The integration of business statistics into the French national accounts

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10th Meeting of the French National Accounting Association (Association de Comptabilité Nationale)

Paris, January 21-23, 2004

Abstract

Business statistics are a central component of the French national accounts. They include surveys and tax data, consolidated in the "intermediate enterprise system" (IES) [*système intermédiaire d'entreprises*: SIE]. Each year, the IES thus contributes to the construction of highly detailed input-output tables (IOTs) by allowing a refined valuation of *production*. It also provides an estimate of *value added* via the "income" approach.

The current *base-1995* system of national accounts comprises a *sequential* reconciliation of the three approaches to value-added estimation. An initial estimate is obtained from an intensive integration of the "final demand" and "production" approaches within the IOT. The reconciliation with the value added obtained using the IES-based "income" approach does not take place until after that initial integration. As a result, the significance of the final figure is restricted.

The base-2000 system will finalize the integration of the three approaches to GDP measurement. The reconciliation between the three value-added estimates—particularly the one obtained with the "income" approach—will be a *simultaneous* and *decentralized* procedure included in the compilation of product supply-and-use tables (SUTs). Business statistics will thus play a greater role in measuring economic growth, thanks to a reconciliation process that is more closely linked to the sources used and, consequently, more transparent.

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For the convenience of English-speaking readers, the following table lists the main abbreviations used in the text and the equations.

CI	*consommation intermédiaire*	IC	intermediate consumption
EAE	*enquête annuelle d'entreprises*	AES	annual enterprise survey
EBE	*excédent brut d'exploitation*	GOS	gross operating surplus
EF	*industrie des biens intermédiaires*	-	intermediate-goods industry (*used in equations only*)
ERE	*équilibre emplois-ressources*	SUT	supply-and-use table
SIE	*système intermédiaire d'entreprises*	IES	intermediate enterprise system
SUSE	*système unifié de statistiques d'entreprises*	USES	unified system of enterprise statistics
TEI	*tableau des entrées intermédiaires*	IIT	intermediate input table
TES	*tableau entrées-sorties*	IOT	input-output table
VA	*valeur ajoutée*	VA	value added

This paper describes arrangements for summarizing the goods and services accounts in the rebased *annual* French national accounts.[1] The new system, rebased to 2000, will be operational in spring 2005. It will incorporate several advances including a *total* harmonization of the three main approaches used to estimate GDP: production, expenditure, and income. This will complete the traditionally substantial integration of business statistics into French national accounts: *sales* in the "final demand" and "production" approaches and *value added* in the "income" approach (see box 1).

1. From the outset, business statistics have been the centerpiece of the French national accounts

Few fields draw on so large—and thus so diversified—a mass of statistical sources as national accounting. Immediately after World War II, the rapid growth of viable sources—tax data and surveys—raised the difficult issue of how to reconcile them. Governments responded in different ways.

1.1 *The "intermediate enterprise system" reconciles business statistics and tax data for national accountants*

In the late 1940s, French national accountants chose to make the maximum use of business statistics, most notably under the stimulus of a new basic chart of accounts (*plan comptable général*) introduced in 1947. They opted for a "micro/macro conversion," i.e., translating business accounts compiled at the enterprise level into the main national-accounting aggregates. Despite the conceptual divergences between the two accounting systems, this initial choice was never revoked.

The business-statistics approach and the growth of annual enterprise surveys (AESs) [*enquêtes annuelles d'entreprises*: EAEs] led to the creation of the *unified system of enterprise statistics* (USES) [*système unifié de statistiques d'entreprises*: SUSE] in the mid-1960s. USES consolidates two major categories of information about enterprises[2] centered on their accounts: (1) data collected by tax authorities, and (2) data from surveys (AESs) conducted by INSEE and ministerial statistical offices. The two sources are overlapping (income statement) and complementary (breakdown of sales by economic activity in the AESs). Extensive checking is needed, within each source but also externally by reconciling the income statements. This involves examination of non-consolidated accounts and automatic tests for intertemporal consistency.

USES is a prodigious base of individual data, but it cannot be mined directly by national accountants. They need a tool for converting micro-data into macro-data. That is the purpose of the *intermediate enterprise system* (IES) [*système intermédiaire d'entreprises*: SIE], created at the same time as USES in the mid-1970s. The IES allows the compilation of accounts by economic activity (sector) but also according to variable criteria such as principal activity, enterprise size, and location. These accounts follow a sequence: production accounts, generation-of-income accounts, and distribution-of-income accounts. The complexity of IES construction reflects the system's central role in French national accounts. Indeed, the IES field has been broadened to "extra-USES" categories such as the public-housing sector, cooperative enterprises, and State-owned enterprises (*régies*). Imputations for absent small enterprises are prepared from SIRENE (the national business register); missing accounting data (also for small enterprises) are imputed as well; lengths of accounting periods, when they differ from twelve months for large enterprises, are adjusted; and taxes on products—which are subject to different accounting treatments—are harmonized.

Despite these procedures, the IES does not directly provide the data needed to prepare the national-accounts aggregates, particularly production, intermediate consumption (IC), and value added (VA). A final operation is required, which we call *conversion to national-accounts format* (CNA) (*passage*

[1] In their *final* version.

[2] Specifically, non-financial corporations and unincorporated enterprises.

aux comptes: PAC). This mainly consists of: new imputations (for fraudulent reporting of sales figures, undeclared labor, value added tax [VAT] discrepancies, benefits in kind, rent-free accommodation, tips), differences in concepts (conversion of producer prices into basic prices, which include taxes on products), double counting for services whose production is measured by a margin, software produced for own account, and so on.

1.2 *Construction of highly detailed input-output tables each year*

The intermediate enterprise system (IES) is the bedrock of the "income" approach to measuring growth. To begin with, it provides a robust framework for the "production" and "final demand" approaches in the base-1995 accounts. In both approaches, the production of industries [French: *branches*] and products is computed from corporate sales provided by the IES. This requires complex operations including the conversion of sector sales into industry sales, the CNA, and the addition of non-market. As we shall see, the use of a single statistical source—the IES—to estimate market production in the three approaches to GDP plays a critical role in their reconciliation through the examination of intermediate consumptions.

