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A PRODUCT APPROACH FOR ICT SATELLITE ACCOUNTS

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I. Satellite systems and ICT

1. Satellite systems of National Accounts are supplements to the core system. Any specific supplement or satellite system is picking up a certain topic, which is not presented in the core accounts. Any such supplement is aligned to the structure of the core system of accounts. Satellite systems made up of satellite accounts could be distinguished as “internal” and “external”. Internal ones can be understood as making visible what is already included but not visible in core accounts. That means splitting and possibly recombining existing data. External satellite systems can be understood as genuine supplements, adding new data to the core accounts.

2. In the broader public, Information and Communication Technology, further on called ICT is not perceived as something which is well defined. Even for ICT-specialists ICT has different shapes, depending on the specialist. In the nineties of the last century, ICT supposedly would have been associated mainly with the internet, or the internet hype or the “new economy”. Of these, not much is left any more, with the exception of the internet itself and, of course, the mobile phones. But are internet and mobile phones really all what is making up ICT? For a satellite account of ICT at least, a widely agreed outline or definition of ICT would be favourable.

II. ICT defined by industries

3. In November 2005, the OECD published both a recommendation and a proposal for statisticians and not only national accountants how to define ICT. It has been an important contribution to a standardized observation of ICT, national and international as well.

The recommended definition of ICT refers to industries. Accordingly, activities of producers of things as different as telephones and wholesale of computers are contributing to ICT.

4. For different industries as part of ICT, there will often be different surveys. Sometimes, their results will be hard to be compared. Besides methodical differences of the respective surveys, turnover of wholesale trade of telephones has a different quality to the turnover of a manufacturer of telephones, for instance.

In case National Accounts should be picked as basis for representing ICT directly, those differences would vanish. Instead of observing turnover with its different meanings in the example above, National Accounts are observing output throughout all industries.

5. There are some limitations to representing ICT in National Accounts directly, though. For a start, representing ICT is limited to the kind of values that National Accounts are dealing with by industries. In addition, publications at least of Germany’s National Accounts are only reporting two-digit divisions of industries according to the European NACE classification. On the other hand, the definition of ICT provided by the OECD also uses three-digit groups and four-digit classes of industries. As a consequence, only three out of eight ICT industries are regularly observable in publications of European NA.

Table 1: **ICT by industries**

Division (NACE)	30	31	32	33	51	64	71	72
ICT (NACE) thereof *)	30	313	32	332	5184, 5187	643	7133	72
Share of ICT **)	100%	5,40%	100%	39,10%	< 28,4%	75,10%	< 4,1%	100%

*) derived from the OECD recommendation
**) refering to the respective division, measured by output, in Germany 2003

6. This could be an incentive to thinking about an ICT satellite system of the internal kind mentioned above: Three additional ICT industries could be split from the (two-digit) rest, using internal documents of NA. Further three four-digit ICT industries had to be determined with additional efforts going distinctively beyond current calculations. Only their upper (three-digit) limits as shown in the table above can be determined easily.

7. Some interesting figures of National Accounts are hard to calculate even on a three-digit level of industries. This is especially true for Value Added and its components or for employed persons. To overcome these data gaps would require new data sources or would at least require to reviewing existing data sources, not to mention additional compilations and estimations.

8. The bottom line is that on the basis of industries there is no simple and easy way to obtain an ICT satellite system. As far as we know, the Australian colleagues were quite successful in putting up an ICT satellite account that way, with “external” elements. Some European colleagues made efforts in that direction, too.

III. ICT defined by products

a. ICT goods

9. Along with the recommendation for an ICT defined by industries, the OECD has also worked out a proposal for a definition of ICT defined by products. Other than the definition of ICT by industries, the definition of ICT by products is very detailed. It comprises about 220 positions of the foreign trade classification HS (harmonised system). However, due to this reference, the definition is restricted to goods. Nevertheless, this definition may open an alternative way to arrive at ICT satellite accounts.

