資料2

Capitalizing Own Account Software in Japan

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Keywords

own-account software, prepackaged software, custom software, capitalization, original and reproduction, software investment and stock, depreciation, cost index and harmonized index

Abstract

In this paper, we measure own-account software investment in Japan as the applications of the OECD Task Force recommendation at the aggregate level and the BEA's methodology at the industry level. We can conclude that the scale of own-account software investment in Japan is 0.60 percent of GDP in 2000. This share is 0.13 percent point lower than that in the U.S. The share of total software investment to GDP is 2.03 percent, which is the almost same as that in the U.S. (2.07 percent), reflecting the larger share of custom software in Japan relative to other countries.

By type of software, in 1970, own-account software has the largest share in software investment and prepackaged software is minor in the U.S. and Japan. The composition is very similar between the two countries. In the U.S., the diminution of the share of own-account software is reflected by the rapid expansion of prepackaged software in the 1970s and the 1980s. On the other hand, in Japan, the diminution is mainly reflected by the expansion by custom software.

To measure software capital stock, we consider four scenarios. First, for depreciation, the 33 percent and 55 percent geometric depreciation rates are assumed. Second, there are two options for prices, a cost index for all types of software and harmonized indexes for each type of software. When we use 33 percent depreciation rates and the cost index, Japan's own-account software stock is 7.6 trillion yen (evaluated by the 1995 constant prices) estimated using the cost index and 8.1 trillion yen using the harmonized prices in 2000, which amounts to about 0.4 percent of fixed capital stock and about 0.2 percent of total capital stock including land and inventories. Total software stock in Japan is 25.2 trillion yen estimated using the cost index and 27.5 trillion yen using the harmonized indexes in 2000.

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1 Introduction

On understanding recent economic growth, the role of software as a capital is becoming more significant. In the U.S. economy, Jorgenson-Ho-Stiroh[forthcoming] shows that the growth of software capital input explains 6.5 percent of the economic growth during 1989-2002. The contribution of software capital input is almost half of that of computer (12.5 percent) and higher than that of communications equipment (4.7 percent). Also, as impacts of software capital to the total capital input, the contribution share is 12.1 percent for the same periods, which increased from the 4.6 percent contribution during 1973-89.

The role of software in national accounts is redefined by the UN's recommendation on the System of National Accounts in 1993 (SNA 1993) that purchases of software, including software produced in-house, should be capitalized. After the recommendation of SNA 1993, statistical divisions in almost all OECD countries published the trial calculation and strive to improve it. For the international comparison of economic growth, it should be an important issue to harmonize the methodology to measure the capitalization of software. The non-comparable exception country is Japan, which may have the second largest scale of software investment in the world.

In Japan, the present official national accounts treat expenditures for custom software, mineral exploration, and plant engineering as gross fixed capital formation (GFCF) of intangible assets. So far, own-account software and pre-packaged software still have not been capitalized in the Japanese national accounts. The reason why the Japanese government avoided them to be capitalized is not evident[*1]. However, it is quite evident that Japanese government does not have particular substantial difficulties preventing from capitalizing, based on similar data and methodology used in other countries. In this paper, we estimate own-account software investment by industry during 1955-2000 in Japan.

Our basic methodological concepts to measure own-account software investment in this paper is based on comprehensive research by the OECD Task Force on software measurement in the national accounts (Lequiller-Ahmad-Varjonen-Cave-Ahn[2003])[*2], whose concept is totally consistent with the SNA 1993. Additionally, we apply the U.S. methodology for estimating own-account software by industry, which is reported by Grimm-Moulton-Wasshausen[2003] of the Bureau of Economic Analysis (BEA), to the Japanese economy.

In section 2, we look through the concept of software and the basic methodology to measure own-account software. In section 3, we measure own-account software investment in Japan as suggested by the OECD Task Force methodology at the aggregate level. Also, we apply BEA's methodology at the industry level and discuss our estimates in comparison with the other Japanese estimates at the aggregate level, Motohashi[2002] and Miyagawa[2003], and with official software investment in the

[*1] One of the direct reasons might be that benchmark 1995 input-output (IO) table, which is one of basic statistics for estimating national accounts, did treat only custom software as a software investment. In the summer of 2004, benchmark 2000 IO table was published and begun to treat pre-packaged software as GFCF, additionally. However, capitalization of own-account software was postponed even in the benchmark 2000 IO table.

