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# Economy-wide Material Flow Accounts
# Importance and analytical potential of indirect flows

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NATIONAL ACCOUNTS

***Environmental Accounts***

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# Economy-wide Material Flow Accounts

## Importance and analytical potential of indirect flows

*June 2006*

[1] The paper is the result of joint work of the authors. Nevertheless, parts 1.1 and 1.3 can be attributed to Donatella Vignani, and the rest to Aldo Femia.

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# 1 The importance of indirect flows

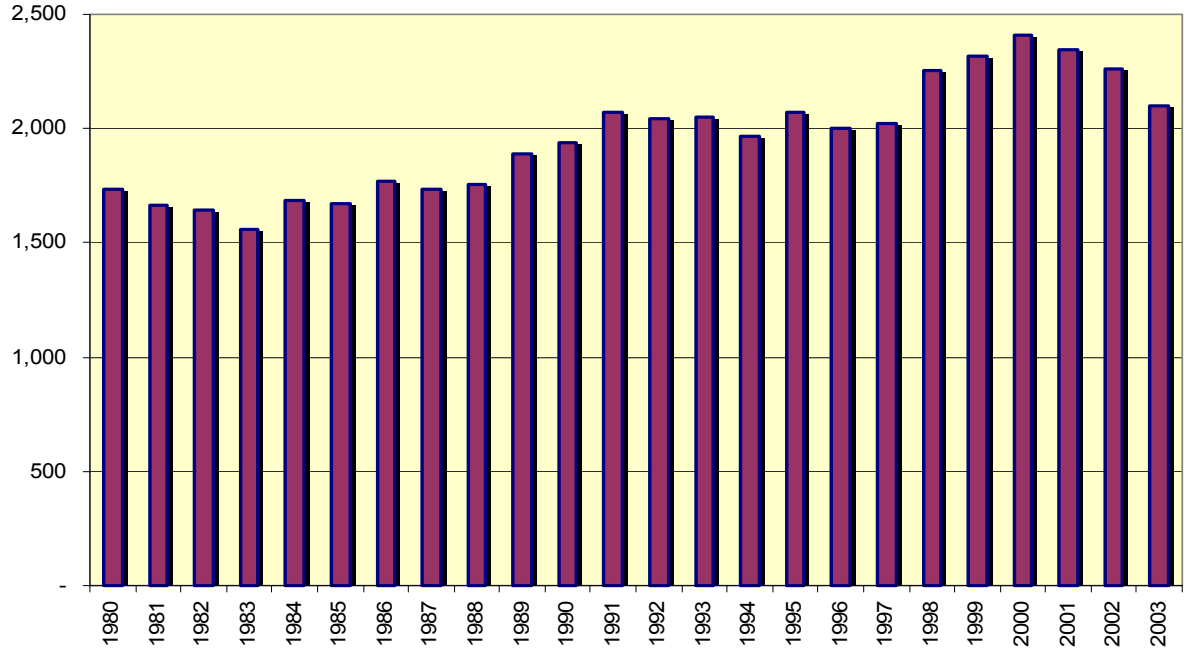
## *1.1 Policy use and overall trend of the Italian TMR*

The Environmental Strategy Action Plan for Sustainable Development in Italy (Ministry of the Environment and Land Protection, August 2002, approved by the CIPE Interministerial Committee for Economic Policy) suggests, among others, the objective of reducing natural resources exploitation by 25% within 2010, by making a more efficient use of natural resources while maintaining the current qualitative living standards.

As an indicator related to this objective, the Strategy makes reference to the Total Material Requirement (TMR). This is the widest indicator in Economy-wide Material Flows Accounting (Ew-MFA) as it measures the total "material base" of an economy. In fact, it includes all the materials (with the exclusion of water and air) that have been moved at the nature-economy border, directly or indirectly, at home or abroad, in order to realize production and/or final domestic uses in a country.

The time series for the Italian TMR (figure 1) shows a sensible growth of TMR (+21%) from 1980 to 2003, when, after three years of substantial decline, it exceeded 2 billion tons of materials. In the same period the Italian GDP grew by 52%. The TMR/GDP ratio declined from 2166 to 1707 tons per million euros, highlighting a steady trend of relative dematerialisation.

**Figure 1 – Total Material Requirement of the Italian Economy, 1980-2003 (million tons)**




## *1.2 Criteria for a first-level classification of material flows*

To understand the dynamics underlying the evolution of the TMR, it is necessary to examine the evolution of its components. This kind of analysis is possible at many different levels of aggregation, since TMR is constructed by aggregation of quite specific flows of individual materials.

At the highest aggregation level, we can consider the following classification criteria of the flows, the first one connected to their relation with the national economy, the second to their environmental origin:

- whether they are embodied in products circulating in the national economy at some stage of their life-cycle, or not;
- whether they are taken from nature in the country or their environmental cradle is in the rest of the world.

The first criterion gives the following two groups of TMR's components:

- Materials actually used as inputs (comprising all flows of materials that cross the nature-national economy or the rest of the world-national economy border and are incorporated in products used in the national economy). These constitute the aggregate commonly known as Domestic Material Input;
- Other life-cycle-wide flows (comprising all flows of materials that have been moved at the nature-economy border, domestically or abroad, in order to ensure that the materials of the former group are made available to the national economy, or else moved for the realisation of economic activities).

The application of the second criterion allows to further classify the flows belonging to each of these two groups, as shown in the table below.

**Table 1 – First-level classification of the flows comprised in TMR**

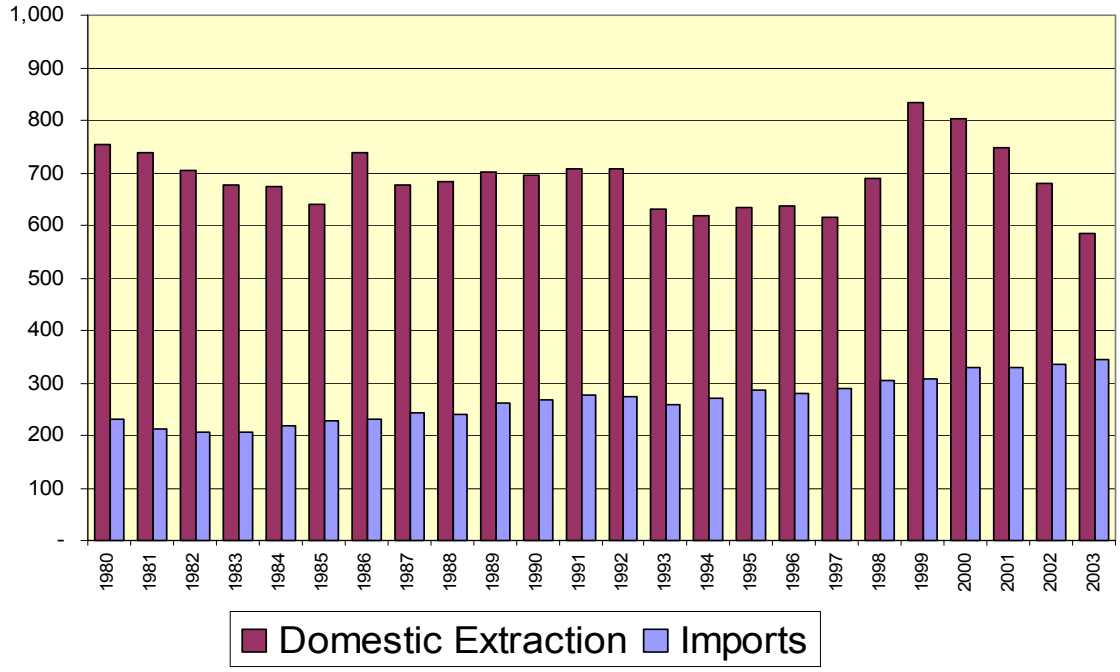
| | | **Origin** | |
|---|---|---|---|
| | | Domestic | Foreign |
| **Use by the national economy** | Materials actually used as inputs | Domestic Extraction of used materials | Imports |
| | Other life-cycle-wide flows | Unused Domestic Extraction | Indirect Flows associated to Imports |

Thus, in the first group we find the Domestic Extraction of used materials, and the Imports, and in the second Unused Domestic Extraction and Indirect Flows associated to Imports. The latter could in principle be further split by applying the same categories from the point of view of the national economies of provenience.

