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GDP Balancing in practice International Approaches and Trade-offs

David Caplan

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GDP Balancing in practice: International Approaches and Trade-offs
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Abstract
Gross Domestic Product (GDP) is a key macroeconomic indicator. There are three ways of measuring GDP – the production, expenditure and income approaches – which are theoretically equal but differ in practice. National accountants therefore need to decide how to reconcile three different approaches – often using a balancing approach. International manuals make recommendations, but individual country practice is highly variable. This report examines how different countries approach the reconciliation and balancing of GDP estimates in practice. Drawing on questionnaires, interviews and documentation from nine national statistical systems, it identifies key dimensions along which national approaches differ. The report explores how these differences reflect institutional context, data availability and professional judgement.

GDP balancing is best understood not as a technical optimisation problem but as an institutional process for managing uncertainty. Because the error structures of underlying data sources are often unknown, compilers cannot rely on purely mechanical optimisation to produce a single GDP estimate. Instead, balancing architectures combine accounting frameworks, professional judgement, institutional structures and analytical tools to reconcile estimates while preserving the informational value of source data. The comparative analysis identifies several dimensions along which national approaches differ, including: the overall approach to compilation and balancing; the assumptions about data reliability; use of mathematical optimisation tools; and treatment of discrepancies between the measures. These differences reflect institutional history, data availability and organisational structures rather than divergence in accounting principles.

The findings highlight both the value and the limits of balancing. Reconciliation strengthens the coherence of national accounts by confronting information from multiple sources, but it cannot fully compensate for weaknesses in underlying data. Such weaknesses may arise from noise in individual data sources or from the need to combine sources that are accurate yet not fully compatible because they were designed for different purposes. Where discrepancies persist, they should be interpreted as signals about data quality rather than problems to be resolved mechanically. Differences in national balancing practices therefore represent alternative ways of managing uncertainty within a shared accounting framework.

Keywords: Gross Domestic Product, Balancing accounts, International statistical practice

JEL classification: E01, E02, C82

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Estimating GDP as a case study in judgement under uncertainty

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Executive summary

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- The assumptions about data reliability;
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1. Introduction

1.1 Gross Domestic Product and the challenges of measurement

Gross Domestic Product (GDP) is a measure of the value of total final goods and services produced within a country. GDP remains one of the most watched economic indicators informing policy decisions by economics ministries and central banks and is often of political significance, although it is widely discussed that other indicators are useful for measuring wider economic and societal progress (ONS, 2022). GDP estimates are typically produced by national statistical institutes (NSIs) or central banks and form a key part of the national accounting framework.

Measuring total economic activity is necessarily complex, with multiple and divergent types of economic activity to be included and a multitude of data sources to be used in its compilation. Additionally, GDP is estimated in both value and volume terms requiring either good measures of the volume of goods and services produced or measures of price change (deflators). Considerable resources are allocated to measurement.

One key feature of GDP is that estimates can be constructed in three ways that are conceptually equivalent:

- Production – the sum of all "value-added" in the economy,
- Expenditure – the sum of "final expenditure" in the economy less imports,
- Income – the sum of all incomes generated in the economy.

The three approaches to measurement represent both a challenge and an opportunity to national accountants. In practice, because of measurement challenges, the three approaches to estimating GDP do not yield the same results. The challenge, therefore, is to decide what to do with the three measures and whether to try to produce a single measure or rely more heavily on one measure. The opportunity is to triangulate the different measures and produce a synthesis measure that is an improvement on each of the single measures.

1.2 The three approaches to measuring GDP

Each of these three approaches represents a different perspective on economic activity and, typically, estimation draws on different data sources.

The **production approach** measures GDP as the sum of gross value added across industries. Gross value added is the difference between the value of goods or services sold and the value of intermediate consumption – the value of goods and services used as inputs in production excluding labour and the consumption of fixed capital (relabelled as depreciation in the 2025 System of National Accounts (SNA)). It is typically measured using business surveys and administrative data. The production approach is typically calculated in both value and volume terms with production and intermediate consumption being deflated separately – a process known as double deflation.

The **expenditure approach** is the sum of final uses of goods and services. These include household final consumption, general government final consumption, investment, the change in inventories and net exports. Measurement is dependent on multiple sources including household expenditure surveys, government administration data and information on imports and exports of goods and services. The expenditure approach is typically estimated in both value and volume terms.

The **income approach** measures GDP as the sum of the incomes generated in production including compensation of employees, gross operating surplus (broadly profits) and mixed income (for example the surplus of unincorporated businesses). Measurement typically comes from tax records. Unlike the other two measures, the income approach can only be calculated in current price terms, although constant price estimates may be derived subsequently for analytical purposes.

In principle, all three approaches should yield the same estimate of GDP, reflecting the underlying accounting identities of the national accounts. In practice, however, differences in data sources, timing, coverage and measurement error mean that the three estimates rarely coincide exactly. Reconciling these differences is therefore a central task of national accounts compilation.

1.3 Reconciling multiple measures: frameworks and practice

National accounts compilers have a range of tools for handling multiple measures and we will see these in practice in the country descriptions. At the simplest level, one of the approaches to measuring GDP can be chosen as the preferred measure. In this case, the other approaches may be calculated and a statistical discrepancy between the measures shown.

A refinement would be to take an average measure of the three approaches to GDP as the headline measure. Again, there would be an explicit statistical

discrepancy between the three individual approaches and the average. A further refinement would see adjustments made to aggregates to bring all three approaches into line. In this case the statistical discrepancies are implicit rather than explicit.

However, national accountants have developed more sophisticated approaches to aligning the different approaches. These methods place a strong emphasis on confronting data from different sources within a structured accounting framework. The confrontation is designed to improve coherence between the different approaches, identify inconsistencies and allow informed judgements to be made to "balance" the accounts.

The most frequently used balancing framework uses Supply and Use Tables (SUTs). These provide a framework for comparing supply and demand at a detailed product and industry level. The supply table shows, for each product, the supply of the product which is equal to the domestic output plus the value of imports. The use table shows how these products are used as intermediate consumption analysed by industry and as final consumption, capital formation and exports. By confronting supply and demand at a detailed level, the SUTs framework allows compilers to assess the plausibility of estimates, identify gaps or overlaps in source data and trace inconsistencies back to underlying components.

While SUTs are primarily a framework for confronting production and expenditure estimates, they also provide an important link to the income approach. By balancing output and intermediate consumption at a detailed industry level, SUTs generate estimates of gross value added by industry. These estimates can then be decomposed into income components, such as compensation of employees and operating surplus, using additional source data.

In practice, the income approach is therefore often derived indirectly from the balanced production framework rather than being confronted simultaneously with production and expenditure at the same level of detail. As a result, income-based estimates typically play a more limited role in the balancing process itself, although they provide an important cross-check on the plausibility of the resulting GDP estimates.

There are some variations on the SUTs approach involving full input-output tables and a simplified model looking at the flows of products. Potentially, although we found no examples, direct use could be made of the fuller sequence of accounts within the national accounts framework to identify potential inconsistencies.

Reconciliation within these frameworks is typically iterative. Initial estimates are reviewed using a combination of automated checks and expert analysis, with adjustments informed by assessments of source data quality, coverage and conceptual alignment. In many systems, some imbalances are resolved through

revisions to component estimates, while others are retained and made explicit through residual balancing adjustments.

While international standards provide guidance on the use of such frameworks and on maintaining accounting identities, they offer limited direction on how competing estimates should be weighted when inconsistencies remain. As a result, reconciliation practices vary across countries, reflecting differences in data availability, institutional arrangements and analytical priorities. These frameworks therefore serve less as optimisation devices than as structured environments within which judgement can be exercised transparently.

1.4 Balancing under uncertainty

The challenge of reconciling alternative measures of GDP has been recognised since the beginning of modern national accounting. Early contributions, most notably by Stone and colleagues (Stone, R., Champernowne, D. G., & Meade, J. E. (1942), who acknowledged that estimates derived from different data sources would not align exactly and that balancing was an inherent part of statistical measurement. From the outset, reconciliation was understood to require judgement informed by accounting structure and assessments of data reliability.

A wide range of approaches to reconciliation has been developed (see, for example, Van der Ploeg, F (1982), Weale (1989)). These include judgemental adjustment within accounting frameworks, as well as more formal methods based on constrained optimisation, reliability-weighted estimation and matrix-balancing techniques (Nicolardi, 2013). Such methods have demonstrated the feasibility of enforcing accounting identities in large and complex systems and have been applied in contexts including benchmarking, SUT compilation and input–output analysis.

International guidance reflects this evolution by strongly promoting the use of accounting frameworks, while remaining largely non-prescriptive about the choice of balancing method and, especially, the approach to implementing the method. The United Nations Handbook on SUTs and Input-Output Tables with Extensions and Applications (UN, 2018) is more prescriptive than, for example, the System of National Accounts (UN, 2025) or the European System of Accounts (Eurostat, 2010). It gives very detailed recommendations on the organisation and compilation of SUTs and their role within the integrated system of economic accounts.

A central difficulty underlying all reconciliation approaches lies in the nature of measurement errors in the basic data which result from a multitude of sources. Errors differ across data sources both survey or administrative, variables, industries and time, and may arise from coverage gaps, reporting behaviour,

conceptual misalignment or model-based estimation. In many cases, their magnitude, direction and correlation structure are unknown, and there is limited basis for assuming that alternative estimates are unbiased or centred on a common true value. Reconciliation is therefore inherently a multidimensional problem in which the informational content of different data sources, and the realistic error margin around them, cannot be fully characterised.

When applied with a clear understanding of these limitations, balancing can be information-enhancing. By exploiting accounting identities and confronting data within structured frameworks, reconciliation can improve coherence and support more plausible estimates than any single source taken in isolation. However, where information about underlying error structures is weak, balancing necessarily involves judgement about how discrepancies are resolved. In such circumstances, enforced coherence does not necessarily imply greater accuracy. The hybrid approaches observed in practice, combining structured confrontation, selective use of formal methods and expert judgement, reflect pragmatic responses to this shared underlying problem rather than fundamental disagreement about accounting principles.

This study argues that GDP balancing is best understood not as a single technical procedure but as an institutional process through which statistical offices manage uncertainty across multiple data sources.

1.5 This study: scope and approach

While the conceptual framework for national accounts is extensively documented in international manuals and methodological literature, there is comparatively little published evidence on how national statistical offices reconcile the different measures of GDP in practice. Much of the balancing process occurs within institutional workflows, professional judgement and internal procedures that are rarely described in detail. This study seeks to address that gap by documenting and comparing how a number of national statistical systems organise the balancing of GDP in practice including which approaches to measuring GDP are emphasised and how are the different estimates reconciled.

The study is not intended to evaluate or rank national practices but to describe and compare them. The aim is to document the key architectures, processes and decision frameworks that are used in different and divergent statistical systems. Specifically, this study does not attempt to evaluate national practices against the guidance given in the UN Handbook (UN, 2018), but, instead, examines how different countries organise the balancing process in practice, reflecting institutional arrangements, data environments and statistical traditions.

