Q 2016
European Conference on Quality in Official Statistics

Automatic balancing of the National Accounts

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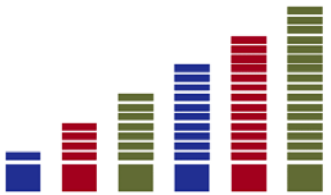
The challenge

The uncertainty of the National Account compilations, such as the GDP, is of great interest to users but often absent in statistic releases. Why?

- Difficulties to identify and quantify the errors in all input data sources
- The “accounting restrictions” of the NA need to be met, which makes post-adjustment or “balancing” necessary
- The balancing is typically done manually, which makes it hard to evaluate



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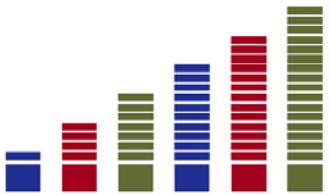
The project

- Derived from ASPIRE: a system for achieving continual improvements in survey quality in key statistical products at Stats Sweden
- Pilot study in 2014, main study in 2015, continued work in 2016
- Viewed as a successful co-operation between methodologists, national accounts experts and subject-matter experts



Current balancing process

- Carried out in a system of Supply and Use tables (SUT)
- All values within the SUT are calculated in both current prices and constant prices, and the balancing is carried out simultaneously in current and constant prices
- Mainly performed manually

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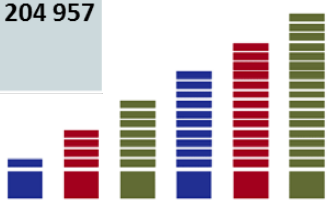
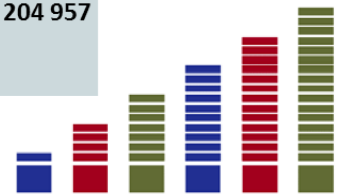
Supply table

Industry	Output NACE 25	Output NACE 26	Output NACE 27	Output NACE 28	Output NACE 29	Total Output	Imports	Total Supply basic prices	Trade and transport-margins	Taxes less subsidies on products	Total Supply, market prices
Product											
CPA 25	103 073	162	288	1 539	1 825	**112 699**	29 627	142 326	12805	3957	**159 088**
CPA 26	14	99 864	1 106	268	16	**102 553**	137 050	239 603	37661	8652	**285 916**
CPA 27	177	2 420	47 877	2 095	23	**53 768**	55 591	109 359	14823	4144	**128 326**
CPA 28	3 044	1 321	2 164	146 210	5 731	**162 775**	99 329	262 104	45743	3439	**311 286**
CPA 29	71	15	73	632	158 286	**159 784**	110 005	269 789	34268	16284	**320 341**
Total Output, industry	**106 379**	**103 782**	**51 508**	**150 744**	**165 881**	591 579	**431 602**	**1 023 181**	**145 300**	**36 476**	**1 204 957**



Use table

Industry	Intermediate consumption NACE 25	Intermediate consumption NACE 26	Intermediate consumption NACE 27	Intermediate consumption NACE 28	Intermediate consumption NACE 29	Total intermediate consumption	Consumption	Gross fixed capital formation	Exports	Total use
Product										
CPA 25	17 323	1 323	3 664	17 149	7 581	**88 726**	7 295	24 755	38 312	**159 088**
CPA 26	479	42 611	4 639	4 889	484	**67 307**	26 282	41 679	150 648	**285 916**
CPA 27	1 517	5 035	4 628	3 626	1 515	**35 321**	13 770	21 554	57 681	**128 326**
CPA 28	1 160	1 709	968	21 975	8 048	**61 079**	4 052	93 095	153 060	**311 286**
CPA 29	695	5	109	6 603	67 483	**83 513**	55 785	54 039	127 004	**320 341**
Total Intermediate consumption, industry	**21 174**	**50 683**	**14 008**	**54 242**	**85 111**	**335 946**	**107 184**	**235 122**	**526 705**	**1 204 957**



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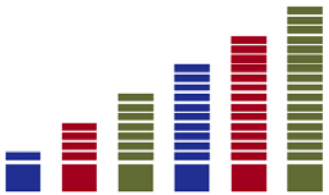
The SCM method

