Measuring capital

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1.The role of capital in the economy

- Role of capital in the economy:
  - Capital can be considered **a production factor**, as it provides services to production, and is remunerated for these services with a rental.
    - The cost of capital in production and the associated service flow were not recognized in the 1993 System of National Accounts. Only recently has the revised SNA acknowledged these flows.
  - Capital can also serve as **storage of value**. It provides a comprehensive picture of economic wealth (assets' balance sheets).
- It is important to measure capital due to its pivotal role in the economy,

2.Main methodological references

Capital measurement has moved through different stages, depending on the methodological recommendations of international institutions in each moment, mainly the OECD, which has published different capital measurement manuals:

- OECD (1992) (it drew on Ward (1976))
- OECD (2001a, 2001b)
- OECD (2009)

The guidelines for estimating capital stock have been updated along the years in order to better reflect the capital services, instead of focusing on the capital valuation or the concept of capital as wealth as in earlier years.

2.Main methodological references

OECD (1992) Manual considers two versions of capital measurement: gross capital stock and net capital stock.

It uses the Permanent Inventory Method (PIM) to obtain stock series from the accumulation of past gross fixed capital formation (GFCF) flows.

- Sectoral disaggregation for private capital and functional disaggregation for public component are emphasized.

OECD (2001) Manual contains new and revised recommendations that marked a major renewal of the capital series estimated up to that moment.

- The concept of productive capital (and capital services) is introduced, which is the theoretical core of the new contribution and is associated with the concept of homogeneous assets and not with the productive sectors, as before.

2.Main methodological references

The last Capital Measurement Manual (**OECD 2009**) revises and qualifies the recommendations of the 2001 Manual, but maintaining the basic features that forced to modify the 1992 methodology. It enforces the role of productive capital and capital services, distinguishing by type of asset.

- In the production process, many types of capital goods of different characteristics are used, which implies differences in the flow of services they provide. From the perspective of output growth theory, what matters are these flows of services and not the market value of capital goods.

3.Different concepts of capital stock

OECD 2009 distinguishes between different capital concepts or measures:

1. **gross capital stock**, (KG) is the result of the accumulation of gross investments (GFCF), after deducting the retirements that have taken place over the period considered.

2. **net capital stock** (also called wealth) (KW) is the market value of the assets under the assumption that it is equal to the present discounted value of the income expected to be generated by the asset. Capital goods are valued at market prices.

   - These two measures were already included in OECD 2001

3.Different concepts of capital stock

3. Productive capital and capital services

- **productive capital** (KP) at constant prices is a quantitative (or volume) concept that takes into account the loss of efficiency as a result of the ageing of the asset. This quantitative concept is related to the price of the services it provides, the capital user cost.
    - This last capital measure, introduced in 2001, complements the well-established traditional measures of capital and introduces the cost of capital services into the capital accounts.

- **capital services** can be defined as the flow of productive services from capital assets to production.

3.Different concepts of capital stock

The concept of **capital services** brought into the picture the age-efficiency profile or age-efficiency function which depicts an asset's loss in productive efficiency as the asset ages.