The reconciliation is achieved with the input-output table (IOT). The construction of a detailed IOT—not only for the base year, but also for each current year—is another important feature of French national accounting. It illustrates the long-standing commitment to an integration framework commensurate with the mass of information analyzed by national accountants: tax statistics, AESs, industry surveys, customs statistics, trade-association statistics, etc. Box 2 recapitulates the major events leading up to the current IOT.

This vision of integrated national accounts relying on annual IOTs based on a wealth of microeconomic information is being gradually adopted by other European Union countries, particularly with the growth of data transmission driven by European integration.

2. The base-1995 system: a sequential reconciliation of value added that restricts the contribution of business statistics

In the base-1995 system, GDP is calculated in *two successive phases*. The *first* is a *double evaluation* of value added: (1) in the IOT, through a joint compilation (as part of an initial reconciliation[3]) of supply-and-use tables (SUTs) [*équilibres entre ressources et emplois*: EREs] by product and production accounts by industry; (2) in the IES, by consolidating the value added of enterprises obtained as the sum of compensation of employees, gross operating surplus (GOS), and taxes net of subsidies. The *second* phase consists of an *reconciliation* between these two estimates of value added.

2.1 *Value added is initially obtained by closely "integrating" the "final demand" and "production" approaches in the IOT*

The estimation of value added in the IOT relies mainly on a *product* approach based on the compilation of SUTs. But this raises a problem: value added is an industry-specific variable; unlike intermediate consumption, it cannot apply to products. In the "demand" approach, we can only estimate its *overall* value:[4]

$$VA_{dem} = \sum_p EF_p = \sum_p (P_p - CI_p) \qquad \text{("demand" approach)}$$

unlike its estimation in the "production" approach:

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[3] This reconciliation is called "row-effect resolution" [*résolution des effets lignes*]. See §2.1.

[4] EF_p denotes final uses of product p, P_p its production, and CI_p its intermediate use. VA_b denotes value added for industry b, P_b its production, and CI_b its intermediate consumption of products.

$VA_b = P_b - CI_b$ ("production" approach)

which takes place at the elementary level of more than a hundred industries. The *direct* reconciliation of these two estimates of value added, $VA_{prod} = \sum_b VA_b$ for the "production" approach and VA_{dem} for the "demand" approach, can thus only give us an *overall* figure—disregarding a wealth of detailed information at the refined level of products and industries.

The preceding equations show that, assuming identical estimates of total production of industries and products ($\sum_b P_b = \sum_p P_p$), the reconciliation of value added obtained with the "production" and "final demand" approaches is equivalent to the reconciliation of intermediate consumptions $\sum_b CI_b$ and $\sum_p CI_p$. The identity hypothesis for production of industries and production of products is acceptable since, as we have seen, both productions are evaluated from the same source: IES sales. Admittedly, some discrepancies are possible owing to the fragility of the conversion from sector sales to industry sales and the subsequent conversion from sales to production. Both conversions will be significantly improved in the base-2000 system.

Under a second assumption, pertaining to the column structure of the IOT, total IC by industries can be classified by product (this is the "projected" IC described in box 3) and thus reconciled at the *detailed level* with the IC of the SUTs. The advantage of this reconciliation procedure is that it exploits a *maximum amount of information*: the information available at the most detailed level of the three competing approaches. In practice, the reconciliation is part of the "row-effect resolution" explained in box 3.

2.2 *A final reconciliation with value added obtained with the "income" approach...*

The field of the final reconciliation is non-financial corporations and unincorporated enterprises. The current practice is a *two-stage* reconciliation.

In the first stage, we estimate *total* value added. A reconciled amount is determined after assessing the room for maneuver in the two approaches. In the IES ("converted to national-accounts format[5]"), we determine production then distribute the overall adjustment of value added by activity subsector prorated for each subsector's value added. The adjustment of each subsector's value added is then performed on the GOS. The total amount of tradable value added is therefore obtained by examining the room for maneuver in each sector, allowing for the change over time in value-added ratios (VA/Production) and margins (GOS/VA). In the IOT, the total amount of tradable value added is expressed, after determining production, as a total adjustment of IC in the SUTs with the same absolute value but an opposite sign. In practice, we modify the "product margins" of the intermediate input table (IIT) [*tableau des entrées intermédiaires*: TEI] for the products for which the SUT gives the counterpart in terms of final uses[6]—these largely consist of household consumption. In fact, it is the possibility of finding such a counterpart that determines the total amount of reconciled value added.[7] The room for maneuver is unfortunately limited: we return to this point in §2.3. We thus revise the IIT "product margins" after the overall reconciliation of value added.

Next, we reconcile the value added of the IOT *industries* with that of the IES *sectors* (benchmarked to the overall reconciliation amount). For this, we need to convert the value added by enterprise sector in the IES to the value added by industry. The procedure is extremely delicate (we discuss it in §4). The industry-by-industry reconciliation of value added leads us to revise the IIT "industry margins." The reconciliation procedure, by the way, ensures that the sum of the new IIT industry margins

[5] As noted earlier, the conversion to national-accounts format consists in assessing the IES aggregates—in particular, production, IC, and value added—in accordance with national-accounting concepts whereas they are spontaneously measured according to business-accounting concepts.

[6] Production being predetermined.

[7] Concretely, the overall reconciliation of value added takes place at a meeting attended by the chief statistician in charge of household consumption.

matches the sum of the new product margins obtained from the overall reconciliation of value added. Lastly, we readjust the IIT to the new product and industry margins using a classic RAS (restrictive additive Schwarz) method.

The value-added reconciliation procedure for the base-year 1995 system is shown in chart 1.

2.3 *...that still restricts the use of business statistics*

In practice, we may find a significant gap between the value added obtained (1) by reconciling the "final demand" and "production" approaches, and (2) from the IES converted to national-accounts format. The reconciliation between the two estimates consists largely in benchmarking the sector accounts in level terms to the IOT value added, while trying to harmonize the rates of change. There are several reasons for this.

First, we lack sufficient economic information to make a serious case for a quantitative reconciliation (or even simply a qualitative one!) at the *overall* level. We have information on IC for some industries at best (the "real-data cells" [*cases fixées*] of the IIT). However, as IOT production is not fully consistent with IES production converted to national-accounts format,[8] reconciliation is not an easy task even for these industries.

