Balancing the SUTs

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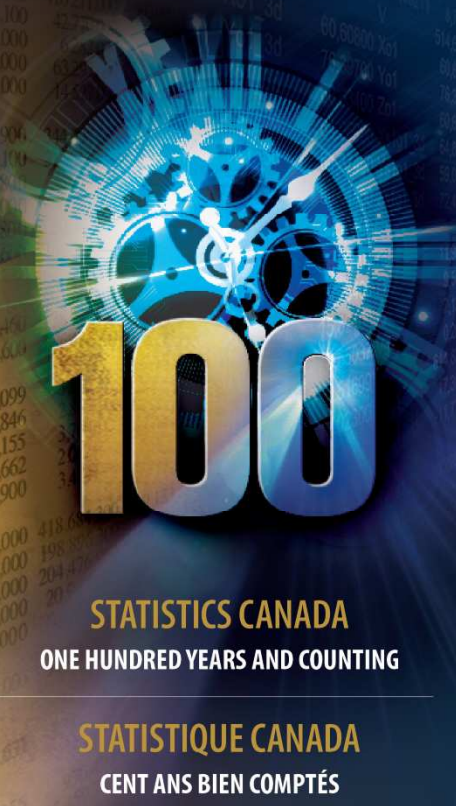


Seminar on the Supply and Use Tables

11-13 September 2018

Beijing, China

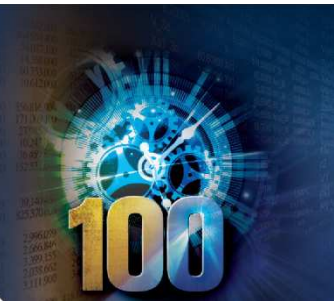
Agenda

- Introduction
- Methods of balancing (Sequential / Simultaneous)
- Step-by-step balancing process
- Interactions with other accounts
- Other considerations

Introduction

- When SUTs are first compiled from source data, there will be imbalances
  - Supply ≠ Uses
  - GDP-P ≠ GDP-E
- This is because sources are disparate, each having its own sample, reliability margins, definitions, and other peculiarities
- It is therefore necessary to undergo a process of balancing the SUTs such that the fundamental identities are met and no inherent “violations” exist in the tables

Basic identities of SUTs



- The following identities have to hold both in current prices and in volume terms, whether SUTs are presented at purchasers' prices or at basic prices
- Total Supply = Total Use, by product
- ∑Output = ∑Inputs, by industry
- Total supply of margins at basic prices = Total margins "used"
- GDP-Production = GDP-Income = GDP-Expenditure

Basic identities of SUTs

- There are also certain violations or pseudo-violations that must not be present in the SUTs. Examples include:
  - Negative entries in most cells of the SUTs
  - The export of a product being greater than its domestic supply (output + inventory withdrawal + asset disposal)
  - The re-export of a product being greater than its import (unless the import took place in a prior period)
  - Industries where there is output but no intermediate consumption
  - Industries where there is GOS but no COE

