A Standardised Time Series of the Stock of Fixed Capital in The Netherlands, 1900-1995

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Abstract

This paper introduces a time series of the Dutch capital stock for 1900-1995. The estimates were derived using the perpetual inventory method. To enhance international comparability, we followed Maddison's standardized methodology. To ensure transparency a thorough description of sources and methods is given. A plausibility check is performed by comparing our results with the stylized facts of Dutch economic growth in the twentieth century. It is concluded that the new data fit other available evidence for Dutch macroeconomic development better than series previously used.

Keywords: Capital Stock, Investment, Netherlands
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INTRODUCTION

Measurement of the capital stock forms an indispensable part of the quantitative study of long run economic growth. The perpetual inventory method has been of major importance in increasing the transparency of post World War II capital stock estimates. However, pre-1950 estimates of the capital stock, if available at all, are often more difficult to compare internationally.

This is also the case for the Netherlands. Previously, only a number of short-run time series of the Dutch capital stock were available. Most of these are not consistent perpetual inventory estimates, or do not cover the whole economy (for example Summers and Heston 1991; CBS 1993). Only Maddison's capital stock series for machinery and structures (Maddison 1995) are well-documented. However, these run from 1950 onward only, and are partly based on less transparent underlying investment series. Time series which stretch further back in time are based on weighted indexes of physical indicators, such as the length of the railway network, or on tax surveys (Tinbergen 1932; Stuvel 1949; Dalmulder 1952). Other, more recent series are the fruits of macroeconomic modelling exercises (e.g. CPB 1983; Kuipers 1977; Kuipers, Muysken and Van Sinderen 1977; see also Minne 1995).

Main economic indicators derived from these existing capital stock series sometimes give idiosyncratic results, which do not fit in with evidence for other countries. This suggests that Dutch data for the earlier period are weaker than those for comparable countries. Maddison (1995), for example, estimates Dutch capital stock in nonresidential structures per head of population to have been $ 12,403 (in 1990 Geary-Khamis dollars) in 1950, which is way above France ($ 8,516), Germany ($ 7,754), and the United Kingdom ($ 5,535). Also, Maddison (1995) presents a 1950 ratio of gross machinery to total non-residential capital stock of 0.13 for the Netherlands, whereas the UK ratio is 0.38 and even the US figure is as high as 0.26. In fact, another example of an implausible result derived from existing capital stock estimates, prompted us to write this paper. Van Ark and De Jong (1996) made a preliminary calculation of the capital intensity of the Dutch economy in 1913 by extrapolating Tinbergen's and Dalmulder's investment series (mentioned above) from Maddison's benchmark estimate of the capital stock in 1950. This resulted in a capital intensity level of more than twice that of the UK, which was considered at least "suspect"

In this paper we introduce a consistent and transparent time series of the capital stock in the Netherlands for the whole period 1900-1995. We linked the results of our research on investment until 1913 to more recent figures in order to obtain a capital stock series which spans almost a century. In making these estimates we followed the procedures set out by

Maddison (1991, 1995). We also carried out a sensitivity analysis to assess the influence of other asset live assumptions on growth rates of the gross capital stock.

SOURCES AND METHODS

To apply the perpetual inventory method it is necessary to obtain (1) an estimate of the value of the capital stock in the first year of the series obtained from a wealth survey or by cumulating investments for a time period as long as the age of the oldest asset still in the stock; (2) investment series in constant prices; and (3) estimates of the lifetime of the capital assets involved, of scrapping patterns, and of depreciation models (see the section on perpetual inventory assumptions, below). Generally, nonresidential capital goods are subdivided into three types of asset: (1) nonresidential buildings, (2) infrastructure or civil engineering works, and (3) machinery and equipment. In addition, we present a time series of the capital stock in residential dwellings.

The Capital Stock at the Beginning of 1900

As a measure of the capital stock at the beginning of our time series (ultimo 1899), we used the outcome of the research project "The National Capital Formation Account of the Netherlands, 1800-1913 " (see Groote 1995, p. 1-2). For civil engineering works the results are published in Groote (1995). Although this work contains annual estimates of both the gross and net capital stock, we could not use these directly, because they are based on more disaggregated perpetual inventory assumptions (regarding lifetime and scrapping patterns) than the ones we apply in this paper. Gross fixed capital formation for infrastructure were deflated by producer price indexes, disaggregated by type of asset and sector. The resulting implicit deflator for aggregate infrastructure consisted in 1913 of labour (weight of 0.39), iron, steel, and copper (together 0.31), wood (0.13), and bricks, stones, and concrete (together 0.17).

For buildings we used estimates prepared by Clemens (see Clemens 1992). His series of the aggregate capital stock in buildings (covering both residential and nonresidential buildings) is essentially based on the annual yield of the land tax. From 1838 onwards, the tax was levied on all real estate except religious and government buildings. The tax yield is a direct measure of the total value of the stock of buildings. For the period 1828-1838 we extended the series backwards with an index series of the total population. First differencing of subsequent tax revenues yields annual additions to the stock. We equated this with annual new investment, and added retirements in order to arrive at gross fixed capital formation (see Feinstein 1988, p. 411). We then added buildings that were exempted from tax levies, or for which better estimates could easily be made: government and church buildings, public utilities, and rail- and tramway stations. In 1913 outlays on religious and public buildings amounted to 1% and 8% of total investment in buildings.

We proceeded to subdivide the aggregate series into residential dwellings and nonresidential buildings. The annual revenues of the land tax in the relevant period would seem the most appropriate source for this. Unfortunately, it is only for the period after 1897 that the tax registers make a distinction between farm buildings, commercial buildings, and residential dwellings (Otten 1996). Even for this later period, it is not possible to directly compare tax revenues for the different categories, as the respective tax bases differed considerably. To distinguish between residential and nonresidential buildings we therefore used detailed investment data for 1921, supplied by CBS. These show that the share of nonresidential buildings in the total was 42%. This percentage is well in line with the results of regional historical studies (for example Collenteur and Paping 1993; table 5.6, p. 97).

We deflated the resulting gross fixed capital formation series in current prices with a producer's price index, consisting of building labour (weight 0.40), bricks (0.28), wood (0.21), and iron (0.11).

The series on investment in machinery for the period 1885-1899 are based on estimates made by Albers (see Albers and Groote 1996). This category covers a wide range of capital goods, and includes plant and equipment in manufacturing industry, equipment in public utilities works, machinery employed in agriculture, vehicles, railway rolling stock and ships. Stocks and work in progress are not included in the series. It must be noted that in our estimates fixed capital formation for a number of sectors is further subdivided by type of asset. For instance, railway tracks, gas mains etc. are grouped with infrastructure, railway stations and construction halls are classified as non-residential buildings, whereas equipment for electricity generation is part of machinery. Livestock, increases in inventories, and work in progress are excluded by definition from our figures, in order to guarantee international comparability (Maddison 1993, p.4). Gross fixed capital formation in machinery consists of two main components: ships and other machinery. The relative importance of shipping in the Netherlands and the nature of the sources warrant this distinction.

The series on other machinery is built up using a commodity-flow concept very similar to the one used by Feinstein (1988, p.292-293). Domestic expenditure on capital goods is estimated as the sum of home production of machinery and net imports. Net imports are taken from the trade statistics. The production of capital goods is calculated from the consumption of its main inputs, namely iron and steel. First, a metal balance of iron and steel available for the production of machinery was drawn up. The consumption of iron and steel for residential and nonresidential construction, railways, consumer durables, and shipbuilding was deducted from the total quantity of iron and steel available. Total material input was converted to values on the basis of the share of materials in the output value of the engineering industry, derived from the financial accounts of a sample of leading Dutch engineering firms. Investment for this category was deflated by a producer

price index combining series for iron and steel (weight 0.72) and engineering wages (0.28). Capital formation in ships was derived in a different manner, because reliable sources are available to approach the issue more directly. The estimates are based on the official registers of merchant shipping, which give very reliable information on the annual tonnage launched. These data were complemented with the output of inland vessels and fishing boats destined for the home market. The tonnage figures were converted to values using information on cost shares from the records of shipyards and shipping companies.
The plausibility of the present estimates series was cross-checked against national income estimates from the production and income sides, and compared to the level of investment established by CBS for 1921. The investment series for machinery fit in well with the other evidence, and the pre-1914 level seems plausible in relation to capital formation in buildings and infrastructure. Our earlier estimates of the gross capital stock of machinery in 1913 (Albers and Groote 1996) cannot directly be compared with the present standardised ones. This is because they are built up from disaggregate perpetual inventory assumptions with longer asset lives. Our 1899 stock figure follows from the cumulation of investment over the previous 14 years.

Gross Fixed Capital Formation, 1900-1995
We constructed our final series of gross fixed capital formation by linking series for subperiods. The periods that must be distinguished are: 1900-1913, 1914-1920, 1921-1939, 1940-1945, 1946-1988, and 1989-1995.

1900-1913
For 1900-1913 we could use the series resulting from the National Capital Formation Account Project mentioned above (see also Albers and Groote 1996).