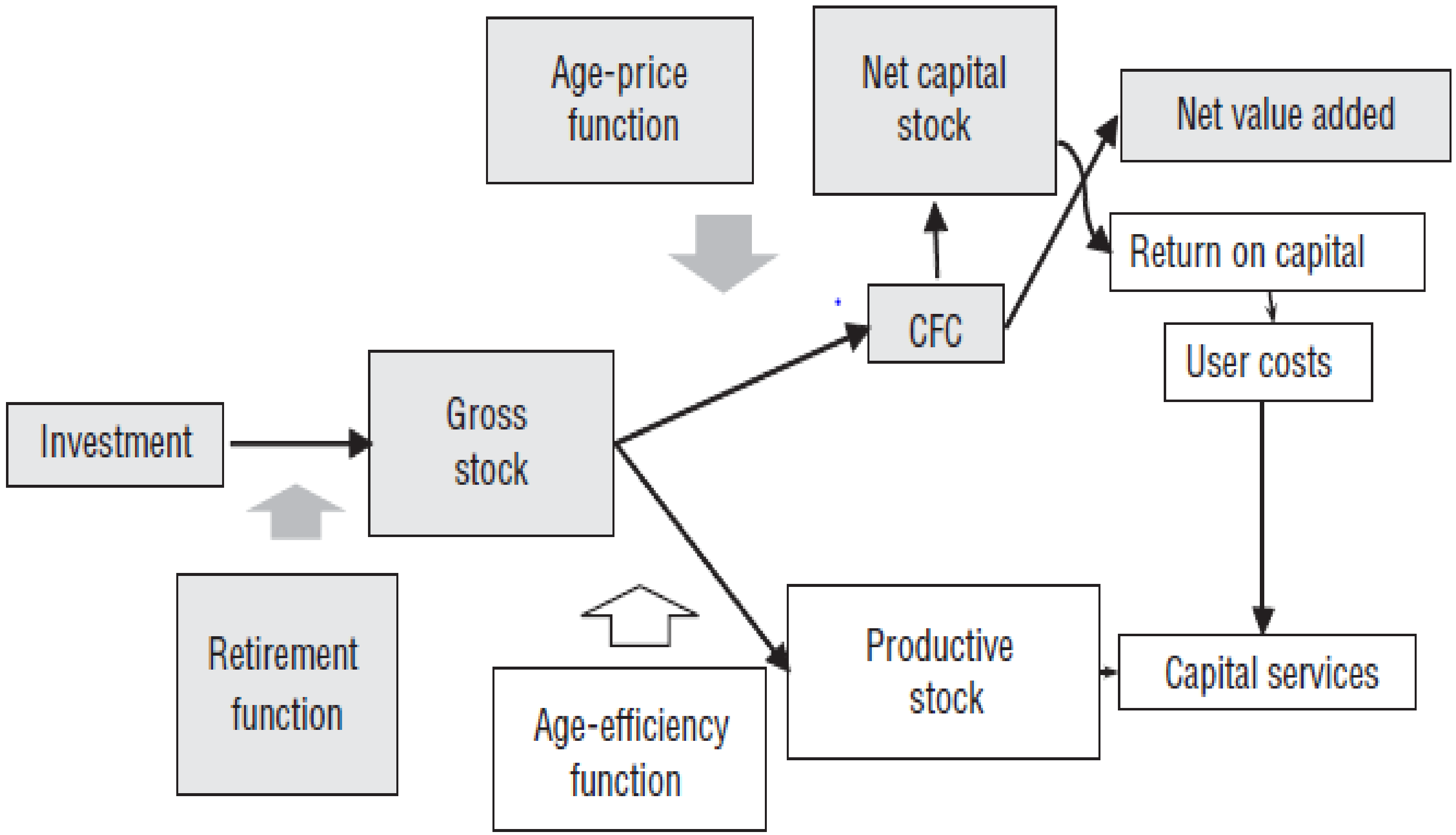
When past investment flows are corrected for retirements and for the loss in productive efficiency, their cumulative value is the ***productive stock***. Capital services are assumed to be proportional to the productive stock.

The **price of capital services** – its **user costs** or rental price – is estimated by combining information on the required return to capital, on depreciation and on revaluation. More elaborated works (i.e. Jorgenson et al.) also include taxes and subsidies.

Given the price of capital services – the user costs – and the quantity of capital services derived from the productive stock, the **total value of capital services** can be computed.

3.Different concepts of capital stock

An integrated set of capital measures



3.Different concepts of capital stock

As OECD (2009) states, the suitable capital measure when working within a growth accounting framework is **capital services**, as

- this measure shows the real contribution of capital assets to GDP/output growth
- it takes also into account the composition of capital by assets and the fact that each one provides a different quantity of services.
- not accounting for shifts in the composition of capital biases input measures, and consequently productivity measures.

4.PIM (Perpetual Inventory Method)

The most widely used approach for measuring stocks and flows of fixed assets is the perpetual inventory method (PIM).

- It rests on the simple idea that stocks constitute cumulated flows of investment, corrected for retirement and efficiency loss.
- The PIM implementation relies on the selection of the age-efficiency profile for each type of asset in the case of the calculation of capital services, or by defining the age-price/depreciation profile for each type of asset in the case of net capital.

4.PIM (Perpetual Inventory Method)

Steps for applying the perpetual inventory method (PIM).