### *1.3 Evidence on the components of the Italian TMR*

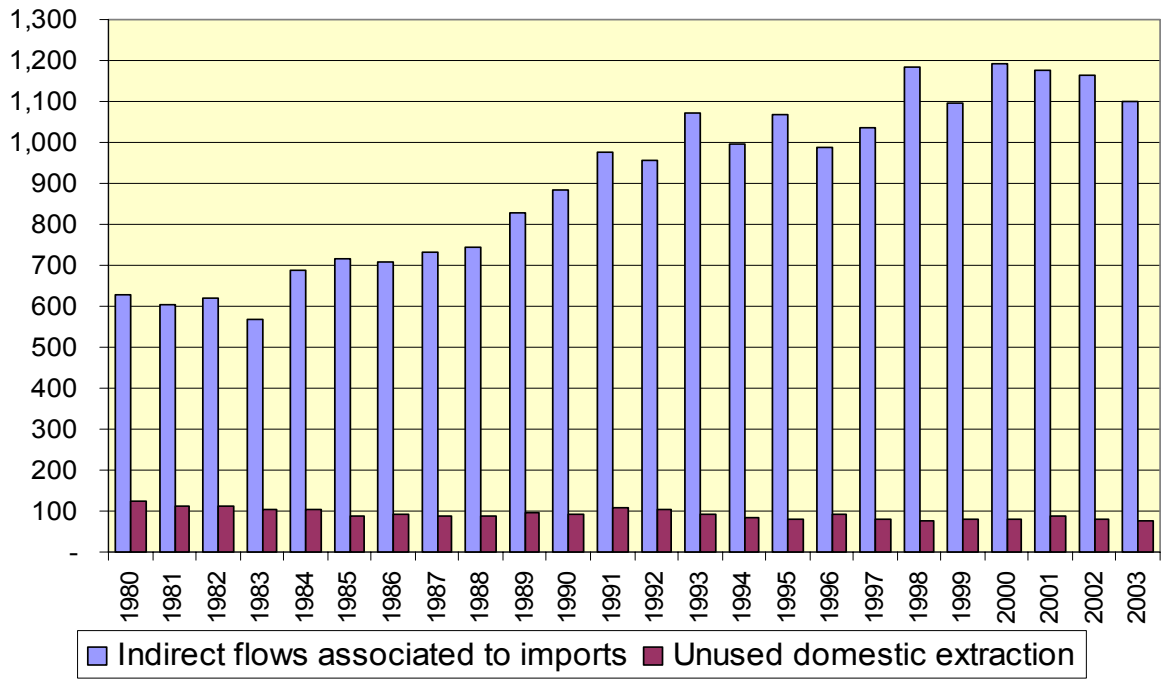
As far as the trend of the Materials actually used as inputs are concerned, the figures show that the Italian economic activities have not actually used growing quantities of materials notwithstanding economic growth. In fact, the DMI remains more or less stable in the long run (1980-2003). Nevertheless the composition of DMI (figure 2) has changed sensibly: the products demanded to the rest of the world increased (Imports +49%), replacing materials extracted domestically (Domestic Extraction -23%). The DE in 2003 was equal to about 585 million tons; this is the minimum value in the whole time series.

**Figure 2 – Materials actually used as inputs in the Italian Economy, by component, 1980-2003 (million tons)**




As for the second group of flows, the Other life-cycle-wide flows, the figures show in particular that Indirect Flows are by far the most important component (figure 3). This component, which represents on average in the period almost 46% of TMR, has increased by 75% from 1980 to 2003, and is the main determinant of the growth of TMR.

**Figure 3 – Other life-cycle-wide flows of the Italian Economy, by component, 1980-2003 (million tons)**




Looking at the composition of TMR in terms of the columns of Table 1, it can be highlighted that from 1980 to 2003 the Italian economy has grown without increasing the demand for materials from with the national natural environment but the resource inputs required at the global level to satisfy

the Italian domestic demand have increased. In fact both direct and indirect flows derived from international trade have grown.

### *1.4 The meaning of the Indirect Flows associated to Imports*

It has been mentioned above that the Italian DMI's long-term stability goes along with the substitution between Domestic Extraction and imported goods. It must be however underlined that this substitution is between materials that cannot be considered equivalent even within a holistic and highly aggregated approach to the measurement of the use of natural resources, as imported products represent more natural resources than they actually embody.

All material flow categories mentioned above, but that of the Indirect Flows associated to Imports have some immediate importance for the environment of the country under analysis: they come from it, or will be returned to it at the end of their life-cycle, or both.

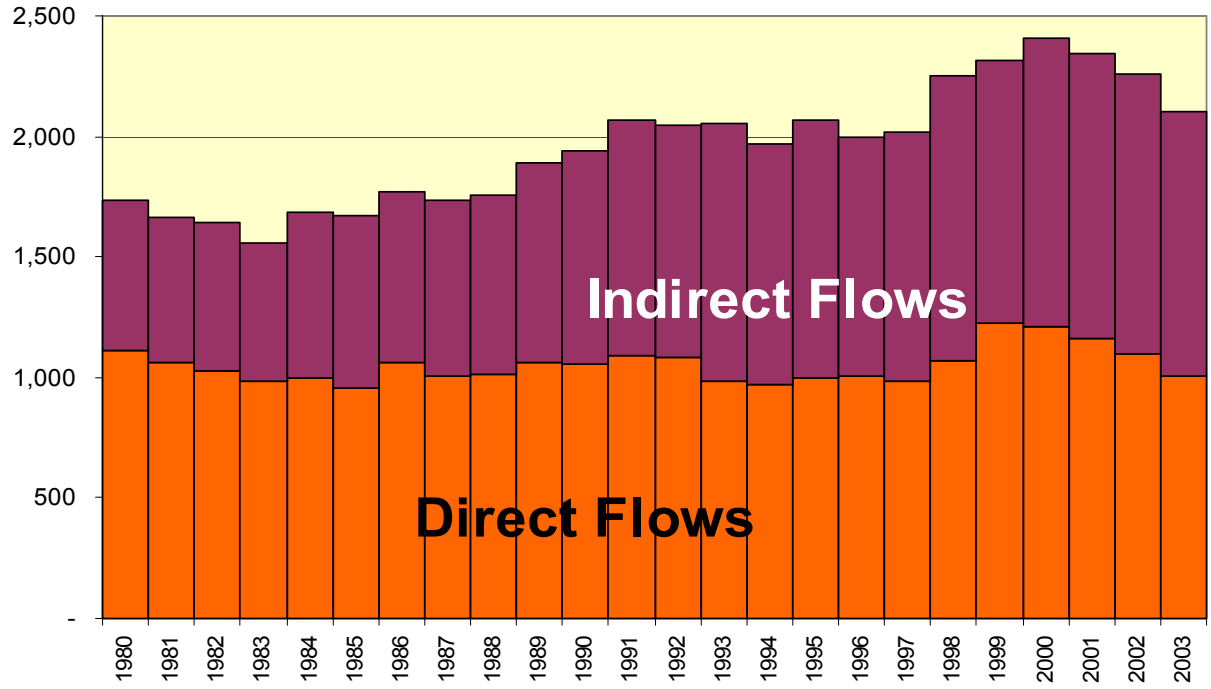
On the contrary, the Indirect flows associated to Imports are not in any immediate relationship with the national physical environment (nor with the national economy), but represent the additional material flows activated abroad by the demand for the products imported. In fact they are the up-stream uses of primary natural resources necessary in order to realise the imported products in a life-cycle perspective, though not actually embodied in the Imports. These are both used and unused natural resources that have been taken from the environment abroad. This matter may have been embodied in the products abroad: it has however been given back to the environment as residual matter (emissions to air and water, and waste), e.g. in production processes that imply discard of matter (extraction, refinement, industrial transformation), or as air emissions from generation of energy or transport processes directly or indirectly entering the production function of the imported goods.

The inclusion of Indirect flows in an indicator has strong implications for its very nature and meaning, as it implies going beyond national economic and territorial boundaries and providing information that is very valuable in a global perspective on ecologically sustainable development and much less in a local perspective. Though models are available in the literature for the calculation of conceptually similar items, such as e.g. embodied energy of traded goods and air emissions saved by a country thanks to trade, IF are at the moment the only aggregate present in Official Statistics' environmental accounting that has this peculiar feature.

The growth of the Italian TMR may be ascribed entirely to the growth of Indirect Flows (figure 4). These were 36.2% of TMR in 1980 and have grown by 80% in the 1980-2004 period, notwithstanding a sensible slowdown of this growth in the latest period. The break year can be identified – as the subsequent analysis confirms – in 1993 (1993-1004 growth has been only of 5.3%).

It seems, given the quantitative importance of these flows for the Italian economy, that Italy can contribute to the reduction of resource use worldwide mainly by putting under control the foreign components of its TMR. Under these premises, the importance of understanding the relationship between the level and structure of Imports and their IFs becomes evident.

**Figure 4 – TMR of the Italian Economy, Direct and Indirect components, 1980-2003 (million tons)**




### *1.5 The calculation of Indirect flows*

There are at least two possible approaches to IF calculation. The most common one is by making use of product-specific coefficients. Another possibility is the application of Input-Output-based modelling. The latter may give results of the kind "avoided material flows" or estimates of the actual flows taking place abroad, according to whether the tables used for calculation are the importing country's ones or the exporter's or use of multi-country models is made.

In Italy the IFs associated to imports have been calculated by using technical coefficients.

Both approaches have merits and drawbacks which will be not be discussed here but for some mention of the characteristics of the coefficients used in the Italian case. These have been kindly supplied, together with their connection to the codes of the Combined Nomenclature (the classification of internationally traded commodities currently in use – CN) and of the NIMEXE (the classification in use before 1988), by the Wuppertal Institute[2].