Supply and use tables @ purchasers' prices

Industries / Final Uses / Products	Supply: Output of industries: Agriculture, forestry, and fishing	Mining, quarrying, and construction	Manufacturing	Trade and transport	Services	General government	NPISH	Total industry outputs	Imports	Supply @ basic prices	Valuation: Margins: Retail	Margins: Transport	Margins: Wholesale	Taxes on products	Subsides on products	Valuation total	Supply @ purchasers' prices	Use: Inputs of industries: Agriculture, forestry, and fishing	Mining, quarrying, and construction	Manufacturing	Trade and transport	Services	General government	NPISH	Total industry inputs	Final uses: Household expenditure (C)	General government expenditure (G)	NPISH expenditure	Gross capital formation (I)	Exports (X)	Total final use	Use @ purchasers' prices
Agriculture, forestry, and fishing product	64	0	1	0	0	0	0	**65**	10	**74**	5	4	4	0	-3	**9**	**84**	14	1	32	0	2	1	0	**50**	15	0	0	-1	20	**34**	**84**
Mining, quarrying and construction	0	406	2	0	0	7	0	**415**	32	**447**	0	16	1	13	-1	**29**	**476**	3	83	75	7	26	11	3	**169**	37	0	0	307	83	**426**	**476**
Manufactured products	0	0	498	3	1	1	0	**502**	342	**845**	109	24	107	63	-0	**304**	**1,148**	15	89	208	23	96	25	1	**458**	341	0	0	80	270	**690**	**1,148**
Trade and transport services	1	0	1	120	1	1	0	**123**	15	**138**	3	0	1	3	-5	**3**	**141**	1	4	9	31	47	6	0	**98**	32	0	0	-4	15	**43**	**141**
Other services	0	7	20	28	1,018	59	12	**1,146**	69	**1,215**	3	0	2	32	-8	**29**	**1,244**	10	66	50	96	322	112	12	**667**	458	0	0	60	59	**577**	**1,244**
General government services	0	0	0	0	0	352	0	**352**	0	**352**	0	0	0	0	0	**0**	**352**	0	0	0	0	0	0	0	**0**	0	352	0	0	0	**352**	**352**
NPISH	0	0	0	0	0	0	23	**23**	0	**23**	0	0	0	0	0	**0**	**23**	0	0	0	0	0	0	0	**0**	0	0	23	0	0	**23**	**23**
Retail trade services	0	2	0	111	6	0	1	**120**	0	**120**	-120	0	0	0	0	**-120**	**0**															
Transport services	0	5	0	8	30	0	0	**43**	0	**44**	0	-44	0	0	0	**-44**	**0**															
Wholesale services	0	0	9	104	2	0	0	**115**	0	**115**	0	0	-115	0	0	**-115**	**0**															
Total	**65**	**420**	**531**	**373**	**1,058**	**421**	**36**	**2,905**	**469**	**3,374**	**0**	**0**	**0**	**111**	**-17**	**94**	**3,468**	**43**	**192**	**373**	**157**	**492**	**158**	**16**	**1,432**	**873**	**352**	**23**	**342**	**446**	**2,036**	
Subsidies on Production																		-0	-0	-0	-0	-1	0	0	**-2**							
Taxes on Production																		2	8	4	9	45	4	0	**72**							
Compensation of employees (W&S)																		7	87	81	122	218	174	17	**705**							
Compensation of employees (ESC)																		1	12	19	17	23	34	2	**108**							
Gross Mixed Income																		7	18	1	7	153	0	0	**186**							
Gross Operating Surplus																		6	103	54	60	129	51	1	**404**							
Total Gross Value Added																		**22**	**228**	**158**	**216**	**566**	**263**	**20**	**1,473**							
Total Inputs																		**65**	**420**	**531**	**373**	**1,058**	**421**	**36**	**2,905**							

GDP-Production = ∑GVA + TLSP = 1473 + 94 = 1567

GDP-Expenditure = C+G+I+X-M = 2036 - 469 = 1567

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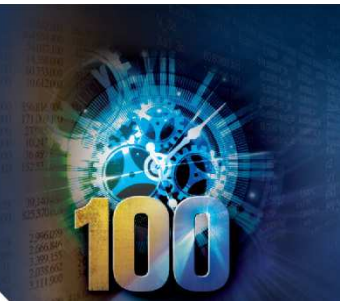
Methods of balancing

Balancing

- Balancing is the process of iteratively making adjustments to the SUT estimates in order to:
  - Satisfy all the basic identities
  - Ensure there are no violations in the system
  - Resolve implausible or inconsistent phenomena
  - Reconcile differences with “controls”
- SUTs could be balanced:
  - Simultaneously (C$ AND K$; at purchasers’ and basic prices) or sequentially (C$ THEN K$; at purchasers’ and basic prices)
  - At basic prices

