CERE Working Paper, 2014:1

Where Was the Wealth of the Nation?

Measuring Swedish Capital for the 19th and 20th Centuries

Magnus Lindmark & Lars Fredrik Andersson

Department of Geography and Economic History

Umeå University

magnus.lindmark@umu.se, larsfredrik.andersson@umu.se

The **Centre for Environmental and Resource Economics** (CERE) is an inter-disciplinary and inter-university research centre at the Umeå Campus: Umeå University and the Swedish University of Agricultural Sciences. The main objectives with the Centre are to tie together research groups at the different departments and universities; provide seminars and workshops within the field of environmental & resource economics and management; and constitute a platform for a creative and strong research environment within the field.

Department of Economics, Umeå University, S-901 87, Umeå, Sweden

www.cere.se

Where Was the Wealth of the Nation? Measuring Swedish Capital for the 19th and 20th Centuries

Magnus Lindmark
Department of Geography and Economic History
Umeå University
magnus.lindmark@umu.se

Lars Fredrik Andersson
Department of Geography and Economic History
Umeå University
larsfredrik.andersson@umu.se

Abstract

This report presents estimates of the Swedish national wealth from 1830 to 2010. This contributes to economic historical research on structural change and growth, while it also supplements debates on the composition of wealth and incomes across countries. The report also includes for the first time a historical estimate of the Consumer Rate Interest CRI and an estimate of wealth based on surveys and insurance data. The report includes an extensive description and documentation of the historical estimates. The main findings are that the proportion of intangible capital grew before modern economic growth was achieved in Sweden during the 1890's. Secondly, we show that the proportion of natural assets fell prior to and during the industrialization, while the share of produced capital has fluctuated, but has remained fairly stable over the period as a whole.

Keywords: capital stocks, national wealth, Historical national accounts, Sweden, Economic history

Content

Introduction

The concept of sustainable development gained significant attention with the UN report "Our Common Future" in 1989. Considerable research effort was devoted to defining the concept and making it empirically manageable. Several indicators that seek to integrate economic and environmental indicators have been suggested. These include various welfare indices such as Index of Sustainable Economic Welfare (ISEW) and the Environmental Sustainability Index (ESI).[1] Neo-classical environmental economists did, however, criticize these and similar measures for the lack of economic theoretical consistency. Instead, measures of a 'green' net national product (NNP), 'genuine' net savings and wealth accounts were advanced in order to integrate economic and environmental accounting. The concept of 'green' NNP seeks, by integrating the degradation and depletion of natural capital, to account for environmental costs incurred in economic activity (Hamilton, 1994; Hamilton and Lutz, 1996). Genuine savings is an equivalent flow measure where the net savings includes the depletion of natural resources and damage that is caused by pollution (World Bank, 1997). In addition to the flow measures on sustainable development, the World Bank among others has advanced wealth accounts to find stock measures on sustainable development. In the World Bank 'Millennium Capital Assessment', wealth estimate for nearly 120 countries for the year 2000 was provided to highlight the key targets of sustainable development and poverty reduction (World Bank, 2006).

Based on the concept of wealth as elaborated in the Millennium Capital Assessment, this report seeks to advance historical wealth assessments. The purpose of the report is to provide an historical account of wealth accumulation and wealth composition. The ambitions is to offer insights into how the transition into modern economic growth is related to the growth of capital and the change in capital structure. Also by examining key hypothesis on wealth accumulation, the report will contribute to the contemporary environmental and economic literature on wealth. The empirical work is based on the case of Sweden, where data on both flows (savings, investments and stocks (natural and produced capital) are accessible.

The remaining of the report is structured as follows. Section one provides an explanation of the wealth concept and its relevance in economic historical research. Section two gives a description of how wealth is measured. Section three provides an account for the long run wealth accumulation and wealth composition in Sweden. Section four gives a wealth accounts by key sectors during the transition into modern economic growth, while section

[1] Daly,H. & Cobb, J., (1989) *For the Common Good*. Beacon Press, Boston; Esty, Daniel C., M.A. Levy, C.H. Kim, A. de Sherbinin, T. Srebotnjak, and V. Mara. (2008) *2008 Environmental Performance Index*. New Haven: Yale Center for Environmental Law and Policy.

five concludes. The documentation of the estimates themselves is central to the report and is provided in appendix 1-4.

Historical perspectives on wealth

As noted in the introduction, capital came to form the basis for an economic theoretical definition of sustainability. In brief, this definition says that development is sustainable if the total capital stock is constant or increasing. This came to be known as weak sustainability. Strong sustainability implies that the environmental capital stock is at least constant even if the total capital stock is growing. Whether sustainability is a constant total capital stock or a constant environmental capital stock depends on the substitutability assumptions between types of capital.

The concept of measuring sustainability by focusing capital stocks also came to form the basis of the UN and the World Bank's proposal for expanded environmental accounts, known as the Integrated System of Environmental and Economic Accounting which was presented along with the System of National Accounts (SNA) 1993. The main idea behind the more extended versions of the economic environmental accounts was to extend the asset boundary to include environmental capital for appropriate measurement of depreciation.

Drawing from the large body of theoretical literature on capital and sustainability it is generally agreed that current wealth should equal the present value of future consumption (Hamilton and Hartwick, 2005). Changes in wealth (net 'genuine' savings) thereby have key implications for welfare and sustainability. Hamilton and Clemens (1999) shows that net savings controlling for depletion in resources, pollution and human capital accumulation is equal to change in welfare and that negative genuine savings implies that future welfare (utility) will be less than current welfare (also see Aronsson & Löfgren, 1996).

There has also been some research on sustainability and environmental accounting in Economic History. Krantz and Lindmark (1995) proposed an extension of the Historical National Accounts to a system of integrated environmental and economic historical accounting. This idea was further elaborated and supported with empirical estimates in Lindmark (1997; 1998). A basic proposal was that the 1950's and 1960's experienced a lower green than traditional growth, while the opposite was true for the 1970's and 1980's. Preliminary estimates of historical environmental accounts for Iceland were also presented in the early 2000's (Arnason 2003). Also Smits (2003) argued that a broader concept of capital would be useful also in economic history mainly to address issues of historical welfare development. Mar Rubio (2004) further used historical environmental accounting for analyzing sustainability in Mexico and Venezuela. Aggregated historical Genuine Savings were also estimated by Lindmark and Acar (2013), showing the possibility of a 19th century transition from slightly negative to positive genuine savings. Greasley et al (2014)

demonstrated that genuine savings can be used for forecasting long-run economic growth in an analysis based on historical data.

The bulk of research on capital in economic history has, however, its roots in other debates. One was the Rostow proposal that pre-industrial societies invest a low proportion of their incomes and that the industrial revolution, or in Rostow's terminology, the "take-off", is the transition to a high investment ratio (Rostow 1960). The industrial revolution was in turn assumed to have been assisted by increased domestic savings, simply because the UK was first to industrialize. For followers such as the Scandinavian countries the debate came more to focus on export-led growth versus domestic growth impulses.

Economic historical research was also inspired by the Solow and Abramowitz debate on economic growth, where, in all cases, capital formation becomes essential for the analyses. The relationship between capital deepening and TFP has also been subject for research. In the Abel–Blanchard model a technological innovation increases the expected returns to capital stock leads to capital deepening because the expected returns from an additional unit of capital exceeds the expected stock returns (Abel–Blanchard 1983). Madsen (2010) made a significant contribution by showing that both labour productivity and capital deepening have been driven by TFP and not the other way around.

Also the composition of capital and investments have been subject for research. As Field (1985) points out, equipment has held a privileged position in economic historical narratives of the industrial revolution, although its share of investments has been small in relation to buildings and structures. De Long and Summers tried to explain this by suggesting that investment in equipment had a high propensity to generate externalities in using industries, resulting in a systematic and substantial divergence between its social and private return (De Long, 1992; De Long and Summers, 1991, 1992). The hypothesis was also tested and confirmed in a study based on US historical data (Field 2005). A similar idea had also been suggested by Krantz and Schön (1983) who argued that a rising share of machinery investment in relation to total investment characterized periods of high economic growth. This generalization, in turn, formed part of a larger partly qualitative interpretation of a Schumpeterian long-term cyclical pattern of Swedish economic growth. From this originally Swedish debate, followed a series of articles providing support for the interpretation.

We notice that most studies have been based on PIM-estimates of broad categories of capital. Often natural resources and environmental capital have been left outside the analyses. Seminal works include Feinstein & Pollard's (1988) estimates of capital formation in the UK 1750 to 1920. This can partly be explained by a scattered, and often unreliable source material. Still, renewed attempts to construct capital stocks would improve the understanding and analysis of long-term sustainability, economic growth and welfare. It would also bring an historical dimension to the contemporary economic literature which

focus upon stocks rather than flows of income (Hamilton et al, 2006). It short, detailed historical estimates of capital stocks can provide an understanding of the long-run dynamics of structural change that is underlying the reported differences between high and low income countries with respect to capital stock composition.

The World Bank research conducted by Hamilton and colleagues shows that low income countries have low shares of intangible capital and high shares of natural capital, while the opposite is true for high income countries. Still, it remains an open question whether this is because of a process in which the share of natural capital decreases which rising incomes, or if economic growth appeared in contemporary high-income countries due to a historically high proportion of intangible assets. The institutional framework and the capacity to change historically given institutions is often regarded as an ultimate driver behind historical economic growth. These institutional factors can be considered intangible or invisible capital. How invisible capital is associated with industrialization and growth exemplifies issues that can be investigated with extended capital accounts.

The main purpose of this report is to gain knowledge about the historical growth process by studying how growth and the composition of the capital stock has changed over time. The point of departure are the empirical generalizations about capital accumulation and long-term economic growth made by the World Bank on basis of a cross-section of developed and developing countries for the year 2000. These generalizations are subsequently compared with the Swedish historical example. A key issue is whether the propositions made by the World Bank are also valid for explaining the historical development of capital in Sweden.

Methodology and sources

The basic methodology used is to assess and reconstruct historical wealth and capital by combining a wide variety of sources, in other words the same approach as in other Historical National Accounting research.[2] The only difference being that we are here using stock rather than flow data. A characteristic of this methodology is that the goal is to arrive at national aggregates; GDP in income and production accounts and total wealth in asset accounting. This means that it is necessary to use both comparatively reliable and more unreliable sources. In some cases it is even necessary to use qualified guesses. A key element in the research process is therefore the documentation of the methods and considerations used.

[2] See for instance the series of publications in the Nordic Historical National Accounts research project for discussions of general and specific methodological issues.

Wealth and capital stocks can be estimated with different basic methodologies. The traditional method has been the Perpetual Inventory Method, where stocks are estimated on basis on investment flow data. We have, however, avoided this method for several reasons discussed later on. Instead, we are using a combination of book keeping values and replacement costs estimates based on observed asset values. Market values are always preferred over other types of valuations. A mix of methods is, however, unavoidable due to the characteristics of the historical source material. Taxation records, balance sheet data and insurance data are the most common sources.

Previous research with estimates of capital stocks includes the first assessments of the Swedish national wealth made in the late 1800s, starting with Bollfras (1878). This investigation was followed by a more comprehensive attempt in 1885 (Fahlbeck 1885). The first attempt to actually measure economic development in Sweden was done by comparing these estimates.

It is also worth noticing that these early investigations utilized multiple approaches and sources. The most common approach was to capitalize income streams by assuming a four percent interest rate. Since the income streams were not seldom mixed capital and labour incomes these benchmarks are not fully compatible with contemporary national accounting.