1914-1920
For 1914-1920 the procedures we adopted for structures and machinery were different. Data on gross fixed capital formation in buildings and civil engineering works were derived in the same manner as for the period 1860-1899 described above. For civil engineering we applied the basic procedure to a sample covering all large railway companies, nearly all electricity companies, and for the central governments' construction of telephone and telegraph networks. Annual investments by these agents were weighted with their shares in the total for 1913 to arrive at total fixed capital formation. The sample comprised 35% of total infrastructure investment in 1913. As a check on the plausibility of the results, we also estimated the level of infrastructure investment in 1921 and compared the results with the independent CBS estimate for this year. Unfortunately, we had to exclude railways from this plausibility check, since the two main companies changed their balance sheets following their merger in 1920. Therefore, only fast growing

sectors (electricity, telecommunications), which covered a mere 8% of 1913 investment, were represented. Because of this unbalanced sampling we expected our 1921 estimate to be higher than the CBS figure. This indeed turned out to be the case, although the discrepancy was not too large. Our estimation procedure results in an investment level of 2,678 million guilders of 1990 against a CBS level of 2,192 million 1990 guilders. In our opinion this may be regarded as a confirmation of the broad validity of our procedure.
For machinery we estimated capital formation in the period 1914-1919 using a commodity-flow index previously published in De Jong and Albers (1994). We calculated the home production of machinery, vehicles, and ships on the basis of the input of materials and the wage sum in the capital goods industry. Net imports of machinery were taken from the trade statistics. The 1920 figure stems from information on the output levels of the engineering and shipbuilding industries in 1920 and 1921.

1921-1939, 1946-1988

For 1921-1939, and also for 1946-1988, the underlying time series of gross fixed capital formation are based on partly unpublished data, which were kindly supplied by the Dutch Central Statistical Office (CBS).[2] The main source was a joint research project carried out in the 1950s under the guidance of CBS and CPB, the Dutch Central Planning Office, which was CBS' partner in the project. The project yielded several macroeconomic time series for the period 1921-38, subdivided by sector and type of asset. These, however, were not published, and remained in the archives for internal use (see Den Bakker, Huitker, Van Bochove 1990, p. 188. Minne 1995 pp. 128-131).
Our aggregate investment figures were derived from the same sources and hence do only marginally deviate from the aggregate series published by Den Bakker, Huitker, and Van Bochove (1990) for the period 1921-1939. We used investment data published by CBS (1989) for the period 1946-1988. We then subdivided our aggregate investment series into 8 sectors and 10 (for some sectors 4) types of asset which together make up the total. The sectors are agriculture, mining, manufacturing, utilities, construction, trade, transport, and other services including government. The types of asset distinguished are as follows: nonresidential buildings, civil engineering works, cars, other vehicles for road transport, trains, ships, air planes, net additions to breeding stock, machinery, and residential dwellings. Den Bakker, Huitker, and Van Bochove (1990, p. 194) give an overview of the methods applied to split the aggregate series into sectoral and type-of-asset subseries for the interwar years. Additional sources were data on social insurance from the CBS archives, trade statistics, and government data on housing.
Some minor corrections were necessary. Government investment in infrastructural works was not available for the years 1946 and 1947. We assumed investment in this category

2 The data were kindly supplied by H. Nieuwenhuizen. CBS bears no responsibility whatsoever for the correctness of these data. They are used and presented here on the sole responsibility of the authors.

to be zero in 1945, and to increase linearly to its 1948 level. In the utilities sector, the breakdown of investments between civil engineering works and machinery obviously was erroneous in the years 1950-56. We redistributed investments for these two categories on the assumption that the share of civil engineering works linearly increased from its 1949 level of 49.3% to its 1957 level of 50.3%, whereas in the original (CBS) series the share fell to approximately 3%.

A major correction was necessary with regard to the deflation procedure. CBS provides all disaggregated time series both in current and in constant (1988) prices. We made a check on the correctness of the implicit deflator by comparing it with official CBS deflators for GDP, and with output prices of the manufacturing sector. The level of the deflator for the 1921-1939 period does not appear to be correct (table 1). Therefore, we opted to use Maddison's 1995 implicit deflator for the period 1921-1939, which we rebased from 1980 to 1988 prices. Maddison derived this deflator from earlier (1992) CBS estimates of fixed capital formation.

Table 1 Comparison of Dutch price levels in 1938 and 1947 according to price indexes from different sources

	1938	1948
(1) original implicit gross fixed capital formation deflator, 1988=100	14.2	16.0
(2) Maddison 1995 Dutch capital stock deflator, 1988=100	6.6	(16.0)
(3) CBS GDP deflator, 1938=100	100	215
(4) CBS output prices metal and electrotechnical industries, 1988=100	12	32

sources: (1): kindly supplied by CBS; (2): kindly supplied by Angus Maddison, originally from CBS; (3) CBS (1994); (4) CBS (1989)

1940-1945

The years 1940-1945 confronted us with two major problems: missing investment data and the necessity to estimate war damage. Not much is known about the effects of the German occupation on the level of investment. On the one hand, it seems natural to expect investment to have fallen sharply, as entrepreneurs were confronted with lack of materials and eventually shortages of labour, which resulted in the closing down of business establishments. Also, direct war damage to capital goods must have been substantial, considering for example the destruction of the city of Rotterdam and its harbour basins, the dismantling of manufacturing plants and railway infrastructure, and the bombing of strategic bridges. On the other hand, the Dutch economy had to contribute to Germany's war production. German economic policy was directed at freeing resources for the war economy, without much consideration for vested economic interests that could have hindered such restructuring. In this respect, the German occupation may also have led to additional investments, in particular in industries which were important to the war effort,

such as electrotechnical engineering and shipbuilding. Data on motive power in manufacturing industry from the censuses of production suggest, for example, an 11% increase from 1938 to 1943. On balance, the negative effects on the development of the economy doubtless predominated, but probably the adverse effects on accumulation were not as large as initially was thought directly after the war.

We used output indices based on CBS data and published by Van Zanden and Griffiths (1989, p. 177) to approximate investment in the period 1940-1944. We assumed the index for manufacturing output to cover machinery investment, we used an unweighted average of the indices for transport and utilities to estimate infrastructure investment, and the index for construction output to obtain investment in both residential and nonresidential buildings. We assumed investment in 1945 to have fallen to half the 1944 level. This may be regarded a conservative assumption, as the war ended in the southern part of the Netherlands already in 1944, and in the rest of the country in May 1945.

Our estimate for war damage was derived from national wealth surveys for 1938 and 1946 (CBS 1947; CBS 1954). We reconciled these to put them on a similar basis. It followed that total nonresidential capital stock (excluding land and inventories) in 1946 was 7% smaller than in 1938. Part of this decline was caused by the decline in investment described above, another part by direct war damage through destruction and plunder. From our estimates of capital formation, and the level of regular retirements of capital goods following from our perpetual inventory assumptions, direct war damage can be put at 7.2% of the 1945 capital stock or 7.0% of the 1938 stock. Our new estimate is much lower than the official calculations made shortly after the war, in which destruction of capital goods was estimated at no less than 40% of total 1939 national wealth, including inventories. The destruction of capital assets in industry was put at 28%. In 1948 CBS adjusted these figures downwards to a level of 18% of industrial capital assets, but still maintained the erroneous assumption of zero investments during the Second World War (see Van Zanden and Griffiths 1989, p. 185). In 1989 Van Zanden and Griffiths (1989, p. 185-186) revised the figure downward to a level of 17% for industrial capital goods and 9% for agricultural land and buildings. Still, their figures included not only direct war damage and German plunder, but also 40% regular retirements. Maddison (1995) went even further in suggesting a level of 10% of pre-1946 cumulated investment. We assumed premature retirements due to war damage to have equally hit all vintages. Retirements in the after war period were corrected for these premature war retirements.

1946-1988

The sources and methods for deriving gross fixed capital formation data for the period 1946-1988 were already described above, in the section dealing with the years 1921-1939.

1989-1995

For 1989-1994 we took investment data, subdivided by type of asset (residential dwellings, buildings, infrastructure, transport vehicles, net additions to breeding stock, and machinery), from the National Accounts (*CBS* 1994). The National Accounts show gross investment in current prices, and annual volume changes as an index series (1990=100). From these it is easy to derive gross investments in constant 1990 prices. Since the National Accounts for 1995 were not yet available at the time of writing, we resorted to preliminary 1995 investment data from the *Central Planning Office* (CPB 1995).

Perpetual Inventory Assumptions

In order to enhance the international comparability of our new series, we applied Maddison's (1993) perpetual inventory assumptions with regards to asset lives, depreciation and scrapping patterns, and purchasing power parities. Although it can be debated whether standardization of perpetual inventory assumptions is the best solution to increase the international comparability of capital stock estimates, it is generally considered a logical first step (Maddison 1995; O'Mahony 1993; Oulton and O'Mahony 1994; Cf. Blades 1993).