Sequential or simultaneous balancing



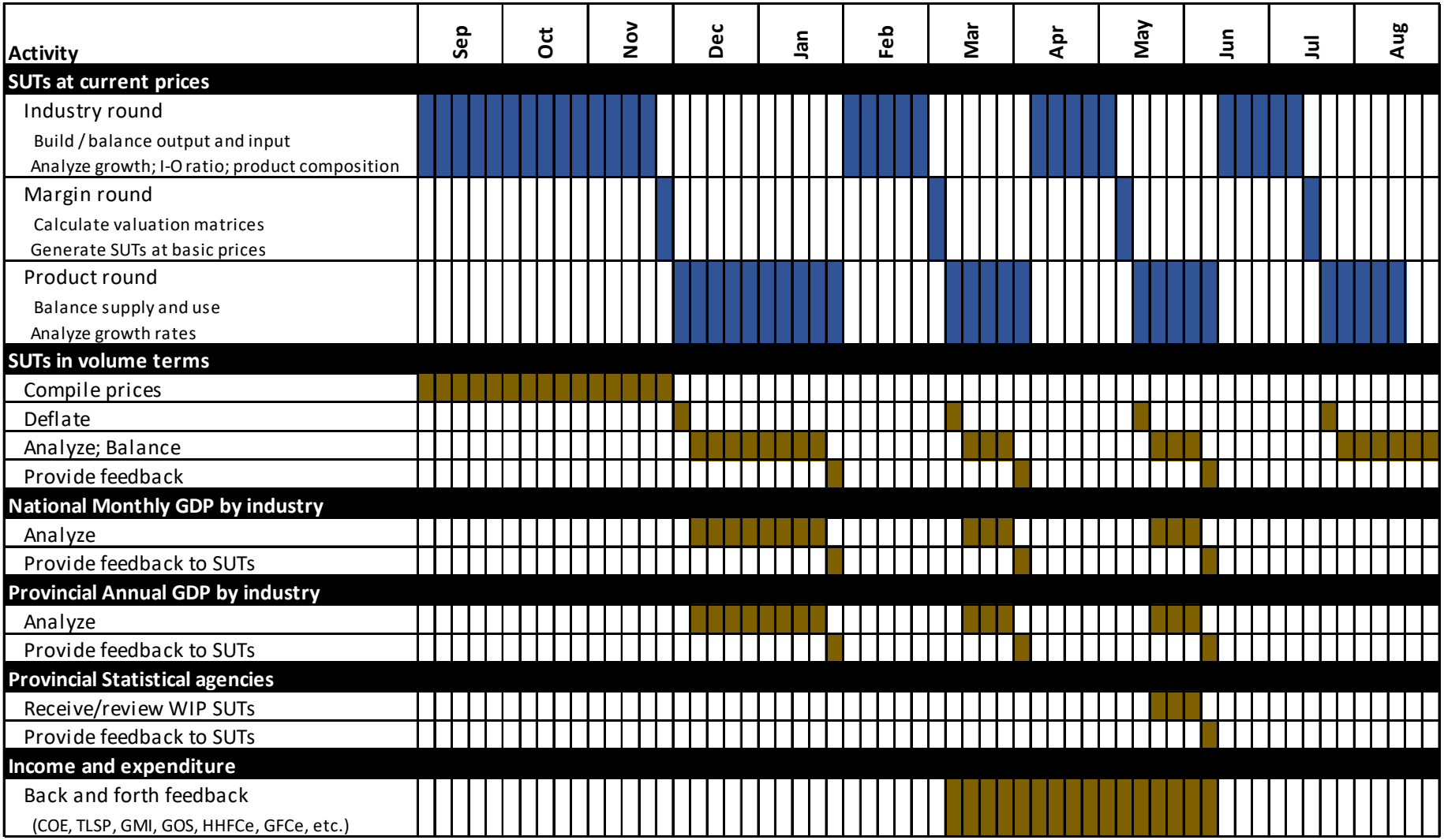
- SUTs at purchasers' and basic prices could be balanced simultaneously or sequentially
  - Sequential balancing: SUTs first balanced in current prices, then deflated and balanced in volume terms
  - Simultaneous balancing (recommended): SUTs in current prices and in volume terms are balanced concurrently
- Advantages of Simultaneous balancing
  - Allows analysis of value, price, and volume in relation to each other
  - Provides feedback that may affect the SUTs in current prices
- Disadvantages of Simultaneous balancing
  - More complicated than sequential balancing
  - Demanding in terms of resources and information, and requires CVALUEt, CVALUEt-1, and KVALUEt
- In Canada, balancing combines elements of both simultaneous and sequential balancing
- In an iterative process that allows feedback loops, SUTs are compiled at purchasers' prices, then converted to basic prices, then deflated

