



OECD SHORT-TERM ECONOMIC STATISTICS WORKING PARTY (STESWP)

**REVIEW OF LINKING PRACTICES FOR THE INDEX OF INDUSTRIAL
PRODUCTION IN OECD COUNTRIES**

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Submitted to the Working Party under item 4 of the draft agenda

Meeting:
26 – 28 June 2006

Franqueville Room
OECD Headquarters, Paris
Starting at 9:30 a.m. on the first day

**OECD SHORT-TERM ECONOMIC STATISTICS WORKING PARTY,
PARIS, 26-28 JUNE 2006**

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0 Executive summary

1 Maintaining long time series of economic statistics is of very high importance to economists and researchers to enable effective empirical analysis. However, a recent review for the index of industrial production (IIP) published in the OECD's *Main Economic Indicators* (MEI) database shows extreme variation in the length of time series currently published by national statistical institutes (NSI) in OECD countries. Such variation is a reflection of differing national practices, policies and philosophies, especially with regards to index compilation methodology, linking and backcasting. In summary, the review outlined in this paper found that:

- countries are using a wide variety of index compilation methodologies to construct the IIP;
- some countries choose to link different segments of historical data to form long time series, others provide medium length time series with fixed weights and others very short time series in accordance with the most recent base year (e.g. on or near 2000);
- index compilation methodology concepts are not well understood, as many countries describe their indices as 'Laspeyres' when in fact a closer analysis reveals they are simple fixed weight indices which in general should not be used.

2 Given the importance they attach to long time series, users, when faced with short time series will frequently either attempt to recreate long series themselves or use alternative sources where such linking has been performed. This increases the risk of the application of inappropriate linking methodologies and leads to different user groups using different versions of the same time series for their analyses, which may ultimately affect the outcomes of such analyses. Ideally only one official source for the full possible length of key economic time series – compiled using internationally agreed recommended practice – should exist.

3 Different policies of national statistical institutes with regard to maintaining long time series and requirements of the European Union Short Term Statistics Regulation are cited as two possible reasons for the short times series currently published by many countries. Also, a lack of international guidelines on recommended practices for compiling indexes and linking time series of short-term economic statistics such as the IIP is a possible reason for the wide range of methodologies used, including the use of non-recommended practices in some countries.

4 Given that most countries will be implementing new industrial classifications in the next few years, it seems timely that NSIs review their policies in regards to producing long time series and the methodology currently used to compile their short-term economic statistics. Consequently, this paper recommends that the OECD Short Term Economic Statistics Working Party (STESWP) should consider undertaking work to develop a set of recommendations and guidelines on index methodology for compiling and linking indexes of short-term economic statistics and be a forum for debate on NSI policy for compiling long time series.

5 As a response to this paper, June 2006 STESWP participants are therefore invited to:

1. verify the accuracy of the stated length of time series currently published and the compilation methodology used for their countries' index of industrial production as presented in Table 2;
2. provide comments on the current policy of their institute for producing long time series for short-term economic statistics, in particular, after the introduction of index rebases or major methodological or classification changes (i.e. backcasting on the basis of the new methodology / classification);
3. provide comment on the scope of the proposed guidelines for producing long time series that are outlined in Section 7 of this paper that could possibly be developed by STESWP;
4. indicate their interest in contributing to STESWP work to develop guidelines on recommended practice for producing long time series of short-term economic statistics, with a view to implementation of these guidelines in conjunction with the introduction of a new industrial classification in the coming years following the recent revision of ISIC;
5. provide comments on any other aspects of this paper.

1 Introduction

6 Maintaining long time series of economic statistics is of very high importance to economists and researchers to enable effective empirical analysis. However, the recent review of national practices outlined below for the index of industrial production (IIP) published in the OECD's *Main Economic Indicators* (MEI) database, shows extreme variation in the length of time series currently published by national statistical institutes in OECD countries. This paper explores possible reasons for these differences and proposes some options for future work of the STESWP. Principally, the paper covers the following issues:

- possible reasons for different lengths of IIP time series published across OECD countries;
- an analysis of methodologies used across OECD countries for compiling and linking the IIP;
- a review of existing international guidelines on recommended practices for linking time series for short-term economic statistics;
- recommendations for possible work by the STESWP to produce guidelines on good practices for producing long time series, particularly in the light of upcoming changes to industrial classifications that will be implemented in most countries in the next few years following the 2006 revision of ISIC..

