The measurement of land on a country's balance sheet

Jennifer Ribarsky[1]

Summary: This paper summarises the work carried out by the joint Eurostat-OECD Task Force on Land and other Non-financial assets which is developing a compilation guide on land estimation. The compilation guide will be finalised by the end of 2014. The following countries and international organizations participated in the Task Force: Austria, Belgium, Canada, Czech Republic, Denmark, Finland, Germany, Italy, Korea, Mexico, Netherlands, Norway, Slovenia, United Kingdom, United States, ECB, Eurostat, and OECD. The Task Force was chaired jointly by Eurostat and OECD and the secretariat was provided by Eurostat.

1 Introduction

The joint Eurostat-OECD Task Force on Land and other Non-financial Assets is in the process of finalising a compilation guide on land estimation. The impetus for the work of the Task Force is in response to the G20 Data Gaps Initiative (DGI) recommendation 15 that recommends "a strategy to promote the compilation and dissemination of the balance sheet approach (BSA), flow of funds, and sectoral data more generally, starting with the G-20 economies."

The concept of compiling national balance sheets for countries is not new, but there is increasing demand, also in light of the causes of the economic and financial crisis, for complete balance sheets of countries. Yet data, especially data on non-financial assets, total and by institutional sector, are often not available. Because of this, initially under the umbrella of the G20 DGI, a template was developed for institutional sector accounts, among which minimum and encouraged stocks of non-financial assets by asset type and by sector are requested.[2] In response to interest on balance sheet data, the revised transmission programme for the European System of Integrated Economic Accounts (ESA 2010) requires additional mandatory items for non-financial assets. Most importantly the total value of land in the combined sector of households and non-profit institutions serving households (S.14 + S.15) are required for EU Member States to be transmitted to the European

[1] This paper presents the work of the members of the Eurostat-OECD Task Force on Land and Other Non-financial assets. Contributions from the task force members to this paper are gratefully acknowledged. The author is accountable for any mistakes in this paper due to the summarisation of the content of the guide.

[2] IMF (2012-7), Templates for Minimum and Encouraged Set of Internationally Comparable Sectoral Accounts and Balance Sheets available at http://www.imf.org/external/np/sta/templates/sectacct/index.htm

Commission (Eurostat) by 2017. In addition, the OECD collects information related to balance sheet items and is the primary data collector for non-European member countries of the OECD.

The primary purpose of the Eurostat-OECD compilation guide[3] (in short, the Guide) is to provide guidance for compiling estimates of land on the balance sheet.[4] Indeed, land is an important component of a nation's wealth and in particular the wealth of households (table 1). Historically, there has been considerable discussion both in official statistics and by academics on the best approach to obtain reliable estimates of land; however, this has not led to agreement across statistical offices on a common or best practice approach. One of the major difficulties in valuing land is that the valuation often is comingled with the valuation of dwellings and other buildings and structures that exist on the land. Therefore, practical guidance on a wide range of issues (e.g. classification, data sources, and estimation methods) is needed.

Table 1: Shares of financial and non-financial wealth in gross wealth of households and NPISH

	Financial wealth	Non-financial wealth		
	Total	*Total*	*of which Housing wealth*	*of which value of land*
Italy	40%	60%	57%	27%
Germany	43%	57%	52%	16%
The Netherlands	54%	46%	43%	21%
United States	69%	31%	25%	-
France	35%	65%	63%	33%

(Sources: Banca d'Italia, DESTATIS, Deutsche Bundesbank, ONS, CBS, FED; ECB calculations. Data for Italy, The Netherlands and France refer to 2011. Data for Germany and United States refer to 2012.)

The rest of this paper presents a brief overview of the Guide and is organized as follows. Section 2 presents the land classification framework. Section 3 discusses the data sources used to estimate land. Section 4 summarises the various estimation methods. Section 5 briefly discusses the importance of service lives and depreciation for indirect estimates. Section 6 closes with the future work and a possible extension of the mandate of the Task Force.

[3] The Eurostat-OECD compilation guide on land estimation includes additional information not addressed in this paper. For example numerical examples, country case studies, sectorisation, and special estimation issues such as estimates for agricultural and forestry land are discussed,.

[4] While the role of land as an asset that provides a flow of capital services and the role of land as an environmental asset are important and interesting topics they are not discussed in Eurostat-OECD compilation guide.

2 Classification

A coherent and consistent classification that covers all types of land within a country is needed to adequately estimate the total value of land. However, that is not to say that the entire geographic surface area of a country is included within the asset boundary of the SNA. (2008 SNA § 12.21) Only land that fits the definition of an asset should be included within the asset boundary, that is, all land on which effective ownership rights can be assigned to an institutional unit(s) and from which economic benefits are derived by their owner(s) by holding or using them over a period of time. (2008 SNA § 1.46)

A well-defined land classification is needed because the use of a particular tract of land can correspond to major differences in price. For instance, the price (development) of land underlying dwellings may differ substantially from agricultural land. Therefore, it is not only important to know the size of the land area (i.e. number of squared meters), the location, but also the use of the land and price it accordingly. Sub-classifications are further necessary to appropriately capture changes in the value of land due to changes in classification (i.e. changes in use) as volume changes instead of price changes.[5]

Thus the proposed classification (table 2) in the Guide is based on land use statistics and is chosen as the lowest common denominator. The intention is to increase the possibilities for cross-country comparisons as well as to provide guidance on the minimal level of detail on which land estimates should be compiled.

Table 2: Proposed classification

Classification of land
1.Land underlying buildings and structures (AN.2111)
1.1 Land underlying dwellings (AN.21111)
1.2 Land underlying other buildings and structures (AN.21112)
2.Land under cultivation (AN.2112)
2.1 Agricultural land (AN.21121)

5 A basic principal of the 2008 SNA is that different land use values are reflected as differences in quality. Therefore changes in economic use of land that lead to a change in classification should be recorded as a change in volume and any excess in the value due to the change in classification should be recorded as an economic appearance of an asset. See 2008 SNA paragraph 12.23.

