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SEMINAR ON MEASURING CAPITAL – BEYOND THE TRADITIONAL MEASURES
SESSION II

Capital measurement in the Netherlands

Submitted by Statistics Netherlands[1]

INTRODUCTION

1. At Statistics Netherlands the development of productivity statistics has been given key priority. The latest national accounts revision entailed two improvements leading to better productivity measurement. First, labour volume data based on full time job equivalents were replaced by hours worked. Labour volume data are being compiled in a system of labour accounts that is fully consistent with the national accounts.

2. Second, capital measurement was substantially improved. The Perpetual Inventory Method (PIM) as now applied at Statistics Netherlands provides a consistent set of statistics on consumption of fixed capital, capital wealth stocks, productive capital stocks and capital services (i.e. the value of capital inputs into production). A first experimental set of productivity calculations at the level of industry branches, excluding non-market services, was carried out last year.

3. There are good reasons why capital measurement should be extended beyond the current

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SNA asset boundary. The innovative capacity and profit opportunities of firms are increasingly determined by information technologies, scientific knowledge, brand building and organisational skills. National accountants are challenged to keep record of these new forms of intangible capital, not only in the context of measuring wealth stocks but also in relation to productivity measurement. Intangible capital is considered an important source of productivity growth (cf. Van Ark, 2007, Corrado et al., 2006).

4. This year Statistics Netherlands will carry out a feasibility study on the measurement of a wider range intangible assets and their contribution to productivity growth. This study will follow research by Corrado et al. (2006)

5. This paper reviews the current state of the art of capital measurement at Statistics Netherlands. The next section of this paper discusses the newly designed PIM as recently introduced by Statistics Netherlands. Section 3 discusses the main features of research and experimental development (R&D) investment and capital stocks calculations in the R&D satellite account of the Netherlands. It is foreseen that the revised SNA will recommend the capitalization of R&D. This section picks up the main issues addressed by the Canberra II Group on the practical implications of capitalizing R&D.

6. This year Statistics Netherlands will carry out a feasilibity study on the measurement of a wider range intangible assets and their contribution to productivity growth. This study will follow the findings of Corrado et al. (2006). Section 5 winds up sums up directions for future work at Statistics Netherlands.

I. CAPITAL MEASUREMENT

7. The OECD (2001) handbook on Measuring Capital provides a useful methodological framework for compiling macroeconomic statistics on consumption of fixed capital, wealth capital stocks and capital services. The handbook explains the interrelationships between each of these statistics and recommends their compilation to be carried out on the basis of one conceptual framework. Statistics Netherlands followed these OECD recommendations when revising the PIM system. A more detailed technical description is provided by Van den Bergen et al. (2005).

A. Gross capital stocks

8. A substantial amount of work involved the reconstruction of investment time series in current and constant (t-1) prices from the year 1953 onwards. The time series were constructed at the level of 57 industry branches, 20 asset types and 18 institutional (sub)sectors. For the starting year 1952 a gross capital stock was derived from an inventory of capital stock that was still in operation after the Second World War (Korn and Van der Weide, 1960). Supplementary assumptions were made about its age structure.

9. Special attention was given to the price indexes applied for (pre-packaged) computer software and computer hardware. Price indexes collected by Statistics Netherlands appeared to be unsatisfactory for two main reasons. Firstly, imports are not well covered. This is a serious omission since larger parts of pre-packaged software and computer hardware purchases in the

Netherlands originate from imports. Secondly, no adequate adjustments are being made for quality changes. Alternatively, price statistics from the US Bureau of Economic Analysis and the US Bureau of Labour Statistics were adopted. Since the influence of exchange rates on computer and software prices in Europe are uncertain, no corrections have been made for US dollar-Euro exchange rate changes.

10. The Dutch PIM runs off with compiling gross capital stocks on the basis of estimated discard functions. These gross capital stocks represent the replacement values of all fixed assets still used in production at a given moment in time. Replacement valuation means that all asset vintages are valued according to currently prevailing market prices of new assets.

