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Introduction

Studies of Scandinavian long-term economic growth rest upon a long tradition of Historical National Accounting (HNA) – a primary goal of which has been to estimate GDP over extended periods of time, allowing for macro-economic periodization of what are called ‘economic growth regimes’. Another important goal has been to create sectoral value-added estimates, thereby allowing for studies of structural change. In the works of Schön (2012, 1991), the HNA-based version of economic history has even led to a historical model – or generalization – of the dynamics of long-term economic growth. To date, HNA-based research has with few exceptions focused on economic flow measures, which include output-related measures (e.g. value added), income-related measures (e.g. labor incomes), and use-side related measures (e.g. consumption and investments). Few attempts have been made to account for and analyze the growth process from a capital stock or an asset-oriented perspective in Sweden.

Studies of the UK, France, Germany and America show substantial shifts in the scope and the structure of capital over time. One key finding is that natural capital has declined, while produced capital has increased its share of the capital stock in line with results reported by Piketty and Zucman (2014). A substantial increase of wealth in relation to income, known as the wealth-to-income ratio or the capital ratio for short, has occurred over the last 40 years, making today’s capital income similar to that of Europe in the eighteenth and nineteenth century.¹ However, in contrast to the European experience, the capital-to-income ratio in the United States has generally been rising since the late eighteenth century; it shows much less of a U-shaped curve over time; Piketty (2014). The trajectory for countries that industrialized later – and smaller economies – is much less known.

¹ In technical terms; the net-capital stock in relation to value added

The objective of this paper is to give an overview of the development of Swedish capital stock and its main components from 1830 to 2010. By accounting for long-term Swedish economic growth and structural change from an asset-oriented perspective, this paper seeks to provide a wider understanding of capital composition and capital-to-income ratio over time at both the overall and the sectorial, or industry, levels. Two main questions underlie our research effort:

- (i) What characterizes the scope and the structure of capital stock over time and across sectors?
- (ii) How does the ratio of income to capital evolve over time, and is the return on capital equal over time and across sectors?

The first question is descriptive, and will provide an empirical basis for comparing changes in capital composition over time. It will make identifying aggregated trends, and structural shifts for capital in Sweden in relation to other findings from other countries, possible. The second question is analytical, and will examine the relation between capital and income and its proximate determinants. This paper argues that a sectorial approach that examines the dynamics of capital structural change can help improve our understanding of the long-term trajectory of the capital ratio.

The paper is structured as follows: Section 2 provides an overview of previous research on capital structures and capital-to-income ratio; Section 3 provides the wealth accounting framework, the methodology applied and the data employed; Section 4 presents the empirical findings on wealth accumulation and capital components across sectors; Section 5 provides an analysis of the capital ratio for total economy and for individual sectors; Section 6 examines how shifts in the composition of the capital stock have affected changes in the capital ratio; and Section 7 presents the conclusions and a general discussion of the findings.

Literature on national wealth

National wealth assessments emerged as an important field in the economic literature in the nineteenth and early twentieth centuries. The first steps towards national wealth balance sheets were taken in the United Kingdom and France in the late seventeenth and early eighteenth centuries (Petty, 1664; Boisguillebert, 1695). In the nineteenth and early twentieth centuries, national wealth assessments became more common, covering both Europe and the New World (Bowley 1920; King 1915; Helfferich 1913).

The first attempt to compile a national balance sheet for Sweden was made in 1878 (Bollfräs, 1878; 1885). A more systematic wealth assessment was presented in 1885 (Fahlbeck 1890), which was later supplemented by a more empirically comprehensive national wealth estimate for 1908 (Flodström 1912). Part of the early work on National Income (Lindahl et al 1937) also included new estimates of capital stocks, although the primary goal was to compile Historical National Accounts focusing economic flows. Although a follow-up on the 1908 wealth assessment was carried out in the early 1950s (Englund 1956), the focus in most economic analyses had shifted from stock to flow measures. Within the national income accounting approach, estimates of production, consumption and investments and division of income garnered more attention than capital stocks.

During the 1980s, however, the concept of wealth attracted increased interest as government reports put forward the idea that long-term economic political goals should be expressed in terms of national wealth, including natural assets as well as human, fixed, and financial capital and not only GDP and similar flow measures (see SOU 1992:19 App. 19). Already before that, Statistics Sweden (SCB) had published estimates of the gross capital stock for the periods 1963-1980 and 1970-1984 (SCB 1981 & 1984). Also Hansson (1989) estimated capital stocks for the period 1963 to 1987, using the Perpetual Inventory Method

(PIM) and rates of depreciation obtained from U.S. age-price profiles for assets. These depreciation rates were considerably lower than those used by SCB. In the mid-1990s, SCB published new series for the period 1980-1995 using depreciation rates more in line with the ones used by Hansson (SCB, 1995). More recently, capital stocks in fixed and current prices have been published by Statistics Sweden. In economic historical research, capital stocks for the manufacturing industry between 1870 and 1930 were published by Holmquist (2004). Lindmark & Andersson (2014) and have presented new capital stock series based on stock and insurance data; this article is entirely based on the estimates by Lindmark and Andersson. Also Waldenström (2016) has presented new stocks. Since the present study is using a functional division of assets, while Waldenström used an institutional one, the studies are complementary.