Maddison does not distinguish investment by industry and subdivides between two types of assets only: nonresidential structures, and machinery and equipment. For his time series of the capital stock, some of which start further back in the nineteenth century than ours, he uses constant lifetimes of 39 years for civil engineering works and nonresidential building and 14 years for machinery and equipment. These lifetimes are geared towards US-standards, since Maddison is interested above all in productivity performance relative to the lead country. Although statistical offices in other countries may apply lifetimes that are out of line with these, Maddison argues that, at least in international comparisons, it is legitimate to give zero value to assets that business men (and thus statisticians) in the lead country evidently consider outdated "junk" (Maddison 1995). For residential dwellings we used the average US lifetime, which is 72 years (US Department of Commerce 1987).[3]

The (standardised) asset live assumptions initially used in this study therefore differ from the ones applied to earlier estimates of the Dutch capital stock in the nineteenth century (for these see Albers and Groote 1996). Maddison's standardisation procedure boils down to using consistently short services lives, gauged towards modern American standards. The resulting estimates for the level of the gross capital stock estimates therefore represent a lower bound, and the growth rates an upper bound. We calculated alternative capital stock series with much higher asset lives to assess the maximal effects of different lifetime assumptions. For this 'sensitivity analysis' we used asset lives appropriate for the period

3 Official US service lives are 80 years for 1-4 unit structures and 65 years for 5 or more unit structures (US Department of Commerce 1987).

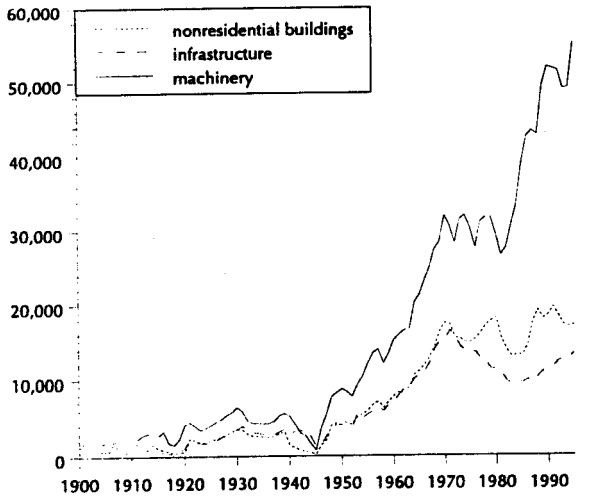
prior to the First World War (60 years for nonresidential buildings, 66 years for infrastructural works, and 20 years for machinery). Since these are clearly too high for the more recent period, this presents an absolute upper bound for the level of the capital stock, and a lower bound for growth rates. The resulting growth rates of the gross capital stock according to both methods are presented in table 2 in the next section. The detailed figures in the appendix tables all refer to the standardised estimates, based on short asset lives. It is to these figures that we consistently refer in our analysis.
Like Maddison, we applied rectangular retirement models for both structures, and machinery and equipment. To calculate depreciation we used an ordinary straight line model. In order to make the resulting time series internationally comparable we have followed general practice in using purchasing power parities rather than official exchange rates. We used the multilateral Geary-Khamis purchasing power parities, as given by Maddison (1995). Measured in Dutch guilders per US dollar, these were 2.7900 for machinery and equipment, and 2.4921 for structures, whereas the average 1990 exchange rate was 1.82.

RESULTS

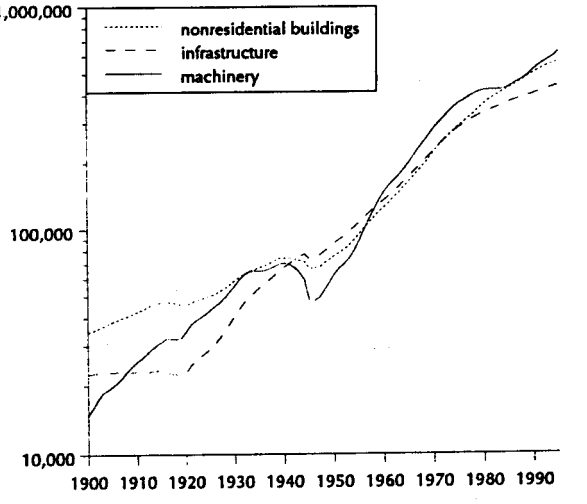
Graph 1 and appendix 1 contain the time series on gross fixed capital formation. Graph 1 covers the twentieth century, and is subdivided into the broad categories of nonresidential buildings, civil engineering works, and machinery and equipment. The appendices contain more detail, with a subdivision in nonresidential buildings, civil engineering works, machinery and equipment, and residential buildings. Appendix 1 contains the investment series that underlie our capital stock estimates in all necessary detail. This means that the time series start in 1828 for residential structures, with a lifetime of 72 years, in 1859 for nonresidential buildings and civil engineering works, and in 1885 for machinery. Graph 2 and appendix 2 show the resulting capital stock series. Again, the graph gives a broad overview, whereas the appendix contains annual data on subsets as well as the aggregate capital stocks. Table 2 in the text gives annual compound growth rates of the gross capital stock. It also shows the results of our sensitivity analysis. Table 2 presents the growth rates of the capital stock for two different sets of estimates. One is based on standardised asset lives (the series to which we refer in the text), the other on longer nineteenth century service lives. Over the whole period even a large upward revision of the average lifetime of capital goods makes surprisingly little difference to growth rates. For shorter subperiods the sensitivity to changes in asset live assumptions is larger, but even then the impact remains relatively limited. It can be concluded that the estimates of the growth rate of the capital stock are quite robust to changes in service lives. The absolute level of the capital stock, on the other hand, will be affected more directly by the application of longer asset

lives. Appendix 3 meets the needs of international comparisons research. It contains the time series of the gross capital stock in international 1990 Geary-Khamis dollars, which makes the series comparable with Maddison's 1995 series. Appendix 4, finally, contains time series of the net capital stocks.

Graph 1: Gross fixed capital formation in the Netherlands, 1900-1995, in millions of 1990 guilders



Graph 2: Gross stock of fixed capital in the Netherlands, 1900-1995, in millions of 1990 guilders



Graph 1 shows an apparently exponential growth of gross fixed capital formation levels, with marked declines, however, during both World Wars, the depression of the 1930s, and in the 1970s. The linking of our investment series, which come from different sources for a number of subperiods, leaves no large unexplained gaps or unexpected jumps. There is ample reason to trust the consistency of the series.

Over the whole period, machinery investment gained in relative importance. As was to be expected, the series on capital formation in machinery is the most volatile, with pronounced responses to business cycle movements. During World War I machinery investment declined less than outlays on structures. It must be concluded that wartime investments were biased towards directly productive activities, inducing and at the same time reinforced by structural change. The growth rate of the capital stock in machinery accelerated further after the First World War. The progress of manufacturing industry during the 1920s (a phase of rapid industrialisation in the Netherlands) clearly shows in the graphs and tables. A shortening of the standard working week in 1920 resulted in a rise of hourly wages, inducing substitution of capital for labour (De Jong and Albers 1994).

Table 2 Annual compound growth rates of the gross nonresidential capital stock at constant prices; calculated with two sets of lifetimes (see text for details)

based on:	20th century international life times			19th century Dutch life times		
	total	structures	machinery	total	structures	machinery
1900-95	3.3%	3.1%	4.0%	3.2%	2.9%	4.0%
1900-29	2.5%	1.8%	4.4%	2.6%	2.0%	4.5%
1929-47	1.5%	2.4%	-0.4%	1.2%	1.7%	0.4%
1947-73	5.9%	5.1%	7.6%	5.5%	4.9%	6.7%
1973-95	2.9%	3.0%	2.9%	3.1%	3.0%	3.2%
1900-13	2.4%	1.5%	5.2%	2.5%	1.8%	5.0%
1913-21	1.3%	0.4%	3.1%	1.9%	1.1%	3.6%
1921-29	3.9%	3.6%	4.4%	3.6%	3.2%	4.4%
1929-38	3.6%	4.0%	2.9%	3.1%	3.1%	3.1%
1938-47	-0.5%	0.8%	-3.6%	-0.6%	0.2%	-2.3%
1947-60	5.9%	4.7%	8.8%	4.6%	4.1%	5.6%
1960-73	5.9%	5.5%	6.5%	6.4%	5.6%	7.8%
1973-79	3.9%	4.1%	3.6%	4.1%	4.1%	4.2%
1979-87	2.3%	2.9%	1.4%	2.7%	2.6%	2.7%
1987-95	2.8%	2.2%	3.8%	2.6%	2.4%	2.9%

During the recession of the 1930s strict deflationary policies, based on the urgent wish to stick to the Gold Standard, were counteracted by measures to protect the agrarian sector. The resulting price stickiness stood in the way of a reduction of real labour costs. This caused a persistent pattern of high relative wages inducing capital deepening investment. Still, the squeezing of profits drained internal resources for investment. As a result, the crisis of the 1930s marks a rare episode —the other one being the late 1970s and early 1980s— in which the rate of increase of the capital stock was substantially lower for machinery and equipment than for nonresidential structures.