11. For the manufacturing industry Statistics Netherlands has in addition to the annual investment survey two supplementary data sources available to estimate capital stocks. These are directly observed capital stock benchmarks and discard surveys. Both sources are based on identical classifications of assets and industries. The combined use of these sources leads to average service lives estimates and discard patterns for the combination of various asset types and manufacturing industry branches. In the Netherlands a first research on service lives was carried out by Meinen et al. (1998). An update of this research led to more detailed and more precise estimates.

12. Weibull distribution functions were derived from calculated discard fractions. These discard fractions were translated into survival rates. These, by definition, declining survival rates generally lead to robust estimates of the average service lives and mortality distribution patterns. In certain cases the estimates were found to be rather high indicating that likely some discards were missed by the Survey. A drawback of the method used is that missing observations on large discards in a certain year may substantially influence estimated service lives and mortality distribution patterns.

13. Incidental information on directly observed capital stocks were also available for crude oil and natural gas mining (ISIC-11) and the water distribution industry (41). Car register information was used for determining the service lives of road transport equipment. Service lives of airplanes were derived from company records of Dutch airline companies. The survival functions of assets in other industry branches were in some cases borrowed from those found in the manufacturing industry. In other cases results were slightly modified when existing evidence gave reason to assume diverging service lives from those observed in the manufacturing industry.

B. Productive capital stocks

14. A next step in the PIM is the compilation of so-called productive capital stocks. These are particularly useful for productivity measurement. Productive stocks reflect the level of capital services assets are expected to generate. The productive capacity of assets is postulated with the help of so-called age-efficiency profiles. It is assumed that the age-efficiencies of most assets decline over their service lives as a result of wear and tear. The total productive capital stock of a particular asset type is derived from aggregating assets of various vintages according to their transformation into efficiency units.

15. The usually declining level of capital services an asset is able to produce over its entire service live is reflected by the asset's age efficiency profile. Empirical information on the shape of age-efficiency profiles is scarcely available. In most cases assumptions were made about the age-efficiency patterns of various asset types. Regarding their general shape two assumptions can be made. A geometric profile is used by Statistics Canada. This profile assumes the largest absolute declines in service levels at the beginning of an asset's service life. At the Australian Bureau of Statistics and the US Bureau of Labour Statistics a hyperbolic profile is used, assuming that the largest absolute declines occur at the end of an asset's service life. Without the availability of any empirical evidence for the Netherlands, a hyperbolic profile is considered the most plausible one.

16. Hyperbolic age-efficiency profiles were postulated with the help of a so-called Winfrey function (OECD, 2001, par. 6.75). The β parameter in this function determines the initial efficiency losses at the beginning of an asset's services lives. The β parameter may vary between 0 and 1. A value of 1 indicates a constant level performance, also referred to as a 'one-horse-shay'. We selected a β value of 0.5 for asset types like machinery and installations and transport equipment, a value of 0.75 for industrial buildings and dwellings and a value of 1.0 for computers, software and other intangible fixed assets.

17. The average age-efficiency profile of a group of (identical) assets is obtained by weighting the age-efficiency profiles, which are dependent on the service life of the asset, with the mortality distribution function. The so acquired average age-efficiency profile is usually more or less geometric, even though the individual assets have a hyperbolic age-efficiency profile.

C. Wealth stocks

18. The net capital stock represents the expected actual market value of the complete stock of fixed assets used in production. Since most capital goods are sparsely traded on second hand markets, asset market values are approximated on the basis of net present value calculations of current and future rentals a capital good is expected to generate during its remaining service life. These rentals are assumed to be equal to the amount of capital services the asset can generate. An asset's expected flow of current and future capital services is postulated on the basis of its expected remaining service life and its age-efficiency profile.

19. The newly estimated service lives of assets are on average a bit shorter than those used before the national accounts revision. Shorter service lives result in higher depreciation levels and lower wealth stocks. However, in total the new method leads to depreciation levels that are about 5.5 percent lower than those according to the former straight-line depreciation method. At the same time the estimated net capital stock levels are about 7.5 percent higher. So the new depreciation calculations provide on average lower depreciation rates than the former straight-line depreciation method. This changed method more than offsets the effect of shorter observed service lives.

D. Return to capital

20. The value of capital services represents the costs of owning and using assets in a given period of time and should approximate their rental prices (if existing). The periodic user costs of

capital include the depreciation of fixed assets, possible holding gains or losses, a return to capital and specific taxes levied on asset ownership.