2 Importance of long time series

7 A key demand for sophisticated users of economic time series (e.g. economists in policy institutes, academics and researchers, finance industry etc.) is to have access to consistent long time series to support their empirical analysis. Therefore whilst national statistical institutions (NSIs) in most OECD countries have been producing an index of industrial production for many years the actual length of time series currently published by these institutes varies significantly as shown in table 1¹

¹ The lengths of published time series have been determined by the length of time series currently provided by each country for the OECD's *Main Economic Indicators* publication. In concept, this should be equivalent to the length of the current nationally published series although in practice there may be some exceptions.

Table 1: Length of time series currently published for the Index of Industrial Production

Length of time series	Countries
Starts before 1980	United States, Australia, Turkey, United Kingdom
Starts between 1980:1989	Canada, Mexico, New Zealand, Norway,
Starts between 1990: 1994	Korea, Belgium, Finland, France, Germany, Ireland, Italy, Spain, Sweden, Switzerland
Starts between 1995: 1999	Japan, Austria, Hungary, Netherlands, Poland, Slovak Republic
Starts on or after 2000	Czech Republic, Denmark, Greece, Luxembourg, Portugal

8 When faced with short time series users will generally attempt to recreate long time series themselves by linking together whatever historical time series they can find. Alternatively, they will source their time series from a secondary supplier such as the OECD who also performs such linking. Due to the number of different secondary data suppliers, sources of historical time series and methods for linking these time series, the result is that different user groups may end up using different versions of the same time series for their analysis. In addition the point(s) in the time series where users or secondary suppliers choose to link different versions of historical data that are available may lead to the resultant long time series having a non definable index methodology (see paragraph 11 for an example). Clearly this is undesirable and could have an impact on the quality of analysis² performed if the long time series used has been poorly constructed. Consequently, the existence of a single time series for key economic statistics such as the index of industrial production using all available historical data published by the responsible NSI which is compiled using international agreed guidelines of recommended practice seems a worthy aim.

3 Producing long time series in the OECD Main Economic Indicators program

9 The OECD has a policy to maintain as long time series as possible for short-term economic statistics disseminated through its monthly MEI publication. A catalyst for this is the requirements of the OECD Economics Department for long time series to use in their forecasting models. The main two methods used by the OECD in the MEI database to link time series are:

- the 12-month (4-quarter) link method which calculates a linking factor as the average of the first common year of observations between a new series and the equivalent observations of an old series;
- the first common period linking method which calculates a linking factor as the ratio of the first observation of the new series to the equivalent observation of the old series in the overlapping period.

10 These methods are also recommended in the IMF Quarterly National Accounts manual (IMF, 2004) and each have their advantages and disadvantages depending on the nature of the underlying data to be linked – for which section 3.1 below outlines a special case. There are also a range of other methods³ which exist.

11 However one of the problems of a secondary data supplier such as the OECD performing linking in using either of the above two techniques is that it has no control over the type of index in regards to its

² Which may lead to poor policy advice

³ See http://www.oecd.org/document/21/0,2340,en_2649_33715_2073813_1_1_1_1,00.html for a description of methods used at the OECD and IMF (2004) Chapter 9.

methodological description that results for the long time series. This will depend on the methodology used by the NSI in producing the various segments of the time series which are being linked together. For example, the current time series provided to the OECD by France is a fixed weight index which starts in 1990 with base year of 2000 (see Table 2). This is linked by the OECD using the 12-month link method with 1990 as the common year to a previous time series held in the MEI database which had a base year of 1990 and a time series starting in 1985. This is then linked at 1985 to another historical segment of the time series with unknown base year (due to a lack of historical information in the MEI system) which extends back to 1955. Consequently the resultant long time series has inconsistent periods between links and thus an inconsistent application of weighting bases throughout the time series. It cannot therefore be classified to any known family of index methodology type (sections 5 and 6 give more information of index methodology types).

