | 77 | 67 | 71 | 444 | 1.828 |
| EA13 countries | 26 | 26 | 26 | 21 | 24 | 21 | 144 | 1.083 |
| NMS12 countries | 49 | 43 | 49 | 50 | 40 | 45 | 276 | 2.241 |
| EU15 countries | 31 | 31 | 26 | 27 | 27 | 26 | 168 | 1.151 |
| NON-EU countries | 18 | 20 | 18 | 19 | 17 | 18 | 110 | 2.793 |
| ALL countries | 98 | 94 | 93 | 96 | 84 | 89 | 554 | 2.020 |

* sums for individual countries.

In contrast to the single Member States the EU aggregates (EU27, EU15, NMS12, EA13) show no irregular probabilities to stay for the dynamic approach, and only two for the static approach in the years 2000 and 2001 for NMS12 (Tables C1, C2 in Annex C). This means that the error correction process works and leads to consistent data at the aggregated level. For NON-EU aggregates, however, irregularities can be also observed.

### 3.4.2. Reasons for "irregularities"

Many irregularities for the static approach are counted in countries like MT, CY, LT, EE, LV, etc. and very few in IT, ES, DE, UK, HU etc. (Table C2). A similar but not identical country ranking can be observed for the dynamic approach (Table C1). This leads to the assumption that irregularities are correlated with sample size.

8 6 instead of 5 years.

In order to test this hypothesis, linear regressions were estimated with the number of irregularities explained by the absolute sample size. The sample size was calculated with population aged 50 to 70 times the sampling share for each Member State. Sampling shares were taken from the Eurostat publication (Eurostat 2005). This gives sampling shares for two thirds of the countries. For the rest the average share of 0.5 % was assumed.

The equation is as follows:

(12) $$n_c = \alpha + \beta f_c$$

| | |
|---|---|
| $n_c$ | *Number of irregular activity rates ($p^s > 1$) over all ages and years for country c* |
| $f_c$ | *Sample size for the population aged 50 to 70 in absolute numbers; averages 2000 to 2005* |
| $\alpha, \beta$ | *Regression coefficients* |

The results of the estimates for 31 countries are given by Table 9. They confirm that there is a significant direct correlation of the number of irregularities with the absolute sample size. All $\beta$-coefficients have the expected negative sign and are significant above the 99.9 % level. The corrected $R^2$ is between 0.3 and 0.4. This is not very high and reveals that a singular variable is not able to fully explain the variance of the number of irregularities. Nevertheless, sample size has a strong impact.

Table 9 Regression of the number of irregular probabilities to stay ($P^s > 1$) on sample size
31 countries; population aged 50 to 70

| | Sample size $\beta$ *T-value* | Standardised coefficient $\beta$ | Significance | Corrected $R^2$ | F-value |
|---|---|---|---|---|---|
| **Dynamic approach** | | | | | |
| Males & females | -5,502 *-4,228* | -0618 | *** | 0,360 | 17,880 |
| Females | -10,166 *-4,448* | -0,637 | *** | 0,385 | 19,788 |
| Males | -11,755 *-4,138* | -0,609 | *** | 0,350 | 17,124 |
| **Static approach** | | | | | |
| Males & females | -7,260 *-3,975* | -0,594 | *** | 0,330 | 15,801 |
| Females | -14,012 *-4,965* | -0,678 | *** | 0,441 | 24,653 |
| Males | -16,496 *-4,644* | -0,653 | *** | 0,407 | 21,566 |

*** = significance > 99.9 %.

The number of irregular probabilities to stay in both, the static and dynamic approach, is also strongly correlated with the mean deviation of these activity rates (Table 10). This means that the error resulting from these irregularities multiplies: a high number of irregularities is correlated with a high mean deviation of the activity rates for ($p^s > 1$) cases. Countries with a small sample size therefore are strongly affected by these errors.

Regarding individual ages, the number of irregular probabilities to stay is u-scaped - low at middle ages of the 49 to 71 bracket and high at lower and higher ages (Chart 3). The lower numbers at middle ages between 56 and 62 can be explained through the stronger changes of activity rates at pension age. The higher numbers for the older ages can probably be attributed to sampling errors, while for younger ages migration and re-entrants into the labour market also has to be considered.

Taken together, the analysis of irregular probabilities to stay shows a clear correlation with the sample size. Compared to this, other behavioural determinants of such irregularities, like migration, change of pension ages or re-entrants into the labour market, seem to have little effects.

Table 10 Correlation matrix
31 countries

| | | SAMPLE-SIZE | OBS_STAT | MD_STAT | OBS_DYN | MD_DYN |
|---|---|---|---|---|---|---|
| SAMPLESIZE<br>Absolute sample size for population aged 50-70; average 2000-2005 | R | 1,000 | -0,594(**) | -0,587(**) | -0,618(**) | -0,606(**) |
| | Significance (2-sided) | | 0,000 | 0,001 | 0,000 | 0,000 |
| | N | 31 | 31 | 31 | 31 | 31 |
| OBS_STAT<br>Number of irregular probabilities to stay<br>(n)<br>static approach | R | | 1,000 | 0,905(**) | 0,843(**) | 0,843(**) |
| | Significance (2-sided) | | | 0,000 | 0,000 | 0,000 |
| | N | | 31 | 31 | 31 | 31 |
| MD_STAT<br>Mean deviation of activity rates static approach | R | | | 1,000 | 0,772(**) | 0,922(**) |
| | Significance (2-sided) | | | | 0,000 | 0,000 |
| | N | | | 31 | 31 | 31 |
| OBS_DYN<br>Number of irregular probabilities to stay<br>(n)<br>dynamic approach | R | | | | 1,000 | 0,799(**) |
| | Significance (2-sided) | | | | | 0,000 |
| | N | | | | 31 | 31 |
| MD_DYN<br>Mean deviation of activity rates dynamic approach | R | | | | | 1,000 |
| | Significance (2-sided) | | | | | |
| | N | | | | | 31 |

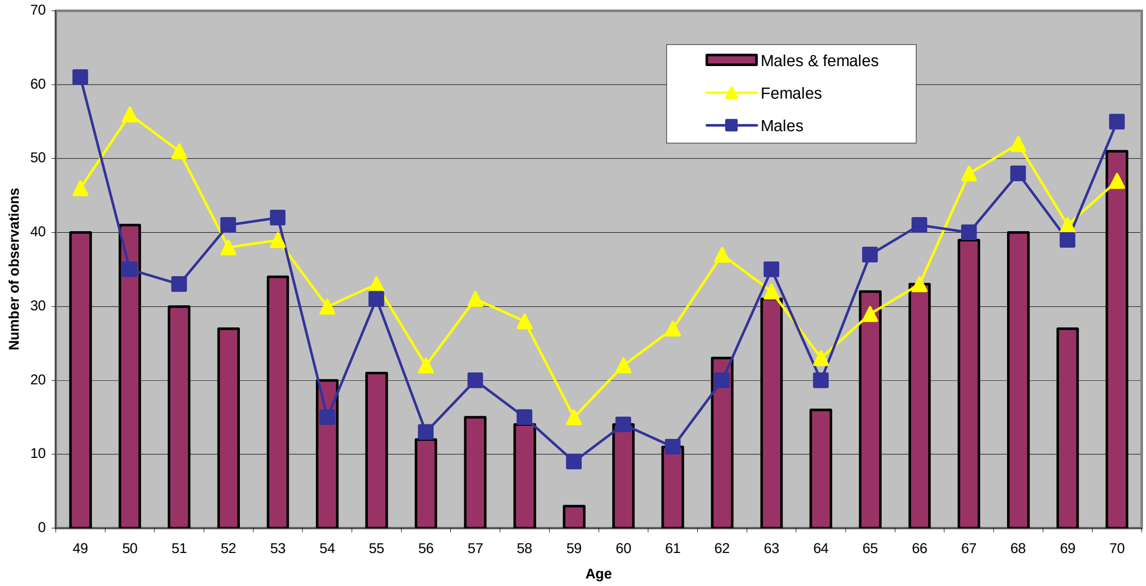
** Significant at > 99 % level (2-sided).
R = Pearsons' correlation coefficient. N = number of observations

In addition to the effects from input data, the calculation method of the dynamic and static approach affects outputs in a specific way. Recent Monte Carlo simulations of the exit age model undertaken by EUROSTAT showed that the variability of the inputs (i.e. the activity rates) is multiplied many times in the model output. The effects are likely due to the accumulated arithmetical operations in equations 3 to 5. Series of 3000 simulations for few selected countries showed a standard deviation for the exit age indicator of around 2 years. This would give 2-sigma confidence intervals of +/- 4 years at 98% (assuming normal distribution), which is extremely high for an indicator of this importance. Moreover, other simulations with reduced variability of the inputs (reduced by 10 times and 50 times) show similar variability in the outputs like the unreduced ones. If confirmed – EUROSTAT states – these results would indicate that the volatility of the results is a feature of the very model, not a consequence of sampling errors in the LFS.

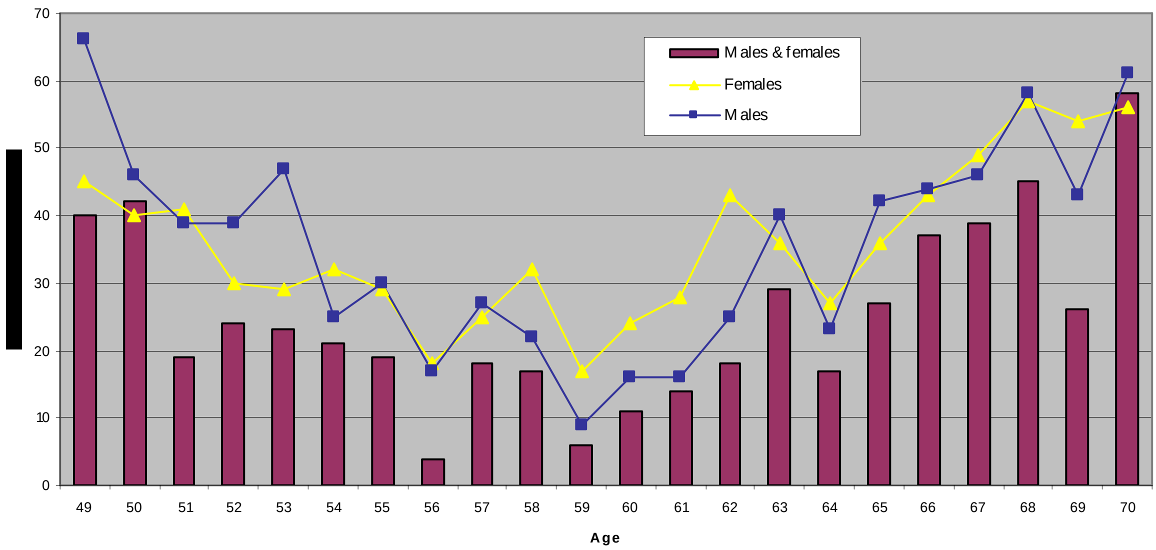
A second finding of the Monte Carlo simulations was that the average of the 3000 simulations is several years lower than the published value, which indicates a disposition to bias downwards in some cases but not in all. Eurostat believes the bias enters in the model when $p^s_{a,y}$ is forced to be 1 whenever $r_{a,y} > r_{a\text{-}1,y\text{-}1}$. This situation (i.e. $r_{a,y}$ being higher than $r_{a\text{-}1,y\text{-}1}$ ) happens more frequently in the Monte Carlo simulations than with real data, and only limited conclusions could be extracted from it. However it shows that the model does not behave well when $r_{a,y} > r_{a\text{-}1,y\text{-}1}$. Indeed, Eurostat experience is that the model gives unsuitable results, typically biased downwards, whenever the curves for the activity rates by age in two consecutive years "cross".

Chart 3 Number of irregular probabilities to stay ($P^s > 1$) by age
All countries, all years

Dynamic approach




Static approach



## 3.5. Instability of probabilities

Both approaches compare activity rates by ages. The dynamic approach compares the activity rate of a given age with the rate of the previous age and in the previous year. The static approach compares the previous age within the same year (equations 1 and 6). The question is how this affects the variance of exit age.

The answer can be given through a comparison of exit age values by countries and years – as calculated in Section 4 – with the change of activity rates as used by the two approaches. For this purpose, the average change of activity rates was calculated for one year over all ages.

For the dynamic approach the formula is

(13) $$\Delta r_y = 1/n \sum_a (r_{a,y} - r_{a-1,y-1}) \qquad a = 50...70$$

For the static approach it is

(13a) $$\Delta r_y = 1/n \sum_a (r_{a,y} - r_{a-1,y}) \qquad a = 50...70$$

Then the difference of $\Delta r$ was calculated over the years and compared with the annual differences of the exit age indicator.

(14) $$\Delta\Delta r_y = \Delta r_y - \Delta r_{y-1}$$

and accordingly for the exit age

(15) $$\Delta e_y = e_y - e_{y-1}$$

The double change of $r$ in the term $\Delta\Delta r$ measures how strongly the average decrease of activity rates over ages changes between years.

For presentation purposes, the $\Delta\Delta r$ and $\Delta e$ terms were aggregated by calculating the standard deviation over the years observed. The results are presented in Chart 4

It shows clearly that the fluctuation of activity rates over years is significantly higher in the dynamic approach than in the static approach. For the dynamic approach the standard deviation of the changes $\Delta\Delta r$ from 2002 to 2005 is 16 times higher than the standard deviation for the static approach. This can be seen in Chart 4 when the wider y-scale for the dynamic approach is considered.

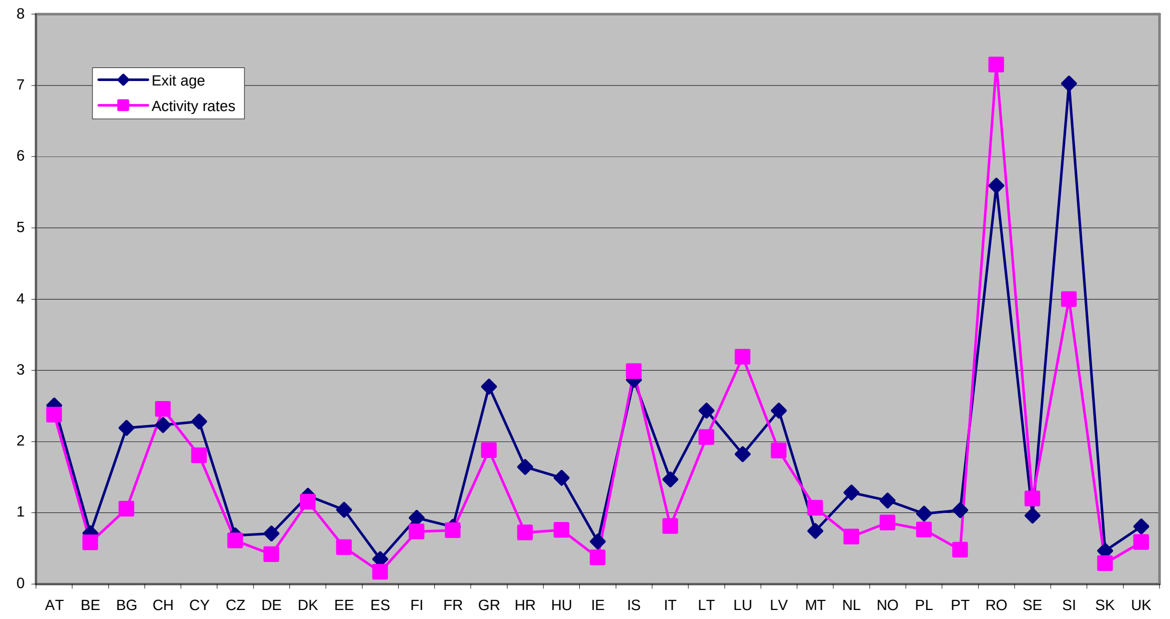
The average changes of activity rates over ages are very stable over time, however, if two different samples are used – as it is done by the dynamic approach – changes become instable.

The cohort perspective, partially applied by the dynamic approach directly leads to the instability of the dynamic exit age indicator. This can be shown by the correlation between annual exit age changes $\Delta e$ and $\Delta\Delta r$. For the dynamic approach this correlation is already visible in Chart 4. The corresponding $R^2$ for the countries represented is 0.81. If the extreme values for Romania and Slovenia are excluded, the correlation becomes even stronger with a value of 0.83. The static indicator however has a rather small $R^2$ of 0.12, and the smaller fluctuation of the static exit age can hardly be explained by changes of $\Delta\Delta r$.

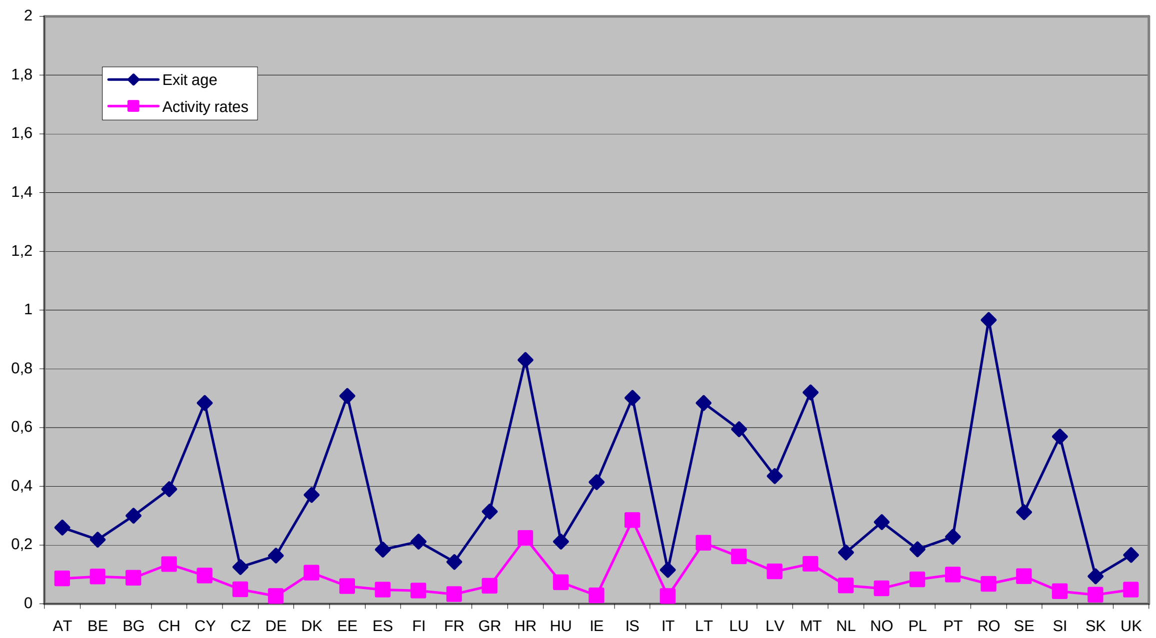
**Chart 4** Correlation between annual exit age change and average activity rates' change

Standard deviation of annual changes; males & females;

Dynamic approach




Static approach



## 3.6. Theoretical effects of biased probabilities

### 3.6.1. Dynamic and static approach

If we assume that activity rates include data errors, the probability to stay for the dynamic approach is

(16) $$p^s_{a,y} = (R_{a,y} + u_{a,y}) / (R_{a-1,y-1} + u_{a-1,y-1})$$

with $u$ as the error associated to the true activity rate $R$. This can be written as

(16a) $$p^s_{a,y} = R_{a,y}\ (1 + u_{a,y} / R_{a,y}) / R_{a-1,y-1}\ (1 + u_{a-1,y-1} / R_{a-1,y-1})$$

where $(1 + u_{a,y} / R_{a,y})$ is the relative error of the activity rate. The observed probability to stay then is the true probability $P$ times the relation of the two relative errors:

(16b) $$p^s_{a,y} = P^s_{a,y}\ \psi_{a,y}$$

where

$$\psi_{a,y} = d_{a,y} / d_{a-1,y-1}$$

with

$$d_{a,y} = (1 + u_{a,y} / R_{a,y})$$

and $d_{a-1,y-1}$ respectively.

On average for the activity rates observed, $u$ can be substituted by the standard error of the activity rates $s$. $\psi$ then is the relation of the two relative standard errors of the activity rates.

The upper part of Chart 5 shows how $\psi$ varies within an assumed range of 0.75 to 1.25 for the relative standard error $d$ – assuming a normalised average activity rate of 1.0. At maximum, when a positive relative error of 1.25 for the numerator is combined with a negative error of 0.75 for the nominator of equation 16a, the observed probability to stay is 1.67 instead of 1, and 0.6 in the opposite case.

In the case of the probabilities to stay, errors correction works in two ways:

At first, errors are compensated if observed values are biased in the same direction. A bias of –25 % for both activity rates leads to $\psi = 1$. In spite of the bias of activity rates, the observed and true probabilities to stay are therefore the same. This means that a systematic bias in the observed data – leading to a general over- or underestimation of activity rates – is not damaging the estimates of the probability to stay.