The most comprehensive of the early national wealth estimate was the investigation led by Isidor Flodström in 1912 (Flodström 1912). This work is by far the most comprehensive of the national wealth investigation and is also utilized for benchmarks in the present study. Also the National Income project (Lindahl et al 1937) included some estimates of capital stocks, although the primary goal was to calculate income streams. The next national wealth investigation was Karl Englund's estimate for 1952 (Englund 1952). By that time the national income accounting approach, including GDP estimates, had come to dominate national accounting. However, from the 1980's, there were suggestions in official reports that the long-term economic political goals should be expressed in terms of national wealth, including natural assets and human, fixed and financial capital (see SOU 1992:19 bil 19). Official capital stocks were only published by Statistics Sweden in the 1990s. Only PIM-stocks were used in the modern official capital stock estimates.

The Swedish Historical National Accounts (SHNA) does not include capital stocks, while attempts have been made to estimate capital stocks on basis of the SHNA investments (For an overview of the development of SHNA, see Bolin 2003).

Capital stocks in the manufacturing industry based on the PIM-approach were estimated by Lindmark & Vikström (2003) for the purpose of measuring TFP. TFP-estimates for the period 1870 to 1930 were also estimated in Holmquist's (2004) doctoral thesis. Holmquist did, however, use foremost fire insurance data for his estimates of the capital stocks. Capital stocks for the manufacturing industry, again based on a different

methodology, are also found in Lindmark (2003). Fire insurance data is also an important source in the present investigation, were 19th century data has been collected from Bergander (1967) and 20th century data is taken from the official insurance statistics. A challenging aspect of using fire insurance data is that property was not always insured (self-insurance), insurance values did not always reflect market values in times of inflation or deflation and that the combination with other sources and approaches may lead to double counting. The first problem has firstly dealt with by estimating the stock of uninsured property in the period prior to 1890 (Andersson & Lindmark 2010). Secondly the estimated value of uninsured property in the manufacturing industry was collected from *Statistisk Tidsskrift*. Thirdly, certain government buildings, infrastructure, hydro-power dams and so forth which are known to seldom or never being insured have been estimated by using book keeping values.

The problem with insurance values not reflecting true market values are historically encountered during the deflation of the early 1920s (see Pettersson 2011). It is, however, not as far as we can judge a persistent problem and is probably only valid for that specific period. For avoiding double accounting we have been careful to separate insurance from other types of assessments such as taxation values. This is especially relevant for housing and farm buildings and for forest land and standing timber.

The concept of wealth

Wealth is a key concept for understanding social welfare and sustainability. It offers a tool for understanding of how the stock of current wealth influences the economic welfare of future generations. Irving Fisher's basic proposal was that the current wealth should equal the present value of future consumption. In his definition, Fisher delimited wealth to tangible assets meeting to basic conditions: (i) it must be tangible/material and (ii) it must be owned. According to Fisher, wealth consists of; Real estates (land, buildings, machinery), commodities (raw materials and finished products), human beings (slaves), while immaterial assets were excluded from his definition of wealth. It seems clear that the wealth components suggested by Fisher had already been employed in a number of national wealth assessments carried out in the 19th century in the US, UK, France, Demark, Norway and Sweden.[3] The national wealth assessments were for based on an economic and political interest of measuring the balance sheet for the nation. However, this interest for measuring national asset balances declined in the first half of the 20th century as the Stockholm-school and Keynesian revolution came to re-direct the economic and political interest towards income flows and demand side management.

National wealth estimates were in the post-war period integrated into the balance sheet of the national accounting system. The 1968 system of national accounts (SNA) provides a guideline for how to measure the national balance sheet.[4] The SNA balance sheet shows the value of all assets held by institutional units (households, government, firms and so forth). The asset accounts provide the value of produced assets (such as buildings, machinery, equipment, inventories, and valuables), non-produced assets (land, mineral, energy reserves, forest, and fishery), financial assets and financial liabilities. The Net Worth, the key measure of national wealth, is the sum of assets minus financial liabilities.[5] The SNA balance sheets exclude intangible capital.

The SNA balance sheet of wealth is delimited by the asset boundary which in turn is affected by the definition of production boundaries and institutional sectors. A basic approach in the environmental economic literature on sustainability was to extend the asset boundaries to also include intangible capital as it is recognized that sum of wealth (values of a heterogeneous set of assets) is equal to the present value of future consumption (Hamilton and Hartwick, 2005). If welfare is affected by degradation of environmental qualities, the

[3] Special Reports of the census office. *Wealth, Dept and Taxation*, Washington, 1907; *Fahlbeck Sveriges nationalförmögenhet, dess storlek och tillväxt*; Stockholm, 1890. Sundberg, G. *Sveriges land och folk*, Stockholm, 1901; Wagner, Statistik des Volk- oder Nationaleinkommens und- Vermögens, besonders mit Verwertung der steuerstatistik. *Bulletin de l'Institut international de Statistique* XIV, Zeitschrift des K. Preussischen Statist. Bureaus 1904; Kiaer Indtaegts- og Formuesforhold i Norge, *Statsökonomisk Tidskrift* (Tillaeg) 1892, 1893; Chiozza, *Riches and poverty*, Ninth edition, London 1909.

[4] UN, A system of national accounts, New York, 1968.

[5] System of National Accounts 2008, New York, 2009.

corresponding environmental capital should also be included in the asset boundary. This means, however, that items that is not owned or controlled by institutional units or traded on asset or even goods markets, should be included in the asset boundary. This is the foundation of the more elaborated version of integrated economic and environmental accounting (SEEA).

Extended asset boundaries are, however, not only relevant with respect to environmental issues. This is evident since sustainable development also includes social and institutional aspects. For instance, endogenous growth theorists such as Lucas (1988) and Romer (1986; 1990) as well as Barro (1991) and Baumol (1986), Grossman and Helpman (1991), Aghion and Howitt (1992) have focused on the importance of human capital for economic growth. Furthermore, studies of Jorgenson and Fraumeni (1992), Aronsson and Löfgren (1996) and Jorgenson (2010) provide comprehensive discussions on how to integrate human capital in national accounts, the way it should be measured and how it contributes to welfare.

The extended asset boundary therefore includes intangible capital, in its capacity of being a productive asset for economic activity. According to the World Bank definition, intangible capital includes human capital and the quality of formal and informal institutions (Hamilton et al 2006).

While efforts to estimate the stock of skills and know-how included in the human capital concept have been widely applied (Becker, 1964; Schultz, 1988), the wealth estimates on informal and formal institutions is scant (Hamilton et al, 2006). Following the World Bank 2006 definition, the measure of informal and formal institutions seek to measure encompasses (i) social capital; the degree of trust among people and the ability to work for common purposes, and (ii) rule of law; the efficiency of the judicial system, the protection of property rights and the efficiency of government.

The emphasis on intangible assets as a key element behind economic growth has for long been a dominating theme in economic history. Here can be noticed North and the neo-intuitionalist school. Also Maddison who emphasizes that ultimate elements (such as national institutions, ideologies and the international economic order) are important for explaining growth by affecting the proximate elements behind growth (real capital, technology, labour, efficiency of allocation)

Wealth accounting

Total wealth

Following the World Bank (Hamilton et al 2006) our wealth estimates is based on measuring total wealth; total value of produced assets, natural resources and intangible assets. Intangible assets are measured as a residual by deducting natural resources and produced assets from the total wealth measure.

Total wealth (W) is calculated as a function of consumption at time t, consumption rate of interest (s) or 'fundamental discount rate'. Following Pearce and Ulph, (1999) the present value of consumption stream is:

$$W = \sum_{t} A(1+s)^{-1} \qquad \text{Eq. 1}$$

Where the consumption rate of interest (CRI) may be decomposed into the formula:

$$S = \delta + \mu * g \qquad \text{Eq. 2}$$

Where δ denotes the rate of time preference. The rate of time preference is measured as the crude death rate (death/total population). The component μ denotes the marginal utility of consumption. The marginal utility is measured as the ratio between capital return and savings ratio, weighted by the labour income and interest rate. The component g is the expected growth in per capital consumption. The growth rate is based on measures of historical consumption growth rates. Details on the estimates are provided in appendix 1.

Based on equation 1 and 2, consumption rate of interest is estimated for the time span 1830 to 2010 in Sweden. The estimates rank from 5.8 in 1830 to 2.5 in 2010. The current estimates is close to the estimates from the UK in 1995 (Pearce & Ulph, 1999) and the average of 120 countries reported in the Millennium Wealth Assessment report (Hamilton et al 2006). Table 1 show the estimates on consumption rate of interest in the United Kingdom, Globally and in Sweden.

Table 1. Estimates on consumption rate of interest in the United Kingdom, Globally and in Sweden.

	UK	Global	Sweden			
	1995	2000	1830	1900	1950	2010
Time preference	1,45	1,7	2,9	1,3	1,3	1,2
Marginal utility of consumption	0,8	1,9	2,7	0,6	0,6	0,6
Expected growth in per capita consumption	1,3	1,6	1,1	3,5	3,1	2,2
Consumption rate of Interest	2,45	2,8	5,1	4,4	3,5	2,2

Source: Own estimates for Sweden 1830-2010; Pearce & Ulph, 1999, World bank, 2006, Appendix A, Total Wealth.

The estimates for Sweden show that the time preference drops substantially in the nineteenth century, while the drop is less pronounced in the twentieth century. The same holds also for the marginal utility of consumption, while the expected growth in per capita consumption rise. The downward slope of consumption rate of interest implies that the total wealth measure will rise in proportion to consumption over time.

Produced capital

Produced capital stocks include fixed assets, inventories and valuables. Fixed assets are buildings, machinery and equipment and man-made structures owned by the corporate, household or government sectors and used for the production of goods and services. Following SNA, 2008, fixed assets should be valued at the prices prevailing in the market for assets in the same condition as regards technical specification in age (replacement value).

For the calculation of fixed capital stocks a number of other methods can be considered. The by far most common is the Perpetual Inventory Method (PIM). To arrive at the value of fixed capital investment series are accumulated over their service life (OECD, 2001). Following the World Bank, the value of the fixed capital stock in period *t* is given by:

$$K_t = \sum I_{t-i} \, (1-\alpha)^i \qquad \text{Eq. 3}$$

where I is the value of investment in constant prices and α is the depreciation rate. The World Bank assumed a geometric depreciation rate of 5 per cent (corresponding to a service life of 20 years). The depreciation rate is simplified to fit with the underlying data. Most fixed capital estimations differentiate the depreciation rate for buildings, machinery and equipment (OECD, 2001). Following guidelines of Statistics Sweden, we assume a service life of 10 years for machinery and 50 years for buildings (SOU 2002:118).

An alternative to PIM is to derive capital stocks from insurance values and accounting values. The advantage with PIM is that it requires only data on investments and assumptions on the depreciation rate and service life. The disadvantage is that assumptions is static and cannot embody scraping of capital due to eg. war, economic downturns, technical progress etc. From a conceptual point of view this is especially troublesome if the long-term dynamics of Schumpeterian creative destruction are assumed, such in Schön (2006).