Finally, we notice that historical research focusing on capital stocks can roughly be divided into growth accounting, sustainability issues, and the distribution of wealth and income. The growth-accounting tradition (the aim of which often has been to estimate Total Factor Productivity growth) uses capital stocks as a factor input in production functions. Scandinavian studies in this tradition include Prado (2008), Houpt (2013), and Edquist (2011), to mention a few. Also worth mentioning in the context of this study – especially as regards the composition of the capital stock – are studies claiming that the economic importance of certain types of capital varies over time. De Long and Summers (1991) argued that investments in equipment have a high propensity to generate positive externalities, resulting in a systematic and substantial divergence between social and private return on investments in equipment (see also Field 2007). A similar idea has also been suggested by Krantz and Schön (1983); they proposed that a rising machinery investment ratio characterizes periods of high economic growth. This idea was further developed by Schön in a number of books and articles on patterns of structural change (e.g. Schön 2012).

Although this study does not specifically test for relationships between growth and the structure of capital, we suggest how changes in the capital stock can be incorporated into the general narrative of Swedish industrialization. The stylized facts on sectoral returns on capital in this study also provide insights on the mechanism linking capital formation to structural changes in the output structure. Accounting for the impact of changing capital structure on aggregated growth of capital return, and understanding the mechanism underlying the long-term development of the capital-to-income ratio under the process of economic growth and structural change, are also equally important.

As previously mentioned, research into sustainable development has involved extending the concept of capital to include environmental capital in the traditional asset boundary (e.g. Hamilton and Hartwick, 2005). Some recent studies on the related ‘Genuine Savings’ concept are McLaughlin (2012) and Kunnas et al (2014). This study, however, uses traditional definitions of capital, and not the extended definitions used in studies of sustainable development. Still, it is the research by Piketty, however, that more than anything else has put capital back in the spotlight. As previously mentioned, some of the findings in this line of research – first and foremost as concerns the capital ratio – have served as a central point of departure for this study. An important issue in this article is if the Swedish historical pattern resembles any of the previously reported patterns for the UK, France, Germany, and the US, or if it did indeed follow some other path.

Wealth accounting

The early work on Swedish wealth assessment was based on a variety of methods and sources. The most common approach was to capitalize income streams by assuming a capitalization rate (rate of return) of four percent. This approach, known as the ‘income capitalization method’ was less frequently used in the 1908 wealth estimate, which was based largely on insurance sums to provide an estimate on produced capital. Natural capital,

formally known as tangible non-produced assets, such as agricultural land and forestry, was based on taxation records (Flodström 1912). The insurance approach was later followed up on in the historical wealth assessments compiled in the 1930s and early 1950s (Lindahl et al 1937; Englund 1952). Again, natural capital was largely based on taxation records. The insurance approach was also used in the present study compiling capital stock in the manufacturing industry during the post-war period. In turn, the wealth estimate from the mid-1990s onwards has been based on the Perpetual Inventory Method.

As previously mentioned, capital stocks in the manufacturing industry for the period from 1870 to 1930 were estimated in Holmquist's (2004) primarily using fire insurance data. Fire insurance records make up one of the main sources for estimating produced capital in the approach used in the present study.

To work on a conceptual basis, the estimates of historical wealth and capital need to be an integrated part of the Historical National Accounting approach, in which the focus is put on compiling estimates of the national balance sheet.² In the present paper, we follow the guidelines provided by System of National Accounts (SNA) 2008 (United Nations 2009). Capital stocks include fixed assets, inventories and valuables; produced capital comprises fixed assets including buildings, machinery and equipment, and other man-made structures owned by 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).

The main purpose 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

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

comparatively reliable and more unreliable sources, and to compare different estimates across different sources and methods in order to attain a robust estimate.

Wealth and capital stocks can be estimated using different methodological approaches. The most commonly applied method is the previously mentioned PIM, where stocks are estimated based on investment flow data and appropriate depreciation rate for various types of capitals (OECD 2001). The advantage with PIM is that it requires only data on investments and assumptions regarding the depreciation rate and service life. The disadvantage is that assumptions are static and cannot embody scraping of capital due, for example, to war, economic downturns, and uneven rates of technical progress and so on. From a conceptual point of view, this is especially troublesome if cyclical long-term dynamics of Schumpeterian creative destruction are assumed (see e.g. Schön (2012)). While we have generally avoided the PIM-estimates, the method has been used at some occurrences when other data has been missing. In those cases we have assumed a service life of 10 years for machinery and 50 years for buildings (SOU 2002:118).