Step-by-step balancing process

Balancing the Canadian SUTs

- The balancing process in Canada consists of the following general steps:
  1. Build initial estimates; Analyze; Adjust
  2. Calculate margins; Generate snapshot of SUTs at basic prices
     - Deflate; Analyze; Feedback (*SUTs in volume terms team*)
  3. Balance products
  4. Rebalance industries and final uses to match “controls”
  5. Repeat steps 2 – 4 until system converges with all basic identities satisfied
- Throughout the balancing process, feedback loops exist between the SUT at current prices team and the teams responsible for:
  - SUTs in volume terms
  - Income and Expenditure Accounts
  - Monthly GDP by Industry
  - Provincial GDP by Industry
  - Productivity
  - Other (provincial) statistical agencies
  - Government Finance Statistics

Balancing schedule



Step 1: Build; Analyze; Adjust

- Building the initial SUTs estimates refers to the process of transforming survey and other source data into the SUTs (conceptual and classification) framework, and is the first step in the compilation of SUTs in current prices
- This is usually done by industry and final demand analysts, each of whom builds the initial estimates for their industries / final demand categories
- When building (most) industries, estimates that populate the output and input tables are developed simultaneously
- Most estimates are built using established processing systems (mostly in SAS, but sometimes in Excel)

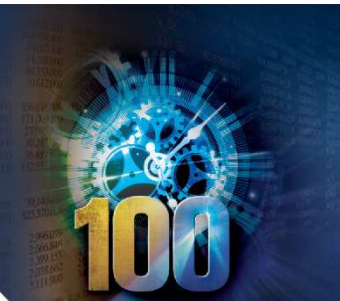
Step 1: Build; Analyze; Adjust

- Once the SUTs are populated with estimates, the next step is to analyze those estimates
- Analysis at the granular level involves investigating inconsistencies such as:
  - Outliers in the time series of “control total” (CT) aggregates e.g. output, IC by industry
  - Large year-over-year changes in I-O ratios of industries
  - Changes in the product composition
- Automated reports identify such inconsistencies, flagging them for the analysts to validate / adjust and document
- Recommendations for analysis include (not an exhaustive list):
  - Reviewing and understanding how the source data was transformed into the SUTs framework
  - Delving into the underlying source data at the unit level
  - Requesting clarification from source data providers or even respondents
  - Understanding the survey coefficients of variation and the imputation rates and methods
  - Comparing with other data sources e.g. company reports, trade association reports

Step 1: Build; Analyze; Adjust

- Based on the results of the analysis, adjustments are then made to the initial estimates
- Adjustments made in “INDCOM” an in-house SUT balancing application
- Adjustments made at the “control total” level, and translated to the product level either automatically or manually
- Rationale for the adjustments are documented (also in INDCOM), making it possible to track deviations from the initial source data and classify them as being due to SNA concepts, coverage, data quality, misclassification, etc.
- By the end of this step, the sum of outputs equals the sum of inputs for all industries, but supply does not equal uses by product

Step 2: Build the valuation matrices



- Once the output, input, and final use tables are populated, the margins and taxes/subsidies on products are estimated
  - For the margins, the margin aggregates (valuation matrix in the supply table) are estimated first; next, these aggregates are allocated by use category
  - For taxes on products, the detailed taxes by tax type and use category are estimated directly and calibrated to match “controls”; these are then summed to obtain the aggregates that populate the valuation matrix in the supply table
- The SUTs at basic prices are then derived (from the values at purchasers’ prices and the vales of the detailed margins and taxes on products)
- Adjustments are made to resolve negative cells in the SUTs at basic prices