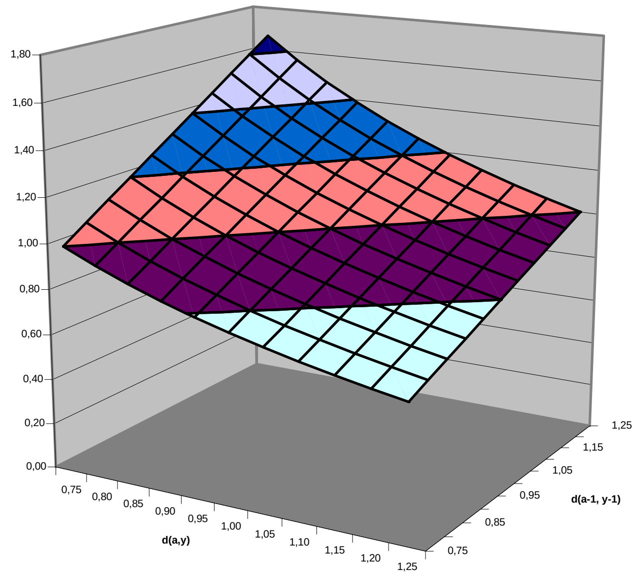
Secondly, error compensation is achieved through a random process which might be included in equation 3 which multiplies the probabilities to stay from the age of 50 up to the present age of a single age group. This can now be split up into

(3a) $$p^{in}_{a,y} = \Pi_{j=a0..a-1}\ P^s_{j,y}\ \Pi_{j=a0..a-1}\ \psi_{j,y}$$

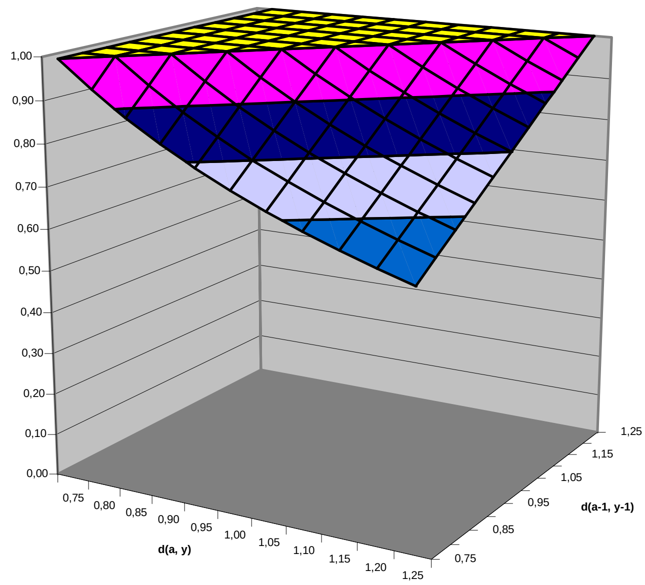
If we assume an equal distribution of the error term $\psi$ as it is shown in the upper part of Chart 5, the product over all error terms is 1. This means that positive and negative errors compensate each other under the assumption of a purely random distribution of errors.

Chart 5 Biased probabilities to stay

Error term $\psi$ without ceiling




with ceiling (for $p^s > 1$)*




* assuming an activity rate of 1

The dynamic and static exit age calculation, however, need to introduce the $p^s \leq 1$ restriction in order to avoid negative exit ages. This blocks the error compensation mechanism. Even if we make the assumption that 1/6 of the probabilities to stay have to be reduced to 1 (see Section 3.4), the error term $\psi$ is below 1 in any, and the exit age is finally underestimated.

The data bias caused through the relative error $d$ is again appearing in equation 4 which defines the probability not to stay in the labour market $p^{ns}$. The relative difference between the observed probability $p^w$ and the true probability $P^w$ to withdraw from the labour market is

(17) $$\delta^w = (p^w - P^w) / P^w$$

(Age and year subscripts used in equation 4 are omitted).

This can be written as

(17a) $$\delta^w = [\, \Pi P^s \, \Pi \psi \, (1 - P^s d) - \Pi P^s (1 - P^s) \,] / \Pi P^s (1 - P^s)$$

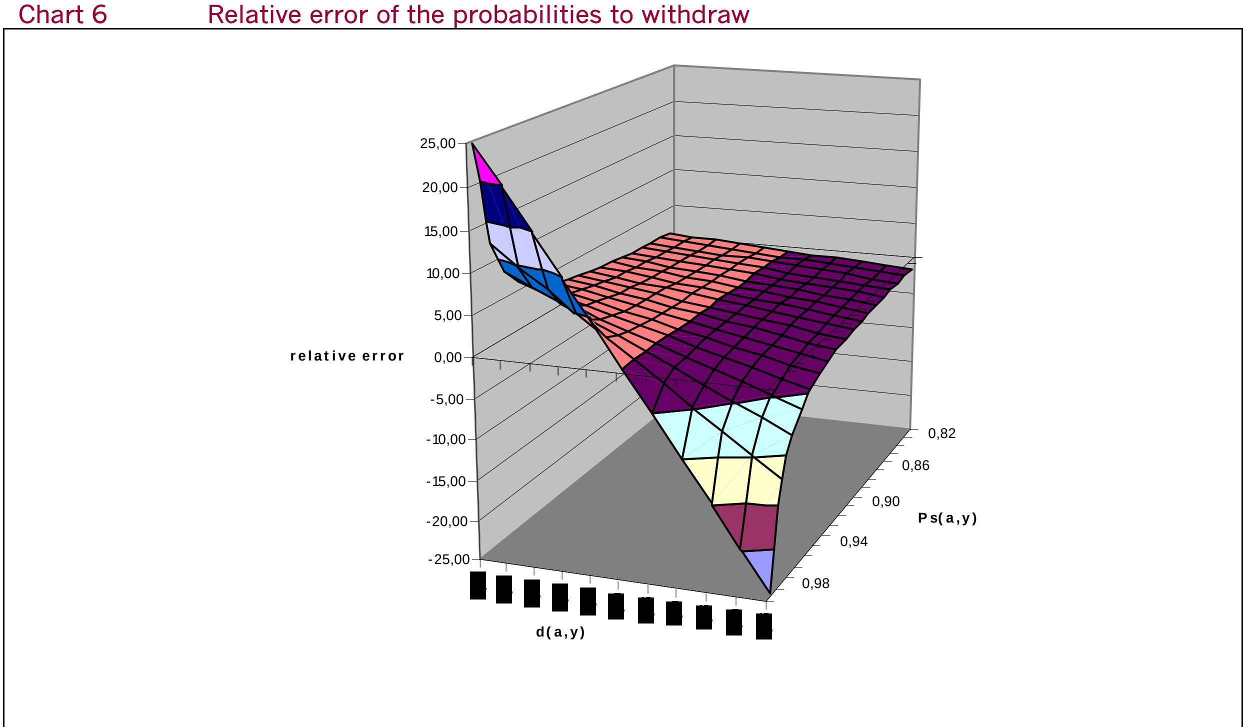
where the first part of the nominator term is the observed and the second part the true probability to withdraw.

Assuming that $\Pi \psi = 1$ (as developed above) this can be transformed into

(18) $$\delta^w = (1 - d) P^s / (1 - P^s)$$

The relative error of the probability to withdraw therefore depends on the reverse relative bias $(1\text{-}d)$ weighted with the odds of the probability to stay. Chart 6 shows that it increases fast if $P^s$ approaches 1. Lower probabilities to stay dampen the effects of the activity rates bias.

Chart 6 Relative error of the probabilities to withdraw



Taken together, these findings show that both the dynamic and the static approach are not sensitive to a general bias of activity rates measurement, and also not to pure random errors. In the first case, error compensation is achieved mathematically, in the second case statistically. Error compensation usually requires a sufficient number of observations. The age period from 50 to 70, however, only provides 21 observations, which is hardly enough to guarantee the efficiency of the process. Most importantly, however, the ceiling of the probability to stay at 1 confines the error correction process and leads to an underestimate of the exit age.

The probability to withdraw from the labour market, which is finally weighted up to the exit age, is sensitive to errors of activity rates close to 1. This happens because errors are multiplied with the odds of the probability to stay, which are increasing strongly, the closer the probability approaches 1.

### 3.6.2. Working life approach

In the working life approach, biases can be included in both, the survival function and the activity rates. As survival functions result from an estimation process, which provides standardised values, they can be assumed to be free of random errors. Systematic errors can be produced through methodological misspecification rather than data errors. Activity rates however can be assumed to include data-related errors produced either through sampling or the survey methodology.

If we assume that survival functions are unbiased, the problem is reduced to activity rates biases. Unfortunately, these are deeply interwoven in the exit age formula. If equation 10 is reformulated according to the approach used for the dynamic and static indicators, it can be written as

(19) $$e^w = (\Sigma_a (a + \Sigma_j (N^w{}_j\, d_j) / l_a)\; N^w{}_a\, d_a) / \Sigma_a N^w{}_a\, d_a$$

with
$N^w$ *the true number of active persons at age a*
$d$ *the relative error term (equation 12c)*
$a = 50 \ldots 70$
$j = a \ldots 70$

$N^w$ is derived from equation 8b which defines the number of active persons at age a in the birth cohort. It excludes the error term associated with the true activity rate *R.*

(19a) $$L^w = L_a\, R_a\, d_a$$

and

(19b) $$N^w = L_a\, R_a$$

The error term *d* is included in the sums over *a* and *j*. This enables the error correction process to operate efficiently – as will be shown in Section 4.3. Systematic biases, however, are multiplied in the nominator sum. This could lead to an exaggeration of such errors.

## 3.7. Impact of employment changes

One of the research leading questions was how strongly exit age indicators depend on cyclical variations of employment. If this were true, long-term comparisons would have to consider these fluctuations through trend estimates or other types of adjustments.

Unfortunately, such long-term comparisons are not yet possible as time series are too short. It is however possible to show that a significant impact on activity rates is coming from employment variation and thus exit age is also depending on employment change.

The estimated equation has the following type:

$$\Delta r_{a,y} = f(\Delta E_{a,y}, a_y) \tag{20}$$

| | |
|---|---|
| $\Delta r$ | *annual % change of activity rate at age a* |
| $\Delta E$ | *annual % change of employment at age a* |
| $a$ | *single age* |
| $y$ | *year of observation* |

The annual % change of the activity rate at age *a* depends on the annual % change of the active population and on age. The $\Delta E$ reflects the employment variation and age *a* the trend of employment variation with ages. In general, the decline of activity rates rises from the age of 60 onwards.

Table 11 Activity rates estimates

| Gender / country pools | Regression parameter (*T-Value below*) | | Adjusted $R^2$ | F-Value |
|---|---|---|---|---|
| | $\Delta E$ | a | | |
| All | | | | |
| EU27 | 0.323** | 0.156** | 0.279 | 548.3** |
| | *32.755* | *2.538* | | |
| EU15 | 0.361** | 0.134 | 0.308 | 352.2** |
| | *26.249* | *1.359* | | |
| EA13 | 0.538** | 0.185 | 0.467 | 597.8** |
| | *34.351* | *1.855* | | |
| NMS12 | 0.223** | 0.178** | 0.201 | 158.9** |
| | *17.457* | *2.830* | | |
| NON-EU | 0.150** | 0.021 | 0.147 | 33.4** |
| | *8.140* | *0.372* | | |
| Female | | | | |
| EU27 | 0.337** | 0.139* | 0.308 | 623.6** |
| | *35.067* | *1.972* | | |
| EU15 | 0.247** | 0.069 | 0.156 | 145.8** |
| | *16.886* | *0.920* | | |
| EA13 | 0.369** | 0.133 | 0.241 | 215.8** |
| | *20.601* | *1.584* | | |
| NMS12 | 0.370** | 0.270* | 0.381 | 382.3** |
| | *27.446* | *2.132* | | |
| NON-EU | 0.177** | 0.122 | 0.151 | 34.5** |
| | *8.147* | *0.966* | | |
| Male | | | | |
| EU27 | 0.071** | 0.164 | 0.059 | 89.2 |
| | *12.829* | *2.834* | | |
| EU15 | 0.165** | 0.068 | 0.140 | 128.6** |
| | *15.880* | *0.979* | | |
| EA13 | 0.507** | 0.029 | 0.450 | 554.7** |
| | *33.225* | *0.449* | | |
| NMS12 | 0.043** | 0.247** | 0.036 | 23.1** |
| | *6.243* | *2.622* | | |
| NON-EU | 0.048** | -0.029 | 0.029 | 6.7** |
| | *3.651* | *-0.456* | | |

** significant at 99 % level; * significant at 95 % level.

The estimates were undertaken with pooled data for country groups on the basis of single ages, gender groups and single countries, which means that countries were observed instead of country aggregates (Table 11).

The results indicate that on average of the EU27 countries about one third of the % change of employment is transferred into activity rates' changes. The parameter of $\Delta E$ is 0.323 for the EU27 countries. The parameters are significant above the 99 % level. For other country groups the results are similar as regards the impact of employment change. This is significant in all groups. It has a stronger impact in the EA13 than in NMS12. The separate results for gender groups confirm these findings.

This means that the annual change of employment levels has a damped but nevertheless significant impact on activity rates and thus on annual exit age. Cyclical fluctuations can therefore be expected to influence exit age indicators. In addition to the behaviour of individuals, the indicator therefore reflects the impact of changing labour market conditions.

# 4. Sensitivity analysis

For the simulation of alternative assumptions, the calculation models for the three indicators were established. These models used Eurostat data and the definition of exit age indicators as described in Section 3.1. The principal results are given in Chart 7 and Table 11. Additional details are included in Annex B. Compared to the Eurostat calculations the results show only minor deviations.

## 4.1. Comparison of results

The calculation of the three exit age indicators clearly reveals the problems described in Section 2. Even at the EU level, the dynamic indicator strongly fluctuates over the years observed, in a way which is not reflected by the other indicators (Chart 7). The static and the working life expectancy indicator – by contrast – are coming to similar results with small changes over time.

At the level of different EU aggregates and also for Member States the static indicator and the working life indicator show a high stability of time series. The values of the working life indicator are generally above the static indicator with deviations of $^1/_5$ year for EU27. For EA13 the difference is even smaller. Compared to the dynamic indicator the values of both the working life indicator and the static indicator are generally lower and more stable.

### 4.1.1. Time series behaviour

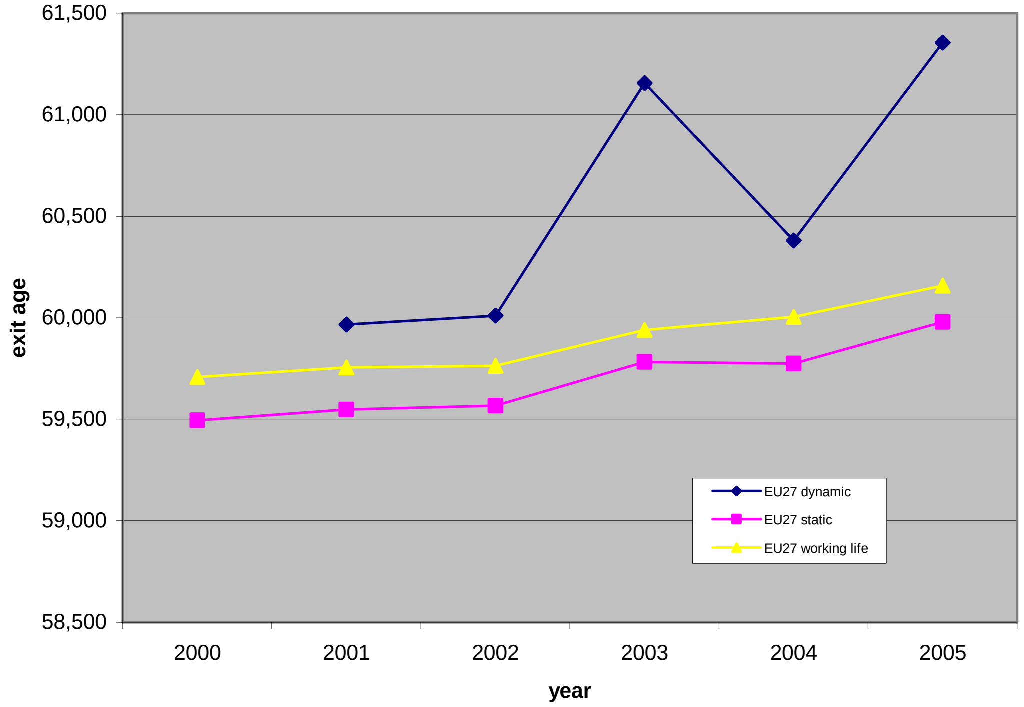
Like the static indicator, the working life indicator shows a clear trend of exit age changes. Over the five years between 2000 and 2005, the average exit age at the EU27 level increases by 0.5 years. The static indicator also increases by 0.5 years, but the dynamic indicator rises by 1.4 years.

The dynamic indicator shows high fluctuations between years which are not visible in the static and working life data. Even for the very short time series available, the variance of the dynamic indicator is three or even more times higher than for the other two indicators (Table 12).

**Chart 7** **Exit age for EU aggregates**

Males & females; adjusted activity rates

EU27




EA13

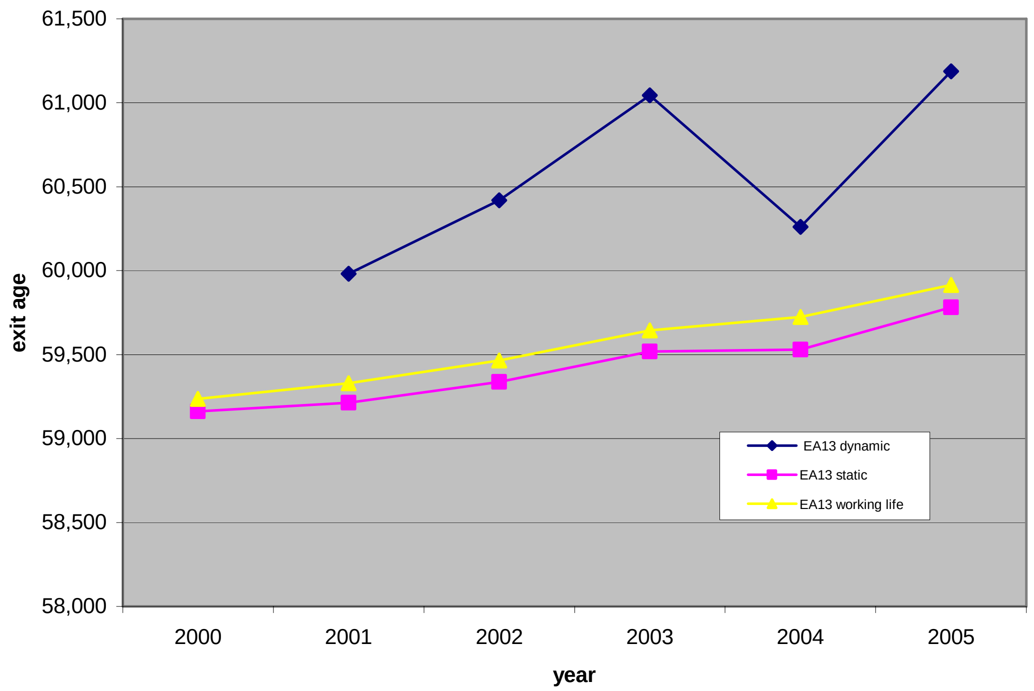
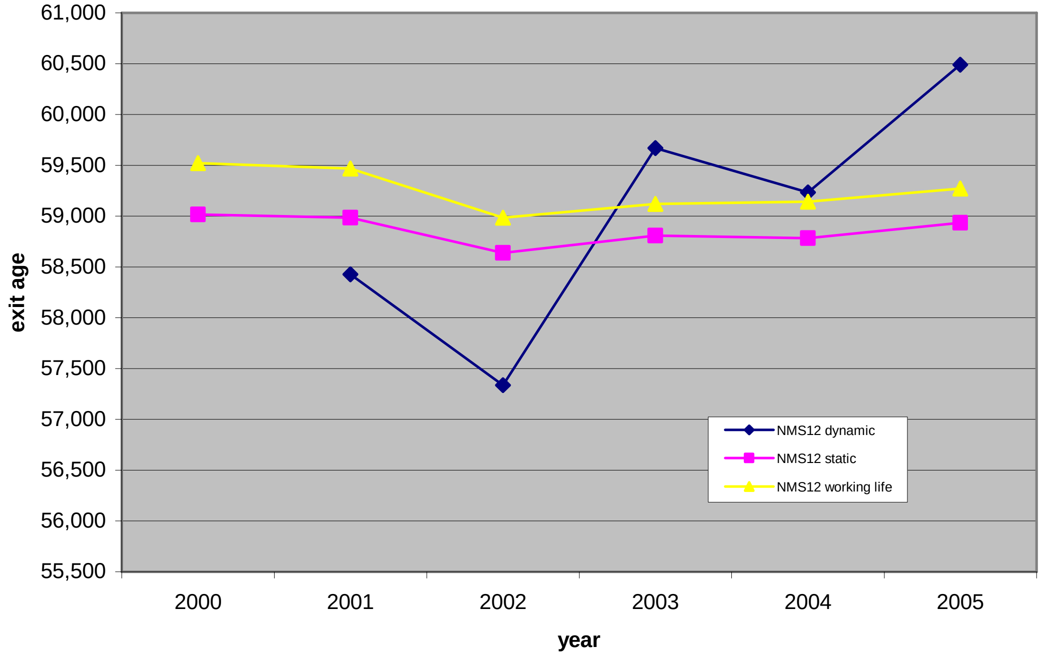