- The definition of a retirement profile with its parameters, among them the average and the maximum service life of each asset.
- This retirement profile is combined with the age-efficiency profile (capital services) or with the age-price profile (net capital) to yield an age-efficiency/retirement profile or an age-price/retirement profile for a cohort.
  - In the case of geometric depreciation, the two profiles coincide.
- The application of these profiles to time series of investment.
  - The age-efficiency profile applied to investment series yields a measure of the productive capital stock.
  - The age-price profile applied to investment series yields a measure of the net or wealth stock.

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4.PIM (Perpetual Inventory Method)

Steps for applying the perpetual inventory method (PIM).

- To compute the unit user cost for a new asset based on the rate of depreciation for a new asset (taken from the age-price profile), the real rate of return and the real rate of holding gains or losses.

- To compute a measure for the total value of capital services for a particular type of asset by multiplying the unit user cost for a new asset by the productive capital stock (also expressed in efficiency units of a new asset).

- The volume change in capital services is obtained by constructing a weighted average of the changes in the productive capital stock by type of asset. Each asset's share in total capital services constitutes the weights in this index.

4.PIM (Perpetual Inventory Method)

Although the PIM implementation could be seen as a simple procedure, it relies on many decisions and assumptions:

- The selection of the level of disaggregation by asset/industry of GFCF flows.
- The selection of some parameters on which the calculation is based, such as average and maximum service life of each asset, depreciation patterns, rates of return (exogenous or endogenous), capital gains inclusion, selected deflators, etc.
- The issue of the ownership vs. use of capital assets.
    - *A particular example is infrastructure: public infrastructure is not allocated to the using industries but rather appears as part of the capital stock of public administration.*

5.Age-efficiency profiles

The age-efficiency profile of a single asset describes the time pattern of productive efficiency of the asset as it ages.

The age-efficiency function for a single asset (of a particular type) can be represented by $g_n(T)$, where n is an index for age that runs from zero (a new asset) to T, the retirement age of the asset.

For practical purposes, three functional forms are possible: hyperbolic, linear and geometric.

The *geometric* age-efficiency profile constitutes the most frequently used profile in empirical applications. It postulates that efficiency for a cohort declines at a constant rate δ.

$$g_n(\text{geometric})=(1-\delta)^n$$

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6.Age-price and depreciation profiles

Depreciation is defined as the loss in value of an asset due to physical deterioration (wear and tear), and due to normal obsolescence. Depreciation is a value concept, to be distinguished from quantity concepts such as the age-efficiency function that capture losses in an asset's productive efficiency.

Functional forms: Straight line model of depreciation and Geometric or declining balance model of depreciation.

The *geometric model* is computationally simple, and because of that it is being gradually adopted by statistical agencies, among them the United States Bureau of Economic Analysis. The geometric model of depreciation δ is characterized by:

$$p_n/p_0 = (1-\delta)^n$$

being p the asset price/value.

6.Age-price and depreciation profiles

The geometric model of depreciation generates a particularly convenient user cost formula.

- The user cost of capital services can be approximated considering three main elements: (i) the cost of financing or the opportunity cost of the financial capital tied up through the purchase of the asset; (ii) depreciation, i.e. the value loss due to ageing; (iii) revaluation, i.e. the expected price change of the class of assets under consideration.

Under a geometric model, the factor of proportionality comprising the rates of return, of depreciation and of revaluation becomes independent of the vintage of the asset. Thus, the value of depreciation does not have to be computed separately for every vintage, but is obtained directly by applying the rate of depreciation to the net capital stock.

Furthermore, the productive capital stock and the net capital stock coincide in the case of geometric rates because age-price and age-efficiency profiles coincide.

6.Age-price and depreciation profiles

In the absence of econometric estimates of geometric depreciation rates, δ has sometimes been estimated with the 'declining balance method':

$$\delta = R/T^A$$

where T^A is the average service life and R an estimated declining-balance rate

- Under the double declining balance formula, R is chosen to equal 2, although it is preferable to turn to empirical results.

$$\delta = 2/T^A$$

7.Service lives and retirement of assets

Service lives

For national accounts purposes, service lives are economic service lives which may be different from physical service lives.

The main sources for estimating service lives are asset lives prescribed by tax authorities, company accounts, statistical surveys, administrative records, expert advice and other countries' estimates.

Ideally, what is required for accurate implementation of the PIM is a set of service lives for narrowly-defined asset groups that are used in different sectors and kinds of activity. However, service life estimates are generally available only for broad asset groups, there is limited information available on differences in lives of asset groups between sectors and kinds of activity and service lives are updated at rare intervals in most countries.