The most conspicuous conclusion on the effects of the Second World War may well be that the productive capacity of the country was not as is suggested in common historiography. The most marked drop occurred with the capital stock of machinery and equipment. An interesting feature is that the effects of the war seem to have been most dramatic with respect to a shortcoming of replacement investment. Scrapping and obsolescence probably were more important factors in the erosion of productive capacity than direct war damage. Thanks to their longer lifetime, this was not as important for buildings and infrastructure.

Recovery of the capital stock in machinery after 1945 was rapid. The capital stock of machinery increased at an unprecedented rate of 8.7% over the period 1947-1960. The growth rates of the aggregate capital stock are as high as in Germany (5.8%), which may at first sight seem surprising. Yet, a number of observations can be made which may solve part of this puzzle. First, in Germany as well war damage was less severe than many would think, so that growth did not start from scratch. Second, in the 1950s and 1960s the Netherlands witnessed a profound increase in highly capital intensive industries. Third, in the first decades after the war the rate of population growth was considerably higher in the Netherlands than in the rest of Western-Europe. Therefore, demographic factors were probably partly responsible for the rapid rise of the aggregate capital stock in the 1950s and 1960s. Fourth, the low level of wages in the Netherlands until the early 1960s, in particular relative to other countries such as Belgium, and strict government policies of wage control may have had a positive effect on retained profits which were ploughed back in the form of capital widening investment.
The relaxation of wage controls after 1960 had strong repercussions on relative prices. Still, considerable capital deepening occurred throughout the 1950s and 1960s. After 1960, investment was increasingly directed at processing industries such as petro-chemicals. The growth rate of the capital stock levelled off after 1973, in line with common experience across OECD-countries. Since the mid 1980s growth rates have picked up again. After the slump of the 1970s and early 1980s, recovery has been remarkably swift over the last decade. The share of machinery investment in total investment reached unprecedented heights during the 1990s.

Infrastructure gained in relative importance in the 1920s and 1930s. This is most clearly seen in the development of the respective capital stocks. Figure 2 shows that for some time the infrastructural capital stock grew even faster than the stock of machinery and equipment. This can be ascribed partly to a fall in retirements. In the first two decades of the twentieth century, many works that had been constructed in the infrastructural boom period of 1860-1880 were at the end of their life cycle and needed replacement. In the 1920s and 1930s, a fall in retirements reflected a fall in investment levels in the second half of 1880s and particularly the 1890s. The relatively fast growth of the infrastructural capital stock in the 1920s and 1930s was of course to al large extent caused by a rise in investment, mainly due to large scale impolderings and dyke construction. This was accompanied by a spectacular rise of road transport and certain network industries, such as electric utilities and telecommunications. The government also, albeit reluctantly, initiated minor public works in order to reduce the effects of the depression. After the Second World War infrastructure investment relatively lost in importance, in spite of extensive road building. In the aftermath of the 1953 flooding disaster in the South-Western part of the country a costly scheme of dam and dike construction called the 'Delta

plan' was set up to ensure safety from further flooding. This resulted in a fivefold increase in infrastructural investment. In 1971 infrastructure investment reached its zenith. After 1971 it declined until the mid 1980s. Following a trough in 1983, with a level of only 9.3 billion guilders, capital formation in infrastructure slowly rose again to a level of 13.4 billion guilders in 1995. This may be seen as the result of a change in government policy with regard to transport infrastructure. The capacity of the existing road network turned out to be insufficient to keep up with the acceleration in world economic growth. At the same time, environmental policies induced large scale and very costly railway infrastructure renewals and extensions.

Until the 1970s investment in nonresidential buildings moved surprisingly parallel to infrastructure investment. Since private construction is more sensitive to general economic conditions than infrastructure, which is often financed through public channels, it was hit harder by the First World War and the Great Depression. On the other hand, recovery was stronger as well. Capital formation in nonresidential construction did not decline as severely as did infrastructure investment during the 1970s. Instead, it remained more or less at the same level, albeit not without large business cycle up- and downswings.

For residential capital formation followed by and large the same pattern as nonresidential building construction. Residential investment was hit severely during the first years of the Great Depression, when it declined from 4.5 billion guilders in 1930 to 2.8 billion guilders in 1933. However, the continuation of population growth gradually induced a recovery. The same mechanism worked during the recession of the 1970s. Although residential capital formation fell from 26.1 billion guilders in 1973 to 21.3 billion guilders two years later, it recovered relatively easy, to surpass the 1973 level again in 1977. Also, the decrease in residential investment in the 1970s was counteracted by a simultaneous fall in the retirement of old houses, which may be regarded an echo of falling investment levels during the Great Depression and the Second World War.

Comparisons with Existing Estimates of the Aggregate Capital Stock

Alternative Estimates for the Pre-1950 Period: Tinbergen, Stuvel, Dalmulder

The first attempts to measure the capital stock of the Netherlands were made by Tinbergen (1932), Stuvel and Tinbergen (CBS 1942), and Stuvel (1949). Their estimates were all based on the same sources and methods. Basically, they applied (weighted) indicators of the physical stock of ships, locomotives and railway equipment, industrial horsepower,

animals, dwellings and road transport. Stuvel (1949) refined the rather crude weighting procedures which were used in Stuvel and Tinbergen's earlier estimates. Therefore, we focus here on Stuvel (1949).

Stuvel's 1949 series is a pioneering attempt to gauge the development of investment in six countries (USA, UK, Germany, France, Sweden, and the Netherlands) over the period 1870-1939. He wrote the paper for the First Conference of the International Association for Research in Income and Wealth, held at Cambridge in 1949. An earlier version of this paper was published in Dutch in 1942 (CBS 1942). Stuvel's approach centres on physical indicators on quantity, size, and capacity for a number of capital goods for which he had information. These were then weighted with their approximate shares in national wealth around 1910 and 1930. (Stuvel 1949, p.12-13, appendix C). Conceptually, there are three marked differences with our figures. First, Stuvel does not apply the perpetual inventory method. Second, he uses livestock figures to quantify the capital stock in agriculture whereas livestock does not figure in our definition. Third, Stuvel includes dwellings, whereas our basic computations refer to non-residential capital stocks. If we include residential housing in our capital stock, large discrepancies with the Stuvel figures in the same direction still remain.

The growth rates of the capital stock as calculated by Stuvel may for the purposes of this paper be compared with our estimates for the period 1900-1939. In general, Stuvel's series show very high growth rates until 1918; an average annual compound growth rate of 2.9% for 1870-1913 well exceeds our 2.4% for total non-residential capital stock in the dynamic years 1900-1913. His growth rate of 2.5% for the war years 1914-1918 seems implausibly high, and well out of line with our 0.15% for the same period. However, Stuvel's growth rate for the 1919-1939 period is below ours: 3.3. as opposed to 3.7%. His aggregates are adjusted downwards by the modest increases in the capital stocks in agriculture and residential housing. Stuvel's figures for manufacturing industry, shipping, and transport are consistently much higher than our calculations indicate. This is probably caused by the unbalanced nature of his sample which in our opinion yields excessively high rates of growth.

Of course, as is the case with Tinbergen's contribution, the unbalanced composition of his sample and the crude weighting procedure mean that Stuvel's figures are not consistent and wholly comparable capital stock values. Paraphrasing Maddison (1995), we may say Stuvel estimates a capital heap rather than a stock. We feel that in these respects the standardised capital stocks using the perpetual inventory method are superior to earlier contributions.

Dalmulder (1952) prepared another estimate for the prewar period. In fact, his must be one of the first applications of the perpetual inventory method, as pioneered by Raymond Goldsmith in 1951. Dalmulder estimated the capital stock (1921-1938) by cumulating net

investments in constant prices. To compare our estimates with Dalmulder's we removed investments in residential structures from his series. The annual growth rate for the period 1921-1938 is a mere 2.6% as against our estimate of 4.0%. The difference cannot be explained by the underlying investment figures and the deflator applied, as these run closely parallel to ours.

Instead, it is caused by Dalmulder confusing different concepts of capital. In the first place, his depreciation allowances, taken from an independent source, seem much too volatile, and show a steep decline during the depression years. In the second place, Dalmulder uses the results of the 1938 national wealth survey as his benchmark capital stock. He then works back to 1921 by subtracting annual estimates of net capital formation. The wealth survey, however, was performed more on a gross than a net basis. Indeed, Dalmulder's benchmark stock in 1938 is much closer to our gross stock than our net stock (deviations of 8% and 48%). In the third place, the 1938 national wealth survey includes land, inventories, and livestock. Dalmulder's capital flows, however, correctly exclude these elements of wealth that are not regarded reproducible fixed capital. It is obvious that Dalmulder's combination of net capital formation flows with a partly gross national wealth benchmark level reduces his resulting growth rates.