2.2 Forestry land (AN.21122)
2.3 Surface water used for aquaculture (AN.21123)
3. Recreational land and associated surface water (AN.2113)
4. Other land and associated surface water (AN.2119)

3 Data sources

One of the major constraints in estimating land is the lack of data from a single source. It appears that most countries that value land do so by combining multiple sources of information. The source of the information used differs by country and has an impact on (as well as being impacted by) the type of method the country uses to estimate the value of land (i.e., direct estimate of land or indirect estimate of land). Results from an OECD questionnaire on methods and data sources used to measure land (OECD, 2011) show that the estimation of the stock of land can be classified into the following three cases:

- Non-existence of data: neither quantities nor prices are available
- Partial existence of data: either quantities or the total value of buildings and structures including land are available
- Existence of data: value estimates for both structures and land shown separately; and/or, both quantity and price information are available

Types of data available can be classified under two broad headings: administrative sources (cadastre maintained by a land registry office, tax authorities, or land information centre) and collection sources (population and housing census, business survey, or other types of survey data). Another common source for data on land is using other governmental organizations information on land.

3.1 Administrative source

Administrative data (cadastre, land registry, tax data) usually provide detailed quantity data, including type of land (land under dwellings, agricultural, etc.), location, and owner.

A cadastre is a comprehensive register of the property within a country. It is commonly maintained to record the physical status and legal ownership of land and is often used (or at least initially created) for taxation purposes. A cadastre could also be used for land management or planning purposes. It includes very detailed maps showing the location of the parcels of land and dimensions of land (e.g., square meters). It also typically includes the use of the land, ownership, and value of the individual parcels of land. Many times the ownership of the land is maintained through the use of a land title registry that records the change in ownership and may be combined with cadastral information (referred to by some countries as a "cadastral system"). In addition, some countries may reassess land values periodically especially if the value is used as a basis for taxation. However, it should be noted that cadastre values may not reflect current market prices. As always with administrative data, adjustments may be needed to align administrative sources with national accounting concepts. Many countries that derive estimates of the value of the stock of land on the balance sheet do so by using cadastral data either fully (quantity and prices) or partly (quantity only).

Additional types of administrative data that may be useful in combination with cadastral data, or if cadastral data are not available, are (land) registers. Typically a register will include a list of addresses of buildings and dwellings (so that a very precise location can be determined), type of use and sector, size of land area, and often transaction prices. The register may be maintained by the national statistical office but it may also be maintained by another government department.

Tax data can be another source of administrative information because many countries levy a property tax. In many cases, the tax bill is proportional to the assessed value of property and the latter is usually based on valuation undertaken by professional chartered surveyors either under contract or directly employed by the taxation authority.[6] As such, tax data provides values (the combined total value of structures and land), or the value of land itself. When valuing the property, tax authorities often take into consideration quality characteristics of the property, such as location and size of plot. In addition, if different levels of taxation are applied to different types of land then land use may be recorded. National compilers of land estimates, usually national statistical offices, may have difficulty with verifying the valuations of the tax authority. In addition, the updating of the valuations may be infrequent due to the field costs involved.

Because of these drawbacks, tax data may be of limited use. That being said, this source of official valuation information has been exploited by national compilers. Sometimes countries used information from tax authorities to derive an average price per square meter that is applied to quantity data from other sources to estimate a total value of structures and land. Alternatively, countries have used the combined real estate value (including land value) from tax data directly as

[6] See Eurostat Handbook on Residential Property Prices Indices (2013) for information on data sources.

the value on the national accounts balance sheet. Evaluation of the tax data must be made by each country to assess whether the tax data conform to national accounting definitions and quality standards. If a country's tax valuation is based on up to date transactions that value the asset using a net present value concept then the valuation may be appropriate to use directly in the national accounts.

3.2 Collection sources

Various national land surveys can be used to provide information for a national statistical office (NSO). Typically these types of surveys capture various characteristics of land such as how the land is used and the size. This data is often collected for land management and planning purposes. For example, land use statistics often provide information on built-up areas that cover dwellings, businesses, recreation, and roads and data on undeveloped areas like forest and other natural resources. Many times this type of survey is conducted by another government department or agency and not the national statistical office that compiles the national accounts.

A survey or census of agriculture is a common source of information for various types of land used for agricultural purposes, such as land under cultivation. Many times this information is collected by another government office with a particular focus on agriculture, such as a department or ministry of agriculture.

Population censuses or housing surveys are common sources for counts of the number of dwellings in a country. In general, this information is combined with price information (usually from another source) to derive a total value of real estate that is the combined value of dwelling and land. Since census information is usually not available every year, construction statistics (such as dwelling completions and demolitions) can be used to interpolate between census years and to extrapolate from the latest census year. This allows NSO's to maintain a more up to date stock.

Another potential source of information that does not appear to be commonly used among countries is statistical surveys requesting the value of land. Business accounting data record the value of the land and the value of buildings and structures separately but such estimates would most likely be valued at historical cost on their balance sheets instead of current market values. In addition, only corporations keep a complete set of accounts so data would most likely not be available for unincorporated businesses. Moreover, if data are collected using a sample survey rather than a census then account should be taken of the fact that many businesses rent land rather than own it with ownership concentrated in certain industries. As a result, the optimal survey design for land may be different than a design of a general economic survey.

Another alternative is asking respondents on construction surveys to provide a value for the land. This approach will mainly capture the value of land that is purchased for new development so it might not be representative of the value of land underlying existing buildings. Also, it might introduce a fairly high level of subjectivity because timing plays an important role in that builders often purchase large areas of vacant or undeveloped land but only develop it with some time lag that could be significant. In such cases, the transaction prices for the land purchase are unlikely to capture its current or fair value. This is of particular concern during periods when residential real estate markets perform strongly, given that most of the appreciation in property values is associated with the land component.

