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Measuring Natural Assets in the Netherlands

Note by the Statistics Netherlands

Summary

This report presents an overview of methods and results concerning the compilation of balance sheets for land and subsoil assets in the Netherlands for the period 1996-2008. These balance sheets are constructed for the total economy as well as by industry. Both theoretical and practical issues dealing with the valuation of natural assets are discussed. In 2008, the total value of natural assets in the Netherlands was 1400 billion euros, representing approximately 40 percent of the total stock value of all non-financial assets.

I. Introduction

1. In recent years wealth stocks have attracted increasing policy attention. Recent developments, like the global financial crisis, show that changes in wealth stocks may have serious consequences for the entire economy. For example, the decline in real estate prices in the United States played a crucial role in the recent economic downturn. In addition, policy attention is also more and more directed towards the sustainable use of natural resources such as energy, water and land.

2. While in general financial and fixed assets are well covered in the national accounts of a wide range of countries, so far relatively little attention has been given to measuring natural resource assets. As in the Netherlands, natural assets like land and mineral and energy resources may represent a considerable part of the total net worth of an economy. Moreover, land and subsoil asset values tend to be much more volatile than the value of fixed assets. Reliable estimates of natural assets are therefore important for understanding economic developments.

3. This report presents non-financial balance sheets of land and subsoil assets for the Netherlands, covering the period 1996–2008. At this stage only the most important land categories are included, i.e. agricultural land, land underlying dwellings and land underlying non-residential buildings. Estimates of subsoil assets include in addition to oil and gas reserves resources like clay, gravel, salt and limestone. The Netherlands does not benefit from the presence of other mineral deposits like metals.

4. Balance sheets for non-produced assets are in most cases requisite when determining a nation's net worth. In the case of the Netherlands, these balance sheets are also used to increase our understanding of economic growth. Capital services derived from natural resources will be included in the Dutch growth accounts. So far, in the Dutch growth accounts, capital service inputs have been restricted to fixed assets and oil and gas resources only. As a negative consequence, changes in assets not covered in the growth accounts (inventories, land and other subsoil assets) are reflected in the multi-factor productivity change. With the introduction of these natural assets in the Dutch growth accounts, the quality of multi-factor productivity change measures will undoubtedly increase. Therefore the development of full-fledged non-financial balance sheets also represents an important step in completing the Dutch growth accounts.

5. This report is structured as follows. Section II discusses the compilation of balance sheets for land while section III deals with those for subsoil assets. Balance sheet results are presented in section IV. Section V sums up and highlights a number of unresolved issues.

II. Land

6. Determining market values of land is not straightforward. In many cases land values cannot be separated from those of buildings and structures. Separating these values may require some assumptions. Furthermore, one may argue whether all land should be valued, particularly land under government ownership strictly used for public purposes. A last conceptual issue concerns the distinction between land ownership and land use. Since letting of land does not fall within the production boundary, problems with the consistency between inputs and outputs may arise. All these issues are further discussion in subsection A. Subsection B discusses estimation methods while subsection C describes the balance sheets breakdown by industry and institutional sector.

A. Valuation issues

1. Land valuation

7. In the System of National Accounts (SNA) the preferred way to value assets is by market valuation. For land these values can be derived from information on sales and purchases of land. For agricultural land this method can be applied quite easily. However, land very often changes hands together with buildings and structures. Using land values derived from transactions without buildings as a proxy for land values underlying buildings and structures may easily lead to downward biases. The reason for this is that most land without structures is located at the outskirts of cities or in rural areas, whereas most land underlying buildings is located within urban areas where land prices are usually much higher.

8. The only alternative is to separate the value of buildings from real estate transaction prices. These transactions usually concern land and buildings or structures on its surface. Separating building values from real estate transaction prices would do the trick. In this context it is important to notice that the prices of two identical houses (or buildings) may differ on different locations. Such price differences are for example the outcome of differences in the presence of environmental and other amenities (e.g. the presence of recreational parks, highways, public services, job opportunities). The benefits and inconveniences of a particular neighbourhood are obviously reflected in the land component of real estate prices. By purchasing a piece of land one will also obtain the quality of its surrounding area.