21. With regard to the return to capital and exogenously or endogenously determined rate can be used. The gross operating surplus is by definition entirely allocated to capital inputs when using endogenous rates of return to capital. Exogenously determined rates of return will in most cases lead to a new residual in the income generation account, being that part of value added that remains unallocated to either capital or labour inputs. This new 'balancing item' could be either positive or negative.

22. The interpretation that could be given to this new balancing item, currently not acknowledged in the SNA, is that companies in certain years may earn real profits or losses. Otherwise it may identify (partly) capital income that remains unallocated due to the incomplete coverage of assets in the accounts. The increasing importance of intangible assets, as for example illustrated by high amounts of goodwill paid for company take-overs, indicates that a substantial amount of capital remains uncovered in balance sheets.

23. So far a default exogenous rate of 4 percent has been used in the valuation of capital services. No attention has yet been given to risk premiums that may contribute to diverging rates of return between industry branches.

E. Summary of results

24. Table 1 provides an overview of constant price changes in volume capital stock estimates for the Netherlands. The table illustrates the substantial volume growth of information technology appliances in production. Computer hardware capital stocks increased dramatically between 1980 and 2005. The increase in software is also substantial, but after 2000 computer software increased moderately.

25. It is important to emphasize that the volume increase of computer hardware and software is partly counterbalanced by very large price declines. Current value shares in the total capital stock of computer hardware and software increased therefore much slower. In the year 2005, both computer hardware and software had only a 0.7 percent share of the capital stock. The bulk of the capital stock consists of dwellings and other buildings and structures. Together they make up 84 percent of the total capital stock in 2005.

Table 1. Volume change of the Dutch net capital stock, 2000 = 100

	1980	1985	1990	1995	2000	2005
Dwellings	60.1	67.8	77.5	87.7	100	111.7
Non-residential buildings	78.4	80.5	87.2	93.8	100	104.8
Civil engineering works	85.9	89.1	91.6	95.2	100	105.1
Passenger cars and other vehicles	47.4	50.9	67.5	72.7	100	104.3
Trains and trams	53.2	67.0	70.5	100.2	100	134.1
Ships	95.7	109.6	106.1	98.3	100	90.0
Aircraft	51.5	74.6	86.5	117.1	100	93.1
Computer hardware	0.5	2.8	8.8	21.1	100	247.7
Machinery and equipment	58.9	65.4	78.1	86.4	100	99.5
Cultivated assets	64.0	70.3	76.3	86.1	100	105.3
Other tangible fixed assets	52.4	55.2	72.8	77.5	100	109.5
Computer software	4.1	11.4	28.3	40.5	100	107.8
Other intangible fixed assets	30.7	48.7	75.6	78.1	100	88.2
Total capital stock	64.8	71.0	80.0	88.3	100	107.9

II. KNOWLEDGE CAPITAL CREATION BY RESEARCH AND DEVELOPMENT

26. The international Frascati guidelines (OECD, 2001) are a good point of reference for the definition of R&D and the knowledge assets resulting from R&D. In the Dutch R&D satellite account data from the annual R&D survey are translated to an economy wide representation of R&D supply and use including international trade of R&D services (De Haan & Van Rooijen-Horsten, 2004).

27. R&D is expected to play a fundamental role in the competitiveness of firms by delivering blueprints for product or process innovations. Knowledge gained from R&D may lead to separately identifiable, and principally exchangeable entities. Exclusive ownership rights can be enforced by way of legal protection, by way of secrecy or having access to complementary human capital needed to provide the knowledge asset its competitive edge. These are important preconditions for codified scientific knowledge to comply with the general SNA definition of an asset.

28. The capitalisation of R&D expenditure in the SNA is therefore an important step forward. However there are a number of conceptual issues that need further attention before national accounts statistics on R&D investment and capital stocks can be compiled in a meaningful way.

A. Freely available R&D

29. It is important to define the conditions under which R&D actually leads to the creation of an asset in the SNA sense. Aspden (2003) indicates that potentially all research provides, one way or another, a service over longer periods of time, either through higher levels of productivity or simply by satisfying people’s curiosity. Therefore he advocates a generic capitalisation of R&D, including both private R&D and R&D carried out in the public domain. Following this line of thinking, knowledge capital would principally not depreciate since it will never stop providing beneficial services to society.