Chart 7 cont. Exit age for EU aggregates
Males & females; adjusted activity rates

NMS12




NON-EU

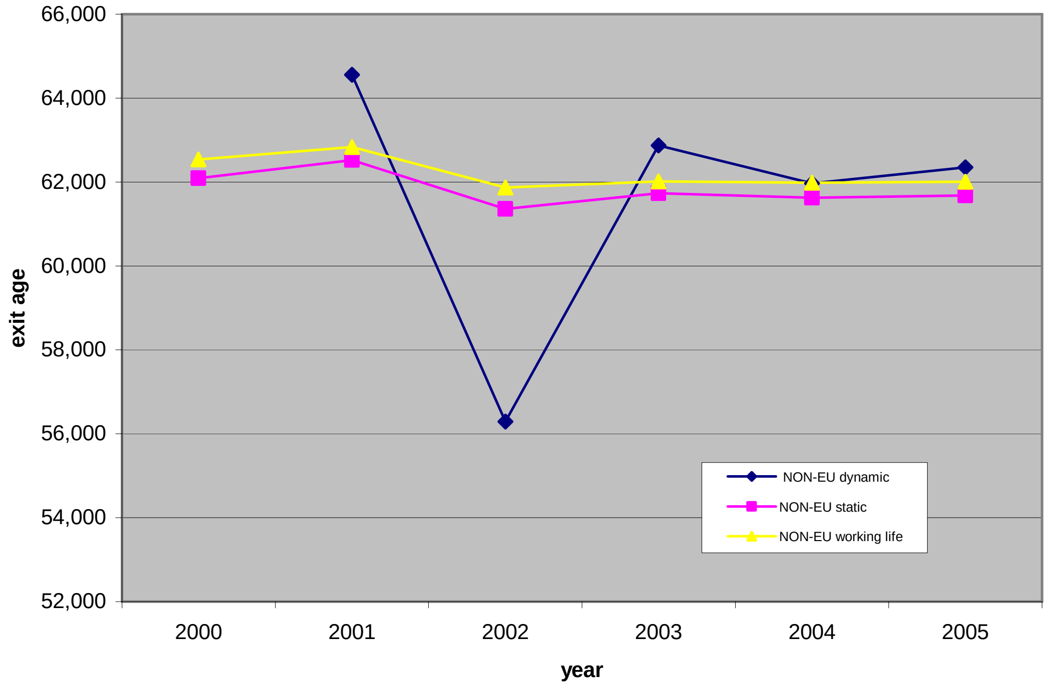


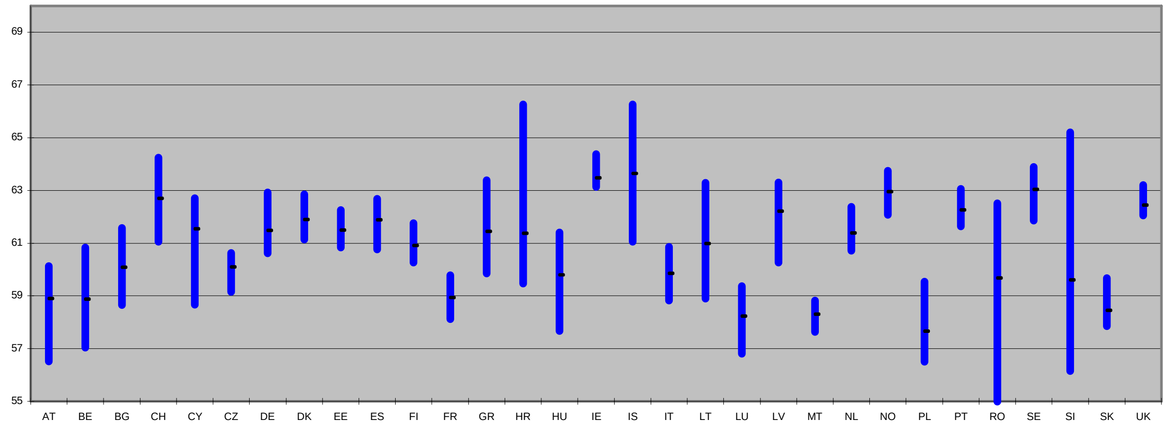
**Table 12 Comparison of exit age indicators at EU level**
Calculation based on adjusted activity rates, and WHO life tables

| Gender/country/approach | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | StdDev |
|---|---|---|---|---|---|---|---|---|
| **Males & females** | | | | | | | | |
| EU27 | dynamic | | 59.966 | 60.010 | 61.155 | 60.380 | 61.356 | 0.647 |
| | static | 59.494 | 59.548 | 59.566 | 59.782 | 59.775 | 59.979 | 0.186 |
| | working life | 59.662 | 59.711 | 59.721 | 59.895 | 59.960 | 60.112 | 0.175 |
| EA13 | dynamic | | 59.981 | 60.419 | 61.045 | 60.262 | 61.187 | 0.517 |
| | static | 59.163 | 59.213 | 59.337 | 59.518 | 59.530 | 59.781 | 0.231 |
| | working life | 59.202 | 59.294 | 59.430 | 59.609 | 59.689 | 59.875 | 0.254 |
| NMS12 | dynamic | | 58.429 | 57.338 | 59.671 | 59.232 | 60.490 | 1.205 |
| | static | 59.015 | 58.985 | 58.639 | 58.807 | 58.784 | 58.934 | 0.143 |
| | working life | 59.457 | 59.405 | 58.932 | 59.067 | 59.090 | 59.217 | 0.205 |
| NON-EU | dynamic | | 64.558 | 56.295 | 62.875 | 61.971 | 62.348 | 3.131 |
| | static | 62.090 | 62.525 | 61.355 | 61.729 | 61.626 | 61.675 | 0.413 |
| | working life | 62.463 | 62.755 | 61.793 | 61.941 | 61.914 | 61.932 | 0.384 |
| Females | | | | | | | | |
| EU27 | dynamic | 0.000 | 59.319 | 59.395 | 60.654 | 60.090 | 60.854 | 0.703 |
| | static | 58.472 | 58.527 | 58.521 | 58.786 | 58.784 | 59.074 | 0.232 |
| | working life | 58.617 | 58.668 | 58.661 | 58.835 | 58.920 | 59.111 | 0.191 |
| EA13 | dynamic | 0.000 | 59.552 | 60.164 | 60.824 | 60.601 | 61.190 | 0.632 |
| | static | 58.232 | 58.245 | 58.297 | 58.594 | 58.626 | 59.031 | 0.311 |
| | working life | 58.024 | 58.123 | 58.279 | 58.456 | 58.578 | 58.829 | 0.300 |
| NMS12 | dynamic | 0.000 | 57.381 | 56.329 | 58.819 | 57.869 | 58.831 | 1.053 |
| | static | 57.721 | 57.760 | 57.456 | 57.604 | 57.602 | 57.679 | 0.109 |
| | working life | 58.598 | 58.561 | 58.007 | 58.200 | 58.227 | 58.296 | 0.227 |
| NON-EU | dynamic | 0.000 | 63.949 | 55.190 | 62.504 | 61.381 | 61.548 | 3.359 |
| | static | 60.591 | 60.574 | 60.061 | 60.777 | 60.979 | 60.481 | 0.309 |
| | working life | 61.285 | 61.677 | 60.793 | 61.012 | 60.914 | 61.071 | 0.316 |
| Males | | | | | | | | |
| EU27 | dynamic | 0.000 | 60.481 | 60.526 | 61.651 | 60.623 | 61.884 | 0.677 |
| | static | 60.368 | 60.460 | 60.483 | 60.666 | 60.657 | 60.834 | 0.171 |
| | working life | 60.749 | 60.790 | 60.803 | 60.975 | 61.013 | 61.136 | 0.153 |
| EA13 | dynamic | 0.000 | 60.288 | 60.622 | 61.211 | 59.990 | 61.323 | 0.576 |
| | static | 59.886 | 59.991 | 60.117 | 60.275 | 60.259 | 60.435 | 0.202 |
| | working life | 60.411 | 60.488 | 60.601 | 60.776 | 60.805 | 60.947 | 0.205 |
| NMS12 | dynamic | 0.000 | 59.380 | 58.460 | 60.597 | 60.765 | 62.219 | 1.433 |
| | static | 60.419 | 60.317 | 59.925 | 60.122 | 60.075 | 60.289 | 0.182 |
| | working life | 60.360 | 60.294 | 59.887 | 59.973 | 59.999 | 60.178 | 0.191 |
| NON-EU | dynamic | 0.000 | 64.466 | 57.496 | 63.002 | 62.623 | 63.033 | 2.681 |
| | static | 62.828 | 62.976 | 62.242 | 62.400 | 62.326 | 62.658 | 0.295 |
| | working life | 63.662 | 63.813 | 62.775 | 62.866 | 62.950 | 62.817 | 0.463 |

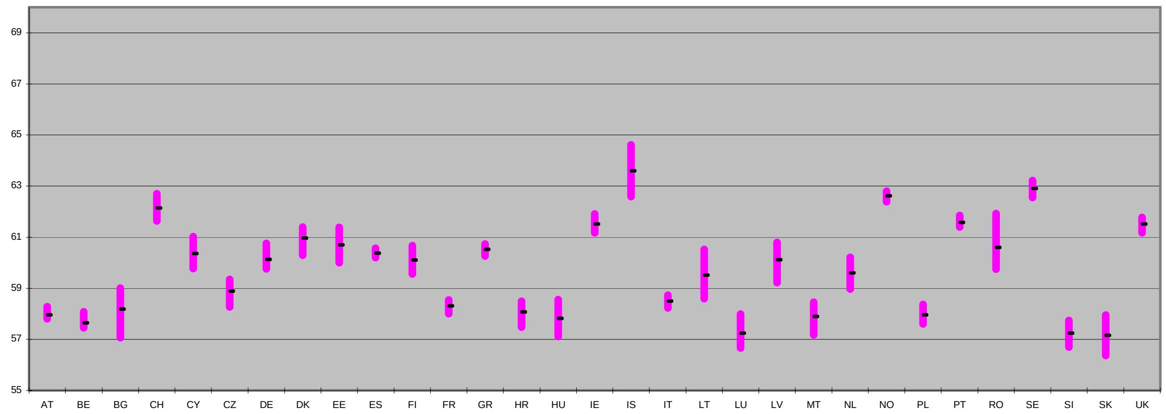
## Chart 8 Dispersion of exit age time series

Maximum, minimum, and average of time series by countries

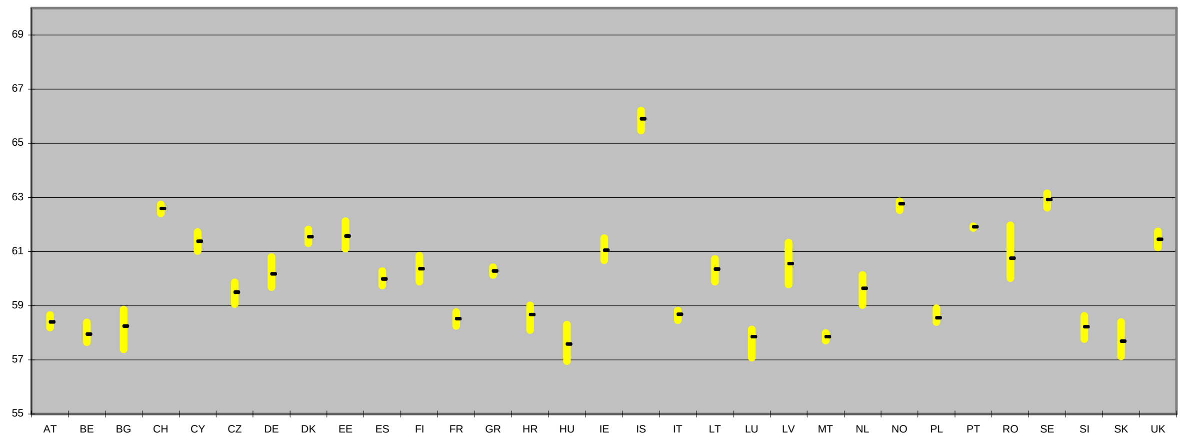
### Dynamic approach (2001-05)




### Static approach (2000-05)




### Working life approach (2000-05)



The detailed view on country time series confirms these comparative results. The time series variation – measured as the band between minimum and maximum values in the period 2000 to 2005 – is much higher for the dynamic exit age than for the two other approaches (Chart 8). On average over all countries maximum and minimum values range within a band of 5 % for the dynamic approach, but only 1.8 % for the static and 1.3 % for the working life approach. Also individual countries show lower fluctuation of time series: for Romania e.g. the dynamic approach's mini-max-band is 14 %, while it is only 3.6 % for the static approach and 3.3 % for the working life approach. Similar examples can be found in Cyprus, Greece, Latvia, Poland, and among the NON-EU countries.

A narrow range of variation can also be expected for practical reasons: the exit age can be expected to change gradually with alterations of pension age, the impact of ageing policies, and the labour market behaviour of workers and employers. Reform policies generally need long transition periods as retirement must be planned through long-term adjustments. Short-term fluctuations of the exit age can therefore hardly be explained through "real" factors. Much of the critique addressed to the dynamic approach is based on this presumption. As the previous Sections showed, the volatility of the indicator can hardly be associated with such policy changes.

Moreover, all three approaches use the same input data but lead to different results regarding the volatility of time series in particular. This has to be attributed to the fact that the dynamic approach uses data from two different annual (or quarterly) samples. This obviously raises the effects of sampling errors and breaks of time series. The static and the working life expectancy approaches, on the other side, remain within the data of one sample.

The static exit age indicator is not affected in the same way in spite of using the same calculation method which multiplies statistical errors and faces "irregular" probabilities to stay. The only difference between the dynamic and the static approach is the definition of the probability to stay with the reference to two instead of one annual sample. For most of the EU countries the Labour Force Survey can provide accurate data for ages and gender, but it is asked too much if it should also guarantee comparability over time at this level of disaggregation.

Trend stability is an attribute which the exit age indicator should provide. It can be measured by the variance of % changes of exit age values between years. Table 13 presents the results for 31 countries and the years 2000/2001 to 2005.

Table 13 Time series behaviour
Standard deviation of annual % changes of exit age; average of 31 countries, 2000/01 to 2005

| Approach | Male & Female | Female | Male |
|---|---:|---:|---:|
| Dynamic (2001-05) | 2.856 | 3.333 | 2.612 |
| Static (2000-05) | 0.584 | 0.788 | 0.587 |
| Working Life (2000-05) | 0.290 | 0.310 | 0.322 |

Consistent with the previous findings, the dynamic approach shows the highest standard deviation of annual % changes over all years and countries (2.856 % for males & females, 3.333 % for females, and 2.612 for males). The variance of the static approach is significantly less with 0.584 % (for males & females) and the working life approach even lower with 0.290 %. In relation to the dynamic approach the working life approach time series have only $^{1}/_{10}$ of the variation. But even in relation to the static approach it is only ½. The working life approach therefore has the highest time series stability.

Another criterion of time series stability is the correlation between annual changes of exit age values of two subsequent years. This tells to which degree the changes in the countries observed follow an underlying trend. A positive correlation coefficient shows a strong connection to a positive or negative trend, a negative correlation reveals reverse changes, and the attribute of the indicator to fluctuate.

As Table 14 indicates, the dynamic approach has a rather high negative correlation for all observed years (between -0.448 to -0.684). The negative correlation under the static approach is weaker, but nevertheless visible. The working life approach, however, shows a rather low correlation which – for the observed years – changes between negative and positive association.

A negative association indicates that changes in one year are (regularly) corrected in the opposite direction in the following year. This is not the behaviour of a random variable which would not show any correlation. As variation of dynamic and static exit age is simply coming from activity rates, there is obviously a systematic fluctuation in these rates which is absorbed in the working life approach through the use of survival functions.

Table 14 Correlation of annual changes of exit age between years
Correlation coefficient (R) of annual % changes of exit age between years; 31 countries

| Approach | Correlation of annual % changes between ... years | | | |
|---|---|---|---|---|
| | 2001/00<br>2002/01 | 2002/01<br>2003/02 | 2003/02<br>2004/03 | 2004/03<br>2005/04 |
| **Male & female** | | | | |
| Dynamic | | -0.448 | -0.502 | -0.609 |
| Static | -0.034 | -0.360 | -0.348 | -0.361 |
| Working life | -0.179 | 0.256 | 0.121 | -0.136 |
| **Female** | | | | |
| Dynamic | | -0.486 | -0.443 | -0.535 |
| Static | 0.080 | 0.207 | -0.528 | -0.371 |
| Working life | -0.298 | -0.149 | -0.174 | -0.006 |
| **Male** | | | | |
| Dynamic | | -0.627 | -0.507 | -0.684 |
| Static | -0.326 | -0.486 | -0.636 | -0.547 |
| Working life | -0.173 | 0.225 | -0.105 | -0.299 |

### 4.1.2. Country profile

In spite of the differences in time series behaviour, the three approaches come to similar results as regards the exit age differences by countries. This is visible in Chart 8 but can also be shown by the correlation of country averages of time series values among the three approaches. This correlation is high for all three approaches, and particularly high for the static and working life approach (Table 15). The highest $R^2$ is measured for the association between static and working life approach, the lowest between dynamic and working life approach.

The comparison of exit age values for single ages, countries and years also shows a striking correlation. It is lower than the correlation of time series averages but reveals the same picture. Again the static and working life approaches have the highest correlation, and the dynamic and working life approaches the lowest. This is visible for males & females and the two gender groups.

Table 15 Correlation of average exit age by countries
Correlation coefficient ($R^2$); 31 countries

| Exit age approach | Time series averages for countries; male & female | Single values for countries and years | | |
|---|---|---|---|---|
| | | Male & female | Female | Male |
| Dynamic / static | 0.794 | 0.581 | 0.524 | 0.629 |
| Dynamic / working life | 0.717 | 0.512 | 0.429 | 0.538 |
| Static /working life | 0.927 | 0.910 | 0.779 | 0.854 |

On average – over the time span observed – the three approaches therefore come to similar results as regards the differences of exit age values among countries. However, single values for countries and years are less correlated in particular if the dynamic approach is compared to the other two. Static and working life approach come more or less to the same results.

### 4.1.3. Gender profile

The gender values also show a high correlation between the static and working life approaches (Chart 9).
There are however some peculiarities:

- The deviation between the dynamic and the other two approaches has to be attributed to females rather than males. With the exception of Iceland and Poland, the dynamic values for females are higher than the static and working life values. The result must be the consequence of higher probabilities to withdraw from the labour market in the dynamic approach. This might be the consequence of a greater number of “irregular” probabilities to stay which are corrected to 1 (see Section 3).
- For males the variance among the 30 countries (excluding Iceland) is slightly higher for the working life approach than for the two other approaches. For females it is the same.

## 4.2. Age limits

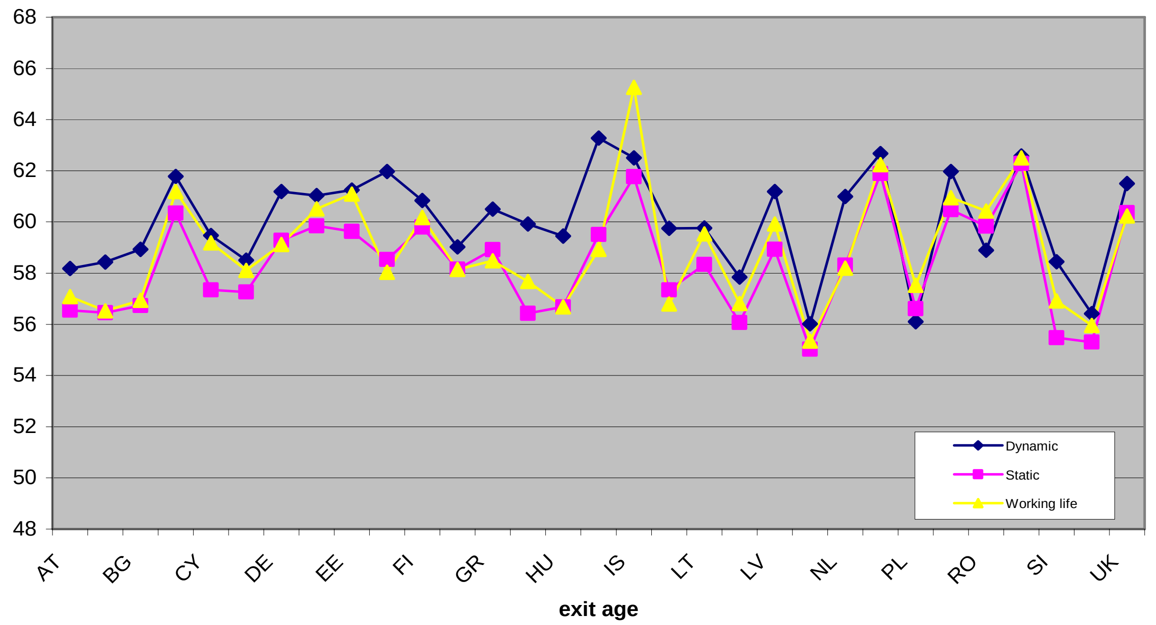
The Eurostat calculations assume a maximum exit age of 70 at which all persons left the labour force. This is mainly due to the rise of the sampling error with age. It is however an assumption which has visible effects on activity rates. Moreover, activity rates beyond 65 are linearly interpolated until the age of 70 in order to achieve the required continuous decrease.