- There are several "sensitivity studies", which run the PIM model with alternative estimates of service lives

7.Service lives and retirement of assets

Retirement patterns

Different assumptions can be made about the distribution of retirements around the average service life:

- Simultaneous exit
- Linear
- Delayed linear
- Bell-shaped. Bell-shaped retirement patterns include gamma, quadratic, Weibull, Winfrey and lognormal functions. The last three are probably the most widely used in PIM models.

8.Rates of return

Two main approaches (*ex-post*, endogenous rates and *ex-ante*, exogenous rates) can be found in the literature, each with its advantages and drawbacks:

- The **endogenous, ex-post approach** is the most frequently used method in empirical applications of capital measurement. It consists of computing the period-by-period ex-post rate of return, on the basis of information about non-labor income, depreciation and real holding gains or losses for the market sector.

- The **ex-ante, exogenous approach** choose an ex-ante rate of return, as for example, the average of different interest rates that prevail on financial markets.
  - OECD studies, where exogenous real rates have been used for capital services measurement at the total economy level, show that in the 18 countries considered, long-run averages of real interest rates oscillated around values between 3 and 5 percent per year, depending on the country.

- Special issues regarding the rate of return for the government sector (Mas et al, 2006)

9.Computing capital stock and capital services

In order to compute capital measures, the following elements should be available:

- an age-price and an age-efficiency profile for cohorts of particular types of assets;
- a depreciation profile which constitutes a direct transformation of the age-price profile;
- time series of gross fixed capital formation at constant prices as well as the corresponding deflators.

With these elements in hand, the computation of the net stock, the value of depreciation, the productive and the gross capital stock is relatively straight forward.

9.Computing capital stock and capital services

Initial capital stocks (W^{t0})

OECD methodology assumes that a sufficiently long-time series of investment data is available for each asset. However, for long-lived capital goods, this may not be the case. Possible solutions:

- to estimate time series of investment, for example by establishing an econometric relationship between GDP and investment based on existing observations. A simple approximation (Kohli 1982) can be used in particular when geometric age-efficiency or age-price profiles apply. In this case, the productive (or net) stock at the beginning of the benchmark year t0 can approximately be written as $W^{t0}=I^{t0}/(\delta+\theta)$ where θ is the long-run growth rate of GDP/GFCF.
- to construct a benchmark estimate on the basis of other sources: wealth surveys, population censuses, fire insurance records, company accounts, administrative property records, share valuations.

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10.Computing capital stocks: practical implementation

BBVA Foundation-Ivie**: “Capital stock in Spain and its distribution by territories (1964-2014)”**

- This database covers three variables: investment, capital stock and capital services.
- It follows OECD (2009) methodology.
- Data are classified by asset and industry: At national level, 18 different asset types and 31 industries (NACE Rev. 2) are considered.
- Public infrastructures have been retained in asset breakdown (which was a distinctive characteristic of the BBVA Foundation-Ivie series)
- It includes also the distinction between public and private sector for two industries: Education (P85) and Health and Social Services (Q86-Q88) (besides Public Administration (O84))
- In addition, it includes data by autonomous communities and provinces with disaggregation by 18 types of assets, and 25 and 15 industries, respectively.
    - More details on the links: *http://www.ivie.es/es_ES/bases-de-datos/capitalizacion-y-crecimiento/el-stock-y-los-servicios-de-capital/* and *https://www.fbbva.es/microsites/base-datos-stock-de-capital/fbbva_stock08_index.html*

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10.Computing capital stocks: practical implementation

Table 1: Asset breakdown

1. Tangible assets
1.1. Dwellings
1.2. Non-residential structures 1.2.1. Road infrastructures 1.2.2. Public water infrastructures 1.2.3. Railway infrastructures 1.2.4. Airport infrastructures 1.2.5. Port infrastructures 1.2.6. Urban infrastructures (local public authorities) 1.2.7. Other structures n.e.c.
1.3. Transport equipment
1.3.1. Motor vehicles 1.3.2. Other transport material
1.4. Other machinery and equipment
1.4.1. Metallic products 1.4.2. Machinery and mechanical equipment 1.4.3. Office equipment and hardware 1.4.4. Other machinery and equipment 1.4.4.1. Communications 1.4.4.2. Other machinery and equipment n.e.c.
1.5. Biological cultivated assets
2. Intellectual property products
2.1. Software
2.2. Other intangible assets 2.2.1. R&D 2.2.2. Rest of intangible assets