Sometimes the sources of information discussed above are not used directly in deriving a total estimate of the value of land but are instead used to allocate the value of land across sectors. For example, land use statistics can be used in allocating land across sectors while another source is used to derive the total value of land in an entire country.[7]

3.3 Prices

Many countries apply a price times quantity approach to valuing either the total value of the real estate (that is the combined value of the building or structure including the land) or just the value of land (the so called direct method in this Guide). Therefore, a brief discussion of price information is needed because many times the price information does not come from the same source as the quantity information.

In practice, reliable information on land prices is often limited with either no relevant price indices existing or the coverage is not appropriate. Prices are typically based on real estate transactions, survey of existing land values, housing price or construction price indices, and are also affected by the methods used to differentiate between land and buildings. Obtaining different prices for different types of land is also a challenge, with prices needed for residential, non-residential and cultivated land, because each type of land has different characteristics. Approaches vary widely from

[7] For information on estimating data see Ruben van der Helm and Zlatina Balabanova National Data on Housing Wealth and ECB estimates Working Group of Euro Area Accounts 11 March 2013

country to country and the price information used is dependent on the source information available and the method used.

Some of the sources described in the administrative and collection sources sections are also used when constructing price indices. For example, land registries often record the transaction price of the property sold. Sometimes national land use surveys record the purchase price of the land. However, because there may be few purchases of land for a particular use (a thin market) the prices are often not representative for valuing the whole land use category.

Residential property price indices (RPPI) are often used in measuring the aggregate real estate housing wealth in an economy. In addition, the RPPI could be decomposed into two components: a quality adjusted price index for structures (dwelling only) and a price index for the land on which the house is built (briefly discussed in this paper as the hedonic approach). The Eurostat (2013) Handbook on Residential Property Prices Indices dedicates a chapter on how to do this.

4 Estimation methods

There are various methods (broadly labelled as direct or indirect) used by countries to estimate the value of land depending on what sources of information are available in a given country. The estimation of land using a direct method may be viewed as a physical inventory method where the area of each parcel of land is multiplied by an appropriate price. Because detailed price and quantity information may not be available— especially when the land has a structure on it— many countries use an indirect method to value the land underlying a structure. An indirect estimation method, as the name implies, either obtains the value of the land indirectly or obtains the price of the land indirectly. There are three different indirect estimation approaches: the residual approach, the hedonic approach, and the land-to-structure ratio approach. The following sections summarise the compilation methods discussed in the Guide.

4.1 Direct method

In the direct method, the value of land is estimated by multiplying the area of each parcel of land by its corresponding price. By summing up the value of each parcel of land that is within the asset boundary across a nation, the total value of land in a given country can be obtained. Although the direct approach seems very simple and easy in computational methodology, it demands huge data requirements. For the direct approach to be applied, ideally, the price and area information of every parcel of land should be available, which will not be the case for most countries. Data on land area is available quite extensively in most countries. How to obtain the current market-price information for each parcel of land by different land types will be an inevitable prerequisite for this approach. Since the value of land is highly dependent on several factors e.g. location, land use, and the presence of nearby facilities, such information should be incorporated in the land price data. This can be illustrated by the fact that agricultural land is generally lower priced than land underlying dwellings. Also, the presence of a nearby road will likely influence the value of the surrounding land. As a consequence, it is important that the direct method employs land prices that are precisely specified and reflect such conditions.

Generally, the direct method can be described by

$$(1) \quad LV_t = \sum_{i=1}^{n} p_{it} \, a_{it}$$

where LV_t is the total value of land in the observed year t. p_{it} reflects the price for land type i in the observed year t and a_{it} the corresponding area measure. Summing up all land types yields the total value of land for that particular year. Since the value of land is highly dependent on the location and land use, it is recommended that this calculation is done at the lower regional level by each land type. In the actual implementation, the direct approach can be described by the following procedure with which the countries can conduct adjustments in a few steps, if needed.

a) Estimation of land area by land types in a single year or over a couple of years
b) Estimation of changes in the land types annually to produce time series
c) Estimation of representative unit prices for each relevant land type for a single year or a couple of years
d) Modelling the price changes for each land type over time (specifying price indices) in order to produce unit price time series
e) Bringing together the area and price information to produce time series on land value (balance sheet information)
f) Specifying volume changes and price changes per year for the Other changes in the volume of assets account and the Revaluation account

If annual data are available for the whole period to be covered then it might be needless to conduct steps b) and d). In this case, the procedure can be conducted using only steps a) c) e) and f).

Considering that the area of land can be obtained from administrative sources and the area of land, at least in total, in a country does not change much it would seem that the most difficult problem with this method is obtaining an adequate price. The price of the land should reflect the actual market transaction price or its equivalents excluding the costs of ownership transfer. (SNA 2008 §13.44) If the actual market transaction price of the land is not available other sources may be used, such as: publicly-appraised market-price equivalent, property tax information converted to a market price, market price of a nearby parcel of land of similar use, generalized standard land values, an artificial price based on a nearby parcel of land that is adjusted by a certain conversion factor, etc.

As discussed in the classification section of this paper, the price should take into account the location and the uses of the land for which it is suitable or sanctioned. Expert knowledge has shown that many issues may arise regarding adequate price information. For instance, price data can be quite old or even missing for some land types or years, since less frequent transactions in that type of land may lead to data gaps. Furthermore, price information can be provided by different sources and it is necessary to match these different data sources to obtain reliable price data. As previously stated, regional aspects have to be taken into account when estimating prices (e.g. by using stratification) since the same land use type of different regions might have significantly different price values.