3.1 Maintaining coherence when linking seasonal adjusted and original time series

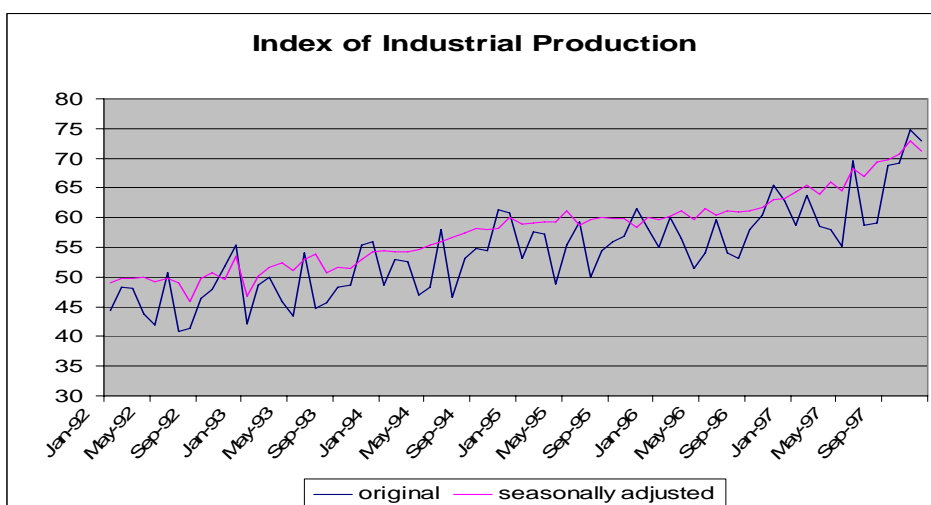
12 In a recent methodological review of its linking methodologies (McKenzie & Parrot, 2003) the OECD discovered that a large inconsistency can occur between linked segments of an original and seasonally adjusted time series, depending on the linking methodology employed⁴. This is particularly likely to occur where institutes take the minimalist approach and only provide short time series (as shown in Table 1) as this can lead to a large change to the previous seasonally adjusted series because the new series is being estimated from very few years' data⁵. This then leaves users with the problem of trying to link a set of relatively short seasonally adjusted series to re-construct long time series.

13 The choice of linking method employed by the user can then have a significant impact on the reconstructed time series and the coherence between the original and seasonally adjusted series, as shown in Chart 1. Consequently, guidelines for linking and the establishment of long time series and its relation to seasonal adjustment are important. Note that the series in Chart 1 were published for the country concerned in the MEI prior to the methodological review and serves to illustrate the point that different linking methods or data sources can lead to different outcomes for a long time series which may affect the quality of user's analysis.

⁴ In short the review found that use of the first common period linking method can lead to such spurious relationships between the original and seasonally adjusted series. As such, the OECD generally uses the 12-month linking method for all subjects where seasonality is likely to be present in time series (e.g. production, retail sales) and the first common period linking method where it is not (e.g. price indices).

⁵ Whilst 5 years is generally considered the minimum amount of data required to seasonally adjust a time series, generally 10 years or more is required to ensure robust estimation of the seasonal parameters in most cases.

Chart 1: Inconsistency in original and seasonally adjusted series caused through linking



4 Possible reasons for short time series

14 The United States Federal Reserve publishes the monthly index of industrial production with the time series starting in 1919. Whilst this length of time series might be viewed as exceptional, this index is the unique source for all possible users' needs and therefore ensures consistency in analysis across the user community. As seen in Table 1 (see paragraph 7), the range of time series currently published by NSIs varies significantly with shorter time series much more common in European Union countries. Possible reasons for these differences could be:

- The existence of NSI policy not to recalculate (backcast) time series as far back as possible when a new base year or methodological changes have been introduced as this is seen as a user's responsibility. Such a policy may stem from the cost of backcasting and / or the philosophical view that the application of new methodologies for an indicator should result in their clear presentation as a break in series which should therefore not be linked.
- The European Union Short-Term Statistics Regulation (STS-R) – which currently requires that member states only provide time series back to 1998.
- A lack of international guidelines and understanding by NSIs on recommended methodologies that should be employed to compile long time series for short-term economic statistics.

15 Whilst the first point may reflect NSI policy, such a policy could lead to the 'multiple historical versions' issue as outlined above which could be considered a questionable service to users. This raises the issue, if the NSI is not the best institute to take responsibility for maintaining the longest possible time series, who is – and how does this become officially recognised? Indeed, the responsibility of an NSI to produce long time series becomes more apparent when faced with a major methodological change such as the introduction of a new industrial classification which almost all NSIs will be facing in the next few years. The second and third points above are related and the remainder of this document discusses these issues.