Source: BBVA Foundation-Ivie

10.Computing capital stocks: practical implementation

Table 2. Industry breakdown at national level

NACE Rev. 2	Description
01-96	0. Total activities
01-03	1. Agriculture, forestry and fishing
05-39	2. Industry
05-09, 35-39	2.1. Mining and quarrying and utilities
05-09	2.1.1. Mining and quarrying
35-39	2.1.2. Electricity, gas and water supply
10-33	2.2. Manufacturing
10-12	2.2.1. Manufacture of food products, beverages and tobacco products
13-15	2.2.2. Manufacture of textiles, apparel, leather and related products
16-18	2.2.3. Manufacture of wood and paper products, and printing
19	2.2.4. Manufacture of coke, and refined petroleum products
20-21	2.2.5. Manufacture of chemicals and chemical products; Manufacture of pharmaceuticals
22-23	2.2.6. Manufacture of rubber and plastics products, and other non-metallic mineral products
24-25	2.2.7. Manufacture of basic metals and fabricated metal products, except machinery and equipment
26-27	2.2.8. Electrical and optical equipment
28	2.2.9. Manufacture of machinery and equipment n.e.c.
29-30	2.2.10. Manufacture of transport equipment
31-33	2.2.11. Other manufacturing, and repair and installation of machinery and equipment
41-43	3. Construction
45-56	4. Wholesale and retail trade, transportation and accommodation and food services
45-47	4.1. Wholesale and retail trade and repair of motor vehicles and motorcycles
49-53	4.2. Transport and storage
55-56	4.3. Accommodation and food services
58-63	5. Information and communication
58-60	5.1. Publishing, audiovisual and broadcasting activities
61	5.2. Telecommunications
62-63	5.3. Computer programming, consultancy and related activities; Information service activities
64-66	6. Financial and insurance activities
68	7. Real estate activities
69-82	8. Professional, scientific, technical, administration and support service activities
84-88	9. Public administration, defense, education, human health and social work activities
84	9.1. Public administration
85(P)	9.2. Public education
85(P)	9.3. Private education
86(P)	9.4. Public health services
87-88(P)	9.5. Public social services
86-88(P)	9.6. Private health and social services
90-96	10. Other services

Note: The "P" indicates that the code is related to more than one sector in the BBVA Foundation-Ivie classification.
Source: BBVA Foundation-Ivie

10.Computing capital stocks: practical implementation

BBVA Foundation-Ivie database's assumptions:

- Geometric depreciation function (see Table 3)

  $$D=d/2,$$

  where the parameter d is the "declining balance rate" which, intuitively, reflects the degree of convexity of the asset age-price profile. For a given service life, higher values for this parameter result in faster rates of economic depreciation.

- Exogenous rate of return: 4% for market sectors, 3% for non-market sectors

- Average service lives: see Table 3

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10.Computing capital stocks: practical implementation

Table 3. Average service lives (years) and geometric depreciation rates by assets

	Average service years	Depreciation rates
1. Tangible assets		
1.1. Dwellings	60	0,0333
1.2. Non-residential structures		
1.2.1. Road infrastructures	50	0,0400
1.2.2. Public water infrastructures	40	0,0500
1.2.3. Railway infrastructures	40	0,0500
1.2.4. Airport infrastructures	40	0,0500
1.2.5. Port infrastructures	50	0,0400
1.2.6. Urban infrastructures (local public authorities)	40	0,0500
1.2.7. Other structures n.e.c.	50	0,0400
1.3. Transport equipment		
1.3.1. Motor vehicles	8	0,2500
1.3.2. Other transport material	20	0,1000
1.4. Other machinery and equipment		
1.4.1. Metallic products	16	0,1250
1.4.2. Machinery and mechanical equipment	16	0,1250
1.4.3. Office equipment and hardware	7	0,2857
1.4.4. Other machinery and equipment		
1.4.4.1. Communications	15	0,1333
1.4.4.2. Other machinery and equipment n.e.c.	12	0,1667
1.5. Biological cultivated assets	14	0,1429
2. Intellectual property products		
2.1. Software	7	0,2857
2.2. Other intangible assets		
2.2.1. R&D	13	0,1500
2.2.2. Rest of intangible assets	7	0,2857

Source: BBVA Foundation-Ivie

10.Computing capital stocks: practical implementation

First step: GFCF data by asset and industry (current, constant prices and deflators)

Main source: National Accounts (NA data, GFCF matrices, SUT, SIOT, etc.)