It can be concluded that collecting reliable price information for the estimation of land can be very difficult especially for land underlying dwellings and buildings. If separate information on the price of land is not available then one could consider deriving the price indirectly as discussed in the hedonic approach under the indirect method section. Depending on the sources and institutional circumstances in a given country, issues that arise may differ significantly amongst countries. How to handle these issues depends on each country's expertise, abilities, and data sources regarding these types of information. Nevertheless the representativeness of the price used for calculations should be guaranteed. In addition, because the availability of detailed unit price data by land type may only be available in specific years indicators may be needed to produce unit price time series. Countries should ensure that whatever data are used to model the price change that the method applied meets the claim of representativeness concerning price information.

4.2 Indirect method

Indirect estimates of land values are often dependent on data sources where land is not separated from the structure. The value of land may be derived from the combined value of land and structures as a residual (the residual approach) or some multiple of the structure (the land-to-structure ratio approach). The price of land could also be calculated indirectly by using the hedonic regression modelling of the real estate value (the hedonic approach) that produces a separate price for the land component. Because the indirect method often relies on the total real estate value as the starting point of the calculations this subsection starts with how the total real estate value, that is the combined value of land and structures (CV), can be estimated before discussing each indirect approach.

Often the only available data in a country is the total value of the combined property on the real estate market. The market value of a given property is most influenced by its location and its use. This information combined with the characteristics of the building such as the size, age, maintenance including major repairs and renovations helps determine the market value.

The Guide discusses two methods— appraisals and ''quantity times price''— used by countries to obtain estimates of the total real estate value of the property. In general, depending on available data sources, these methods can be applied in estimating the real estate value of residential and non-residential buildings. Ideally the data would be based on transaction-price data. However, the real estate value for non-residential buildings (i.e. commercial buildings, schools, hospitals, etc.) is usually not based on actual transactions because not many non-residential buildings are traded in a given period. Therefore, various methods should be applied such as the net present value of future rentals (i.e. the income approach) or as an alternative, the depreciated value of construction costs.[8]

The appraisal method is a bottom-up approach that builds the total real estate value from individual characteristics of the property specified in great detail (e.g. price, location, size, age, etc.). This information is usually provided from a well-built property registration system in a country. Micro level characteristics of a property are linked together to form a larger regional system of property information until a complete top-level system is formed in order to obtain the appraised total real estate value in a country.

[8] For further information see the Dutch approach in De Haan, 2013; Van den Bergen, 2010

In many countries, official government assessments are available for all properties because such data are needed for real estate taxation. Many countries may have an official property valuation office that provides periodic appraisal of all taxable real estate properties (i.e. tax assessment).

In a typical appraisal, there are three approaches to estimating the CV: (i) the cost approach, where the appraiser relies upon information about input costs for building a replacement of the property; (ii) the income approach, where the appraiser relies on the income from the property being valued and on a capitalization rate; (iii) and the sales comparison approach, where the appraisal relies upon comparable sales (IAAO, 2013).

The “quantity times price” method is an estimation method used mainly for calculating the combined value of residential real estate and is rarely used for estimation of the real estate value of non-residential buildings. It is a top-down approach where e.g. the number of dwellings in a country is broken down into regions. Each region is again concentrated in yet greater detail according to prices on the real estate market.

The main idea that underlies the “quantity times price” approach is availability of plausible market values of the combined value (dwellings including land) which can be observed on the real estate market. The assumption is that properties sold are representative of properties not sold. Price information from properties sold is then used to infer (or assume) an average value of all the properties not sold during the period. Using actual transactions data on sales of properties is one of the better ways to estimate the price component.

The sales data should provide broad geographical coverage, encompassing both urban and rural areas. This is especially important in countries where regional differences have significant impact on the real estate prices.

Data sources supporting the “price” part of this approach can be sales registers or similar administrative sources where information on the transfer of ownership of dwellings and land is recorded. Whenever a property is sold, information about the timing of the sale (contracts date), the property sold (e.g. information about the location and quality characteristics of the building) and the price paid is available. Similar databases have been developed by several countries for the compilation of a Residential Property Price Index (RPPI), which measures house price movements usually on a quarterly basis.[9]

Data sources supporting the "quantity" part of this approach— the number of dwellings stock— can be derived from a combination of census data as a starting point and additional information from construction statistics on the number of completions and conversions that occur between two censuses. The estimated stock between two censuses should be compared with other data sources such as cadastral data.

Stratifying the stock will help reduce the compositional effects—that is, the effect of applying collective characteristics of properties to individual properties. The finer the stratification the more representative and less compositionally affected the data become. For stratification purposes, it is useful to classify dwellings into different types, e.g. separate houses, attached dwellings (e.g. semidetached, row and terrace houses and flats, units and apartments, etc.). This information can be derived from census data as well. Nevertheless, there is no single convention for classification; it can be different from country to country.

As noted by Reuter Town (2013) additional variables (e.g. age, location of the building, number of rooms, etc.) for further stratification of the stock could be useful for improving representativeness but new variables must be balanced against the requirement for having sufficient sales data in each stratum to derive mean values.

4.2.1 Indirect method: residual approach

For many countries the real estate value of the property is available and can be used in conjunction with capital stock estimates (i.e. the depreciated structure cost) to derive the value of the land residually. Therefore, the residual approach is used by many countries to estimate the value of land underlying buildings because of the accessibility of the data.

Generally, the residual approach can be described as follows.

---

[9] Reuter Town, A. (ABS Australia) (2013), "Valuing dwellings and land as an input into household wealth and household balance", paper presented at OECD Working Party on National Accounts, 1-2 October 2013, Paris.

The value of underlying land (LV^i_t) for each category of constructions *i* (e.g. dwellings, non-residential buildings, other structures) is obtained as a residual, by subtracting the estimate of constructions (C^i_t) from the real estate value that is the combined value of constructions and land (CV^i_t), at time *t*.