5 Current international guidelines for compiling indexes and linking time series

16 One of the reasons the OECD created the Short-Term Economic Statistics Working Party (STESWP) in 2002 was to fill a perceived gap in collaborative information sharing on recommended practices between NSIs in the field of short-term economic statistics (STES). Due to this gap and the difficulty to define precisely the scope of this field of statistics, it is not surprising that international guidelines on compiling indexes and linking time series for STES as a whole don't exist.

17 The most comprehensive set of guidelines in general for STES appears to be the publication: *Methodology of short-term business statistics – Interpretation and guidelines* (Eurostat, 2002). This publication presents guidelines for linking time series when performing index rebases as outlined below.

18 There are other partial sets of guidelines on a subject basis related to the scope of STES, most notably the *Producer Price Index Manual – Theory and Practice* (IMF, 2004) and the soon to be completed *Compilation guide for an Index of Services Production* (OECD Short-term Economic Statistics Working Party). However as these are narrow in scope they are most likely to be overlooked by statisticians working with other specific STES or 'business statistics' as they are known in some NSIs. In addition, detailed guidelines are available from several sources (e.g. Eurostat, IMF) for compiling quarterly national accounts but it appears that no concerted effort has been made to transfer the concepts for compiling indexes and linking time series presented in these manuals to the more general field of short-term economic statistics.

5.1 Methodology of short-term business statistics – Interpretation and guidelines (Eurostat, 2002)

19 The issue of compiling indexes and linking is only briefly mentioned in this manual and somewhat indirectly in section 8.5.2 *Weights for activity aggregation of indices* in the sub-heading *Why revise weights?*

'The STS-R requires that weights are updated at least every five years and implies that this should be coordinated with changes in the base years. The STS-R leaves open the possibility of updating weights more frequently. The change of weights can be carried out only when reliable annual data for the year under consideration are available ...

When weights are updated there is a break in series compiled under the previous system of weights and the series compiled under the new system. These series need to be spliced in order to maintain a coherent time series. In the standard case of a rebasing every five years, the indices relative to a new weighting system have to be calculated retrospectively for several years, so that the point where the two series are spliced is between the two base years. For example when the new base year 1995 was introduced, an index with the new system of weights should have been calculated back to January 1993. As a result the indices for the reference periods from 1988 to 1992 have 1990 weights; from 1993 to 1997 have 1995 weights and so on. It is unknown to what extent this practice is actually followed.

A terminology box follows which points out that:

'..in the STS there is no established collective term for the collection of weights that may be used in a single series, although in the Handbook on price and volume measures these are referred to as base years.

Section 8.5.3 *Length of time series* also contains some information on the issue:

Long time series are often requested by users in many types of statistics but this is particularly important for STS, for several reasons. To carry out statistical analysis such as seasonal adjustment it is generally considered necessary to have observations for a minimum of 5 years. The same is true for the correction of working days, insofar as regressions are used. Moreover, the use of time series (raw or adjusted) is delicate or even impossible if the series are too short. This concerns both the econometric aspects (stability and quality tests of the forecast are very relative on short series) and the direct use of the series for economic analysis, for example, in the search for turning points it is important to be able to have data available for several complete cycles.

20 The STS-R lays down no provision on sending long series and only requires that data are sent from a particular starting period, generally January or first quarter 1998. Changes in weights require previous series to be spliced but there is no requirement foreseen in the STS-R for the reconstructed time series to be transmitted to Eurostat.

Analysis of STS guidelines

21 The Eurostat guidelines outlined above are somewhat vague and are probably difficult to interpret. Also, there is a lack of recommendations and examples. Neither the term ‘splice’ is defined nor the methodology of splicing. In fact, splicing actually means the same as linking for which there are several methodological options and associated issues as discussed in Section 3.