Maddison's 1995 Standardised Estimates for 1950-1990

In contrast to Summers and Heston, to be treated below, Maddison (1995) makes ingenious efforts to overcome the problem of a missing capital stock estimate for the opening year of his time series (1950). He does not make an independent survey estimate of the capital stock in 1950, but instead extends the time series of the underlying capital flows as far back as 1910 for structures and 1935 for machinery and equipment. For 1921-39 and after 1948 Maddison uses unofficial CBS estimates, from the same origin and therefore closely resembling our series. For the missing years, Maddison was forced to use a series for machinery and equipment investment by enterprises, presented in Den Hartog and Tjan (1979). Two important problems related to this procedure must be pointed out. In the first place, the origin of the Den Hartog and Tjan series is unclear . The series can be traced back to estimates made by the Dutch Central Planning Office using the FREIA macroeconomic model (see CPB 1983, compare Minne 1995, p.128). It is difficult to judge, however, whether the series are based on empirical sources and only used as inputs in the model, or must be regarded as the output of simulations performed with the model. The investment series presented in a recent CPB publication (Minne (1995), pp. 141-142) closely resemble ours for most of the period from 1922 onwards.[4] They probably stem from the same basic source as the CBS estimates, which is reassuring. Nevertheless, the

4 The average deviation of Minne's series relative to our investment levels is 3.2% over the period 1922-1960. The discrepancies are, however, concentrated in the years 1931-1933 and 1940-1945. The differences are generally well below 1% for other years.

origin of the CPB figures for earlier years remains unclear.
In the second place, Maddison was forced to assume investment in structures to move parallel to private investment in machinery. Of course, this is in contradiction not only with our new series, but also with the main stylized fact regarding the increasing importance of machinery investment. Kuznets' conclusions about the increasing share of machinery in total capital formation since the nineteenth century are widely accepted (Kuznets 1961. For a more recent reformulation with additional empirical evidence see De Long 1992; De Long and Summers 1991). This conclusions has been elaborated and generally validated for the Netherlands (Albers and Groote 1996). Assuming infrastructural and building investment to grow parallel to machinery investment thus induces a substantial overestimation of the former. As a result, Maddison's estimate for the capital stock in nonresidential structures for 1950 seems to be too high. International comparisons of the capital stock per capita and the share of the machinery capital stock in the total nonresidential capital stock suggest that it may in fact be too high by a factor of 1.5-2.0 (Maddison 1993, tables 4 and 6b; see also our introduction to this paper). The ratio of our estimate of the 1950 capital stock in nonresidential structures to Maddison's is 1.752.

The Penn World Tables 5.6 Series for 1965-1990
Together with Maddison's time series the Penn World Tables (Summers and Heston 1991) are the most widely used international macroeconomic data set. Although this is not fully justified by the quality of the capital stock data in the Penn World Tables, we cannot refrain from making a comparison with our series. Unfortunately, the capital stock estimates in the Penn World Tables are not consistent long run time series. Although Summers and Heston do suggest that they apply the perpetual inventory method, they do not dispose of the necessary capital flow series to accumulate into consistent capital stocks. Neither did they make an independent estimate of the capital stock in the opening year of their time series (1950). Probably, the relative shortness of the time series they had available made them apply extraordinarily short lifetimes of 28.6 years for construction, 12 years for machinery, and 7.5 years for transport equipment. This still means, however, that their aggregate capital stock estimate is comprehensive for the first time by 1979, which is one lifetime of structures after the opening year of their flow series.
They nevertheless do publish capital stock estimates from 1965 onwards. The obvious result is that the growth rates of the capital stock for the early years are, to say the least, positively biased. Their annual compound growth rate of the Dutch capital stock for nonresidential structures for the period 1965-1973, for example, is as high as 8.2%. For machinery and equipment, with a shorter lifetime, the problem is less severe, exemplified in a growth rate of 6.8% for the same period. The only conclusion can be that aggregate capital stock estimates from the Penn World Tables (mark 5.6) are of use for eleven years only (1980-1990). The applicability of the Penn World Table capital stock estimates in

international comparisons is further reduced by the use of double declining balance depreciation models. Although one might argue that net capital stocks should be used in productivity analysis, it is very uncommon to use other than straight line depreciation models.

Conclusions

In this paper we presented for the first time standardised estimates of capital stocks for the Netherlands for the period 1900-1995. The series have been constructed using a transparent perpetual inventory approach, following Maddison's (1993) methodology to enhance international comparability. The advantage of our series over most alternative previous attempts is that the figures are conceptually consistent and that they relate to the whole economy. A first analysis of the results confirm their general plausibility. A sensitivity analysis has been carried out to assess the effects of other asset live assumptions. The growth rate of the capital stock is remarkably robust to changes in average asset lives. For the post-World War II period we used investment statistics published by CBS, for earlier years disaggregated investment series which go back to 1860 (structures) or 1885 (machinery). The latter are partly the outcome of the National Capital Formation Account research project, for another part they are based on basic data from the archives of the Dutch Central Statistical Office, with some further adjustments. Our series are subdivided into buildings, infrastructure, and machinery. Although our main interest lies with non-residential capital, we also present estimates of the stock of dwellings.
Finally, we compare our results with existing estimates of the aggregate capital stock in the Netherlands. For the pre-World War II period our growth rates generally are lower than those found in earlier literature, which are mostly based on a physical indicator method. One of our main findings is an estimate of direct war damage for World War II of 7.2%. This is a considerable downward adjustment to previous valuations. The growth rate of the capital stock during the first two decades after 1950, on the other hand, is 1.4 percentage points higher than Maddison's previous estimate. This is caused by a considerable downward adjustment of the 1950 stock valuation, which is plausible in the light of a comparison with the capital intensity in other countries for which standardised estimates of capital stocks are available. Our 1988 stock estimate differs is only 0.6% lower than the CBS (1995, p.14) estimate. The growth rates of the aggregate capital stock in the Netherlands in the period 1950-1970 are high relative to other OECD-countries, in particular with regard to the stock of machinery and transport equipment. This may be explained by demographic factors, by rapid industrialisation, and by the capital intensive nature of the Dutch services sector.

APPENDIX 1: GROSS FIXED CAPITAL FORMATION IN THE NETHERLANDS, 1828-1995 (RELEVANT YEARS ONLY), IN MILLIONS OF 1990 GUILDERS

Gross Fixed Capital Formation in the Netherlands, 1828-1995 (Relevant Years Only), in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential structures	total
1828					635	
1829					444	
1830					525	
1831					295	
1832					217	
1833		124			508	
1834		157			495	
1835		149			586	
1836		159			667	
1837		95			555	
1838		155			669	
1839		114			688	
1840	523	263			714	
1841	512	168			698	
1842	529	180			721	
1843	533	270			726	
1844	536	222			731	
1845	519	206			708	
1846	500	155			682	
1847	541	238			737	
1848	552	128			753	
1849	610	104			832	
1850	514	104			701	
1851	507	92			692	
1852	518	609			707	
1853	458	275			625	
1854	453	297			617	
1855	476	260			650	
1856	507	259			692	
1857	483	190			659	
1858	507	231			691	
1859	488	255			665	
1860	506	411			691	
1861	544	332			742	
1862	552	338			753	
1863	550	461			751	
1864	553	494			754	
1865	584	608			796	
1866	582	765			794	
1867	561	743			765	
1868	566	670			771	
1869	628	664			856	
1870	618	807			843	
1871	680	579			927	
1872	669	816			913	
1873	525	611			716	
1874	493	582			672	
1875	706	571			963	
1876	746	630			1,017	
1877	835	889			1,139	
1878	731	731			997	
1879	987	572			1,346	