These coefficients, gathered and calculated on the basis of accurate and in some cases country-of-provenience-specific life cycle analyses, have been so far used in several country studies carried out by NSIs and research institutes, and therefore guarantee, to a certain extent, a comparability of data that would not be currently ensured by a different method. Moreover, the subsequent analyses are based on this calculation method, and would not necessarily have been possible otherwise.

As for their weaknesses, the following seem the most important:

- In the vast majority of cases they conceal the variability of production techniques across countries, as they are attached to goods irrespective to their provenience. However, this is not the case for metal minerals, metals and fuels, the goods for which the variability of the

[2] As these coefficients are defined at variable levels of aggregation, they have been re-organised as to have a coefficient for each individual (8-digit) item of the Combined Nomenclature, in order to include and use the information in Istat's database, which for the years after 1990 elaborates data at the maximum level of detail available from current surveys.

waste produced per unit of product is largest, as a consequence of the different metal concentrations in ores and characteristics of extraction sites. These goods alone give from 30% to 40% of indirect flows connected to Italian imports.

- They are fixed through time for any given product/country of provenience.
- It seems that in many cases they have been calculated considering only some part of the production cycle: this can be seen by the fact that for many raw materials and for the goods thereof the same coefficient is given, when the latter should of course have higher values; however, the stages considered are clearly the most important ones from the point of view of indirect flows generation (again, those of extraction and refinement of the raw materials).
- They do not cover in any way services, which are not produced "free of charge" for the environment and play an increasingly important role in international trade.
- Finally, they do not allow calculating separately Raw Material Equivalents and unused materials connected to imports, as ideally required by the Methodological Guide. Nevertheless having an estimate of the total is an important first step.

# 2 An analysis of the Indirect flows of the Italian economy

## *2.1 General analytical setting: macro drivers' effects decomposition*

The following identity expresses IFs as the product of a chain of factors that can be considered analytically meaningful.

$$IF \equiv (IF/Ip) * (Ip/Iv) * (Iv/Y) * Y$$

Where IF is the Indirect flow's level, Ip the Imports in physical terms (total weight, e.g. in tons), Iv their real value (e.g. million euros) and Y is GDP.

On this basis, the changes in IFs' level can be interpreted as the result of the combined effect of changes in these factors. Each of them can be seen as expressing some characteristic of the economy playing a role in IFs determination.

The last factor (Y) expresses the overall level of economic activity. *Ceteris paribus,* the higher the GDP, the higher the IFs. Of course some qualitative characteristics of GDP are of primary importance important, such as the composition of GDP generation by economic activity (e.g. a country with no steel production will not import much iron ores, and will therefore not have their IFs, but will probably import the steel it needs and have even higher IFs for that) or the way GDP is spent (e.g. whether more in luxury goods or for basic needs) but this becomes relevant only at a later stage of the analysis, when differences in time and space are under study.

The next-to-last factor (Iv/Y) expresses imports' penetration, which can be put in relation to the globalisation phenomenon.

The Ip/Iv factor expresses average weight of imports per value unit. This can be related to the importance of the imports of raw materials for industrial transformation: *ceteris paribus*, the more downstream in the production chain are the imported goods the lower is their material content per value unit (e.g. a country importing steel or steel products pays much more per ton of imports than one importing coke and iron ores).

Finally, the IF/Ip factor expresses the average IF intensity of Imports. Again, composition factors play a paramount role.

As we want to focus on the physical aspects of the matter, let us for simplicity split the equation above into the following two:

$$1) \qquad IF \equiv (IF/Ip) * Ip$$

$$2) \qquad Ip \equiv (Ip/Iv) * (Iv/Y) * Y$$

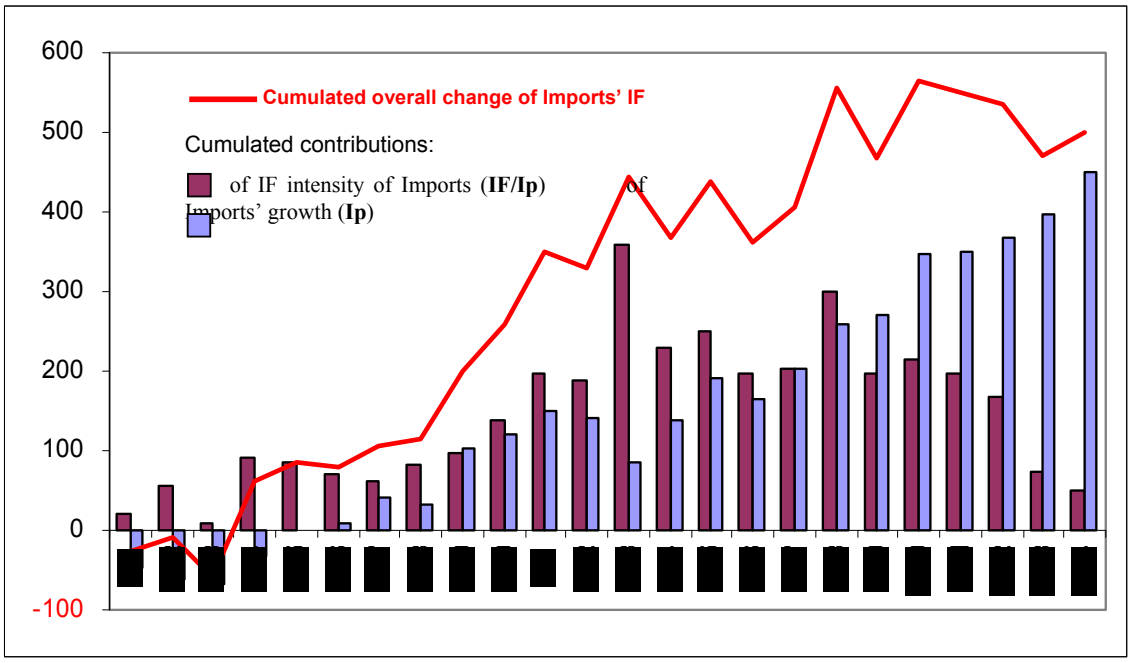
Of these two equations, it is on the first one that we will concentrate our analysis and realise a decomposition analysis properly said, and particularly on its first factor, while we will only show the overall evolution of the determinants appearing in the second equation in order to give some hints on the reasons of their growth.

### *2.2 The contributions of the changes in Imports' quantity and their average IF intensity to the overall change of IFs*

Figure 5 shows the results of the two-factor decomposition of total IFs, based on equation 1[3].

The continuous line shows the overall cumulated change, calculated on a year-by year basis, while the bars show the cumulated contribution given to each of the factors.

**Figure 5 – Decomposition of Italian Imports' IF change: cumulated effects and contributions of IF intensity and direct Import's growth, 1980-2004 (million tons)**




It can be noticed that the cumulated contribution of Imports' growth is steadily increasing. This reflects the steadiness Imports' growth itself, already noted in section 1 (figure 2). On the contrary the behaviour of IF intensity's contribution is very interesting: after reaching peaks in 1993 and 1998 it fell, almost becoming null. This means that the year-by-year contribution was negative from a certain point onwards, i.e. that the average IF intensity of Italian Imports was falling. As this factor is the one displaying the most interesting dynamics, the focus of our analysis will be on it.

[3] Thanks to the more timely availability of foreign trade data with respect to other components of TMR, it has been possible to include also 2004 in the analysis of the IFs.

### *2.3 Macro driving forces of physical Imports' growth*

Before going into a deeper analysis of Imports' IF intensity, let us briefly consider the factors behind the steady growth of Italian physical Imports, highlighted by equation 2 (figures 6 to 8).

It can be noted that the growth of the Italian economy goes along with an increasing openness of the domestic market: residents' purchases from the rest of the world were around 15% at the beginning of the 1980ies and passed 25% at the end of the 1990ies. The positive contribution to Imports' growth in physical terms of these two factors, however, is partially counterbalanced by the reduction of Imports' weight per unit value.