The key purpose is to illustrate the institutional choices through which national accountants manage the practical challenges of balancing GDP under conditions of uncertainty.

This project was carried out by the Economic Statistics Centre of Excellence under a commission and funding from the UK Office for National Statistics (ONS).

The primary research for this project had two stages: first a survey was sent to 10 statistical offices. Eight completed the survey; no response was received from one country and a further country declined to participate as they were unable to provide any information beyond what was already published. For six of the responding countries, we were able to arrange follow-up semi-structured interviews which allowed clarification of the approaches. For the UK, information was collected through a series of interviews rather than through the use of the questionnaire.

For each country the focus is on how production, expenditure and income measures are used, how and if they are confronted, and the role played by frameworks such as SUTs. The study also looked at the degree to which approaches to producing GDP were judgemental, prescribed or mechanised.

This report emphasises annual current price and volume measures of GDP. Information was collected and is reported on short term compilation but is not the main purpose. The key objective is to provide a coherent account of how countries manage the practical and conceptual challenge of producing a reconciled measure of GDP under considerable uncertainty.

1.6 Structure of the report

The remainder of this report is organised as follows. Chapter 2 provides a synthesis of the comparative analysis drawing out common themes, contrasts and typologies in national approaches to estimating GDP. It focuses on how countries address the problem of balancing multiple data sources under uncertainty rather than focusing, in detail, on the mechanics of individual systems. The chapter reaches some conclusions based on country practices but does not seek to make recommendations as to how to approach the issue.

The rest of the report contains nine country descriptions using a common template. These chapters provide the evidence base used for the synthesis, documenting national approaches in a consistent and factual manner. The level of detail varies partly depending on the depth of information provided by that country and partly on the relevance of a country's approach to the general balancing GDP problem.

The countries covered are Australia, Canada, Chile, Denmark, France, the Netherlands, Spain, United Kingdom and the United States. We thank the staff in these countries for the readiness to support the study.

2. National approaches to GDP balancing under uncertainty

2.1 Purpose and approach to the synthesis

This chapter synthesises the approaches to measuring GDP observed in the study countries. It does so by examining a set of analytical dimensions along which national practices vary, each reflecting different ways of organising and reconciling the underlying data. There is no attempt to evaluate or rank these approaches, although some may appear preferable to others. Differences, instead, reflect varying professional judgements, institutional cultures, data environments and practical constraints.

Comparative studies often seek to group systems into a small number of typologies or models. In this study, however, the evidence does not support a clear typology of national approaches to GDP balancing. Countries combine elements from multiple organisational and methodological dimensions, and the same tools often appear in quite different institutional contexts.

The diversity observed in practice reflects different configurations of institutional arrangements, data environments and professional practices rather than distinct balancing "models". For this reason, the analysis that follows examines a set of analytical dimensions through which national systems vary, rather than attempting to classify countries into types.

Although the following sections consider each dimension separately for clarity, the most important variation arises from how these dimensions interact. Balancing architecture, assumptions about reliability, the location of judgement and the use of formal tools tend to co-evolve within each institutional setting. It is, therefore, the full configuration of these elements, rather than any single dimension taken in isolation, that characterises national practice.

Despite the diversity of institutional arrangements described in this chapter, the country studies also reveal some common features in how GDP balancing is organised. These similarities reflect the shared accounting framework within which national statistical offices operate and the practical realities of reconciling multiple measures of GDP. These common features are summarised in Table 2.1.

Table 2.1: Common features of GDP balancing across countries

Common feature	Description
Independent compilation of GDP approaches	Production, expenditure and usually income measures are generally compiled separately before reconciliation.
Reconciliation process enforcing accounting identities	All systems ultimately impose the national accounting identities, even where discrepancies are published.
Assessment of data reliability	Compilers assess the relative reliability of data sources when resolving inconsistencies.
Role of professional judgement	Analysts make judgements about relative data quality even when mechanical tools are used.
Structured confrontation frameworks	Supply–use tables or similar confrontation systems are used either in annual balancing or as an analytical tool.
Institutional constraints	Organisation reflects practical factors such as resources, release schedules and IT systems.

The chapter begins by considering the overall architecture of compilation and balancing. It then examines assumptions about data reliability, the role and location of judgement, the use of mechanical and optimisation tools, and the treatment of discrepancies and residuals. The following sections then consider the interaction between current-price and volume balancing, organisational arrangements and resourcing, and finally approaches to transparency and documentation.

2.2 Integration of compilation and balancing

The first key dimension along which national approaches to GDP balancing differ addresses how reconciliation is integrated into the wider compilation process. In some systems, coherence between alternative measures is achieved through continuous confrontation and convergence as the estimation evolves. In others, balancing takes the form of a more explicit and distinct reconciliation step, undertaken once individual component estimates have been finalised. These alternative architectures reflect different ways of organising judgement, transparency and production risk in the presence of uncertainty.

In systems where balancing is embedded within compilation, confrontation between data sources occurs iteratively and often at a very detailed level. Adjustments are made as part of normal estimation activity, informed by source knowledge and economic context, with the aim of reducing inconsistencies before they accumulate. Coherence emerges gradually through successive iterations rather than through a single, identifiable balancing stage. The Netherlands provides a clear example of this approach, with GDP compilation driven within an integrated SUT framework in which reconciliation is internalised as part of the core production process.

By contrast, other systems place greater emphasis on maintaining the independence of alternative measures and making divergence explicit. In the United States, production, expenditure and income estimates are developed largely independently, with the expenditure-based measure serving as the featured estimate of GDP growth. Differences between approaches are retained and published as a statistical discrepancy, and balancing is not used to force equality between measures. In this architecture, reconciliation plays a more limited role, and transparency about divergence is prioritised over enforced convergence.

Between these approaches lie systems in which convergence is achieved primarily through compilation design rather than through explicit reconciliation procedures. In France, the production approach plays a dominant role, supported by unusually strong underlying source data. Coherence is achieved through integrated compilation processes and selective calibration rather than through a formal balancing stage. While SUT frameworks exist and are used extensively for annual benchmarking, balancing is less visible as a discrete activity in the production of the headline GDP estimate.

These different architectures reflect contrasting views about where and when reconciliation should occur. Embedded approaches prioritise early confrontation and detailed consistency, potentially reducing residual imbalances but requiring sustained coordination across teams. Approaches that preserve independence between measures allow divergence to remain visible, supporting diagnostic use of discrepancies but concentrating judgement at higher levels. Systems based on compilation-led convergence seek to exploit strong source data and integrated processes to minimise the need for explicit balancing. None of these models is inherently superior; rather, each represents a different response to the same underlying problem of reconciling imperfect information within practical production constraints.

2.3 Hierarchies and assumptions about data reliability

A further dimension along which national approaches to GDP balancing differ is the extent to which explicit hierarchies are used to reflect assumptions about the relative reliability of different data sources and measures. In some systems, these hierarchies are formalised and documented and play a central role in guiding reconciliation decisions. In others, assessments of reliability are more implicit, ad hoc and embedded in professional judgement and compilation practice rather than articulated as fixed rules. Such implicit hierarchies can be highly influential in practice even where they are not explicitly codified.

In practice, hierarchies arise from two distinct considerations. First, some components are treated as fixed because they are constrained by requirements for consistency with external systems. Examples typically include trade in goods and possibly services and government consumption. In these cases, the scope for adjustment within GDP balancing is limited, and these components operate as effectively fixed controls regardless of broader judgements about data quality. Second, other components are treated as primary because compilers judge the underlying data to be relatively strong, comprehensive or reliable. In many systems, production data, for example, are considered more reliable than other elements. While both considerations lead to similar practical outcomes, certain estimates being adjusted less than others, the underlying rationale differs.

Some countries make these hierarchies explicit and systematic. Denmark provides a clear example, with formal assumptions about which measures should be given the greatest weight in the balancing process. These hierarchies help structure reconciliation, limit the range of permissible adjustments and provide clarity and transparency about how conflicts between data sources are resolved.

By contrast, other systems rely less on formal hierarchies and instead assess reliability on a case-by-case basis. In these approaches, decisions about which estimates to adjust are made by individual analysts, informed by detailed knowledge of data sources, economic conditions and recent developments, rather than by pre-specified rankings. Reliability is therefore treated as contingent and context-dependent, allowing compilers to respond flexibly to changes in data quality or economic structures. The UK provides a clear example here with a suggested hierarchy but leaving individual analysts to make their own judgement.

Canada provides a clear example of this model. Given the scale and complexity of its regional supply–use system, reconciliation decisions are informed by detailed confrontation of source data and senior professional judgement rather than by pre-defined rankings of reliability. While some components may be constrained by external consistency requirements, there is no fixed ordering of estimates that automatically dominates the balancing process. Instead, assumptions about

reliability are revisited as part of each production cycle, allowing reconciliation decisions to respond to changes in data quality, economic structure and emerging information.

Across countries, the production approach often plays a dominant role in these assessments, particularly where strong business surveys or administrative sources underpin value added estimates. In such cases, production-based measures may act as the primary anchor for GDP levels, with expenditure and income estimates used to inform refinement or validation. Elsewhere, alternative hierarchies emerge, reflecting differences in data availability, institutional history and user needs.

The choice between explicit and implicit hierarchies has important implications for transparency and the exercise of judgement. Explicit hierarchies provide clarity and consistency, but may be less responsive to changing circumstances. Implicit approaches offer flexibility, but place greater weight on professional judgement and may be harder to explain externally. As with other dimensions identified in this chapter, these choices reflect different ways of managing uncertainty rather than differences in technical competence or statistical ambition.

2.4 Role and location of judgement

Across all systems examined, professional judgement plays a central role in GDP compilation and balancing. A key dimension of difference lies not in whether judgement is exercised, but in where in the production process it is located and how it is structured. Judgement may be applied at multiple decision points, including adjustments to underlying source data, choices made during balancing or reconciliation, and decisions taken at aggregate levels to resolve residual inconsistencies.

In some systems, judgement is exercised primarily at early stages of compilation through detailed confrontation of raw or near-raw data. Adjustments may be made to component series before they are incorporated into the national accounts' compilation process. For example, survey returns, administrative inputs or model-based estimates may be adjusted to address implausible movements, known data limitations, or when alternative data sources suggest different paths. Where this approach applies, much of the reconciliation occurs implicitly, and later balancing stages play a more limited role. The Netherlands provides a clear example, with judgement embedded throughout the SUT compilation process as part of continuous confrontation between sources.

The UK provides an example of a system in which judgement is both distributed and centralised at different stages of the process. At the compilation stage, much

of the work takes the form of verification and quality assurance within individual domains, while final reconciliation decisions are made within a more formal balancing framework, reflecting both the scale of the system and the need to manage uncertainty across multiple domains.

In other systems, judgement is concentrated at specific stages of the balancing process itself. Here, component estimates may be developed with relatively limited intervention, with reconciliation decisions taken once inconsistencies become visible. These decisions may involve selecting which aggregates to adjust, determining the scale of adjustment, or deciding when remaining discrepancies are acceptable. In Canada, for example, judgement is exercised through senior-led balancing decisions informed by extensive analytical work, but without reliance on fixed hierarchies or mechanical rules. Judgement is therefore structured and explicit but applied selectively in response to the configuration of discrepancies observed in each cycle.