30. There is however one major obstacle. Knowledge freely disseminated in the public domain misses any form of ownership. This is a decisive factor in the SNA definition of an asset. Although the government can be identified as the financer and performer of R&D, it is not necessarily true that governments also own this public knowledge. The comparison, made by some, with public infrastructure is unjustified. Usually roads are legally owned by either governments or private institutions. The government could at any point in time decide to sell a road to a private party or to start levying access fees. This is simply impossible for knowledge once this is made freely accessible to the public. At that moment ownership ceases to exist.

31. There is one important reason why R&D may lead to the creation of an asset in the SNA sense. Due to exclusive access to knowledge obtained by R&D, the owner may exert a certain level of market power. The service of a knowledge asset decays together with the inevitable loss in monopolistic power the owner will experience over time. This inevitable loss in market power will ultimately terminate the service life of a knowledge asset. Also sharing of knowledge incurs an opportunity cost since it delimits the monopolistic power of the initial owner. This opportunity cost does not exist in the case of freely accessible knowledge. Freely accessible knowledge is therefore a free good. In conclusion, exclusive ownership maintains to be a decisive precondition for knowledge to be accepted as an asset in the SNA sense.

32. The discussion then boils down to how the exclusive ownership of knowledge assets is understood. Legal enforcement of ownership by way of patenting is in our minds not a necessary condition. Exclusive ownership can also be obtained by way of secrecy or by having exclusive access to the complementary tacit knowledge. Usually the main purpose of R&D performed or funded by companies is to increase a firm´s competitiveness. Since most of the returns of this R&D are expected to go to the investor, private R&D will usually lead to assets in the SNA sense.

B. Measuring R&D trade

33. R&D import and export data may be derived from survey information about R&D financed by foreign entities (apart from foreign government funding) and reversely, domestically financed R&D carried out in other countries. It should be kept in mind that most R&D surveys do not explicitly ask for actual (foreign) R&D sales and purchases. This type of information would certainly improve R&D surveys for national accounting purposes. Also most R&D surveys are directed to R&D performers. This may lead to under reporting of R&D imports if large amounts of R&D are obtained by non-performers from non-domestic producers. However, in the Netherlands this underreporting is probably of minor significance.

34. Results from the Dutch R&D survey2 illustrate that the Netherlands is a net exporter of R&D services. This may indicate that the Netherlands enjoy beneficial conditions for carrying out R&D. However, the spill over effects of this R&D are likely to occur outside the Netherlands.

35. An attempt was made to investigate whether data from the Dutch R&D survey correctly

[2] Assuming the questions on R&D financed by foreign entities and reversely, domestically financed R&D carried out abroad, accurately reflect R&D export and import.

reflect the international trade of R&D flows, especially with regard to multinational companies. In the Netherlands eight multinationals are responsible for approximately 50 percent of the Dutch gross expenditure on R&D. Comparing the number of employees of these companies working in the Netherlands as a proportion of total worldwide employees with the number of R&D employees in the Netherlands as a proportion of worldwide R&D employees indicates that R&D performance of these companies is concentrated in the Netherlands. For total of these companies, 11 percent of total personnel worldwide and 44 percent of R&D personnel worldwide is employed in the Netherlands (1999).

36. This apparent concentration of R&D activities in the Netherlands indicates that these multinationals are likely to transfer certain amounts of R&D services to foreign company divisions. Remarkably however, only two out of 8 multinationals report substantial amounts of R&D export whereas the other 6 report zero R&D export or a very small amounts.

37. These results seem to indicate that R&D transfers to the rest of the world are underreported in the survey. It may be that R&D is being transferred between different company divisions without any financial compensation. These unobserved transfers in kind really hamper a robust measurement of R&D investment and capital stock in small and open economies like the Netherlands. One may conclude that R&D surveys should include questions about on whose behalf (domestic versus foreign) R&D is undertaken. Similarly, questions could be added about whether access to knowledge has been obtained from R&D carried out by other (foreign) company divisions. In the Netherlands consultations will be carried out on short notice to investigate whether officials of these multinational companies are able to respond to such questions.