Gross Fixed Capital Formation in the Netherlands, 1828-1995 (Relevant Years Only), in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential structures	total
1880	922	627	816	2,365	1,258	3,623
1881	1,006	779	748	2,533	1,372	3,905
1882	1,046	447	505	1,998	1,427	3,425
1883	1,072	578	819	2,469	1,462	3,931
1884	984	686	898	2,567	1,342	3,909
1885	1,016	614	738	2,368	1,386	3,754
1886	1,152	661	582	2,394	1,571	3,966
1887	1,051	542	613	2,206	1,433	3,639
1888	1,284	426	528	2,238	1,751	3,989
1889	1,109	280	753	2,142	1,512	3,655
1890	1,130	495	1,049	2,673	1,541	4,214
1891	1,060	518	1,181	2,758	1,445	4,204
1892	1,052	546	948	2,546	1,435	3,981
1893	1,076	450	953	2,479	1,468	3,947
1894	1,106	479	899	2,484	1,508	3,992
1895	1,065	544	964	2,573	1,453	4,026
1896	1,089	435	1,003	2,528	1,486	4,014
1897	1,103	368	1,293	2,765	1,505	4,270
1898	1,041	463	1,371	2,876	1,420	4,296
1899	1,188	397	1,717	3,301	1,620	4,921
1900	1,246	473	1,663	3,382	1,699	5,081
1901	1,239	531	1,663	3,434	1,690	5,124
1902	1,282	565	1,981	3,828	1,748	5,576
1903	1,390	682	1,941	4,012	1,896	5,908
1904	1,459	687	1,630	3,777	1,991	5,768
1905	1,416	684	1,856	3,956	1,931	5,887
1906	1,492	778	1,745	4,015	2,035	6,050
1907	1,246	742	1,995	3,983	1,700	5,683
1908	1,330	789	2,257	4,376	1,814	6,190
1909	1,495	586	2,203	4,284	2,039	6,323
1910	1,617	679	2,165	4,461	2,205	6,666
1911	1,643	601	2,208	4,453	2,242	6,695
1912	1,658	620	2,726	5,004	2,262	7,266
1913	1,744	898	2,951	5,593	2,379	7,972
1914	1,522	749	2,833	5,104	2,076	7,180
1915	1,024	579	2,656	4,259	1,397	5,656
1916	842	508	3,217	4,567	1,148	5,715
1917	646	411	1,741	2,799	882	3,681
1918	432	387	1,476	2,294	589	2,884
1919	495	709	2,184	3,388	676	4,064
1920	603	1,062	4,073	5,738	823	6,561
1921	2,294	2,192	4,419	8,906	3,093	11,999
1922	2,065	1,968	3,945	7,978	2,776	10,754
1923	1,764	1,691	3,403	6,859	2,380	9,239
1924	1,854	1,689	3,653	7,196	2,572	9,767
1925	2,011	1,824	3,975	7,809	2,817	10,627
1926	2,271	2,053	4,482	8,806	3,194	12,000
1927	2,527	2,440	4,792	9,759	3,361	13,120
1928	2,842	2,716	5,344	10,902	3,765	14,667
1929	3,159	3,224	5,754	12,137	3,994	16,131
1930	3,478	3,491	6,434	13,402	4,459	17,861
1931	3,433	3,864	5,809	13,106	3,905	17,011
1932	2,823	3,442	4,520	10,784	2,934	13,718
1933	2,594	3,058	4,261	9,913	2,818	12,731
1934	2,561	2,985	4,292	9,838	2,901	12,739
1935	2,491	2,873	4,218	9,581	2,818	12,399

Gross Fixed Capital Formation in the Netherlands, 1828-1995 (Relevant Years Only), in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential structures	total
1936	2,423	2,772	4,226	9,421	2,791	12,213
1937	2,546	2,788	4,537	9,871	3,065	12,937
1938	2,977	3,164	5,315	11,456	3,632	15,088
1939	3,183	3,466	5,599	12,248	3,811	16,059
1940	1,393	2,922	5,202	9,517	1,667	11,184
1941	1,094	3,211	4,063	8,368	1,310	9,678
1942	763	3,245	3,022	7,030	913	7,943
1943	597	3,347	2,626	6,570	715	7,284
1944	464	2,514	1,585	4,564	556	5,120
1945	232	1,257	793	2,282	278	2,560
1946	1,361	1,381	3,626	6,368	2,782	9,150
1947	2,010	2,523	5,343	9,875	4,100	13,976
1948	3,967	3,674	7,754	15,395	5,468	20,863
1949	4,298	4,068	8,288	16,655	5,820	22,475
1950	4,466	4,051	8,804	17,321	6,235	23,556
1951	4,308	3,880	8,409	16,597	5,963	22,560
1952	4,039	3,673	7,803	15,515	5,524	21,039
1953	5,209	5,575	9,328	20,112	6,379	26,491
1954	5,443	4,956	10,442	20,841	7,393	28,234
1955	5,999	5,416	12,095	23,511	8,570	32,081
1956	6,679	5,862	13,498	26,039	9,603	35,642
1957	7,129	6,344	14,016	27,489	9,966	37,456
1958	6,282	5,936	12,102	24,320	8,678	32,998
1959	7,093	6,686	13,426	27,205	9,630	36,835
1960	7,846	7,043	15,236	30,125	10,819	40,944
1961	8,289	7,992	15,938	32,219	11,464	43,683
1962	8,652	8,584	16,515	33,751	11,870	45,621
1963	8,911	9,138	16,709	34,757	11,909	46,666
1964	10,620	10,126	20,264	41,010	14,384	55,394
1965	11,076	10,594	21,300	42,970	15,239	58,209
1966	11,931	11,060	23,239	46,229	16,646	62,876
1967	12,927	12,203	24,941	50,071	17,909	67,980
1968	14,424	14,046	27,436	55,907	19,733	75,639
1969	16,440	14,998	28,408	59,847	18,667	78,513
1970	17,493	15,379	31,978	64,850	19,564	84,414
1971	17,225	16,479	30,566	64,269	21,413	85,682
1972	15,499	15,582	28,315	59,396	24,347	83,743
1973	15,380	14,272	31,486	61,139	26,086	87,225
1974	14,891	13,763	32,014	60,669	23,059	83,728
1975	14,901	13,581	30,294	58,775	21,325	80,100
1976	15,423	13,561	27,618	56,602	21,728	78,330
1977	16,164	12,577	31,132	59,873	26,105	85,978
1978	17,154	12,250	31,747	61,151	27,000	88,151
1979	17,780	11,237	31,772	60,789	25,875	86,665
1980	18,159	11,278	29,519	58,956	26,880	85,836
1981	15,409	10,764	26,645	52,818	24,102	76,920
1982	13,903	9,714	27,617	51,233	22,495	73,728
1983	12,926	9,302	30,652	52,881	22,325	75,205
1984	13,193	9,573	33,439	56,205	22,909	79,114
1985	13,122	9,491	39,086	61,699	22,723	84,422
1986	14,486	9,875	42,641	67,002	24,038	91,041
1987	17,702	9,598	43,416	70,715	25,788	96,503
1988	19,194	10,300	42,891	72,385	28,511	100,896
1989	18,041	10,989	49,442	78,472	27,743	106,215
1990	18,580	11,190	51,920	81,690	27,040	108,730
1991	19,583	11,626	51,731	82,940	25,580	108,520

Gross Fixed Capital Formation in the Netherlands, 1828-1995 (Relevant Years Only) , in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential structures	total
1992	18,376	12,421	51,440	82,236	27,229	109,466
1993	17,149	12,510	49,002	78,662	27,013	105,675
1994	16,964	12,712	49,174	78,849	29,203	108,053
1995	17,176	13,411	55,198	85,784	30,809	116,594

APPENDIX 2: GROSS FIXED CAPITAL STOCK IN THE NETHERLANDS, 1900-1995, IN MILLIONS OF 1990 GUILDERS

Gross Fixed Capital Stock in the Netherlands, 1900-1995, in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential buildings	total
1900	34,360	16,880	14,935	66,175	67,952	134,127
1901	35,047	17,073	15,986	68,106	69,198	137,304
1902	35,778	17,177	17,439	70,394	70,422	140,816
1903	36,615	17,365	18,626	72,607	72,023	144,629
1904	37,491	17,445	19,208	74,143	73,796	147,939
1905	38,325	17,364	19,883	75,572	75,220	150,792
1906	39,255	17,400	20,680	77,335	76,759	154,095
1907	39,936	17,472	21,721	79,130	77,873	157,003
1908	40,639	17,597	23,079	81,315	79,020	160,335
1909	41,516	17,376	24,319	83,210	80,504	163,714
1910	42,453	17,476	25,480	85,409	82,041	167,450
1911	43,427	17,261	26,395	87,083	83,595	170,678
1912	44,560	17,270	27,749	89,580	85,143	174,723
1913	45,812	17,587	28,983	92,382	86,824	179,205
1914	46,627	17,764	30,153	94,545	88,179	182,723
1915	46,905	17,713	31,146	95,765	88,849	184,614
1916	46,913	17,332	32,383	96,627	89,267	185,894
1917	46,828	17,012	32,183	96,023	89,441	185,464
1918	46,273	16,827	32,028	95,128	89,348	184,477
1919	45,847	16,908	32,356	95,111	89,286	184,398
1920	45,444	17,191	34,685	97,320	89,357	186,677
1921	46,693	18,936	37,109	102,738	91,617	194,355
1922	47,686	20,326	38,797	106,809	93,693	200,502
1923	48,467	21,331	39,997	109,795	95,381	205,176
1924	49,305	22,406	41,486	113,196	97,245	210,441
1925	50,164	23,569	43,252	116,985	99,438	216,423
1926	51,385	25,079	45,008	121,472	102,015	223,487
1927	52,627	27,093	46,849	126,570	104,726	231,296
1928	54,361	29,529	49,360	133,250	107,799	241,049
1929	56,391	32,258	52,457	141,106	111,134	252,241
1930	58,809	35,231	55,674	149,714	114,902	264,616
1931	61,190	38,549	59,742	159,481	118,142	277,623
1932	62,937	41,541	62,787	167,264	120,385	287,650
1933	64,425	44,120	64,864	173,409	122,461	295,870
1934	65,921	46,561	65,082	177,565	124,609	302,174
1935	67,323	48,999	64,881	181,203	126,676	307,879
1936	68,643	51,403	65,162	185,208	128,714	313,921
1937	70,147	53,728	66,296	190,171	130,983	321,154
1938	71,937	56,495	67,958	196,390	133,820	330,210
1939	73,875	59,488	69,582	202,944	136,866	339,810
1940	74,028	61,879	70,302	206,209	137,762	343,971
1941	73,841	64,524	69,572	207,938	138,216	346,153
1942	73,214	67,088	67,251	207,553	138,286	345,839
1943	72,351	69,747	64,123	206,222	138,073	344,295
1944	71,400	71,577	59,275	202,252	137,716	339,968
1945	66,587	68,187	48,009	182,783	127,364	310,146
1946	66,793	68,925	47,561	183,279	129,611	312,890
1947	67,564	70,758	49,090	187,412	132,886	320,297
1948	70,127	73,945	52,999	197,071	137,474	334,545
1949	72,900	77,433	57,515	207,848	142,293	350,142
1950	75,813	80,983	62,539	219,335	147,669	367,004
1951	78,554	84,342	66,858	229,753	152,424	382,177
1952	80,940	87,216	69,792	237,948	156,827	394,775