Estimating fixed capital by measures from insurance data, that it gives a market valuation of the replacement value, may overcome this specific shortcoming of PIM estimates. As pointed out previously, insurance values are expected to underestimate the capital stock due to self-insurance. An alternative approach for especially assets owned and controlled by the corporate sector is to use balance sheet accounts. Such accounting values should preferable give information on replacement value. The most common accounting practice is to report book values, which are subject to historical prices and accounting rules. For most cases only book values are accessible which will give a down-ward bias in the wealth estimate. It is also known that book values were occasionally, such as Ivar Kreuger did in the 1920's and early 1930's, manipulated for the purpose of creating fraudulent profits. Having said this, balance sheets are also accessible for the public sector. The public sector provides book values of assets which give a lower bound estimate of the capital stock. Given the advantages and disadvantages that the different method holds, the most preferable is to cross-check the results of different approaches. Having said this, the theoretically preferable approach is to estimate several versions of the stocks based on different methods. Given the limitations of the historical records, this is, however, not possible.

In table 2 report fixed capital stock estimates applying the PIM approach and the Insurance approach. The real capital stock attained from using PIM is reflated with investment prices to express the fixed capital stock in current prices. Insurance values are expressed in current prices. The value of fixed capital is substantially lower following the PIM approach. In 1850 the PIM values are 23 per cent of the insured values. The share increases to 36 percent in the twentieth century. Today, the PIM-value corresponds to 45 per cent of the insured value of the fixed capital stock.

Table 2. Fixed capital stock estimates based on PIM and insurance values, current prices, M SEK in Sweden, 1850, 1900, 1950 and 2010.

Year	PIM	Insurance	P/I (%)
1850	489	2 144	23
1900	2 982	8 369	36
1950	56 753	156 405	36
2010	6 525 512	14 571 532	45

Source: PIM Calculation based on Krantz & Schön, 2007. The calculation of stocks based on insurance values is given in Appendix 2.

Insurance data provide high coverage of the fixed capital stock held by households and corporations from the early twentieth century and onwards. To avoid bias caused by non-insured property during the nineteenth century, we use Lindmark and Andersson's (2010) estimate of insurance demand for the period 1830 to 1850. Based on household's demand for fire insurance in the twentieth century a counterfactual estimate (if household would have kept same insurance coverage 1830-1950) of premium incomes for fire insurance is presented. By using information on mean premium, the ratio between premiums and insurance sum (Bergander, 1967), the contra factual premium incomes are employed to calculate insurance values in the nineteenth century.

Natural capital

Non-produced assets or natural capital (assets) are classified in the SNA 2008. However, the inclusion of natural resources in the national accounting system is limited to international organizations (UN, World Bank). The valuation of natural resources is often based on the present discounted value of economic profits, or by information on physical volumes in terms of proven reserves and net unit price of the stock. The World Bank approach is to calculate net present values of the natural resources (Hamilton et al 2006). The stock of energy and mineral resources are expressed as the discounted value of economic profits over the life of the resource. The stock of timber resources is calculated as the net present value of rents from round-wood production. A similar approach is applied on agriculture, where land values are based on the present discounted value of land rents.

The accounting practice applied in our historical wealth assessment, follows the World Bank approach on mineral resources. However, value of agriculture land, forest and fisheries are also based on prices and volumes. The value of agriculture land is calculated based on annual average sales prices of land multiplied by the size of the agriculture land (se details in appendix c). The value of timber resources is calculated based on timber prices and standing timber volume. To arrive at an average price of standing forest, insurance values of standing forest is used as a benchmark. Forest land is valued by average sales prices of the land (excluding timber volume) multiplied the total size of forest land. The fishing stock is measured as the present discounted value of fishing rents (see appendix 3 for data and calculation).

Intangible capital

Intangible assets are calculated as residual, deducting produced and non-produced assets from total wealth. The measurement is however refined by measuring human capital by accumulating educational expenditure over individual's life-cycle. Standard measures of savings usually regard expenditures on the formation of human capital simply as consumption. However, human capital is a valuable asset for sustainability because it helps the formation or maintenance of national wealth both for today and future generations. Hence the World Bank uses current educational expenditures as a proxy for the value of human capital investment as a lower bound approximation for human capital premium. Needless to say, it is far from reflecting the real value of the change in human capital. First of all, there are additions to knowledge or R&D activities that are not accounted for when only education expenditures are taken into account. Second, the WB procedure does not assume any depreciation in human capital which might be stemmed from the fact that the knowledge accumulated via education might become outmoded or people get retired which makes their knowledge inactive most of the time.

A long run account of wealth accumulation and composition

Historical wealth estimates provide a wider context for understanding the mechanism underlying the development in capital structures and capital accumulation. Based on recent findings on the contemporary wealth structure across high and low income countries, key propositions on the wealth structure holds that; (i) intangible assets is the predominant form of wealth, (ii) the share of intangible assets increase with income, (iii) the share of natural capital fall with income and (iv) the share of produced capital is constant to income. To address there propositions, a long-run account of wealth accumulation and composition for Sweden is provided for the period before the industrial breakthrough up till present day.

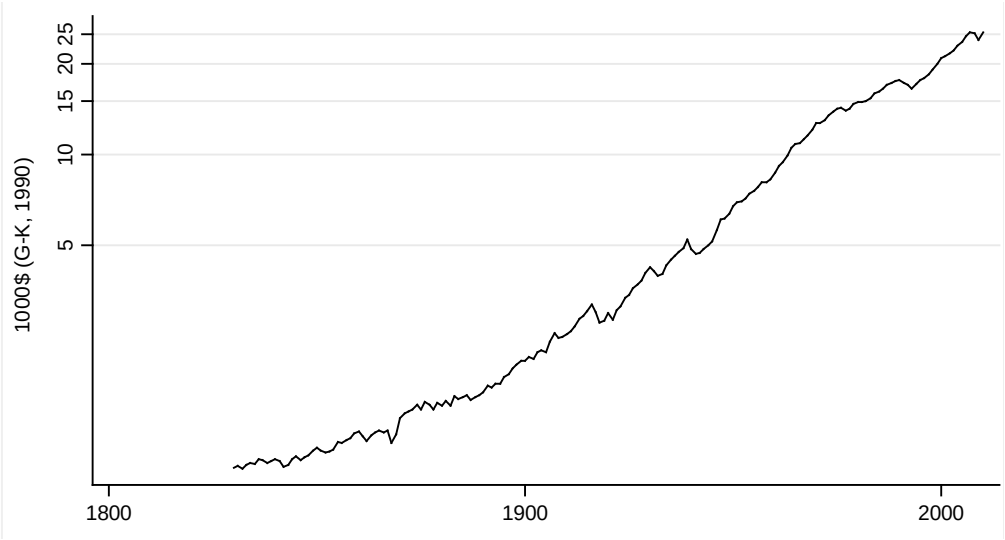
The historical wealth estimate reviles that intangible assets holds the predominant part of total wealth for most of the nineteenth and twentieth century. Pre-industrial estimates from the first half of the nineteenth century however indicate that intangible assets were less predominant than tangible assets. During the period 1830 to 1850 the share of intangible assets was close to 40 per cent of all assets. From the second half of the nineteenth century and up till late nineteenth century, the share of intangible assets increased rapidly and became the predominant form of capital. From the late nineteenth century up till the inter-war the share of intangible was approximately 70 percent. The intangible capital share increased during the 1920s and the 1990s and declined in the 1930s and 1970s. Figure 1 shows the share of intangible capital (of all assets) in Sweden for the period 1830 to 2010.

Figure 1. The Share of Intangible Capital in Sweden, 1830-2010.

Source: Appendix 1, Appendix 4.

The Swedish economy underwent a transition into modern economic growth during the late nineteenth century and early twentieth century. In Jörberg's classic analysis it was only in the 1890's, when the obstacles due to poor communications had been overcome, that the industry reached what he called 'its self-generating stage' characterised by increasing demand from Swedish industry for Swedish industrial products. (Jörberg 1961 p. 362-363). Aggregated productivity growth raised per capita incomes figures from the low pre-industrial annual income level of 1000 $ (G-K, 1990) in the first half of the nineteenth century up till 2000 $ (G-K, 1990) in the early twentieth century (Andersson & Lindmark, 2008). The long run progress in labour productivity raised real income per capita approximately 12 times during the twentieth century. From being the Swedish per capita income was among the highest (rank 6) world-wide in 2010 (Bolt & van Zanden 2013). Figure 2 shows real GDP per capita figures in 1990s GK$ in Sweden for the period 1830 to 2010.

Figure 2. Real GDP per capita in 1990 Int. GK$, in Sweden 1830-2010.



Source: Bolt and van Zanden 2013. The First Update of the Maddison Project; Re-estimating Growth Before 1820

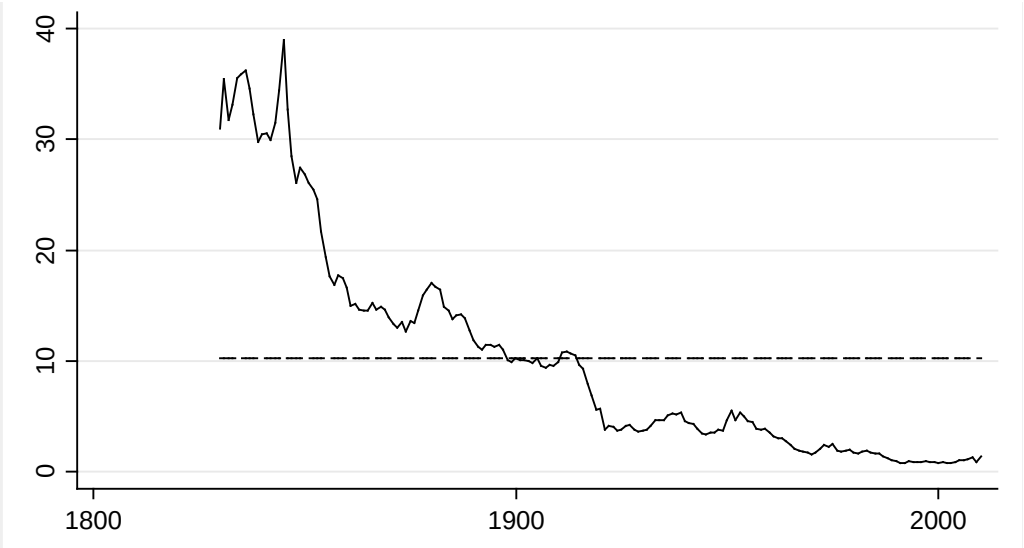
The rise of income level from approximately twice the subsistence level in the pre-industrial phase 1830-1849) to three times substance level in the early phase of the industrialization (1850-1869), correlates positively with the rise in the share of intangible assets. From the 1870s and onwards the correlation is weak or non-existing, basically due to continued economic growth and a stagnant share of intangible assets. It may be noticed that during two decades, the 1930s and 1970s, the correlation was negative.

We can therefore conclude that the original World Bank proposition of a positive correlation between income and the share of intangible capital is therefore limited to the transition from pre-industrial growth to modern economic growth. The first historical

proposition is therefore that the share of intangible wealth increase during a transition phase occurring before high and sustained economic growth is reached. The increasing share of intangible capital is accordingly interpreted as a prerequisite for high and sustained economic growth and not a long-run co-integration phenomenon between intangible assets and income. The suggested mechanism is that the increase in intangible capital shifts the time perspective on investments as human health improves which in turn affects the evolution of modern political and economic institutions, such as parliamentarism and a modern financial system.

Figure 3 shows that natural assets were important in the pre-industrial economy. The share of natural capital constituted between 30 and 40 per cent of the total wealth during the period 1830 to 1850. As intangible capital increased in the early phase of industrialization the share of natural capital declined. A substantial drop in the natural capital share occurred from the mid nineteenth century to the late nineteenth century.

Figure 3. The Share of Natural capital share (per cent) of Sweden's Total Wealth, 1830-2010.