Our main approach has instead been to use valuation of capital based on insurance underwriting records, thereby providing a close approximation of the stock of fixed assets at written down replacement costs. Estimating fixed capital using measures from insurance data gives a market valuation of the replacement value, which may overcome this specific shortcoming in PIM estimates. Insurance values are, however, expected to underestimate the capital stock due to uninsured property, known as self-insured assets. This is especially so concerning large, government-owned capital structures, not the least infrastructure, but also non-produced assets such as land for which there is no insurance need. Where insurance records were lacking, sales prices, balance sheet-based bookkeeping values and official taxation records were used to approximate a market value of assets. Such accounting values should preferably give information on written down replacement values. Notice that book

keeping values may still deviate from market prices due to the use of historical price levels and accounting rules, and even tax-dodging behavior and similar.

Given the advantages and disadvantages of the different methods, it is useful to cross-check the results of different approaches in order to indicate measurement problems. Table 1 reports fixed capital stock estimates that apply the PIM approach and the Insurance approach. The real capital stock attained from using PIM is reflatd with investment prices (expressed in current prices) to express the fixed capital stock in current prices. As seen from table 1, the value of fixed capital is substantially lower following the PIM approach produces substantially lower estimates of the capital stock, as compared to insurance values. In 1850 the PIM values were 23 percent of the insured values; this share increased to 36 percent in the twentieth century. Today, the PIM value corresponds to 45 percent of the insured value of the fixed capital stock.

Table 1. 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

As evident from Table 1, insurance values exceed the PIM-stock by 23 to 45 percent in all benchmarks. It is unlikely, however, that the insurance market would have overestimated the value of insured property to such a degree, as large and systematic overvaluation ultimately leads to severe financial problems among the insurers.

Insurance data provides high coverage of fixed-capital stock held by households and corporations from the early twentieth century and onwards. To avoid bias caused by

uninsured property during the nineteenth century, we use Lindmark and Andersson's (2010) estimate of insurance demand for the period from 1830 to 1850. Based on household demand for fire insurance in the twentieth century, a counterfactual estimate (assuming households have kept the same insurance coverage from 1830 to 1950) of premium incomes for fire insurance is presented. By using information on mean premium – the ratio between premiums and insurance sums (Bergander, 1967) – the counterfactual premium incomes are employed to calculate insurance values in the nineteenth century. Even though an indirect method is used for the 1850s, it is important to realize that the relation between PIM stocks and insurance values is exactly the same in both 1900 and 1950.

Non-produced assets or natural capital are also classified in the SNA 2008, while its inclusion in the national accounting system is limited to assets which are controlled by institutional units (e.g. households, companies or the government). In this study, asset values of agricultural land, forest, and wild fish are included. The value of agricultural land is calculated on the basis of annual average sales prices of land multiplied by the size of the agriculture land. The value of timber resources is calculated based on prices for standing timber and standing timber volume (Lindmark 1998). Since sale prices of timber (known as 'stumpage prices') mostly concern trees ready for cutting, the insurance value of standing forest was used as a benchmark to arrive at an average price for standing forest. Forest land is valued by average sales prices of the land (excluding timber volume) multiplied by the total size of forest land.

The value of wild fish is measured as the present discounted value of fishing rents (see Lindmark and Andersson 2014 for details). Concerning sub-soil assets, we have only estimated the value of iron ore mineral reserves. The approach used in the present study uses the so-called 'net-price' method based on data and from Lindmark (1998). Here we depart from a calculation of iron ore resource rents, which are the additional returns on working

capital in extractive industries as compared to other industries. In the second step, the resource rent per unit of extracted ore is multiplied by the amount of extracted ore. This corresponds, theoretically, to the income stream generated by the mineral deposit itself. As a final step, the income stream is capitalized with the Consumer Rate of Interest (CRI) as calculated in Lindmark and Andersson (2014). Water resources are estimated for hydropower only and follows an opportunity cost method, where we capitalize the difference between the higher U.S. electricity prices (mainly based on coal) and Swedish electricity prices (historically average costs for hydro). Also here the CRI is the preferred interest rate.

Comparing the totals in this study with Waldenström's estimates, both studies are close to Flodström's estimates for 1908, while, for the later period, our estimates resemble Englund's figures for 1952, but are clearly higher than the Statistics Sweden estimates for the period 1980 to 1995 (SCB 1992). Waldenström's estimates are considerably lower than both the Englund and SCB estimates. Both Waldenström and SCB arrived at lower estimates as compared with insurance values. In short, the low estimate of assets suggests a high return on capital, especially during the 1980s and early 1990's. Since this was a period of slow productivity growth this may indicate that both SCB and Waldenström underestimated the aggregated capital stock.

Wealth accumulation and structural change

The wealth structure of the Swedish economy was transformed during the process of industrialization. Natural capital was the largest tangible asset in the pre-industrial economy. As shown in Table 2, natural capital exceeded produced capital up until the mid-nineteenth century. The stock of man-made produced capital expanded slowly from the early nineteenth century. From the mid-nineteenth century, produced capital stock became increasingly more valuable than natural capital stock. Table 2 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 three times that of natural capital.

Table 2. Wealth structure in million SEK, current prices and % share, 1830-2010.