22 Consequently, the STS guidelines only weakly encourage the creation of long time series and this is not supported with supplementary information which is needed to better interpret the suggestions in the manual. In fact, the method described (i.e. that reference periods 1988 to 1992 use weights from 1990 which are then linked (or spliced) to reference periods 1993 – 1997 with 1995 weights etc.) is referred to in the literature as a 5 yearly linked ‘midyear index’ belonging to the class of ‘Lowe’ indexes (see PPI manual p. 385). This is generally regarded as a sound method for constructing long time series. Therefore, even though it may not be foreseen as a future requirement of the STS-R for countries to provide long time series it would seem sensible to clearly explain what are regarded as ‘good practices’ in the guidelines to maximize the chances of harmonization of methodology across countries.

5.2 IMF guidelines on linking for Quarterly National Accounts

23 Chapter 9 of the International Monetary Fund’s (2001) publication: *Quarterly National Accounts Manual – Concepts, Data sources, and Compilation* covers several sections outlining methods for linking time series of quarterly national accounts. Similar to the STS guidelines, it points out the importance of linking together different segments of time series to form long time series:

“.....The pattern of relative prices in the base year, however, is less representative of the economic conditions for periods farther away from the base year. Therefore, from time to time it is necessary to update the base period to adopt weights that better reflect the current conditions (i.e., with respect to production technology and user preferences). Different base periods, and thus different sets of price weights, give different perspectives. When the base period is changed, data for the distant past should not be recalculated (rebased). Instead, to form a consistent time series, data on the old base should be linked to data on the new base. Change of base period and chain-linking can be done with different frequencies; every 10 years, every 5 years, every year, or every quarter/month. The 1993 SNA recommends changing the base period, and thus conducting the chain-linking, annually.”

24 However, in other parts of the IMF manual (e.g. para. 9.17) there is often reference to ‘traditional methods’ of *fixed base quarterly Laspeyres volume index* in comparison to *annually chain-linked quarterly*

Laspeyres volume index which could give the reader the impression that these ‘traditional methods’ from past guidelines (e.g. SNA 68) are not chain linked indexes when in fact they are – just that the frequency of linking is less than annual (e.g. 5 or 10 years).

6 Analysis of index compilation and linking methods used by OECD countries for the index of industrial production

25 Table 2 below contains a description of the index compilation and linking methodology used by OECD countries for compiling their monthly (or quarterly) index of industrial production. This information was obtained by reviewing metadata provided by countries to the OECD *Main Economic Indicators*, Eurostat STS sources, and the IMF Special Data Dissemination Standards (SDDS). Of the 29 countries reviewed, only 14 reported the use of an index compilation methodology involving linking and these were the countries that generally tended to publish longer time series. Here a variety of methods are used (annual chain linked Laspeyres, Fisher, Paasche and 5-yearly chain linked Laspeyres) which could all be considered ‘good practice’.

Table 2: Time series length, index type and linking methods for Index of Industrial Production

Country	Length of published time series	Type of index used / method of linking
Canada	1981M1	Annual chain link Fisher (Part of national accounts)
Mexico	1980M1;	Fixed weight 1993 base year (stated as Laspeyres)
United States	1919M1	Annual chain link Fisher
Australia	1974Q3	Annual chain link Laspeyres (Part of national accounts)
Japan	1998M1	Fixed weight 2000 base year (stated as Laspeyres)
Korea	1990M1	5 yearly chain linked Laspeyres
New Zealand	1986Q2	Annual chain link Laspeyres (Part of national accounts)
Austria	1996M1	Fixed weight 2000 base year (stated as Laspeyres)
Belgium	2001M1; 1990M1 s.a.	Annual chain link Laspeyres
Czech Republic	2002M1	Fixed base yr Laspeyres
Denmark	2000M1	Fixed base yr Laspeyres (2000)
Finland	1990M1	Annual chain link Laspeyres
France	1990M1	Fixed weight 2000 base year (stated as Laspeyres)
Germany	1991M1	Fixed weight 2000 base year (stated as Laspeyres)
Greece	2000M1	Fixed base yr Laspeyres (2000)
Hungary	1998M1	Chained Paasche, wts change every month of the reference yr
Ireland	1990M1	Fixed weight 2000 base year (stated as Laspeyres)
Italy	1990M1	5 yearly chain linked Laspeyres ⁶
Luxembourg	2000M1	Fixed base yr Laspeyres (2000)
Netherlands	1995M1	Annual chain link Laspeyres
Norway	1986M1	Annual chain link Laspeyres

⁶ This method has been “guessed” from information provided on the IMF SDDS website where the term ‘splicing’ is used which generally has the same meaning as ‘linking’. The relevant SDDS extract is: Linking of reweighted index to historical index: Splicing the groups of products and, in a second step, grouping them using spliced weights.