However, 12 % of the EU27 population is still active at the age of 65. Among women the share amounts to 8 %, and 17 % of men (Table 16). In Denmark, Greece or Portugal e.g. the rates are even higher. The Eurostat calculations solve the problem through the calculation of a linear decline between 65 and 70. Considering the high activity rates at 65, this is a rather strong assumption.

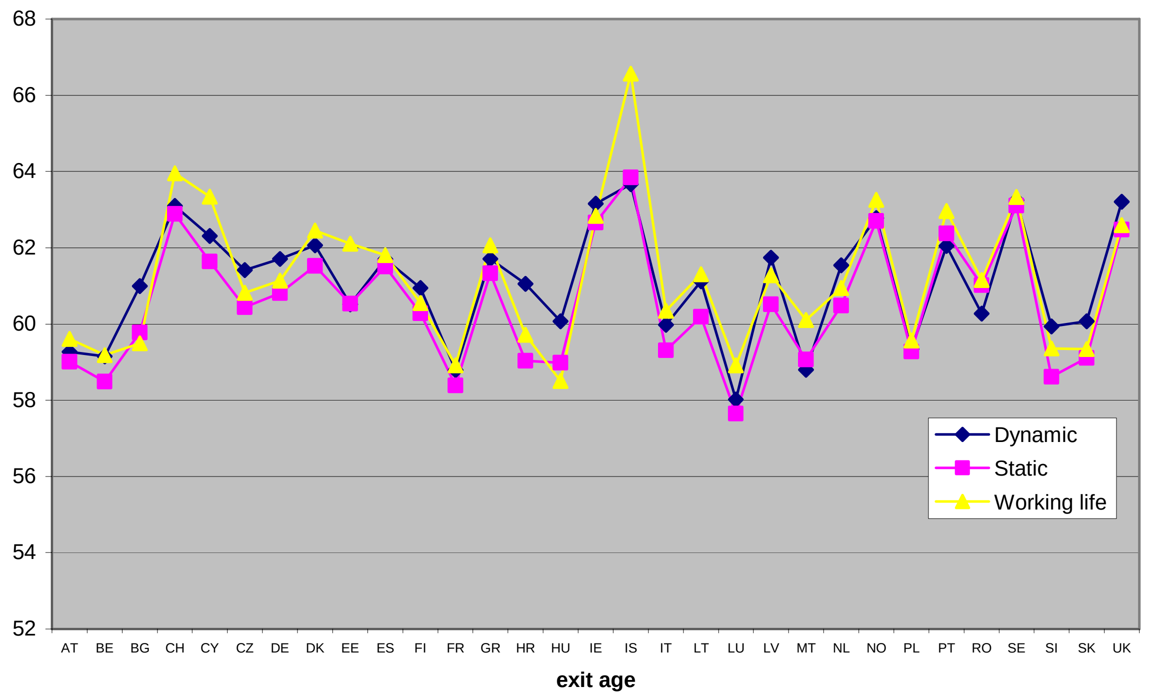
The question is how this assumption affects the calculation of average exit age. Ideally the calculations could be done with observed activity rates at higher ages. These however are not available due to the small sample size. The effect of potentially longer labour participation therefore was calculated under the assumption that the maximum exit age is 75. Between 65 and 75 activity rates decline linearly.

Chart 9 Exit age by gender and country
Averages over time series values by countries

Females




Males



This appears as the only method which can cope with the problem of smaller samples at higher ages. Alternatives to linear interpolation can be tested, in particular those who use activity profiles by age and gender, e.g. by spline or logit functions. For the reason of simplicity, this study used linear interpolation.

The results of this assumption are presented by Table 17. It compares the calculations of Table 11 with the calculation for the extended exit age: for the dynamic approach the exit age for all countries observed increases on average by 0.778 years if the maximum exit age is 75 instead of 70. There is a considerable variation of this difference among countries and years. The standard deviation over all observations is 0.613. For females the average increase is 0.704 and 0.779 for males. Standard deviation is higher for females than for males.

The effect of the extension is smaller for the static approach, where the average exit age increases by 0.457 years with a standard deviation of 0.325. For females the difference is clearly lower than for males.

The working life expectancy approach shows a difference which is closer to the dynamic approach as regards the size of the difference. The standard deviation of differences however is much lower. For females the average increase of the exit age is smaller than for males.

The results are certainly no surprise as they show the expected increase. An explanation however is needed for the differences between the approaches: The size of the effect obviously depends on the approach used. The dynamic approach again shows the strongest reaction to the extension of the calculation period. This is due to the fact that the dynamic approach reflects the rise of activity rates which is included in the estimated activity rates for persons above 70. The higher variability is caused by the probability to stay which is also higher compared to the static approach.

The working life expectancy approach does not only include the activity rates of older persons. It also includes the (standardised) active population as weights. This additionally raises the values compared to the results of the static approach.

The extension of the maximum exit age to 75 seems to be advisable as the activity rates of at least some EU countries are not negligible at 70. This should be considered adequately. The problem of the small sample size at higher ages is removable through appropriate estimates of activity rates at higher ages. A smoothed non-linear path can be estimated using the change of activity rates before 65 as input. As already mentioned, spline or logit functions can be applied.

The length of the age span considered by exit age indicators is a question of both, data availability and the bias created by any shortening of the span. Ideally therefore, the age span should be extended to the highest age for which activity can be measured. The suggestion to extend the span to 72 instead of 75 considers the limited data availability but does not account for the bias. In particular for countries where activity rates are still high at the age of 65, the indicators tend to underestimate the exit age. This should be avoided through the methods suggested above.

Table 16 Original activity rates at the age 65
2005

| | All | Females | Males |
|---|---|---|---|
| AT | 6.6 | 5.0 | 10.5 |
| BE | 4.4 | 2.5 | 14.9 |
| BG | 6.7 | 4.3 | 12.1 |
| CH | 22.8 | 17.6 | 50.4 |
| CY | 22.8 | 12.0 | 44.8 |
| CZ | 10.4 | 7.3 | 17.5 |
| DE | 7.2 | 5.3 | 16.1 |
| DK | 18.1 | 10.7 | 29.4 |
| EE | 26.5 | 21.1 | 40.1 |
| ES | 7.6 | 4.9 | 32.1 |
| FI | 7.1 | 4.1 | 17.9 |
| FR | 4.9 | 4.3 | 7.7 |
| GR | 17.6 | 10.2 | 36.8 |
| HR | 12.7 | 10.7 | 17.0 |
| HU | 4.6 | 3.1 | 9.3 |
| IE | 20.4 | 10.6 | 44.9 |
| IS | 73.4 | 64.2 | 90.3 |
| IT | 9.9 | 4.2 | 23.6 |
| LT | 13.1 | 11.5 | 22.4 |
| LU | 3.5 | 3.9 | 12.2 |
| LV | 19.4 | 14.4 | 30.0 |
| MT | 5.0 | 2.4 | 9.6 |
| NL | 8.0 | 4.1 | 19.9 |
| NO | 30.9 | 26.6 | 40.2 |
| PL | 13.1 | 9.3 | 22.5 |
| PT | 32.5 | 25.9 | 49.0 |
| RO | 33.5 | 30.8 | 36.7 |
| SE | 18.7 | 14.4 | 43.1 |
| SI | 12.4 | 10.7 | 16.2 |
| SK | 3.3 | 1.9 | 6.6 |
| UK | 17.7 | 12.5 | 40.8 |
| EU27 | 12.1 | 8.3 | 16.5 |
| EA13 | 9.8 | 6.2 | 13.8 |
| NMS12 | 14.5 | 11.3 | 18.8 |
| NON-EU | 20.0 | 16.0 | 25.2 |

Source: Eurostat.

**Table 17 Effect of the extension of maximum exit age to 75**
Difference to average exit age calculated with maximum exit age 70
All countries; calculation based on adjusted activity rates

| | Average Difference (years) | StdDev (years) |
|---|---|---|
| Dynamic approach | | |
| All | 0,778 | 0,613 |
| Female | 0,704 | 0,660 |
| Male | 0,779 | 0,608 |
| Static approach | | |
| All | 0,457 | 0,325 |
| Female | 0,325 | 0,264 |
| Male | 0,529 | 0,351 |
| Working life expectancy approach | | |
| All | 0,664 | 0,408 |
| Female | 0,588 | 0,398 |
| Male | 0,725 | 0,433 |

## 4.3. Moving averages

The Eurostat calculation is based on single age values. Scherer operates with five-year age groups in order to reduce sampling errors. This however reduces the accuracy of the indicator considerably.

As an alternative which avoids the disadvantages of age groups, 3-ages moving averages were calculated. For age 49 only the two ages up to 50 were used. For all other ages up to 69, three ages were included with a zero value for 70.

The effect is measured through the mean deviation of exit age calculated with 3-ages averages of activity rates minus the exit age with single age activity rates. The mean deviation is calculated over 31 countries and years (2002-2005 for the dynamic approach, 2001-2005 for the static and working life approach).

**Table 18 Effect of 3-ages moving averages**
Difference to average exit age calculated with single age activity rates
All countries; calculation based on adjusted activity rates

| | Mean deviation of differences (31 countries, years) |
|---|---|
| Dynamic approach | |
| All | 1,723 |
| Female | 2,026 |
| Male | 1,552 |
| Static approach | |
| All | 0,368 |
| Female | 0,499 |
| Male | 0,398 |
| Working life expectancy approach | |
| All | 0,003 |
| Female | 0,004 |
| Male | 0,002 |

As Table 18 shows, the effect of moving averages on the calculation of the average exit age is very different between the three approaches. The dynamic approach reacts strongly as the smoothing affects the probability to stay. The static approach reacts much less, and for the working life approach the differences are very small. This can be explained through the fact, that the working life approach includes already a smoothing procedure through the weighting of activity rates with the survival rates.

The reason why the dynamic approach shows considerable variation even with 3-ages moving averages is that averages were calculated for 3 ages of the same year of observation. The dynamic approach, however, compares two years. The moving averages of two consecutive years obviously are not more stable than those of single ages.

# 5. Conclusions and recommendations

*The problem*

The strong fluctuations of the dynamic approach time series which can hardly be related to determinants from the "real" world were the starting point for this study, and it appears to be the end point as well: The major problem is that a comparison of two LFS samples raises the estimation error of the probabilities to stay in the labour market.

This appears to be surprising, as two ages can also be understood as independent samples. However, labour force participation is the result of more determinants than age, gender, and country. It is determined by occupation, health, labour market orientation of individuals, recruitment behaviour of employers and many more. These factors can be expected to be more homogeneous within clustered LFS samples of one year than between independent samples of two years. This seems to be true even if a certain amount of revolving samples is used in practice. Moreover, changes of sampling, weighting and extrapolation methodologies might increase bi-annual differences.

Surprisingly, the multiplication of activity rates – which is suspected by EUROSTAT of producing the fluctuations – is the same in both the dynamic and static approach. However, they result in totally different time series behaviour of the exit age indicators. The multiplication of the probabilities to stay in the labour market for future years (equation 3) therefore can hardly be taken as a main reason. The correction rule that $p^s_{a,y}$ must be ≤ 1 is also applied by both approaches. Even if the dynamic approach includes more of these cases, the increase in not big enough to explain the differences of the variance. The only difference which remains as an explanation is the fact that the probability to stay is derived from two different samples in the dynamic approach

$$p^s_{a,y} = r_{a,y} / r_{a-1,y-1}$$

and from the same sample in the static approach

$$p^s_{a,y} = r_{a,y} / r_{a-1,y}.$$

The cohort-related probability of the dynamic approach contains stronger fluctuations not only between two ages but between the probabilities of two subsequent years. This therefore appears as the reason for the volatility of the exit age indicator.

*Estimation bias*

The static indicator is criticised because it reflects differences of labour market participation between age cohorts in addition to retirement behaviour. Female participation is used as a well-known example. However, if we want to know the average exit age of workers aged 50 to 70 for a given year, the heterogeneity of participation behaviour between ages must be reflected. The indicator does not seek to make a forecast of the exit age for a certain age cohort. In contrast, it describes the average exit age of the 50 to 70 years old for a single year. The composition of age cohorts with different participation behaviour and its changes over time are therefore part of the observation. From this point of view it can be questioned whether a cohort approach is adequate, a partial cohort approach as used by the dynamic indicator in particular.

Like the dynamic approach, the static approach is faced with a similar number of above-one probabilities for staying in the labour market. These “irregular” probabilities rates are reduced to 1 in order to avoid negative probabilities not to stay and produce negative exit ages. This would obviously be nonsense, but a nonsense which is due to the multiplicative calculation method (see equation 3). An additive method would avoid such inconsistencies.

Increasing activity rates with growing age are not an error. Even if their probability is low at the age group 50 to 70, they can be imagined for various reasons: in the dynamic view such factors can be the impact of immigration between two years, the change of retirement regulations, the return of women to the labour market, the change of recruitment behaviour of employers etc. In the static view, differences of participation behaviour between ages can produce such results and all factors mentioned if they are not age-neutral. The idea of an indicator describing “pure” exit behaviour which is not influenced by changes in the composition of the population remains a fiction. By contrast, indicators which exclude these changes or differences are therefore biased.

### *Advantages of the working life expectancy indicator*

The working life expectancy indicator is not faced with such problems. It uses sums rather than products to calculate exit age. Its starting point is the survival function of an age group, describing the present probability to be alive at a certain age. The probability to be alive is combined with the probability of being part of the labour force at the moment of observation. The weighted average of the resulting probability over the ages 50 to 70 (or 74) is the exit age. It can hardly be simpler.

Another advantage of the method is that survival functions are continuously decreasing, while the probabilities to be part of the labour force can decrease or increase. There is no restriction for activity rates changes and thus the method does not require altering empirical inputs.

Of course, the sampling errors of the LFS are included in these results. But two things reduce the problem: the survival functions provide stable probabilities over time, and the summing up over ages through weighted averages considerably contributes to error balancing. This suggests using the working life indicator as the better alternative out of the three calculation methods.

### *No alternative to LFS data*

The LFS data on labour force participation remain the most important input of the calculation for all approaches. The similarity of surveying methods, the homogeneity of definitions, and the structured timing of data provision makes it an indispensable data source which is comparable across countries. There is no alternative from other surveys. Even if the analysis showed that sampling errors are a problem for smaller countries, the strategy should be to solve these difficulties through adequate estimation procedures rather than changing the data source. This appears particularly important as the demand for the extension of the sample size cannot be achieved within a feasible time horizon.

### *Activity rates' estimates needed*

The analysis showed that at the level of EU aggregates much of the sampling error disappears due to error balancing. If the indicator should only provide data at this level, no additional efforts appear to be necessary. However, data at the country level are required for the open process of coordination. Accuracy at the country level is needed. This can only be achieved through adequate estimation procedures for the activity rates of smaller countries in particular. Two approaches should be tested in particular:

- The first approach estimates yearly activity rates by ages through smoothing over time and age. With regression analysis a three dimensional plane of activity rates is estimated for ages and years. This should use a logistic function for the dependency on ages and adequate non-linear (quadratic) function for the dependency on time.
- The second approach could be based on LFS micro-data. This would allow considering many more variables which determine labour force participation by age. The above mentioned list of factors could easily be extended. Participation rates would be estimated on the basis of significant regressions from a series of years. The annual change of participation rates would be induced by the independent variables.

It was not the task of this study to investigate these alternatives. It is therefore suggested to test these propositions in particular with those countries showing considerable fluctuations over time.

### *Extension of age span*

The partial estimation of activity rates would also help extending the age limits of the exit age calculation. As shown, in some countries activity rates at the age of 65 are still considerably high, and for some countries the decline to zero until 70 can hardly be expected. The visible effects of the age limit on exit age recommends extending the age limit. In the case of estimated high-age activity rates this could be done without a common limit for all countries. As minimum alternative, the extension to 75 is suggested.

The working life approach does not require the smoothing of activity rates for single ages as the intrinsic error correction process achieves the same result. For the static and in particular the dynamic approach, smoothing contributes to the reduction of variance. Compared to the suggested estimation of activity rates, however, averages over several years are a rather simple method which does not fully exploit the information available. This approach would only be a second best solution.

### *Calculation of life tables*

The use of the working life indicator would require the calculation of life tables for all countries observed. The provisional data estimated on the basis of WHO tables with five-year age groups will not be sufficient. Therefore, the Eurostat calculations of life tables are important for the further development of the exit age indicator.

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# Annex A: Expert survey

## Survey among EMCO Indicators Group

The questionnaire was sent to the working group members of the EMCO Indicators Group at the beginning of August by the European Commission. A reminder has been sent by the European Commission in September 2007. Up to 27th of September 2007, we received 16 answers from 15 countries (in the case of Romania we got two answers, from different institutions). The survey overview and the literature review will be completed if we get further answers until the submission of the final report.

In most cases no other indicator than the dynamic indicator based on LFS is calculated. The main reason named by the respondents for using the “dynamic indicator” is to the wish to have harmonised data at EU level.

It is noteworthy, that in the UK and Sweden, the “static exit age” is used.
In Finland exit age is calculated on the grounds of the working life expectancy.

In several Member States it has been stressed (RO, DE, BG, EL) that pension data are used for calculating average retirement age – either as additional information source or as main information source (BG, EL). Also other respondents do not refer to it this might be true also for other countries.

With regard to the quality of the dynamic exit age indicator it needs to be stressed that most respondents the accuracy of measurement as well as the clarity of interpretation either as “sufficient” or “poor”. The assessment of the comparability over time also was rather mixed. The coherence of LFS data with other statistics, accessibility to data and timeliness of updates was rated in most cases as “sufficient”. Only the comparability by gender was mostly assessed as “excellent”.

## Telephone Interviews and E-mail exchanges with the following experts

(1) Bernard Casey, IER, University of Warwick; formerly pension policy expert at the OECD

(2) Martin Brussig, Institut Arbeit und Qualifikation, Universität Duisburg – Essen (formerly IAT – Institut Arbeit und Technik); expert in age management and transition from work to exiting the labour market

(3) Luis Centeno, S2E2 / ISCTE (Instituto Superior de Ciências do Trabalho e da Empresa, University of Lissabon), Portugal

(4) Jacques Dahan, Bernard Brunhes consultants, Groupe BPI, France. Expert in the construction of internationally comparable indicators