Judgement also differs in how it is distributed within the compilation process. In some systems it is widely dispersed across subject-matter teams as part of ongoing compilation, while in others it is concentrated within a smaller group responsible for final reconciliation. These patterns often reflect broader architectural choices: approaches where balancing is embedded in compilation tend to distribute judgement more widely, whereas systems with a distinct balancing stage may concentrate judgement at that point in the process.

Where judgement is applied is not a binary choice and many systems allow judgement to be exercised at any point in the process. For example, the UK has an extensive review of data loaded into the national accounts system, but judgement remains a central feature of the balancing stage.

These differences illustrate that judgement is not a residual activity applied only when formal methods fail, but a core feature of GDP compilation. Decisions about where judgement is located, whether dispersed across detailed compilation, concentrated at balancing stages, or constrained by architectural choices, shape how uncertainty is managed and how reconciliation outcomes are interpreted. As with hierarchies and balancing architecture, these choices reflect different strategies for structuring professional judgement under conditions of imperfect information, rather than differences in statistical rigour or competence.

2.5 Use of formal optimisation and mechanical tools

A range of formal balancing tools has been developed to allow the balancing of SUTs by enforcing accounting identities. These vary in the degree of complexity and in their underlying assumptions about how discrepancies should be redistributed to achieve balance. The RAS (bi-proportional balancing) algorithm represents the simplest class of these methods, adjusting cells proportionately to their initial size to satisfy row and column constraints. More general variants, such

as KRAS (Lenzen et al, 2009), extend this approach by allowing selected elements to be constrained or weighted, reflecting differences in perceived data reliability or other balancing rules. Statistics Canada has developed a formal balancing system within this broader family of constrained optimisation techniques.

Some countries make using optimisation solvers, such as Fico xPress and Gurobi Optimizer (commercial mathematical programming software), which support more complex formulations including linear programming and mixed-integer linear programming. These tools allow a wide range of constraints to be specified explicitly, but still require substantive assumptions about flexibility, priorities and acceptable adjustment.
Countries differ markedly in how such tools are deployed in practice. Chile, for example, makes no use of automated balancing algorithms, carrying out the reconciliation process manually through detailed confrontation of data sources. Spain uses the system developed by Statistics Canada, but primarily as a diagnostic and reconciliation tool rather than as an automatic final step to produce balance. Canada uses tools during the compilation process but its complex system of provincial accounts is too complex for a final automated balance. In contrast, many countries apply automated balancing methods as a final stage, once a broadly acceptable balance has already been achieved through judgemental adjustment. The UK uses FICO xPress once manual balancing has produced tables that are close to balance and to produce its volume tables. Australia represents a somewhat more automated approach, using a two-stage optimisation process in which the constraint problem is specified using AMPL (A Mathematical Programming Language) and solved using Gurobi.

2.6 Treatment and role of discrepancies and residuals

National approaches to annual GDP balancing differ primarily in the way they treat residual inconsistencies between the production, income and expenditure measures. While all systems confront divergence between underlying data sources, countries adopt one of a small number of coherent strategies for handling the remaining discrepancies.

In the United States, the three measures of GDP are developed largely independently and residual differences are retained and published explicitly as statistical discrepancies. These discrepancies are not treated as compilation failures, but as transparent indicators of unresolved uncertainty in the underlying data. This approach preserves information about divergence between measures and allows users to assess its scale and evolution over time.

In contrast, other systems aim to eliminate discrepancies through compilation design. In France, coherence between approaches is achieved primarily through integrated compilation processes centred on the production measure, supported

by strong underlying source data. Reconciliation occurs implicitly as part of estimation and calibration, such that no explicit residual discrepancy remains at the end of the process.

Between these approaches lie systems that resolve discrepancies through structured balancing frameworks. In these cases, inconsistencies are addressed within an explicit accounting structure, most commonly supply and use table, through a combination of judgemental adjustment and formal balancing procedures. While discrepancies are not published explicitly, neither are they implicitly ignored. Instead, they are resolved through systematic confrontation of data sources within the accounting framework.

These approaches reflect different views about the informational role of discrepancies. Whether residual inconsistencies are highlighted, absorbed or resolved through structure depends on how systems balance transparency, interpretability and the desire for coherence, rather than on differences in accounting standards or technical capability.

2.7 Interaction between current price and volume balancing

Many users of GDP estimates are primarily interested in the growth over time after adjusting for price changes. To produce estimates of growth, national accounts produce volume measures either by deflating the current price measures or by using direct measures of quantity. Whilst almost all countries now use annual chain-linking, approaches to volume measurement and reconciliation vary. Three broad approaches emerge from this study

In some systems, volume measures are derived by deflating a selected current-price GDP measure, most commonly the expenditure approach. No economy-wide volume balance is produced, and consistency between alternative volume measures is not enforced. This approach prioritises a single growth narrative and treats volume measurement as conceptually separate from reconciliation at current prices. The US is the main example of this approach.

Other systems adopt a sequential approach, in which current-price accounts are first fully balanced and closed, typically within a supply and use framework. Volume estimates are then derived from the balanced nominal structure, with deflators applied once reconciliation has been completed. In Chile, for example, the deflators are constrained so that the current price balance is maintained in the deflated tables. In other countries, the deflated tables are initially unbalanced. Balancing is then typically achieved primarily using automated balancing systems. Under sequential approaches, there is generally limited scope for information from volume reconciliation to feed back into the balancing of the value tables.

Finally, some countries confront current-price and volume estimates simultaneously as part of a single reconciliation process. Here, values, quantities

and deflators are adjusted iteratively, allowing volume information to inform nominal balancing decisions and vice versa. This approach makes fuller use of the available signal in the data, but is more demanding in terms of computation, coordination and judgement. The Netherlands provides the clearest example of this approach, with compilers able to view value and volume data together and transparently assess the impact of adjustments across values, volumes and deflators.

These different treatments reflect trade-offs between conceptual integration, transparency and practical feasibility, rather than differences in statistical standards or objectives.

2.8 Organisational coordination and division of labour

Approaches to GDP balancing are also shaped by how national accounts production is organised and how responsibilities are distributed within statistical offices or, in the case of Chile, central banks. While all countries rely on collaboration between subject-matter experts, source data teams and national accountants, the degree of centralisation and the formalisation of coordination mechanisms vary.

In more centralised systems, responsibility for balancing is concentrated within a small number of expert teams or senior roles, with reconciliation decisions taken at aggregate levels and escalated where they have system-wide implications. This model supports consistency and risk management in complex systems, particularly where supply–use tables or other integrated frameworks play a central role. Canada provides a clear example, with balancing decisions led by senior analysts and supported by continuous coordination across divisions responsible for industry, expenditure, income and sector accounts.

Other systems distribute responsibility more widely, embedding balancing activities within the routine work of compilation teams. In these cases, coordination occurs through structured production cycles, shared tools and regular confrontation meetings rather than through formal escalation. The Netherlands illustrates this approach, with balancing embedded throughout the SUT process and close interaction between compilers responsible for different parts of the accounts.

Some countries operate hybrid arrangements, combining distributed compilation with central oversight or final reconciliation at key stages of the production cycle. These organisational choices reflect trade-offs between efficiency, resilience and transparency, and influence how judgement is exercised and documented, particularly under tight production timetables.

Overall, differences in organisational coordination shape not only how balancing is carried out, but also how uncertainty is managed and communicated within national statistical systems.

2.9 Resourcing, scale and production constraints

Differences in GDP balancing practices also reflect variations in resourcing, scale and production timetables. Direct comparison of resources across countries is difficult, however, because, as seen in the previous section organisational structures differ markedly. In some systems, balancing is a distinct and identifiable function, while in others it is distributed across compilation teams and embedded within routine production processes. As a result, reported staff numbers or time allocations are not directly comparable.

The contrast between Spain and Canada illustrates this point. In Spain, responsibility for balancing is concentrated in a small number of roles, with one individual identified as having primary responsibility for reconciliation. This reflects a highly centralised balancing function operating within tight resource constraints and supported by formal tools. In Canada, by contrast, balancing is dispersed across a large, integrated system involving multiple divisions and extensive regional supply–use tables. While no single individual is identified as "the balancer", substantial analytical effort is devoted to reconciliation across the production cycle, supported by senior oversight and escalation mechanisms.

Production timetables also vary significantly across countries, further complicating comparison. Some countries report a process that takes many months whilst others have a much more compressed timetable. Some systems prioritise timeliness, working to relatively short publication lags and relying on subsequent revisions to improve coherence. Others accept longer production cycles to allow more extensive confrontation of data and more complete reconciliation within an integrated framework. These choices influence not only the depth of balancing that is feasible, but also the stage at which judgement is exercised and the extent to which formal tools can be deployed.

Taken together, differences in resourcing and timescales shape how balancing is implemented in practice. The different organisational arrangements and resourcing provide constraints within which the national accounts systems operate. And these constraints force trade-offs and methodological choices.

2.10 Transparency and documentation practices

Approaches to GDP balancing also differ in the degree and form of transparency applied to reconciliation processes and outcomes. All countries maintain internal documentation to support quality assurance and continuity, but practices vary in

how systematically adjustments are recorded and how much information is made available beyond the compilation teams.

In several systems, balancing adjustments are captured in structured ways, such as process tables, with changes classified by type, motivation or stage of the production process. Distinctions are made between adjustments to source data, conceptual adjustments, reconciliation between approaches and residual balancing. This level of detailed documentation supports any audit process, learning over time and handover between staff, particularly in complex or highly integrated systems.

Other countries operate with less formalised documentation of balancing decisions, relying more heavily on professional continuity and institutional memory. While adjustments may still be well understood by compilers, scale, and particularly the rationale, of individual decisions may be less systematically recorded.

Across countries, however, there is a clear boundary between internal transparency and external publication. While methodological frameworks and high-level descriptions of balancing processes are commonly published, detailed information on individual balancing adjustments, their scale, or the judgements underpinning them is rarely made public. This reflects concerns about misinterpretation, the provisional nature of many decisions, and the risk that transparency about balancing mechanics could be mistaken for evidence of poor data quality rather than careful reconciliation.

These sensitivities were evident in the conduct of this study itself, with one country choosing not to participate due to reluctance to place detailed balancing practices in the public domain. This highlights an inherent tension: while transparency supports accountability and trust, balancing necessarily involves judgement under uncertainty, and countries differ in where they draw the line between openness and exposing the practical realities of producing national accounts under uncertainty.

2.11 Summary: patterns and trade-offs

This chapter has reviewed national approaches to GDP balancing through a set of nine dimensions along which practices differ. These dimensions capture variations in how reconciliation is integrated into compilation, how judgement is structured and exercised, how formal tools are used, how discrepancies are treated, how value and volume measures interact, and how organisational arrangements, resources and transparency shape what is feasible in practice.

