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PRODUCTION AND USES OF SOFTWARE

Invited Paper submitted by Central Bureau of Statistics of Israel*

Introduction

1. In recent discussions of software in OECD and Eurostat the aspect of investments in software has been emphasized, but an analysis of the software production also seems important, especially since many countries have to rely on data on software from the supply side only to derive GFCF.

2. In Israel, production in the software industry is currently estimated to 8% of GDP, so that the software industry is larger than many industries that traditionally are examined thoroughly on a current basis in establishment surveys and covered in production and price indices. Below we attempt to analyze the production process and to place the production within a supply-use

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framework. Special emphasis is put on the estimation of software exports and work-in-progress, in order not to overvalue the GFCF in software, given the importance of those two uses in Israel.

Conceptual issues

Activities of the software industry

3. There are a number of different kinds of activities in the software industry:

- Production of software originals, which are later used for mass production by the producer or sold. In the OECD/Eurostat software task forces such software originals were further classified into originals for reproduction and other originals, which can be used in the process of production of other goods and services;
- Production of software for clients – tailor-made software;
- Reproduction of software;
- Software consulting and support.

4. The output generated by the activities in the software industry does not fit some of the characteristics enumerated in the SNA93 definition of services. SNA's paragraph 6.8 states that "services are not separate entities over which ownership rights can be established. They cannot be traded separately from their production. Services typically consists of changes in the conditions of the consuming units realized by the activities of producers at the demand of consumers". However, the production of originals or production of software for clients does not fit this description - software originals are separate entities over which ownership rights can be established.

5. On the other hand, software is not among "physical objects" as described in the definition of goods in paragraph 6.7. Software belongs to the group described in paragraph 6.13 (which does not fit the definitions given in 6.7 or 6.8 to 6.12) that produces "outputs over which ownership rights may be established, that are often stored on physical objects".

6. SNA93 thus in fact talks about a third category in paragraph 6.13 which is "generally classified as service industries that produce outputs that have many characteristics of goods" and mentions computer programs as one of these outputs. The paragraph also says that "Whether characterized as goods or services, these products...", which indicates that SNA93 has not recommended a single treatment of this group.

7. The lack of properly defined categories is especially felt in ISIC and CPA, where it seems that the production mentioned in SNA93 paragraph 6.13 often is not treated explicitly. It seems that goods and services could be redefined in terms of tangible and intangible outcome of production, so that the mention of a third group with unclear classification would not be needed. All production

which now falls under the definition of services + intangible outcome of production such as software, R&D, originals of music, literature etc. could be included in the intangibles group. The intangibles that can be used more than once and for more than a year should probably be part of GFCF – but R&D would have to be treated differently due to the existing decision to treat R&D as intermediate consumption.

Software as work-in-progress

8. The development of software often takes a number of years similar to the construction of ships and aircraft. The SNA93 recommends including unfinished software as work-in-progress unless it is sold in advance (SNA93 par. 10.102): "Work-in-progress consists of output produced by an enterprise that is not yet finished, i.e., not yet sufficiently processed to be in a state in which it is normally supplied to other institutional units. Work-in-progress occurs in all industries, but is especially important in those in which some time is needed to produce a unit of finished output -- for example, in agriculture, or in industries producing complex fixed assets such as ships, dwellings, computers, software or films. Work-in-progress can therefore take a wide variety of different forms ranging from growing crops to partially completed film productions or computer programs. Although work-in-progress is output that has not reached the state in which it is normally supplied to others, its ownership is nevertheless transferable, if necessary. For example, it may be sold under exceptional circumstances such as the liquidation of the enterprise."

9. If original sophisticated software that takes more than an accounting period to be finished is sold in advance, following SNA93 and ESA95 recommendations, the unfinished software should, in principle, be accounted as part of the buyer's fixed capital formation. One could, however, say that the successful outcome of R&D on software is less certain then the outcome of production of ships and aircraft. The treatment of R&D on software as work-in-progress and not as GFCF in the early stages would be preferable, even in cases where the R&D on software is sold in advance or produced for own use.