9. Considering a building as a self standing asset apart from the land leads to the following useful definition: *the value of a building or structure, excluding the land on which it is built, is equal to the depreciated value of obtaining the building or structure.* Since the depreciated value of buildings and structures are measured (at a macro or meso level) by way of a Perpetual Inventory Method (PIM), these indirectly measured asset values for buildings and structures can be used to separate land values from real estate values.

2. Scope of balance sheets for land

10. In the European System of Accounts (ESA) all land subject to ownership should be valued on the basis of its market price. In case private ownership cannot be identified, the government could be considered the land owner by default. In this way all land within the borders of the national territory is in principle represented in the nation's balance sheet. However, some land categories, like remote and inaccessible deserts or tundra's, may have close to zero markets values. Generally, one may expect all privately owned land to have positive values.

11. For certain parts of government owned land, like land underlying public roads, one may argue that their values are already included in the value of adjacent privately owned land. Determining a value for this government owned land in the balance sheet may in these cases lead to double counting. On the other hand, one may argue that this surplus value of the adjacent land resembles a spill over effect which means that the government owned land should be valued in addition to the privately owned land. However, spill overs could only come into being in case the government owned land would have a demonstrated value on its own. Independent asset values do not seem to exist for roads that have only one function, namely giving access to residential areas.

12. This double counting issue arises when the value of privately owned land is based on the expectation that the government will neither sell land nor will change its use. This may for example be the case for land underlying roads and public parks. The value of most

privately owned land depends, among other things, on its accessibility to the public infrastructure. An accessible house (including the land) has usually a higher value than a remote house next to a dirt road. This surplus value is created by roads or public means of transport with which the house is easily accessible. This surplus value follows the landowner's trust that the government will neither sell the land underlying these roads nor will use it for other purposes. As soon as the government would reallocate the land underlying roads, the adjacent privately owned land would quite likely decrease substantially.

13. A second argument against valuing land underlying roads is that it does not seem to have a real market value as long as it is used as such. In the Netherlands, as in many other countries, the government develops spatial zoning plans in which the use of land to various purposes (agriculture, dwelling, office locations, nature, etc.) is predetermined. Land prices are largely determined by the kind of economic activities this land is allowed to be used for. Changes in zoning plans will lead via the other changes in volume of assets (a reclassification of land use) to changes in the national balance sheet positions for land.

14. Based on these arguments, but also due to measurement difficulties, land underlying public infrastructure is not valued as such in the Dutch national balance sheet for land. Only government owned land underlying dwellings (EA.2111 and EA.2121), land underlying non-residential buildings (EA.2112 and EA.2122), agricultural land and associated surface water (EA.22) and construction land (Part of EA.21?[1]) is included. Excluded is all land used for transportation and utilities (EA.2113 and EA.2123), wooded land and associated surface water (EA.23), mayor surface waters (EA.24) and other land (EA.25).

3. Land ownership versus land use

15. Like any other type of asset, the value of land should be recorded in the balance sheet of its economic owner. However, land ownership and land use may be in distinct hands. At least two situations can be distinguished. Firstly, the land owner (usually the government) may provide free access to the land as a public service. This is for example the case for land underlying public roads or parks. A second possibility is that the landowner charges the use of land. Examples are the rent of agricultural land or land underlying buildings. The building itself may, or may not be subject to the rental agreement. Land rents, or natural resource leases more generally, may create problems when accounting for the full cost of production including the use of natural resources like land.

16. According to the SNA income derived from resource leases should be recorded as property income in the income distribution account. This means that rent payments are not directly reflected as production cost in the production (or income generation) account of the land user. For tenants (for example farmers) this leaves a somewhat distorted picture: (agricultural) output associated with the use of the land is properly recorded in the production account while the cost of using land is not explicitly accounted for. As such the production account may show operating surpluses or mixed incomes which could partly be wrongly interpreted as profits. The omission of land in the production account may also lead to distorted productivity and profitability measures. Multi-factor productivity change can be understood as the volume component of profitability change.[2]

[1] The System of Environmental and Economic Accounts (SEEA), to whom the SNA refers when disaggregating land, does not state clearly under which asset type land like construction land, land underlying graveyards and dumping grounds should be recorded.