Second, the IOT is largely complete when the value-added reconciliation begins: the IOT summarizes a considerable body of work carried out by about thirty "sector-product officers"[9] with the team in charge of summarizing goods and services accounts in the national accounts. It is therefore too late to make more than marginal changes in the IOT. Recall that changing the value added of an IOT industry means changing the industry IC (as production is determined at the start of the statistical operation for a final account) and thus the IC uses of many products (particularly in wholesale/retail trade and business services). Now it would be unthinkable, at this stage, to revise more than a handful of SUTs. Moreover, as SUTs have few final uses at the refined level at which they are compiled[10]—and, as a rule, those uses are already reconciled (e.g., gross fixed capital formation: GFCF) or exogenous (consumption, foreign trade)—the standard practice is to manage the reconciliation in the IIT, at the cost of distorting the table.[11]

3. The base-2000 system will finalize the integration of the three approaches to GDP measurement

The methodology for determining GDP and its growth will therefore be further refined in the future base-2000 system of French national accounts. The aim is an even fuller implementation of the principle of a dual reconciliation of value added via ICs in the supply-and-use tables. In addition to the IC evaluated spontaneously by the "sector-product officers" in the SUTs and the projected IC, there will be a third estimate of IC by product, paired with the sector value-added figures computed from the IES. The reconciliation between three approaches to value added will thus be achieved totally and simultaneously during the preparation of the SUTs.

[8] See §1.2. Fixing this problem is one of the priorities in the preparatory work on the base-year 2000 system.

[9] *Responsables secteurs-produits* (RSPs): the experts in charge of preparing SUTs.

[10] About 500 products.

[11] If we want to change the value added of two industries that are identical in absolute terms but carry opposite signs, we must transfer equivalent amounts of IC from one industry to the other. However, as the two industries have different technical coefficients, the transfer will inevitably undermine the robustness of the latter.

3.1 *The reconciliation of the three value-added estimates will be simultaneous and decentralized during the preparation of SUTs*

In practice, the examination of row-effects (see box 3) will therefore remain the reference framework for the "sector-product officers," but there will be three types of product intermediate consumptions instead of two: (1) the IC obtained from the spontaneous balancing of the SUTs, assessed by the "sector-product officers," (2) the projected IC, as in the base-1995 system, and (3) a new assessment of product IC essentially derived from the intermediate enterprise system (IES).

§3.2 describes in detail the procedure for evaluating the third IC. It will be the *target* of our statistical efforts: it will take precedence, in the processing of "row-effects," over projected IC (which tends to freeze the technical coefficients). This is consistent with the conclusions of the audit of French national accounts, which recommended the "income" approach.

The decision to incorporate the *entire* reconciliation of the three approaches to value added in the preparation of SUTs meets the dual objective of making *optimal use* of a *maximum amount* of statistical information: business statistics via the IES, consumption statistics, trade statistics, and so on. The best way to attain this dual goal is to *decentralize* the reconciliation among the "sector-product officers," as they possess the information and are largely responsible for producing it.

Some principles will need to be applied. A "band" around the target IC may be defined, and the "sector-product officers" would have to bring the spontaneous IC in their SUTs inside the band. The SUTs whose IC is the only domestic use would, of course, be exonerated from reconciling their value with the target IC. These cases mainly concern SUTs for intermediate goods. For such goods, the trade-flow assessments are reliable. The production figure is not in doubt, since it is obtained from the IES. As a result, the spontaneous IC in the SUT is naturally preferable to the target IC.

Projected IC will still be computed, but its status will be that of ancillary information supplied to all players (along with the industry value-added rates). There will have to be arrangements for taking into account the two types of "real data" cells: the *permanent cells* (designed to incorporate new information) and the *non-recurring cells* (a strategy for eliminating a row-effect).

This reconciliation procedure is shown in chart 2.

3.2 *Expressing IES value added as product IC*

The concrete implementation of this new procedure for summarizing the goods and services accounts requires another procedure for transforming sector value-added figures obtained from the IES into intermediate consumption of products. The procedure consists of three successive stages.

The *first stage* is the conversion from sector value added to industry value added. This conversion plays a substantially greater role than in the current base-1995 system, so it reliability must be improved. The method will therefore be revised when the base-2000 system comes into effect (§5). The only industry value added thus obtained is that of the "non-financial corporations and unincorporated enterprises" institutional sector. We must therefore add the value added of the other institutional sectors: financial corporations, general government, non-profit institutions serving households, and households. For certain industries, either the value added obtained from the sector-to-industry conversion (e.g., "freight transportation" and "recycling") is regarded as unreliable, or we have a better estimate elsewhere, as in a satellite account (in particular, "private research" and "housing services"). In such cases, we will substitute the exogenous data for the value added obtained from the sector-to-industry conversion.

The *second stage* is the transformation of the resulting industry value added into industry IC: for this, we subtract the industry value added from the industry production figures—which are also the product production figures in the SUTs. The perfect consistency between the production figures derived from the *sector* accounts and the *product* SUTs is a prerequisite for the efficiency of the reconciliation procedure. Otherwise, the IC obtained in this second stage would not be comparable with that of the SUTs. Achieving consistency is not easy, despite the fact that both production figures derive from the same source: IES sales statistics. The production figure in the industry accounts will have to take into account, in particular, the statistical adjustment between sales and production performed by the "sector-product officers" in some circumstances (e.g., when production is known independently of sales, or to correct double counts that should have been dealt with at the sales level or cannot be so dealt with: for example, production measured by a margin). This adjustment of production in activity subsectors will be matched by a equivalent adjustment of IC in the standard accounts.

The *third stage* is the breakdown by product of industry ICs: by summing the IC of each product by each industry in the economy, we obtain the "target" IC for the "sector-product officers." The "projected" IIT comes into play here (see box 2). As the IES value added is expressed in value terms, we need to convert the projected IIT in volume terms into IIT in value terms.[12] To do this, we apply to each cell in a row—i.e., in a product—the price index for the IC of that product. The only index available is the SUT price index for the product. We shall return to the weakness of this index and, most important, its fluctuations with each IOT iteration.