Measurement of production of software

10. The production of software originals typically involves R&D activities, especially at the early stages. There may be problems with the classification of the output at these preliminary stages, especially since such stages may extend over more than a year.

11. As mentioned above the production often takes a relatively long time, so that quite a large part of the output of software is "work-in-progress". In practice, many countries have difficulties to measure work-in-progress on software separately due to lack of information, and may choose not to include an item of work-in-progress on software in the accounts. In some cases, the lack of separate measurement of work-in-progress may mean that production of software is undervalued. In other

cases, when for example the estimates on own-account software output are based on wages of software professionals (with or without mark-ups for other costs and operating surplus), work-in-progress will be included in output but may be classified as GFCF.

12. The observation on the practical difficulties to estimate work-in-progress is also valid in relation to expenditure on the unsuccessful production of software. No information on the success of production will be available, if own account development of software is estimated on the basis of the wages of software professionals as mentioned above. In this case, all estimated software output will probably be classified as part of GFCF, so that total GFCF will be overvalued.

13. Another problem is that data about the market value of originals or software produced for clients usually are not available, so that the basic price of the output usually will have to be estimated using the value of input plus a mark-up. In practice, many countries measure software through costs, and in some cases cover only an estimated value of compensation of employees for the software development staff. Often no mark-up is added to these costs, even though the SNA93 recommends including an estimate for mark-up.

14. To avoid underestimation of finished output and work-in-progress for which no basic prices are available, all the current expenditure on R&D in connection with software should be classified separately, and included in the measurement of software output. Estimates should, in principle, include the value of compensation of employees, intermediate consumption, and consumption of fixed capital plus a mark-up based on information on average mark-up in the software industry.

15. Estimates at constant prices, when based on labour input, should also assume a change in productivity over time. The size of this change could be based on data about the long-term growth of sales at fixed prices of the final product divided by the growth in weighted work hours (weighted according to type of labor input).

16. In Israel, the information on R&D in the software industry is collected in the framework of R&D surveys, and not in ordinary industry surveys. Some special cases of R&D in software are not covered or identified in these surveys.

17. Start-ups engage in R&D to develop software. If data on these units are collected, their activities will often be classified as R&D in the early stages and not identified as R&D on software. In other cases, data on such R&D will not be included at all, since start-ups do not register sales at the early stages and in many cases are not routinely included in survey samples or even in the business registers. It should be mentioned that start-ups have a big impact in Israel - their value added amounted to 3% of GDP in 2000, and even after the recent drop in hi-tech activities their value added amounts to 2%, so that these cases are important.

18. Enterprises in non-software industries may engage in R&D to develop software for own use. Such software may not be identified separately as R&D in software. Even if the recommended method for estimation of software production for own use is applied and data on the cost of high-level employees in computer-related occupations are used, some costs may be missing.

19. As mentioned above part of the software development – some say quite a large part – does not succeed. In this respect, software development is like other R&D and like oil exploration. We argue that the activity should be included in work-in-progress under any circumstances – the successful outcome is the result of a trial and error process. The mark-up included in the estimates is the average mark-up – for successful and unsuccessful activity. This also means, that even if data on the market value of the software are obtained at a later stage, the value of production should not be updated according to the actual mark-up for a single product. The method of estimation is explained through two numerical examples:

A. A software enterprise engages in 5 different projects. Each project involves labour input of 100, intermediate consumption 20, consumption of fixed capital 15. Assume the projects take 2 years and there is no inflation. Average mark-up in software enterprises has been measured to 19%. Work-in-progress at a value of 5*(50+10+7.5)*1.19=402 will be included each year. Only two projects succeed and are sold during the third year, within the country to enterprises at a price of 400 each. For this enterprise, the mark-up is close to 19%. Since we estimated the value of its activity using cost of production + 19% there would be almost no need to correct the estimates. In the third year, we would record a decrease of work-in-progress and an increase in gross fixed capital formation of 800.