Gross Fixed Capital Stock in the Netherlands, 1900-1995, in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential buildings	total
1953	84,719	92,141	73,968	250,827	161,972	412,799
1954	89,229	96,617	79,654	265,500	168,075	433,575
1955	94,478	101,624	88,133	284,235	175,321	459,556
1956	100,601	107,174	99,055	306,830	183,720	490,550
1957	107,389	113,231	110,892	331,512	192,438	523,949
1958	113,267	118,557	121,854	353,679	199,682	553,361
1959	119,848	124,281	134,933	379,063	208,016	587,079
1960	125,491	129,231	146,544	401,265	217,222	618,486
1961	131,806	135,354	157,139	424,299	227,311	651,610
1962	138,784	142,346	165,899	447,030	237,778	684,808
1963	145,932	149,894	174,320	470,146	248,380	718,525
1964	154,632	158,295	185,780	498,708	261,466	760,174
1965	163,528	166,936	198,671	529,135	275,374	804,509
1966	173,023	175,656	214,107	562,786	290,650	853,436
1967	183,199	185,242	229,720	598,161	307,244	905,405
1968	194,555	196,164	246,714	637,432	325,628	963,061
1969	207,608	207,770	263,027	678,405	342,928	1,021,333
1970	221,759	219,385	281,507	722,651	361,209	1,083,861
1971	236,252	232,522	298,057	766,831	381,140	1,147,971
1972	249,247	245,145	314,271	808,663	403,925	1,212,588
1973	262,157	256,531	332,331	851,019	428,460	1,279,479
1974	274,649	267,521	349,109	891,279	449,908	1,341,187
1975	287,218	278,429	363,465	929,112	469,475	1,398,587
1976	300,186	289,301	374,568	964,055	489,350	1,453,405
1977	313,464	298,813	388,991	1,001,268	513,662	1,514,930
1978	327,526	307,696	400,474	1,035,696	538,765	1,574,461
1979	344,004	316,111	410,946	1,071,061	563,078	1,634,138
1980	361,160	324,277	417,226	1,102,663	588,281	1,690,944
1981	375,898	331,895	418,930	1,126,723	610,481	1,737,205
1982	389,295	338,361	419,111	1,146,767	630,908	1,777,675
1983	401,848	345,248	421,355	1,168,451	651,129	1,819,580
1984	414,900	353,663	422,815	1,191,379	671,914	1,863,292
1985	426,661	361,773	431,335	1,219,769	692,395	1,912,164
1986	439,138	369,125	445,661	1,253,924	714,495	1,968,419
1987	452,873	375,049	457,591	1,285,513	739,024	2,024,537
1988	467,769	381,281	468,468	1,317,517	766,524	2,084,041
1989	481,343	388,218	487,616	1,357,178	793,523	2,150,701
1990	495,616	395,528	511,918	1,403,063	820,112	2,223,174
1991	511,160	403,482	532,517	1,447,159	845,153	2,292,312
1992	524,326	410,328	552,210	1,486,864	871,697	2,358,561
1993	536,033	417,882	569,440	1,523,355	895,755	2,419,109
1994	546,997	425,178	589,095	1,561,270	922,320	2,483,589
1995	557,493	432,727	617,648	1,607,869	950,886	2,558,755

APPENDIX 3: GROSS FIXED CAPITAL STOCK IN THE NETHERLANDS, 1900-1995, IN MILLIONS OF 1990 GEARY-KHAMIS DOLLARS

Gross Fixed Capital Stock in the Netherlands, 1900-1995, in millions of 1990 Geary-Khamis dollars

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential buildings	total
1900	13,787	6,774	5,353	25,914	27,267	53,181
1901	14,063	6,851	5,730	26,644	27,767	54,411
1902	14,357	6,893	6,250	27,500	28,258	55,758
1903	14,692	6,968	6,676	28,337	28,900	57,237
1904	15,044	7,000	6,884	28,928	29,612	58,540
1905	15,378	6,968	7,127	29,473	30,183	59,656
1906	15,752	6,982	7,412	30,146	30,801	60,947
1907	16,025	7,011	7,785	30,822	31,248	62,070
1908	16,307	7,061	8,272	31,640	31,708	63,349
1909	16,659	6,972	8,716	32,348	32,304	64,651
1910	17,035	7,013	9,133	33,180	32,920	66,101
1911	17,426	6,926	9,461	33,813	33,544	67,357
1912	17,881	6,930	9,946	34,757	34,165	68,922
1913	18,383	7,057	10,388	35,828	34,840	70,668
1914	18,710	7,128	10,808	36,646	35,383	72,029
1915	18,822	7,108	11,164	37,093	35,652	72,745
1916	18,825	6,955	11,607	37,386	35,820	73,206
1917	18,791	6,826	11,535	37,152	35,890	73,042
1918	18,568	6,752	11,480	36,800	35,853	72,652
1919	18,397	6,785	11,597	36,779	35,828	72,607
1920	18,235	6,898	12,432	37,565	35,856	73,421
1921	18,736	7,599	13,301	39,635	36,763	76,399
1922	19,135	8,156	13,906	41,197	37,596	78,793
1923	19,448	8,560	14,336	42,344	38,273	80,617
1924	19,784	8,991	14,869	43,645	39,021	82,666
1925	20,129	9,457	15,503	45,089	39,901	84,990
1926	20,619	10,063	16,132	46,815	40,935	87,750
1927	21,118	10,871	16,792	48,781	42,023	90,804
1928	21,813	11,849	17,692	51,354	43,256	94,610
1929	22,628	12,944	18,802	54,374	44,595	98,969
1930	23,598	14,137	19,955	57,690	46,106	103,796
1931	24,554	15,468	21,413	61,435	47,407	108,842
1932	25,255	16,669	22,504	64,428	48,307	112,735
1933	25,852	17,704	23,249	66,804	49,140	115,944
1934	26,452	18,684	23,327	68,463	50,002	118,464
1935	27,015	19,662	23,255	69,931	50,831	120,762
1936	27,544	20,626	23,356	71,526	51,649	123,175
1937	28,148	21,559	23,762	73,469	52,559	126,028
1938	28,866	22,670	24,358	75,893	53,698	129,591
1939	29,643	23,871	24,940	78,454	54,920	133,374
1940	29,705	24,830	25,198	79,733	55,279	135,012
1941	29,630	25,892	24,936	80,458	55,461	135,919
1942	29,378	26,920	24,104	80,403	55,490	135,893
1943	29,032	27,987	22,983	80,003	55,404	135,407
1944	28,650	28,722	21,245	78,618	55,261	133,879
1945	26,719	27,361	17,207	71,288	51,107	122,395
1946	26,802	27,658	17,047	71,506	52,009	123,515
1947	27,111	28,393	17,595	73,099	53,323	126,422
1948	28,140	29,672	18,996	76,807	55,164	131,971
1949	29,252	31,072	20,615	80,939	57,098	138,036
1950	30,421	32,496	22,416	85,333	59,255	144,587
1951	31,521	33,844	23,963	89,328	61,163	150,491

Gross Fixed Capital Stock in the Netherlands, 1900-1995, in millions of 1990 Geary-Khamis dollars