3.3 *The consistency between SUTs and sector accounts will increase*

When a new base is implemented, a new IIT is usually estimated in *value* terms. For this purpose, we use the breakdown of industry intermediate consumptions by product. For the base-2000 system, we will prepare a summary of goods and services accounts for 1999. We have already calculated an IIT in value terms for 1999. By preparing a 1999 summary under the base-2000 system, we will be able to define the maneuvering room that should be granted to "sector-product officers" for treating row-effects: this is practically equal to the width of the band around the IES IC, in which they will have to fit the spontaneous IC of their SUTs. Because of the lesser reliability of the IES in some sectors, the band will, no doubt, be managed more flexibly than in the base-1995 system.[13] The management will reflect the looser or stricter choice (or, more pragmatically, the possibility) of pegging the growth measure to the direct measure of corporate value added.

For *each product*, the "sector-product officers" will have to reconcile two proposed IC measures (see box 1): their own, and the IES intermediate consumption. The reconciliation will basically be achieved in the *product* SUTs:

Production + valuation[14] = IC + final uses[15]

But also, ideally, the figures should be reconciled simultaneously for *each sector*, within the framework of the IES "standard account"[16]:

Production = IC + GOS + Compensation of employees + Taxes - Subsidies

The main focus will be on GOS, but the value-added and margin rates will be checked as well. This two-pronged reconciliation would make the term "sector-product officers" totally appropriate. Most important, it would permit the simultaneous use of all the statistical information available, both on corporate accounts and on the exogenous variables: consumption and foreign trade.

3.4 *Should we reconcile levels or growth rates?*

[12] In the base-1995 system, row-effects are processed in *volume* terms: the projected IC is naturally in *volume* terms (i.e., at year-earlier prices), as the assumption of fixed technical coefficients concerns "physical" data, whereas the IC of the SUTs is naturally in *value* terms. The SUT IC is therefore deflated as part of the preparation (balancing) of SUTs in volume terms.

[13] ±2% regardless of product.

[14] Margins, taxes, and subsidies.

[15] Of which "exports net of imports."

[16] At least the portion restricted to the production account and generation-of-income account.

As described, the new procedure for summarizing the goods and services accounts concerns value-added *levels*. This is the only possibility for the base year. However, starting from the first current year, there is an alternative: instead of comparing value-added *levels* obtained with each of the three approaches, we can compare their respective changes on year-earlier levels *before* reconciliation.

For this purpose, the conversion to industry figures would not involve the value-added levels of the IES, determined spontaneously from the conversion to national-accounts format. Instead, we would use the levels obtained by applying (1) the rates of change determined spontaneously from the IES converted to national-accounts format to (2) the *reconciled* year-earlier levels (the value added of subsectors in the integrated economic accounts table).

Now the two procedures are not equivalent, as the reconciled value added will always diverge, to some extent, from each of its three pre-reconciliation estimates. In particular, there will never be complete convergence with the IES value added. This discrepancy does not arise with the other two approaches: whereas the IES is constructed autonomously (§1.1) year after year, the SUTs and IIT are compiled in growth terms by comparison with the previous-year tables of *reconciled* figures. The only aggregate determined in level terms (for a final revision) is production, but its evaluation is common to the three approaches (§3.3).

The base-1995 system gave precedence to the reconciliation of rates of change over that of levels. As a result, after a few years, the level gap between value added obtained spontaneously with the "income" approach (IES converted to national-accounts format) and reconciled value added became significant—on the order of about €20 billion. If we want to give priority to the "income" approach in the base-2000 system, we must stop the drift. This is an argument in favor of a reconciliation with the spontaneous level of IES value added rather than with its direct rate of change. However, the issue remains open.

4. The new sector-to-industry conversion procedure for value added will be at the core of the system

In France, we do not have elaborate accounting data for local business units [*établissements*], and so we cannot directly prepare generation-of-income accounts for industries treated as groups of local business units. A sector-to-industry conversion is thus inevitable.

The sector-to-industry conversion of IES value added makes use, in one way or another, of the sector-to-industry conversion matrix for production. The matrix shows the value of the production generated by each sector in each of the industries where it operates. Recall that total sector production is supplied by tax sources, while its distribution by industry is provided by the annual enterprise surveys (AESs).

In the base-1995 system, each sector's value added is broken down by industry in the same way as production. The sector-to-industry conversion procedure consists in assigning to a sector the same value-added rate in each of the industries where it operates: the overall sector rate. In consequence, *the value-added rate for an industry is the average of the sector value-added rates weighted by the share of each sector's production in the industry's total production*.

In this procedure, the least satisfactory estimates concern weights: the sector sales breakdown by industry is given by the AES but is not very reliable. But the method's basic weakness is fairly clear: it assumes that an enterprise operating in two industries as distinct as a manufacturing industry and a wholesale/retail industry—a common occurrence—will generate the same value added in both. This assumption is questionable: in manufacturing, value added typically ranges from 30% to 40%; in wholesale/retail, it can easily exceed 60%. As a sector value-added rate is *effectively* the weighted average of such widely diverging rates, assigning sector value added by means of the method described above entails a narrowing of the range of industry value-added rates. Indeed, when we compare the industry value-added rates obtained from the IES using this procedure with the industry value-added rates obtained from the production accounts, we note that (1) value added in service industries is understated and (2) value added in agriculture, the food industry, and manufacturing is overstated.

It is preferable to assume that *all sectors operating in the same industry generate the same value added there*. However, the implementation of such a procedure (which had been envisaged for the base-1980 system[17]) is more complex. It involves breaking down an industry's total value added—in the same manner as its production—among the sectors contributing to the industry. Now this total industry value added is precisely what we are seeking to determine on the basis of the known figures for sector value added. Box 4 describes how the procedure is put into practice.

5. GDP measurements in value and volume terms will be inseparable

The base year is followed by "current" years. For these, we have an IIT in *value* terms for the *previous* year. This is obviously the case for the current year immediately following the base year. For any given current year, we *project* the year-earlier IIT in value terms using the same method as in the base-1995 system (processing of "real data" cells and capacity subcontracting). We obtain an IIT in volume terms for the year under review. We deduce the IIT in value terms through a line-by-line valuation applying the IC price indices determined from the SUTs.[18] However, the only portion of this projected IIT in value terms that we utilize is the breakdown of industry intermediate consumptions by product. This enables us to convert total industry IC into product IC (§3.2).