(2) $$LV^i_t = CV^i_t - C^i_t$$

The total value of land underlying buildings and structures at time *t* (LV_t) is obtained summing all the estimates of LV^i_t

(3) $$LV_t = \sum_{i=1}^{n} LV^i_t$$

To apply the residual approach, the following information is needed:

a) The real estate value (i.e. the value of constructions including land at current market prices), by type of construction (the so called “combined value” CV^i_t)

b) The net capital stock of constructions (this value excludes the value of the land) at current prices, by type of construction (C^i_t);

c) Indicators to breakdown estimates by institutional sector, if the detail is required and the information a) and b) is not available by institutional sector

The value C^i_t is generally estimated by applying the Perpetual Inventory Method (PIM). The PIM estimate excludes the value of underlying land by definition because land is a tangible non-produced asset; as a consequence, its acquisition is not included in gross fixed capital formation (SNA 2008 § 13.44).

To correctly estimate the value of underlying land through the residual method, it is necessary to verify what the values CV^i_t and C^i_t include, in order to obtain a value from their difference; in particular, costs of preparing the land to be built and costs of ownership transfer are critical components to investigate.

According to SNA 2008 (10.70, 10.74, 10.76) and ESA2010 (Annex 7.1), PIM estimate C^i_t is the value of constructions, including all the costs of site clearance and preparation; also CV^i_t generally incorporates such costs, as on the real estate market a single contract refers to the value of constructions, including land in its natural state and costs of preparing the land to be built. From a theoretical point of view, the costs of site clearance and preparation, being included in both elements, should not produce any distortion: of course a statistical discrepancy between the two valuations must be taken into account.

CV^i_t often does not include costs of ownership transfer, depending on the available data sources and on the methodology chosen to calculate it: for example, if a “quantity times price approach” is applied to estimate CV^i_t and the prices observed on the real estate market are used (ISTAT, 2012, 2011, 2008), they usually do not include professional charges paid to lawyers, commissions paid to estate agents and tax paid on the transfer of the ownership of the asset. [10] On the contrary, the PIM estimate C_{it} has to incorporate this value: the SNA 2008 and the ESA 2010 recommend to treat it as gross fixed capital formation and to include it in the balance sheet jointly with the value of the relevant asset.

As a consequence, to correctly estimate the value of underlying land, costs of ownership transfer should be excluded from the value C^i_t or their value (for example, estimated by the PIM) has to be added to the CV^i_t. If not, the value of the underlying land would be systematically underestimated.

4.2.2 Indirect method: hedonic approach

The hedonic approach utilises a hedonic regression model to separate the price of the land from the price of the building. Currently this approach is not frequently used by countries most likely because it is very data intensive and requires quite technical skills.

The hedonic regression model provides an estimate of the representative price for one square meter of land for a given period of time. A useful secondary outcome of the calculation is a representative price for one square meter of building located on the land. The total value of land is derived by multiplying the representative price per square meter of land with the total number of square meters of land for the area to be measured.

The minimum data requirements are the real estate price (that is the price for the combined value of land and building), the size of the building in square meters, and the size of the parcel of land in square meters. The specification of the regression model is not unique, i.e. the number of independent variables could vary depending on available source data and which setup gives the best

[10] Also the value of buildings including land registered for tax purposes may exclude the cost of ownership transfer (Statistics Netherlands, 2011, 2010).

model. Additional characteristics may be added to the model, such as information on the year of construction.

The description of the basic hedonic regression model provided in the Guide is based on theory from Eurostat's Residential Property Price Index Handbook (RPPI 2013) and an article by Diewert, de Haan and Hendricks (2010). The RPPI presents a hedonic regression model that decomposes a general residential property price index into two separate indices, one for the price development for land and the other for the price development for structures.

4.2.3 Indirect method: land-to-structure ratio approach

The land-to-structure ratio approach represents another option to indirectly derive the value of land. This method is similar to the residual approach in its reliance on the depreciated value of the structure— usually estimated using the PIM— built on a given property. Therefore, this approach is suited for the estimation of land underlying dwellings and other buildings and structures.

The land-to-structure ratio approach is recommended when available data sources permit the derivation of a higher quality estimate of land using a representative land-to-structure ratio compared to the value of land derived residually using an estimate for the total property value.

At its most basic, the land-to-structure ratio method uses a simple identity valid at any level of aggregation:

Land-to-structure ratio = Value of land / Value of structures

Using estimates for the value of structures and the land-to-structure ratio, the value of land can be easily derived by reversing the previous identity:

*Value of land = Value of structures * Land-to-structure ratio*

The accuracy of the land value estimates obtained through this approach increases with the level of detail at which these calculations are done, as the matching between structures and land-to-structure ratios will more fully take into account property characteristics in terms of type, location, and geography.

Estimation of land-to-structure ratio

The derivation of the land-to-structure ratio relies on the availability of data on the value of structures and land components for a clearly defined set of properties, in other words, a sample of total stock of properties within an economy. An essential aspect of this step in the land-to-structure ratio methodology is the degree of representativeness of the land-to-structure ratio sample relative to the total set of properties for which it will be used.

The accuracy of the method increases with a closer match between the type of structures and the land-to-structure ratio available. In most cases, PIM estimates are available for dwellings by type of dwelling as well as for non-residential structures. In countries where regional differences are significant, the geographical detail is also very important; therefore it should be included in the derivation of the value of structures.

The next step in the methodology is the matching of structures with the corresponding land-to-structure ratio, at the lowest level of detail afforded by data availability, deriving thus a value for land for that particular type of property with a specific geographical profile. This approach can be easily applied at a high level of aggregation, however at the expense of some loss in estimate accuracy. This impact will be more significant the more heterogeneous the set of developed properties in an economy.

Data requirements for the estimation of land-to-structure ratios

The estimation of a land-to-structure ratio requires complete information on two of the three variables involved – the total value of property, the value of the structure, the value of land – through research or preferably, regular observations for a representative sample. This would allow the calculation of the value of structures and the corresponding value of underlying land and thus the desired ratio.