Year	Produced	(%)	Natural	(%)	Financial	(%)	Total	%
1830	1 495	44	1 787	52	138	4	3 420	100
1850	2 311	45	2 728	53	146	3	5 185	100
1870	4 739	56	3 804	45	-128	-2	8 414	100
1890	8 430	70	4 299	36	-726	-6	12 003	100
1910	17 045	78	6 314	29	-1 482	-7	21 878	100
1930	52 042	85	9 600	16	-120	0	61 522	100
1950	179 902	84	36 492	17	-2 466	-1	213 928	100
1970	1 075 060	95	65 427	6	-4 802	0	1 135 686	100
1990	7 498 843	96	385 941	5	-82 072	-1	7 802 712	100
2010	16 244 379	86	1 409 606	7	1 313 559	7	18 967 545	100

Financial capital, corresponding to the balance of financial assets and liabilities to foreign countries (net financial position to foreign countries), was positive up until the mid-nineteenth century. Substantial foreign loans during the industrialization process –especially for financing railways – changed the balance towards a growing foreign debt up until the First World War.

Due to booming net exports, foreign liabilities went down substantially during the war. The net financial position against foreign countries was in balance for most of the inter-war period. After the Second World War, the situation remained fairly stable up until the 1990s. After the export boom following the economic crises of the 1990s, financial capital expanded substantially.

The industrialized period from around 1890 has thus been characterized by a growing stock of produced (man-made) capital. The structure of wealth shows that produced capital, as a share of total capital, expanded from 78 percent to 84 percent between the two world wars. After the Second World War, the share of produced capital expanded, peaking at 96 percent in 1990. Thereafter, the share of produced capital lost ground: most of the reduction has been

due to increasing foreign net financial holdings, while a less significant factor is the growing wealth attributed to natural capital stock.

In the pre-industrial period, natural capital consisted predominantly of forest capital – standing timber and forest land (see Table 3).

Table 3. Natural capital structure by assets of Sweden in per cent, 1830-1910.

Year	Crop land	Timber, forest land	Fish stock	Energy and Minerals	Total
1 830	31	68	1	0	100
1 850	46	53	1	0	100
1 870	50	49	1	0	100
1 890	46	51	3	1	100
1 910	50	43	3	3	100
1930	42	47	4	7	100
1950	18	60	4	18	100
1970	24	52	4	19	100
1990	6	77	3	15	100
2010	8	47	1	44	100

Source: Appendix 1.

Forest capital accounted for 70 per cent of all natural capital in 1830. The expansion of agricultural land and price developments – most markedly in the 1830s and 1840s – substantially changed the structure of natural capital. The benchmark for 1850 shows that forest capital share was 53 per cent and agricultural land 46 per cent, while other natural capital items (wild fish, energy and mineral resources) were far less important. The changes to the structure of natural capital 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 agricultural land in the 1890 benchmark. Large-scale logging, however, reduced the standing timber volume until approximately the First World War. This also explain the increasing share of agricultural land in total natural capital over the same period. During the inter-war period, however, agricultural land declined relative to forest and energy and mineral assets; by 1950, agricultural land made up 18 percent of natural capital.

Standing timber volume increased from the 1920s due to, among other things, compulsory replantation in a highly regulated silvicultural system (Östlund 1992).

Energy and minerals increased in importance during the post-war period, which was a result of the high international demand for iron, resulting in high ore prices and the expansion of hydroelectricity during the 1950's and 1960's. When mineral prices peaked in 2010, energy and mineral assets comprised 44 percent of natural capital. Timber capital and forest land, which had peaked in value by the 1990's, declined in relative terms to 47 percent of natural capital by 2010; that same year, agricultural land only held eight percent of natural asset values.

As regards the sectoral distribution of capital, the structure of pre-industrial produced capital was dominated by assets held by the primary production sector (agriculture, forestry and fishing) – a 43 percent share of all produced assets in 1830. Produced capital in primary production was dominated by agricultural buildings, livestock and inventories. An almost equally large share of the produced capital stock was held by private services and the household sector. Buildings, as well as inventories and valuables, were the predominant assets in the household sector.

To a lesser extent, the structure of pre-industrial produced capital included manufacturing and transport assets. Public services and the government sector also held a relatively large share of produced assets. In the 1830 benchmark, this sector held as large a share of produced capital as the manufacturing and transport sectors did. Up until the mid-nineteenth century, the structure of produced capital was largely held by the primary sector, the private service sector and the household sector.

During the early phase of industrialization, changes to the structure of produced capital took place most noticeably in the manufacturing industry and the transport and communications sector, as seen in Table 4. The capital formation in transport and

communications developed initially owing to canal construction, while the building of railways from the mid-1850s onwards constituted a more pronounced boost in the capital formation in the sector. Investment in the shipping sector contributed to strong capital formation during the second half of the nineteenth century. Communication equipment also took off from the mid-1850s. Produced capital in the form of infrastructure and related equipment was therefore a vital part of the transition to modern economic growth. In Table 4 the structure of produced capital in Sweden is given per individual asset for the benchmarks between 1830 and 2010.

Table 4. Produced capital structure by sector in Sweden in per cent, 1830-2010.