[2] This interpretation is not possible when the neoclassical model is used, since in this case, profits are zero by definition.

17. Land is a non-produced asset and as such the cost of using land could never appear as intermediate consumption in the production account of the tenant. Alternatively, the cost of land use could be reflected as a subcategory of the tenant's operating surplus or mixed income. The actual rent payment will subsequently show up in the income distribution account. As a consequence land balance sheets for productivity measurement need to be established on the basis of land use instead of land ownership.

B. Measurement issues

18. In the Netherlands land use statistics are a key source in the compilation of balance sheets for land. Land use statistics provide a breakdown of all land (and inland water bodies) in the Netherlands into types of land. They are based on aerial photographs and are published about every three years. Using land use statistics ensures consistency between the sum of the areas of all types of land and the total area of land in the Netherlands.

19. A disadvantage of using land use statistics is that their classification does not always align with SNA classifications of economic activities and assets. Land under small roads within neighbourhoods is for example classified as land underlying dwellings. Furthermore, the delineation of land areas is not necessary according to the SNA, for example with regard to associated surface water. However, the land use statistics are still the most comprehensive source available.

1. Agricultural land

20. In the case of the Netherlands agricultural land is subdivided into two groups: open farmland and land underlying greenhouses. The scarce data that exist about the difference in prices between land for cattle breeding and land for arable farming show that these prices are fairly equal. A distinction between these two kinds of open farmland does not add much extra quality to the estimates. For open farmland a distinction is made between leased and non-leased land. Data shows that the average price for land encumbered with a lease is about half the price of land not subject to lease contracts.

21. The agricultural census is being used to interpolate and extrapolate estimates of open farmland as derived from the land use statistics. This annual census provides data on the use of agricultural land. The agricultural land surface according to the agricultural census is about 18 percent lower than the land surface derived from land use statistics. Unlike the agricultural census, the land use statistics include for example farmyards and land underneath farms. Both statistics show rather similar rates of change in agricultural land which indicates that the agricultural census is a suitable source for interpolation and extrapolation.

22. Several sources are used for determining the price per hectare of agricultural land. For different time periods different organisations have been responsible for measuring prices of agricultural land. The most recent data come from the Economic Institute for Agriculture (LEI). All data sources provide the weighted average price per hectare of agricultural land for the whole of the Netherlands as well as for different regions. Since outcomes from the various data sources are within a 1 percent margin of each other, they are used in combination as a continuous time series. [3]

24. The value of the agricultural land is subsequently estimated by multiplying total agricultural land by the average price per hectare. This means that farmyards and land underlying farms is given the same price as all other agricultural land.

[3] Comparison is possible because of overlapping time periods.

25. Flower and vegetable cultivation in greenhouses represents a significant industry in the Netherlands. For land underlying greenhouses, data from the agricultural census on total areas, and changes therein, aren't anything like the data from the land use statistics. The main reason is that (depreciated) greenhouses are increasingly used for alternative non-farm purposes, like storage of camper trailers and vans. The agricultural census only registers land actually used for greenhouse farming. Due to lack of alternative data sources, year-by-year estimates are derived from linear interpolations and extrapolations. The estimated area of land that is used for agricultural purposes is derived from the agricultural census while the remainder, which is used for non-farm purposes, is classified as land underlying structures. Since all land underlying greenhouses may be used both for farming and non-farm purposes, it is assumed that prices are equal for both types of land use.

26. Values of land underlying greenhouses are derived from LEI data. These prices exclude the value of greenhouses but include land value surpluses due to infrastructure connections like power grids. It is not clear whether it will be possible, or even necessary, to exclude these supplementary values. Since the grid is constructed and owned by private parties who would have the freedom to sell it to others, this example seems to constitute a spill over.