The quality and degree of representativeness of the sample are essential aspects to consider in deciding to use the land-to-structure ratio method. As a general observation, such samples are less of a challenge for residential properties, as many countries already have in place survey frameworks to capture current residential construction, an economic activity very relevant to a number of high-profile statistical programs (as well as policy making). In addition, any information on the total value of residential properties entering the real estate market is likely to be close to fair values, based on the assumption that residential real estate price dynamics would be implicitly incorporated in transaction prices.

For non-residential properties, the estimation of land-to-structure ratios is likely to pose more challenges. For the most part, markets for such properties are very illiquid if observable at all. Therefore, total property values are as subjective as the associated land values. Property value assessments, typically done by specialized assessors may provide a reasonable fair value estimate for one of the two variables – property or land value.

Maintaining a survey frame that would allow a representative coverage for these types of properties is inherently difficult. This is a particularly valid concern for non-residential buildings, such offices and plants. For certain components of engineering structures, such as bridges and roads, information that could be used to derive land-to-structure ratios can potentially be available in public accounts, as most of these properties would fall under government or public ownership.

For both residential and non-residential properties, property tax assessments represent another potential data source, at the extent that the breakdown between the value of the structure and the value of the land is required and is reported reliably. One major advantage of property tax assessments is the full (or near full) coverage of properties. However, differences in assessment approaches across jurisdictions, a reality for most countries, adds an additional layer of complexity to ensure full consistency.

Finally, irregular research into the valuation of real estate that could provide insight on average or aggregate land-to-structure ratios can constitute an alternative method to valuing land, in the absence of more accurate data sources. In such cases, given that the ratios would not be available on a regular basis, price information through real estate indexes as well as indicators of real estate activity may be used as supplementary inputs into the derivation of land-to-structure ratios.

5 Importance of service lives and depreciation for indirect estimates

The previous sections discussed the residual approach and the land-to-structure ratio approach for producing separate estimates of national stocks of structures and underlying land. These indirect methods rely on estimates of the net stock of structures usually obtained through a perpetual inventory method (PIM). In a PIM, gross fixed capital formation (GFCF) adds to the stock, and depreciation and retirements of assets subtract from the stock. Although the PIM has many advantages, a disadvantage of the PIM is that precise information on service lives and patterns of depreciation are difficult to obtain. Errors in the assumptions of the PIM, estimates of GFCF, and prices can all lead to errors in estimates of net stocks of structures, which can then lead to errors in the estimates of the value of the underlying land.

Because of the importance of service lives and depreciation for the indirect estimates of land the OECD-Eurostat Task Force conducted a survey of national practices in estimating net stocks of structures. The survey asked national accountants to provide, for a detailed list of structures, the assumptions and methods used for the PIM. The goal was not to select a single "best" approach for the PIM, although we note recommendations from Measuring Capital (OECD, 2009) and ESA2010. The goal of the survey was to promote discussions, facilitate detailed comparisons of PIM methods, and provide concrete options for those seeking to produce improved, internationally comparable estimates of net stocks of structures and underlying land.

This section summarises initial responses based on fifteen countries that responded to the survey. The results show that all of the respondents at least partly rely on the Perpetual Inventory Method (PIM), based on available time series of gross fixed capital formation (GFCF). In fact, most countries rely entirely on PIM using available time series of GFCF. Five out of the 15 respondents use census-based estimates in benchmark years and two countries rely on an imputed time series of GFCF for earlier years. At least one country utilizes a mixed approach where PIM was used for ownership transfer costs and other structures and administrative property records for dwellings and other buildings.

Respondents reported a range of approaches to measure depreciation. Eight out of the 15 respondents reported using a linear type of depreciation (with and without additional retirement distributions); four countries reported using geometric depreciation; and three countries reported using a mixed approach. For those countries that reported the use of linear depreciation, the retirement patterns varied across respondents with no one type of retirement pattern being most commonly used (if a retirement pattern was used at all).

The level of detail provided in the survey varied across responses. Some respondents provided a very detailed break out of assumptions while other countries use a less detailed set of assumptions. Assumptions may vary by asset type, industry, and/or sector. Some countries reported a detailed set of assumptions for estimating net stocks while other countries reported averages or ranges of assumptions over broad categories of assets.

Comparing assumptions for narrow categories of assets can be difficult but the following table and graphs make an attempt to compare the results. For a specific asset, respondents may report similar service lives, but use different depreciation patterns or retirement functions. Some respondents report only geometric depreciation rates, others only service lives making comparisons difficult.

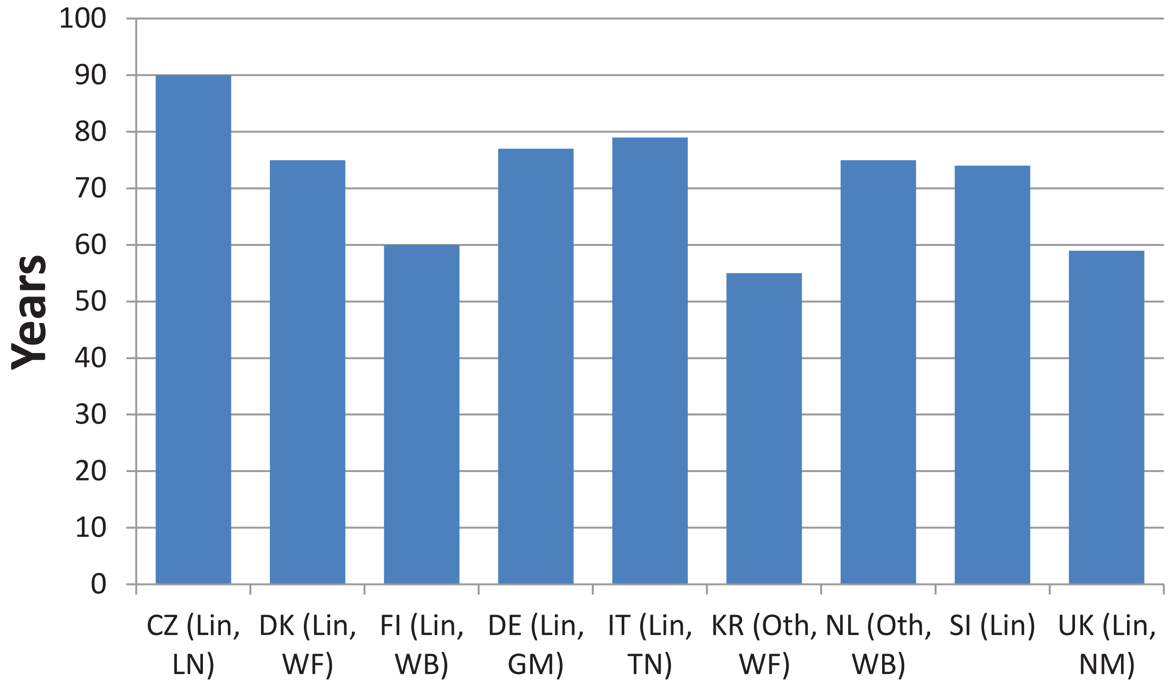
Because of the importance of dwellings in household wealth there is a particular interest in how the net stock of dwellings is estimated. Table 3 summarizes country responses on the assumptions and methods used for dwellings. As seen in table 3, all the countries shown on the table (with the exception of Denmark) estimate the value of the net stock of dwellings using the PIM method. The assumptions on service lives for dwellings varied across countries.