Step 3a: Deflate the SUTs

- The SUTs at basic prices are then deflated to obtain measures of GVA in volume terms
- In Canada, this step is performed by a dedicated Deflation Section concurrently as the SUTs at purchasers' prices continue to be compiled
- The following are analyzed in order to feed information back to the current price balancing process
  - Rates of "real" growth of Gross Output and Value added; Implicit price
  - Stability of Input-Output ratios over time
  - Effect on ratios after chaining to a reference year
  - Validation and confrontation of deflators
  - Comparison with published estimates e.g. Monthly GDP by industry; Quarterly GDP expenditure

Step 3b: Balance products

- Although at this point the sum of outputs equals the sum of inputs for all industries, total supply could be quite different from total uses by product
- The next step is therefore to balance the products
- As this is done, it is best to “offset” such that the aggregates (of output or inputs by industry, for example) stay “on their controls”; however, this is not usually possible, especially in the early rounds
- By the end of this step, all products are balanced, with the supply of each product being equal to the sum of its uses

A note on product balancing

- Clearly, there is an investigative dimension to balancing, and it is helpful to have some knowledge of the:
  - Subject matter underlying the estimates
  - Strength of the data sources
  - Methods of compilation of initial estimates
- It helps to have easily referenced documentation that give brief descriptions on data sources used and their strengths and weaknesses.
- This helps guide the product balancer determine which cells should be less susceptible to adjustment than others
- It also helps to have access to microdata through pivot-table-style reports

Step 4: Rebalance to match “controls”

- The product balancing exercise of step 3 inevitably causes changes to industry outputs and inputs and to the final use categories
- These are now rebalanced to be back on their controls, or the control itself is changed to take into account feedback from product balancing
- Furthermore, feedback from the deflated SUTs are incorporated into the analysis, and adjustments are made in current prices if necessary

Step 5: Repeat steps 2-4

- Steps 2-4 are repeated until the system converges to a point where the imbalances are small enough to be resolved in an automated way
- Although it is mechanically possible to have automated this looping process from the start, the resulting estimates would have experienced unacceptable quality loss; this is why balancing combines both manual and automated processes

Other considerations

Other accounts

- The balancing of SUTs can be extended to include additional accounts either in a simultaneous or sequential manner
- In Canada, an integral part of the SUTs balancing process is a “reconciliation” process that occurs with the Quarterly Income and Expenditure Accounts
- At specific points in the production schedule, there are data hand-offs and feedback cycles to compare common estimates such as Compensation of employees, Gross operating surplus, Taxes/subsidies, HHFCe, GFCe, Trade, and GFCF
- The SUTs are not considered final until these estimates are “reconciled”
- Feedback from the institutional sector accounts is also useful, but quite rare

Fictive industries and products

- To facilitate the balancing process, “fictive” or “dummy” industries and products are used in the compilation of the Canadian SUTs
- The use of these classes is a technique for routing groups of heterogeneous products, used in a relatively minor way as inputs, into industries when the precise product content is not known
- Fictive products are absent from the final uses table, and fictive industries have no value added
- Using fictives adds efficiency to the balancing process

Product code	Name	Industry code
FIC110000	Repair and maintenance	FC110000
FIC120000	Operating supplies	FC120000
FIC130000	Office supplies	FC130000
FIC210000	Advertising, promotion, meals and entertainment	FC210000
FIC220000	Travel, meetings and conventions	FC220000

“Post-balancing” adjustments

- Some adjustments to the SUTs are done after the SUTs are fully balanced
- This is done when there is some operational benefit from not doing these adjustments during the balancing process
- Example: The fictives just described in the previous slide are removed from the SUTs and replaced with the a representative product structure in the use table

THANK YOU!

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