C. R&D and computer software overlap

38. Data from the Netherlands indicate that R&D devoted to software development can be substantial. Mantler & Peleg (2003) identify two kinds of possible R&D-software overlaps. First, R&D may be performed with the aim of developing a software original. Second, the development of software may be part of a R&D project. Mantler & Peleg argue that "…in the case of R&D on software, as in other cases where assets are being produced using R&D, there are in fact two products, a) an asset – the software – that can be used repeatedly in production, and b) R&D that is a product in itself, whether regarded as an asset or as intermediate consumption".

39. The Frascati guidelines (cf. par's 135 and further) indicate that certain software development projects may entirely fall under the Frascati definition of R&D. "For a software development to be classified as R&D, its completion must be dependent on a scientific and/or technological advance, and the aim of the project must be the systematic resolution of a scientific and/or technological uncertainty", and, "The nature of software development is such as to make identifying its R&D component, if any, difficult".

40. R&D that is entirely devoted to the creation of a new software original may constitute an inseparable part of a production process generating a software original. Since in most cases software and R&D assets are valued by summing up their production costs, it seems unwanted to sum up in such cases production costs twice: first as a software asset and second as an R&D

asset. The most straightforward recommendation that could be made for these cases is that all R&D with the specific goal of developing a software original should be identified as software and not as R&D. This is also in line with the present recording of software in the SNA-1993.

41. In case the R&D concerns basic or applied research of a more general nature that could be of use in several software development projects, it would be meaningful to identify this R&D output (and the resulting knowledge asset) separately from software. When the development of software is an inseparable part of an R&D project (not resulting in the development of a software original), this software should not be identified as a separate asset. The costs of this software development should be an integral part of the R&D project. In case software is being developed as a supplementary tool, the accounting recommendations of Mantler & Peleg should be adopted. That is, when the developed software can be identified as an independent multipurpose software tool, this software should be defined as a separate asset, and the consumption of fixed capital of this software should be part of the production costs of the R&D output.

III. OTHER INTANGIBLE FIXED ASSETS

42. At this moment, the standard national accounts of the Netherlands cover the following intangible asset categories: computer software, mineral exploration and entertainment, literary and artistic originals. In addition satellite accounts are annually being compiled for R&D.

43. Corrado et al. (2006) indicate that business capital stocks are increasingly dominated by a much wider range of intangible assets. The work of Corrado et al. provides concrete directions in which intangible capital measurement can be expanded. In addition to those intangible asset types covered in the Dutch national (satellite) accounts, they identify intangible assets such as non-scientific R&D, brand equity and firm-specific training of personnel. Their estimates suggest that these, up to now, mostly uncounted intangibles may have an appreciable effect on GDP levels, investment rates and labour productivity levels.

44. The main criterion on which Corrado et al. base their expanded capital measurement is that any use of resources that reduces current consumption in order to increase it in the future qualifies as an investment. They argue that most business expenditures aimed at enhancing the value of a firm and improving its products, including human capital development and R&D should be recorded as intangible capital in national accounting systems. However, since according to SNA guidelines education expenditure is still not recorded as investment in human capital, there are apparently additional criteria playing a role in the SNA definition of assets. These are discussed for each newly proposed asset category.

A. Job training

45. Although firm specific training primarily improves the human capital of employees, it can reasonably be argued that a company would not pay for it unless it expects a return on investment. Since the expected returns on company training will usually last several years, expenditure on firm specific training meets at this point the criterion of an asset. Also innovations will probably fail without sufficiently skilled employees. This means for example that the creation of knowledge assets will usually not lead to rising profits unless access is guaranteed to the complementary human capital.

46. However it is questionable to what extent a firm really exercises ownership rights over the created knowledge embodied in its personnel. A trained employee may choose at any point in time to leave the company for another job. However companies may demand compensation from recently trained employees when leaving shortly after being trained. In this way the benefits of job training are expected to be largely captured by the employer. This may be seen as some sort of ownership.

47. In summary, although it is hard to recognize job training as a separately identifiable and exchangeable asset, job training usually provides income for several years, and therefore meets an important criterion of an asset. However, it seems difficult to argue why job training is, and other education expenditure is not, part of investment.