Table A 1 Synthesis of responses

| *Country* | *Use of dynamic indicator* | *Use of static indicator* | *Use of other indicator* | *Comments* |
|---|---|---|---|---|
| AT | | | X (retirement age) | Administrative pension data of the Federal ministry of Soial Affairs and Consumer Protection is used in order to measure the effective retirement age. The clarity of of interpretation this indicator, the accuracy of the measurement as well as the comparability over time are regarded as excellent. The availability of data is seen as a strong point. The coherence with other statistics is perceived as sufficient.<br><br>There have been no further scientific discussions |
| BE | X | | | The dynamic indicator is used because it is a harmonised indicator.<br>The accuracy of measurement is regarded to be poor. It is stated that the indicator is difficult to interpret the changes having in mind political evolutions. Overall, the clarity of interpretation is rated as “sufficient”.<br>The Comparability over time is regarded as “poor”. The respondent states that it is sometimes difficult to assess the evolution. Further, the accessibility of data is assessed as “poor”. The timeliness of updates is perceived as “sufficient”.<br><br>There have been no further scientific discussions |
| BG | | | X (retirement age) | The calculation of the retirement age is the main indicator used in Bulgaria. The average retirement age is calculated by the National Security Institute on the grounds of the own data basis.<br><br>The reason for not using the dynamic indicator is that the results seem rather implausible, as since 2000, participation in the labour market of the 49-70 years old has permanently risen, while the average exit age has even decreased in some years. Thus the indicator is regarded as being not relevant in Bulgarian context. |
| CZ | X | | | No No other calculations than those made by Eurostat. The Czech Statistical Office gives preferences to common processes, comparable data and methods undertaken in other European statistical institutes as it is coordinated and carried out by Eurostat.<br>However, problems are seen as regards the clarity of interpretation. Interpretation of the methodology used for calculating the “dynamic indicator” is insufficient and should be clarified in more details. The accuracy of the measurement is regarded as “sufficient”. Also the comparability, the accessibility to data and the coherence with other statistics is regarded as “sufficient”. However, the timeliness of updates is considered as “poor”.<br>The comparability by gender is regarded as sufficient, but the respondent also comments that some data relating to insufficient interpretation of method of measurement seemed to be inaccurate, e.g. 2005 Iceland: average total is higher than male/female data. Tables should be compared with measurement method.<br>The There have been no further scientific discussions. |

| | | | | |
|---|---|---|---|---|
| DE | X | | X (retirement age) | The dynamic indicator based on LFS is used because it is a harmonised indicator. Additionally the retirement age is used as an indicator<br>The dynamic indicator is perceived as being problematic. The accuracy of the indicator is doubtful: Theoretically the dynamic exit-age indicator is sensitive to cyclical effects. Due to structural break in the LSF in 2005 the respondent and his colleagues cannot check if the results correspond with the evolution of the employment rate of older and the retirement age during the recent recovery of German Economy. The clarity of interpretation is regarded as poor for two reasons: (a) it is difficult to explain it to the public and b) it does not take into account the employment rate. The comparability over time is limited. Due to a structural break in the LFS in 2005 it is not possible to check if the results correspond with the evolution of the employment rate of older and the retirement age during the recent recovery of the German economy. This limits the comparability with other data. The timeliness of updates is normally sufficient (except in year). The comparability by gender is excellent.<br>With regard to the retirement age: This indicator is calculated on the basis of the data of the Federal German Pension Insurance (Deutsche Rentenversicherung). This indicator is traditionally used in the public debate. It fits well with the debate concerning the increase in the legal retirement age. The disadvantage is that the indicator does not include the whole working population. Further, due to a poor accessibility to data the retirement age of a cohort can only be calculated after a long time lag. With regard to the comparability with other national statistics it is regarded as sufficient. The evolution of the retirement age corresponds to the evolution of the employment rate of older workers (55-64 years). The comparability by gender is excellent. |
| DK | | | | Statistic Denmark does not have any regular dissemination of a national indicator for measurement of the average exit-age |
| EL | | | X (retirement age) | The Greek Ministry of Employment and Social Protection is calculating the average retirement age in order to measure average exit-age of the labour force on the basis of administrative data from the Social Security Funds (see publications in IKA statistical bulletins). The quality of the indicator is regarded as “sufficient” in all its dimensions.<br>The reason for using this indicator is that it represents the average effective retirement age of people insured in IKA, i.e. all private sector employees and workers. This population represents more than 50% of employed persons in Greece.<br>It needs to be added that in 2006, in the context of the LFS of the 2nd semester, National Statistical Service has also conducted an ad hoc survey on the transition from the labour market to retirement. |
| FI | | (x) | X (working life expectancy) | In Finland, a new indicator has been constructed for monitoring at which age older persons withdraw from the labour market based on life expectancy. This indicator is calculated by the Statistics Finland and the Ministry of Labour. It is based on the Population Statistics and Labour Force Survey, Statistics Finland. The working life expectancy indicator is regarded by the respondent as excellent in all respects. It is stated that the indicator is suitable for life-cycle approaches and is easy to use in the EU context.<br><br>The discussion started when it was found that the EU-exit age indicator, both the dynamic and the static one yield contradictory outcomes for Finland compared to other statistics about the phenomenon, e.g. participation rates and employment rates by age. Additionally, the EU-exit age indicator does not take into account the level of labour force participation rate in each country.<br><br>Nevertheless, rather the static than the dynamic indicator is used as a parallel information to the working life expectancy indicator is used. The dynamic indicator is not able to catch the cohort impact because the economic fluctuation between the 2 years is included in the dynamic indicator.<br><br>Literature: The Social Insurance Institution, Finland, Social Security and Health research: Working Papers 38/2004<br>EMCO Indicators Group paper INDIC/23/071206 |

| | | | | |
|---|---|---|---|---|
| FR | X | | | The indicator is regarded as being intuitively best reflecting average exit age. The indicator is easy to present and to interpret in terms of level and in terms of evolution. Thus, the accuracy of measurement as well as the clarity of interpretation are rated as “excellent”.<br><br>The comparability over time is perceived as “sufficient”. There was a rupture in 2002.<br>The comparability by gender is regarded as “excellent”.<br>The accessibility of the data is “sufficient”.<br>The timeliness of the updates is rated as “sufficient” and the coherence with other statistics is “sufficient”.<br><br>There have been no further scientific discussions about the indicator. |
| LU | X | | | No other calculations are made. No specific assessment about the quality of the indicator |
| LV | X | | | The accuracy of measurement and the clarity of interpretation are regarded as being “excellent”. The comparability over time, the accessibility of data and the timeliness of updates are perceived as “sufficient”. The comparability by gender is not possible, due to the low sample size.<br><br>There is not other statistics on the average exit age. The data calculated by Eurostat are used.<br><br>There are no other scientific articles addressing this indicator in Latvia. |
| NL | X<br>(but not based on LFS) | | | In the NL, a dynamic exit-age indicator is used but which is not based on LFS but upon the Enquête beroepsbevolking (EBB) of Statistics Netherlands (comparable with the Labour Force Survey, but with exclusion of jobs for less than 12 hours a week).<br><br>In view of the ageing populations the cohort-model developed by the OECD has been copied in order to be able not only making more precise projections of future employment, but also calculating a dynamic average exit-age. So, the exit-age was a by-product of the cohort-model.<br>Due to data limitations (no data available for employment of persons of 65 and above) the calculation of the average exit age was initially restricted to workers of age 55-64. At present, it is also possible to calculate the average exit age for workers of age 50-79.<br>For the five year age groups up to the age of 65 employment data are available from 1987, and for the age groups above the age of 65 from 1992. So, the average exit age series have to start in 1992 respectively 1997.<br><br>It is explained by the respondent why the average exit age, when calculated according to the dynamic approach, and the employment rate of older workers may move in opposite directions. The clear fall of the average exit age in 2003 while the employment rate of older workers remained on its rising trend, has given rise to some discussion. This discussion resulted in an explanatory note (sent separately in addition to the questionnaire) which shows the framework in which these seemingly contradictory movements can coexist.<br><br>According to this note it is important to stress that the Dutch Statistical Office does use age brackets of 5 years. The resulting overlapping cohorts function as a moving average which may suppress volatility in the figures due to small samples and/or lack of panel data which allow following the labour force participation of individuals over their lifetime.<br>It is also argued that the dynamic method is vulnerable for too small samples and a lack of panel data by which some erratic patterns in the figures may occur. |

| | | | | |
|---|---|---|---|---|
| UK | | X | | The calculation of the static indicator is based on LFS. The accuracy of measurement, the clarity of interpretation and the comparability over time, the timeliness of updates as well as the coherence with other statistics are regarded as being "sufficient". The comparability by gender as well as the accessibility of data is regarded as being excellent.<br><br>It is argued that average exit age /retirement age indicators were being used to describe changing retirement patterns. Therefore, the Office for national Statistics engaged in comparisons between dynamic & static measures resulting in static being adopted for reasons of stability. The indicator is now updated annually.<br><br>See article by Richard Wild (2006), pensions analysis unit. |
| RO | X | | X (retirement age) | The first respondent – a representative from the Labour Market Statistic Division - evaluates the dynamic indicator used by the EU as follows: The comparability over time, the accessibility of data, the timeliness of updates and the comparability by gender are regarded as excellent.<br><br>The clarity of interpretation and the accuracy of measurement are perceived as sufficient. Also the coherence with other statistics is coherent.<br><br>A second respondent from the National House of Pensions; state that with their data they can calculate the average retirement age. The accuracy as well as the clarity of interpretation of the indicator "average retirement age" based on pension data is perceived as sufficient. The accessibility to data, the timeliness of updates, the comparability over time as well as the comparability by gender are perceived as excellent. |
| SW | | X | | Accuracy of measurement and clarity of interpretation of the static indicator are regarded as "sufficient".<br>Comparability over time and comparability by gender are perceived as excellent.<br>The accessibility of data, the timeliness of updates and the coherence with other statistics is regarded as sufficient.<br><br>The dynamic exit-age indicator (the main alternative) is affected by changes in activity rates that are parallel among age groups. For instance, a down-turn in economic activity that hits all age groups equally would lead to a decrease in the exit age measured. Such irrelevant fluctuations in exit ages are easily seen in the Eurostat calculations (where the dynamic approach is used). The static approach is not affected in this way.<br>However, the dynamic approach is attractive from a formal point of view, insofar as it more fully corresponds to the method of calculating life expectancies, as used by population statisticians.<br><br>There is a scientific debate in Sweden about the calculation of exit age indicators. It has been questioned if labour force participation is the best foundation for the calculations. An alternative might be employment, or even employment less long-term sick absence. Finally, mainly labour force participation is used and the differences are not proved to be too large.<br><br>Another point concerns the age at which calculations start. We use 50 years, but a lower age is arguable since some leave the labour market at lower ages (and moreover increasingly so).<br><br>Literature: "Genomsnittlig pensionalder i de nordsiska länderna – med internationell utblick", Analyserar 2006: 11 from Försäkringskassan (Swedish Social Insurance Agency). Contains some further references. Also available in English on request from hans.olsson@forsakringskassan.se. |

# Annex B: Exit age indicators

## Table B 1 Exit age – dynamic indicator – males & females

Adjusted activity rates

| | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|
| AT | 59.502 | 59.428 | 58.889 | 56.520 | 60.130 |
| BE | 57.035 | 58.504 | 58.789 | 59.180 | 60.837 |
| BG | 61.573 | 58.658 | 58.749 | 61.126 | 60.329 |
| CH | 64.251 | 61.056 | 63.168 | 62.296 | 62.693 |
| CY | 62.295 | 61.361 | 62.673 | 62.709 | 58.670 |
| CZ | 59.148 | 60.427 | 60.171 | 60.130 | 60.636 |
| DE | 60.624 | 60.804 | 61.592 | 61.452 | 62.923 |
| DK | 61.786 | 61.276 | 62.438 | 62.850 | 61.138 |
| EE | 61.072 | 61.645 | 60.843 | 62.262 | 61.671 |
| ES | 60.767 | 61.749 | 61.936 | 62.248 | 62.678 |
| FI | 61.492 | 60.449 | 60.263 | 60.581 | 61.764 |
| FR | 58.124 | 58.928 | 59.787 | 58.973 | 58.839 |
| GR | 59.850 | 61.790 | 63.381 | 59.878 | 62.327 |
| HR | | | 64.059 | 60.597 | 59.463 |
| HU | 57.667 | 59.373 | 61.407 | 60.372 | 60.130 |
| IE | 63.289 | 63.339 | 63.129 | 63.240 | 64.382 |
| IS | 62.515 | 64.358 | 61.056 | 64.028 | 66.257 |
| IT | 59.805 | 59.856 | 60.864 | 58.821 | 59.951 |
| LT | 58.900 | 61.954 | 63.291 | 60.784 | 59.979 |
| LU | 56.808 | 59.261 | 57.365 | 58.335 | 59.375 |
| LV | 62.434 | 63.303 | 60.264 | 62.937 | 62.102 |
| MT | 57.633 | 58.234 | 58.812 | 58.001 | 58.819 |
| NL | 61.032 | 62.383 | 60.721 | 61.108 | 61.655 |
| NO | 63.752 | 62.557 | 62.961 | 62.073 | 63.406 |
| PL | 56.507 | 56.772 | 57.882 | 57.578 | 59.535 |
| PT | 61.791 | 62.752 | 62.046 | 61.634 | 63.062 |
| RO | 59.320 | 54.988 | 62.514 | 59.206 | 62.329 |
| SE | 61.853 | 63.400 | 63.195 | 62.792 | 63.900 |
| SI | 61.470 | 56.631 | 56.151 | 65.212 | 58.539 |
| SK | 57.944 | 57.853 | 58.069 | 58.706 | 59.675 |
| UK | 62.045 | 62.267 | 63.202 | 62.204 | 62.505 |
| EU27 | 59.966 | 60.010 | 61.155 | 60.380 | 61.356 |
| EU15 | 60.394 | 60.871 | 61.537 | 60.703 | 61.599 |
| NMS12 | 58.429 | 57.338 | 59.671 | 59.232 | 60.490 |
| EA13 | 59.981 | 60.419 | 61.045 | 60.262 | 61.187 |
| NON-EU | 64.558 | 56.295 | 62.875 | 61.971 | 62.348 |
| ALL | 60.123 | 59.933 | 61.233 | 60.458 | 61.393 |

Table B 2 Exit age – dynamic indicator – females

Adjusted activity rates

| | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|
| AT | 58.514 | 59.206 | 58.258 | 55.482 | 59.433 |
| BE | 55.912 | 58.383 | 58.692 | 59.577 | 59.612 |
| BG | 61.677 | 57.636 | 57.513 | 59.475 | 58.355 |
| CH | 63.284 | 59.886 | 62.522 | 61.256 | 61.954 |
| CY | 60.678 | 59.522 | 60.144 | 61.017 | 56.032 |
| CZ | 57.393 | 58.336 | 59.081 | 58.780 | 58.939 |
| DE | 60.193 | 60.369 | 61.272 | 61.136 | 62.964 |
| DK | 60.965 | 59.844 | 62.012 | 61.585 | 60.731 |
| EE | 61.048 | 61.325 | 60.412 | 61.999 | 61.449 |
| ES | 60.213 | 61.764 | 61.496 | 63.186 | 63.192 |
| FI | 61.296 | 60.384 | 60.038 | 60.829 | 61.655 |
| FR | 58.023 | 58.837 | 59.724 | 59.455 | 59.093 |
| GR | 57.617 | 61.979 | 62.546 | 58.805 | 61.529 |
| HR | | | 61.793 | 60.607 | 57.374 |
| HU | 56.993 | 58.760 | 62.147 | 60.670 | 58.699 |
| IE | 62.963 | 63.498 | 63.050 | 62.258 | 64.599 |
| IS | 60.362 | 63.646 | 61.087 | 61.932 | 65.487 |
| IT | 59.829 | 59.584 | 60.949 | 59.653 | 58.731 |
| LT | 57.287 | 60.036 | 63.322 | 59.515 | 58.655 |
| LU | 55.285 | 58.888 | 56.981 | 58.178 | 59.871 |
| LV | 61.831 | 61.428 | 59.718 | 61.526 | 61.450 |
| MT | 54.756 | 59.752 | 54.526 | 55.754 | 55.310 |
| NL | 60.797 | 61.571 | 60.097 | 61.075 | 61.408 |
| NO | 63.578 | 62.780 | 62.797 | 61.150 | 63.061 |
| PL | 55.451 | 55.765 | 56.308 | 55.698 | 57.275 |
| PT | 61.262 | 62.347 | 60.306 | 62.687 | 63.238 |
| RO | 58.663 | 54.205 | 62.164 | 58.555 | 60.881 |
| SE | 61.633 | 63.106 | 62.771 | 62.405 | 62.951 |
| SI | 61.005 | 54.913 | 55.270 | 63.697 | 57.328 |
| SK | 55.956 | 55.656 | 55.890 | 56.996 | 57.601 |
| UK | 60.945 | 61.744 | 61.814 | 61.231 | 61.772 |
| EU27 | 59.319 | 59.395 | 60.654 | 60.090 | 60.854 |
| EU15 | 59.922 | 60.654 | 61.190 | 60.831 | 61.433 |
| NMS12 | 57.381 | 56.329 | 58.819 | 57.869 | 58.831 |
| EA13 | 59.552 | 60.164 | 60.824 | 60.601 | 61.190 |
| NON-EU | 63.949 | 55.190 | 62.504 | 61.381 | 61.548 |
| ALL | 59.499 | 59.278 | 60.724 | 60.176 | 60.872 |

Table B 3 Exit age – dynamic indicator – males

Adjusted activity rates

| | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|
| AT | 59.911 | 59.411 | 59.407 | 57.242 | 60.345 |
| BE | 57.825 | 58.566 | 58.616 | 59.122 | 61.604 |
| BG | 60.580 | 59.830 | 60.051 | 62.061 | 62.441 |
| CH | 64.648 | 61.210 | 63.616 | 62.909 | 63.118 |
| CY | 62.156 | 61.447 | 63.567 | 63.312 | 61.078 |
| CZ | 60.456 | 62.179 | 61.112 | 61.215 | 62.114 |
| DE | 60.897 | 61.133 | 61.920 | 61.445 | 63.123 |
| DK | 62.147 | 61.938 | 62.339 | 62.641 | 61.250 |
| EE | 60.159 | 61.504 | 60.252 | 60.081 | 60.567 |
| ES | 60.955 | 61.705 | 62.004 | 61.718 | 62.105 |
| FI | 61.487 | 60.575 | 60.686 | 60.162 | 61.787 |
| FR | 58.228 | 58.927 | 59.824 | 58.408 | 58.542 |
| GR | 61.350 | 61.007 | 63.314 | 60.400 | 62.475 |
| HR | | | 62.551 | 60.352 | 60.241 |
| HU | 58.380 | 59.615 | 60.899 | 60.276 | 61.190 |
| IE | 63.406 | 62.768 | 62.679 | 63.371 | 63.556 |
| IS | 63.285 | 63.947 | 60.813 | 65.258 | 65.016 |
| IT | 59.855 | 60.090 | 60.925 | 58.329 | 60.692 |
| LT | 59.606 | 61.504 | 62.292 | 61.322 | 60.853 |
| LU | 57.458 | 57.564 | 58.135 | 58.395 | 58.555 |
| LV | 61.465 | 63.988 | 60.525 | 62.115 | 60.583 |
| MT | 58.220 | 58.863 | 59.415 | 58.018 | 59.479 |
| NL | 61.098 | 62.881 | 60.977 | 61.101 | 61.621 |
| NO | 63.049 | 62.164 | 62.786 | 62.795 | 63.114 |
| PL | 57.695 | 57.980 | 59.638 | 59.765 | 61.624 |
| PT | 61.869 | 62.587 | 63.103 | 60.698 | 61.997 |
| RO | 59.879 | 55.822 | 61.739 | 60.179 | 63.751 |
| SE | 61.908 | 63.446 | 63.468 | 63.135 | 64.277 |
| SI | 60.618 | 58.115 | 56.998 | 64.529 | 59.409 |
| SK | 59.274 | 59.633 | 60.019 | 60.310 | 61.129 |
| UK | 63.039 | 62.615 | 64.160 | 63.032 | 63.204 |
| EU27 | 60.481 | 60.526 | 61.651 | 60.623 | 61.884 |
| EU15 | 60.755 | 61.055 | 61.793 | 60.554 | 61.818 |
| NMS12 | 59.380 | 58.460 | 60.597 | 60.765 | 62.219 |
| EA13 | 60.288 | 60.622 | 61.211 | 59.990 | 61.323 |
| NON-EU | 64.466 | 57.496 | 63.002 | 62.623 | 63.033 |
| ALL | 60.588 | 60.455 | 61.699 | 60.683 | 61.932 |

**Table B 4** **Exit age – static indicator – males & females**

Adjusted activity rates

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| AT | 57.883 | 57.819 | 57.974 | 57.993 | 57.799 | 58.284 |
| BE | 57.479 | 57.513 | 57.453 | 57.705 | 57.642 | 58.078 |
| BG | 57.064 | 57.862 | 57.919 | 58.397 | 58.870 | 59.001 |
| CH | 61.635 | 62.150 | 61.931 | 62.288 | 62.102 | 62.705 |
| CY | 59.845 | 60.398 | 60.186 | 59.765 | 61.020 | 60.937 |
| CZ | 58.266 | 58.476 | 58.863 | 59.047 | 59.303 | 59.344 |
| DE | 59.752 | 59.833 | 59.947 | 60.184 | 60.283 | 60.756 |
| DK | 60.302 | 60.651 | 61.288 | 61.395 | 61.033 | 61.087 |
| EE | 60.466 | 59.991 | 60.901 | 60.826 | 61.389 | 60.596 |
| ES | 60.414 | 60.469 | 60.198 | 60.268 | 60.336 | 60.573 |
| FI | 59.559 | 60.010 | 60.044 | 60.083 | 60.225 | 60.674 |
| FR | 58.054 | 58.001 | 58.271 | 58.497 | 58.496 | 58.540 |
| GR | 60.438 | 60.456 | 60.691 | 60.738 | 60.253 | 60.579 |
| HR | | | 57.475 | 58.471 | 58.497 | 57.840 |
| HU | 57.120 | 57.301 | 57.488 | 57.912 | 58.497 | 58.560 |
| IE | 61.369 | 61.541 | 61.503 | 61.587 | 61.178 | 61.914 |
| IS | 63.597 | 63.241 | 62.586 | 63.583 | 63.891 | 64.620 |
| IT | 58.228 | 58.299 | 58.383 | 58.680 | 58.673 | 58.731 |
| LT | 58.598 | 59.109 | 59.067 | 60.166 | 59.611 | 60.521 |
| LU | 57.573 | 56.661 | 56.864 | 57.050 | 57.300 | 57.994 |
| LV | 59.214 | 59.818 | 60.272 | 59.913 | 60.644 | 60.796 |
| MT | 57.352 | 57.177 | 58.457 | 58.436 | 57.799 | 58.143 |
| NL | 58.972 | 59.286 | 59.639 | 59.577 | 59.865 | 60.209 |
| NO | 62.386 | 62.805 | 62.508 | 62.713 | 62.593 | 62.659 |
| PL | 58.366 | 58.054 | 58.038 | 57.881 | 57.610 | 57.749 |
| PT | 61.496 | 61.479 | 61.851 | 61.726 | 61.533 | 61.392 |
| RO | 61.921 | 61.674 | 59.747 | 60.297 | 59.827 | 60.118 |
| SE | 62.974 | 62.555 | 62.781 | 62.946 | 63.217 | 62.968 |
| SI | 56.870 | 57.311 | 57.049 | 56.703 | 57.736 | 57.742 |
| SK | 56.370 | 56.772 | 57.005 | 57.284 | 57.520 | 57.950 |
| UK | 61.168 | 61.406 | 61.376 | 61.691 | 61.621 | 61.769 |
| EU27 | 59.494 | 59.548 | 59.566 | 59.782 | 59.775 | 59.979 |
| EU15 | 59.612 | 59.689 | 59.792 | 60.015 | 60.008 | 60.248 |
| NMS12 | 59.015 | 58.985 | 58.639 | 58.807 | 58.784 | 58.934 |
| EA13 | 59.163 | 59.213 | 59.337 | 59.518 | 59.530 | 59.781 |
| NON-EU | 62.090 | 62.525 | 61.355 | 61.729 | 61.626 | 61.675 |
| ALL | 59.563 | 59.646 | 59.635 | 59.851 | 59.843 | 60.043 |