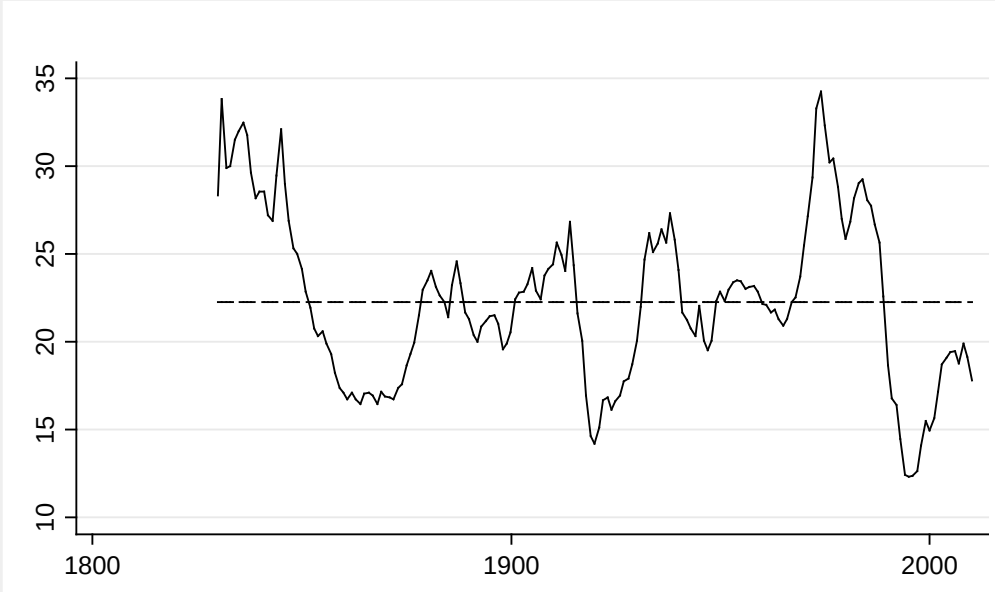
This period coincides with Schön's notion of a first wave of Swedish industrialisation already in the 1850s, foremost driven by developments in certain manufacturing industries such as textiles and saw-mills (Schön 2007 p 137). The share of natural capital continues to decline even after 1870, which coincides with the more definitive first waves of Swedish industrialisation, which up to the 1890s were foremost driven by the saw-mill industry (Hecksher 1953, 1957, p.266). Since the early twentieth century the natural capital share has declined from 10 per cent to only 1 per cent today. Here, the pronounced fall around the First World War is noticeable.

It is therefore clear that the World Bank (Hamilton et al 2006) proposition of a negative relationship between the share of natural capital and per capita income decline find

general support in the long-run change of capital structure in the Swedish economy. However, the change in capital structure was more substantial during the transition into modern economic growth than afterwards. Most of the decline in the natural capital occurred in the early phase of industrialization when per capita income growth was relatively low (1% 1850-1870) compared to later part of the industrial phase (2.2% 1890-1910).

As the share of intangible capital increased in the mid-nineteenth century, there was a decline in the relative importance of natural capital. It does, however, also appear as if produced capital lost in relative importance during the period. While the long-term declining trend is quite obvious in the case of natural capital, the share of produced capital seems to be more of cyclical phenomenon. Produced capital as a share of total wealth declined from approximately 30 per cent in the pre-industrial period 1830 to 1850 to approximately 18 per cent during the period 1850 to 1890 (see figure 4).

Figure 4. The Share of Produced Capital (per cent) in Sweden, 1830-2010.



The share again increased during the early twentieth century but went down substantially during the First World War and in the early 1920s. The produced capital share went up in the 1930s and stabilized on the historical average of 21 per cent up till the late 1960s. In the 1970s and 1980s share of produced capital went up to substantially, showing historically high figures especially in the early 1970s. Again, the share declined in the 1990s and recovered in the early 2000s.

The share of produced capital therefore underwent significant fluctuations during the period studied period. Figures on produced capital share have reaching both higher bound (30-33) and lower bound of (13-16) in during the nineteenth century and during the twentieth century. The up- and downward slope of the produced capital share fit poorly with

the raise of incomes, making the World Bank (Hamilton et al 2006) proposition of constant produced capital share over incomes valid in the long-run. However, as noted in comparison between high and low income countries at present, the produced capital share fluctuate across contemporary income levels as well as across historical income levels.

The transition of capital structure during the last two centuries provides a number of stylized facts on the key mechanism underlying long-run economic development.

- The rapid development of formal and informal institutions, including aspects of human capital preceded industrialization
- The share of natural and produced capital declined as intangible capital become took a larger share of the capital stock
- The share of natural capital has declined along with long-run income growth
- Produced capital share has fluctuated around an approximately zero-growth trend. Intangible capital growth therefore equal natural capital decline in the long run

The historical wealth assessment identifies the industrialization phase as a key for understanding the transition of capital structure over time. Capital structure change in the phase of industrialization therefore is examined by providing a wealth account by key sectors in the economy for the period 1830 to 1913. In the following section a sectorial wealth account is outlined.

Wealth formation and transition to modern growth

The transformation of the capital structure gives an insight into the mechanism underlying the development from a pre-industrial economy towards an industrial economy. The preindustrial economy was characterized by predominance of tangible capital. Natural capital was the largest tangible in pre-industrial economy. As shown in table 3 the capital structure of the Swedish economy was dominated by tangible capital in the two first benchmark years 1830 and 1850. It is also evident that natural capital exceed produced capital during the same years.

The rise of institutional capital from the mid nineteenth century marked the starting point for the development into an industrial economy. The evolution of informal institutions, broadly defined as the degree of trust and the ability to work for common purposes, and formal institutions, defined as rule of law and the efficiency of the judicial system was necessary for the transition to high and sustained economic growth.

Institutional changes that potentially matches this development includes human rights, changes of the political system and economic liberalization. The development of human

rights former includes equal inheritance for men and women in 1845, the abolishment of dishonorable and painful punishment (1855-64) and freedom of religion in 1860. Political changes such acts as the freedom of the press ordinance in 1812 and the introduction of parliamentarism in 1866. Economic reforms included the abolishment of guilds (1846-1864) which along with the right to freely migrate in 1860 ensured market liberalization. Important changes in the Swedish financial sector between the 1850's and 1870's were e.g. the liberalisation of banking and the abolishment of interest rate controls in 1864 (Sandberg, 1979; Ögren 2009, Adams et al 2009).

It is, however, important to reflect upon the fact that the CRI is an important driver behind the development of the intangible capital. Also, the predominating effect in the 19th century is a falling CRI, which is turn is mainly driven by falling mortality (see appendix 1 for an explanation of the methodology). This is in turn compatible with an explanation suggested by Croix et al (2008) who studies the correlation between education and growth. They suggest that the main mechanisms at work are rises in life expectancy that increase the incentive to get an education, which in turn has permanent effects on growth through a human capital externality. Thus, the various institutional reforms can be seen as manifestations of the human capital externality. This gives that that the whole category intangible capital is an estimate of the human capital externality.

The stock of man-made produced capital evolved already from the beginning of the investigated period. It is furthermore evident that the produced capital stock increased faster than natural capital stock from the 1850's. Table 3 shows that produced capital exceeded natural capital in 1870 and that the difference had become even larger in 1890. In 1910 produced capital was almost than three times the amount of natural capital.

Table 3. Overall wealth structure 1830-1910 in million SEK, current prices.

Year	Tangible capital				Intangible capital		
	Produced	Natural	Financial	Total	Human	Insitutions	Total
1830	1 495	1 787	138	3 420	3	2 344	2 347
1850	2 311	2 728	146	5 185	13	4 974	4 987
1870	4 739	3 804	-128	8 414	81	18 795	18 876
1890	8 430	4 299	-726	12 003	215	23 903	24 118
1910	17 045	6 314	-1 482	21 878	618	41 198	41 816

Note: The total economy (GDP) deflator have been applied for real price calculations on all assets.

Natural capital was predominantly constituted by forest capital, standing timer and forest land, in the pre-industrial period. Forest capital accounted for 70 per cent of all natural capital in 1830. Expansion of crop land and price developments, most markedly in the 1830's and 1840's, substantially changed the natural capital structure. The benchmark for 1850

shows that forest capital share was 53 per cent and crop land 46 per cent, while other natural capital items (fish stock and energy and mineral resources) were less important. The change of natural capital structure slowed down in the second half of the nineteenth century. Increasing foreign demand for timber led to higher timber prices, making forest land relatively more valuable than crop land in the 1890 benchmark. Large-scale forest harvest however reduced the volume of standing timber, giving relatively more weight to crop land as share of total natural capital. Table 4 shows benchmarks of natural capital structure for the period 1830 to 1910.

Table 4. Natural capital structure by assets of Sweden in per cent, 1830-1910.

Year	Crop land	Timber, forest land	Fish stock	Energy & Minerals	Total
1830	31	68	1	0	100
1850	46	53	1	0	100
1870	50	49	1	0	100
1890	46	51	3	1	100
1910	50	43	3	3	100

Source: Appendix 3.

The pre-industrial produced capital structure was dominated by assets held by the primary production sector (agriculture, forestry and fishing), holding a 43 per cent share of all produced assets in 1830. Produced capital in primary production was dominated by agricultural buildings, livestock and inventories. An almost equal large share of the produced capital stock was held by the private services and household sector. Foremost buildings, but also inventories and valuables were the predominant assets in the household sector.

The pre-industrial produced capital structure included to a less extent manufacturing and transport assets. Also public services and the government sector held a relatively large share of the produced assets. In the 1830 benchmark, this sector held the same share of produced capital as did the manufacturing and transport sector. Up till the mid-nineteenth century the produced capital structure was largely held by the primary sector, private service sector and household sector.[6]

During the early phase of industrialization changes in the produced capital structure most markedly took place in the transport and communications sector. Table 4 shows that the capital formation was stronger in the transport and communications sector and in the

[6] It is very difficult to separate assets between agriculture, services and households. This is because the majority of 19th century households are producing agricultural goods and services for self-consumption. The stable farmhand and maid are part of the household and are producing the bulk of private service output in the economy. See Krantz, O.

manufacturing industry sector during the latter part of the 19th century as compared to the agriculture and private service sector.

Transport and communication developed initially due to canal constructions. The building of private and state railways from 1855 and onwards constituted the largest boost in the transport and communication sector. Also shipping saw a strong capital formation during the second half of the nineteenth century. Communication equipment's also took-off from the mid-1850s. Produced capital in the form of infrastructure was therefore a vital part of the transition into modern economic growth. In table 5 the produced capital structure by assets in Sweden is given for benchmarks between 1830 and 1910.

Table 5. Produced capital structure by assets of Sweden in per cent, 1830-1910.

	Agriculture	Manufacturing	Transport, communications	Government	Services & Households	Total
1830	43	6	3	9	39	100
1850	46	5	3	7	39	100
1870	41	5	10	4	39	100
1890	32	9	19	3	37	100
1910	28	13	19	4	37	100

Source: Appendix 2.

Wealth formation during the industrialization phase point towards the key importance of restructuring the capital stock. From being predominant by tangible natural capital assets the Swedish case show us how the evolution of an informal and formal institutional setting precede the substantial investments in industrial production.