B. Non-scientific (R&D) innovations

48. Up to now official statistics have focussed mainly on technological product and process innovations (cf. Oslo manual for data collection on technological innovation, OESO, 1996). Not much is known about non-technical innovations in particularly the services industries. Corrado et al. restrict their estimates in this area to expenditure on developing new motion picture films and other forms of entertainment. However, in the Dutch national accounts this category of expenditure is, following SNA 93 guidelines, already recorded as investment in entertainment, literary and artistic originals.

49. Expectedly, the host of innovations related to new service business concepts is not captured in official innovation statistics. Most innovations in the services industries have both technical and non-technical dimensions (Van Ark, 2007). The technical dimension is dominated by new applications of information and communication technology. Information technology can be regarded as an important facilitator of most innovations in services. Yet, expenditure on information technology, computer hardware, software and communication equipment, is already captured as investment in the main stream national accounts. This is also the case in the Netherlands.

50. The non-technical dimensions distinguished by Van Ark entail new service concepts (e.g. call centres), new client interfaces (e.g. e-commerce) and new delivery concepts (e.g. home shopping, electronic banking). Further investigation is needed to identify which non-technical investment expenditure contributes to these forms of new commercial and financial services design. One may expect that job training plays an important role in non-scientific innovations as well.

C. Marketing assets

51. Expenditure on marketing and advertising may contribute to the value of brand names. In many businesses establishing solid brand names is an important precondition for commercial success. Although brand names are not recognised as assets in the SNA, the value of brand names will usually add to a company's goodwill. One conceptual problem concerns how marketing spending is related to brand building. Corrado et al. refer to empirical evidence from which they conclude that only 60 percent of advertising expenditure contributes over longer

periods of time to the value of brand names. So when estimating investment in brand names, it seems important to separate spending with expected long lasting effects from other spending on advertising such as personnel ads.

IV. FUTURE WORK

52. As argued in this paper there are good reasons why capital measurement should be extended beyond the present and future SNA asset boundaries. The innovative capacity and profit opportunities of firms are increasingly determined by information technologies, scientific knowledge, brand building and organisational skills. However, it is questionable whether all these new categories of intangible assets can be introduced independently in the core National accounts. R&D deliver the blueprints for new production or product technologies. In that sense R&D carries similar 'tangible' properties as for example a computer software code. They both represent codified knowledge. This makes R&D quite similar to computer software and perhaps other regular types of assets.

53. This property seems absent in intangible asset types such as brand building, non-technical innovations and improvement of organisational skills. Although expenditures on these forms of capital are likely to enhance the value of firms, they cannot easily be identified as separate entries on balance sheets. As opposed to most R&D assets, it is probably difficult, if possible at all, to sell them as separate entities. In other words, it is more difficult to perceive them as separately identifiable and exchangeable assets than is the case with most R&D. Within the core national accounts this property of exchangeability may be considered an important precondition for capitalization. However, a broader concept of intangible capital can very well be explored in satellite accounts.

54. In the Netherlands improvements in capital measurement started within the SNA asset boundary. At this moment in the Dutch national accounts annual capital stock estimates of SNA-type fixed assets cover the period from 1952 onwards. Anticipating the upcoming SNA revision, research on R&D capital has been started. Time series of R&D gross fixed capital formation and capital stocks from 1970 onwards will soon be completed. However it is important to stress that capital and productivity measurement at Statistics Netherlands are still under construction.

55. Following Corrado et al. this year a feasibility study will be carried out on measuring a broader range of intangible fixed assets such as firm specific training, non-technical innovations and brand names. This work will be carried out as extension of our knowledge satellite accounts.

56. In addition, it is expected that this year balance sheets will be compiled for inventories and non-produced assets such as land and subsoil assets (especially natural gas). For the purpose of productivity analysis these stocks will be classified by industry branch and institutional sectors.

57. A next step will be introducing these new capital stock measures in multifactor productivity statistics. Multi-factor productivity can be seen as a measure of our ignorance. It represents that part of output growth that can not be explained by the growth in the inputs of production. When more types of assets services are included as inputs in productivity measures, usually a bigger part of output growth is explained. Furthermore, productivity measurement provides direct estimations of impacts of each of these assets on output growth. Including these

new assets in productivity statistics is expectedly leading to a better understanding of the drivers of economic growth.

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