## Table B 5 Exit age – static indicator – females

Adjusted activity rates

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| AT | 56.624 | 56.116 | 56.666 | 56.644 | 56.332 | 56.957 |
| BE | 55.950 | 56.008 | 56.393 | 56.680 | 56.715 | 57.005 |
| BG | 55.490 | 56.238 | 56.502 | 57.184 | 57.506 | 57.448 |
| CH | 59.650 | 59.654 | 59.959 | 60.715 | 60.450 | 61.606 |
| CY | 58.256 | 56.921 | 56.657 | 56.034 | 57.546 | 58.664 |
| CZ | 56.572 | 56.932 | 57.145 | 57.402 | 57.705 | 57.851 |
| DE | 58.938 | 58.941 | 58.996 | 59.389 | 59.424 | 59.966 |
| DK | 58.756 | 59.589 | 60.032 | 60.581 | 60.004 | 60.111 |
| EE | 58.827 | 59.811 | 60.177 | 59.275 | 60.267 | 59.454 |
| ES | 58.544 | 58.689 | 58.254 | 58.312 | 58.473 | 58.891 |
| FI | 59.242 | 59.720 | 59.624 | 59.764 | 59.901 | 60.576 |
| FR | 58.028 | 57.771 | 57.953 | 58.374 | 58.264 | 58.534 |
| GR | 59.086 | 58.288 | 58.992 | 59.444 | 58.459 | 59.265 |
| HR | | | 55.368 | 56.962 | 57.327 | 56.077 |
| HU | 55.852 | 56.005 | 56.335 | 56.829 | 57.558 | 57.504 |
| IE | 59.385 | 59.296 | 59.149 | 59.745 | 59.433 | 60.085 |
| IS | 61.875 | 60.877 | 61.011 | 62.016 | 62.147 | 62.713 |
| IT | 56.868 | 57.088 | 57.246 | 57.519 | 57.633 | 57.711 |
| LT | 57.631 | 57.468 | 58.066 | 59.051 | 58.429 | 59.353 |
| LU | 55.296 | 55.136 | 55.932 | 56.609 | 56.883 | 56.578 |
| LV | 57.285 | 58.522 | 59.214 | 58.861 | 59.896 | 59.794 |
| MT | 54.810 | 54.016 | 55.354 | 56.180 | 54.428 | 55.422 |
| NL | 57.622 | 58.269 | 58.350 | 58.202 | 58.490 | 58.967 |
| NO | 61.117 | 61.898 | 62.068 | 61.749 | 62.116 | 62.359 |
| PL | 56.947 | 56.910 | 56.699 | 56.547 | 56.282 | 56.288 |
| PT | 60.203 | 60.316 | 60.477 | 60.833 | 60.659 | 60.372 |
| RO | 61.395 | 60.480 | 58.987 | 59.560 | 59.019 | 59.543 |
| SE | 62.233 | 61.790 | 62.169 | 62.277 | 62.699 | 62.540 |
| SI | 54.629 | 55.504 | 55.427 | 55.143 | 55.928 | 56.216 |
| SK | 54.613 | 55.033 | 55.170 | 55.222 | 55.655 | 56.182 |
| UK | 60.097 | 60.177 | 60.301 | 60.556 | 60.470 | 60.628 |
| EU27 | 58.472 | 58.527 | 58.521 | 58.786 | 58.784 | 59.074 |
| EU15 | 58.730 | 58.755 | 58.826 | 59.144 | 59.128 | 59.488 |
| NMS12 | 57.721 | 57.760 | 57.456 | 57.604 | 57.602 | 57.679 |
| EA13 | 58.232 | 58.245 | 58.297 | 58.594 | 58.626 | 59.031 |
| NON-EU | 60.591 | 60.574 | 60.061 | 60.777 | 60.979 | 60.481 |
| ALL | 58.539 | 58.624 | 58.573 | 58.866 | 58.863 | 59.132 |

## Table B 6 Exit age – static indicator – males

Adjusted activity rates

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| AT | 58.804 | 58.971 | 59.087 | 58.976 | 58.976 | 59.242 |
| BE | 58.421 | 58.511 | 58.147 | 58.575 | 58.321 | 58.937 |
| BG | 58.856 | 59.531 | 59.489 | 59.607 | 60.417 | 60.786 |
| CH | 61.968 | 63.051 | 63.087 | 63.253 | 63.062 | 62.921 |
| CY | 61.329 | 61.352 | 61.174 | 61.621 | 61.825 | 62.552 |
| CZ | 59.998 | 59.950 | 60.342 | 60.635 | 60.894 | 60.802 |
| DE | 60.392 | 60.519 | 60.660 | 60.828 | 61.040 | 61.397 |
| DK | 61.408 | 61.453 | 61.878 | 61.241 | 61.704 | 61.448 |
| EE | 61.632 | 59.352 | 60.879 | 59.502 | 61.379 | 60.470 |
| ES | 61.254 | 61.542 | 61.470 | 61.424 | 61.626 | 61.706 |
| FI | 59.840 | 60.166 | 60.402 | 60.257 | 60.535 | 60.490 |
| FR | 58.061 | 58.109 | 58.443 | 58.614 | 58.548 | 58.522 |
| GR | 61.174 | 61.342 | 61.356 | 61.419 | 61.211 | 61.444 |
| HR | | | 58.751 | 58.883 | 59.192 | 59.315 |
| HU | 58.459 | 58.805 | 58.720 | 58.981 | 59.249 | 59.670 |
| IE | 62.513 | 62.826 | 62.853 | 62.786 | 62.351 | 62.613 |
| IS | 64.600 | 63.525 | 62.878 | 64.030 | 64.076 | 63.951 |
| IT | 59.177 | 59.177 | 59.180 | 59.461 | 59.358 | 59.481 |
| LT | 59.100 | 59.480 | 59.688 | 61.422 | 60.323 | 61.104 |
| LU | 58.175 | 57.267 | 57.357 | 57.555 | 57.507 | 58.012 |
| LV | 60.839 | 60.658 | 60.792 | 60.418 | 60.613 | 59.773 |
| MT | 59.498 | 58.797 | 59.452 | 59.162 | 58.726 | 58.747 |
| NL | 59.852 | 60.057 | 60.548 | 60.525 | 60.928 | 60.960 |
| NO | 62.954 | 62.586 | 62.673 | 62.758 | 62.535 | 62.727 |
| PL | 59.712 | 59.310 | 59.403 | 59.203 | 58.925 | 59.120 |
| PT | 62.565 | 62.542 | 62.702 | 62.206 | 62.130 | 62.121 |
| RO | 62.247 | 62.201 | 60.020 | 60.519 | 60.375 | 60.729 |
| SE | 63.159 | 62.799 | 63.103 | 63.138 | 63.361 | 63.089 |
| SI | 58.549 | 58.655 | 58.411 | 58.172 | 58.925 | 58.946 |
| SK | 58.249 | 58.642 | 58.926 | 59.452 | 59.480 | 59.904 |
| UK | 62.129 | 62.442 | 62.362 | 62.601 | 62.704 | 62.623 |
| EU27 | 60.368 | 60.460 | 60.483 | 60.666 | 60.657 | 60.834 |
| EU15 | 60.321 | 60.449 | 60.558 | 60.725 | 60.740 | 60.923 |
| NMS12 | 60.419 | 60.317 | 59.925 | 60.122 | 60.075 | 60.289 |
| EA13 | 59.886 | 59.991 | 60.117 | 60.275 | 60.259 | 60.435 |
| NON-EU | 62.828 | 62.976 | 62.242 | 62.400 | 62.326 | 62.658 |
| ALL | 60.443 | 60.530 | 60.539 | 60.723 | 60.729 | 60.884 |

Table B 7 Exit age – working life indicator – males & females
WHO life tables, adjusted activity rates

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| AT | 58.168 | 58.325 | 58.371 | 58.505 | 58.237 | 58.624 |
| BE | 57.797 | 57.628 | 57.779 | 57.866 | 58.105 | 58.357 |
| BG | 57.366 | 57.920 | 58.099 | 58.398 | 58.694 | 58.838 |
| CY | 60.957 | 61.177 | 61.245 | 61.416 | 61.648 | 61.398 |
| CZ | 59.025 | 59.129 | 59.439 | 59.633 | 59.695 | 59.834 |
| DE | 59.663 | 59.819 | 59.996 | 60.218 | 60.425 | 60.771 |
| DK | 61.259 | 61.426 | 61.371 | 61.515 | 61.766 | 61.654 |
| EE | 61.040 | 61.234 | 61.452 | 61.582 | 61.679 | 62.034 |
| ES | 59.708 | 59.809 | 59.853 | 59.987 | 60.060 | 60.232 |
| FI | 59.862 | 60.153 | 60.272 | 60.380 | 60.524 | 60.812 |
| FR | 58.238 | 58.235 | 58.410 | 58.684 | 58.703 | 58.744 |
| GR | 60.213 | 60.108 | 60.199 | 60.351 | 60.079 | 60.300 |
| HU | 56.933 | 57.048 | 57.302 | 57.732 | 58.109 | 58.277 |
| IE | 60.614 | 60.743 | 60.909 | 61.033 | 61.135 | 61.419 |
| IT | 58.421 | 58.521 | 58.614 | 58.772 | 58.722 | 58.778 |
| LT | 60.134 | 59.847 | 60.108 | 60.504 | 60.604 | 60.684 |
| LU | 57.877 | 57.081 | 57.941 | 57.986 | 58.019 | 58.106 |
| LV | 59.729 | 59.993 | 60.393 | 60.586 | 61.022 | 61.260 |
| MT | 57.892 | 57.858 | 57.827 | 57.970 | 57.695 | 57.723 |
| NL | 59.003 | 59.249 | 59.599 | 59.788 | 59.924 | 60.095 |
| PL | 58.853 | 58.651 | 58.361 | 58.402 | 58.342 | 58.403 |
| PT | 61.816 | 61.808 | 61.830 | 61.829 | 61.782 | 61.834 |
| RO | 61.854 | 61.745 | 60.118 | 60.174 | 59.929 | 60.123 |
| SE | 62.868 | 62.568 | 62.741 | 62.862 | 63.024 | 63.091 |
| SI | 57.914 | 58.302 | 57.915 | 57.723 | 58.570 | 58.562 |
| SK | 57.121 | 57.318 | 57.517 | 57.715 | 58.016 | 58.387 |
| UK | 61.097 | 61.190 | 61.287 | 61.506 | 61.571 | 61.684 |
| CH | 62.335 | 62.663 | 62.394 | 62.582 | 62.544 | 62.569 |
| HR | | | 58.046 | 58.668 | 58.828 | 58.962 |
| IS | 65.893 | 65.975 | 66.043 | 65.594 | 65.333 | 65.627 |
| NO | 62.451 | 62.695 | 62.654 | 62.731 | 62.769 | 62.760 |
| EU27 | 59.662 | 59.711 | 59.721 | 59.895 | 59.960 | 60.112 |
| EA13 | 59.202 | 59.294 | 59.430 | 59.609 | 59.689 | 59.875 |
| NMS12 | 59.457 | 59.405 | 58.932 | 59.067 | 59.090 | 59.217 |
| EU15 | 59.717 | 59.792 | 59.919 | 60.100 | 60.177 | 60.338 |
| NON-EU | 62.463 | 62.755 | 61.793 | 61.941 | 61.914 | 61.932 |
| ALL | 59.752 | 59.811 | 59.802 | 59.977 | 60.038 | 60.185 |

## Table B 8 Exit age – working life indicator – females

WHO life tables, adjusted activity rates

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| AT | 56.727 | 56.911 | 57.105 | 57.214 | 56.932 | 57.420 |
| BE | 56.389 | 56.066 | 56.356 | 56.440 | 56.839 | 57.008 |
| BG | 55.858 | 56.563 | 56.852 | 57.175 | 57.488 | 57.546 |
| CY | 59.112 | 59.158 | 58.971 | 59.157 | 59.359 | 59.015 |
| CZ | 57.617 | 57.773 | 57.963 | 58.248 | 58.400 | 58.470 |
| DE | 58.558 | 58.758 | 58.944 | 59.183 | 59.389 | 59.800 |
| DK | 60.130 | 60.389 | 60.232 | 60.536 | 60.751 | 60.800 |
| EE | 60.177 | 60.642 | 61.040 | 60.818 | 61.564 | 61.914 |
| ES | 57.815 | 57.830 | 57.838 | 57.965 | 58.132 | 58.384 |
| FI | 59.623 | 59.951 | 60.123 | 60.151 | 60.378 | 60.714 |
| FR | 57.868 | 57.822 | 57.996 | 58.247 | 58.327 | 58.459 |
| GR | 58.494 | 58.320 | 58.464 | 58.573 | 58.208 | 58.524 |
| HU | 55.811 | 55.968 | 56.337 | 56.930 | 57.397 | 57.533 |
| IE | 58.285 | 58.480 | 58.766 | 59.048 | 59.139 | 59.528 |
| IT | 56.403 | 56.551 | 56.692 | 56.925 | 56.965 | 57.028 |
| LT | 59.261 | 58.927 | 59.112 | 59.837 | 59.849 | 59.974 |
| LU | 56.689 | 55.743 | 57.022 | 56.932 | 57.111 | 57.238 |
| LV | 58.782 | 59.357 | 59.674 | 60.042 | 60.498 | 60.855 |
| MT | 54.966 | 55.384 | 55.005 | 55.919 | 55.355 | 55.337 |
| NL | 57.522 | 57.844 | 58.108 | 58.281 | 58.490 | 58.721 |
| PL | 57.868 | 57.640 | 57.333 | 57.414 | 57.340 | 57.321 |
| PT | 60.718 | 60.760 | 60.934 | 60.807 | 60.860 | 61.008 |
| RO | 61.531 | 61.458 | 59.830 | 59.894 | 59.570 | 59.647 |
| SE | 62.387 | 62.170 | 62.314 | 62.488 | 62.651 | 62.659 |
| SI | 56.426 | 57.113 | 56.613 | 56.485 | 57.248 | 57.251 |
| SK | 55.428 | 55.639 | 55.687 | 55.944 | 56.276 | 56.743 |
| UK | 59.884 | 59.970 | 60.119 | 60.261 | 60.308 | 60.532 |
| CH | 60.798 | 61.225 | 60.959 | 61.225 | 61.168 | 61.414 |
| HR | | | 56.854 | 57.778 | 57.712 | 58.107 |
| IS | 65.052 | 65.253 | 65.717 | 65.068 | 64.639 | 64.945 |
| NO | 61.823 | 62.188 | 62.230 | 62.218 | 62.273 | 62.239 |
| EU27 | 58.617 | 58.668 | 58.661 | 58.835 | 58.920 | 59.111 |
| EA13 | 58.024 | 58.123 | 58.279 | 58.456 | 58.578 | 58.829 |
| NMS12 | 58.598 | 58.561 | 58.007 | 58.200 | 58.227 | 58.296 |
| EU15 | 58.623 | 58.699 | 58.842 | 59.008 | 59.105 | 59.328 |
| NON-EU | 61.285 | 61.677 | 60.793 | 61.012 | 60.914 | 61.071 |
| ALL | 58.709 | 58.774 | 58.750 | 58.926 | 59.002 | 59.191 |

Table B 9 Exit age – working life indicator – males
WHO life tables, adjusted activity rates

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|
| AT | 59.484 | 59.593 | 59.558 | 59.722 | 59.417 | 59.714 |
| BE | 59.058 | 58.956 | 59.018 | 59.103 | 59.230 | 59.555 |
| BG | 58.784 | 59.151 | 59.275 | 59.573 | 59.877 | 60.114 |
| CY | 62.713 | 62.941 | 63.185 | 63.401 | 63.788 | 63.502 |
| CZ | 60.361 | 60.434 | 60.840 | 60.968 | 60.946 | 61.129 |
| DE | 60.665 | 60.787 | 60.955 | 61.168 | 61.379 | 61.683 |
| DK | 62.216 | 62.320 | 62.229 | 62.392 | 62.703 | 62.456 |
| EE | 62.020 | 61.861 | 61.967 | 62.270 | 61.837 | 62.216 |
| ES | 61.552 | 61.674 | 61.723 | 61.850 | 61.836 | 61.937 |
| FI | 60.106 | 60.347 | 60.421 | 60.625 | 60.676 | 60.911 |
| FR | 58.624 | 58.657 | 58.831 | 59.126 | 59.080 | 59.042 |
| GR | 61.991 | 61.926 | 61.941 | 62.112 | 61.896 | 62.068 |
| HU | 58.009 | 58.116 | 58.292 | 58.569 | 58.864 | 59.055 |
| IE | 62.553 | 62.642 | 62.722 | 62.732 | 62.834 | 63.031 |
| IT | 60.164 | 60.229 | 60.292 | 60.409 | 60.286 | 60.346 |
| LT | 61.122 | 60.876 | 61.143 | 61.395 | 61.506 | 61.534 |
| LU | 59.052 | 58.235 | 59.080 | 59.045 | 59.000 | 58.940 |
| LV | 60.848 | 60.732 | 61.172 | 61.218 | 61.628 | 61.715 |
| MT | 60.321 | 60.182 | 60.182 | 60.018 | 59.853 | 59.923 |
| NL | 60.322 | 60.512 | 60.928 | 61.127 | 61.188 | 61.318 |
| PL | 59.826 | 59.652 | 59.384 | 59.387 | 59.336 | 59.460 |
| PT | 63.002 | 62.950 | 62.814 | 62.924 | 62.747 | 62.698 |
| RO | 62.248 | 62.110 | 60.480 | 60.519 | 60.362 | 60.669 |
| SE | 63.335 | 62.952 | 63.152 | 63.226 | 63.383 | 63.501 |
| SI | 59.161 | 59.364 | 59.070 | 58.825 | 59.729 | 59.713 |
| SK | 58.698 | 58.928 | 59.238 | 59.394 | 59.693 | 60.020 |
| UK | 62.222 | 62.321 | 62.385 | 62.667 | 62.755 | 62.779 |
| CH | 63.869 | 64.057 | 63.770 | 63.902 | 63.920 | 63.699 |
| HR | | | 59.157 | 59.631 | 59.964 | 59.928 |
| IS | 66.787 | 66.626 | 66.454 | 66.088 | 66.150 | 66.273 |
| NO | 63.078 | 63.178 | 63.063 | 63.148 | 63.254 | 63.260 |
| EU27 | 60.749 | 60.790 | 60.803 | 60.975 | 61.013 | 61.136 |
| EA13 | 60.411 | 60.488 | 60.601 | 60.776 | 60.805 | 60.947 |
| NMS12 | 60.360 | 60.294 | 59.887 | 59.973 | 59.999 | 60.178 |
| EU15 | 60.845 | 60.910 | 61.015 | 61.207 | 61.252 | 61.367 |
| NON-EU | 63.662 | 63.813 | 62.775 | 62.866 | 62.950 | 62.817 |
| ALL | 60.838 | 60.884 | 60.877 | 61.049 | 61.089 | 61.202 |