Table 2.2 summarises the characteristics of national approaches across the nine dimensions identified in this chapter.

Across the countries studied, no two approaches share the same overall profile. As a result, the evidence did not support the emergence of a stable typology of balancing systems. Instead, each reflects a particular combination of data availability, institutional history, production constraints, professional practice. Differences in balancing practice therefore do not indicate divergence in accounting standards or objectives, but alternative ways of managing uncertainty within a common conceptual framework.

The analysis also highlights that balancing is not a single technique or stage, but a set of choices about where to locate judgement, how to use information, and how to trade off coherence, transparency and timeliness. These choices are shaped as much by context and constraint as by methodological preference.

The next chapter draws these dimensions together to compare national approaches more directly, identifying patterns and contrasts across countries and considering what these imply for understanding GDP balancing as a practical and institutional activity, rather than a purely technical one.

Table 2.2: Summary table: nine countries across nine dimensions

Blank cells indicate aspects for which no clear information was available from the source material

Country	1. Integration of compilation & balancing	2. Hierarchies / assumptions about data reliability	3. Role & location of judgement	4. Use of formal optimisation / mechanical tools	5. Treatment of discrepancies / residuals	6. Current price / volume interaction	7. Organisational coordination / division of labour	8. Resourcing / scale / production constraints	9. Transparency / documentation practices
Australia	Integrated annual SUT balancing with a manual stage followed by optimisation;	Implicit; weaker items such as inventories are more adjustable; robust volume data used where available	Distributed across analysts early in compilation, with team discussion and final review around the optimisation stage	Manual balancing first; final constrained optimisation using AMPL + Gurobi	Residual inconsistencies resolved within the balancing framework	Primarily sequential,	~25 analysts assigned by industry; weekly balancing meetings	Source data mid-March to mid-May; current price balance in early July; volume by end-July; benchmarks finalised by end-August	Query registers used and balancing decisions logged internally
Canada	Fully integrated annual regional SUT benchmark system	Case-specific reliability assessment with some controls fixed	Senior-led and structured; judgement applied early through system diagnostics and confrontation across divisions	System based balancing tools used alongside analyst adjustments	Annual discrepancies resolved within the SUT framework	Sequential with iterative diagnostic feedback from volume estimates during current-price balancing	Highly centralised system with multiple divisions; substantial effort across annual and quarterly processes	About 65 staff involved in quarterly GDP(I/E); annual SUT balancing ~9 months plus 3 to 4 more months to benchmark downstream accounts	Adjustments documented systematically in bespoke systems and classified by reason
Chile	Integrated two-phase SUT process (industry/column then product/row balancing)	Implicit but clear quality-based hierarchy	Strongly analyst-dependent and embedded in both phases; no final algorithmic closure	No automatic balancing procedure	Residual discrepancies resolved through targeted analyst adjustments within the SUT framework	Simultaneous balancing of current prices, volumes and deflators	Two interacting teams (industry specialists and product balancers) with continuous coordination	18 staff; benchmark balancing takes about 8 months; quarterly/non-benchmark system is lower-detail	Full audit trails in the bespoke data model; adjustments tracked, though no distinction is made between quality and balancing adjustments
Denmark	Explicit SUT balancing stage, with separate processes for t-2 and t-3 benchmark years	Explicit, rules-based hierarchy with predetermined items and fixed controls	Judgement is constrained by formal rules; manual intervention focuses on weaker areas after automatic steps	Highly structured mechanical balancing using VBA/Pascal tools and validation dashboards	Residual discrepancies resolved through enforced balancing	Current prices and previous-year prices are balanced sequentially	Centralised within Statistics Denmark, with overlapping t-2 and t-3 teams and heavy use of in-office collaboration	t-2 team of 4 over ~2 months; t-3 team of 6 over ~6 months	
France	Embedded within compilation	Implicit production-led hierarchy	Judgement is embedded in synthesis teams and product specialists, with final calibration late in compilation	Formal optimisation is limited	Residual discrepancies are absorbed through compilation adjustments	Volume and value considerations are addressed jointly during synthesis	Central synthesis teams coordinate convergence across goods and services	Resource constrained	
Netherlands	SUT-based balancing embedded within compilation	Explicit hierarchy	Judgement is distributed across specialists and head integrators, with manual resolution of major imbalances	Manual confrontation first, then Fico Xpress for residual imbalances	Residual discrepancies resolved within the SUT framework	Current prices, volumes and deflators are balanced simultaneously in one integrated system	Dedicated national accounts department with head integrators and specialist teams; around 40 staff involved in SUT work	Main balancing window is about 3 months (January–March) for final t-2 and provisional t-1 tables	Process tables record both quality and balancing adjustments
Spain	Explicit, centralised annual SUT balancing stage	Flexible, product-by-product constraints based on confidence in sources	Judgement is concentrated in the central balancing role,	Constrained least-squares balancing in SAS/Excel, with algorithmic balancing	Residual discrepancies resolved within the balancing framework	Sequential: current prices first, then previous-year-price tables balanced algorithmically	Centralised balancing function with one principal balancer and 25–30 contributing specialists	Balancing takes around 3–5 months; resource constraints are explicitly noted	
United Kingdom	Integrated annual SUT balancing in current prices	Implicit, variable dependent hierarchy:	Judgement is central to the balancing stage, but preceded by structured data review and compiler 'curiosity' processes	Manual iterative balancing supported by FICO Xpress for final annual closure	Annual discrepancies are absorbed through balancing	Primarily sequential: current price tables are balanced first, then volume tables	Central SUT team (11 staff) works with 12 compiler teams plus small supporting teams	Annual balancing cycle typically 7 to 10 weeks from data supply to completion; open years are t-2, t-3 and t-4	Master spreadsheet retained; balancing stories are requested, but detailed documentation is incomplete because of scale
United States	Independent production, expenditure and income measures.	Expenditure is the featured measure;	Judgement sits with subject-matter experts and the systems processing group through constraint-setting and plausibility review	Constrained KRAS balancing within make-use and industry tables	Statistical discrepancies are published explicitly rather than eliminated through balancing	No economy-wide volume balance; real headline GDP is derived from deflated expenditure	Operationally centralised balancing support within BEA, with interaction between systems staff and compilers	Very large annual make-use system (about 1,200 industries and 4,700 products); revisions generally open for 5 years	Full public transparency on discrepancies

Source: Individual country questionnaire responses and interviews

3. Conclusions

Producing estimates of GDP is an inherently difficult statistical task, with no simple or universal solution. National accountants must reconcile large volumes of data with unknown and heterogeneous error structures within an accounting framework that imposes its own constraints. Decisions must be made about whether to prioritise a single approach to measuring GDP or to confront alternative estimates through balancing processes.

Against this background, it is unsurprising that national practices differ. As shown in the preceding analysis, countries adopt distinct approaches to GDP balancing that reflect institutional histories, data availability, resource constraints, production timetables, professional cultures and user expectations. Crucially, they also reflect the informed judgement of experienced statisticians operating under uncertainty.

This study demonstrates that GDP estimates are better understood not as precise point measures but as the outcome of a structured reconciliation process applied to imperfect and incomplete data. As such, they are inherently subject to error and revision as new information becomes available or methods improve. Differences in balancing practice do not imply weaker statistics or lower professional standards; rather, they represent alternative ways of managing uncertainty within a shared conceptual framework.

Trust in GDP estimates should therefore rest less on the idea of a single "correct" number and more on confidence in the integrity of the processes that produce them. From a user perspective, this includes assurance that balancing practices are grounded in coherent accounting frameworks, that the role of professional judgement is understood, and that discrepancies and revisions are treated transparently and consistently over time.

At the same time, the study highlights the limits of balancing. Balancing cannot compensate fully for weaknesses in underlying source data. Where large or persistent discrepancies remain, these should be interpreted primarily as diagnostic signals, indicating areas where core measurement processes require review and improvement rather than as problems to be resolved mechanically.

For national accountants designing or evaluating balancing systems, these considerations suggest the value of processes that are reproducible, transparent in their assumptions and treatment of judgement, and make effective use of available data signals. While these criteria may be difficult to achieve fully in practice, they provide useful benchmarks against which systems can be assessed and improved.

The dimensions of difference identified in Chapter 2, alongside international guidance, provide a framework for understanding how countries navigate these challenges in practice. They also underline that balancing is not a search for an unobservable "truth" but an effort to make the best possible use of available information while maintaining coherence, transparency and professional integrity under unavoidable uncertainty.

The evidence assembled in this report provides a rare comparative view of how national statistical offices approach compilation of GDP in practice. Although the institutional arrangements, tools and sequencing of balancing differ across countries, the underlying objective is shared: to produce a coherent set of national accounts estimates from diverse and imperfect sources. The variation observed across systems reflects the practical realities of statistical production rather than divergence in accounting principles, illustrating the inherently applied and institutional nature of GDP compilation.

Appendix

This Appendix includes reports for the nine countries in the study. For most countries they are derived from both questionnaire responses and interviews. For Australia and France no interviews were carried out and for the UK the content comes from interviews

Australia

Canada

Chile

Denmark

France

Netherlands

Spain

United Kingdom

United States

Australia

Introduction

The Australian GDP system is balanced primarily using SUTS. The annual balancing process follows two stages: first by ensuring economic coherence of the source data, consistent economic narratives and judgement. The second phase is a systematic/mechanical process using constraint optimisation. Balancing is sequential with current prices compiled before the previous year prices tables, although with the current price balance is reviewed for coherence whilst compiling of the volume tables.

Quarterly GDP is calculated as the average of the three approaches to measuring GDP.

Organisational structure

GDP is compiled by the National Accounts Branch which is part of the Insight and Statistics Group sitting withing the Economic and Environment Division of the Australian Bureau of Statistics. Annual benchmarking is carried out by a team of roughly 25 analysts, each of whom are assigned to specific industries.

The team meets weekly to discuss balancing seeking to identify implausible observations or relationships within the data and address these. There are ad hoc meetings with compiles as the balancing process moves towards its conclusion.

ABS uses FAME as its core National Accounts time-series software. FAME is used for all stages from aggregation of input streams to the level of the structured SUTs. Excel and Excel tools are used by the analysts with balancing responsibilities.

Balancing architecture

Balancing is done within the Supply and Use framework with 307 products and 67 industries although for publication the number of products is reduced to 114.
In year T, the tables are produced for T-1 with open revisions for the previous two years.

Source data is delivered between mid-March and Mid-May. The ABS adopts a sequential approach to balancing: current price data is balanced in early July with the previous year prices completed by the end of July. All benchmarks are finalised by the end of August.

The balancing is a manual process with a final process using a constrained optimisation tool. The optimisation process uses two tools, AMPL (A Mathematical Programming language) is used to describe the constraint optimisation problem and GUROBI is used as the actual solver.

Current price balancing

Data supply and initial verification

Each of the data suppliers with ABS carries out rigorous quality and consistency checks before the data is delivered to the SUTs team. Clearance meetings are held to allow for questions and identification of possible data issues. The clearance process for survey data includes triangulation with other data sources, for example industry data from the Australian Tax Office.