5.1 *Value-added reconciliation is an iterative process...*

But here a difficulty arises: the calculation of the column structure of this IIT relies, in particular, on the IC price indices derived from the SUTs. From this structure, we can obtain the target IC, and thus resolve the row-effects. But the reconciliation entails a revision of the SUTs and hence of their IC price indices. This changes the product breakdown of industry IC in value terms and consequently the target IC, so that even the row-effect resolutions are called into question! The phenomenon looks as if it could become "circular," making it impossible to reach a stable value added. As we shall see, however, this fear is unfounded.

Let us examine a product and its spontaneous SUT in value terms:

$$P_0 = CI_0 + EF_0$$

In this equilibrium, the intermediate consumption is the value proposed by the "sector-product officer." Let us suppose that, in the row-effect processing, the officer replaces it by the target IC. Let us further assume that production remains constant, as well as the price indices for production and final uses. This gives us a new SUT in value terms:

$$P_1 = CI_1 + EF_1$$

and

$$P_1 / indP = volCI_1 + EF_1 / indEF$$

in volume terms. In this equilibrium, the balancing item is IC in volume terms: $volCI^1$. We deduce the new IC price index for the product:

$$indCI_1 = CI_1 / volCI_1$$

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[17] See Gac (1988).

[18] The future base-2000 system and the current base-1995 system pose the same problem: we need a price index that will enable us to compare two ICs—spontaneously expressed in value terms and volume terms respectively—and thus to reconcile them.

We show (Appendix 1) that *if the price indices for production and final uses converge and if the row-effect is not too strong* then the correction (in percentage points) of the product IC price index is proportional to the row-effect, to the inflation differential between production and final uses in the SUT, and to the inverse of the IC share of total uses. For example, assuming price changes of 3% and 2% for production and final uses respectively, a 10% row-effect, and a 50% share of IC in the total uses, the IC price change adjustment will be ((3% - 2%)/0.5).10%, or 0.2%: the IC price change goes from 4% to 4.2%. The adjustment is therefore minimal.

5.2 *...but the iterations converge swiftly*

This adjustment of the product IC price index entails an adjustment of the projected IIT *in value terms* (an IIT that enables us—as seen earlier—to determine the product breakdown of total industry IC obtained from the IES). Consequently, while the IES value added is unchanged, we obtain a new target IC and so a new row-effect. The resolution of the new effect leads, in turn, to a new revision of the IC price index in the SUT. An iterative procedure is thus established, the resolution of the n^{th} row-effect (difference between the SUT IC and the target IC) giving rise to a new row-effect n+1. The relationship between these successive row-effects is the following:

$$\frac{CI_{n+1} - CI_n}{CI_n} \approx \frac{e_P - e_{EF}}{CI_n / P} \; \frac{CI_n - CI_{n-1}}{CI_{n-1}} - \Delta\bar{e}_{n/n-1}$$

(see appendix) where e_P (or: e_{EF}) is the change in producer prices (or: final uses) on the previous year. If $\Delta\bar{e}_{n/n-1} = 0$ then, in the earlier example, the new row-effect is 0.1%—a value comfortably within range! More generally, we have an iterative procedure that converges swiftly (one iteration suffices): it brings the SUT IC back inside the range.

6. Conclusion

The new arrangements for the summary goods and services accounts in the rebased French national accounts are informed by a key principle: the *complete integration* of the three approaches to GDP in the preparation of the IOT.

Conceptually, the statistical information underlying each approach will be compared at its most refined level and throughout the IOT compilation process.

In practice, this involves *decentralizing* the value-added reconciliation in the multiplicity of SUTs. The procedure therefore calls for the total involvement of the "sector-product officers," who possess in-depth expertise on sectors and products; in particular, they have the most detailed information available, and are thus the best qualified to use it for reconciling value added.

It is important to rehabilitate the pure, objective analysis of the statistical sources used to measure growth, without prejudging the result to be reached: given the importance of the macroeconomic aggregate, that is a natural temptation on the part of team that has so far been asked to do its work in a heavily *centralized* manner.

The fully integrated reconciliation procedure will enable us, when measuring growth, to take full account of business statistics, in particular the value added determined via the "income" approach.

Arguably, a strong integration of business statistics into the growth measurement could create an instability from which we were shielded by the predominance of the "demand" approach and, even more so, the "production" approach. The risk may arise, but in that case it is the business statistics that would have to be re-examined. We must draw a clear distinction between the procedure for summarizing the goods and services accounts described here, and the uses that will be made of it. In resolving the row-effects, the "sector-product officers" will still be able to choose between (1) benchmarking to the target IC, i.e., the value added obtained from business accounts, and

(2) continuing to give precedence to "projected" IC (which will still be computed and should be seen as a safeguard) or final uses. They would do so deliberately rather than by obligation—as is the case today, given the overly rigid reconciliation procedure.

In our test using 1999 as the base year, the procedure has proved effective: with three IOT iterations, the gap between (1) the value added obtained from the IES (converted to national-accounts format), i.e., with the "income" approach, and (2) the value added obtained from SUTs with the "final demand" approach was narrowed from €49 billion to €23 billion and, in the end, to less than €2 billion!

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Chart 1: Reconciliation of value added in base-1995 system