- Adjusted when necessary:
  - To estimate some non-available assets details (i.e. IT assets and public infrastructures)
  - Linkages between ESA 1995 - ESA 2010
  - Correspondences NACE Rev. 1 - NACE Rev. 2

Complementary sources: Encuesta Anual de Servicios; Encuesta de Financiación y Gastos de la Enseñanza Privada; Establecimientos Sanitarios con Régimen de Internado; Encuesta Industrial; AENA, ANIEL, SEDISI, Banco de España, CMT, Dirección General de Seguros, Fundación Argentaria, IEF, IGAE, Ministerio de Agricultura, Pesca y Alimentación, Ministerio de Administraciones Públicas, Ministerio de Ciencia y Tecnología, Ministerio de Industria y Energía, Ministerio de Fomento, Ministerio de Sanidad y Consumo, OCDE, RENFE, Telefónica, etc.

10.Computing capital stocks: practical implementation

First step: Estimation of GFCF data by asset and industry (current, constant prices and deflators)

Methods applied for the estimation (taking as benchmark NA data):

- Interpolation and/or extrapolation methods are applied if the missing data is within an interval in which the extreme values are known; or, alternatively, when the unknown data is outside the known interval.
- Regression analysis in its different versions (linear, exponential…) are used when the lack of information is greater.
- Use of information from annual reports, yearbooks or reports from large companies. Any publication considered to be of interest is used to complete and improve the estimations and also to check the reliability of the figures in the final database.
- Use of data on GFCF (values and prices) from similar industries or countries (i.e. USA software prices).
- Bi-proportional adjustment procedures are used, such as the RAS method (i.e. region-asset-industry adjustment).

10.Computing capital stocks: practical implementation

Second step: Estimation of initial capital stock by asset and industry

- For Dwellings and Other non-residential structures, data from the publication “Riqueza Nacional de España” (Universidad Comercial de Deusto, 1968) is taken as reference for the estimation of initial capital.

- Initial stocks for the remaining assets, except R&D, are calculated applying the PIM to GFCF data, as the available information is enough to cover all the years required for the estimation.

- As R&D GFCF data is only available from 1985 onwards, initial stock is calculated using the approach proposed by OECD (2009) (Kohli 1982) and the initial stock at the beginning of the benchmark year t0 can approximately be written as $W_{t0}=I_{t0}/(\delta+\theta)$ where θ is the long-run growth rate of GFCF.

10.Computing capital stocks: practical implementation

Third step: Application of OECD methodology to calculate capital stocks measures

- Being IN_{ijt} the nominal investment in asset i of industry j in the year t and P_{it} the price of asset i in year t, the real investment can be defined as

$$IR_{ijt} = IN_{ijt} / P_{it}$$

- Net capital stock at constant prices of asset i accumulated by industry j in the year t is defined as:

$$KW_{ijt} = KW_{ijt-1} + IR_{ijt} - d_i \ (IR_{ijt} / 2 + KW_{ijt-1})$$

  being d the depreciation rate, which is supposed to be different by asset, but equal by industry.

  The depreciation rate can be defined as $d_i = 2 / T_i$, where T_i is the asset's average service life.

- Net capital stock at current prices (KW^C) is obtained as:

$$KW^C_{ijt} = KW_{ijt-1} \ P_{it}$$

10.Computing capital stocks: practical implementation

Third step: Application of OECD methodology to calculate capital stocks measures

- Fixed capital consumption (FCC) is calculated as follows:

$$FCC_{ijt} = d_i \ (IR_{ijt} / 2 + KW_{ijt-1})$$

and at current prices: $FCC^C_{ijt} = FCC_{ijt} \ P_{it}$

- Productive capital stock at constant prices of asset i accumulated by industry j in the year t is defined as:

$$KP_{ijt} = IR_{ijt} / 2 + KW_{ijt-1}$$

- The value of capital services of asset i, in the industry j in the year t (VCS) is obtained as:

$$VCS_{ijt} = \mu_{it} \ Kp_{ijt}$$

where μ_{it} is the user cost of asset i in the year t.