B. 5 software enterprises engage in the development of software. Each enterprise uses labour input of 100, intermediate consumption 20, and consumption of fixed capital 15. Again assume the projects take 2 years and there is no inflation, mark-up is 19% on average. Only 2 enterprises succeed and obtain 400 when the projects are sold. One could think of 2 methods of estimation:

   a. The work-in-progress in each enterprise is estimated using 19% mark-up. After 2 years, when the projects are sold, for the 2 enterprises succeeding the mark-up will be revised to 196%. For the 3 enterprises not succeeding the estimates of work-in-progress will revised to 0. It will mean that some of the employees are employed in an activity that has a negative added value. But as said above the success of some of the enterprises is dependent on trial and error – so that indirectly the activities of the unsuccessful enterprises also have a positive outcome.

   b. The work-in-progress in each enterprise is estimated using 19% mark-up. After 2 years, when the projects are sold, mark-up is checked for the whole group and seen

to be 19% on average. Since we look at the whole group, there is no need to revise the estimates in this example.

20. A combined production and generation of income account for the five enterprises (example B) will show that the costs of the unsuccessful production are included together with the ones of the successful production. The generation of income account will include, as a residual, an operating surplus equal to the difference between the positive one generated by the successful producers and the negative ones generated by the others.

21. The aggregate result will be the same, and conceptually the second solution seems to capture the fact that all enterprises contributed to the result. Also the result is similar to the result in example A - there really does not seem to be difference between the two cases.

22. If production of software is registered only after the successful production has ended, what will happen to the description of the production process? Added value will seem too high and mark-up will also be too high from the point of view of the aggregate of enterprises that engaged in the process of trial and error. One will also get changes in production linked to demand for products and discrepancies between changes in labour input and changes in production.

23. In Israel, a combined account for all the start-ups engaged in software production is prepared. Since we know that in the first periods start-ups do not sell any products, we may assume that all activities are for work-in-progress. Partial data on financing of start-ups are used to estimate costs of production in start-ups and an average mark-up is added. Also since no detailed data on start-ups are yet available, it is only possible to treat the start-ups as a group similar to example Bb. When sales start to be recorded (in Israel mostly exports) a decrease in inventories of work-in-progress is recorded.

24. Data on work-in-progress have not yet been collected in Israel for software corporations that are not start-ups. Such data will have to be gathered in special surveys. Some rough estimates of production for own use have been included in the national accounts as GFCF, assuming that 20% of software professionals engage in production for own use and 80% in production of marketed software.

Measurement of supply and use of software

25. Supply of software includes domestic production and imports. Data on imports of software may suffer from under-coverage, since transfer of software and R&D through the Internet is very common, and is not registered in many cases. So far, no special efforts have been made in Israel to improve the coverage of imports, but business surveys are planned in the framework of the improvement of the services account of the balance of payments.

26. The two most important final uses of software in Israel are exports and increase in work of progress. The size of the latter is due to the fast increase of activities in start-ups.

27. Data on exports of software included in the balance of payments are usually also deficient. Sales over the Internet may not be covered, and sales of originals may not be classified as sales of software, but rather sales of R&D or patents. Due to the growing globalisation of production, in many cases software or R&D in software are also transferred from subsidiaries to the international firm that owns them without being fully registered in the balance of payments. Even if exports from the subsidiary to the parent enterprise are recorded, distribution of the value production between the two may be misleading due to tax considerations.

28. In some cases, (such cases have been quite common in Israel in the last 5 years) a whole enterprise is bought by a non-resident unit in order to, among other purposes, acquire the software developed by the enterprise (usually a start-up), and to use it abroad. In such cases, the acquisition of the software is usually not separately registered, and the software implicitly included in the sale has to be separately evaluated in order to register export of software that will be owned and used abroad by the new owner of the enterprise. A transfer of property rights to the new owner of the enterprise exists, and in some cases the acquired software is patented abroad directly by the new owner.