27. Another concern is that the price per hectare of land underlying greenhouses depends on how square a parcel is. A square parcel is cheaper to heat which tend to increase its price. Unfortunately, good data on the contours of greenhouses is unavailable. This means that some additional assumptions are needed.

28. The resulting average price per hectare is subsequently multiplied by the total land area underlying green houses to arrive at a total value of land underlying greenhouses.

2. Land underlying dwellings

29. Land underlying dwellings is measured by subtracting the depreciated value of dwellings from total property values as derived from tax registers. In the Netherlands there is for tax purposes a register including the (so called) WOZ value of each dwelling including land.[4] These values are based on actual transaction prices and provide as such accurate estimates, despite the fact that the WOZ value lags the market value with a few years. A price index for existing owner-occupied dwellings is used to estimate values at current prices. Although this price index takes hold of price differences between different kinds of dwellings, it does not correct for the on average increasing size of dwellings in time. As such the price index probably suffers from an upward bias. No data on the size of this bias is available, so for the time being the expected bias is being ignored.

30. The Perpetual Inventory Method (PIM) is used to determine the depreciated cost of dwellings. The PIM measures the net value of dwellings excluding the underlying land, but including the depreciated value of ownership transfer cost. Since the WOZ value represents the price for which dwellings are expected to be sold, it will exclude cost of ownership transfers. Therefore, land values are determined by subtracting the PIM values excluding ownership transfer cost from the WOZ values.

31. Not only land values but also volume changes in land use can be derived from the above mentioned sources. It is important to emphasize that volume changes of land are not necessarily equal to changes in concomitant land areas. This is because land underlying dwellings can not be treated as a homogeneous asset. Land prices in city centres are usually

[4] In the Netherlands, a number of taxes are based on the ownership of dwellings or buildings. This is laid down in the Dutch Real Estate Appraisal Act (WOZ). The value that the government subsequently assigns to each dwelling or building is called the WOZ value.

much higher than those in smaller villages. In practice, the year-by-year volume changes of land underlying dwellings appear to be higher than the corresponding increases in land underlying dwellings. This is consistent with the fact that in the Netherlands a larger part of dwellings are being built in the densely populated areas where land prices are above average. However, the plausibility of these results needs to be further investigated.

3. Land underlying non-residential buildings

32. In principle the value of land underlying non-residential buildings can be estimated in a similar way as that of land underlying dwellings. WOZ values are available for almost all non-residential buildings with the exception of tax exempted buildings like churches. Unlike dwellings, WOZ values for non-residential buildings are not based on actual transactions. Transactions in non-residential buildings take place less frequently. Various alternative methods are being applied by the tax authorities instead to determine these WOZ values. When possible, the net present value of future rentals is applied as an alternative valuation method. In other cases, the depreciated value of construction costs is used based on extensive guidelines.

33. In theory, these WOZ values should provide reasonable estimates. In practice however, PIM based values of the non-residential buildings (excluding land) appear to be higher than the corresponding WOZ values (including the land). The service lives underlying the PIM as applied by Statistics Netherlands are quite similar to the ones used for estimating WOZ values so this can not explain this lack of correspondence. However, differences may result from deviating depreciation profiles. The approximately geometrically depreciation profiles as applied by Statistics Netherlands are in accordance with the OECD handbook *Measuring Capital*. On the other hand the WOZ values are based on linear depreciation which will lead to lower net asset values than those based on geometric depreciation. This may (partly) explain the unexpected difference between the two estimates.

34. Therefore, PIM values of non-residential buildings (excluding ownership transfer cost) are recalculated with the help of linear depreciation profiles. These values subsequently subtracted from corresponding revaluated WOZ values to arrive at the required asset values of land underlying non-residential buildings. As mentioned revaluation is needed since WOZ values lag the (estimated) market prices.

C. Assigning ownership and use

35. The use of land balance sheets for productivity analysis purposes requires a breakdown by institutional sectors as well as by industries. The institutional sector classification is particularly used to calculate wealth stock estimates. Breakdown by sector is based on ownership. The industry classification is based on the use of land in production. The industry classification poses the biggest problems and is therefore discussed first.