For those countries that use geometric depreciation, only the depreciate rate is shown in table 3. Geometric depreciation patterns have the property that the amount of depreciation (in currency units) is largest earlier in the asset's life and declines over time. Because the shape of geometric depreciation plausibly combines both an age-price profile and the retirement distribution for a cohort of assets, it is not necessary to specify a separate retirement function. Over time, the remaining stock grows smaller but does not disappear unless forced to do so.

Graph 1 (as well as table 3) shows that countries reported service lives ranging from 55-60 years (Korea, United Kingdom, and Finland) up to 90 years (Czech Republic), the median being 75 years. One wonders whether this is a statistical artefact, or a reflection of different characteristics of the relevant dwellings. However, since it is not easy to compare and contrast the different assumptions and because the relationship between service lives and depreciation are often unclear caution is needed in interpreting table 3 and graph 1.

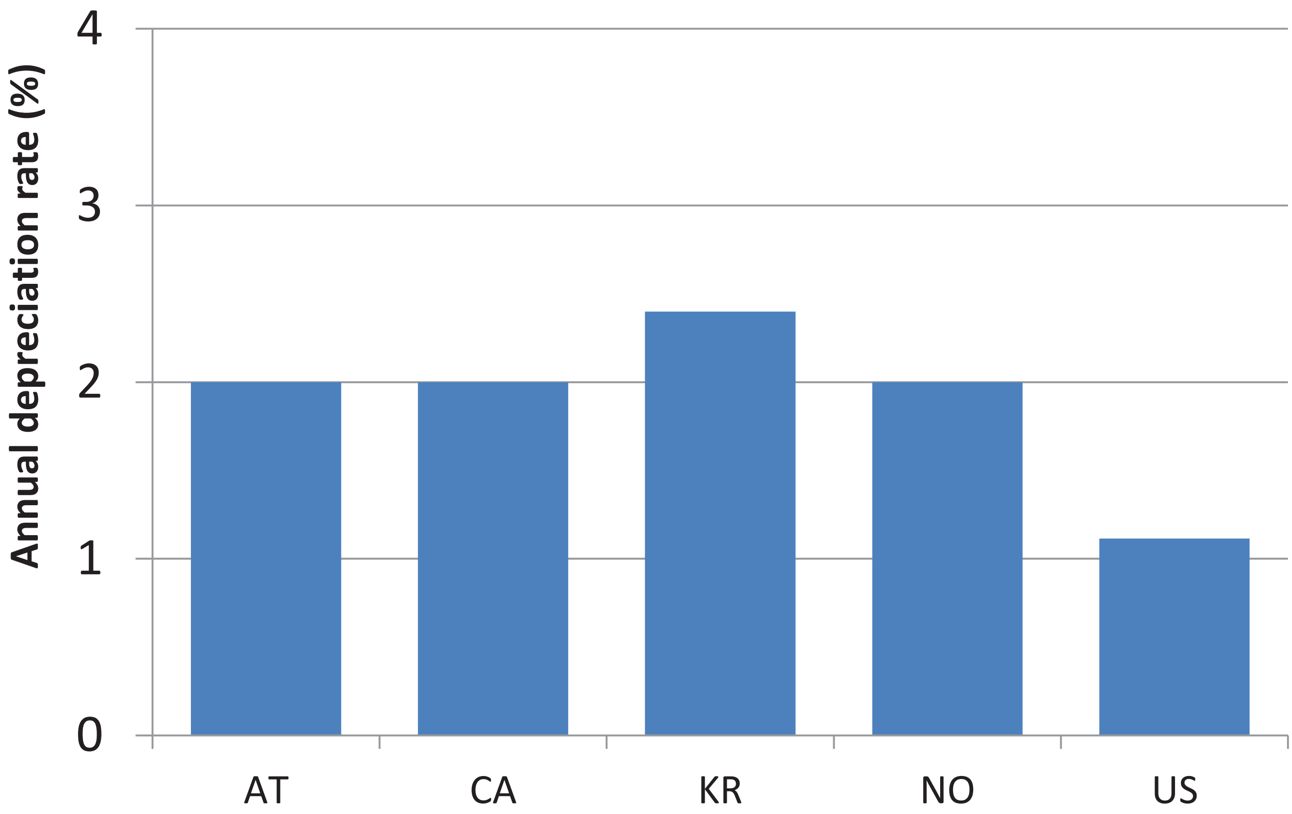
One way to facilitate these cross-country comparisons of depreciation patterns is to calculate, for specific types of assets such as dwellings, the proportion of an initial cohort of assets that remains in the stock after a specific number of years. The calculations for each country should be based on each country's assumed functional forms and parameters for depreciation and retirement. This information would enable one to assess whether their assumptions produce unusually fast or slow rates of depreciation. The Guide provides a more in-depth discussion of the service life assumptions and depreciation patterns. As well as facilitating cross-country comparisons by showing the proportion of the stock available after 25, 50, and 75 years.