Conclusions

Our estimate of the historical development of wealth in Sweden shows that an increase of the share of intangible capital preceded the industrial breakthrough. As the transformation to modern growth rates was completed in the 1890's, the share of natural capital continued to decline, while produced capital remained fairly constant. A detailed account of tangible capital formation during the industrialization process shows that produced capital was stronger than natural capital improvements from the 1850s. Natural capital was changing from a predominance of forest towards crop land as the main asset in the early twentieth century. Produced capital was largely bounded in the agriculture sector until the second half of the nineteenth century. Heavy investments in infrastructure was followed by capital formation in the manufacturing sector.

Appendix 1. Measuring the Consumption Rate of interest

Following the definition of total wealth in chapter 2, and equation 1 and 2, the consumption rate of interest is measured as follows. A key prerequisite for the calculation of total wealth is an appropriate estimate of the Social Time Preference Rate (or Consumption Rate of interest or CRI for short) for estimates of total wealth. The Consumption Rate of interest is defined as the rate at which the marginal welfare of consumption falls over time. As such the CRI is important for Cost Benefit Analyses, not the least within environmental economics (see Angelsen, 1991 for a general discussion).

The reason why the CRI is important in this investigation is, as previously stated, because intangible capital is calculated residually. Total wealth is composed of Reproducible Capital (Man-made structures); Non-reproducible capital (land, mineral reserves, fish stocks) and Intangible Capital (social capital, institutional capital). Since the total wealth is estimated as the discounted stream of consumption, using the CRI interest rate, Reproducible Capital and Non-reproducible capital is accounted for and intangible capital is estimated as a residual.

In other words: Consumption/CRI = Total Wealth.

For the CRI estimate we follow the methodology used in Pearce & Ulph (1999). This means that we are working with the following basic components:

ρ = pure time preference
L = Changing Life Chance (negative sign)
μ = Marginal utility of consumption
g = expected growth rate of consumption

The CRI is accordingly calculated as:

$$CRI = \rho - L + (\mu g)$$

The basic components have in turn been estimated in the following way.

Pure Time Preference

ρ is a constant and is assumed to be 0.3 % which is the pure time preference used by Pearce and Ulph (1999). It cannot be observed historically, why it is necessary to assume that the time preference has been constant over the full period investigated.

Marginal utility of consumption

The marginal utility of consumption is given by:

$$\mu = \frac{r-\rho}{\frac{S}{Y}(r-y)+y}$$

where r = rate of return on investment, S/Y is the investment ratio, y is the expected growth rate of incomes from work. Accordingly the marginal utility of consumption requires careful considerations before it can be estimated empirically. First, S/Y is the savings ratio of GDP and is estimated on basis of the Historical National Accounts for Sweden (Krantz and Schön 2007). S is Investments + balance of trade, while Y is GDP. All items are in current prices.

The interest rate *r* should be represented by the real interest rate adjusted for inflation, measured as changes in the Consumer Price Index. This is, however, easier said than done, and arriving at an appropriate empirical estimates of the interest rate is perhaps the most severe challenge when estimating the CRI. It is certainly possible to use direct observations of interest rates, such as the Central Bank discount rate or even rates of return in certain well documented companies. Although seemingly straightforward, the Central Bank discount rate is problematic due to its close relation to historical monetary regimes and monetary politics. The Central Bank discount rate reflects policy goals that varies over time. The bank even functioned as an ordinary commercial bank during the first three decades of our investigation, while the modern type of central bank functions were only defined during the late 1860's. Furthermore, even the Central Bank discount rate includes a risk premium due to risk of inflation, depreciation of the currency and so forth. An alternative is actual rates of returns from business life. They are, however, also biased. For one, they do not include public investments, where the expected rate of return is usually lower. Actual rates of return is also biased towards successful industrial enterprises, since, firstly, the records of unsuccessful enterprises are more seldom kept, and, secondly, collections of returns (such as Gårdlund 1947) only covers a small number of companies that became successful and therefore large enough to be worth collecting and study. Thirdly, also the actual rate of return includes a risk premium.

Also other market based interest rates could be considered, such as bank rates. However, just like the actual return from successful (and therefore observable) companies, the bank interest rate will include a risk premium. This is important since the risk premium is a reflection of the fact that not all investments ends up as fixed capital formation. The risk *is* simply the risk of losing the investment. And since there is a risk, it means that all investments do not end up as capital in the national balance sheet (as technically assumed in the National Accounts).On an aggregate level this means that the capital stock grows at a lower rate than what it would have done if the higher rate of return, including a risk premium, was to be used. This leaves us with a dilemma that cannot be resolved until other parts of the equation are considered.

First, we notice that *y* is the expected growth rate of incomes from work. It is therefore measured as the growth rate of total wages (W) collected from Vikström (2002). W is furthermore adjusted for inflation (CPI). We also assume that expected future growth rates are solely based on historical experiences. We therefore estimated a stochastic but smooth trend in a structural time series framework. The slope of the trend in a given year is interpreted as the long-term expected growth rate of incomes. This also means that we assume that cyclical and irregular components of the wage time series were recognized as business cycle phenomena by the economic agents and did not affect their expectations.

Now we return to *r* and notice that *r* is conceptually very close to the expected growth rate of incomes. While *r* concerns capital income, *y* concerns labor income. Therefore, we argue that it is reasonable that *r* is defined as *the expected growth rate of incomes from capital*. In correspondence to how we measure *y* also *r* was therefore estimated as the growth rate of gross profits *(Y-W)*. With this definition we also avoid the problematic consequence that an interest rate which exceeds the GDP growth rate will cause the capital stock to grow faster than GDP in the long run. This is not compatible with a relatively stable functional income distribution (see Kaldor for a pioneering effort). Data was collected from Vikström (2002).

Changing Life Chance, L

Changing Life Chance reflects that if chances for a long life are small, then a high interest rate is needed in order to motivate a certain savings ratio. Empirically L corresponds to the “crude death rate”: L = - (Total Deaths/Total Population). Data were collected from Statistics Sweden (SCB) vital statistics.

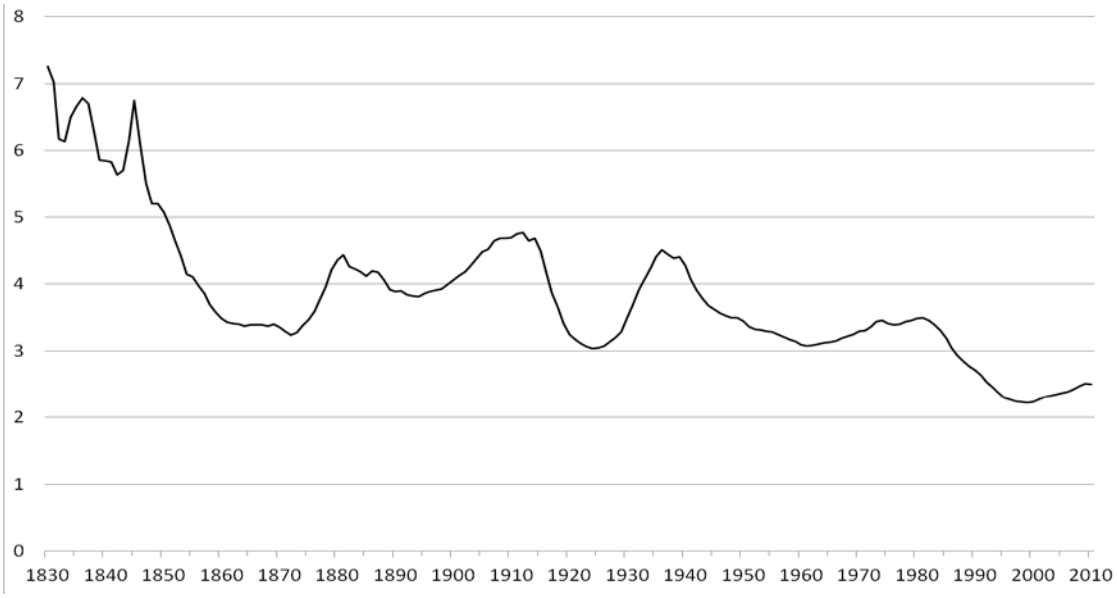
Expected growth rate of consumption

Is the long term growth rate of consumption or Y-S. Data were collected from the historical national accounts (Krantz and Schön 2007). As in the case of *r* and *y* we used a structural time series framework to estimate the stochastic long-term trend.

The Consumption Rate of interest in Sweden 1830-2010

The development of the CRI is shown in figure 4. The sharp fall in interest rates during the period 1830 to 1860 is noticed. After that it is evident that the interest rate is fluctuating around four percent and that it again falls between 1940 and 1960 and again between 1985 and 2000. The contemporary estimate is 2.5 percent which is very close to the Pearce and Ulph estimate for the UK.

Figure 4. The Consumption Rate of interest in Sweden, 1830-2010.



In short we conclude that interest rates fell sharply prior to the industrialization of Sweden. The CRI is here mainly driven by increasing life chances. Improved health therefore preceded growth in Sweden.

Appendix 2. Produced capital

Estimates based on insurance data

The produced capital stock is to a large extent measured by the value of insured assets. Data is mainly collected from the official statistics on private insurance companies. Based on the aggregated calculation of fire insurance sum as shown in previous section 'produced capital', we have disaggregated the fire insurance sum by sectors by using a set of different approaches. Due to the limitation of the data, the division on sector is attainable for; (i) agriculture, (ii) manufacturing, (iii) non-agricultural households and private services. The considerations on division is outlined in the section 'Crop land and agricultural buildings'.

Produced capital was to a large extent covered by fire insurance. Marine and transport insurance covered the Swedish merchant, fishing boat fleet and transported goods. It is worthy of note that some produced infrastructural capital was not covered by fire insurance. This includes for instance railway tracks, canals and roads. Neither was public owned facilitates covered by private insurance since the government often relied on self-insurance. To overcome this omission in the insurance data, book keeping data is used as a supplementary source. Book keeping data cover infrastructure owned by the state through government agencies. In this investigation we include *Statens Järnvägar*, *Luftfartsverket*, *Posten*, *Statens Vattenfallsverk* and *Televerket*. As the state-owned share of infrastructure was close to 100 per cent in a large part of post-war period, we have benchmarks for all assets. For assets the prior or after benchmark is not owned by state, we have applied a method we combine volume and price changes of assets to provide a value index. In the following, a more detailed description of the sources and considerations is outlined.

Book keeping accounts

The book keeping accounts include produced assets not covered by private insurance. Book keeping accounts basically cover state-owned property in the infrastructure and public service (military and civil services) sector. Some part of the private assets are also included in the infrastructure sector, foremost the vehicles stock, but also parts of railways, rolling stock and power plants. Further details on data and methodological consideration is given below.

Railways, telegraphs and power stations

The value of railways and rolling stock has been obtained from Lindahl et al (1937), *Historisk Statistik för Sverige* (1960) and *Statistisk Årsbok*. The estimate includes both state owned and private railways. The basic method is to arrive at bookkeeping values. As a benchmark, the Book keeping values of the state owned Railway Company, reported in

Statistisk årsbok from 1946, has been applied (railway capital was entirely state owned in 1946). For the pre-1946 period, the volume of railways and rolling stock (private and state owned) for real capital calculations. For wealth calculation, a price index was calculated from information on investments cost in Lindahl et al (1937) and Nykander (1980).

Values of telegraph facilities, state- owned power plants and transmission facilities, postal service equipment, airports and lighthouses are also based on bookkeeping values. The benchmark is derived from the official statistics, *Statistisk årsbok* and Annual reports of government departments from 1914. For the pre-1914 period, we have derived data from *Sveriges officiella statistik i sammandrag*.