1. Industry classification

(a) Agricultural land

36. All open farmland is assigned to the industry agriculture, forestry and fishing. This includes all land underlying greenhouses used in agricultural production. For land underlying other greenhouses, an estimate is made of the area (and value) of land that is occupied by garden centres, based on the number of garden centres and their average size. This asset value is assigned to the industry retail trade and repair. All other land underlying greenhouses (sidelines) is assigned to agriculture, forestry and fishing.

(b) Land underlying dwellings

37. When a dwelling and underlying land are subject to one lease contract, the combined rent(al) payments are in the national accounts recorded as the sale of a service. In this case, the lease of the land and the generated income stream fall within the SNA production boundary. As a result, from a production perspective, the use of this land needs to be assigned to the landlord. When only the underlying land is leased separately from the building, the lease falls outside the production boundary and the lessee is therefore deemed the user.[5]

38. In the Netherlands, the use of land underlying dwellings in production is assigned to the following industries: real estate industry (including owner-occupied housing), insurance and pension funds and government. This allocation is based on the value distribution of dwellings.

39. The use of annual business reports for assigning more precisely land underlying dwellings to insurance and pension funds is subject to further research. In addition, the division of land underlying dwellings between the real estate industry and the government needs also further consideration. These improved estimates could be based on data on land leases which are common practice in some Dutch municipalities.

(c) Land underlying non-residential buildings

40. Dividing land underlying non-residential buildings by industries poses the biggest problems. Some industries are located in densely populated areas (retail trade, hotels and restaurants) while others are located outside urban areas (e.g. manufacturing). An allocation based on the industry-by industry distribution of non-residential building ownership (excluding land) is quite probably a less reliable way forward.

41. Alternatively, an attempt was made to link the WOZ register to the business register. The WOZ register records among other things the addresses, property values and names of the owners. The International Standard Industrial Classification (ISIC) industry codes of owners are not recorded.

42. At Statistics Netherlands, among other things, company names, addresses and industry coding are recorded in its business register. Linking both registers appeared infeasible since business names in both registers are not standardised. Only a small subset could be matched. Linking addresses also failed. The business register often includes contact addresses of companies. When several companies are located in one building, it is impossible to determine which of them, if any, is the actual owner. Due to these and other problems, the resulting link between the WOZ register and the business register proved too incomplete and biased to be used for statistical purposes.

43. This means that some sort of shortcut seems unavoidable. An option that is currently used is to divide all industries into two groups: one group with high land value – property value ratios and a second group with relatively lower ones. The first group would typically be represented by those economic activities concentrated in city centres but occupying buildings with a restricted number of floors. Obviously, tall buildings are more expensive to build leading to lower 'land value – property value' ratios. The first group is assumed to be represented by industries like retail trade, hotels and restaurants, and education. The ratio of the first group is assumed to be twice as high as that of the second group. Based on this assumption land values can still be distributed on the basis of non-residential property ownership by industry. In future research, an exception will be made for banking and

[5] For land underlying non-residential buildings the same argument applies.

insurance companies, for which annual reports may appear to be valuable additional sources of information.

2. Ownership by institutional sector

44. Statistics Netherlands is about to release for the first time balance sheets for land by institutional sector. Unlike measuring the use of land by industry, the balance sheets by institutional sectors will be based entirely on ownership. In many cases ownership can be derived from information on the economic use of land. Obvious exceptions are leases of agricultural land and land leases separate from buildings. For agricultural land, the agricultural census provides for some reporting years information on land leases. This information is combined with government reports on government ownership of agricultural land. Local governments are usually the lessor of land leases separate from buildings. Further, data on rent income received by government is used to estimate government ownership of land.

III. Subsoil assets

45. The Netherlands benefit from the presence of several different types of subsoil assets such as oil, gas, clay, peat, sand, salt, gravel and limestone. Over the last two or three decades, the exploitation of remaining coal reserves has appeared economically infeasible and as such no economic value is assigned to these coal deposits in the national balance sheet.