**Figure 6 – Gross Domestic Product, Italy, 1980 - 2004 (billion Euros, chain index-based real values)**

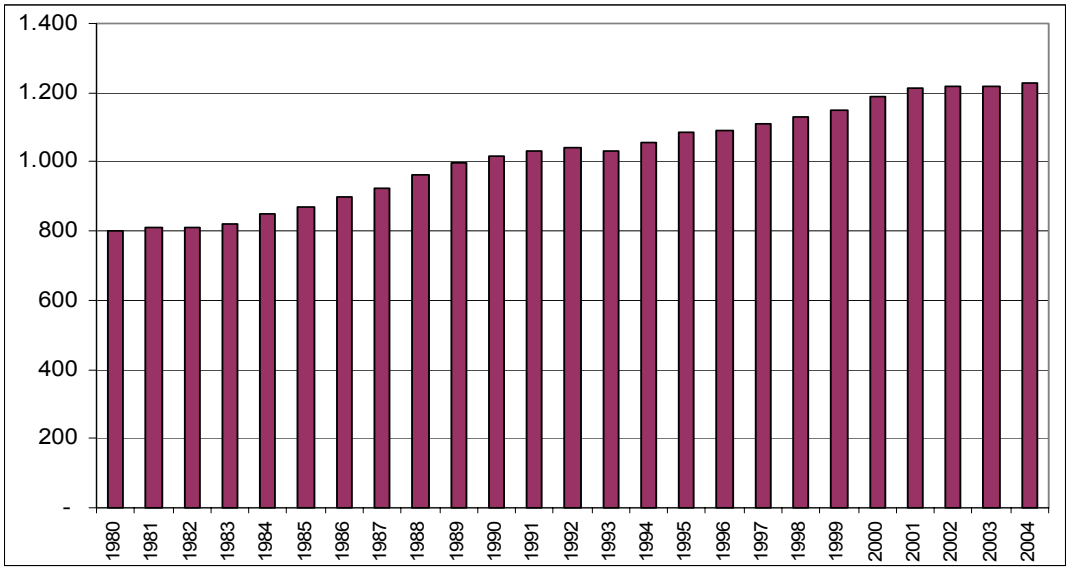



**Figure 7 – Imports' penetration (value of Imports on GDP), Italy, 1980 - 2004 (from chain index-based real values of Imports and GDP)**

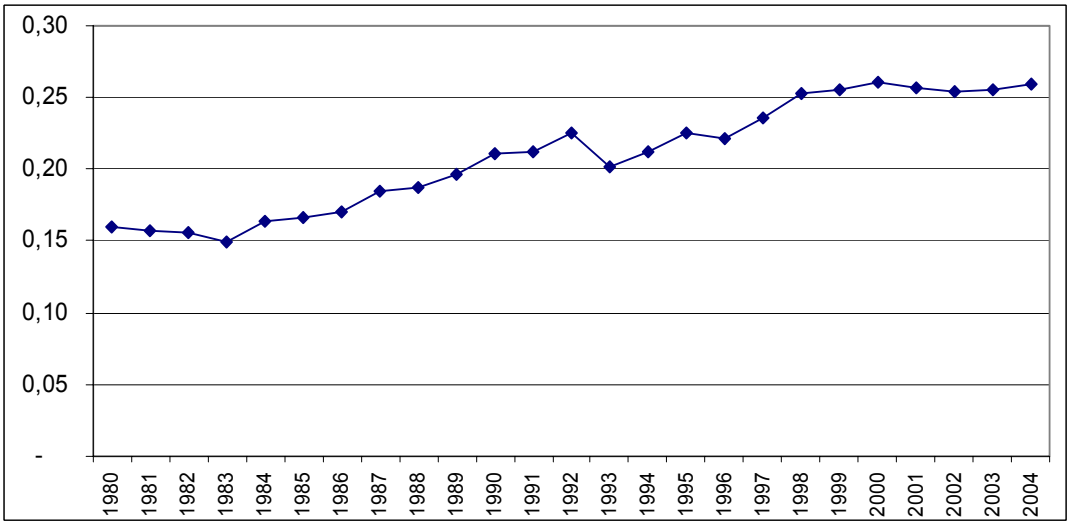
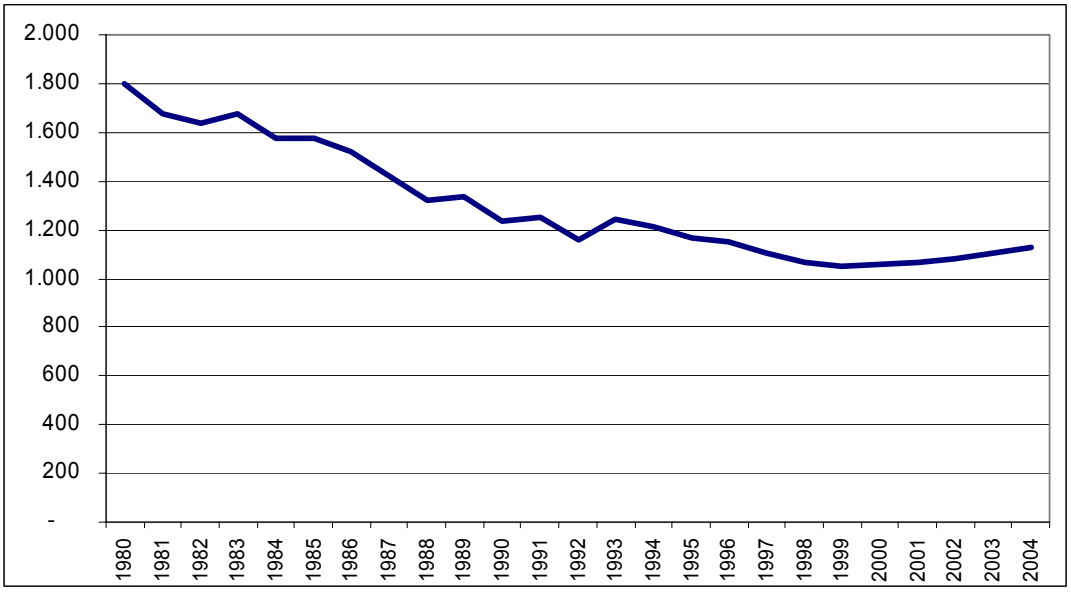


**Figure 8 – Imports' weight per unit value, Italy, 1980 – 2004 (tons per million Euro, from chain index-based real values of Imports)**



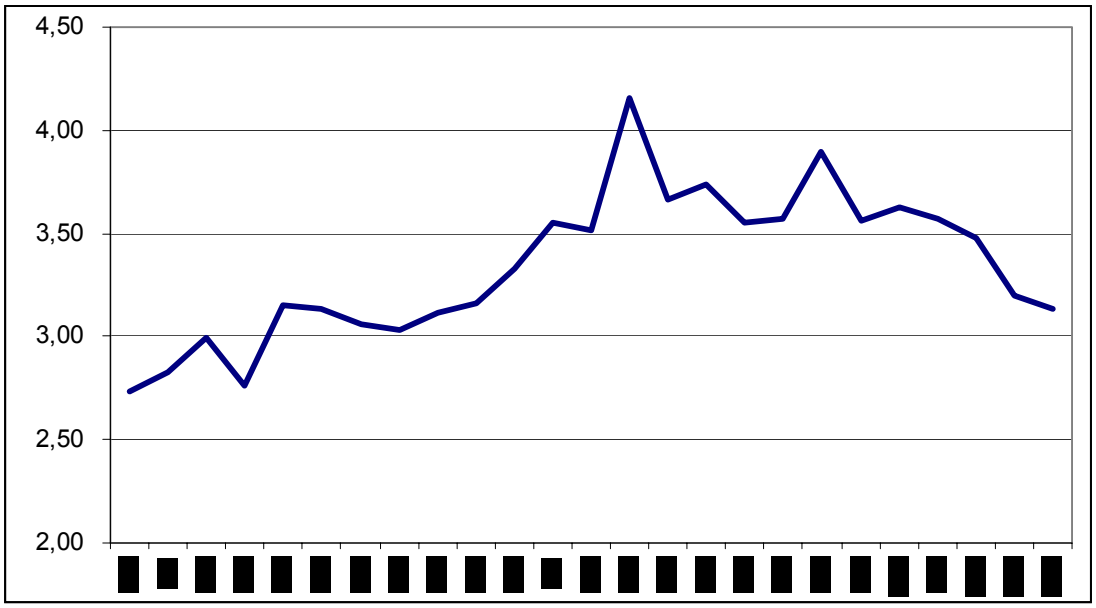

The latter factor can be put in relation to a phenomenon of "tertiarisation" of the Italian economy, i.e. to the shift of domestic economic activities' composition away from industrial transformation in favour of service activities. A consequence of this shift is that the composition of imports also shifts in favour of more elaborate industrial goods than raw materials. The latter have – *ceteris paribus*, and in particular for products within a same production chain (e.g. iron ores with respect to steel) – higher material content per unit value than manufactured goods. Indeed, the very nature of industrial transformation processes implies that value is *added* while matter is *subtracted* from circulation in the economy (and given back to the environment). This is all the more true for the early stages of industrial transformation, i.e. for activities that have since long stopped growing in Italy, while both production and consumption activities that require semi-finished and finished industrial goods continue growing. In a sense, the downward trend of Imports' weight per unit value is the other side of the coin of the Imports' penetration phenomenon.

We did not disentangle and measure the individual contributions of these factors, as they appear clear enough for our purposes from the above graphs.

## *2.4 Overall IF Intensity of the Italian Imports: two sub-periods*

Figure 9 shows that the Italian Imports' composition has substantially changed during the period under analysis. In is evident how in the 1980ies and early 1990ies there was a shift in favour of products with a higher material "rucksack", while the opposite tendency prevails for the years after 1993. These may be either different products, or – to the extent that the calculation of IFs is made by using different coefficients according to the country of provenience – the same products having different origin.