[*2] The OECD Task Force had the first meeting in October 2001. The chairperson of the Task Force is Carol Moylan, Division Chief of National Income and Wealth, BEA, the U.S., and the secretariat are Francois Lequiller and Nadim Ahmad, OECD.

U.S. and other OECD countries in section 4. Based on the estimates of software investment, we compute software stock with some scenarios about depreciation rates and prices by type of software in section 5. We conclude in section 6.

2 Concept and Methodology

2.1 What Should be Capitalized?

In order to clarify the object to be capitalized, we start with the definition of software as an intangible asset, as recommended by the SNA 1993 and the OECD Task Force on software measurement in the national accounts. Paragraphs 10.92 and 10.93 of the SNA 1993 define software as,

> Computer software that an enterprise expects to use in production for more than one year is treated as an intangible fixed asset. Such software may be purchased on the market or produced for own use. Acquisitions of such software are therefore treated as gross fixed capital formation. Software purchased on the market is valued at purchasers' prices, while software developed in-house is valued at its estimated basic price, or at its costs of production if it not possible to estimate the basic price. Gross fixed capital formation in software also includes the purchase or development of large databases that the enterprise expects to use in production over a period of time of more than one year. These databases are valued in the same way as software, described above.

By this definition, it is comprehensible why acquisitions of software should be treated as gross fixed capital formation (GFCF) in the national accounts. However, for the sake of the measurement, it is not clear enough to apply. Lequiller-Ahmad-Varjonen-Cave-Ahn[2003] reports the OECD Task Force on software measurement in the national accounts to describe a more detailed descriptive definition of software. The OECD Task Force recognizes that software as a distinct entity has two sub-categories: *originals* and *reproduction of originals* (recommendation 1(1)). This conceptual distinction of two sub-categories is consistent with the SNA recommendation. They define *originals* as,

> Original software are machines used in the process of production of other products, and as such are considered as investment. Originals can be produced on own-account (they are then called "own account original software") or can be bought ("purchased original software"). This includes games' originals. Originals cover two types:
>
> - *Originals for reproduction*: original software whose purpose is to be reproduced. They are generally the result of the production of software editing companies.
> - *Other originals*: software that can be used in the process of production of other products.

Also, the OECD Task Force defines *reproduction of originals* as,

> Reproductions of software are copies of original software. They include software giving users the rights, or license, to use, and software that gives the rights, or licenses, to reproduce:
>
> - *Licenses to use*: They are mostly marketed, and thus called "packaged software" or "off-the-shelf software". In general they legally provide a license to use the software. This category

includes reproduced software for final use and reproduced software for bundling in hardware, other equipment or other software. This category also covers "multiple copy" licenses to use and software "rented" for use, for which payments often take the form of "royalties". It excludes licenses that permit copies to be made for sale.

- *Licenses to reproduce*: Licenses to reproduce permit companies to make further software reproductions (licenses-to-use) for subsequent sale. These reproductions can be sold via licenses-to-use or as part of a bundle, whether the bundled software is included separately or embedded directly onto hardware. Often, licenses to reproduce are paid for using royalties.

In order to consider the capitalization of software, it is significant to identify originals and reproduction of originals, even if the physical formats of both are exactly the same. Reproduced games are not treated as GFCF, since they are not used in the production process. However, the games' originals should be treated as GFCF, since they are used for producing the reproductions of the games. Prepackaged software used in production process for more than one accounting period is treated as GFCF by the purchasers. Also, the originals should be treated as GFCF by the producers to reproduce the copies. This is not double-counting, but the proper treatment for the description of two different production processes. The U.S. initial measurement of own-account software investment was under this misconception. Expenditures for software originals, whose purpose is to be reproduced, were excluded from own-account software investment. In the benchmark 1997 input-output table, the BEA revised it to the proper treatment that originals and reproduction of originals should be recorded as investment in the two different production processes (Grimm-Moulton-Wasshausen[2003]).[*3]