10. Indeed, some standard tables of Germany’s National Accounts are broken down by goods and products, respectively. This is concerning consumption of households, imports and exports. But the tables published (which are also part of the transmission programme of Eurostat) are by far not broken down sufficiently detailed to serve as correspondence to the definition of ICT suggested by the OECD.

11. Input-output tables IOT as well as the supply and use tables SUT, which belong to the input-output family, are inherently itemised by products. But the problem is similar to the tables mentioned before: The breakdown of items published is not sufficiently detailed to match the requirements of the ICT definition.

12. However, things are quite different for the SUT on a working level, at least in Germany. Tables are available for about 1700 kinds of goods, on a modified basis of the CPA (Classification of Products by Activity). For the output table, which is an essential part of the supply table, the details are even kept up to

the final results. So it was tempting to try to use these tables to identify ICT not only by name but also by numbers.

13. Before applying the OECD list of ICT goods to the SUT, about 220 original items had to be transposed to about 100 adequate items of the classification used for the SUT. Inevitably, the transposition covered some target items only partly as ICT. Exemplary calculations with imports and export revealed the transposed ICT to deviate at about 10% from the total amount of ICT goods of the originally used classification. Aiming at items that are completely ICT or are completely not ICT, the only decision left for the incompatible cases was to take them and have an overestimation or leave them and have an underestimation of ICT. Actually, all cases in question were included to ICT.

b. ICT services

14. The ICT list of the OECD is only concerning goods. But to fully exploit the information that is available in SUTs over the whole range of products, the definition of ICT should comprise services, too.

The definition of ICT by industries of the OECD just abandoned gives some hints what could be regarded as ICT services. There, ICT service industries are wholesale trade of ICT goods, leasing of ICT goods and telecommunication services as well as software production and data processing.

15. Though arbitrary in the end, it is almost self evident to pick telecommunication services as well as data processing and software as ICT services. After all, these kinds of services are indispensable links between many ICT goods (like mobile phones and computers) and their use by consumers. Therefore, they were added to the list of ICT goods, extending it to a list and a definition of ICT products.

16. Trade and leasing of ICT goods from the list of ICT industries are not taken as ICT products here. These industries and their typical products have an intermediary character, with ICT goods only as a kind of carrier. Leasing of ICT goods would add about 1% to ICT as defined above (Germany 2003). So, the impact of dropping it is negligible.

The impact of trade is bigger. But as trade margins are part of purchasers' prices, at least this important aspect of trade with ICT is kept: Whenever considering final uses of ICT goods, the respective trade margins are part of them. Moreover, these margins are explicitly estimated and they are included in the transition items of the supply table. So, in principle they can be made visible as part of an ICT satellite system.

c. Framework for a satellite system

17. Finally, the complete list of product divisions (as container for ICT) according to CPA looks as follows:

22 Printed matter and recorded media (small parts of)

24 Chemicals, chemical products and man-made fibres (small parts of)

25 Rubber and plastic products (small parts of)

30 Office machinery and computers (parts of)

31 Electrical machinery (parts of)

32 Radio, television and communication equipment and apparatus (parts of)

33 Medical, precision and optical instruments; watches and clocks (parts of)

35 Other transport equipment (small parts of)

64 Post and telecommunication services (part of)

72 Computer and related services (total).

It should be noted that the above list is an aggregated list of about 120 single items of ICT products on their most detailed level.

18. In the framework of National Accounts and especially in the framework of SUTs, a complete list of goods and services of ICT offers several opportunities. First, the impact of adding services as described above can be quantified. Second and as already told, SUTs can be exploited over the whole range of one of its dimensions to draw a complete picture of ICT by products. Third, another window of opportunity is opened: The full description of ICT by products allows the full description of ICT by industries due to the second dimension of SUTs.

19. Expanding ICT over all parts of the SUTs would probably be a way to obtaining an ICT satellite system, as the SUTs are forming a system in its own right. But before, the question has to be answered, from which parts of the complete SUT icy tea can be extracted for a satellite system.

So, what we are at for now is to forming an "internal" satellite system of ICT, as it was mentioned at the beginning.