46. In practical terms, two categories of subsoil assets can be distinguished: those with 'finite' and 'infinite' service lives. Of course, truly infinite subsoil asset deposits do not exist. However, some asset deposits are sufficiently abundant to guarantee service for the foreseeable future. For practical reasons, which are explained in subsection B, one may assume these asset deposits as being infinite.

47. Subsection A deals with the finite natural resources oil and gas. All other subsoil assets are discussed in subsection B.

A. Oil and gas reserves

48. An elaborated methodological description of estimating oil and gas reserves in the Netherlands is given by Veldhuizen et al (2009).[6] This report provides only a short overview.

49. Asset values in the national accounts should reflect as much as possible representative market values. Since observed market values for transactions in oil and gas reserves are not widely observed, net present value calculations are used alternatively to determine the monetary values of oil and gas reserves. The future income flow is calculated by multiplying projected yearly physical extractions with the expected income per unit of the reserves, the so called unit resource rent.

50. Physical extraction patterns may be derived from data on remaining available reserves and (expected) extraction schedules.[7] In the Netherlands, data on available reserves

[6] Veldhuizen, E., C. Graveland, D. van den Bergen and S. Schenau (2009), '*Valuation of oil and gas reserves in the Netherlands 1990-2005*', Statistics Netherlands, The Hague-Heerlen, discussion paper nr. 09029.

and physical extraction are derived from a series of reports 'Oil and gas in the Netherlands, 1987–2007' by the Netherlands Organisation of Applied Scientific Research (TNO). Future extraction schemes are based on remaining reserves, observed extraction trends in recent years and on government induced limits to maximum extraction levels. These predictions result mostly in linear declining extraction schemes.

51. The unit resource rent is calculated endogenously. The (exogenously estimated) user cost of capital of the fixed assets and the pure profits for secondary economic activities are subtracted from the gross operating surplus of the mining industry to determine the resource rent for oil and gas extractions.[8] Subsequently, this combined resource rent has to be assigned oil and gas extractions. Due to lack of data, this division is for now entirely based on production value ratios.

52. For both oil and gas, the individual resource rents are subsequently divided by their physical extractions to arrive at their unit resource rent. Due to large price variations, these unit resource rents are highly volatile. Expected future income streams are therefore resource rent predictions based on three year averages.

B. Other subsoil assets

53. In the case of the Netherlands, other economically significant subsoil assets are clay, peat, sand, salt, gravel and limestone. In principle, there economic values can be assessed in a similar way as that of oil and gas reserves. Data on the physical reserves of these assets is however not available. The abundant presence of these reserves makes deposit quantity assessments relatively meaningless. For example, the depletion of sand in the Netherlands is not expected to occur anytime soon if ever. The relative insignificance of these other subsoil assets in terms of economic value is another reason why extensive research on available reserves has not been carried out.

54. Alternatively, asset values of each of these assets are based on the assumption of infinite service lives and future income streams. As the net present value method increasingly discounts income receipts further away in the future, errors made in this regard seem relatively small. It is assumed that future annual extractions equal to the average extraction in the past three years. Data on physical extractions are obtained from several government agencies.

55. A consequence of infinite physical reserves is the omission of depletion of these subsoil assets. The size of extracted quantities does not have any influence on remaining deposits. As such physical balance sheets for these subsoil assets are meaningless.

56. In the Netherlands, two industries are responsible for the extraction of each of these other subsoil assets: (non energy) mining and the chemical industry (as secondary production). An endogenous resource rent calculation based on the production account of an industry which does not carry out mining operations as a core business (like chemical industry in the Netherlands) may lead to serious measurement errors. Alternatively, all resource rents, also those captured by the chemical industry, are derived from the production account of the mining industry.

[7] The future income is based on the expected extraction schedule at the moment of valuation, not on the actual extraction as is measured years later. The reason behind this is that we want to value the reserve at the moment the balance sheet is made. Data on the realised (future) extractions are not yet available at this moment.

[8] In the Dutch national accounts, extraction of oil and gas is classified in a single industry.