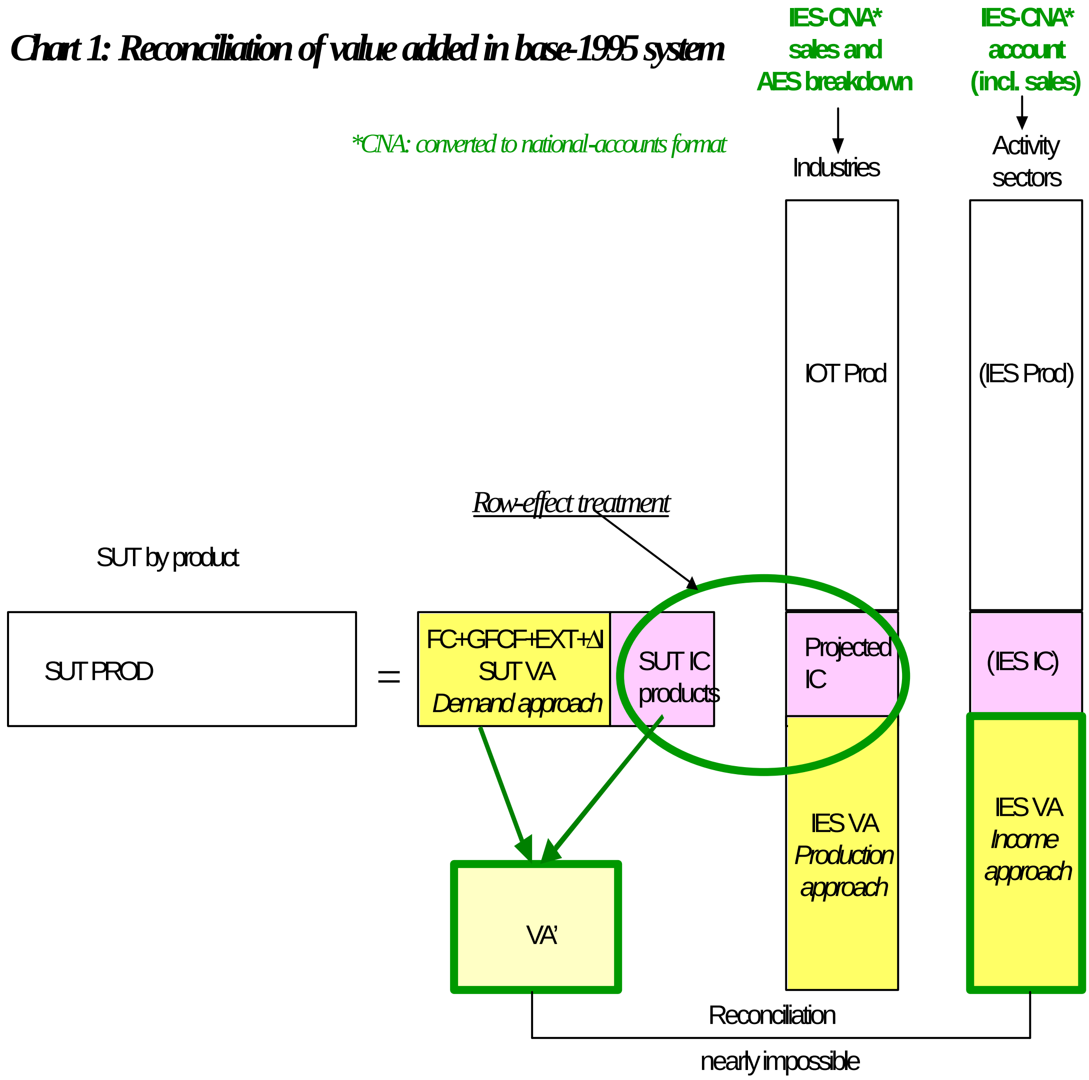
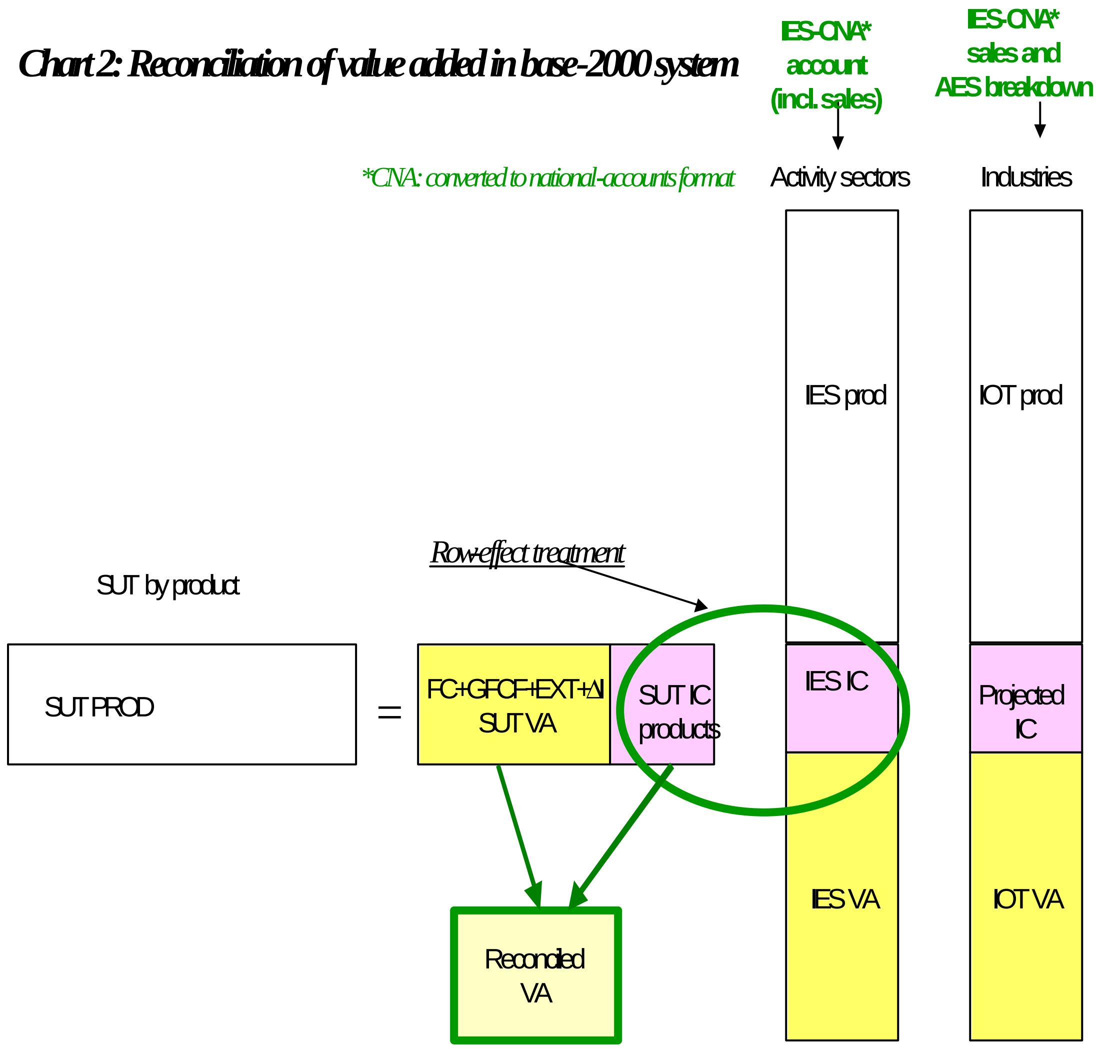


Chart 2: Reconciliation of value added in base-2000 system



Box 1. The three approaches to GDP

National accountants use three different methods to measure GDP. In countries that implement more than one of these approaches, the resulting estimates are not always reconciled.