Road transport equipment

The value of roads were calculated on basis of benchmark values on roads. Such a benchmark is assessable from 1994 onwards from *Ekonomistyrningsverket* from 1994 onwards (*Årsredovisning för staten*). The pre-1994 period is measured by combing data on the volume of roads and price of roads. The volume data is derived from *Statistisk årsbok* (1950-2013) and *Historisk Statistik*, (1960). Prices on roads was calculated from information on the investment costs derived from the aforementioned sources.

The present value of road transport equipment of vehicles (stock of vehicles) is estimated on the basis of the number of registered vehicles according to official statistics (*Statistisk årsbok*; SIKA SSM 001:0301). The year 2010 is used as a benchmark by the following assumed average values for vehicle types; Private Cars 70; Trucks: 300; Buses: 200; Tractors: 150 th. SEK. To avoid double-counting, tractors used in agriculture is calculated as produced capital in agriculture, and non-agriculture tractors is integrated in the stock of vehicles used in road transport. Prices indexed by vehicle price index taken from Ljungberg (1988) and vehicles in the CPI.

Canals

The value of the canals is estimated at replacement cost. First the number of canals, including artificially constructed length in km and years of construction was collected from http://kanaler.arnholm.nu/. In some cases even the total construction cost for a particular canal was obtained. Based on the year of the completion of the canal the construction cost was reflated with the deflator for construction investments (Krantz & Schön 2007). For canals where the construction cost could not be found we used the average per kilometer construction cost of the Göta Canal project, reflated to the price level of the year of inauguration of the specific canal. Altogether the investigation includes 43 canals.

Table 6. Canals included in the investigation

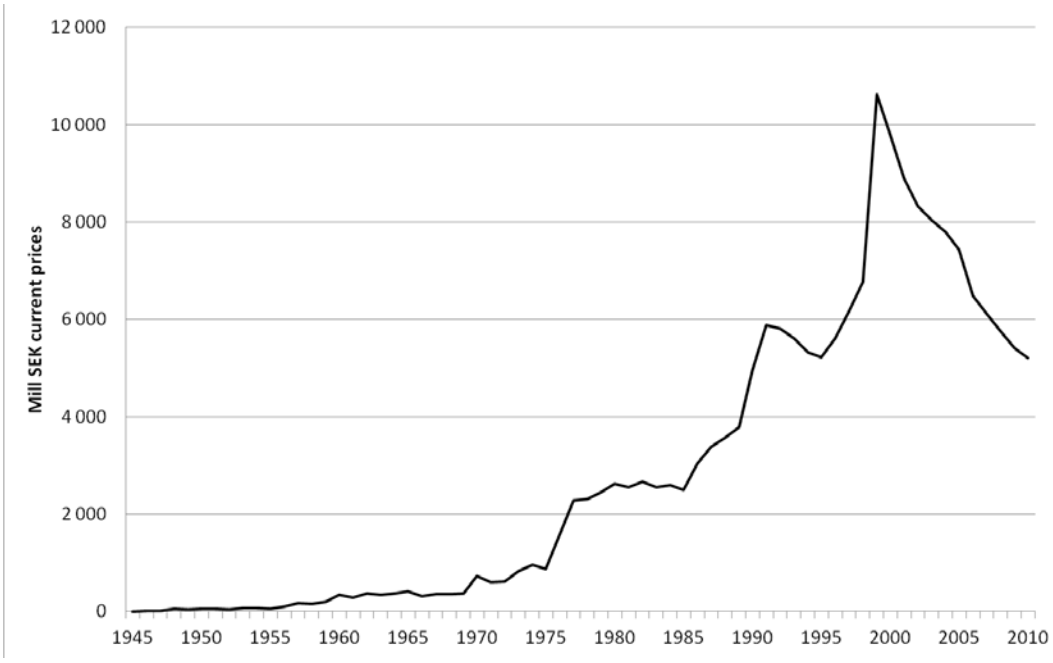
Name of canal	Artifically constructed length (km)	Year of completion
Göta kanal	87	1830
Fåens kanal	13	1898
Strömsholms kanal	12	1860
Bergslagsrännan	11	1869
Dalslands kanal	10	1867
Silarnas kanal	10	1870
Hjälmare kanal	8,5	1830
Kinda kanal	7	1875
Trollhättekanal	7	1832
Kinda kanal	5,6	1870
Hjälmare kanal	5	1830
Södertälje	4	1830
Herrhultskanalen	3,7	1902
Bredsjö kanal	3,5	1858
Asphyttekanal	3,3	1857
Bergslagskanalen	3	1857
Futtenkanalen	2,7	1858
Rönneå	2,6	1862
Bångbro kanal	2	1874
Karlsdals kanal	1,8	1840
Räppe-Asa kanal	1,7	1870
Eskilstuna nedre kanal	1,7	1860
Risåkanalen	1,7	1851
Hällaryds kanal	1,5	1898
Bergskanalen	1,2	1881

Brotorpets kanal	1,1	1909
Djurgårdsbrunnskanalen	1	1830
Kanal förbi Kengisforsen	1	1830
Pershyttanskanal	1	1830
Ristens kanal	0,8	1870
Ede (Stöde) kanal	0,75	1870
Härnösandskanal	0,683	1850
Hyttekanalen	0,5	1830
Forshaga kanal	0,46	1856
Höganäns	0,2	1830
Rössjö		1850
Sala kanal		1830
Tofta kanal		1870
Sandviken kanal		1863
Storstruckan		1907
Säffle kanal		1870

Civil Aircraft

The value of the aircraft is estimated as present value depreciated cost (see figure 5). The basic information is collected from http://www.hilmerby.com/ which gives a complete overview over all *SAS* operated aircraft and their individual history. Additional information was collected from http://www.linjeflyg.info/flygplan/flygplan.htm providing similar information of the *Linjeflyg* (the second largest operator on domestic flights until deregulation of the market in the 1990s) fleet. In some cases, these sites also gives information on purchasing costs. The information on purchases and operation with Swedish carriers has been combined with information on historical purchasing prices for specific aircraft types at specific years. Costs are usually stated in USD and has been collected from various sources (see Joosung, 2001; Cho, 2004). In the cases were prices could not be obtained we used prices for similar types. Costs expressed in SEK have been converted to USD with the official exchange rate.

Figure 5. Value of the civil aircraft stock in Sweden 1945-2010.



Source: Own estimates

Furthermore, aircraft have been depreciated with an interest rate equivalent to 15 year of service life. Since aircraft usually have an international second hand market, prices in SEK have been converted to USD. SAS aircraft registered in Denmark (DK) or Norway (LN) or Finland (OY) have not been included in the Swedish stock, shown in figure 4B. The series could be improved for later years since a considerable part of operations today is undertaken by *Norwegian*. This operator was using aircraft registered in Norway until the 2010's. From one perspective, all capital that is used for operations within Sweden should be counted to the Swedish capital stock independently of ownership. This is because the operation of the capital contributes to generation of Swedish GDP.

Capital for the production of public services

This category includes capital used for the production of civil and military services supplied by state, regional (*landsting*) and local government (*kommuner*, previously divided on *landskommuner, köpingar, municipalsamhällen* and *städer*). Notice that military equipment is included here, while this is not always common practice in contemporary growth accounting.

The produced capital held by regional and local government is calculated as the sum of buildings and inventories reported in SOS *Årsbok för sveriges kommuner*, SOS *Statistisk årsbok för landsting* and SOS *Statistisk årbok*. For the pre-1914 period, the lack of book-keeping data, make a PIM estimated stock more reliable than calculating only e.g. number of buildings used in public services. Investment series have been derived from Krantz and Schön (2007). For the calculation we are assuming a depreciation rate of 70 years for buildings. The fixed price PIM-stock was reflated with the HNA investment deflator.

Appendix 3. Natural assets: Non-produced non-financial assets

Sub-soil assets: Iron ore

Concerning iron ore, we use historical extraction figures. Appropriate net prices use the difference in return-on-capital in iron ore industry, in comparison with other manufacturing industries, as a point of departure. This is the same method as used in contemporary resource accounting. The exact methodology is described in Lindmark (1998) while an outline is given below. For the post-1990 estimates of iron ore net prices we used LKAB annual reports. Depletion of iron ore is based on iron ore extraction data and estimated net prices (Lindmark 1998; 2004). Prices are estimated using the net-price method (El Serafy 1989, 1991) where the net price can be represented by the part of profits in the iron ore company LKAB which exceeds the rate of return in comparable non-extractive industries. "Excess profits" (övervinster), as the phenomenon was labelled in the public debate, were highest in the 1950's and 1960's up until the 1970's industrial crisis. High profit rates again appeared in the 2000's. As such, net prices can be considered as a proxy for Hotelling rents in Swedish iron ore extraction. The omission of other minerals than iron causes a bias, during foremost the decades after 1990, when also other minerals experienced a boom.

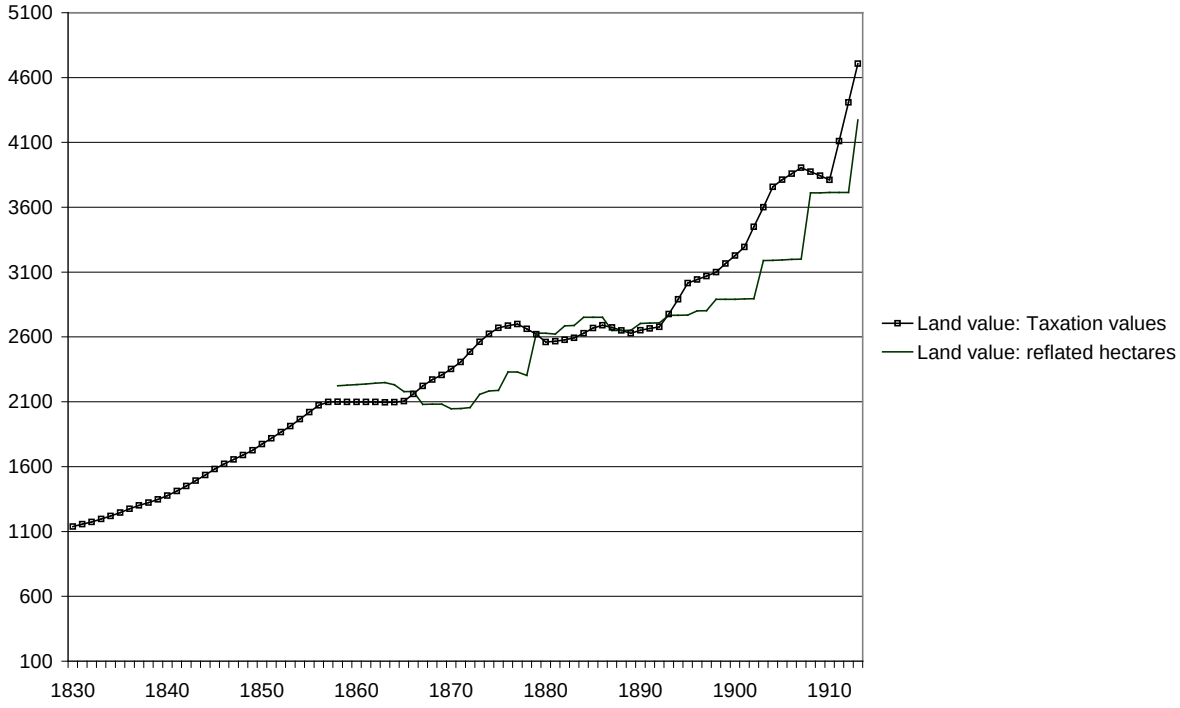
Agricultural land and agricultural buildings

Land includes the soil covering and associated surface water of land but not buildings, plantations and so forth. The present estimate includes only agricultural and forest land, while other cultivated and uncultivated land is omitted. This omissions include for cultivated land most notably land underlying buildings and works.