	Primary	Manufacturing	Services & Dwellings	Transport, communications	Government	Total
1830	43	6	39	3	9	100
1850	46	5	39	3	7	100
1870	41	5	39	10	4	100
1890	31	9	37	19	3	100
1910	27	13	37	19	4	100
1930	8	14	57	17	5	100
1950	4	13	67	11	4	100
1970	2	13	67	13	5	100
1990	1		85	10	4	100
2010	1		85	11	3	100

source: Appendix 1.

While the transformation of the capital structure had been high during the industrialization process, it slowed down during the inter-war period. Produced capital in the agricultural sector developed relatively slowly. Although investments in machinery and equipment expanded due to mechanization, progress was slow compared to other sectors; the share of agricultural capital declined from 27 percent in 1910 to only 4 percent in 1950. Capital formation in the manufacturing industry kept pace with the general expansion of

produced capital, while the value of produced capital owned by households and service industry increased more rapidly. Between 1910 and 1950, the share of produced capital made up by buildings and movable property in the household and private service sectors increased from 37 percent to 57 percent. Wealth formation in transport and communications developed more slowly, implying that the share of produced capital declined from 19 percent to 11 percent. The share of produced capital used by government for civil and military service remained at 4 to 5 percent for most of the inter-war period.

The structure of produced capital across sectors underwent minor changes in the post-war period. The predominance of the industrial and household sectors increased after 1970, constituting 85 percent of all produced capital. The agricultural sector declined from 4 percent to only 1 percent of total produced capital stock. Transport and communications, as well as government, declined relatively compared to the industrial and household sectors during the post-war period.

Capital, income and rates of return

The Swedish capital-to-income ratio declined substantially during the industrialization phase. In the early phase, capital stock was equal to nine years of accumulated national income. As shown in Figure 1 (solid line), the capital ratio was down to a proportion of 7:1 (capital 700% larger than income) by the early twentieth century.

After 1914, the longer-term average remained at a 7:1 proportion. However, the capital ratio has fluctuated over the short and medium term. In particular, we found that the capital ratio was low following the First World War and in the mid-1990s. In the 1970s and 1980s, as well as the present era, the ratio has been high.

Figure 1. Swedish national wealth to income and value return on capital 1830-2010.

Compared with Piketty's results, the Swedish trajectory holds less of a U-shape than is seen in those of the UK and of France. Instead, it declined during the phase of industrialization and remained stable over the long term during the post-industrialization period. The Swedish case fits more with the German trajectory, where the capital ratio declined during the second industrial revolution. However, we see fewer similarities in the post-war period, where the capital ratio increased substantially more in Germany than in Sweden. In the post-war period, Sweden fit more with the US trajectory. In turn, the US trajectory fit less with the Swedish trajectory in the period before 1945. In contrast to the Swedish experience, the US capital ratio increased substantially during the second industrial revolution. Piketty (2014) also argues that the capital ratio was initially lower in the US as compared to the Western European countries in his study. The explanation proposed is that the low US ratio reflects the abundance of agricultural land and agricultural capital, and consequently lower land prices in the US. In line with this argument, the higher Swedish ratio is compatible with a shortage of productive agricultural land (Sandberg 1978). Shortage of

land was one of the reasons behind the substantial emigration from Sweden to the US in the nineteenth and early twentieth centuries (Schön, 2012). Piketty also shows how the capital-to-income ratio dropped substantially in the UK, France and Germany between 1910 and 1950, while it remained fairly stable in the US. This is explained by the severity of interruptions caused by exogenous events affecting the European economy. As previously stated, Sweden is more reminiscent of the US during this period. Sweden may also have been less disrupted by economic crises and other events since the country remained neutral in both World Wars. The depression of the 1930's was relatively mild (Grytten 2008) while, on the other hand, the depression of the 1920's was severe. However, other contextual circumstances may also play a role. The industrialization process occurred later in Sweden than in the core of Western Europe, and the institutional and economic structures were also fairly different. Due to the later industrialization in Sweden, heavily influenced by second industrial revolution technologies and in that sense resembling the US experience, may have affected the accumulation of capital and output growth in the US and the Swedish differently as compared to the European countries investigated by Piketty. With different rates of return across sectors and categories of assets, the timing of industrialization may also have contributed to variations between countries with respect to the aggregated capital ratio. We will explore this further. A basic indicator of changes in the rate of return on capital is the ratio of national income to tangible wealth – in other words, the inverse of the capital ratio. The measure is, however, only an indicator since the national income includes compensation to labor services, which distorts the level of returns and only makes the measure useful as an indicator of changes in the rate of return. Secondly, the capital stock is per definition reflecting net capital formation, while the national income (value added) includes depreciation. Thirdly, the measure can only interpreted as an indicator of changes in the rate of return on capital if the functional income distribution, the share of gross operating surplus and compensation to

employees is assumed constant. With these reservations, the indicator here labelled ‘gross value added to capital ratio’ or ‘value added ratio’ for short is shown in Figure 1 (dashed line) for the period from 1830 to 2010.