Poland	1995M1	5 yearly chain linked Laspeyres
Portugal	2000M1	Fixed base yr Laspeyres (2000)
Slovak Republic	1998M1	Fixed weight 2000 base year (stated as Laspeyres)
Spain	1992M1	5 yearly chain linked Laspeyres
Sweden	1990M1	Fixed base yr Laspeyres (2000)
Switzerland	1990Q1	Fixed weight 1995 base year (stated as Laspeyres but metadata is unclear if linking is used or not)
Turkey	1955M1	5 yearly chain linked Laspeyres
United Kingdom	1966M1	Annual chain link Paasche

26 The remaining 15 countries all compiled fixed weight indexes of various lengths with various base years used as the weighting reference (year 2000 for EU countries). In their metadata each of these countries stated that the index type was ‘Laspeyres’. However an index can only be of the fixed weight Laspeyres type if the base year coincides with the start of the time series. This is the case for Denmark, Greece, Luxembourg, and Portugal whose data start in 2000 – thus whilst these countries satisfy the definition of a Laspeyres index they are only providing a very short time series. The other 11 countries are simply producing a fixed weight index. Such fixed weight indexes have few desirable qualities and can be shown to be biased (McKenzie, 2004) the longer the underlying time series. Consequently, this could be regarded as a problem for countries using this methodology and producing relatively long time series such as Mexico (1980), France (1990), Germany (1991), Ireland (1990) and Sweden (1990). Countries producing true fixed weight Laspeyres indexes or shorter fixed weight indexes (e.g. Japan – 1998; Austria – 1996; Slovak Republic – 1998) leave users with the option of creating longer linked indexes but this can lead to the problem as discussed previously of many different versions of the same series being produced by different analytical users or secondary data providers. In addition, linking short-time series of seasonally adjusted series can be problematic depending on the linking method used as shown in section 3.1.

27 It is also interesting to note that no European Union country compiles a chained mid-year Lowe index as recommended in the STS guidelines.

7 Future work - achieving harmonisation

28 The methodological differences currently apparent across countries and the fact that undesirable methodologies are being used in some cases can also have quality implications when forming aggregates (e.g. Euro area, OECD area etc.) and in making international comparisons.

29 However, this is perhaps not surprising given the lack of clarity in existing international guidelines or their generalisation to all short-term economic statistics. A preliminary study of methods used by OECD countries for compiling and linking time series of retail trade volume indexes suggests that similar problems exist for this variable and consequently is most likely to exist for other short-term economic statistics. It would therefore seem worthwhile for STESWP to compile a set of guidelines for producing long time series for short-term economic statistics. Such guidelines could cover the following issues:

- identification of a basic set of terminology for backcasting and linking;
- definitions of different index types, their advantages and disadvantages;
- advice on frequency for updating weights;

- overview of different linking methods, their strengths and weaknesses;
- guidelines on how to compile chain-linked indices when index rebases are performed (including when changes to industrial classifications are made);
- pointing out the problems of fixed weight indices and why these should not be used;
- advice on matching NSI policy with a preferred index compilation methodology. This would include issues such as the need for consistent practices (where appropriate) across different indicators disseminated by the same agency;
- compilation of required metadata outlining national practices for specific indicators (both with respect to backcasting, linking and index compilation methodology);
- summarising with a set of A (optimal), B (alternative) and C (not to be used) methods for compiling indexes and linking in the production of long time series.

30 STESWP could be considered an appropriate forum for discussion on NSI's policies for the production of long time series through which a series of recommendations could possibly be made to the OECD Committee on Statistics which consists of the heads of all NSIs.

31 The proposed development of good practice guidelines for producing long time series and the associated debate on NSI policy in this area should be considered within the context of the upcoming introduction of new industrial classifications in most countries and could possibly be merged with other work on this topic.

32 Finally, it is envisaged that these guidelines would be incorporated in some way to OECD's *Data and Metadata Reporting and Presentation Handbook* finalized by STESWP and CSTAT in 2005.

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 April 2006

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