In those cases where some administrative data cannot be interrogated or verified, analysts will build an understanding of the limitations of the data.

Supply and Use analysts and data providers will discuss with upstream providers the data and the balancing process. They will also discuss with the users of the benchmark such as quarterly and State Account compilers.

Generating a balance

The initial balancing process is co-ordinated within the team. Anomalies are identified, investigated and reconcile manually. Initial balancing is not rules based, but weaker data items, such as the change in inventories, may be adjusted. The final balancing uses the constrained optimisation approach and is rule based. Query registers are established on internally accessible databases, and analysts convene meetings to discuss. Balancing decisions are logged as a response to each query.

Volume balancing

The ABS compiles SUTs at previous years prices. Chain volume measures are calculated outside of the constraints of the Supply and Use framework.

A concurrent approach is taken to balancing. The columns (industries) are looked at first to ensure sensible overall volumes for Total Supply and Intermediate Use. Analysts them move to the products. The key to concurrent balancing is finding coherent solutions across the Current Price estimates, previous years prices and the Implicit Price Deflators.
For some industries, robust volume data is available. But this is not the case for many industries particularly within services. Balancing takes account of, particularly for the supply side, where robust volume data is available. Decisions

made earlier in Current Price row balancing may need to be re-evaluated once previous year imbalances are explored and any incoherent implied deflator movements are assessed.

Quarterly and latest period approach

For the latest quarters, GDP is calculated as the average of the three approaches. Coherence is achieved by the use of coherent source data and consistent economic narratives. ABS do produce modelled data using the Supply and Use framework. They confront data from other sources such as government financial statistics, business activity and capital expenditure survey responses.

Issues/reflection

The Australian approach remains heavily reliant on professional judgement and manual intervention. While optimisation tools (AMPL and GUROBI) are used, these primarily ensure internal consistency once the manual balancing work has been completed. The overall balance is achieved through expert assessment rather than algorithmic optimisation, which limits replicability. The use of analysts using both qualitative and quantitative information helps ensure that the published estimates can be explained.

In principle, the concurrent balancing of current and previous-year prices offers a useful feedback mechanism that should strengthen coherence across time. However, the details of how this feedback operates are not well-documented, and the process appears to rely more on analyst judgement than on systematic analytics. A more structured use of quantitative diagnostics could potentially enhance transparency and reproducibility without diminishing the role of expert oversight.

ABS identifies some challenges including moving to “big data” rather than conventional surveys requiring more transformation to fit national accounts concepts. Higher staff turnover is also a challenge with less experienced staff need more quality assurance from those more experienced.

Canada

Introduction

Canada operates a fully integrated system of national accounts combining annual SUTs, quarterly GDP by income and expenditure, and monthly GDP by industry. The approach is a deliberate mix of judgemental and systematic balancing. Annual SUTs provide the core benchmark to which other GDP measures are aligned over time. The SUTs are built up from regional tables covering provinces and territories as well as Canadian enclaves abroad. This unusual, regional dimension adds considerable complexity to the compilation task.

At the quarterly stage, GDP by income and expenditure are confronted and aligned in nominal terms using judgement informed by data quality. Any remaining difference is published transparently as a statistical discrepancy rather than eliminated mechanically. Growth in GDP by industry is required to be coherent with expenditure-based GDP growth within the balanced SUT framework.

Organisational structure

Responsibility for national accounts sits within Statistics Canada under a highly centralised statistical system. Key divisions involved include the Industry Accounts Division (SUTs and GDP by industry), the National Economic Accounts Division (GDP by income and expenditure), the International Accounts and Trade Division, and the Public Sector Statistics Division.

GDP balancing is led by senior analysts (Assistant Director level), supported by subject-matter experts across divisions. Coordination between source data compilers and national accounts teams is continuous throughout the production cycle, with balancing decisions escalated early where they have system-wide implications. This senior-led structure is explicitly designed to manage risk in a highly complex and integrated system.

Annual SUTs compilation and balancing draws on a substantial dedicated team within the Industry Accounts Division alongside inputs from other divisions. Around 65 staff are involved in quarterly compilation of GDP by income and expenditure.

Balancing architecture

Annual GDP balancing is conducted within a Supply-Use Table framework. Canada's SUT system is unusually complex, being compiled annually on a regional basis for 15 regions (Canada total, provinces and territories, and Canadian enclaves abroad). The system covers approximately 220 industries, 473 products, 295 final use categories and 33 margins.

SUTs are compiled once per year and published around 34 months after the reference year. They serve as fixed benchmarks; other components of the national accounts are revised annually to align to the most recent SUTs. The full annual SUTs compilation and balancing process takes around nine months, with a further three to four months required to benchmark downstream accounts.

Current price balancing

Data supply and initial verification

Initial SUTs estimates undergo extensive verification before balancing. Automated checks flag outliers, implausible values and accounting violations, while analysts interrogate micro-level survey and administrative data, including tax records.

Generating a balance

Balancing adjustments are guided by a clear understanding of relative data quality. Some aggregates (for example, changes in inventories or interprovincial trade) are recognised as more adjustable than others, while key control totals may be held fixed. All adjustments are documented systematically in bespoke systems and classified by reason (e.g. data quality, reclassification, reconciliation, pure balancing).

In practice, many inconsistencies are resolved early through analyst judgement informed by system diagnostics, with formal system-based balancing then used to ensure full accounting coherence once major issues have been addressed.

Although system-based balancing tools are used extensively within the Canadian SUT framework, there is no single end-stage algorithm that determines the final balance. Given the scale and structure of the system — with simultaneous constraints across regions, industries, products and uses — a fully automated optimisation is not considered feasible. Instead, balancing is achieved through a combination of staged system checks and analyst judgement, with formal system-based procedures applied once major inconsistencies have been resolved.

Volume balancing

Canada compiles SUTs in volume terms using annual chain-linking. Gross value

added in volume terms is derived through double deflation, and volume estimates are produced iteratively during the current-price balancing process to provide diagnostic feedback.

Analysts monitor input–output ratios, implicit prices and growth rates at both industry and commodity level. Where deflation results are implausible, targeted adjustments are made. While mechanical procedures play a role, volume balancing retains a significant judgemental component, particularly in interpreting structural change.

Quarterly and latest period approach
At the quarterly level, GDP by income and GDP by expenditure are the primary nominal measures, with chained Fisher GDP(E) serving as the headline real measure. Nominal income and expenditure estimates are reconciled using judgement informed by the robustness of underlying sources, and any remaining difference is published as a statistical discrepancy.

Growth rates from monthly GDP by industry are confronted with quarterly GDP(E) to ensure coherence, recognising conceptual differences between the measures. Commodity-flow approaches are used for selected components such as machinery and equipment investment, and simplified quarterly SUT-style confrontations are used internally to identify emerging discrepancies.

Issues/reflection

StatsCan say their main strengths lie in the depth and integration of its system: bottom-up regional SUTs, close integration with balance of payments and government finance statistics, and strong access to micro-data within a centralised statistical office. The approach prioritises conceptual consistency and transparency over speed, accepting longer production times as the cost of system-wide coherence.

Key constraints are the timeliness of annual source data and the resource intensity of maintaining a regionally integrated SUT framework. Recent and planned innovations focus on efficiency rather than conceptual change, including reducing the scope of volume balancing in SUTs and centralising ingestion of key data sources to improve consistency across accounts.

Chile

Introduction

In Chile, the national accounts are compiled within the Central Bank. Responsibility lies within the Macroeconomic Statistics Area which reports to the Statistics Directorate. The Central Bank's role is primarily that of an integrator and balancer of multiple data sources rather than a primary data producer. The Central Bank only carries out limited primary data collection for sectors such as fisheries, communication and air transport that are not covered by INE surveys.

The Chilean approach to balancing is based on criteria including the robustness of data sources, time-series consistency and cross-validation with other variables or data sources. The process is specific to each product or industry and is dependent on the judgement of the analyst with responsibility for balancing. Volume and value balancing are carried out simultaneously, within a single integrated system, with adjustments to prices, volumes or values feeding back into the system in real time.

Organisational structure

There are two teams in the balancing process. The first team is primarily composed of industry specialists and is responsible for the compilation of production accounts by industry (column balancing). This stage is an intensive process of ensuring internally consistent production, intermediate consumption and value-added time series by industry. The second team is responsible for product balancing across rows.

The two teams work closely together during the balancing process, with continuous feedback between industry and product specialists. Industry balancing is more intensive in the first part of the process which lasts for four months. Product balancing is more dominant in the final step which also lasts for four months. In total there are 18 staff working on the compilation of the tables with most working on the industry balancing element.

The benchmark balancing process is carried out for the year t-3 with publication in March of the year t. Therefore, in March 2026, the benchmark tables for 2023 will be published alongside a provisional version of GDP for 2024 and a preliminary version for 2025 which are compiled and balanced at a lower level of

detail with structures largely inherited from the latest benchmark

The balancers use a bespoke system with a database and custom-built data modelling. The data model allows incremental adjustments, full audit trails, and multiple simultaneous views of the accounts (by industry, product, value and volume), which significantly supports a judgement-led balancing approach. The database is connected to spreadsheets and PowerBI is used to visualise the results.

Balancing architecture

Balancing is done through a Supply and Use framework with 168 industries and 291 products. The balancing process typically takes eight months starting in June each year.

Current price balancing

Data supply and initial verification

The bulk of data is supplied by INE, the National Statistical Office which carries out business and other surveys. The surveys are complemented with administrative records supplied by the internal revenue service. There is an extensive process of data verification ahead of the compilation process including outlier detection and cross-validation with other sources. Consistency checks are also used for data within the balancing process including time series and across different accounts (key identities).

Industry experts are an integral part of the balancing process and, therefore, involved in providing feedback within that process.

Since 2020, Chile has incorporated a comprehensive business-to-business administrative dataset, which substantially enhances structural understanding of intermediate consumption, trade margins, and import-use relationships, even though product classification from free-text descriptions remains partial. This gives Chile an unusually rich microdata foundation for SUT balancing, strengthening the production and income constraints used in its two-phase balancing architecture.

Generating a balance

The Bank has a two phased approach for balancing the accounts. The first step is the compilation of the industry (column) data. The objective of this process is to get the right data for domestic supply and intermediate consumption. The second phase involves balancing the supply and demand at product level.

Although there is no formal mechanical hierarchy encoded in a balancing algorithm, Chile applies a clear and consistent quality-based prioritisation grounded in analyst judgement. Variables considered most reliable - production account variables, imports, and exports—are generally treated as predetermined. Adjustments fall mainly on intermediate consumption, household consumption and above all, change in inventories. This approach reflects the high confidence in industry-level production and income data, especially since the introduction of business-to-business transaction records. In practice, the production approach clearly leads the balancing process with expenditure components adjusted to achieve consistency.

Because Chile has limited direct information on trade margins by product, a dedicated trade margin balancing step is performed once the SUTs are expressed at purchasers' prices. This process aligns margin output by trade industries with the distribution of margins across products, using both survey data and B2B transaction information. This makes margins an explicit balancing instrument rather than a residual item, improving the accuracy of distribution channels within the use table.