The figure shows that the value added ratio was already increasing as early as the first phase of industrialization in the late 1840’s. From a 10 percent value added ratio by 1830, the ratio had increased to 15 per cent by the First World War. This included a prolonged period of what can be interpreted as a constant rate of return between 1860 and 1890, followed by a pronounced increase between 1890 and 1910, which is traditionally considered as the take-off period industrial take-off in the Swedish economy (Heckscher 1954; 1957). From the start the industrialized period through 1970, the ratio fluctuated around 15 per cent on average. It also seems likely that the ratio fell to roughly 12 percent in the late 1970s. Peaks in the value added ratio can be seen after the First World War and following the crisis in the 1990s, and drops can be identified during the 1980s and in the early twenty-first century.

One of the major structural changes in the structure of wealth and income was the expansion of produced capital and the corresponding decline in natural capital. The expected proximate mechanism behind the shift is differences in the rates of return between different categories of capital. It can be expected that Natural capital had a comparatively low rate of return compared to produced capital. This difference would have caused different rates of capital formation, which would have shifted the composition of the capital stock and the aggregated rate of return. To provide a basic analysis of this hypothesis, we have compiled sectorial value added ratios as well as estimates of the value return, the latter defined as the gross operating surplus (value added less compensation to employees) in relation to the capital stock in the sector, using the terminology proposed by Irving Fisher (1906 p 186). The sectorial gross operating surplus was obtained from Vikström (2002).

Beginning with the primary sector (agriculture, forestry, fishing), it can be shown that produced capital, consisting of livestock and buildings, had a smaller share – 25 percent – in the pre-industrial period. The pre-industrial wealth structure provided a low return. As seen in Figure 2, the value return in the primary sector available from 1870 was as low as two to three percent.

Figure 2. Value return on capital in the primary sector, 1850-2010.

The. By the turn of the twentieth century, the share of produced capital had increased to 37 percent of the total capital in the primary sector. This contributed to increasing returns as indicated both through the value added ratio and the value return, which increased to five per cent by the 1920s and remained so up till the 1980s. Returns in the primary sector, however, have declined in the past few decades. At present the value return is again down to two to three per cent. Rising asset prices on land and forest seem to have picked up, while producer prices on agricultural and forest products have stagnated, causing the value return to deteriorate. Compared with investment opportunities in the primary sector, investors in the

emerging manufacturing industry faced better opportunities for high yields on capital. This is shown in Figure 3.

Figure 3. Value return on capital in the manufacturing sector, 1850-1980.

Value returns boomed during the early phase of industrialization. After a peak in the 1870s of close to 40 per cent, the value return stabilized at 15–20 percent during most of the industrialization period. From the late nineteenth century up through the late 1950s, the value return remained fairly stable at 17 percent. Returns have subsequently declined and have since then on average equaled 11 percent.

Compared with the primary sector, our investigations suggest that the return on investments in the manufacturing sector was substantially stronger than in the primary sector. During the phase of industrialization in particular, where primary sector returns were low and manufacturing return high, the incentives for accumulating capital to achieve high future incomes were arguably stronger in manufacturing. As shown in Table 1, the share of

produced capital increased from 44 percent to 78 percent during the phase of industrialization. This was due in part to manufacturing, which expanded its share of produced capital from six percent to 13 percent. Still, this shows that there were other important sectors as well. Capital in the transport and communications sector expanded from only three percent of total produced capital to 19 percent in the period from 1830 to 1890. In the early phase of expansion the returns on investment were probably close to those for manufacturing, as seen in Figure 4.

Figure 4. Value return on capital in the transport and communications sector, 1850-2010.

As shown in Figure 4, the high figures of the early 1870s dropped substantially down to approximately four percent. The value return has therefore fluctuated around this level, but with pronounced fluctuations, with one clear spike around the First World War, but also with two more extended fluctuations 1930 to 1960 and 1980 to 2000.

The capital formation was slower in the private service sector including dwellings as compared with manufacturing, transport and communication, while it had kept pace with the general growth of produced capital during the nineteenth century. Figure 5 shows a slow increase during the latter part of the 19th century and a long term decline from the turn of the century.

Figure 5. Value return on capital in the private services sector (incl. services of dwellings), 1850-1980.

In conclusion this means that the value returns have not been stable between sectors and neither over time, indicating different rates of return on capital. This aspect of structural change has rarely been discussed previously.

The impact of structural change on long-run growth of capital return

The industrialization came with a changing capital structure in which the shift from natural to produced capital was one of the most prominent features. From the previous section we can conclude that there were sectoral differences in the rate of return on capital, not the least during the industrialization phase. This means that the changing structure of the capital stock had an effect on the aggregated return on capital, and therefore also on the capital ratio.

To account for the impact of the transformation of capital structures on the changes of the return on capital, a shift-share analysis has been employed. The method allows us to quantify the shift-effect on the aggregated rate of return caused by differences in rate of capital formation between sectors experiencing different rates of return. Changes in returns on capital that occurs within a sector, and independently of shift-effects are captured as a so-called within effects (see note in Table 5). Further development of the historical capital stock accounts are needed before we can analyze the effect on returns due to shifts in the capital structure with respect to types of capital.