**Figure 9 – Indirect Flow intensity of Imports', Italy, 1980 – 2004 (tons per ton)**




The relationship between the evolution of this factor and Import's weight per unit value is an intriguing one, that would deserve more attention than what we can give to it now. It may be noticed however, that in the first sub-period (1980-1993) the growth of IF intensity is accompanied by a fall in weight per unit value, while in the second (1993-2004) at the same time the weight per unit value continues to decrease– though much slower – the IF intensity decreases from its peak of more than 4 tons of matter discarded abroad on average per ton of imported matter to around 3.1 tons per ton.

The dynamics of the first sub-period are easily explained, as they are an obvious consequence of the matter subtraction/value addition process mentioned above. Much less intuitive are the reasons for the second sub-period's trends, which cannot be interpreted as the result of a simple shift downward along given production chains of Import's composition, but hint to a quite complex change of the basket of semi-finished and finished goods produced and consumed by the Italian economy.

## *2.5 Decompositions of IF intensity (shift-share analysis)*

### 2.5.1 Overall IF intensity as a weighted average

The overall IF intensity can be expressed as a weighted average of the individual imported goods' IF intensities, with weights given by their share in total physical Imports:

$$3) \qquad IF_{tot} / Ip_{tot} \equiv \Sigma_i (IF/Ip)_i * (Ip_i / Ip_{tot})$$

The first factor is a fixed one for most goods: only those calculated on a country-of-origin basis may change, as a consequence of the changing of the composition of their total import by country of origin.

However, if *i* is taken to indicate groups of goods, rather than individual goods, the same equation may be used for disentangling the contribution of the changes that take place inside the groups from the changes in the composition by group. The goods can be grouped in many different ways: some groupings will show that the change in the overall IF intensity is the result of changes *between* the groups rather than *within* them, some the opposite. It is by considering and comparing the results obtained from different groupings that useful insights on the reasons of the overall change can be gained.

The effects of year-by-year changes in imports' composition are calculated assuming that the IF intensities of the individual Imports' groups remain equal, for each couple of subsequent years to the average of these two years. The effects of the changes of the groups' IF intensities are calculated similarly by keeping constant for each couple of subsequent years the composition by group. The cumulated effects are given by the sum of year-by-year changes.

### 2.5.2 Dimensions of the analysis (groupings of the imported goods)

The analysis described above has been performed with reference to the following groupings of the goods:

- by kind of material embodied in the imported goods: four groups of goods have been identified on this basis, according whether made prominently from biomasses, fossil fuels, minerals or more than one of these materials (*i*: B,F,M,P);
- by individual commodity (*i* = 8-digit codes of the Combined Nomenclature).
- by geographical origin, according to the continent to which the exporting countries belong (*i*: Africa, North America, South America, Asia, Europe, Oceania);
- by use destination, according whether the imported goods are going to producers for further transformation or directly to investors and final consumers, or are suited for both kinds of uses (*i*: intermediate/final/mixed).

Due to the existing limits to the availability of details in foreign trade basic data, the analysis has been possible only for the years 1988 onwards as for the first kind of grouping, for 1991 onwards for the other two. For these in the following we restrict the presentation of the analysis to the 1993-2004 period, as this has been identified as the most interesting one as for the dynamics of the IF intensity. Moreover, the second and third groupings have been applied to all commodities for which coefficients are available that are differentiated according to the country of origin; nevertheless we will present only the results concerning mineral ores and precious metals as these represent the most important category.

## *2.6 Analysis by kind of material*

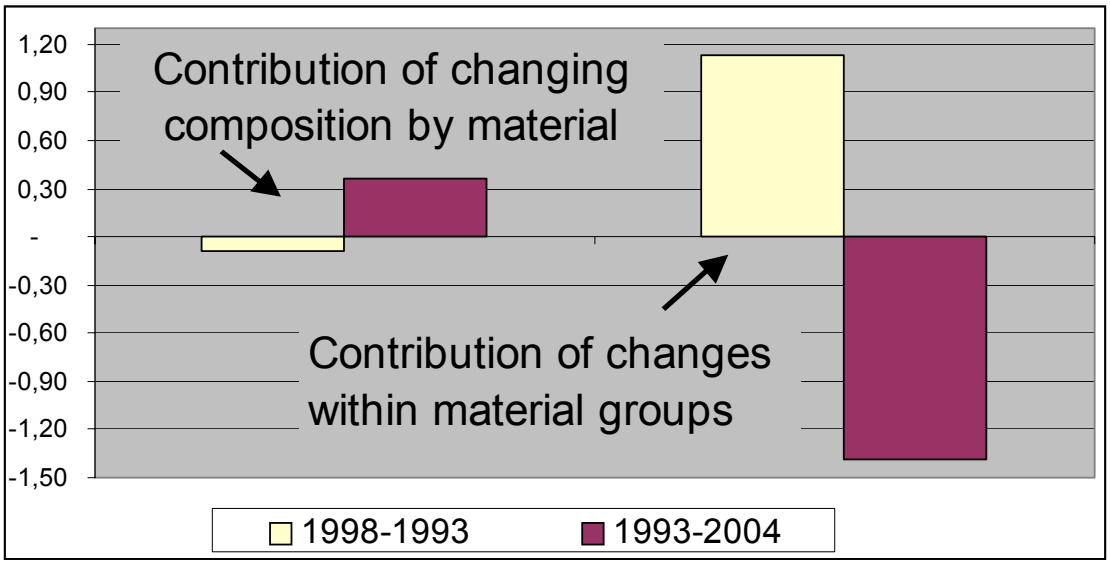
### 2.6.1 Overall cumulated change

The following groups of goods have been identified:

- Biomasses and products thereof, representing on average 16% of imports and 9% of IFs in the 1988-2004 period. The IF intensity of the group is little more than half the average;
- Fossil fuels and products thereof, representing on average 59% of imports and 14% of IFs. The IF intensity of the group is around one fourth the average);
- Minerals and products thereof, representing on average 24% of imports and 76% of IFs. The IF intensity of the group is more than thrice the average;
- Composite products, i.e. products where materials of more than one kind are assembled together, representing on average 1% of imports and 1% of IFs. The IF intensity of the group is around average.

Figure 10 shows the cumulated effects on the overall IF intensity of Italian imports of their changes in composition by material and of the changes in the average intensities within these material groups, the effects of each of the two factors having been cumulated on the basis of year-by-year contributions to change.

**Figure 10 – Overall Imports' IF intensity change: analysis by kind of material, cumulated contributions, Italy, 1993-2004 (tons per ton)**




It can be noted how the two sub-periods display opposite trends, as in the first sub-period the contribution of the changing composition is slightly negative while that of the changes within each material group determines the overall trend of increasing IF intensity, while in the second sub-period the opposite occurs, again with a much stronger effect of within-group changes.

### 2.6.2 Some underlying dynamics

Let us now have a closer look and consider the most important underlying dynamics.