Adjustments are systematically tracked and recorded but no distinction is made between quality and balancing adjustments. Quality adjustments are predominant in the first part (column balancing) while the second part is more intensive in balancing adjustments (row)

Unlike many other countries, Chile does not apply any automatic balancing procedure (such as RAS or constrained optimisation) at the end of the process, even for small residual discrepancies. Minor imbalances are removed using small, targeted analyst adjustments at the end of the process rather than by an algorithm.

Volume balancing is done using annual chain linking and simultaneously with the current price balance. Deflators include CPI, PPI and trade deflators but also include information on volume and quantities for specific industries such as agriculture, fisheries, mining and manufacturing from external organisations. The procedure calculates the deflators for the supply using a weighted average of the deflators for demand. In this way, the balance at current prices is preserved when computing at previous years prices. However, there is a feedback loop and any element of the table (value, volume, deflator) can be adjusted for consistency and balance.

This approach ensures coherence between nominal and real growth rates and allows analysts to judge the plausibility of results across prices, volumes and values simultaneously.

Quarterly and latest period approach

The latest period and quarterly estimates (non-benchmarked) use the production and expenditure approaches, balanced using a simplified Supply and Use table based on the structure of the most recent benchmark tables. The quarterly system uses 45 industries and 55 products. The latest year is derived as the sum of the four quarters and is not independently rebalanced at the annual level.

Issues/reflection

Strengths include:

the B2B dataset, which enhances intermediate consumption, margins and import allocation;

strong integration of industry specialists within the balancing workflow;

a robust data model that provides full traceability and prevents miscoding; and

genuine simultaneous balancing of value and volume.

Challenges include:

- weak PPI coverage for services, requiring reliance on labour cost indices as proxies;
- the complexity of managing an eight-month balancing cycle; and
- maintaining coherence between benchmark and non-benchmark years as new data arrive, particularly given publication timetables that may prevent newly available information from being incorporated immediately

Denmark

Introduction

Denmark has a long history of using SUTs at the core of their national accounts. The development of the SUTs system started in the 1970s as the core of a new national accounts system. It has been further developed and adjusted to new technology, data and concepts over the years since then. However, it was only in 2024 that tables for the year t-2 started to be compiled. For benchmark years (t-2 and t-3), production and expenditure measures of GDP are reconciled through a Supply and Use framework whilst the income estimate is derived by residual. Most recent quarters are produced as a reconciliation of the production and expenditure measures with the income measure aligned with this measure by calculating gross operating surplus and mixed income as a residual.

Balancing of SUTs tables at current and previous year prices is carried out sequentially. There is a clear hierarchy for the variables to be adjusted during the balancing process.

Organisational structure

National accounts are the responsibility of Statistics Denmark. Organisationally they sit in the Economic Statistics team and are split between two different units: National Accounts, Climate and Environment and Government Finances.

Unusually, Statistics Denmark has a different approach for balancing the tables for the time periods T-2 and T-3. The T-2 team has 4 members, and the T-3 team consists of 6 analysts, although there is some overlap. Statistics Denmark note that it is a considerable advantage that staff are expected to work in the office four days a week.

Core systems are designed makes us of Pascal, Excel and VBA. Validation tools for the T-2 calculation use PowerBI.

Balancing architecture

There are different structures for balancing in the years t-3 and t-2. In t-2 there are approximately 350 porducts and 84 industries (including 3 technical industries which are artificial, zero value added industries used purely to make the balancing process cleaner and more manageable).

- The tables include the following dimensions for components of demand

  Household final consumption expenditure: 70 + 2 tourism
- NPISH consumption expenditure: 1
- Government individual consumption expenditure: 5
- Government collective consumption expenditure: 1

- Gross fixed capital formation: 13
- Changes in inventories: 7
- Acquisitions less disposals of valuables: 1
- Imports: 1
- Exports: 1

The benchmark tables at t-3 are balanced at a significantly greater level of disaggregation with around 2,350 products and 120 industries (including 3 technical). There is also greater disaggregation in the components of demand

- Household final consumption expenditure: 81 + 2 tourism
- NPISH consumption expenditure: 10
- Government individual consumption expenditure: 18
- Government collective consumption expenditure: 13
- Gross fixed capital formation: 13
- Changes in inventories: 7
- Acquisitions less disposals of valuables: 1
- Imports: 1
- Exports: 1

Revisions are generally only taken back to t-3 with the main revisions being published in June of year t. In general, they will not reopen early years because of the wide ramifications of doing so. However, benchmark revisions takes place every fifth year according to the Harmonised European Revision Policy (HERP).

The balancing tool for SUTs-system for T-2 calculations is based on VBA with an excel interface. Validation tools are developed in PowerBI.

The balancing tool for SUTs-system for T-3 calculations is based on Pascal with an excel interface and VBA routines. Data are stored in "flat" files with a fixed data structure.

The T-2 process takes around 2 months for a team of 4 people including the take-on and validation of data. Balancing itself takes around two weeks The T-3 process is longer and take approximately six months with two of these months devoted to balancing. Balancing at previous year's prices takes around six weeks.

Balancing at current and previous year prices

Denmark balances its SUTs at current and previous years prices sequentially, although at t-2 there is a more integrated process. As noted, it has a different process for the periods t-2 and t-3.

Data supply and initial verification

Both years processes start with the receipt and validation of data from a wide range of data sources. Members of each of the teams have responsibility for areas of the economy and be familiar with the data and methods in these areas. They will have a dialogue with those responsible for primary statistics. Additionally, they will engage with the large cases unit for those sectors which are dominated by large players. The dialogue is more significant for the t-3 benchmark when compared to the latter year.

One feature of the Danish system is the use of a large case unit. About 30 to 50 firms are reviewed representing a substantial share of the Danish Economy. For these firms, data at firm level have been confronted by the large cases unit before delivery to national accounts. If a need for further investigation and adjustments in data is detected during the SUTs balancing, the large cases unit is involved.

For the volume data, a wide range of price indices and volume measure are used to deflate the value estimates. Each value measure in the tables has an associated deflator, at the product level, with different deflators applied for different uses.

Generating a balance

Denmark uses a highly structured, rules-based method for balancing SUTs at both current and previous year's prices. They produce unbalanced tables and then use a mechanical process to generate an initial balance. There is a strict hierarchy of variables when it comes to balancing as shown in the following table starting with the variable that are least likely to be adjusted

SNA code	Transaction (SNA terminology)
P.3 (for sectors S.13 and S.15)	Final consumption expenditure of **general government (S.13)** and **NPISH (S.15)**
P.1	Output
P.6 + P.7	Exports and imports of goods and services

SNA code	Transaction (SNA terminology)
P.2	Intermediate consumption
P.51g	Gross fixed capital formation
P.52 + P.53	Changes in inventories and acquisitions less disposals of valuables
P.3 (for S.14)	Final consumption expenditure of **households (S.14)**

In addition, some industries are pre-balanced before populating the tables. Therefore, variables such as government expenditure, imports and exports (of both goods and services) energy and for large enterprises are treated as pre-determined and cannot be changed in the balancing process.

The automatic balancing process begins with a vertical balance to align industry totals with pre-determined targets. The next step is a horizontal balance to align product totals. The targets are not immutable and can be revised if inconsistencies are found.

At the end of the mechanical balance, balance will typically have been achieved for all but 300 of the products within the mechanical constraints. Manual balancing is directed at the areas where source data are weakest – household final consumption, gross fixed capital formation and intermediate consumption – while predetermined items such as government spending or external trade remain fixed.

Volume balancing
Volume balancing is primarily mechanical with the supply side fixed. Adjustments made to domestic use to produce a balance.

A range of indicators are used to verify the balance. These included reviewing the development of both prices and volumes at both detailed industry and household final consumption levels. The review also includes the ratio of production to intermediate consumption for each industry. If necessary, to produce a more plausible estimate, price indices may be adjusted.

Although both the t-2 and t-3 volume processes are integrated with the current prices, there is more opportunity for a feedback loop in the t-2 process where there is true simultaneous balancing. In t-3, reopening current-price tables at this

stage is rare; in t-2, volume and value balancing are genuinely simultaneous and allow feedback adjustments.

Quarterly and latest period approach

For the latest period, a combination of the production and expenditure approaches is used. These two measures are reconciled at an aggregate level – no use made of the SUTs or a pared down commodity flow methodology. For the income approach, gross operating surplus and mixed income are calculated by residual.

Issues/reflection
Statistics Denmark reflect that key strengths of the work include the collaboration with data suppliers and their large case unit. They also stress the benefits of the balancing teams working in the office rather than from home, improving collaboration.

Statistics Denmark sees its approach as highly systematic, reproducible and automated involving less judgement than in other countries. Balancing is iterative and constrained by clear rules – with good diagnostics.

France

Introduction

In France, the level of GDP is determined primarily through the production approach, with income estimates derived from the same underlying sources. Expenditure estimates are used mainly to support convergence across approaches rather than being treated as an autonomous measure. The reconciliation of approaches is embedded within the broader compilation process, and balancing is not treated as a distinct, standalone stage. SUTs are compiled as part of the accounting framework, but they do not play a direct role in determining the final level of GDP.

Organisational structure

Compilation of the national accounts is carried out within INSEE's Department of National Accounts. The organisational structure distinguishes between synthesis functions, goods and services accounts, quarterly accounts, and methodological development, with overall coordination achieved through central synthesis teams. This structure supports convergence across approaches within a single institutional framework rather than treating balancing as a separate activity.

Balancing architecture

The production approach is the primary basis for determining the level of GDP in France, with the compilation of production and income measures fully integrated and based on the same underlying data and processes. The expenditure approach is used mainly as a point of comparison with the production approach, helping to refine estimates for selected aggregates.

Compilation of the expenditure approach is coordinated by a dedicated team that liaises with sector and product specialists. Convergence across approaches is achieved through an iterative process, with remaining imbalances addressed by revising production estimates, including through corrections to source data where necessary.

In practice, the estimate of the production approach is finalised at the very end of the convergence process, once the remaining imbalance has been reduced to a residual level of approximately €500 million. At this stage, national accountants judge it to be more straightforward to calibrate the production approach to the level of GDP implied by the expenditure approach. This final adjustment takes place at the end of compilation and is described as a form of statistical balancing.

SUTs, with 139 industries and products, provide the detailed accounting framework within which convergence is assessed and plausibility checks are carried out at product level, but they do not operate as a standalone balancing mechanism determining the final level of GDP.

Current price balancing

Current price compilation takes place within the supply and use framework, with product specialists and a central synthesis team jointly assessing consistency across resources and uses. Balancing work focuses on plausibility checks, including the coherence of technical coefficients, margins and taxes, with adjustments made as part of the convergence process rather than through formal optimisation.

Volume balancing

Volume SUTs are compiled at previous year's prices and chain-linked. Deflation is based on a range of price and volume indices, with consistency checks carried out on implied deflators and structural movements. Volume and value considerations are addressed jointly during the synthesis process.