# Annex C: “Irregular” probabilities to stay

## Table C 1 $P^s > 1$ by country and year (dynamic approach)

Males + females, all ages

| Country | Number of observations ($p^s > 1$) 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Sum | Mean deviation* |
|---|---|---|---|---|---|---|---|---|
| **EU countries** | | | | | | | | |
| MT | | 9 | 8 | 7 | 6 | 9 | 39 | 2,395 |
| LV | | 3 | 12 | 4 | 8 | 8 | 35 | 2,338 |
| CY | | 7 | 7 | 9 | 6 | 5 | 34 | 2,714 |
| LU | | 0 | 12 | 6 | 6 | 4 | 28 | 2,73 |
| DK | | 4 | 5 | 6 | 7 | 5 | 27 | 1,802 |
| EE | | 5 | 5 | 4 | 6 | 7 | 27 | 2,594 |
| NL | | 6 | 6 | 6 | 4 | 3 | 25 | 0,935 |
| BG | | 11 | 2 | 6 | 3 | 1 | 23 | 0,79 |
| SI | | 6 | 1 | 0 | 13 | 3 | 23 | 2,043 |
| LT | | 0 | 4 | 8 | 5 | 4 | 21 | 1,289 |
| BE | | 2 | 1 | 6 | 5 | 6 | 20 | 0,72 |
| AT | | 6 | 2 | 3 | 0 | 8 | 19 | 0,854 |
| SK | | 2 | 1 | 7 | 4 | 5 | 19 | 0,532 |
| PT | | 7 | 4 | 2 | 2 | 3 | 18 | 1,102 |
| SE | | 2 | 1 | 2 | 1 | 10 | 16 | 1,135 |
| FR | | 0 | 1 | 4 | 5 | 4 | 14 | 0,334 |
| HU | | 0 | 4 | 6 | 4 | 0 | 14 | 0,405 |
| IE | | 1 | 2 | 3 | 5 | 3 | 14 | 0,846 |
| FI | | 5 | 1 | 3 | 0 | 3 | 12 | 0,766 |
| CZ | | 1 | 3 | 3 | 0 | 4 | 11 | 0,552 |
| DE | | 3 | 1 | 1 | 1 | 5 | 11 | 0,199 |
| GR | | 1 | 1 | 5 | 2 | 1 | 10 | 0,623 |
| ES | | 0 | 2 | 2 | 2 | 1 | 7 | 0,244 |
| UK | | 1 | 3 | 0 | 2 | 1 | 7 | 0,596 |
| PL | | 1 | 0 | 0 | 0 | 3 | 4 | 0,237 |
| RO | | 1 | 0 | 1 | 0 | 2 | 4 | 1,878 |
| IT | | 0 | 0 | 1 | 0 | 0 | 1 | 0,07 |
| **NON-EU countries** | | | | | | | | |
| IS | | 7 | 11 | 5 | 7 | 8 | 38 | 3,397 |
| HR | | 0 | 0 | 10 | 5 | 5 | 20 | 2,004 |
| CH | | 7 | 4 | 4 | 2 | 2 | 19 | 1,331 |
| NO | | 5 | 3 | 2 | 0 | 4 | 14 | 0,85 |
| **EU aggregates** | | | | | | | | |
| EU27 | | 0 | 0 | 0 | 0 | 0 | 0 | |
| EU15 | | 0 | 0 | 0 | 0 | 0 | 0 | |
| NMS12 | | 0 | 0 | 0 | 0 | 0 | 0 | |
| EA13 | | 0 | 0 | 0 | 0 | 0 | 0 | |
| NON-EU | | 4 | 1 | 1 | 1 | 2 | 9 | 0,789 |

* $1/n \sum (r_{a,y} - r_{a-1,y-1})$ *for all observations* $p^s > 1$

**Table C 2** $P^s > 1$ by country and year (static approach)
Males + females, all ages

| Country | Number of observations ($p^s > 1$) 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | Sum | Mean deviation* |
|---|---|---|---|---|---|---|---|---|
| **EU countries** | | | | | | | | |
| MT | 9 | 11 | 8 | 7 | 10 | 7 | 52 | 2,695 |
| CY | 7 | 7 | 6 | 7 | 6 | 4 | 37 | 3,769 |
| LT | 7 | 6 | 6 | 5 | 3 | 7 | 34 | 2,599 |
| EE | 6 | 5 | 3 | 6 | 5 | 7 | 32 | 3,308 |
| LV | 5 | 3 | 5 | 6 | 4 | 7 | 30 | 1,994 |
| DK | 6 | 4 | 3 | 6 | 3 | 6 | 28 | 1,862 |
| LU | 4 | 3 | 5 | 4 | 6 | 2 | 24 | 2,315 |
| SI | 5 | 3 | 5 | 3 | 4 | 4 | 24 | 1,501 |
| RO | 2 | 2 | 3 | 3 | 2 | 4 | 16 | 1,363 |
| SE | 4 | 2 | 2 | 2 | 4 | 2 | 16 | 1,287 |
| FI | 4 | 2 | 2 | 3 | 3 | 1 | 15 | 0,699 |
| SK | 4 | 1 | 4 | 2 | 3 | 1 | 15 | 0,491 |
| AT | 2 | 4 | 2 | 2 | 1 | 3 | 14 | 0,934 |
| BE | 2 | 3 | 3 | 2 | 4 | 0 | 14 | 0,461 |
| PT | 1 | 2 | 2 | 3 | 2 | 4 | 14 | 0,939 |
| FR | 1 | 2 | 2 | 3 | 1 | 4 | 13 | 0,309 |
| NL | 3 | 3 | 3 | 1 | 1 | 1 | 12 | 0,730 |
| BG | 1 | 2 | 2 | 3 | 2 | 1 | 11 | 0,468 |
| CZ | 1 | 0 | 3 | 4 | 1 | 2 | 11 | 0,533 |
| PL | 2 | 2 | 2 | 2 | 0 | 1 | 9 | 0,771 |
| IE | 2 | 2 | 1 | 0 | 1 | 0 | 6 | 0,655 |
| GR | 1 | 2 | 0 | 0 | 0 | 2 | 5 | 0,842 |
| HU | 0 | 1 | 2 | 2 | 0 | 0 | 5 | 0,320 |
| UK | 0 | 2 | 0 | 1 | 0 | 1 | 4 | 0,160 |
| DE | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0,140 |
| ES | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0,020 |
| IT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| **NON-EU countries** | | | | | | | | |
| IS | 10 | 10 | 10 | 8 | 8 | 7 | 53 | 4,170 |
| CH | 5 | 6 | 3 | 5 | 4 | 2 | 25 | 1,669 |
| NO | 3 | 4 | 2 | 3 | 3 | 5 | 20 | 1,147 |
| HR | 0 | 0 | 3 | 3 | 2 | 4 | 12 | 1,793 |
| **EU aggregates** | | | | | | | | |
| EU27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| EU15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| NMS12 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0,4 |
| EA13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| NON-EU | 3 | 5 | 0 | 0 | 3 | 2 | 13 | 1 |

* $1/n \sum (r_{a,y} - r_{a-1,y})$ *for all observations* $p^s > 1$

## Table C 3 $P^s > 1$ by gender, age and country groups (dynamic approach)

Number of observations 2001-2005

| | Countries of ... | | | | | |
|---|---|---|---|---|---|---|
| Gender / Age | EU27 | EA13 | NMS12 | EU15 | NON-EU | ALL |
| All | | | | | | |
| 49 | 33 | 16 | 12 | 21 | 7 | 40 |
| 50 | 37 | 19 | 13 | 24 | 4 | 41 |
| 51 | 22 | 12 | 7 | 15 | 8 | 30 |
| 52 | 23 | 12 | 12 | 11 | 4 | 27 |
| 53 | 26 | 13 | 9 | 17 | 8 | 34 |
| 54 | 12 | 1 | 6 | 6 | 8 | 20 |
| 55 | 17 | 3 | 9 | 8 | 4 | 21 |
| 56 | 9 | 5 | 4 | 5 | 3 | 12 |
| 57 | 10 | 1 | 7 | 3 | 5 | 15 |
| 58 | 11 | 4 | 8 | 3 | 3 | 14 |
| 59 | 1 | | 1 | | 2 | 3 |
| 60 | 10 | 3 | 8 | 2 | 4 | 14 |
| 61 | 9 | 6 | 5 | 4 | 2 | 11 |
| 62 | 20 | 4 | 18 | 2 | 3 | 23 |
| 63 | 27 | 10 | 19 | 8 | 4 | 31 |
| 64 | 15 | 4 | 12 | 3 | 1 | 16 |
| 65 | 29 | 12 | 16 | 13 | 3 | 32 |
| 66 | 29 | 10 | 17 | 12 | 4 | 33 |
| 67 | 37 | 17 | 18 | 19 | 2 | 39 |
| 68 | 36 | 19 | 16 | 20 | 4 | 40 |
| 69 | 25 | 10 | 15 | 10 | 2 | 27 |
| 70 | 45 | 21 | 22 | 23 | 6 | 51 |
| Total | 483 | 202 | 254 | 229 | 91 | 574 |
| Female | | | | | | |
| 49 | 38 | 18 | 14 | 24 | 8 | 46 |
| 50 | 48 | 28 | 15 | 33 | 8 | 56 |
| 51 | 43 | 22 | 18 | 25 | 8 | 51 |
| 52 | 34 | 16 | 13 | 21 | 4 | 38 |
| 53 | 34 | 22 | 10 | 24 | 5 | 39 |
| 54 | 22 | 4 | 13 | 9 | 8 | 30 |
| 55 | 27 | 9 | 13 | 14 | 6 | 33 |
| 56 | 19 | 16 | 4 | 15 | 3 | 22 |
| 57 | 22 | 12 | 9 | 13 | 9 | 31 |
| 58 | 23 | 11 | 13 | 10 | 5 | 28 |
| 59 | 12 | 4 | 8 | 4 | 3 | 15 |
| 60 | 18 | 6 | 14 | 4 | 4 | 22 |
| 61 | 24 | 10 | 16 | 8 | 3 | 27 |
| 62 | 32 | 10 | 24 | 8 | 5 | 37 |
| 63 | 27 | 13 | 17 | 10 | 5 | 32 |
| 64 | 19 | 5 | 15 | 4 | 4 | 23 |
| 65 | 28 | 9 | 16 | 12 | 1 | 29 |
| 66 | 30 | 13 | 15 | 15 | 3 | 33 |
| 67 | 44 | 24 | 19 | 25 | 4 | 48 |
| 68 | 43 | 25 | 14 | 29 | 9 | 52 |
| 69 | 36 | 20 | 18 | 18 | 5 | 41 |
| 70 | 42 | 27 | 17 | 25 | 5 | 47 |
| Total | 665 | 324 | 315 | 350 | 115 | 780 |

Table C3

| Male | EU27 | EA13 | NMS12 | EU15 | NON-EU | ALL |
|---|---|---|---|---|---|---|
| 49 | 52 | 25 | 22 | 30 | 9 | 61 |
| 50 | 30 | 8 | 20 | 10 | 5 | 35 |
| 51 | 26 | 12 | 11 | 15 | 7 | 33 |
| 52 | 34 | 13 | 19 | 15 | 7 | 41 |
| 53 | 35 | 11 | 19 | 16 | 7 | 42 |
| 54 | 8 | 2 | 2 | 6 | 7 | 15 |
| 55 | 27 | 1 | 19 | 8 | 4 | 31 |
| 56 | 8 | 2 | 5 | 3 | 5 | 13 |
| 57 | 14 | 1 | 10 | 4 | 6 | 20 |
| 58 | 13 | 5 | 8 | 5 | 2 | 15 |
| 59 | 5 | 1 | 5 | | 4 | 9 |
| 60 | 10 | 3 | 7 | 3 | 4 | 14 |
| 61 | 10 | 4 | 8 | 2 | 1 | 11 |
| 62 | 19 | 5 | 15 | 4 | 1 | 20 |
| 63 | 30 | 9 | 21 | 9 | 5 | 35 |
| 64 | 18 | 2 | 16 | 2 | 2 | 20 |
| 65 | 34 | 15 | 19 | 15 | 3 | 37 |
| 66 | 35 | 19 | 12 | 23 | 6 | 41 |
| 67 | 38 | 20 | 17 | 21 | 2 | 40 |
| 68 | 45 | 22 | 19 | 26 | 3 | 48 |
| 69 | 36 | 13 | 22 | 14 | 3 | 39 |
| 70 | 47 | 24 | 19 | 28 | 8 | 55 |
| Total | 574 | 217 | 315 | 259 | 101 | 675 |

Table C 4 $P^s > 1$ by gender, age and country groups (static approach)
Number of observations 2000-2005

| | Countries of ... | | | | | |
|---|---|---|---|---|---|---|
| Gender / Age | EU27 | EA13 | NMS12 | EU15 | NON-EU | ALL |
| All | | | | | | |
| 49 | 31 | 7 | 17 | 14 | 9 | 40 |
| 50 | 35 | 10 | 20 | 15 | 7 | 42 |
| 51 | 10 | 5 | 4 | 6 | 9 | 19 |
| 52 | 19 | 4 | 11 | 8 | 5 | 24 |
| 53 | 17 | 4 | 9 | 8 | 6 | 23 |
| 54 | 13 | 1 | 8 | 5 | 8 | 21 |
| 55 | 14 | 3 | 9 | 5 | 5 | 19 |
| 56 | 3 | | 2 | 1 | 1 | 4 |
| 57 | 10 | | 9 | 1 | 8 | 18 |
| 58 | 11 | 1 | 9 | 2 | 6 | 17 |
| 59 | 4 | 1 | 3 | 1 | 2 | 6 |
| 60 | 7 | 1 | 6 | 1 | 4 | 11 |
| 61 | 12 | 7 | 8 | 4 | 2 | 14 |
| 62 | 16 | 3 | 14 | 2 | 2 | 18 |
| 63 | 24 | 8 | 18 | 6 | 5 | 29 |
| 64 | 15 | 3 | 12 | 3 | 2 | 17 |
| 65 | 25 | 10 | 16 | 9 | 2 | 27 |
| 66 | 33 | 11 | 20 | 13 | 4 | 37 |
| 67 | 36 | 16 | 21 | 15 | 3 | 39 |
| 68 | 38 | 19 | 19 | 19 | 7 | 45 |
| 69 | 22 | 9 | 16 | 6 | 4 | 26 |
| 70 | 49 | 21 | 25 | 24 | 9 | 58 |
| Total | 444 | 144 | 276 | 168 | 110 | 554 |
| Female | | | | | | |
| 49 | 35 | 12 | 19 | 16 | 10 | 45 |
| 50 | 31 | 10 | 13 | 18 | 9 | 40 |
| 51 | 34 | 9 | 19 | 15 | 7 | 41 |
| 52 | 24 | 9 | 10 | 14 | 6 | 30 |
| 53 | 23 | 7 | 13 | 10 | 6 | 29 |
| 54 | 24 | 4 | 13 | 11 | 8 | 32 |
| 55 | 22 | 6 | 12 | 10 | 7 | 29 |
| 56 | 17 | 10 | 5 | 12 | 1 | 18 |
| 57 | 15 | 6 | 8 | 7 | 10 | 25 |
| 58 | 25 | 8 | 18 | 7 | 7 | 32 |
| 59 | 14 | 3 | 12 | 2 | 3 | 17 |
| 60 | 19 | 7 | 14 | 5 | 5 | 24 |
| 61 | 24 | 12 | 16 | 8 | 4 | 28 |
| 62 | 38 | 15 | 26 | 12 | 5 | 43 |
| 63 | 30 | 12 | 20 | 10 | 6 | 36 |
| 64 | 24 | 7 | 17 | 7 | 3 | 27 |
| 65 | 32 | 11 | 20 | 12 | 4 | 36 |
| 66 | 39 | 16 | 22 | 17 | 4 | 43 |
| 67 | 44 | 18 | 25 | 19 | 5 | 49 |
| 68 | 48 | 23 | 22 | 26 | 9 | 57 |
| 69 | 46 | 25 | 23 | 23 | 8 | 54 |
| 70 | 47 | 25 | 23 | 24 | 9 | 56 |
| Total | 655 | 255 | 370 | 285 | 136 | 791 |

Table D4

| Male | EU27 | EA13 | NMS12 | EU15 | NON-EU | ALL |
|---|---|---|---|---|---|---|
| 49 | 54 | 21 | 26 | 28 | 12 | 66 |
| 50 | 39 | 11 | 22 | 17 | 7 | 46 |
| 51 | 27 | 11 | 15 | 12 | 12 | 39 |
| 52 | 32 | 11 | 18 | 14 | 7 | 39 |
| 53 | 38 | 9 | 27 | 11 | 9 | 47 |
| 54 | 16 | 3 | 8 | 8 | 9 | 25 |
| 55 | 22 | 2 | 17 | 5 | 8 | 30 |
| 56 | 12 | 1 | 8 | 4 | 5 | 17 |
| 57 | 19 | 3 | 14 | 5 | 8 | 27 |
| 58 | 17 | 4 | 10 | 7 | 5 | 22 |
| 59 | 6 | | 6 | | 3 | 9 |
| 60 | 10 | 1 | 9 | 1 | 6 | 16 |
| 61 | 11 | 6 | 7 | 4 | 5 | 16 |
| 62 | 18 | 6 | 13 | 5 | 7 | 25 |
| 63 | 34 | 15 | 22 | 12 | 6 | 40 |
| 64 | 18 | 1 | 17 | 1 | 5 | 23 |
| 65 | 38 | 15 | 25 | 13 | 4 | 42 |
| 66 | 39 | 19 | 17 | 22 | 5 | 44 |
| 67 | 42 | 18 | 24 | 18 | 4 | 46 |
| 68 | 52 | 25 | 24 | 28 | 6 | 58 |
| 69 | 37 | 14 | 23 | 14 | 6 | 43 |
| 70 | 52 | 26 | 21 | 31 | 9 | 61 |
| Total | 633 | 222 | 373 | 260 | 148 | 781 |

## Annex D: Data provisions and programming code

The report contains a CD-ROM which includes the data used for the calculations in EXCEL files. Starting from the raw data delivered by EUROSTAT, the following data types were created:

Table D 1 Data provisions

| Type | Files | Content |
|---|---|---|
| Raw data | EXITAGE_RAWDATA.XLS | Raw data provided by Eurostat |
| Country workbooks | CWB*.XLS | Workbook with country sheets;<br>Country sheets contain<br>• time series for gender groups and ages;<br>• averages<br>• standard deviation<br>• coefficient of variation<br>• count of zero values<br>• count of extreme values in time series<br>for rates - count of irregular rate (Ps > 1):<br>• static approach<br>• dynamic approach<br>EU aggregates are included:<br>• aggregates included in raw data<br>• aggregates created through sums or weighted averages |
| Gender workbooks | GWB*.XLS | Workbook with gender sheets;<br>Gender sheets contain time series for countries and EU aggregates; |
| Exit age workbooks | ExitAge*.XLS | Workbooks with calculation results for different types of exit age indicators;<br>Workbooks are organised as gender workbooks; |
| Miscellaneous Workbooks and files | WHO-ERC life tables 2000-2005.XLS | Country workbook with survival functions (life tables) calculated form WHO data |
| | EU COUNTRY GROUPS.XLS | Definition of EU aggregates |
| | EXITAGE_RAWDATA.TAB | Structure of raw data file |
| Program | Exitage_Program.TXT | Extract from C++ Program which calculated exit age data. |

The raw data provided by EUROSTAT was organised in country workbooks for each indicator:

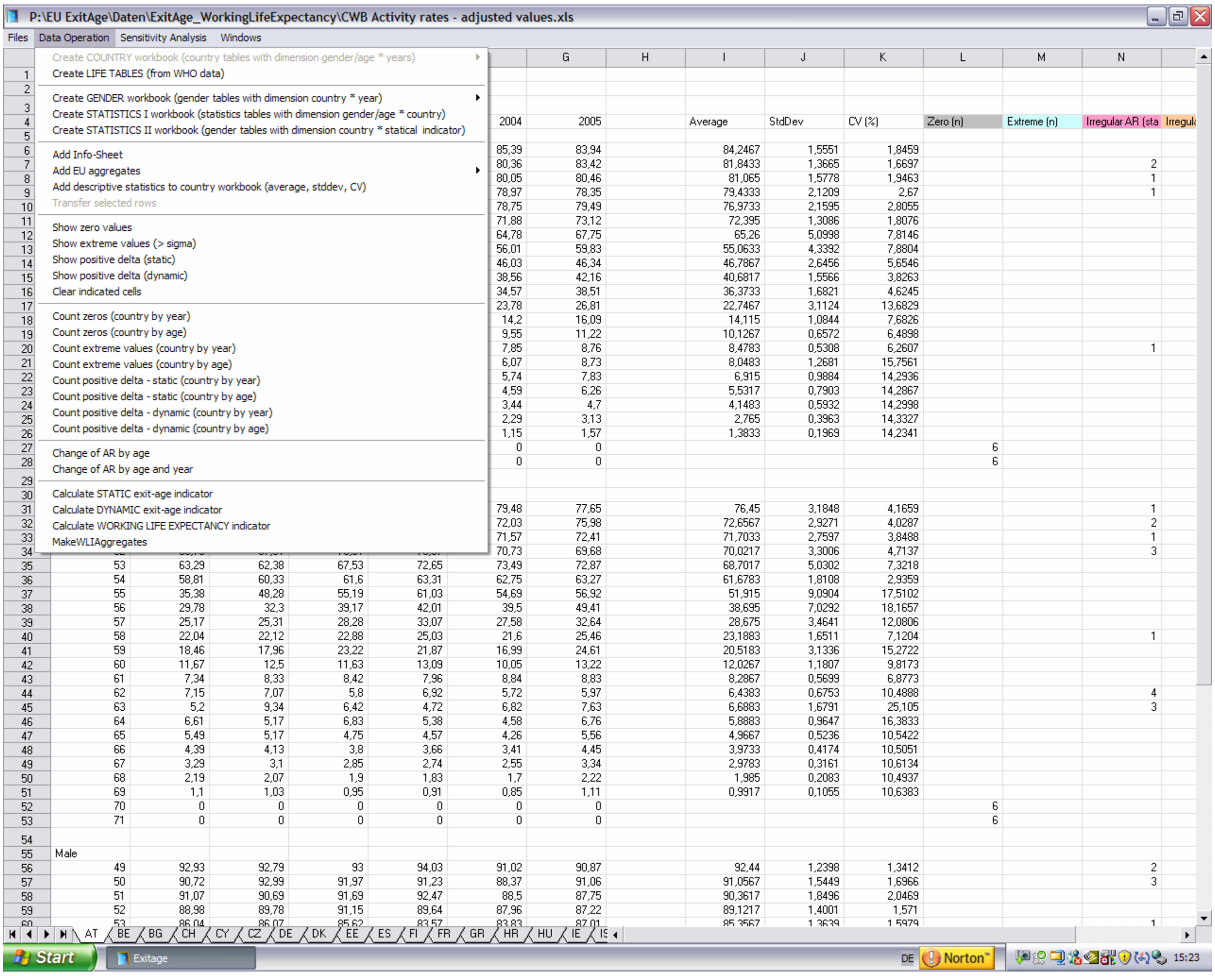
- original activity rates (ACT_RATE_ORIG)
- adjusted activity rates (ACT_RATE_ADJUST)
- final activity rates (ACT_RATE)
- employment rate (EMP_RATE)
- population (POP)
- active population (POP_ACT)
- employed population (POP_EMP)

These data were used for data analysis and the calculation of exit age indicators.