Graph 1.Service Lives: Dwellings



Notes: "Lin" is the linear depreciation pattern and "Oth" is other. Retirement (or mortality) patterns may be Normal (NM), Winfrey (WF), Weibull (WB), Log-normal (LN), Gamma (GM), Truncated normal (TN), Delayed Linear (DL), or Poisson (PS)

Graph 2. Depreciation Rates: Dwellings



Note. AT, CA, NO, and US are geometric depreciation rates. KR does not use a geometric approach.

6 Summary

The aim of the Guide is not to provide a single ''best'' approach for estimating the value of land on a country's balance sheet but to provide a compilation guide that gives national statistical offices various tools to accomplish the task. With this goal in mind the Guide provides numerical examples along with country case studies to better illustrate the estimation methods described in the Guide.

In light of the G20 DGI and new ESA 2010 transmission requirements, countries are focusing their efforts on compiling a more complete set of balance sheets. Because of this, it is proposed to extend the mandate of the joint Eurostat-OECD Task Force on Land and Other Non-financial Assets. Under this extended mandate (subject to approval by the Eurostat National Accounts Working Group and the OECD Working Party on National Accounts) the Task Force will research other non-financial assets. The topics most cited for the research agenda are inventories (AN.12), valuables (AN.13), mineral and energy reserves (AN.212), and contracts, leases, and licenses (An.22).

Table 3. Summary of OECD-Eurostat survey: DWELLINGS

	Net stock estimation method		Service life or depreciation rate	Other assumptions		Variation of Service life and other assumptions	Source of information	Used in estimating land stock?
		(Benchmark-year based on)		Depreciation	Retirement			
Austria	PIM, based on available time series		2% depreciation rate	Geometric		No	Other countries' estimates	No
Canada	PIM, based on available time series	Population census	2% depreciation rate	Geometric		No	Related studies	Yes
Czech Republic	PIM, based on imputed time series		90	Linear	LN	No	Expert advice, Tax lives, Census, Survey	No
Denmark	Other		75	Linear	WF	Yes	Related studies, Administrative records	No
Finland	PIM, based on available time series		60	Linear	WB	No	International experiences, Expert advice	No
Germany	PIM, based on available time series	Population census	77 (avg)	Linear	GM	Yes	Tax lives, Administrative records, Expert advice	No
Italy	PIM, based on available time series		79	Linear	TN	No	Expert advice	Yes
Korea	PIM, based on available time series	Initial stock as of 1953	55	Other pattern (Present Value of Efficiency approach)	WF	Yes	Housing Census, Own estimate	Δ (For comparison)
Netherlands	PIM, based on available time series		75	Other pattern	WB	No	Expert advice	Yes
Norway	PIM, based on available time series		2% depreciation rate	Geometric		No	Expert advice, Other countries' estimate	No
Slovenia	PIM, based on available time series	Population census	74	Linear	None	No	Census, Tax lives, Administrative records, Expert advice	No
United Kingdom	PIM, based on available time series		59	Linear	NM	Yes	Tax lives, Company accounts, Related studies	No
United States	PIM, based on available time series		1.14% depreciation rate	Geometric		No	Survey, Expert advice, Related studies	No

Notes: Retirement (or mortality) patterns may be Normal (NM), Winfrey (WF), Weibull (WB), Log-normal (LN), Gamma (GM), Truncated-normal (TN), Delayed linear (DL), or Poisson (PS).

Bibliography

Barańska, A. (2013), *Real estate mass appraisal in selected countries – functioning systems and proposed solutions*, Real Estate Management and Valuation, Vol. 21, No. 3, pp. 35-42.

Balabanova, Z. and Helm , R. van der. (2012), Enhancing Euro Area Non- financial Assets Estimates. ECB, Eurostat.

International Association of Assessing Officers (IAAO) (2013), *Standard on Mass Appraisal of Real Property*. Kansas City, Missouri, USA.

Organisation for Economic Co-operation and Development (2009), Measuring Capital: OECD Manual, Second edition. Link: www.oecd.org/dataoecd/16/16/43734711.pdf

Organisation for Economic Co-operation and Development (2011) Land valuation in the National Accounts, paper presented at OECD Working Party on National Accounts, 2011, Paris.

United Nations, European Commission, International Monetary Fund, Organisation of Economic Cooperation and Development, World Bank, System of National Accounts 2008, 2009. unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

Eurostat, European Commission, European System of Accounts (ESA) 2010 http://epp.eurostat.ec.europa.eu/portal/page/portal/esa_2010/introduction

Eurostat (2013), Handbook on Residential Property Prices Indices, http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-RA-12-022

De Haan, M. (2013), Balance sheets for land, energy reserves and mineral reserves in the Netherlands, paper presented at OECD Working Party on National Accounts, 3-4 October 2013, Paris.

De Vries, P., Haan, J. de, Van der Wal, E., Marlën, E. (2009), A house price index based on the SPAR method, Journal of Housing Economics 18, pp. 214-223.

Reuter Town, A. (ABS Australia) (2013),Valuing dwellings and land as an input into household wealth and household balance, paper presented at OECD Working Party on National Accounts, 1-2 October 2013, Paris.

Van den Bergen, D., de Boo, A.J., Taminiau-van, P., Veldhuizen, E. (2010), Compiling Complete Balance Sheets for the Netherlands, paper presented at OECD Working Party on National Accounts, 1-3 December 2010, Paris.