IV. Supply of ICT

a. Output

20. The output table is the most important part of the supply table, which again is part of the system of SUT and IOT. Commonly, the output table is the starting point of input-output calculations. So it seems to be quite reasonable to start with it for an ICT satellite system which is based on input-output.

21. An adequate list of ICT products and the detailed version of the output table both allow a simple selection of ICT output by products. Once selected from the table, ICT output by industries can be identified, too. The result is shown below as an aggregated table of ICT output, giving a first insight into ICT structures.

It should be noticed that the two-digit headers of the table are only indicating to which divisions the ICT belongs. The total output by divisions is shown for comparison only by industries.

Table 2: **Output of ICT**
by product divisions and industry divisions, 2003

ICT products (CPA)	Typical ICT industries (NACE)								Other industries	Total output of ICT
	Manufacturing					Services		Sum		
	30	31	32	33	22,24,25,35	64	72			
	million Euro									
30	7.235	104	18	36	6	-	75	7.474	1.498	8.972
31	4	4.671	39	61	56	-	-	4.831	230	5.061
32	17	5.129	18.038	287	68	-	-	23.539	193	23.732
33	20	3.490	238	11.886	928	-	-	16.562	1.123	17.685
22, 24, 25, 35	2	26	14	25	6.944	-	-	7.011	162	7.173
64	-	-	-	-	-	59.965	-	59.965	-	59.965
72	134	320	326	65	473	270	42.340	43.928	3.890	47.818
Sum	7.412	13.740	18.673	12.360	8.475	60.235	42.415	163.310	7.096	170.406
Total *) **)	13.460	79.820	32.360	36.980	255.330	83.930	42.780			
Share of ICT, %	55,1	17,2	57,7	33,4	3,3	71,8	99,1			

*) including products which are not ICT **) cf. Statistisches Bundesamt, Series 18, 1.4, table 3.2.3, August 2005

22. The column of total output of ICT shows that ICT consists mostly of services, with a share of 63% of total ICT. Telecommunication services alone hold about one third of ICT output. This is almost as much as the production of all ICT goods. The output of ICT in telecommunication equipment (32) and precision instruments (33) together have not as much output as the software production (72).

In 2003, total output of the economy amounted to 3,811 billion Euro. With an amount of 170 billion Euro, total ICT output had a share of 4,5%.

The structures shown in the table were rather constant from the year 2000 to the year 2006. This is also true for the share of ICT production in total production.

23. A comparison of table 1 and table 2 shows the (typical) industries of ICT to be much the same both by the industry definition and by the product definition of ICT. But comparing industry 30 and 32 reveals an important difference: Taken by the industry definition, both industries are completely ICT. By the product definition however, in this time and this place they are only slightly above half ICT, each.

b. Imports

24. Together with output, imports make up supply (at basic prices), which is a key magnitude of input-output systems and National Accounts in general. Identifying ICT imports follows the pattern of identifying ICT output.

25. Obviously, ICT imports are an important part of ICT in Germany. While the share of total imports measured by total supply amounted to about 12% during the last years, for ICT it was 31% in 1995 and 35% in 2004. Concerning ICT goods, the share of imports was significantly higher than for ICT products on average. Accordingly, with ICT services the share was significantly lower.

Table 3: **Shares of ICT imports in ICT supply**

ICT Product group (CPA) / Year	30	31	32	33	22, 24, 25, 35	64	72	Total
	%							
1995 *)	71,1	33,3	51,6	31,7	47,0	4,8	3,6	31,3
2004 **)	74,5	40,7	60,4	34,4	46,1	4,5	11,5	34,9

*) on the basis of unrevised data for output **) on the basis of preliminary data for output

V. Uses of ICT

a. Final uses

26. With the description of ICT supply, the potential of the input-output system to form an ICT satellite system is not yet exhausted. The use table is available on the same detailed working level like the supply table.

27. The use table can be subdivided into three parts in principle. One is Value Added by industries. The other parts are intermediate consumption and final use. Final use can be subdivided into final consumption, fixed capital formation, exports and changes of inventories. Intermediate consumption and all categories of final use can be broken down by products.