- Proposed in 1942 by Stone et al.
- A generalized least square approach for balancing economic accounts
- Formalized and further developed by Byron (1978, 1996)
- Some applications exist, e.g. at the Bureau of Economic Analysis (Chen 2006, 2012)



The SCM method

Consider the accounting restriction

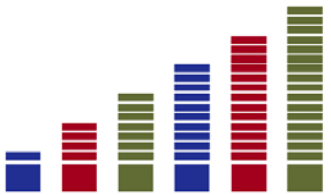
$$\boldsymbol{AX} = 0$$

where

$\boldsymbol{X}$ = the NA estimates (can contain thousands of elements)

$\boldsymbol{A}$ = known constants

Let $\boldsymbol{X}^*$ be an initial unbiased estimate of $\boldsymbol{X}$ which does *not* fulfill the restriction



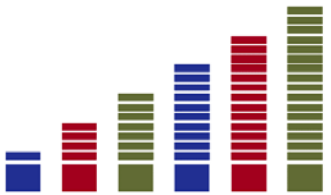
The SCM method

The balanced estimate $\boldsymbol{X}^{**}$ of $\boldsymbol{X}$ is given by

$$\boldsymbol{X}^{**} = \boldsymbol{X}^{*} - \boldsymbol{W}\boldsymbol{A}'(\boldsymbol{A}\boldsymbol{W}\boldsymbol{A}')^{-1}\boldsymbol{A}\boldsymbol{X}^{*}$$

where $\boldsymbol{W}$ is the covariance matrix of $\boldsymbol{X}^{*}$. If $\boldsymbol{W}$ has full rank and $\boldsymbol{X}^{*}$ is unbiased for $\boldsymbol{X}$, the covariance matrix of $\boldsymbol{X}^{**}$ is given by

$$Var(\boldsymbol{X}^{**}) = \boldsymbol{W} - \boldsymbol{W}\boldsymbol{A}'(\boldsymbol{A}\boldsymbol{W}\boldsymbol{A}')^{-1}\boldsymbol{A}\boldsymbol{W} \leq \boldsymbol{W}$$



Test of the SCM approach

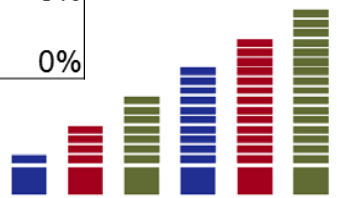
- Based on the Swedish annual NA for 2012
- Applied on the system of Supply and Use tables
- 66 industries and 65 products
- The initial estimates in $\boldsymbol{X}^*$ were obtained from an earlier time point in the compilations
- Different weights were tested: constant weights, “neutral” weights, the sampling error, and the total error
- In order to estimate the total error, nonsampling errors were identified and judged jointly by methodologist and subject-matter experts and added to the sampling error

Results of the test

	Total supply	Total use	Total Discrepancy
Neutral weight, SEK Mn	-9261	1168	10429
%	-89%	11%	
Variance, SEK Mn	-8304	2125	10429
%	-79%	20%	
Total uncertainty, SEK Mn	670	11099	10429
%	6%	106%	

Results of the test

	Neutral weight		Variance		Total uncertainty	
	Goods	Services	Goods	Services	Goods	Services
Discrepancy, SEK Mn	**-31984**	**42413**	**-31984**	**42413**	**-31984**	**42413**
Market producers IC	3%	13%	48%	37%	14%	16%
Government IC	0%	-5%	0%	0%	1%	1%
Household consumption	11%	20%	4%	16%	33%	34%
Government consumption	0%	0%	0%	0%	0%	0%
GFCF	9%	4%	35%	14%	37%	15%
Inventories	0%	0%	10%	6%	14%	12%
Exports	27%	8%	0%	6%	2%	25%
Production	-43%	-51%	-1%	-16%	1%	6%
Imports	-3%	-6%	0%	-4%	0%	-3%
Taxes on products	-4%	-2%	-1%	-2%	0%	0%



Summary

- The SCM method is possible to use for the balancing process in the Swedish National Accounts
- Use of the method can make the balancing process more objective, fully replicable, and less resource-demanding
- More work is needed before implementation, e.g.
  - Criteria for evaluating the approach
  - Choice of weights
  - Balancing in constant prices (if possible)