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential buildings	total
1952	32,479	34,997	25,015	92,491	62,930	155,421
1953	33,995	36,973	26,512	97,480	64,994	162,474
1954	35,805	38,769	28,550	103,124	67,443	170,567
1955	37,911	40,779	31,589	110,278	70,351	180,629
1956	40,368	43,005	35,504	118,877	73,721	192,598
1957	43,092	45,436	39,746	128,274	77,219	205,493
1958	45,451	47,573	43,675	136,699	80,126	216,825
1959	48,091	49,870	48,363	146,325	83,470	229,795
1960	50,355	51,856	52,525	154,736	87,164	241,900
1961	52,889	54,313	56,322	163,525	91,213	254,738
1962	55,690	57,119	59,462	172,271	95,413	267,684
1963	58,558	60,148	62,480	181,186	99,667	280,853
1964	62,049	63,519	66,588	192,156	104,918	297,074
1965	65,619	66,986	71,208	203,813	110,499	314,312
1966	69,428	70,485	76,741	216,655	116,629	333,283
1967	73,512	74,332	82,337	230,180	123,287	353,468
1968	78,069	78,714	88,428	245,211	130,664	375,875
1969	83,306	83,372	94,275	260,953	137,606	398,559
1970	88,985	88,032	100,899	277,916	144,942	422,857
1971	94,800	93,303	106,831	294,934	152,939	447,874
1972	100,015	98,369	112,642	311,026	162,082	473,108
1973	105,195	102,938	119,115	327,248	171,927	499,175
1974	110,208	107,347	125,129	342,684	180,534	523,218
1975	115,251	111,725	130,274	357,250	188,385	545,636
1976	120,455	116,087	134,254	370,796	196,361	567,157
1977	125,783	119,904	139,423	385,111	206,116	591,227
1978	131,426	123,469	143,539	398,433	216,189	614,622
1979	138,038	126,845	147,292	412,175	225,945	638,120
1980	144,922	130,122	149,543	424,587	236,058	660,646
1981	150,836	133,179	150,154	434,169	244,967	679,136
1982	156,212	135,774	150,219	442,204	253,163	695,367
1983	161,249	138,537	151,023	450,809	261,277	712,086
1984	166,486	141,914	151,547	459,947	269,617	729,564
1985	171,205	145,168	154,601	470,974	277,836	748,810
1986	176,212	148,118	159,735	484,065	286,704	770,769
1987	181,723	150,495	164,011	496,230	296,547	792,776
1988	187,701	152,996	167,910	508,606	307,582	816,187
1989	193,148	155,779	174,773	523,700	318,415	842,115
1990	198,875	158,713	183,483	541,071	329,085	870,155
1991	205,112	161,904	190,866	557,883	339,133	897,016
1992	210,395	164,651	197,925	572,971	349,784	922,756
1993	215,093	167,683	204,100	586,876	359,438	946,314
1994	219,492	170,610	211,145	601,248	370,097	971,345
1995	223,704	173,640	221,379	618,723	381,560	1,000,283

APPENDIX 4: NET FIXED CAPITAL STOCK IN THE NETHERLANDS, 1900-1995, IN MILLIONS OF 1990 GUILDERS

Net Fixed Capital Stock in the Netherlands, 1900-1995, in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential buildings	total
1900	11,776	12,204	8,117	32,097	40,711	72,808
1901	12,116	12,298	8,638	33,052	41,440	74,492
1902	12,481	12,422	9,374	34,277	42,210	76,487
1903	12,931	12,659	9,984	35,574	43,106	78,680
1904	13,430	12,899	10,242	36,571	44,071	80,642
1905	13,863	13,138	10,678	37,679	44,958	82,636
1906	14,348	13,470	10,945	38,764	45,927	84,691
1907	14,570	13,765	11,389	39,723	46,545	86,268
1908	14,858	14,102	11,997	40,957	47,262	88,219
1909	15,289	14,243	12,463	41,994	48,183	90,177
1910	15,817	14,474	12,808	43,098	49,249	92,347
1911	16,347	14,632	13,131	44,110	50,330	94,439
1912	16,863	14,809	13,874	45,546	51,409	96,955
1913	17,432	15,256	14,755	47,444	52,582	100,026
1914	17,758	15,550	15,435	48,743	53,433	102,176
1915	17,579	15,675	15,866	49,120	53,596	102,716
1916	17,219	15,738	16,770	49,727	53,505	103,232
1917	16,664	15,714	16,212	48,590	53,144	101,735
1918	15,910	15,669	15,400	46,979	52,492	99,471
1919	15,229	15,944	15,273	46,447	51,928	98,375
1920	14,668	16,565	16,868	48,101	51,510	99,612
1921	15,765	18,272	18,637	52,674	53,331	106,005
1922	16,607	19,719	19,811	56,136	54,806	110,942
1923	17,129	20,863	20,357	58,349	55,861	114,210
1924	17,719	21,977	21,047	60,743	57,082	117,825
1925	18,443	23,196	21,932	63,572	58,519	122,091
1926	19,397	24,606	23,199	67,203	60,296	127,499
1927	20,574	26,351	24,645	71,571	62,202	133,773
1928	22,023	28,310	26,463	76,796	64,470	141,266
1929	23,737	30,707	28,470	82,913	66,921	149,834
1930	25,707	33,294	30,927	89,927	69,784	159,711
1931	27,570	36,169	32,469	96,209	72,048	168,257
1932	28,780	38,546	32,504	99,830	73,310	173,140
1933	29,722	40,472	32,132	102,326	74,427	176,753
1934	30,593	42,264	31,775	104,632	75,597	180,229
1935	31,358	43,880	31,358	106,596	76,656	183,252
1936	32,021	45,334	30,930	108,285	77,659	185,944
1937	32,768	46,745	30,732	110,244	78,905	189,150
1938	33,900	48,460	31,192	113,553	80,678	194,231
1939	35,190	50,401	31,821	117,411	82,588	199,999
1940	34,684	51,736	32,002	118,422	82,342	200,764
1941	33,885	53,293	31,095	118,273	81,732	200,005
1942	32,771	54,817	29,313	116,901	80,725	197,626
1943	31,512	56,376	27,359	115,247	79,522	194,769
1944	30,146	57,055	24,711	111,911	78,165	190,076
1945	26,607	52,492	20,485	99,583	71,154	170,737
1946	26,308	52,210	20,827	99,345	72,212	171,557
1947	26,638	53,022	22,777	102,438	74,543	176,981
1948	28,860	54,904	26,859	110,624	78,179	188,802
1949	31,342	57,092	31,153	119,586	82,099	201,686
1950	33,917	59,171	35,603	128,691	86,360	215,050
1951	36,264	60,992	39,350	136,606	90,283	226,888
1952	38,281	62,534	42,281	143,095	93,705	236,800

Net Fixed Capital Stock in the Netherlands, 1900-1995, in millions of 1990 guilders

	nonresidential buildings	civil engineering works	machinery & equipment	total nonresidential	residential buildings	total
1953	41,370	65,850	46,439	153,660	97,911	251,570
1954	44,578	68,433	51,305	164,317	103,046	267,363
1955	48,208	71,348	57,219	176,775	109,257	286,032
1956	52,361	74,566	63,755	190,682	116,385	307,067
1957	56,789	78,112	69,964	204,864	123,755	328,619
1958	60,220	81,112	73,475	214,807	129,736	344,543
1959	64,293	84,716	77,376	226,385	136,553	362,939
1960	68,974	88,550	82,145	239,669	144,432	384,101
1961	73,936	93,176	86,858	253,970	152,816	406,786
1962	79,082	98,214	91,523	268,820	161,461	430,281
1963	84,304	103,613	95,781	283,697	169,996	453,694
1964	91,012	109,784	102,775	303,571	180,825	484,396
1965	97,948	116,202	109,884	324,034	192,316	516,350
1966	105,495	122,863	117,829	346,187	205,002	551,189
1967	113,778	130,421	126,361	370,560	218,721	589,281
1968	123,266	139,541	136,175	398,983	234,008	632,991
1969	134,436	149,317	145,796	429,549	247,988	677,537
1970	146,296	159,175	157,666	463,137	262,612	725,749
1971	157,516	169,796	166,943	494,254	278,808	773,062
1972	166,676	179,197	172,810	518,683	297,622	816,304
1973	175,388	186,996	180,558	542,941	317,834	860,775
1974	183,290	194,004	187,636	564,930	334,721	899,651
1975	190,879	200,550	191,968	583,397	349,602	932,999
1976	198,658	206,798	192,831	598,286	364,610	962,896
1977	206,837	211,817	196,177	614,831	383,658	998,489
1978	215,646	216,282	199,319	631,247	403,252	1,034,499
1979	224,658	219,518	201,738	645,914	421,383	1,067,297
1980	233,609	222,586	201,455	657,650	440,170	1,097,819
1981	239,433	224,944	198,176	662,553	455,869	1,118,422
1982	243,407	226,086	195,856	665,350	469,678	1,135,027
1983	246,083	226,640	196,412	669,135	483,035	1,152,170
1984	248,690	227,249	199,650	675,589	496,689	1,172,278
1985	250,872	227,464	207,926	686,262	509,872	1,196,134
1986	254,099	227,874	218,734	700,707	524,063	1,224,770
1987	260,189	227,855	229,464	717,508	539,664	1,257,172
1988	267,389	228,378	238,894	734,661	557,605	1,292,266
1989	273,088	229,413	253,506	756,007	574,403	1,330,410
1990	278,960	230,461	268,861	778,281	590,130	1,368,411
1991	285,436	231,742	282,554	799,732	604,048	1,403,780
1992	290,368	233,641	294,550	818,559	619,247	1,437,806
1993	293,773	235,437	302,879	832,088	633,896	1,465,984
1994	296,711	237,247	309,974	843,932	650,365	1,494,297
1995	299,591	239,562	321,054	860,208	668,045	1,528,253

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