29. In Israel, some adjustments to data on software exports have been made using data obtained from the producers, Surveys with better coverage are planned in the framework of work to improve the services account in the balance of payments.

30. Data on inventories of work-in-progress are collected in the framework of production statistics, and as mentioned above they may be deficient.

31. GFCF produced on own account in Israel is measured as described above. Statistics on investments by enterprises in purchased software are currently not very developed. Business accounting often does not separate investments in software. Even if data are gathered in enterprise surveys, the responses which often are based on information available from the enterprises' business accounting are not always reliable.

32. It seems that there are no problems of coverage of statistics on use of software by households, as data are obtained from household expenditure surveys. The amounts used by households are usually small, since much of the software will be embedded in computers.

33. Statistics on intermediate consumption are only collected every 5-7 years in the framework of input-output tables. Current data are not readily available and current estimates are derived comparing supply and other uses.

Measurement of supply of software at different stages of production and its uses in Israel

Supply	Measurement method of the supply side				Use
	Domestic production			Imports	
	Start-ups	Software corporations	Non-software corporations		
R&D on software	Estimates based on funding of startups	R&D surveys for software corporations	All work included in GFCF	Not covered	Increase in inventories (work in progress)
Unfinished software (work in progress) for own use	-	Estimates : proportion of value based on employment data on software specialists	Estimates based on employment data on software specialists	-	Gross fixed capital formation
Unfinished software (work in progress) sold in advance to resident unit	-	Not covered, surveys planned	-	Not covered	Gross fixed capital formation
Unfinished software (work in progress) sold in advance to non-resident unit	-	Not covered, surveys planned	-	-	Exports
Finished software for own use	Not covered, surveys planned	Estimates based on employment data on software specialists (only a proportion of total taken)	Estimates based on employment data on software specialists	-	Gross fixed capital formation
Finished software not sold and not for own use	Not covered, surveys planned	Not covered, surveys planned	-	-	Increase in inventories (finished products)
Finished software sold to resident unit	Not covered, surveys planned	Industry surveys	-	Balance of payments statistics	Gross fixed capital formation or private consumption expenditure - data on private consumption from household surveys
Finished software sold to non-resident unit	Balance of payments statistics. In cases where the whole start-up company is bought to obtain software, assumptions about the value are made	Balance of payments statistics, industry surveys	-	-	Exports
Finished software transferred by subsidiaries (which do not use it) to non-resident parent corporation	-	Balance of payments statistics, industry surveys	Balance of payments statistics, industry surveys	-	Exports

Production and uses of software in Israel

Millions of dollars

	Supply of software			Uses of software					
	Domestic produced software	Imports of software (2)	Total	Gross fixed capital formation (2)	Exports	Private consumption expenditure (2)	Intermediate consumption	Increase in work in progress	Total
1995	1,790	93	1,883	658	617	22	457	130	1,883
1996	2,570	114	2,685	821	1,117	23	404	321	2,685
1997	3,046	111	3,156	865	1,278	23	528	463	3,156
1998	4,774	112	4,886	1,075	1,985	22	620	1,184	4,886
1999	5,201	134	5,335	1,141	2,361	21	612	1,200	5,335
2000	9,299	153	9,452	1,391	5,076	22	678	2,286	9,452

(1) Partial estimates - estimates are still under development

(2) Not including imbedded software

Conclusion

34. As production of software becomes more and more important in many countries, more precise and consistent recommendations for measurement of production of software and its uses are needed. The recently established workgroups in OECD and Eurostat will obviously contribute to such improvements. The emphasis in these workgroups has been on software as GFCF, while discussions have also covered the whole range of software production and uses. The experience in Israeli shows that exports of software and inventories of work-in-progress on software are of special importance.