28. For Germany, the detailed use table to be employed for extracting ICT has two characteristics to be mentioned. First, it does not include Value Added, which is no disadvantage for the moment: ICT is defined by products in detail and this is no category that would help to identify the respective Value Added directly. Second, intermediate consumption by products and changes of inventories by products are not yet fixed. This is done only on a more aggregated level of the table. But values for final consumption, fixed capital formation and exports are (widely) the final ones.

29. Data of final consumption, fixed capital formation and exports are the mainstays of total final use and their data are reliable enough to be the basis of extracting ICT. But for a complete picture of final use of ICT, changes of inventories are missing. Provisionally, they are assumed to be zero.

Table 4: **Final uses of ICT**

2004	ICT						All products *)	
	Goods		Services		Goods and Services			
	mill. Euro	% of (5)	mill. Euro	% of (5)	mill. Euro	% of (7)	mill. Euro	%
	1	2	3	4	5	6	7	8
Consumption	16.149	32,0	34.282	68,0	50.431	2,9	1.725.290	58,4
Fixed Capital Formation	27.064	58,1	19.500	41,9	46.564	12,1	384.940	13,0
Exports	88.389	89,7	10.125	10,3	98.514	11,7	842.840	28,5
Sum	131.602	67,3	63.907	32,7	195.509	6,6	2.953.070	100,0

*) cf. Statistisches Bundesamt, Series 18, 1.4, table 2.3.1, August 2005

30. In 2004, final consumption of ICT was consisting of ICT services to a share of about two thirds. A more detailed table would reveal these services to be almost entirely telecommunication services. ICT for fixed capital formation consisted to roughly equal parts of goods and of services. Here, services are mainly software products. Exports of ICT were mostly consisting of goods, as expected.

31. Slightly more than a quarter of the ICT products for final use were for final consumption. Of all products, the share of consumption was 58%. Not quite a quarter of ICT products for final use served for fixed capital formation, while the percentage for all products is considerably lower with 13%. Half of ICT for final use were exports, for all products the share amounted to only slightly more than a quarter.

32. In 2004, ICT products had a modest share of 2,9% in total final consumption. For both capital formation and exports, the share was about 12%. ICT share of total final use was 6,6%.

b. Direct imports for final uses

33. Each value in the use table consists of a combination of domestic production and imports in principle. For preparing a domestic input-table, the entire use table is regularly split into its components of a domestic part and one of imports. Mostly, the splitting is not backed by special data sources, but is based on estimation. Usually, the most useful hint for the estimation is the kind of product in detail, which tells much about its purpose and to which category of uses it belongs.

34. As the imports are estimated for all parts of the use table and on the most detailed level, the respective results can also be used for determining the direct imports for all final uses of ICT. The results provide useful insights concerning the degree of foreign supply of final demand for ICT. Reversely, they indicate to which extent final demand for ICT will actually affect the domestic economy.

Table 5: **Shares of direct imports for final uses, 2004, percentage**

ICT Product group (CPA) / Final Use	30	31	32	33	22, 24, 25, 35	ICT goods	64	72	ICT services	Total
Consumption	35,9	17,0	40,2	35,9	46,5	38,5	0,2	5,3	0,4	12,6
Fixed Capital Formation	50,7	39,1	60,4	43,4	48,6	50,7	-	5,0	5,0	31,6
Exports	64,4	27,0	38,8	18,2	22,1	38,3	0,6	7,7	6,3	35,0
Sum	56,8	28,8	41,9	24,8	26,5	40,9	0,2	5,8	2,7	28,4

35. In 2004, a share of 28% of total final use of ICT products has been imported. In other words, the domestic effects of demand for ICT products were only 72% of the amount that (domestic) money was spent for. The share of imported ICT goods for final use was even 41%, with an especially high share of 57% for computers. Direct imports have to be considered with exports, too. Here, direct imports are simply re-exports which have to be taken into account at an occasion like this. They amounted to a third of all ICT exports.