1. The “final demand” approach focuses on *products*. It relies on the compilation of supply-and-use tables at fairly disaggregated levels. GDP is measured by the sum of final uses (consumption, investment, changes in inventories, and net trade flows).

2. The “production” approach concentrates on *industries*. It consists in measuring the production of industries, deducting their intermediate consumptions from a “projected” IIT (box2), and, lastly, determining their value added by subtracting the first aggregate from the second.

3. The “income” approach centers on economic-activity *sectors*. It estimates sector value “from the bottom up,” by summing the terms of its allocation between the factors of production: gross operating surplus (GOS) for capital and compensation of employees for labor.

Box 2. A brief history of IOT construction methods[19]

The input-output table (IOT)—the framework for synthesizing the three approaches to GDP—has become a highly complex construction. It represents the final phase of a process begun by W. Leontief in the 1940s, which later evolved with the expansion of business statistics and their harmonization with tax data.

First stage. From the postwar years to the base-1962 system: the intermediate input table (IIT) is perfected

IIT construction began in the early 1950s. The first French IIT covered the year 1951. It was a "sectors-products" table, like the accompanying production matrix. These early versions were fragile. They relied on the tax data and business statistics then available: production statistics gathered by ministries, transportation statistics, and pilot studies by trade associations in specific areas (e.g., coal, iron and steel). Two methods for estimating GDP—the "income" approach and the "final demand" approach—were implemented and reconciled at an overall level.

The first comparison of values-added estimates for sectors and industries was made in the *base-1956* system, implemented in 1960, thanks to the introduction of the first "sectors-to-industries" conversion. The results, however, were crude owing to the absence of proper business statistics and to the lack of consistency between the classifications in use. It is in this period that statisticians began reversing the IIT to obtain production from final demand.

In the *base-1959* system, the "final demand" and "production" approaches were reconciled quite thoroughly and the result obtained was compared, at the margin, with the "income" approach. Sector accounts were compiled from tax sources but remained outside the national-accounts framework: there were differences in the rates of change at the detailed level. Production remained an adjustment factor: the SUTs gave IC, the "income" approach gave value added, and production was obtained by summing the two. The resulting figure was compared with that of the SUTs, and the process was reiterated.

The *base-1962* system integrated tax statistics by setting up an effective sector-to-industry conversion tool developed by means of the 1962 industrial census. The use of computers allowed a far more complex comparison of sources. Three approaches to GDP were implemented and reconciled in a complex mechanism.

Second stage. From base-1971 to base-1980: implementation of AESs and consistency with tax returns in USES

The *base-1971* system featured the development of annual enterprise surveys (AESs) and the unified system of enterprise statistics (USES)/intermediate enterprise system (IES) operation (from 1977 on), which merged their results with tax data (USES) and provided national accountants with a channel (IES) to convert micro-data into macro-data. The IIT became an input-output table (IOT), incorporating generation-of-income accounts for industries in which value added is determined from its income and GOS counterparts converted from a sector basis to an industry basis. IOT preparation was extensively computerized (most notably the SUTs, compiled at level 600 of the French product classification).

The *base-1980* system took the base-1971 advances one step further: AESs in the service industries were introduced in 1982, and the sector-to-industry conversion matrix was annualized using USES data. The fullness of USES coverage allowed an annual measurement of production in level terms (rather than resorting to rate-of-change indices). The *base-1995 system* has not brought major changes in IOT construction.

[19] For more details, see Hamaide (1987).

Box 3. IIT projection and row-effect resolution

"Row-effect resolution" is the name given to the reconciliation of the value-added estimates obtained with the "production" approach and with the "final demand" approach via product IC.

In a current year, the reconciliation is performed on ICs in volume terms. The SUTs are compiled first in value terms then in volume terms with the aid of the several price indices available (consumer price indices, producer price indices, unit value indices for international trade, etc.); the production-account IC is obtained directly in volume terms by "projecting" the IIT. For this purpose, the IIT is initially estimated in *volume* terms from the year-earlier IIT in value terms by applying a change coefficient to all the cells of an industry in this IIT (except the "real data" cells and excluding capacity subcontracting) identical to the change coefficient for the industry's production in volume terms. We thus make two assumptions:[20] (H1) the value-added rates in volume terms are unchanged from the previous year; (H2) the product breakdown of industries' intermediate consumptions in volume terms is unchanged from the previous year.

The row-effects resolution itself consists in comparing, product by product, the IC of the supply-and-use table and the projected IC. The rule is to bring back SUT-based IC into a range of ±2% around the projected IC. To this end, the "sector-product officers" (RSPs)—the experts in charge of preparing the SUTs—alter the IC in their SUTs either in value terms, by finding a counterpart under another heading with a shaky estimate, or in volume terms, by adjusting the price index of one or more other headings.

For some highly active sectors (such as plastics and electronic components), the convention is to leave a positive row-effect (the SUT IC exceeds the projected IC) greater than 2%: this causes an annual distortion of the IIT. Likewise, some decelerating sectors (hence industries, hence products) routinely display a negative row-effect; at least part of this differential is eventually included in the IIT. These opposite effects modify the IIT structure. As they do not cancel out (in the end, an *overall* non-null row-effect subsists), the overall IC level does not change in step with production. Consequently, the total economy's value added varies independently from the reconciliation with the IES value added, which comes later.

Box 4. An iterative procedure for sector-to-industry conversion of value added

On the principle that all sectors active in a given industry generate the same rate of value added there, we prepare an initial estimate of the rate from the rate of the sector whose industry is its principal activity. Next, we assume that, in a particular industry, any given sector generates the same value added as calculated earlier. As the production matrix gives a sector's production in each industry, we deduce the value added by sectors in each industry. By summing the value added of all sectors in a given industry, we obtain an estimate of the total value added for each industry. However, we discard the sector value-added amounts. We therefore benchmark, for each sector, the sum of its value added estimated in each industry from that sector's total value added. This gives new values for industry value added, hence new rates that can be used instead of the initial value-added rates. An iterative procedure is therefore implemented. When we tested it in an initial large-scale exercise to measure GDP in the base-2000 system (§6), we found a fairly rapid convergence.[21]

[20] Together, these two hypotheses express the stability of the *technical coefficients*.