The three exit age indicators are presented as gender work books, containing time series for countries in three gender worksheets.

The calculations were undertaken by a C++ programme using the above listed EXCEL worksheets as input and output files and data presentation at the screen. This appeared to be necessary in order to have a fixed and readable programming code. The program was structured into a series of subroutines for data analysis, calculation, and data presentation purposes. These sub-routines were addressable from the Windows screen. An example of the program's main window is given in the following Chart.

## ExitAge programme – main window




An extraction from the C++ code is attached in file EXITAGE_PROGRAM.TXT. This might be of some interest in order to see how calculations were done. Comments can certainly be given on demand. The program was written in Borland C++Builder for Windows XP. It is for internal use only.

## Table D 2 Country aggregates

| ACRO | COUNTRY | EU27 | EU15 | EU25 | EA13 | NMS12 | NON-EU | ALL |
|---|---|---|---|---|---|---|---|---|
| AT | Austria | 1 | 1 | 1 | 1 | | | 1 |
| BE | Belgium | 1 | 1 | 1 | 1 | | | 1 |
| BG | Bulgaria | 1 | | | | 1 | | 1 |
| CY | Cyprus | 1 | | 1 | | 1 | | 1 |
| CZ | Czech Republic | 1 | | 1 | | 1 | | 1 |
| DE | Germany | 1 | 1 | 1 | 1 | | | 1 |
| DK | Denmark | 1 | 1 | 1 | | | | 1 |
| EE | Estonia | 1 | | 1 | | 1 | | 1 |
| ES | Spain | 1 | 1 | 1 | 1 | | | 1 |
| FI | Finland | 1 | 1 | 1 | 1 | | | 1 |
| FR | France | 1 | 1 | 1 | 1 | | | 1 |
| GR | Greece | 1 | 1 | 1 | 1 | | | 1 |
| HU | Hungary | 1 | | 1 | | 1 | | 1 |
| IE | Ireland | 1 | 1 | 1 | 1 | | | 1 |
| IT | Italy | 1 | 1 | 1 | 1 | | | 1 |
| LT | Lithuania | 1 | | 1 | | 1 | | 1 |
| LU | Luxembourg | 1 | 1 | 1 | 1 | | | 1 |
| LV | Latvia | 1 | | 1 | | 1 | | 1 |
| MT | Malta | 1 | | 1 | | 1 | | 1 |
| NL | Netherlands | 1 | 1 | 1 | 1 | | | 1 |
| PL | Poland | 1 | | 1 | | 1 | | 1 |
| PT | Portugal | 1 | 1 | 1 | 1 | | | 1 |
| RO | Romania | 1 | | | | 1 | | 1 |
| SE | Sweden | 1 | 1 | 1 | | | | 1 |
| SI | Slovenia | 1 | | 1 | 1 | 1 | | 1 |
| SK | Slovak Republic | 1 | | 1 | | 1 | | 1 |
| UK | United Kingdom | 1 | 1 | 1 | | | | 1 |
| CH | Switzerland | | | | | | 1 | 1 |
| HR | Croatia | | | | | | 1 | 1 |
| IS | Iceland | | | | | | 1 | 1 |
| NO | Norway | | | | | | 1 | 1 |
| | TOTAL | 27 | 15 | 25 | 13 | 12 | 4 | 31 |

# Annex E: Calculation method for the coefficient of variation (Eurostat)

**Calculation of the CV for activity rates for men and women by year age groups (50-54, 55-59, 60-64, 65-69), using the known CVs for the total number of employed persons and for the total number of unemployed persons.**

1. The following is assumed: $p_a = p_e + p_u$, where $p_e = \hat{E}/N$, and $p_u = \hat{U}/N$ and $\hat{E}$ and $\hat{U}$ are the estimated number of employed and unemployed in the population, respectively. Thus $\hat{E}$ can also be written as $Np_e$ and $\hat{U}$ can be written as $Np_u$.

2. The variance for the number of employed persons (ignoring the *fpc*) is given as $V(\hat{E}) = deff_e \dfrac{N^2 p_e(1-p_e)}{n-1}$ and thus $cv(\hat{E}) = \dfrac{\sqrt{deff_e \dfrac{N^2 p_e(1-p_e)}{n-1}}}{Np_e} = \sqrt{deff_e \dfrac{1-p_e}{(n-1)p_e}}$, where *deff* is the design effect. It can be gleaned from above that the *cv* for the employment **rate** ($p_e$) is exactly the same as for the number employed persons. With some algebra the variance can be calculated from the *cv* if the number of employed is known as $V(\hat{E}) = \hat{E}^2 cv(\hat{E})^2$. The variance and the coefficient of variation for the number of unemployed follows easily.

3. From 1 it can be derived that $p_a(1-p_a) = (p_e + p_u)(1-p_e-p_u) = p_e(1-p_e) + p_u(1-p_u) - 2p_e p_u$, where the last term indicates the covariance. When only the variances for the employed and the unemployed is known separately, the variance for the active persons can thus be approximated by summing the two and subtracting the covariance from the result: $V(\hat{A}) = V(\hat{E}) + V(\hat{U}) - 2C$, where $C = N^2 \dfrac{p_e p_u}{n-1}$.

4. The Member States provide *cv*'s separately for the number of employed persons and for the number of unemployed persons. In order to calculate the *cv* for the activity rate, these must be reverted back to the variances: $V(\hat{A}) = \hat{E}^2 cv(\hat{E})^2 + \hat{U}^2 cv(\hat{U})^2 - 2C$.

5. Since the Member States consider the design effect in their calculations, the design effect can be retrieved by the simple calculation: $deff(\hat{A}) = \dfrac{V(\hat{E}) + V(\hat{U}) - 2C}{V_{SI}(\hat{A})}$, where $V_{SI}(\hat{A}) = \dfrac{N^2 p_a(1-p_a)}{n-1}$ is the variance of number of active persons assuming a simple random sample.

6. It would not be realistic to assume that the design effects for the total are the same as the design effects for the sex and age sub-groups. This is because often the efficiency of the total is achieved by post-stratifying by sex and age, or taking sex and age into account. Because employment/unemployment often covaries with age and sex this improves the estimates of totals.

7. In case of post-stratification, the variance of the total $\hat{E}$ is the sum of the squared weighted sub-strata variances: $V(\hat{E}) = \sum\sum deff_{hk} N_{hk}^2 \frac{p_{(E)hk}(1-p_{(E)hk})}{n_{hk}-1}$, *h* and *k* denote the age and sex classes. In the absence of evidence to the contrary we will assume that the design effects are constant over the age and sex classes, so that the formula above can be expressed as: $V(\hat{E}) = deff' \sum\sum N_{hk}^2 \frac{p_{(E)hk}(1-p_{(E)hk})}{n_{hk}-1}$. The constant ($deff'$) can be calculated in the same way as expressed above in paragraph 5.

8. In some Member States, the weighting scheme does not use 5 year age classes, but broader age bands. In those cases, the estimated *deff* will nevertheless be calculated using 5 year age cohorts, leading to a conservative estimate of the *deff*.

9. Some Member States have not provided *cv* for the annual estimates. In those cases the annual variance of the total activity rate will be estimated from the quarterly variances, assuming a full theoretical overlap in the rotation scheme and a correlation of 1.0 between any two quarters. The variance for each of the annual averages ($\hat{T}$) is approximated by the following expression: $V'(\hat{T}) = \left[\sum V(\hat{T}_q) + 2\sum_q \sum_{k>q} o_{qk} r_{qk} \sqrt{V(\hat{T}_q)}\sqrt{V(\hat{T}_k)}\right] / 4^2$, where $o_{qk}$ and $r_{qk}$ represent the overlap and correlation between quarters *q* and *k*, respectively. Since $r_{qk} = 1$ for all paired cases, the somewhat simpler expression is used: $V'(\hat{T}) = \left[\sum V(\hat{T}_q) + 2\sum_q \sum_{k>q} o_{qk} \sqrt{V(\hat{T}_q)}\sqrt{V(\hat{T}_k)}\right] / 4^2$.

10. The age and sex specific variance are now calculated using the assumption of the single random sample, and then multiplied with the constant age and sex specific design effect found in paragraph 7.

**Table E 1** Estimated coefficient of variation for the annual activity rates by country, sex and age groups 50-69, EU and EEA 2006 (%)

| Country | Age group | Men | | Women | |
|---|---|---|---|---|---|
| | | *Activity rate* | *CV* | *Activity rate* | *CV* |
| BE | All ages | 60,9 | 0,42 | 45,8 | 0,55 |
| | 50-54 | 85,2 | 1,01 | 61,1 | 1,89 |
| | 55-59 | 58,3 | 2,12 | 36,2 | 3,28 |
| | 60-64 | 22,6 | 5,17 | 10,3 | 8,05 |
| | 65-69 | 5,2 | 12,58 | 2,1 | 18,94 |
| BG | All ages | 56,7 | 1,21 | 46,3 | 1,42 |
| | 50-54 | 79,2 | 3,02 | 76,4 | 3,13 |
| | 55-59 | 66,2 | 4,13 | 53,4 | 5,08 |
| | 60-64 | 38,6 | 7,95 | 11,7 | 15,93 |
| | 65-69 | 8,8 | 21,31 | 3,4 | 31,76 |
| CZ | All ages | 68,6 | 0,40 | 50,6 | 0,56 |
| | 50-54 | 90,6 | 0,84 | 88,1 | 0,93 |
| | 55-59 | 83,2 | 1,17 | 51,2 | 2,40 |
| | 60-64 | 36,1 | 3,76 | 13,0 | 6,92 |
| | 65-69 | 12,8 | 8,83 | 5,7 | 12,20 |
| DK | All ages | 71,1 | 0,37 | 60,9 | 0,43 |
| | 50-54 | 89,4 | 0,85 | 84,6 | 1,01 |
| | 55-59 | 87,2 | 0,91 | 79,2 | 1,16 |
| | 60-64 | 50,6 | 2,36 | 31,6 | 3,53 |
| | 65-69 | 17,3 | 6,55 | 7,2 | 11,00 |
| DE | All ages | 66,3 | 0,17 | 52,5 | 0,21 |
| | 50-54 | 91,6 | 0,32 | 78,9 | 0,54 |
| | 55-59 | 82,4 | 0,51 | 65,9 | 0,78 |
| | 60-64 | 42,8 | 1,36 | 24,7 | 2,00 |
| | 65-69 | 8,7 | 3,48 | 5,1 | 4,40 |
| EE | All ages | 67,3 | 1,29 | 54,8 | 1,58 |
| | 50-54 | 84,2 | 3,74 | 87,4 | 3,15 |
| | 55-59 | 75,8 | 5,32 | 75,2 | 4,88 |
| | 60-64 | 42,7 | 12,32 | 42,4 | 11,02 |
| | 65-69 | 34,8 | 13,77 | 23,0 | 16,40 |
| IE | All ages | 73,2 | 0,49 | 52,9 | 0,76 |
| | 50-54 | 86,2 | 1,36 | 62,1 | 2,58 |
| | 55-59 | 76,8 | 1,91 | 48,1 | 3,68 |
| | 60-64 | 58,7 | 3,31 | 30,1 | 5,87 |
| | 65-69 | 24,7 | 7,61 | 9,0 | 13,88 |
| EL | All ages | 64,8 | 0,92 | 42,5 | 1,41 |
| | 50-54 | 89,6 | 1,91 | 51,2 | 5,38 |
| | 55-59 | 74,2 | 3,32 | 33,7 | 7,79 |
| | 60-64 | 44,9 | 6,87 | 21,8 | 11,18 |
| | 65-69 | 15,9 | 13,31 | 5,2 | 23,53 |
| ES | All ages | 68,3 | 0,21 | 47,4 | 0,31 |
| | 50-54 | 87,9 | 0,50 | 55,1 | 1,18 |
| | 55-59 | 76,3 | 0,78 | 39,6 | 1,66 |
| | 60-64 | 48,9 | 1,51 | 21,3 | 2,71 |
| | 65-69 | 7,7 | 5,55 | 3,2 | 8,25 |

Table E1

| | | | | | |
|---|---|---|---|---|---|
| FR | All ages | 62,2 | 0,45 | 50,3 | 0,55 |
| | 50-54 | 90,1 | 0,88 | 77,3 | 1,39 |
| | 55-59 | 61,2 | 2,10 | 53,7 | 2,37 |
| | 60-64 | 15,8 | 7,29 | 13,8 | 7,58 |
| | 65-69 | 3,2 | 19,31 | 2,3 | 21,16 |
| IT | All ages | 61,0 | 0,21 | 38,1 | 0,31 |
| | 50-54 | 89,0 | 0,40 | 54,0 | 1,02 |
| | 55-59 | 58,0 | 0,95 | 32,8 | 1,55 |
| | 60-64 | 28,9 | 1,92 | 10,2 | 3,46 |
| | 65-69 | 12,5 | 3,17 | 3,0 | 6,41 |
| CY | All ages | 73,4 | 1,40 | 54,4 | 2,00 |
| | 50-54 | 93,3 | 2,76 | 62,4 | 7,71 |
| | 55-59 | 83,2 | 4,57 | 47,9 | 10,14 |
| | 60-64 | 62,9 | 8,61 | 25,6 | 19,20 |
| | 65-69 | 26,3 | 19,69 | 7,7 | 37,55 |
| LV | All ages | 67,7 | 0,91 | 52,4 | 1,12 |
| | 50-54 | 89,0 | 2,15 | 81,2 | 2,62 |
| | 55-59 | 75,5 | 3,59 | 68,6 | 3,72 |
| | 60-64 | 51,4 | 6,28 | 33,8 | 7,86 |
| | 65-69 | 29,0 | 10,24 | 19,7 | 10,24 |
| LT | All ages | 61,8 | 1,49 | 50,9 | 1,71 |
| | 50-54 | 84,6 | 3,89 | 78,1 | 4,53 |
| | 55-59 | 74,0 | 5,96 | 72,1 | 5,70 |
| | 60-64 | 44,4 | 12,23 | 22,8 | 18,30 |
| | 65-69 | 13,2 | 30,17 | 8,8 | 31,67 |
| LU | All ages | 60,4 | 0,62 | 49,4 | 0,76 |
| | 50-54 | 91,9 | 1,12 | 58,5 | 3,08 |
| | 55-59 | 58,3 | 3,36 | 41,8 | 4,72 |
| | 60-64 | 15,0 | 10,02 | 10,4 | 12,84 |
| | 65-69 | 1,1 | 45,47 | 1,2 | 40,97 |
| HU | All ages | 58,9 | 0,93 | 43,4 | 1,18 |
| | 50-54 | 74,4 | 2,59 | 71,7 | 2,62 |
| | 55-59 | 61,3 | 3,77 | 44,1 | 5,11 |
| | 60-64 | 19,6 | 10,85 | 9,4 | 14,75 |
| | 65-69 | 6,2 | 22,01 | 2,5 | 28,70 |
| MT | All ages | 69,7 | 0,81 | 31,7 | 1,76 |
| | 50-54 | 87,8 | 1,92 | 29,1 | 7,73 |
| | 55-59 | 71,5 | 3,03 | 19,6 | 9,74 |
| | 60-64 | 26,9 | 8,75 | 2,2 | 34,98 |
| | 65-69 | 7,5 | 22,42 | 0,7 | 71,63 |
| NL | All ages | 72,8 | 0,30 | 58,0 | 0,42 |
| | 50-54 | 91,6 | 0,61 | 71,1 | 1,27 |
| | 55-59 | 79,2 | 1,02 | 53,2 | 1,88 |
| | 60-64 | 36,2 | 3,01 | 19,9 | 4,58 |
| | 65-69 | 14,3 | 8,80 | 5,6 | 25,17 |
| AT | All ages | 68,1 | 0,60 | 52,8 | 0,79 |
| | 50-54 | 87,6 | 1,57 | 75,0 | 2,32 |
| | 55-59 | 69,1 | 2,83 | 41,9 | 4,89 |
| | 60-64 | 21,9 | 8,75 | 10,1 | 13,15 |
| | 65-69 | 9,7 | 14,12 | 4,9 | 19,61 |

Table E1

| | | | | | |
|---|---|---|---|---|---|
| PL | All ages | 62,1 | 0,42 | 46,6 | 0,54 |
| | 50-54 | 75,6 | 1,16 | 59,8 | 1,61 |
| | 55-59 | 51,6 | 2,18 | 25,3 | 3,60 |
| | 60-64 | 26,8 | 4,78 | 12,3 | 7,12 |
| | 65-69 | 14,3 | 7,23 | 6,7 | 9,64 |
| PT | All ages | 69,7 | 0,65 | 55,8 | 0,83 |
| | 50-54 | 87,7 | 1,53 | 72,6 | 2,39 |
| | 55-59 | 71,7 | 2,61 | 51,4 | 3,84 |
| | 60-64 | 51,9 | 4,27 | 38,1 | 5,21 |
| | 65-69 | 33,6 | 6,34 | 21,9 | 7,75 |
| RO | All ages | 62,6 | 0,80 | 47,8 | 1,03 |
| | 50-54 | 78,7 | 2,09 | 61,2 | 3,06 |
| | 55-59 | 61,8 | 3,33 | 40,2 | 4,93 |
| | 60-64 | 38,4 | 6,09 | 27,8 | 7,11 |
| | 65-69 | 27,8 | 7,30 | 22,6 | 7,40 |
| SI | All ages | 65,7 | 0,96 | 53,3 | 1,22 |
| | 50-54 | 81,5 | 2,67 | 73,6 | 3,33 |
| | 55-59 | 61,8 | 4,79 | 30,2 | 9,26 |
| | 60-64 | 22,3 | 13,44 | 10,3 | 21,26 |
| | 65-69 | 16,3 | 17,10 | 9,5 | 23,57 |
| SK | All ages | 68,3 | 0,43 | 50,7 | 0,59 |
| | 50-54 | 88,2 | 0,97 | 81,9 | 1,17 |
| | 55-59 | 76,7 | 1,54 | 31,6 | 3,85 |
| | 60-64 | 24,2 | 5,94 | 7,1 | 10,70 |
| | 65-69 | 3,6 | 17,87 | 1,6 | 22,36 |
| FI | All ages | 65,3 | 0,42 | 57,1 | 0,49 |
| | 50-54 | 84,8 | 1,08 | 87,4 | 0,96 |
| | 55-59 | 71,2 | 1,58 | 74,8 | 1,44 |
| | 60-64 | 41,5 | 3,45 | 36,4 | 3,73 |
| | 65-69 | 9,8 | 10,01 | 6,1 | 12,36 |
| SE | All ages | 67,6 | 0,23 | 59,2 | 0,27 |
| | 50-54 | 90,2 | 0,52 | 85,7 | 0,63 |
| | 55-59 | 85,4 | 0,62 | 80,4 | 0,73 |
| | 60-64 | 66,2 | 1,10 | 58,2 | 1,28 |
| | 65-69 | 16,5 | 5,98 | 9,8 | 7,97 |
| UK | All ages | 69,5 | 0,24 | 55,8 | 0,30 |
| | 50-54 | 87,4 | 0,60 | 76,8 | 0,84 |
| | 55-59 | 78,4 | 0,81 | 64,4 | 1,11 |
| | 60-64 | 56,4 | 1,47 | 33,3 | 2,27 |
| | 65-69 | 20,9 | 3,53 | 11,6 | 4,81 |
| IS | All ages | 84,1 | 1,88 | 77,1 | 2,27 |
| | 50-54 | 92,5 | 4,67 | 88,1 | 5,47 |
| | 55-59 | 95,8 | 3,63 | 82,4 | 7,80 |
| | 60-64 | 88,9 | 7,04 | 79,6 | 9,92 |
| | 65-69 | 65,2 | 15,76 | 49,3 | 22,79 |
| NO | All ages | 75,4 | 0,38 | 68,3 | 0,45 |
| | 50-54 | 87,6 | 0,94 | 81,3 | 1,20 |
| | 55-59 | 82,8 | 1,16 | 71,6 | 1,62 |
| | 60-64 | 63,5 | 2,08 | 51,2 | 2,72 |
| | 65-69 | 25,2 | 5,71 | 16,3 | 7,55 |

Table E1

| | | | | | |
|---|---|---|---|---|---|
| CH | All ages | 75,4 | 0,42 | 59,8 | 0,55 |
| | 50-54 | 93,1 | 0,89 | 79,5 | 1,61 |
| | 55-59 | 89,5 | 1,14 | 72,0 | 1,96 |
| | 60-64 | 62,5 | 2,56 | 44,0 | 3,42 |
| | 65-69 | 22,5 | 6,83 | 12,9 | 8,39 |

Note: "All ages" refer to 15+, except in IS and NO where it refers to 15-74.

Source: Eurostat