Bench-mark values of agricultural land are found in historical national wealth estimates (Fahlbeck 1890; Flodström 1912; SOS *Statistisk Årsbok* 1920 tab 236). The estimate here is based on agricultural land areas (SCB *Historisk Statistik*). These figures have been adjusted upward, due to a well-known problem of underreporting during the 19th century. These adjustments have been done up to 1910 and is based on Gadd (1999, 2007). Land prices from 1861 were found in Åmark's study (SOU 1923:45). For the period 1830-1860 we used the smoothed deflator for agriculture (Krantz & Schön 2007) as a variation index linked to Åmarks prices. For the period 1950-1993 we used smoothed taxation values as a variation index and further linked these to market prices for the 1993-2010 period (*Jordbruksstatistisk årsbok*). Note that all agricultural land prices includes buildings prior to 1993-period. Therefore, a benchmark for the post-1993 period is used to arrive at crop land values only.

A comparison with taxation values are provided in figure 6. As seen in the figure both measures show a similar development, providing credibility to the first estimate.

Figure 6. Land values obtained from reflated arable land (reflated hectares) and taxation values. Sweden 1830-1913. Million SEK, current prices.



Sources: own estimates based on SCB Historisk statistik and Swedish official statistics: BiSOS and SOS Statistisk årsbok

The value of buildings in agriculture is disaggregated from the total insurance value (insurance sum). From the total insurance sum, the value of manufacturing industry capital stock is deducted based on a benchmark from Lindahl et al (1937, vol 3). From the 1937-bemchark, taxation values for manufacturing industry properties is used an in index for the change in the underlying capital stock. After ceding the manufacturing capital stock from total insurance sum, a division between property in rural and urban areas is attained. The division is based on Lindahl et al (1937, vol 3) that provide a benchmark from 1909 (and a time series up till 1930) on the division of insured real properties (buildings). From that benchmark, we have used Flodström (1912) division of real capital on rural and urban areas back to 1891. For the pre-1891 period, the division is based on number of rural and urban households (SCB *Historisk statistik, Befolkning*). As the rural capital stock included both agriculture, private households and non-agricultural households, we have used Flodström (1912), that provide estimates on the value of real and movable property for non-agricultural use in 1908. The lack of pre-1908 data has forced us to keep the same division for the entire period 1830-1908.

Standing timber and forest land

Timber is difficult to classify in historical accounting since it has shifted from being a predominantly non-produced asset (wild biota) to a produced asset (cultivated natural growth asset). In the present study we have, however, chosen to follow the World Bank study approach, which means that standing timer is treated as a non-produced asset.

The first national forest survey was undertaken in the early 1920s, providing an accurate estimate of the standing timber volume around 1925. Only indirect evidence is available before this. Forest ecologists have demonstrated that the depletion of standing timber was substantial from at least the 1870s (Östlund 1992, 1993). These findings are in turn supported by narrative historical evidence. Thus, the most generally accepted view is that the standing timber volume declined with the growing saw mill industry up until at the latest 1920.

The data used here are based on Östlund's historical estimates are found in Lindmark (1998). Net prices measured as stumpage prices are available from 1876 and collected and reported in Lindmark (1998). By using Jörberg's (1972) timber prices and wage series for agricultural workers, the stumpage prices can be extrapolated backwards to 1800. A bench mark was also found for 1957 namely insurance values for privately owned standing timber (SOS *Enskilda försäkringsanstalter*). Since the volume insured timber is also provided, the unit value can be used for estimating the total value of standing timber since the total timber volume is known.

To indicate the value of the land used for production of timber, taxation records were used for the value of forest land from SOS *Statistisk årbok*, SOS *Skogsstatistisk årsbok*, 1950-2013 and SCB *Historisk Statistik*, 1960. The separate estimates of forest land is based on taxation records.

Wild fish

The estimate of wild fish stocks offers a number of challenges. What we have in terms of data sources are official statistics of the value of boats and equipment from the 1940s and onwards. There are also value added estimates of fisheries in the Historical National Accounts. Estimates of fish stocks are, however, limited to Flodström who reports on the rents paid to land owners for access to inland fishing waters. Flodström uses an interest rate of 5.5 per cent to capitalize the rents and to find the value of the fish stock. The institutionally owned fishing stock corresponded to 25 percent of the catches in 1908, making the total fishing stock four time larger. In order to arrive at a time series on the fishing stock, the value of catches was used as an index of the capital stock. The value of catches was derived from Krantz and Schön (2007). One obvious problem with such an approach is that over catching in the short-run will overestimate the underlying stock. In the long-run such an over catching

will give lower returns and thereby reduce the estimate of the stock. In addition the value of the fishing fleet was derived from official reports on fishing vessels, insurance value of fishing vessels and volume of vessels (SOS *Enskilda försäkringsanstalter*, 1912; SCB *Historisk Statistik*, 1960; SOS *Fiske*, 1960-2013).

Appendix 4. Intangible capital

Human capital

The only part of intangible capital that is not estimated as a residual is human capital. Human capital is not part of formal national accounting but has gain substantial attention in economics and economic history. Among the pioneering efforts is Sandberg (1979) who attributed the successful development of the Swedish economy during the nineteenth century to its comparatively higher literacy levels. An attempt to estimate historical human capital is found in Prados de la Escosura and Rosés (2010) who concludes that the use of alternative measures does not change the broad interpretation of the role of human capital in productivity advance.

In our estimates we use the investments figures from Lindmark & Acar (2013) which are based on municipal education expenditures obtained from Krantz (1989). For the government part of education (higher education and universities) we use actual expenditure available in the official statistics from 1913 and onwards. Prior to 1913 we use the number of professors and teachers at universities and research institutions for back-casting government educational expenditure between 1866 and 1913. For reflating this proxy, we used the public service deflator collected from Krantz & Schön (2007). Accordingly our estimate accounts for R&D undertaken at universities and other government research bodies. Private expenditures are however not included and neither is on-the-job-training schemes and similar arrangements.

References

Official Print

Riksrevisionsverket (RRV)

Årsredovisning för staten RRV – Riksrevisionsverket, Stockholm, per. 1995-2013.

SIKA

SSM 003:0301 *Fordon vid årsskiftet 2003/2004*

Statistiska Centralbyrån (SCB)

Historisk statistik för Sverige Statistiska översiktstabeller: utöver i del I och del II publicerade t.o.m. år 1950, Örebro ; Statistiska centralbyrån (SCB), 1960.

Sveriges officiella statistik i sammandrag, Stockholm : Bonnier, per. 1861-1914.

Sveriges Officiella Statistik (SOS)

SOS*, Årsbok för Sveriges Kommuner*, per. 1918-2013.

SOS, *Det enskilda skogsbruket*, per. 1905-1954

SOS, *Enskilda försäkringsanstalter*, per. 1912-

SOS, *Fiske*, per. 1960-2013.

SOS, *Jordbruksstatistisk Årsbok.* per*. 1913-*

SOS*, Skogsstatistisk årsbok.* per. *1955-*

SOS, Statistisk årsbok för landsting Stockholm, Landstingsförbundet, per. 1974-2005.

SOS, Statistisk årsbok för Sverige, Stockholm: Statistiska centralbyrån, per. 1914-2013.

Statens Offentliga Utredningar (SOU)

SOU 1923:45 *Undersökning ang. jordegendomsvärdenas utveckling i Sverige och vissa främmande länder. Verkställd av Karl Åmark*. Sthlm 1923.

SOU 1992:19. Bil 19, *Nationalförmögenheten*, bilaga till långtidsutredningen, Stockholm 1992.

SOU 2002:118 *Utveckling och förbättring av den ekonomiska statistiken Bilaga 3 Beräkningsrutiner för nationalräkenskaperna,* Stockholm 2002.

Literature

Abel, A. B. & Blanchard, O. J. (1983) An intertemporal model of savings and investment. *Econometrica* 51, 675–692.

Adams, M.B., Andersson, J., Andersson, L.F. & Lindmark, M. (2009) Commercial Banking, Insurance, and Economic Growth in Sweden between 1830 and 1998, *Accounting Finance and Business History*, 19:1, 21-38

Aghion, P., Howitt, P. (1992) A model of growth through creative destruction. *Econometrica* 60, 323-351

Andersson L.F. & Lindmark, M. (2008) Is Structural Change Speeding Up? The Case of Sweden, 1850-2000, *Scandinavian Economic History Review*,56:3,192 — 208

Angelsen, A. (1991) *Cost-Benefit Analysis, Discounting, and the Environmental Critique: Overloading of the Discount Rate?* Report R 1991: 5, Chr. Michelsen Institute,Department of Social Science and Development

Arnason, R. (2003) Green national accounts for Iceland: First hesitant steps, in: Gudmundur Jonsson (ed.) *Nordic Historical National Accounts, Proceedings of Workshop VI*, Institute of History, University of Iceland, Reykjavik, pp 233-252

Aronsson, T. & Löfgren, K.G. (1996) Social accounting and welfare measurement in a growth model with human capital. *Scandinavian Journal of Economics* 98, 185-201.

Barro, R. J, (1990) Government spending in a simple model of endogenous growth. *Journal of Political Economy* 98, 103-126

Baumol, W. J. (1986) Productivity growth, convergence, and welfare: What the long-run data show," *American Economic Review* 76, 1072-1085

Becker, G. S. (1964) *Human Capital: A Theoretical and Empirical Analysis, With Special Reference to Education*. New York: National Bureau of Economic Research (NBER), Columbia University Press.

Bergander, B. (1967) *Försäkringsväsendet i Sverige 1814-1914*, Stockholm: Wesmanns Skandinaviske Forsikringsfond,

Bohlin, J. (2003) Swedish historical national accounts: the fifth generation. *European Review of Economic History* 7:1: 73–97.

Bollfras, K.D. (1878) *Försök till uppskattning av den svenska nationalförmögenheten*, Stockholm.

Bollfras, K.D. (1885) Svenska nationalförmögenheten vid 1880 års slut, *Svensk Trävarutidning* 1885:15, pp-3-4.

Bolt & van Zanden, J.L. (2013) *The First Update of the Maddison Project; Re-estimating Growth Before 1820* Maddison-Project Working Paper Nr. 4

Chiozza, *Riches and poverty*, Ninth edition, London 1909.

Cho, D.W. (2004) *A Chain-Type Price Index for New Business Jet Aircraft*. Department of Economics, Wichita State University

Croix, D., Lindh, T. & Malmberg, B. (2008) Swedish economic growth and education since 1800, *Canadian Journal of Economics / Revue canadienne d'Economique*, Vol. 41, No.1

Daly,H. & Cobb, J., (1989) *For the Common Good*. Beacon Press, Boston

De Long, J.B., (1992) Productivity Growth and Machinery Investment: A Long Term Look, 1870-1980. *Journal of Economic History* 52, 307–324.

De Long, J.B. & Summers, L., (1991) Equipment Investment and Economic Growth. *The Quarterly Journal of Economics* 106, 445–502.

De Long, J.B., Summers, L.H., (1992) Equipment Investment and Economic Growth: How Strong is the Nexus? *Brookings Papers on Economic Activity* 1992 (2), 157–211.

El Serafy, S. (1989) The Proper Calculation of Income from Depletable Natural resources. In Ahmad, Y.J., El Serafy, S., Lutz, E. *Environmental Accounting for Sustainable Development*. The world Bank, Washington D.C.