Quarterly and latest period approach

Quarterly accounts are compiled using a mixed production and demand approach, based on assumptions about trends in technical coefficients observed in the annual accounts. The approaches are not balanced against each other, with goods largely production-led and services more directly informed by use-based indicators. Income is not treated as an independent quarterly balancing approach.

Issues/reflection

France reports having particularly comprehensive information for the production measure and, therefore, give it prominence in the compilation process. They are resource constrained and considering increasing the amount of mechanisation in their balancing processes.

Netherlands

Introduction

The Netherlands has. Long history of using SUTs at the centre of their approach to measuring GDP with full implementation for both annual and quarterly accounts. The balancing approach is to use manual approach to remove large inconsistencies and a mechanical approach to remove residual imbalances.

Organisational structure

Statistics Netherlands has a dedicated department for national accounts sitting inside the directorate, Sector economy, Business and National Accounts. Within the National Accounts department there are teams covering, supply and use table, sector accounts, environmental, Labour and Regional Accounts, and publications and research.

With the SUTs team, there are head integrators for quarterly and annual accounts. Their teams consist of specialists in industries and in components of final demand. These specialists are often the primary compilers of the data that goes into the unbalanced tables, providing the column data that is balanced. There are around 40 people who work on the SUTs taking everyone into account.

Balancing the annual accounts (final estimate of T-2 and preliminary estimate of T-1) is typically done in a three-month window between March and May. This includes producing a final table for the year t-2 and a provisional table for the year t-1.

Balancing architecture

Balancing is done completely within a Supply and Use framework. Annually, there are around 600 product groups and 120 industry groups. For annual data, revisions of up to two years are incorporated although The Netherlands is investigating the possibility of revising earlier years when deemed necessary,

There are bespoke programs for managing the SUTs data and for the final mechanical balance. The mechanical balancing is done using Fico xPress which is integrated into their bespoke system.

Current price balancing

The starting point for the balance is the column data in the SUTs. Checks on the input data are completed by the data suppliers.

A process table is maintained to record quality and balancing adjustments.

Data supply and initial verification

CBS confronts multiple sources - including the structural business statistics, PRODCOM-type production data, Intrastat/Extrastat, short-term indicators, and detailed information on the largest enterprises. Analysts examine discrepancies at both macro and micro levels, drilling down to the level of individual firms where necessary. For large enterprises, there is continuous feedback with CBS's specialist "large case unit", which reconciles production, trade flows and financial information at the enterprise level before the SUTs are even populated.

Generating a balance

There is a manual process to remove major imbalances from the tables. There is a hierarchy for making balancing adjustments. At the top of the hierarchy sit production and intermediate consumption from SBS, which CBS regards as the strongest, owing to extensive internal validation, enterprise confrontation, and supporting microdata. Household consumption and gross fixed capital formation also receive substantial weight. . Lower in the hierarchy sit imports and exports of goods and services (though they require many conceptual corrections such as removing non-resident traders associated with the Rotterdam effect), and trade margins. Unusually, the change in inventories on an annual basis is considered a high-quality estimate and less likely to be adjusted. Some variables, particularly those with known values (subsidies, specific government final consumption), are fixed and not altered as part of machine balancing. With this hierarchy GDP by production approach is the most dominant approach but its value can be adjusted as part of the balancing process.

For income components, there are some sources from labour accounts. However, there are no complete sources for gross operating surplus at an enterprise level so the income measure is calculated as a residual.

Once the major discrepancies have been investigated and resolved manually, the remaining imbalances are passed to a **machine-balancing algorithm.** Typically, there is threshold of €150 million. This tool, which uses Fico xPress uses a **weighting scheme** applied to every cell in the SUTs.

Volume balancing

Volume balancing is completely integrated and simultaneous with the current price tables. Analysts have full visibility of current, volume and deflator data and can see the impact of changing any one of these variables on the balance.

Volume balancing, as with other elements, can involve further discussion with the original data suppliers.

Quarterly and latest period approach

The quarterly approach is implemented using a Supply and Use framework using the structures of the latest provisional table unless there is information which suggests how these might have changed.

Issues/reflection

CBS makes estimates of factory-less production. In addition, they are using micro data on a quarterly basis to improve estimates of the changes in inventories.

Spain

Introduction

Spain compiles annual SUTs that form the core framework for balancing GDP estimates. Given resource constraints, a significant share of the reconciliation process relies on systematic and algorithmic balancing procedures, with expert oversight focused on approving and validating the resulting adjustments rather than undertaking extensive manual confrontation.

Organisational structure

Compilation of GDP is carried out within the Department of National Accounts in the National Statistics Institute. Inputs are also received from the Central Bank for financial sector data and the Audit Office for public sector data.

Around 25 to 30 staff contribute to the SUTs mainly as sector and aggregate specialists. Balancing is highly centralised with one person doing most of the balancing, supported by structured discussions with compilers. Roles are not as clearly demarcated as in some other countries.

Balancing architecture

Balancing is carried out using 102 industries and 140 products. The tables for three years are open at any one time (T, T-1 and T-2). The balancing system is a bespoke system written in SAS and Excel.

The balancing process takes between three and five months, although this includes initial checks for accuracy and consistency.

Current price balancing

Data supply and initial verification

For each national accounts aggregate, there is an analyst responsible for checking for consistency and revising as necessary. These estimates are then uploaded into the balancing system which runs automatic consistency checks. During balancing, estimates are triangulated with other data sources.

Generating a balance

Spain uses a mixture of judgement and mechanical balancing with a greater reliance on algorithmic balancing than many other countries. Once the verified

data has been uploaded, a constrained, least-squares algorithm is applied. The algorithm is primarily designed to balance output and intermediate consumption. The results from the algorithm are reviewed with manual adjustments applied to remove implausible values.

There is no single hierarchy for adjusting variables and constraints are applied flexibly using a product-by-product judgement-based approach depending on the confidence in sources. Resolving inconsistencies is explicitly collaborative with balancing adjustments agreed with the data compilers. However, income estimates are not routinely used to drive balancing and if income estimates look implausible then the supply-side estimates will be reviewed rather than the income figures being adjusted.

Volume balancing

Volume balancing is carried out in previous years prices with national accounts aggregates being chain-linked. A price index is compiled for each aggregate or product in the SUTs and unbalanced tables are calculated. These are balanced algorithmically with checks on the resulting deflators. The process is sequential and there is no feedback to the current price balancing process.

Quarterly and latest period approach

When annual accounts are available, quarterly GDP estimates for the supply and expenditure approaches are derived to ensure consistency with the annual benchmarks. For the most recent periods, where annual benchmarks are not yet available, quarterly balance between supply and demand is achieved through an iterative process that brings the two approaches into alignment. In both cases, consistency with the income approach is obtained by treating gross operating surplus and mixed income as a residual, calculated as the difference between quarterly GDP and the other income components, which themselves are disaggregated from annual data where available.

Issues/reflection

Interview discussion highlighted that the reliance on systematic balancing reflects binding resource constraints rather than a preference for fully mechanical reconciliation, with a desire for more integrated current-price and volume balancing limited by staffing and data availability.

United Kingdom

Introduction

This section describes in detail the approach to balancing adopted by the ONS. As with every country, the balancing approach reflects history, organisational choices, available systems and data, resource levels and other constraints.

The ONS approach for benchmark years is centred on current price SUTs – an approach that has been used for over 20 years. Since 2022, volume tables are also published. However, as we will see, the approach to balancing in volume terms is quite different to that applied in current prices.

Organisational structure

The ONS is responsible for the collection and publication of the main economic statistics within the UK. National Accounts which sit under the Deputy National Statistician for Economic, Social and Environmental Statistics and the Director of Economic Statistics Production and Analysis. The National Accounts Co-ordination Division contains the central SUTs Team as well as some of those who provide data for the balancing process.
This central team is made up of 11 people. In addition, there is a small team producing input-output tables who also support the balancing process. Finally, the central team draws in a small amount of additional resource from across the wider economic statistics group during the peak balancing period.
Data for the SUTs are provided by 12 distinct compiler teams some of whom may be sector based (households for example) and others may be transaction specific based (non-financial assets). The compilers are responsible for supplying the data for the unbalanced SUTs. The central team is responsible for balancing the tables and producing the final statistics.

The ONS uses a processing system called CORD for its data management. Compilers upload their data through the CORD system and the SUTs Team load their revised aggregates to the same system. The CORD system retains the balanced data through each balancing iteration. There are typically around 20 iterations generated by the processing of source and method changes and around 40 iterations generated by the "open" balancing process for the latest years, those these can vary depending on the scope of changes and the nature of the data. The SUTs Team also maintain a "Master" spreadsheet which shows both the original data and the data following adjustment.

Balancing architecture

All balancing is done within the SUT framework working in through a square with 112 products and 112 industries, although the published tables have only 104 products and industries. The tables are balanced at purchasers' prices with the

supply table including imports of goods and services, distributors' trade margins and taxes less subsidies on products.

In Year T, the annual national accounts process involves the compilation of a new supply and use table for the year T-2 and revised tables for T-3 and T-4. So, in the latest exercise in 2025, new tables were compiled for 2023, with revisions to the 2021 and 2022 tables. This open year structure allows for the incorporation of revised and improved data into the tables for the previous two years.
For an October Blue Book publication, the national accounts consistent with the newly balanced tables are published at the end of September with the full "Blue Book" containing detailed annual data following at the end of October. The timing is driven by availability of key datasets including the results of the Annual Business Survey and administrative data. The elapsed time from initial data supply to completion of the balancing process varies from year to year but is typically between 7 and 10 weeks.
The ONS adopts a primarily sequential approach to balancing. The current price tables are compiled and balanced first. Then the volume tables are balanced. Current price balancing is primarily a manual and iterative process with adjustments made directly by the balancing team. The final balance is constructed using FICO Xpress which is a proprietary tool which applies complex constraints and economic relationships to produce consistent tables. The process to produce the volume tables is much less manual and makes more extensive use of the FICO system.

Current price balancing

Data supply and initial verification
The current price balancing process starts with the supply of data from each of the compiler branches. They upload the data into CORD which is then transferred into the SUTs system. When the data are added to the SUTs system they are spliced onto the existing data to create a starting point for the new balancing exercise. Balancers then verify and adjust the spliced data before the balancing process itself begins.

The splicing process

The splicing process is complex and depends upon the variable being updated. There are three classes of variable:

- Those that take balancing adjustments.
- Those that usually do not take balancing (such as trade in goods).
- Those that never take balancing (such as government final consumption).

The splicing process does nothing to the third group. Items that do not usually take balancing are reset with the adjustment set to zero.

For those items that include balancing adjustments for years t-3 and t-4, the outcome of the splice depends on whether the new data brings the raw values closer to the balanced value or not. If it is closer, the previous balanced value is preserved. If the new value is further away, then the splice adds the change to the balanced level leaving the balancing adjustment unchanged.

For the latest year (t-2), the growth rate of the unbalanced data is applied to the new balanced value at (t-3).