**Figure 11 – Composition by material of Imports: minerals' and fossil fuels'shares, Italy, 1993-2004**

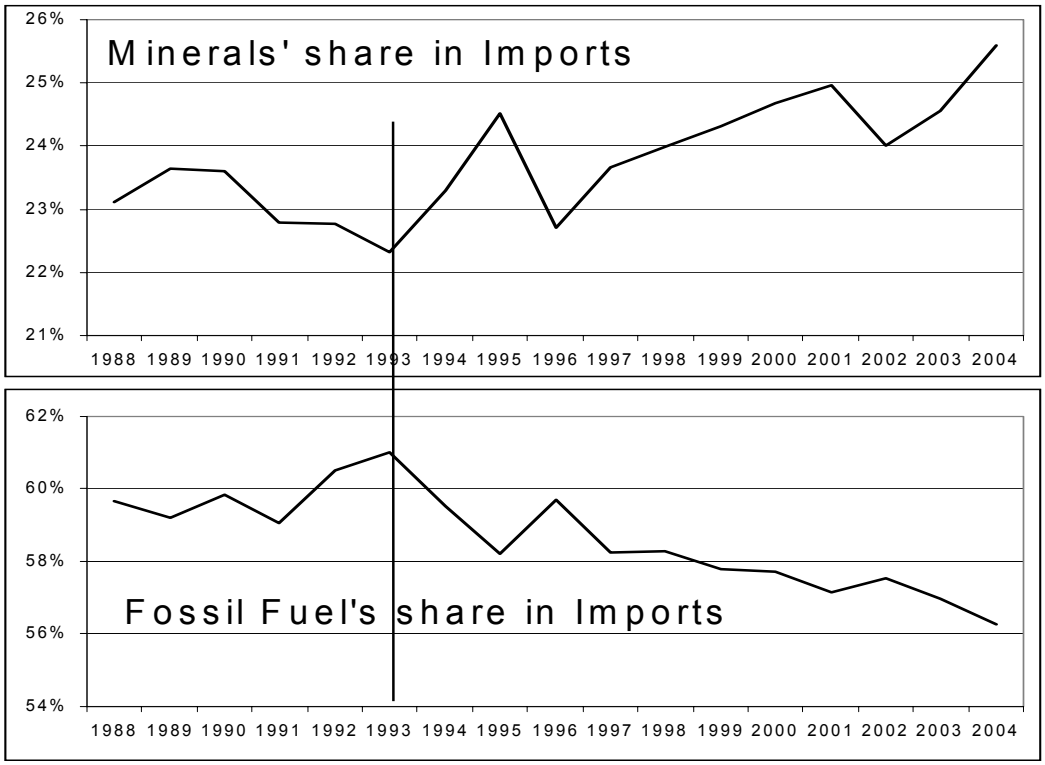
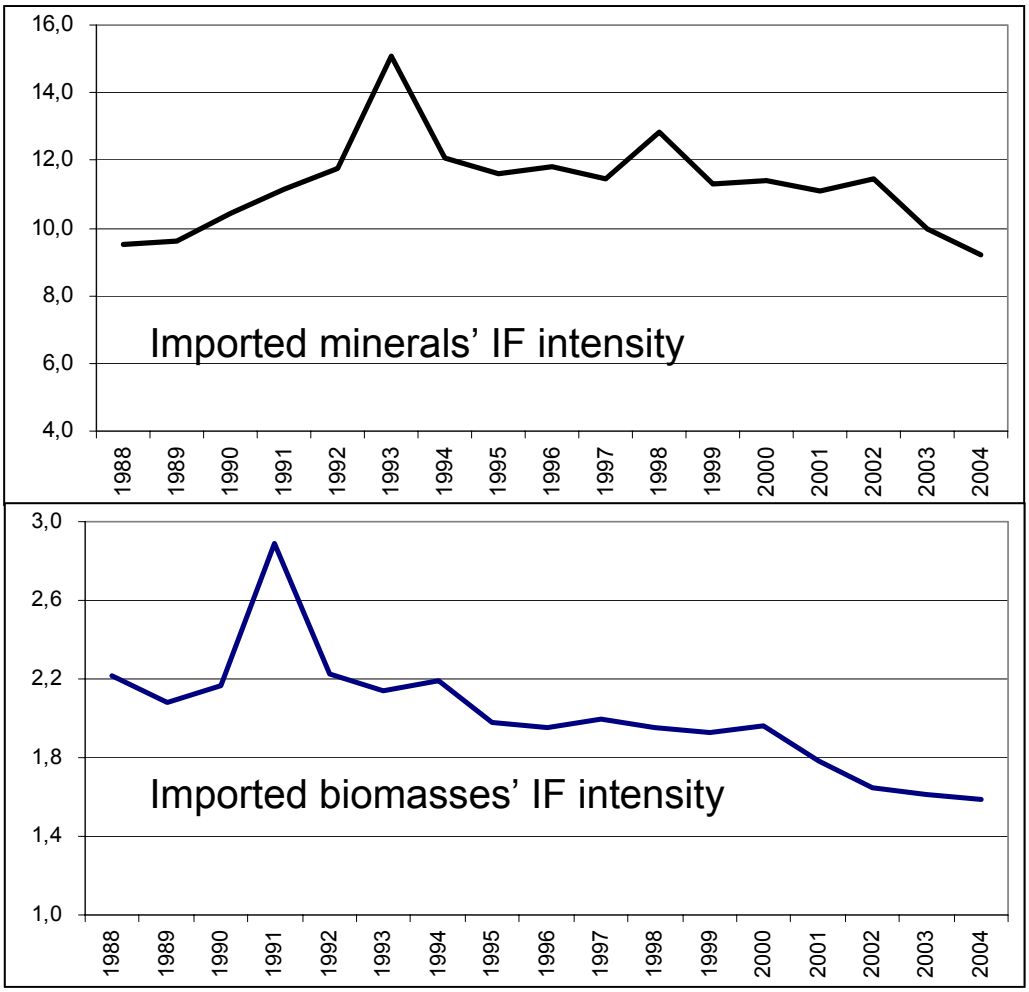


Figure 11 shows the diverging trends of fossil fuels' and minerals shares in Imports, and highlights 1993 as a point of reversal of the trends. As pointed out above, the IF intensity of minerals is well above average, so an increase of their share leads to higher overall IF intensity. The opposite can be said for fossil fuels. Biomasses have been excluded from this figure as their share does not show relevant changes.

Figure 12 shows the evolution of Imports' IF intensities of minerals and biomasses. It can be appreciated how both decline, respectively starting from 1993 and 1991. This time we have excluded fossil fuels, as their IF intensity series is stationary.

As it is minerals that have the highest share, it is mainly the dynamics of their IFs that dictates the overall trend of the IF intensity of Italian imports. This is all the more true for the years 1993-2004, where their share in Imports grew.

**Figure 12 – IF intensity of Imports by material: minerals' and fossil fuels'shares, Italy, 1993-2004 (tons per ton)**



## *2.7 Analysis of some mineral Imports' IFs*

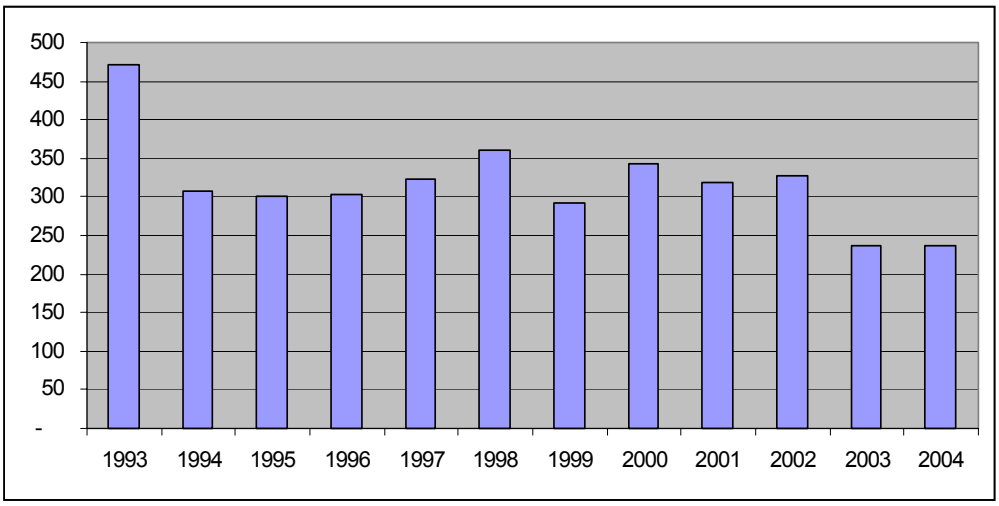
### 2.7.1 The included items: ores and precious metals

We have performed an effects decomposition based on equation 1 for the Indirect Flows of all imports for which coefficients by country of provenience are available. These belong to the minerals and to the fossil fuels categories. In the following, only the analysis for the first ones is reported, in view of the importance of minerals for the overall trends, highlighted above.

The products considered here are metal ores and refined precious metals. These categories are by far the most important contributors to overall IFs in relative terms, as they represent on average in 1993-2004 only 0.9% of total direct imports and 28.9% of total IFs, with an IF intensity that is 30 times above average.

As shown in figure 13, the IFs associated to these materials' Imports decreased significantly from 1993 to 2004, mainly due to a sharp fall in 1994.

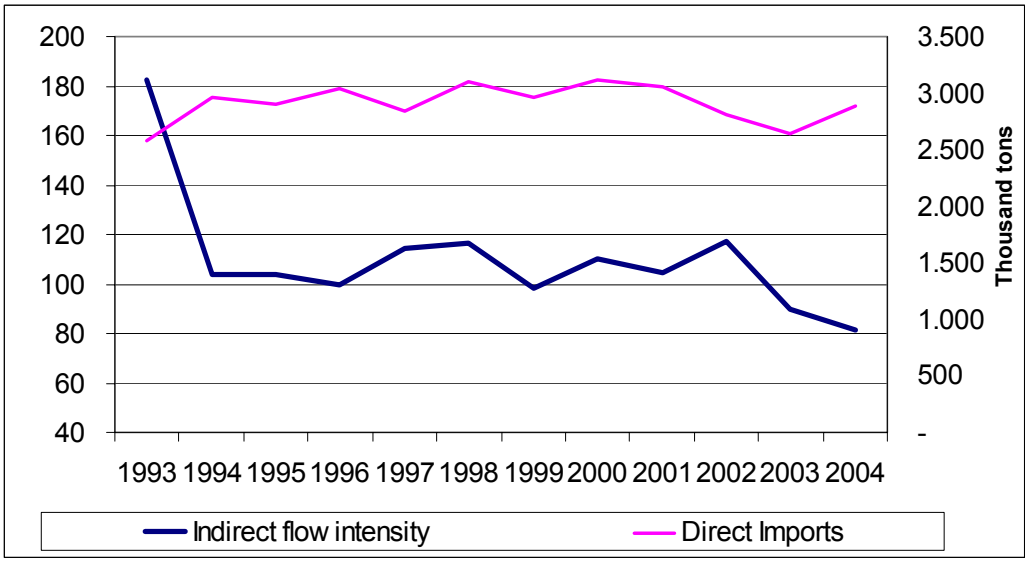
**Figure 13 – Indirect Flows associated to Ores and precious metals' Imports, Italy, 1993-2004 (million tons)**




### 2.7.2 First-level determinants

Figure 14 shows the first-level determinants of the IFs depicted in figure 13. Their respective contributions appear quite clear by immediate comparison with figure 14 needs no highlighting.