VI. Gross Value Added and Gross Domestic Product

a. Gross Value Added of ICT, modified production approach

36. One of the most important aspects of National Accounts is the determination of Value Added, which is also a part of the use table. But as already stated, this part is not accessible by the product definition of ICT in question. This is true both in practice and in a more abstract sense. Practically, the detailed table which is available does not contain Value Added. But even if it did, it would not help. Value Added of ICT according exactly to the product definition of ICT would require the respective breakdown to ICT industries, before. This kind of breakdown is out of reach.

37. The method usually used to determine Value Added is the production approach in the first place, with Value Added being the difference of production and input (intermediate consumption). Applied to ICT, its production and the respective inputs would be needed. The first ingredient for this calculation exists already, as the production of ICT was determined before. The second ingredient is out of reach, again.

38. But there is a direct link of production and Value Added, too. For all industries on the two-digit level of publication, there is a ratio of production and Value Added. If the ratio was about the same for ICT within an industry, Value Added for ICT could easily be determined. In reality however, the average ratio by industry and the ratio for ICT within will probably differ. Deviations from a "true" value will probably be low with high shares of ICT in a two-digit industry. Further, an approximation of that kind will still work quite well with very low shares of ICT in an industry. Then, the distorted results do not contribute too much to the total estimate of Value Added of ICT.

Table 6: **Value Added of ICT approximated, Germany 2004**

Industries (NACE)	30	31	32	33	22, 24, 25, 35	ICT Manu-facturing	64	72	ICT services	All ICT industries	Other ICT producing industries	Total
Million Euro	2.022	5.463	6.453	6.280	3.019	23.238	29.770	30.944	60.714	83.952	3.469	87.421
Percentage of Total	2,3	6,2	7,4	7,2	3,5	26,6	34,1	35,4	69,5	96,0	4,0	100,0

39. Some results of the estimation method described are shown in table 6 above. About two thirds of the total estimate of Value Added of ICT is on account of the typical ICT service industries. Only about a

quarter is on account of the typical manufacturing industries of ICT. Surprisingly, the computer industry has a relative small share of Value Added of ICT. It is not half the amount which falls upon Value Added generated by ICT in industries which are not typical ICT industries. In 2004, the share of Value Added of ICT compared with total Gross Value Added was 4,4%.

40. Table 2 further above (estimates of output by industry) shows the quality of estimated Value Added in table 6 to be excellent for software production, with an ICT share of 99% in production. With 72% ICT production in post and telecommunication, estimates of Value Added for ICT within this industry should be still acceptable. The estimates for some other industries can be distorted considerably. This is mainly true for the typical ICT manufacturing industries, like computers and communication equipment. As table 6 shows, Valued Added estimates for single ICT manufacturing industries are of limited influence on the total estimate.

41. The estimation model employed above could be improved by taking into account structural business statistics with Value Added and its components at a three-digit level. Figures at the four-digit level are also available. But taking them would bring no additional advantage, because the industries of the output table (which is the estimation basis) are available only at the three-digit level.

42. It is worth noticing that the estimation described above comprises Value Added of ICT production both for final use and for intermediate consumption. But the estimation of (domestic) ICT products described above refers to final use only. So, the concepts behind both estimations do not correspond. This leads to a different kind of estimation of Value Added:

b. Gross Value Added of ICT, input-output approach

43. Especially in conjunction with input-output as it is the case here, there is a further method of estimating Value Added of ICT: Starting from final use of domestic production by a certain amount, input-output analysis allows to determining the respective Value Added.

44. The input-output method for estimating Value Added of ICT takes into account the Value Added generated by ICT production for final use as with the method described before. Further, and in difference to the first method, the input-output method takes into account Value Added which is generated by any (and not only ICT) production used as intermediate consumption for ICT production. This applies to all pre-stages of ICT production. In other words, the values of ICT products are decomposed completely and reassembled as Value Added directly and indirectly generated by ICT in each industry.

45. Estimating Value Added of ICT by the input-output method takes two things: The amount of final use of ICT products of domestic origin and an adequate input-output table. ICT by domestic products is available, as described above. But it would take an input-output table as detailed as the list of ICT products, to precisely calculate the respective Value Added. The existing input-output table (71x71) can be used only for an approximation. Then, final uses of ICT products are expressed as parts of the 71 product groups according to the input-output table.