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10.Computing capital stocks: practical implementation

Third step: Application of OECD methodology to calculate capital stocks measures

- In general terms, and if we do not take into account the influence of fiscal variables, the user cost is given by:

$$\mu_{it} = P^b_{it} (i_t + d_i - q_{it})$$

where i_t is the nominal interest rate, q_{it} is the asset's price growth and P^b_{it} is the asset i's price at the beginning of the period, that is,

$$P^b_{it} = (P_{it} + P_{it-1}) / 2$$

- In the case of the BBVA Foundation-Ivie database and following the OECD (2009) recommendations, the asset's revaluation (expected price change) is not taken into account. Therefore, the user cost has only two terms: real interest rate and depreciation:

$$\mu_{it} = P^b_{it} (r_t + d_i)$$

11.Computing capital stocks: OECD manual example

OECD (2009) Annex B

Implementation of capital estimates using an artificial dataset

The purpose of this exercise is to document the sequence of implementation, to show how to aggregate across sectors and industries and to examine the effects of using an ex-ante versus an ex-post approach when measuring user costs.

The documented dataset with all the calculations is available in spreadsheet **oecd_example.xlsx**. It has the following features:

- Distinction between institutional sectors and industries: manufacturing industry is exclusively composed of market producers, whereas for services, a distinction has been made between market producers and non-market producers.
- Three types of assets: machinery, software and land.
- Geometric model
- Two methods in the computation of user costs: ex-ante and ex-post.

11.Computing capital stocks: OECD manual example

OECD (2009) Annex B

Main steps in the calculation procedure:

1. Apply price indices of GFCF to machinery and software investment to obtain GFCF series in chained dollars of the reference year 2000.
2. Estimate an initial stock for each asset in year 1979 as initial stock = GFCF in 1979/(long-run growth of constant price GFCF + rate of depreciation).
3. Given the net stock at the beginning of the first period, W^{1979B}, end-period net stocks for all consecutive periods are set up by applying the stock-flow relationship $W^{tE} = W^{tB} + It - \delta(It/2+W^{tB})$. All stocks are valued at average prices (chained dollars) of the year 2000.
4. On the basis of net stock and rates of depreciation, the value of depreciation at average prices of the year 2000 is computed by applying the rate of depreciation to the net stock at the beginning of the period plus half the current period's investment: $D^t/P0^t = \delta[It/2 + W^{tB}]$. Subsequently, depreciation is re-valued to current prices by multiplying through by the price index for capital goods, $P0^t$.

11.Computing capital stocks: OECD manual example

OECD (2009) Annex B

Main steps in the calculation procedure:

5. Compute the year-average net stock for every period as well as the productive stock K^t which equals the wealth stock plus investment in the latest period: $K^t = I^t/2 + W^{tB}$.

6. Given time series of gross operating surplus G^t along with depreciation re-valued to current prices, D^t, net operating surplus N^t is measured as $G^t - D^t$.
   - For non-market producers, the net operating surplus is zero in the first instance. However, if costs of capital are imputed in the way shown in the example, the net operating surplus will be non-zero.

7. Indices of real asset prices are established by deflating nominal asset price indices by the consumer price index.

11.Computing capital stocks: OECD manual example

OECD (2009) Annex B

Main steps in the calculation procedure:

8. For every type of asset, industry and sector, the value of capital services is computed in three variants:

    1) Ex post, endogenous real rate of return, ex-post real asset price changes (marked in grey in the spreadsheet);

    2) Ex post, endogenous real rate of return, simplified method (marked in orange in the spreadsheet);

    3) Ex-ante, exogenous real rate of return, ex-ante (average) real asset price changes (marked in yellow in the spreadsheet)

11.Computing capital stocks: OECD manual example

OECD (2009) Annex B

Main steps in the calculation procedure:

9. A chain Laspeyres volume index and a Paasche-type index of capital services are computed. The geometric average of both indices yields a Fisher index of capital services for each industry.

10. Aggregation towards a measure of capital services for market producers and for nonmarket producers: The volume index for capital services for the market sector is a weighted average of the volume index for market producers in the manufacturing and in the service industries. The capital services shares of each producer serve as weights in the aggregation. The same procedure is applied to non-market producers.

11. Aggregation across market and non-market producers to yield a measure for the total economy.

Measuring capital

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