Between 1830 and 1890, the relative decline of the capital stock in the primary sector and the increase of the stock in manufacturing led to a total increase in value return of 10 percent (a change from 10.7 percent to 11.8 percent in annual value return). Most of the impact occurred due to the rapid expansion of produced capital yielding high returns. During the second industrial revolution, the effect of expansion of produced capital became even stronger as services and dwellings increased their share of the capital stock. In turn, the primary sector contributed negatively to the aggregate growth of value returns. But since the low-yielding natural capital stock of the primary sector was replaced by produced capital, yielding higher returns, the net effect of structural change on the value return was largely positive between 1890 and 1930.

Table 5. Decomposition of change in capital return in per cent, by benchmarks 1830-2010.

Year	Primary	Manufacturing	Services & Dwellings	Transport, communications	Public Services	Total
Within effect						
1830-1890	5,5	-0,9	-9,0	-3,5	4,5	-3,3
1890-1930	14,4	-2,2	-3,6	2,7	-1,0	10,3
1930-1965	-0,5	-4,0	-10,4	0,0	4,4	-10,4
1965-2010	-3,9		-9,2	0,9	16,4	4,1
Static and dynamic effect						
1830-1890	-12,2	14,6	8,3	7,1	-4,7	13,1
1890-1930	-26,9	25,0	28,7	0,2	3,4	30,3
1930-1965	-6,4	13,5	3,3	0,0	1,9	12,2
1965-2010	-1,0		11,3	-2,3	-12,0	-4,1
Contribution (total effect)						
1830-1890	-6,7	13,7	-0,7	3,6	-0,1	9,8
1890-1930	-12,6	22,7	25,0	3,0	2,4	40,5
1930-1965	-6,9	9,5	-7,1	0,0	6,4	1,8
1965-2010	-4,9	2,1		-1,5	4,4	0,1

Between 1930 and 1965, the aggregate value return had increased by approximately two percent. Manufacturing and public services had the strongest contribution while, similar to previous periods, the primary sector contributed negatively to the aggregate growth of capital return. Since the mid-1960s, the value return has fluctuated greatly although the average level of return has remained fairly stable. One reason seems to be an overall long-term convergence in returns on capital across sectors.

Concluding remarks

The study has provided a new assessment of national wealth over the long term, and an empirical account for the relation between income and capital for Sweden at the aggregate and sectorial level. The capital ratio level has been shown to be similar to that of other European countries, as reported by Piketty, and therefore lower than the United States; this can be explained by the relative shortage of agricultural land. Nor did the Swedish capital

ratio experience the same U-shaped pattern as Piketty reports for other European countries; after 1920 it therefore more resembles the US pattern. We suggest that this has to do with late industrialization, based on the second industrial revolution. The general pattern of structural change from an agricultural to an industrialized economy is reflected, or even proximately caused, by shifts in the capital stock. This study highlights the role of natural capital in the early phase of industrialization, and the growth of produced capital during industrialization and its aftermath. One of the key findings is that produced capital provided a significantly higher rate of return, making investments in new technologies embodied in man-made capital more profitable than further utilizing natural capital.

The growth in capital return during industrialization was significant. We have also shown the key role of manufacturing industry in improving aggregated capital return. The role of services increased during the second industrial revolution, thus contributing significantly to improving the income-to-capital ratio in the national economy in general. During the post-industrialization period, long-term capital returns have been stable. In the short and medium term, we find major fluctuations occurring during periods of crisis and other periods of major asset-price fluctuations.

Further work is needed to more fully understand the mechanisms between capital and income growth over the long term. One of the puzzles arising from the empirical account is the differences in rate of return: why are the rates of returns dispersed among the main sectors, and why is the convergence of rates of returns such a slow process? It was unexpected that the convergence process even exceeded the service life of fixed capital assets. Further studies are needed to uncover the mechanisms behind this. One potential line of research is examining the potential differences in rates of depreciation, service life, damages or outdated technology. In a dynamic setting, the rate of technological progress will constantly affect depreciation rates, causing a constantly changing equilibrium.

The present study showed how the rate of return on capital probably exceeded growth rates over the long term. Piketty (2014) argued that capitalists will benefit from the excess rate of return, skewing income distribution in the long run. On a related theme, the World Bank (2006) argued that some rather important parts of capital stock have been omitted: the limitations in measuring tangible capital, and the omission of intangible capital represented by institutional and human capital. Important steps have been taken within the framework of Genuine Savings and in Environmental Accounting to narrow the gap, but still more work is needed to finally arrive at a comprehensive capital stock.

An additional possibility is that the differences in rates of returns implies that national wealth should not be calculated as the sum of different types of capital. This could be the case if the substitutability between various forms of capital is low. Depending on which explanation is correct, this may have implications not only for how industrialization in a small country as Sweden is analyzed, but also for how the industrial revolution itself is understood. For instance, which interest rates were expected to fall, or which rates of returns were expected increase in order to trigger sustained economic growth, if the rates of return vary among sectors and among types of capital? Being unable to provide answers to these questions, we conclude that further research into the role of capital in the growth process will be most welcome.