**Figure 14 – Direct imports (right axis, thousand tons) and average IF intensity (left axis, tons per ton) of ores and precious metals, Italy, 1993-2004**

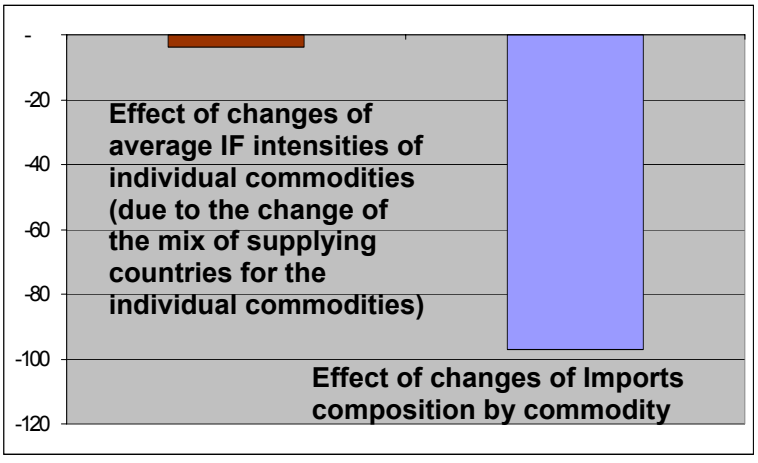



### 2.7.3 Analysis of the IF intensity – changing composition by individual commodity

We first applied equation 3 to the group of products specified above with reference to the individual products ($i$ = 8-digit codes of the Combined Nomenclature).

As figure 15 shows, the calculation of the cumulated effect leads to the conclusion that the change of mix in supplying countries did not have almost any importance. Indeed the change is almost only due to the shift between products, i.e. towards ores and minerals with lower average coefficients. If the sources for the individual materials have changed, this has not resulted in great changes of the average coefficients by product, i.e. changes may have occurred as for the supplier countries of a given commodity, but such that they tended to compensate each other in terms of IF intensity for that commodity.

**Figure 15 – Ores and precious metals Imports' IF intensity change: analysis by individual commodity, cumulated contributions, Italy, 1993-2004 (tons per ton)**



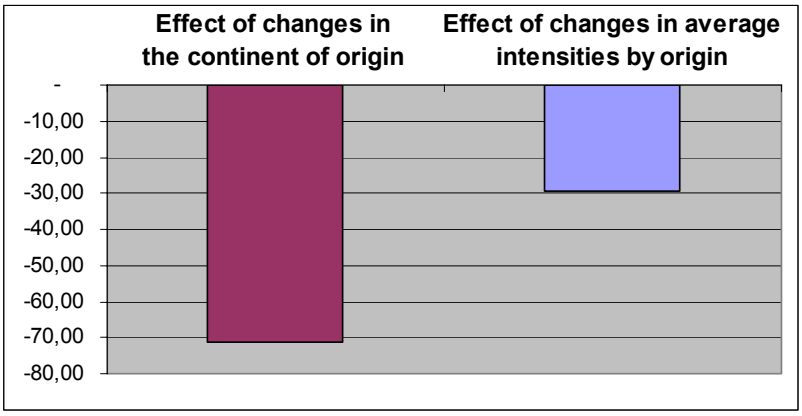

However, different products may come from different countries. Does the change in products go along with a change in the supplying countries?

### 2.7.4 Analysis of the IF intensity – changing composition by sources

#### *2.7.4.1 Overall cumulated change*

We then applied equation 3 to the group of products specified above with reference to the continent to which the country of origin of the product belongs (*i*: Africa, North America, South America, Asia, Europe, Oceania). Figure 16 displays the overall cumulated results of this application, showing that the answer to the question posed above is affirmative: more than 70% of the change in average intensity is due to the change of supply sources in terms of the continents they belong to.

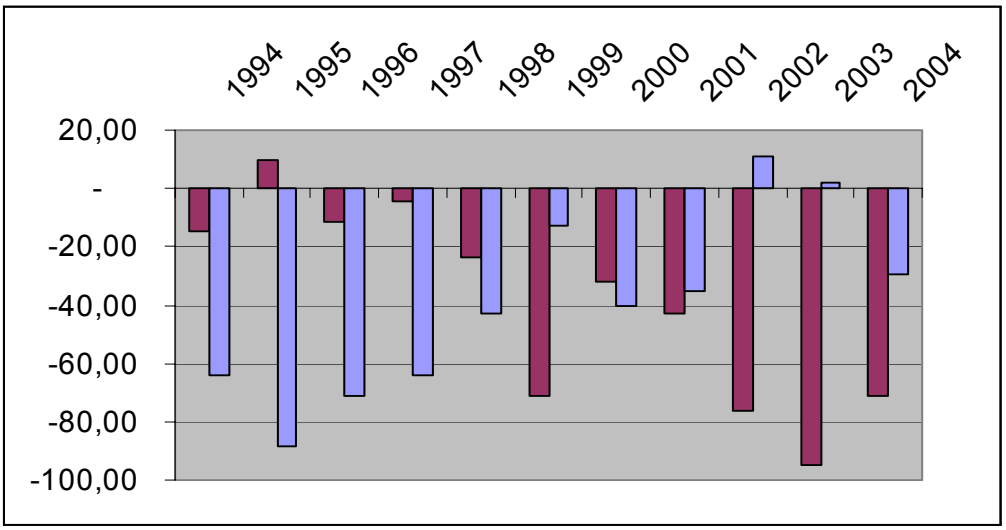
**Figure 16 – Ores and precious metals Imports' IF intensity change: analysis continent of origin, cumulated contributions, Italy, 1993-2004 (tons per ton)**




#### *2.7.4.2 Year by year changes*

The cumulated effects conceal an interesting year-by-year dynamics. This is shown in figure 17, which displays the year-by-year cumulated effects.

**Figure 17 – Ores and precious metals Imports' IF intensity change: analysis by continent of origin, cumulated year-by-year contributions, Italy, 1993-2004 (tons per ton)**




It can be highlighted that in the first years there was a big shift between countries of the same continent, towards countries with lower IF intensity, but this was followed by an opposite tendency, which implied this factor's contribution even becoming negative in 2002 and 2003, before reaching the levels seen above. It is only in the years from 1998 that a strong new tendency emerges,

dominated by the shift towards continents with lower average IF intensity for their products (which are also different from the ones imported before, as seen above).

*2.7.4.3 Some underlying dynamics*

As figures 18 and 19 show, while the share of ores and precious metals imported from Africa fell, their unitary upstream flows increased dramatically.