Verification

Once the spliced data are in the system, the SUTs Team conduct a verification process working with the compiler teams. They will seek explanations for anomalies and data outside of the expected range and assess whether the supplied data aligns with the known economic narrative and previously published data. The Team also look for anomalies that might have been introduced during the splicing process.

The curiosity process

There are multiple curiosity points during compilation. There is an initial data review with the supplying area who are asked to explain their data including revisions and provide an economic rationale. There is then feedback to the more senior, National Accounts Project Board who will meet close to the end of the current price balancing process and allow a broader discussion on the picture painted by the data. They will also meet when the compilation of the volume data is close to completion. As an example of where this process fits in with the production timeline: 3 weeks for delivery of data and holding compiler curiosity; 1 week then for the splicing process; a further 6 to 9 weeks for balancing; and then a Project Board curiosity 3 weeks from the end and then a final sign-off.

Generating a balance

The balancing process is, by necessity, both iterative and fairly ad-hoc, allowing for considerable discretion from the balancing team. Two types of adjustments are made: quality adjustments and balancing adjustments. A quality adjustment is made when there is evidence that there is error in the supplied number and is agreed with the compiler. A balancing adjustment, which is more common, is made, as the name would suggest, to achieve the balance.

When making balancing adjustments there is a hierarchy of variables for adjustment. For example, in the income approach, the estimate of profits of non-financial corporations is far more likely to be adjusted than wages and salaries which are considered much more robust at the industry level. Within the production approach, there is a general expectation to keep balancing adjustments plus or minus 10% of the unbalanced level, unless there is an established precedent. The Supply and Use Table Team would justify any new balancing exceeding this threshold to the compiler area. The balancing team

liaise with individual compilers to agree quality adjustments but mostly to inform them of balancing adjustments. Balancers are encouraged to follow a process:

- Get a deep understanding of the data in their area
- Use alternative data sources for triangulation (such as Annual Survey of Hours and earnings, Business Register and Employment survey
- Consider price effects particularly if there is high general or sector inflation
- Work through industries first and then products.

While balancing adjustments are not explicitly held in the SUTs system; the balanced and unbalanced data are, so the current balancing adjustment is the difference between the two. There is vintage information held of the balanced and unbalanced data. From a practical perspective, we cannot document every balancing adjustment because there is approximately 1.5m data points, many of which have balancing. However, balancers are asked to document a balancing story, where up to two paragraphs detailing the "story" of the data and how they resolved the imbalance. However, time and work pressures mean this is not always completed by all balancers. Movement of interest can, in general, be explained.

Automated balancing

Once a near-final balance is reached, the team runs a mechanical balancing process in FICO Xpress. The objective is to balance the tables mathematically but with some control on the judgements made. The tool allows different and complex constraints to be put on different variables. These constraints can include setting some variables as invariant or within a tolerance band. This frees balancers from the time-consuming task of achieving an exact balance, which adds little economic value. FICO Xpress then runs to balance row and column totals. The FICO output is not considered final and is still subject to review, and compiler areas will challenge cases where automated balancing changes data narratives they believe correct.

Chained volume measure balancing

The ONS has adopted annual chain linking for its volume measures. The chained volume estimates are calculated in previous years' prices and then chained together to produce a consistent time series. The series are indexed to the latest year for which SUTs are available. From the publication of the 2025 Blue Book, that will be 2023.
Unlike the current price process, balancing the volume tables is primarily automated. The starting points for the compilation of the volume tables are the current price tables and a complete set of deflators for the tables. These are fed into FICO Xpress and a balanced table is produced. Different constraints are fed

into the algorithm depending on the quality of deflators. For example, government and non-profit institutions serving households (NPISH) deflators will not be changed because conceptually they need to be unchanged to achieve balance. Data derived from the Consumer Price Indices are given very tight constraints. Trade deflators are generally considered to be high quality and so are less adjusted. Intermediate consumption and output deflators are allowed to vary more. Intermediate consumption deflators are not directly collected; they are a weighted average of output and import deflators, plus relevant product taxes.

Once the FICO model has run, the results are scrutinised by the central balancing team who also seek feedback from the compilers. Feedback is not systematised and some areas are more engaged in the process than others – reflecting, primarily, the level of understanding of volume measures in the balancing process.
The FICO model balances one year at a time so there are no constraints on year-on-year growth – although extreme values will be identified during the scrutiny process. Current price balances can be (and are) revisited in light of the volume balance, although time pressure limits the scope of this work.

Quarterly and latest period approach

The ONS works on the basis that the production approach to measuring GDP provides the best estimate of quarterly growth. For those years where there is an annual balance, the annual data are interpolated so that the quarterly growth matches, as far as possible that of the output measure. However, mathematically, GDP is calculated as the mean of the three approaches to measuring GDP, although the path of short-term growth is anchored to the growth in the production measure.
This average approach is also used for quarters after the latest annual balance, apart from the two latest quarters. However, there is an extensive balancing process to bring the three approaches into line before averaging. Coherence and alignment adjustments are used in this process. Coherence adjustments are adjustments applied to individual components based on judgements made on data quality or other information. Alignment adjustments are mechanical adjustments made to bring the measures into line and are applied to the change in inventories for expenditure and the gross operating surplus of non-financial corporations on income. These adjustments sum to zero over a calendar year. As with the annual balancing process, FICO is used to generate a balance with specific constraints including on the size of alignment adjustments and the path of the statistical discrepancies – the differences between the headline average measure and each of the three different approaches.
As with the annual process, there is a curiosity process with compilers to discuss adjustments to data.

Commodity flow modelling

Commodity flow modelling allows the production (plus net trade) of a product to be confronted with the use of the product. ONS has developed a commodity flow approach, primarily for comparing supply and use for consumer facing industries and used as part of the quarterly GDP processing.

Outstanding issues/reflections

The ONS approach to balancing mixes judgemental and automated approaches. The current price balance is mostly judgemental based on a set of relatively loose rules. Annual volume balancing is a more mechanical process using the FICO model but with opportunity for feedback. The quarterly model is heavily based around the output/production measure with a mixture of adjustments to the other measures based both on judgemental and mechanical approaches. A commodity flow model is used to inform the quarterly balancing.

This approach has evolved over multiple years. An attempt at using an approach based on the "H" model within the ONS did not work, primarily because of data limitations in areas like trade margin matrices. The imbalances between the three approaches to measuring GDP on an annual basis are increasing over time. Although this worsening suggests that basic data are continually becoming less reliable, it is timely to look at other countries' approaches to balancing to identify what innovations might improve the ONS's output.

United States

Introduction

The US Bureau of Economic Analysis (BEA) estimates GDP using the expenditure and income approaches and reports a statistical discrepancy. The expenditure measure is the BEA's preferred measure. A production-based estimate is also compiled and is used for analysis and benchmarking, but it is not used to determine the published headline level of GDP.

Organisational structure

Responsibility for GDP compilation and reconciliation sits within the National Economic Accounts Directorate of the Bureau of Economic Analysis. Compilation of source components is undertaken by subject-matter experts (industry and final demand specialists), while a dedicated systems processing group manages the formal balancing of make-use tables using automated tools. Balancing is therefore operationally centralised but analytically informed, with real-time interaction between systems staff and compilers when inconsistencies arise. Final decisions on non-standard adjustments are reviewed and approved by subject-matter experts rather than imposed mechanically.

Balancing architecture

As noted above, the US do not produce explicitly balanced accounts but show a statistical discrepancy. There is a reconciliation process within a "make-use" table framework where, on an annual basis, around 1,200 industries and 4,700 products are balanced.

The US has a relatively open revisions policy, typically allowing five years of revisions. However, significant methodological changes during a comprehensive update, the entire time-series, going back to 1929, can be revised. A key driver of the revisions policy is that there is a five-yearly economic census.

Current price balancing

In the US current-price balancing activities are used to support internal accounting consistency within the national accounts framework rather than to determine the published level of GDP. A central element of this process is the use of constrained RAS-type algorithms (KRAS) within make–use and industry table, which are applied to enforce accounting identities while respecting predefined constraints and preserving key data features.

The application of KRAS is accompanied by judgemental review, including the specification of constraints, the treatment of outliers and the assessment of

plausibility at detailed product and industry level. These processes are designed to improve coherence within datasets and across related accounts, but they do not force reconciliation between the expenditure-, production- and income-based measures of GDP.

The expenditure-based estimate remains the headline measure, with differences relative to other approaches explicitly retained and published as the statistical discrepancy rather than eliminated through balancing adjustments. The statistical discrepancy is monitored and explained, but it is not used diagnostically to drive reallocations or to force reconciliation across approaches.

Volume balancing

The US does not produce an explicit economy-wide volume balance. Headline real GDP growth is derived from the deflated expenditure measure. For real GDP by industry, unpublished SUTs are produced and used as the basis for the estimates. Volume balancing, therefore, supports internal coherence at detailed level but does not operate as a mechanism for reconciling alternative measures of aggregate real GDP.

Quarterly and latest period approach

For the latest quarters, expenditure is the featured measure with, as with annual data, a statistical discrepancy reported. A production measure is produced with inputs calibrated so that its growth is aligned with growth in the expenditure measure. As a result, a single real GDP growth path is enforced through the expenditure approach, even while nominal discrepancies across approaches are accepted and published. Some use is made of commodity-flow modelling to produce estimates of fixed capital formation.

Issues/reflection

The US Survey responses emphasise the scale and level of detail of the US national accounts system, alongside an organisational structure that integrates national and industry accounts within the same working units. This is seen as supporting consistency between quarterly and annual estimates. The main factor limiting accuracy and timeliness is reported to be the availability of timely source data, particularly for intermediate inputs. Recent and planned developments focus on incremental improvements to existing balancing processes, including refinements to KRAS controls, expanded detail, greater automation, and exploration of multi-quarter balancing, rather than changes to the overall architecture.

References

European Commission (2013), European System of Accounts – ESA 2010. Luxembourg: Publications Office of the European Union.

Lenzen, M., Gallego, B., & Wood, R. (2009). Matrix balancing under conflicting information. Economic Systems Research, 21(1), 23–44.

Nicolardi, V (2013), Simultaneously balancing supply–use tables at current and constant prices: a new procedure. Economic Systems Research 25(4):409-434

Office for National Statistics (2022). Inclusive Income Methodology. https://www.ons.gov.uk/economy/economicoutputandproductivity/output/methodologies/inclusiveincomemethodology (Retrieved 22 April 2026).

Stone, R., Champernowne, D. G., & Meade, J. E. (1942). *The Precision of National Income Estimates.* Journal of the Royal Statistical Society 105(2), 111–125.

United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, and World Bank (2025), System of National Accounts 2025 New York: United Nations.

United Nations (2018), Handbook on Supply and Use Tables and Input-Output Tables with Extensions and Applications. New York: United Nations.

Van der Ploeg, F (1982) *Reliability and the adjustment of sequences of large economic accounting matrices,* Journal of the Royal Statistical Society: Series 145(2) 169-186

Weale, M (1989), *The reconciliation of national income estimates.* Journal of the Royal Statistical Society: Series A (Statistics in Society), 152(1), 1–34.