El Serafy, S. (1991) The Environment as Capital. In: Costanza, R (Ed.) *Ecological Economics: The Science and Management of Sustainability*. Columbia Univ. Press, New York.

Esty, Daniel C., M.A. Levy, C.H. Kim, A. de Sherbinin, T. Srebotnjak, & V. Mara. (2008) *2008 Environmental Performance Index*. New Haven: Yale Center for Environmental Law and Policy.

Fahlbeck , P. (1890) *Sveriges nationalförmögenhet, dess storlek och tillväxt*; Stockholm

Feinstein, C.H. & Pollard, S. (1988) *Studies in Capital Formation in the United Kingdom 1750-1920*, Calarendon Press, Oxford.

Field, A.J. (1985) On the Unimportance of Machinery, *Explorations in Economic History* 22, 378–401.

Field, A.J. (2007) The equipment hypothesis and US economic growth, *Explorations in Economic History* 44, 43–58

Flodström, I. (1912) *Sveriges nationalförmögenhet omkring år 1908 och dess utveckling sedan midten av 1880-talet*, Stockholm.

Gadd, C.-J. (1999) *Svensk jordbruksstatistik 200 år*. Statistiska Centralbyrån

Gadd, C.-J. (2007) *Underskattningsproblemet i svensk jordbruksstatistik omkring år 1800. Åkerareal och utsäde.* Uppsats från Ekonomisk Historiska instutionen, Göteborg.

Gårdlund, T. (1947) *Svensk Industrifinansiering under Genombrottsskedet: 1830–1913*. Stockholm: Victor Pettersons Bokindustriaktiebolag.

Giuseppe Folloni, G. & Giorgio V. (2010) Human Capital Measurement. A survey. *Journal of Economic Surveys* Vol. 24, No. 2, pp. 248–279

Greasley., D., Hanley, N., Kunnas, J., McLaughlin, E., Oxley, L. & Warde, P. (2014. forthcoming) Testing Genuine Savings as a forward-looking indicator of future well-being over the (very) long-run, *Journal of Environmental Economics and Management*

Grossman, G. & Helpman, E. (1991*) Innovation and growth in the global economy*. Cambridge, MIT-Press

Hamilton, K. & Lutz (1996) Green National Accounts: Policy Uses and Empirical Experience. Environment Department Paper, Number 39. World Bank, Environment, Department, Vice presidency for Environmentally Sustainable Development. Washington DC.

Hamilton, K. (1994) Green adjustments to GDP, *Resources Policy* 20, 155–168.

Hamilton, K., & Hartwick, J. M. (2005) Investing Exhaustible Resource Rents and the Path of Consumption*, Canadian Journal of Economics* 38 (2): 615–21.

Hamilton, K., Ruta, G., Bolt, K, Markandya, A., Pedroso-Galinato, S., Silva, P., Ordoubadi, M.S., Lange, G-M. & Tajibaeva, L. (2006) *Where is the Wealth of Nations. Measuring Capital for the 21st Century*, The World Bank, Washington DC.

Heckscher, E.F. (1954) *An economic history of Sweden*, Cambridge, Mass.: Harvard University Press

Heckscher, E.F. (1957) *Industrialismen: den ekonomiska utvecklingen sedan 1750*, Stockholm

Holmquist, S. (2004) *Kapitalbildning i svensk industri 1870-1930*. Lund Studies in Economic History, Lund.

Joosung J. Lee, J.J., Lukachko,S.P., Waitz, I.A. & Schafer, A. (2001) Historical And Future Trends In Aircraft Performance, Cost, And Emissions. *Annual Review of Energy and Environment* 26:167–200

Jörberg, L. (1961), *Growth and fluctuations of Swedish industry 1869-1912: Studies in the Process of Industrialisation*, Almqvist and Wiksell, Stockholm.

Jörberg, L., (1972) *A History of Prices in Sweden 1732-1914*. Vol I. CWK Gleerup, Lund:.

Jorgenson, D.W. & Fraumeni, B.M. (1992) *The output of the education Sector*. In Z. Griliches (Ed.) Output measurements in the service sector (pp. 303-338), Chicago: The Chicago University Press

Kiaer, A.N. (1893) Indtaegts- og Formuesforhold i Norge, *Statsökonomisk Tidskrift* (Tillaeg) 1892, 1893

Krantz, O. & Schön, L. (1983) ”Den svenska krisen i långsiktigt perspektiv”, *Ekonomisk debatt* 1983:3, s 478–486.

Krantz, O. (1987) *Historiska Nationalräkenskaper för Sverige: Husligt arbete*, Ekonomisk-historiska föreningen, Lund

Krantz, O. (1987) *Historiska Nationalräkenskaper för Sverige: Offentlig verksamhet 1800-1980*. Ekonomisk-historiska föreningen, Lund.

Krantz, O. (1991*) Historiska Nationalräkenskaper för Sverige: Privata tjänster*, Ekonomisk-historiska föreningen, Lund

Krantz, O. & Lindmark, M. (1995) *Environmental Historical National Accounts. Some Problems and Prospects*, Umeå Papers in Economic History (1995):15.

Krantz, O. & Schön, L. (2007) *Swedish Historical National Accounts 1800-2000,* Lund: Lund Studies in Economic History 41 (updated figures 2013)

Lindahl, E., Dahlgren, E & Kock, K. (1937) *Wages, cost of living and national income in Sweden 1860-1930, National income of Sweden 1861-1930* P. 2. Vol. 3, London : P.S. King

Lindmark, M. (1997) Some Principles for Environmental Historical National Accounting. A Discussion Paper, in Jari Eloranta, (ed.) *Nordiska Historiska Nationalräkenskaper*. Suomen historian jujkaisuja 25, Jyväskylä , ss 57-78

Lindmark, M. (1998) *Towards Environmental Historical National Accounts for Sweden 1800-1990. Methodological Considerations and estimates for the 19th and 20th centuries*,(Diss) Umeå Studies in Economic History 21, Umeå 1998

Lindmark, M. (2003) Technical Change and the Pattern of Industrialization in Sweden 1880-1990. TFP Calculations based on new estimates of capital stocks, in: Gudmundur Jonsson (ed.) *Nordic Historical National Accounts, Proceedings of Workshop VI*, Institute of History, University of Iceland, Reykjavik (2003), ss 197-214

Lindmark, M. (2004) The Nature of Natural Resource Net Prices, In Peter Vikström (ed*.) Studying Economic Growth. New Tools and Perspectives*, Occasional Papers in Economic History 7, Umeå University pp 189-205

Lindmark, M. & Acar, S. (2013) Sustainability in the making? A Historical estimate of Swedish sustainable and unsustainable development 1850-2000. *Ecological Economics* 86 176-187

Lindmark, M & Vikström, P. (2003) Growth and structural change in Sweden and Finland 1870-1990: a story of convergence, *Scandinavian Economic History Review*, 51:1, 46-74

Ljungberg, J. (1990) *Priser Och Marknadskrafter i Sverige 1885-1969 : En Prishistorisk Studie*. (diss.), Ekonomisk-historiska Föreningen, Lund: Ekonomisk-historiska föreningen.

Madsen, J.B. (2010) Growth and Capital Deepening since 1870: Is it all technological progress? *Journal of Macroeconomics* 32 (2010) 641–656

Nicander E., *Järnvägsinvesteringar i Sverige 1849-1914*, Diss., Lund, 1980.

OECD (2001) *Measuring Capital. OECD Manual Measurement of capital stocks, consumption of fixed capital and capital services.*

Ögren, A. (2009) Financial revolution and economic modernisation in Sweden, *Financial History Review*, 16.1, pp. 47-71.

Östlund, L. (1992) Förändringar I det boreala skogslandskapet. Virkesförrådets utveckling 1850-1991, in: Jörgen Björklund & Lars Östlund (eds.) N*orrländsk skogshistoria. Människan, skogen och industrin*. Umeå, Umeå Universitet.

Östlund, L., (1993) *Exploitation and structural changes in the north Swedish boreal forest 1800-1992 (Diss.)* Umeå: Dissertations in Forest Vegetation Ecology 4, 16-23.

Östlund, L., Zackrisson, O. & Axelsson, A. L. (1997), "The history and transformation of a Scandinavian boreal forest landscape since the 19th century", *Canadian Journal of Forest Research,* vol. 27, 1198-1206.

Pearce, D. & Ulph, D. (1999) A Social discount rate for the United Kingdom. In David Pearce (ed.) *Environmental Economics: Essays in Ecological Economics and Sustainable Development*, 268-285. Cheltenham: Edward Elgar Publishing.

Prados de la Escosura, L. & Rosés, J.R. (2010) Human capital and economic growth in Spain, 1850–2000, *Explorations in Economic History* 47 520–532

Romer, P.M. (1986) Increasing returns and long run growth. *Journal of Political Economy*, 94 1002-1037.

Romer, P.M. (1990) Endogenous technological change*. Journal of Political Economy* 98, 71-102

Rostow, W.W. (1960). *The stages of economic growth: a non-communist manifesto,* Cambridge : Cambridge University Press

Rubio, M. del Mar, (2004) "The capital gains from trade are not enough: evidence from the environmental accounts of Venezuela and Mexico," *Journal of Environmental Economics and Management*, Elsevier, vol. 48(3), pages 1175-1191

Sandberg, L.G. (1978). Banking and economic growth in Sweden before World War I, *Journal of Economic History*, 38, 650-680.

Schön, L. (1991). Development blocks and transformation pressure in macroeconomic perspective: a model of long term cyclical change. *Skandinaviska Enskilda Banken Quarterly Review* 34, pp. 65–67.

Schön, L. (1997) 'The economic development of Sweden since 1870', in L. Jonung, R. Ohlsson (eds), *The Economic Development of Modern Europe since 1870*. Cheltenham, UK: Edward Elgar.

Schön, L. (2007) *En modern svensk ekonomisk historia: tillväxt och omvandling under två sekel*, Stockholm, SNS-förlag

Schön, L. (2012) *An Economic History of Modern Sweden*. London: Routledge.

Schultz, T. P. (1988). "Education Investments and Returns." In Hollis Chenery & T.N. Srinivasan (ed.) *Education investments and returns, Handbook of Development Economics*, Handbook of Development Economics, edition 1, volume 1, chapter 13, pages 543-630 Elsevier.

Smits, J.P. (2003) Historical National Accounts: where do we go from here? In: Gudmundur Jonsson (ed.) *Nordic Historical National Accounts*, Proceedings of Workshop VI, Institute of History, University of Iceland, Reykjavik, pp 9-32

Special Reports of the census office. *Wealth, Dept and Taxation*, Washington, 1907

Sundberg, G. *Sveriges land och folk*, Stockholm, 1901

Sylla, R. (2002). Financial systems and economic modernization, *Journal of Economic History*, 62, 277-285.

United Nations, *A system of national accounts*, New York, 1968.

United Nations, *System of National Accounts* 2008, New York, 2009.

Vikström, P. (2002) *The Big Picture. A Historical National Accounts Approach to Growth, Structural Change and Income Distribution in Sweden 1870-1990*, (Diss.) Umeå Studies in Economic History 26.

Wagner, A. (1904) *Statistik des Volk- oder Nationaleinkommens und- Vermögens, besonders mit Verwertung der steuerstatistik*. Bulletin de l'Institut international de Statistique XIV, Zeitschrift des K. reussischen Statist. Bureaus

World Bank (1997) *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development.* Environmentally Sustainable Development Studies and Monographs Series No. 17. World Bank: Washington DC