57. As for oil and gas, the resource rents of all other subsoil assets are being determined by subtracting from gross operating surplus the (exogenously estimated) user cost of capital of fixed assets. Micro data show that for the years 2005, 2006 and 2007, the ratio between gross output and resource rent is for most subsoil assets fairly similar for all types of subsoil assets.[9] The total sum of resource rents is therefore allocated to the different subsoil asset categories according to their corresponding production values.[10]

58. Each individual resource rent is subsequently divided by its corresponding physical extraction quantity to arrive at a unit resource rent. This (three year average) resource rent is used to determine the discounted (infinite) future income stream and as such the net present values of each of these assets.

59. Since both real unit resource rents and yearly physical extractions are assumed to remain constant over (infinite) time, the net present value of future rentals can be simplified to the yearly expected (real) resource rent divided by the (real) discount rate. As a real discount rate is set at 4 per cent, the value of the subsoil assets therefore equals 25 times the expected real resource rent.

IV. Results

60. Table 1 shows for a selected number of years the Dutch balance sheet of non-financial assets. In 2008, the total value of all non-financial assets was approximately 3500 billion euro. Natural resources comprise 39 per cent of this value. However, in 1996, this was only 22 per cent. The values of land and subsoil assets have thus increased much more than those of produced assets. This is mainly a matter of holding gains. In 2008, the unit price of land was over 4 times the unit price in 1996, whereas the unit price of natural resources was over 2.5 times the unit price in 1996.

61. Land underlying dwellings comprises the major part of the value of natural assets. Due to increasing land scarcity and the tax-deductibility of mortgage payments, the value of land underlying dwellings has grown to little under a trillion euro in 2008. On average, its value is approximately equal to the total value of dwellings themselves. Land underlying non-residential buildings by contrast equals only 41 per cent of the value of non-residential buildings.

62. The value of subsoil assets consists almost entirely of the value of the reserve of natural gas. A large gas field in the northern part of the Netherlands is the major contributor to this value. The remainder of the subsoil assets represent less than 10 percent of the value of natural resources.

[9] For the extraction of salt, results are inconclusive. Furthermore, micro data on sand and gravel can not be separated, so it is not completely clear whether this ratio is also similar for the extraction of sand and gravel separately.

[10] For other subsoil asset categories, the method for dividing the resource rent into different types of subsoil assets is therefore equal to the method for dividing the resource rent of oil and gas. Unlike for oil and gas however, the division of other subsoil assets is supported by evidence from micro data.

Table 1
Balance sheet of non-financial assets

	1996	*2000*	*2005*	*2008*
	billion euro			
Land	264	753	1042	1212
Land underlying dwellings	174	568	839	979
Land underlying non-residential buidlings	46	110	144	151
Agricultural land [a]	43	74	60	82
Subsoil assets	68	71	110	178
Oil and gas reserves	66	66	103	172
Other subsoil assets	2	4	6	6
Natural assets	**332**	**823**	**1152**	**1389**
Fixed assets	1052	1302	1651	1892
Inventories	55	68	72	79
Consumer durables	98	126	146	157
All assets	**1538**	**2319**	**3022**	**3518**

[a] Includes land underlying greenhouses used for non-agricultural purposes

63. Table 2 shows complete asset accounts for natural resources in the Netherlands. On the national level the acquisition of assets is zero by definition and therefore not shown. Land acquisitions will definitely appear in the asset accounts of individual sectors.

64. In 2006, the value of natural assets increased with 79 billion euro. Most of this was due to price changes. All other changes in assets amounted to only minus 1.4 billion euro. For land, the other changes in assets totalled 5 billion euro. This is caused by an increase in the area of land underlying dwellings at the expense of agricultural land. Since land underlying dwellings is much more valuable than agricultural land, substitutions between these two categories will lead to substantial volume (quality) changes.

65. For subsoil assets, the other changes in volume totalled minus 6 billion euro. This is caused by the net depletion of natural resources. In recent years, only few new deposits were discovered in the Netherlands. The “other subsoil assets”, showed a small increase in the volume of the reserves, representing 80 million euro.[11] This volume increase is caused by an increase in the yearly extraction volumes of these natural resources.