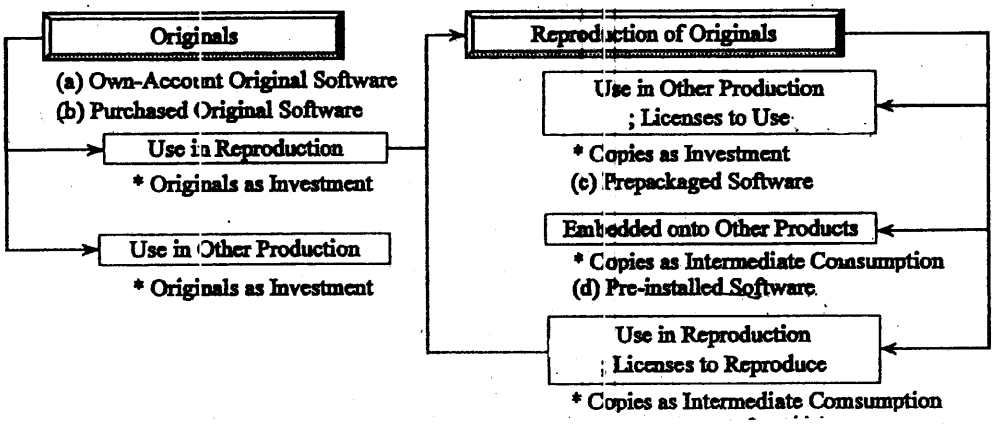

Figure. 1 Production Process and Use of Software

Figure 1 briefly summarize software production flow and investment activity. Originals consist of (a)own-account originals and (b)purchased originals. (a) is called simply as *own-account software* and

[*3] Like software to be reproduced, some thought software to be embedded onto other products should be excluded. However, the software originals, whose copies will be embedded onto other products, also should be recorded as own-account software. This kind of misconception is found in U.S. Congressional Budget Office[1998], Motohashi[2002,], and so on.

most of (b) is so-called *custom software*. (a) and (b) are used in reproduction and other production process. The values of (a) and (b) should be defined as investment, including *work-in-progress* (WiP), destined for investment (Recommendation 1(2))[4]. As for the reproduction of originals, (c)prepackaged software should be treated as GFCF, if it is durable and used in the production process. Some reproduction of software will be embedded onto products; equipment, machinery, and other software. This pre-installed software should be recorded as intermediate consumption and the final products can be treated as GFCF. The SNA and the OECD Task Force recommend that payments for licenses to reproduce should be treated as intermediate consumption.

The OECD Task Force defines own-account software as a *production process* that leads to the creation of a software original. For originals to be reproduced, in equilibrium, the total present value of profits from the sales of reproductions is equal to the value of originals. For originals to be used in other production, the present value of net capital flow is also equal to the value of originals. From the point of view of measurement, the value of own-account software is practically determined by a production cost (imputation) approach since it is difficult to directly observe the market value[5]. Ahmad[2003] indicates that every OECD country estimates own-account software using the production cost approach. Therefore, the imputation strongly depends on the definition of costs included in the valuation. The OECD Task Force describes the eight stages of the production process of own-account software; (1)Feasibility analysis, (2)Functional analysis, (3)Detailed analysis, (4)Programming, (5)Test, (6)Documentation, (7)Training, (8)Maintenance. They recommend that own-account software should include compensation of all staff and all internal overheads cost incurred in own-account production on stages (2)-(6) above (Recommendation 1(3)).

2.2 Methodology to Measure

Practically, there are two main difficulties in measuring own-account software investment. The first difficulty is to extract the production process only for own-account software. The second difficulty is to identify the cost for each stage of the production process for software. Companies may not capitalize own-account software, unless the expenditure is substantial. Also, the production cost for own-account software is not recorded separately in their business accounts. Because of the difficulties in measuring own-account software, we have to start with the measurement of the number of workers engaged in software production.

Here, we examine methodologies of the OECD Task Force and the BEA (Grimm-Moulton-Wasshausen[2003]). The standard measurement process of own-account software investment

[4] In general, the expenditure for non-completed assets is reported as WiP. When the asset is completed, at which point the cumulative value of WiP is transferred to investment. Although this rule should be followed for software if possible, very few companies capitalize originals for software at all. OECD Task Force concluded that, in practice, most own-account software WiP would ultimately be recorded as investment and, so, where it was not possible to identify WiP, own-account production should be recorded directly as investment (Lequiller-Ahmad-Varjonen-Cave-Ahn[2003]).

[5] The production process of own-account software can also include unsuccessful software development. In the SNA, some unsuccessful development is recorded as WiP while development is on-going, and the written-off when the project is abandoned. The OECD Task Force looked to the analogy of mineral exploration, where unsuccessful projects are, in practice, capitalized.