46. Tentative calculations with the input-output method resulted in total Value Added of ICT which was slightly below the one resulting from the first method.

c. Share of ICT in Gross Domestic Product

47. For some purposes, not Value Added but Gross Domestic Product is the magnitude in question. So, the share of ICT in Gross Domestic Product could be of interest, too.

As for the aggregates, Gross Domestic Product can be determined via Gross Value Added. For parts of the economy like ICT, this method is not viable because Value Added of a certain part of the economy does usually not correspond to final use of the respective products. So, the share of ICT in Gross Domestic Product has to be determined as sum of final use less imports.

48. The amount of ICT for final use is known, as is the amount of ICT imports for final use. So, the resulting amount of domestic ICT could be perceived as the share of ICT in Gross Domestic Product, which in 2004 was about 6,3% in Germany.

49. But the imports for intermediate consumption are not considered yet. To keep the calculation consistent, these imports have to be taken in account, too. The question is, if imports of ICT products for intermediate consumption or if all imports for the intermediate consumption of ICT production should be part of the calculation. The answer for the first alternative could simply be found in the import part of the use table.

50. The second alternative is to identify all imports included in domestic ICT products. From a systematic point of view, this alternative seems to be more attractive. But its implementation by an input-output analysis is more demanding than the first alternative and its faces the same (if not more) deficiencies as the alternative calculation of Value Added introduced above.

A tentative calculation resulted in an overall share of 34% of imports for intermediate consumption included in domestic ICT products at basic prices. This share cannot be applied to ICT of final uses of domestic supply at purchaser's prices directly. Rather, domestic ICT products for final use at basic prices have to be lessened by these imports for intermediate consumption. Then, the results have to be supplemented with the respective taxes and trade margins.

VII. Summary

51. For purposes of National Accounts, the definition of ICT by products issued by the OECD can be made as operational as the definition of ICT by industries, also issued by the OECD.

52. Input-output accounts are adequate accounts to apply the definition of ICT by products. By the same token, input-output accounts are offering a framework for ICT satellite accounts. This framework is open for a self-sufficient or internal ICT satellite system, which should consist of as much parts of the framework as possible.

53. For a start, the output table as part of the supply table can express ICT quite easily. Among other results, it shows that ICT defined by industries and ICT defined by products can differ considerably. Adding imports is no difficult task, so the supply of ICT at basic prices is completed.

54. A detailed preliminary use table offers the opportunity to determine final use of ICT by final consumption, by fixed capital formation and by exports. The ICT imports included in these categories of final consumption are also available.

55. Value Added as a further part of the use table can be estimated on the basis of data calculated for ICT up to this point in two ways. Both methods return values with different contents. Additionally, the share of ICT in Gross Domestic Product can be calculated.

56. So far, the picture of ICT in the framework of input-output is not quite complete. Concerning the supply table, the transition items for purchasers' prices are missing. But there are no serious barriers for these calculations. As for the use table, the changes of ICT inventories were provisionally defined zero. To keep them zero would probably be no obstacle for a complete picture of ICT.

57. Missing Intermediate Consumption of ICT has a different quality. This is not so much about intermediate consumption of ICT which could be estimated quite satisfying but without much additional use. The problem is more the intermediate consumption specific for the production of ICT which is not identified yet. In other words, at least up to now there are no ICT-specific input-output relations which would support a dedicated ICT input-output analysis further on.

58. As the input-output framework comprises products and industries as well, all respective kinds of supplements are imaginable to make the satellite accounts “external”. First steps in that direction would be to include employed persons or fixed capital formation for ICT production. As a further example, the number of private DSL subscribers could be appended to consumption of households. Of course, all this depends on data sources available or reliable estimations.

59. In the recent past, ICT was mostly related with enhanced productivity and growth. For economists, the challenge was or still is to find out if there is such a relation and if there is one, how strong it is. The “internal” ICT satellite system outlined above will give no direct answer to those questions. But it can help to currently figure out the position of ICT in the economy quite precisely with the possible additional advantage of reliable international comparability.