[11] In table 3, this is rounded off to zero.

Table 2
Balance sheet of natural assets, 2006

	Opening balance sheet	*Revaluation*	*Other changes in assets*	*Closing balance*
		billion euro		
Land	1042	50	5	1098
Land underlying dwellings	839	45	5	889
Land underlying non-residential buildings	144	3	0	147
Agricultural land [a]	60	2	0	62
Subsoil assets	110	30	-6	133
Oil and gas reserves	103	31	-7	127
Other subsoil assets	6	-1	0	6
Natural assets	**1152**	**80**	**-1**	**1231**

[a] Includes land underlying greenhouses used for non-agricultural purposes

66. Table 3 shows the exploitation of natural resources by industry. This table is also available at the level of 57 industry branches. Please be aware that this table does not necessarily identify ownership but sometimes use, especially in the case of agricultural land and subsoil assets, as explained in chapter II. Over 70 per cent of the value of natural resources is allocated to financial and business activities. Most of this value consists of land underlying dwellings. Obviously, this value represents real estate activities including owner occupied dwellings.

Table 3
Natural assets by industry, 2008

	Land	*Land underlying dwellings*	*Land underlying buildings*	*Agricultural land* [a]	*Subsoil assets*
			billion euro		
Agriculture, forestry and fishing	93.5	0	11.0	82.4	0
Mining and quarrying	0.2	0	0.2	0	177.0
Manufacturing	13.5	0	13.5	0	0.7
Electricity, gas and water supply	2.1	0	2.1	0	0
Construction	1.7	0	1.7	0	0
Trade, hotels, restaurants and repair	20.8	0	20.7	0.1	0
Transport, storage and communication	7.0	0	7.0	0	0
Financial and business activities	1003.4	975.2	28.2	0	0
General government	50.0	3.6	46.4	0	0
Care and other service activities	19.7	0	19.7	0	0
					0
Total economy	**1211.8**	**978.7**	**150.6**	**82.5**	**177.7**

[a] Includes land underlying greenhouses used for non-agricultural purposes

V. Future research

67. This paper introduces the recently developed non-financial balance sheets of natural resources for the Netherlands, covering the period 1996 to 2008. Although this work leads to a first impression of the total wealth represented by non-financial asset ownership in the Netherlands, several outstanding issues remain.

68. First, estimates of land are still somewhat incomplete. Construction land and privately owned recreational land are not yet included. Furthermore, land underlying tax-exempted buildings, like churches, are excluded as well, since no data on the value of these real estate objects is available from the tax registers. Future work should result in additional estimates for these remaining land categories.

69. Second, the breakdown of land use by industry needs improvement. For the banking and insurance industries, data from annual reports may be used to estimate the value of land. The distribution over all other industries should also be improved. Using the current breakdown of buildings and dwellings by industry poses problems when price changes vary across industries. A relative price increase of buildings in one industry leads to higher asset shares of buildings. Since the distribution of the underlying land is based on these shares, changes therein my affect land volume changes on the industry level. This is an undesirable outcome. A way forward might be to use the breakdown of the volume change in buildings by industry to divide the volume change of land into industries. This method needs to be explored further.

70. Third, due to data restrictions with regard to production costs, the combined resource rent is divided between oil and gas on the basis of production value shares. This is probably an inaccurate allocation method since experts indicate that per unit extraction cost are higher for oil compared to natural gas. As a result, resource rents for oil and their asset values are likely to be overstated. Future research needs to focus on these cost differences.

71. Fourth, the Dutch balance sheets still need to be broken down by institutional sector. This will allow direct confrontations between total assets positions and liabilities by sector leading to sector based measures of net worth. This would in turn provide a clearer picture of recent economic trends such as the possible consequences of increasing (mortgage) debts of households compared to their ownership assets. Complete balance sheets by institutionalsectors will therefore certainly increase our understanding of the economy.