**Figure 18 – Change of continent of origin of imported ores and precious metals, Italy, 1993-2004**

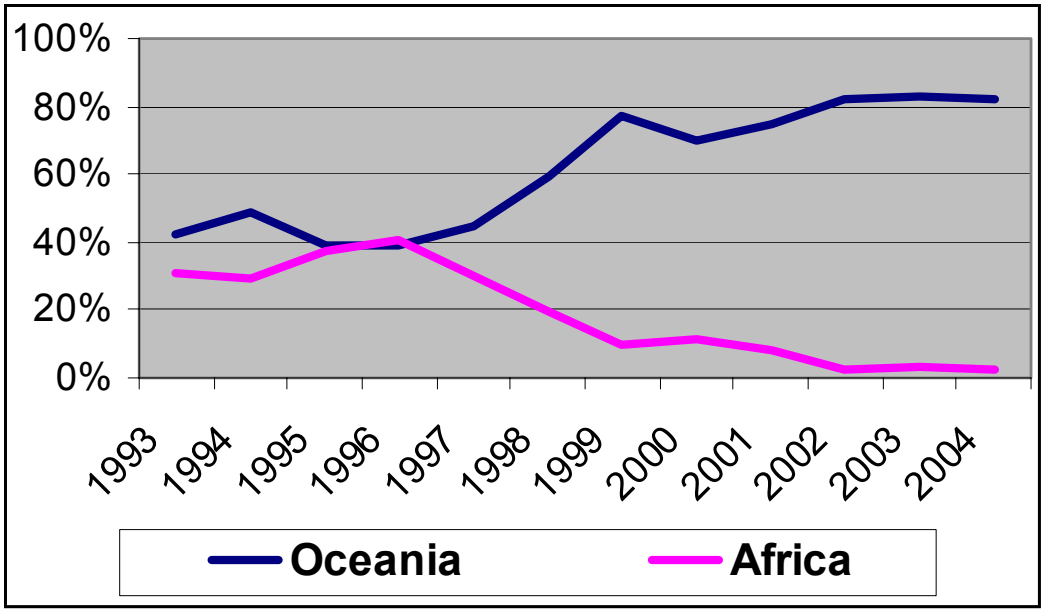
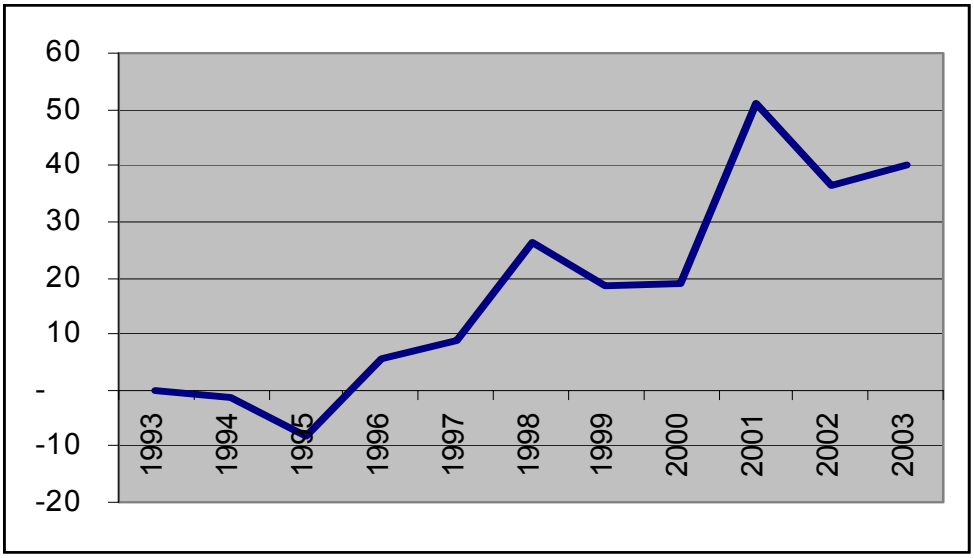



**Figure 19 – Cumulated contribution of the shift between African countries as ores and precious metals suppliers to the change of the overall IF intensity of this group of Imports, Italy, 1993-2004 (tons per ton)**



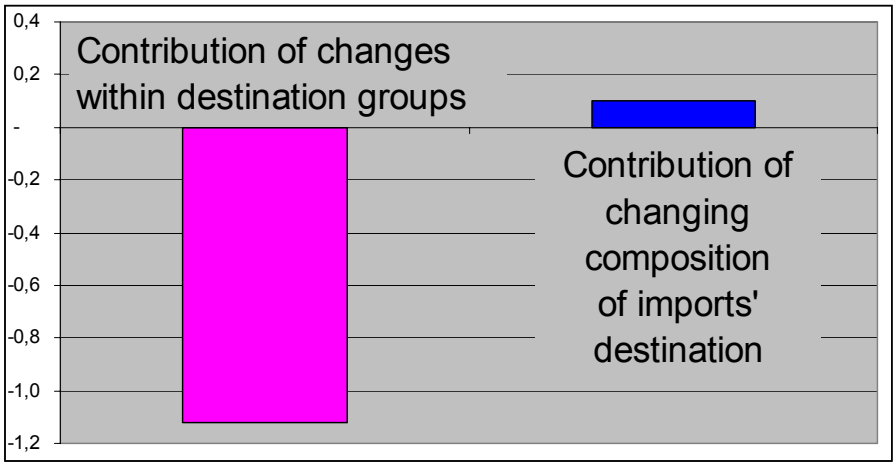
## *2.8 Analysis by use destination*

### 2.8.1 Overall cumulated change

Another dimension of our analysis is connected to the immediate destination of the imported goods, and is particularly interesting in the light of the issues introduced in section 2.4. Goods for final use tend to have on average higher IF activation coefficients, as they tend to be more elaborated and refined. With respect to this dimension we considered three groups of Imports. Information provided by Istat national accountants has allowed classifying each imported commodity, as identified by 8-digit CN codes, into one of the following groups: goods suited for intermediate uses only, goods suited for final uses only and goods suited for both kinds of uses.

The change in Imports' composition by use destination favoured the growth of IFs, as shown in Figure 21. Nevertheless, the overall tendency has been dominated by the changes *within rather than between* the groups, i.e. by a tendency favourable to the decrease of overall IF intensity.

**Figure 21 – Overall Imports' IF intensity change: analysis by destination, cumulated contributions, Italy, 1993-2004 (tons per ton)**




### 2.8.2 Some underlying dynamics

Figure 22 highlights a decrease of the IF intensity both for the goods going to intermediate uses only and for the other goods, the latter remaining higher.

**Figure 22 – IF intensity of Imported goods by destination category, Italy, 1993-2004 (tons per ton)**

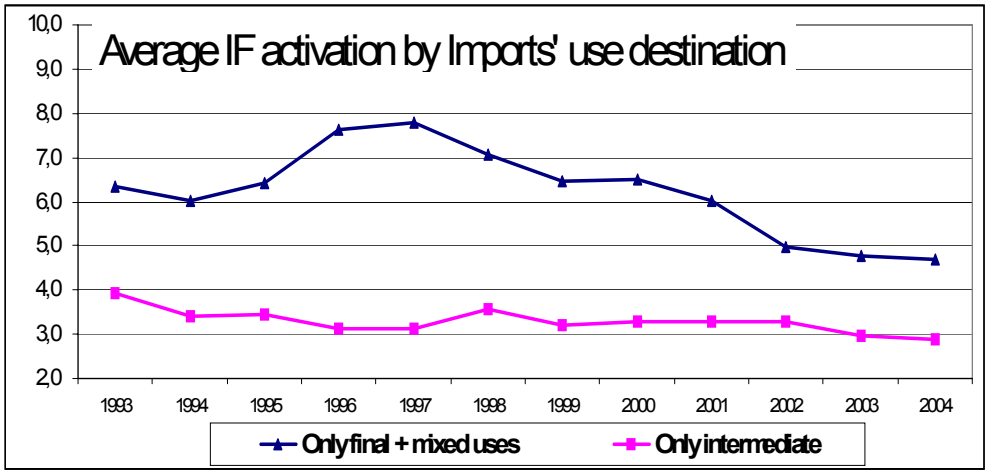
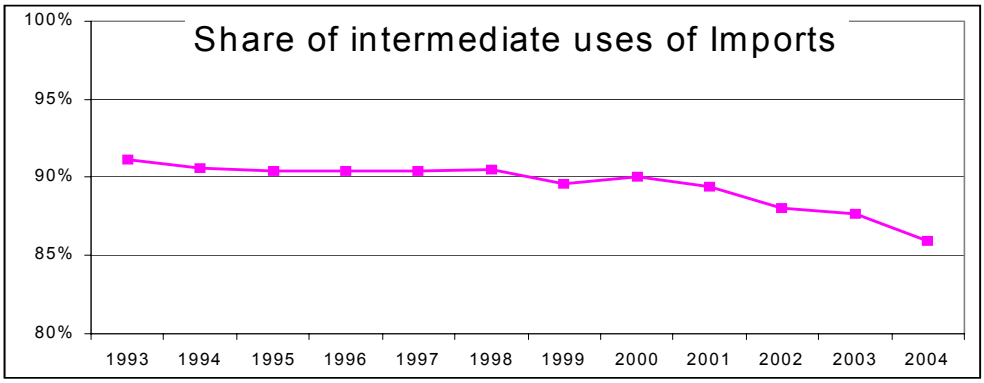


Figure 23 shows that there has been a certain shift away from the import of intermediate goods in the 1996-2004 period, confirming the tendency towards a "tersiarisation" of the Italian economy. This explains, given the IF intensities seen above, the positive contribution to overall IF intensity of the change in Imports composition by destination.

**Figure 23 – Share of the intermediate uses of Imports, Italy, 1993-2004 (tons per ton)**




# 3 Conclusions

IFs are quantitatively and qualitatively important and policy relevant. They are an important component of the total material requirements of highly developed economies and should therefore not be disregarded in a global sustainability perspective.

IFs also provide great potential for communication and for analytical purposes, some of which have been highlighted in the present paper by referring to the Italian example. The examples provided here show that it is possible to look behind macro-aggregated indicators and understand the dynamics that determine their evolution. This is valid not only for the IFs themselves but also for the even more aggregate indicators to whose construction they contribute.

The analysis examples provided in this paper are connected to a particular calculation method, but surely different methods like IO-based calculations have their possibilities as well (e.g. decomposition and shift-share analysis can be done with respect to uses by industry).

Though the current calculation methods may not be fully convincing and require refinement in order to fulfil the quality standards of official statistics, the very concept and perspective that IFs bring along enriches environmental accounts with a substantial value added. The further development and implementation of these methods appears an issue that is worth tackling.