[21] It converges in about twenty iterations.

Appendix. The iterative procedure for row-effect resolution is convergent

1. *Revision of IC price index entailed by resolution of row-effects*

For a given SUT, let:

$$1+e^{n-1} = indCI^{n}/indCI^{n-1}$$

We have:

$$1+e^{n-1} = \frac{P\text{ -}EF^{n}}{P/indP\text{ - }EF/indEF^{n}}\,\frac{P/indP\text{ - }EF^{n-1}/indEF}{P\text{ -}EF^{n-1}} = \Psi_n\left(EF^{n}\right)$$

with:

$$\Psi_n(x) = k\,\frac{a-x}{b-x/c} \qquad \text{where} \qquad a = P\,,\ b = P/indP\,,\ c = indEF\ \text{ et } k = \frac{volCI^{n-1}}{CI^{n-1}}$$

By recurrence:

$$\Psi_n^{(u)}(x) = n!kc\,\frac{a-bc}{(bc-x)^{u+1}}$$

Thus, the full-series expansion of Ψ_n into EF^{n-1} gives:

$$e^{n-1} = \frac{kc(a-bc)}{bc-EF^{n-1}}\sum_{u=1}^{+\infty}\left(\frac{EF^{n}-EF^{n-1}}{bc-EF^{n-1}}\right)^{u}$$

$$= \frac{volCI^{n-1}}{CI^{n-1}}InEF\,\frac{(P-P\frac{IndEF}{InP})}{P\frac{IndEF}{IndP}-EF^{n-1}}\sum_{u=1}^{+\infty}\left(\frac{EF^{n}-EF^{n-1}}{P\frac{IndEF}{InP}-EF^{n-1}}\right)^{u}$$

$$= \frac{volCI^{n-1}}{CI^{n-1}}\,\frac{(P-P\frac{IndEF}{InP})}{volP-volEF^{n-1}}\sum_{u=1}^{+\infty}\left(\frac{EF^{n}-EF^{n-1}}{P\frac{IndEF}{InP}-EF^{n-1}}\right)^{u}$$

$$= \frac{e^{EF}-e^{P}}{CI^{n-1}/P}\,\frac{a}{1-a}$$

where

$$a = \frac{EF^{n}-EF^{n-1}}{P\frac{IndEF}{InP}-EF^{n-1}}$$

Thus:

$$e^{n-1} = \frac{e^{EF}-e^{P}}{CI^{n-1}/P}\,\frac{EF^{n}-EF^{n-1}}{P\frac{IndEF^{n-1}}{InP}-EF^{n}}$$

$$= -\frac{e^{EF} - e^{P}}{CI^{n-1}/P} \frac{CI^{n} - CI^{n-1}}{CI^{n} + P\left(e^{EF} - e^{P}\right)}$$

$$= -\frac{e^{EF} - e^{P}}{CI^{n-1}/P} \frac{CI^{n} - CI^{n-1}}{CI^{n-1}} \frac{CI^{n-1}/P}{CI^{n}/P + (e^{EF} - e^{P})}$$

$$= -\frac{e^{EF} - e^{P}}{CI^{n}/P + (e^{EF} - e^{P})} \frac{CI^{n} - CI^{n-1}}{CI^{n-1}}$$

$$= -\frac{e^{EF} - e^{P}}{CI^{n}/P} \frac{CI^{n} - CI^{n-1}}{CI^{n-1}} \quad (*)$$

2. *The sequence of row-effects converges toward 0*

Let a_{pb}^{n-1} be the share of product p in industry b's IC before resolution of the row-effect n, i.e., the substitution of CI_p^n for CI_p^{n-1}. We obtain:

$$a_{pb}^{n} = \frac{(1 + e_p^{n-1}) a_{pb}^{n-1}}{\sum_{p'} (1 + e_{p'}^{n-1}) a_{p'b}^{n-1}}$$

This change in the projected IIT in value terms gives a new target IC:

$$CI_p^{n+1} = a_{pb}^{n} CI_b^n = (1 + e_p^{n-1}) \sum_b \frac{a_{pb}^{n-1}}{1 + \sum_{p'} a_{p'b}^{n-1} e_{p'}^{n-1}} CI_b^n$$

for product p. The adjustment of the target IC therefore depends on the adjustment of the price index of intermediate consumption of p, but also on the $e_{p'}^{n-1}$ adjustments to the implicit price indices of intermediate consumption of all the other products $p' \neq p$. We obtain:

$$CI_p^{n+1} \approx (1 + e_p^{n-1}) \sum_b (1 - \bar{e}_b^{n-1}) a_{pb}^{n-1} CI_b^n = (1 + e_p^{n-1}) \left[CI_p^n - \sum_b a_{pb}^{n-1} CI_b^n \bar{e}_b^{n-1} \right]$$

where

$$\bar{e}_b^{n-1} = \sum_{p'} a_{p'b}^{n-1} e_{p'}^{n-1}$$

denotes the *mean* adjustment to industry b's IC price index. Thus:

$$CI_p^{n+1} \approx (1 + e_p^{n-1}) \left[1 - \sum_b \frac{a_{pb}^{n-1} CI_b^n}{CI_p^n} \bar{e}_b^{n-1} \right] CI_p^n = (1 + e_p^{n-1}) \left[1 - \sum_b \frac{CI_{pb}^n}{CI_p^n} \bar{e}_b^{n-1} \right] CI_p^n$$

$$CI_p^{n+1} \approx (1 + e_p^{n-1})(1 - \bar{d}_b^{n-1}) CI_p^n$$

i.e.,

$$CI_p^{n+1} \approx (1 + e_p^{n-1} - \bar{d}_p^{n-1}) CI_p^n \qquad (**)$$

where

$$\bar{d}_p^{\,n-1} = \sum_b \frac{CI_{pb}^n}{CI_p^n}\bar{e}_b^{\,n-1}$$

denotes the mean adjustment to the industries' IC price index, the industry weights being equal to their share of product *p* consumption. Relationship (5) results from (*) and (**).