References

Bergander, B. (1967). *Försäkringsväsendet i Sverige 1814-1914* [Insurance in Sweden 1814-1914].

Stockholm: Wesmanns Skandinaviske Forsikringsfond

Boisguilebert, P. (1695). *Le de'tail de la France*, Paris, 215 pp. Reprinted in E. Daire, *Economistes*

financiers du 18e siècle, Paris: Guillaumin, 1843, 222-424

- Bollfras, K.D. (1878). *Försök till uppskattning av den svenska nationalförmögenheten* [Attempt to estimate the Swedish national wealth]. Stockholm: Ivar Häggströms tryckeri.
- Bollfras, K.D. (1885). Svenska nationalförmögenheten vid 1880 års slut [The Swedish national wealth by the end of 1880]. *Svensk Trävarutidning* 1885:15, pp-3-4.
- Bowley, A.L. (1920). *The Change in the Distribution of National Income, 1880–1913*. Oxford: Clarendon Press.
- DeLong, J.B. & Summers, L.H. (1991). Equipment Investment and Economic Growth. *Quarterly Journal of Economics* 106: 2, 445-502.
- Edquist, H. (2011). Parallel development? Productivity growth following the diffusion of electric motors and ICT. *Scandinavian Economic History Review*, 59:1, 29-47
- Englund, K. (1956). Försök till skattning av Sveriges nationalförmögenhet omkring 1952 [Attempt to estimate Sweden's national wealth around 1952]. *Statistisk tidskrift*, 1956:10 493-518
- Fahlbeck, P. (1890). *Bidrag till svensk statskunskap: Sveriges nationalförmögenhet, dess storlek och tillväxt*. [Sweden's national wealth, its size and growth]. Stockholm: Norstedts.
- Field, A.J. (2007) The equipment hypothesis and US economic growth. *Explorations in Economic History* 44, 43-58
- Fisher, I. (1906). *The Nature of Capital and Income* (2007 edition). New York: Cosmio Classics.
- Flodström, I. (1912). *Sveriges nationalförmögenhet omkring år 1908 och dess utveckling sedan midten av 1880-talet* [Sweden's national wealth around 1908 and its development since the mid 19th century]. Stockholm, Finansdep.
- Grytten, O.H. (2008). Why was the great depression not so great in the Nordic countries. *European Journal of Economic History*, 2 p. 369-393
- Hansson, B. (1989). *Construction of Swedish Capital Stocks 1963-87. An Application of the Hulten-Wyckoff Studies*. Economic Studies 1989:2. Uppsala: Uppsala University.
- Hamilton, K., and Hartwick, J. M. (2005). Investing Exhaustible Resource Rents and the Path of Consumption. *Canadian Journal of Economics* 38 (2): 615–21.

- Heckscher, E.F. (1954). *An economic history of Sweden*, Cambridge, Mass.: Harvard University Press.
- Heckscher, E.F. (1957). *Industrialism: den ekonomiska utvecklingen sedan 1750* (The industrialism: the economic development since 1750] Stockholm: Raben & Sjögren.
- Helffferich, K. T. (1913). *Germany's economic progress and national wealth, 1888-1913*, Berlin: Georg Stilke.
- Holmquist, S. (2004). *Kapitalbildning i svensk industri 1870-1930* [Capital formation in the Swedish manufacturing industry 1870-1939]. Lund Studies in Economic History, Lund.
- Houpt, S. (2013). Productivity and transition in Swedish iron and steel, 1870-1940. *Scandinavian Economic History Review*, 61:1, 34-59
- King, W.I. (1915). *The Wealth and Income of the People of the United States*. New York: McMillan Press.
- Krantz, O. & Schön, L. (1983). Den svenska krisen i långsiktigt perspektiv [The Swedish crisis in long-term perspective]. *Ekonomisk debatt* 1983:3, s 478–486.
- Krantz, O. (1987). *Historiska Nationalräkenskaper för Sverige: Husligt arbete* [Historical National Accounts for Sweden: household work]. Lund: Ekonomisk-historiska föreningen,
- Kunnas, J., McLaughlin, E., Hanley, N., Greasley, D., Oxley, L., Warde, P. (2014). Counting carbon: historic emissions from fossil fuels, long-run measures of sustainable development and carbon debt, *Scandinavian Economic History Review*, 62:3
- Lindahl, E., Dahlgren, E and 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. (1998). *Towards Environmental Historical National Accounts for Sweden. Methodological Considerations and Estimates for the 19th and 20th Centuries* (diss.), Umeå Studies in Economic History 21, Umeå: Umeå University.
- Lindmark, M. & Andersson, L.F. (2010) All Fired up: the growth of fire insurance in Sweden 1830-1950. *Journal of Financial History* 17:1, 99-117

- Lindmark, M. & Andersson, L.F. (2014). *Where was the wealth of the nation? Measuring Swedish capital for the 19th and 20th centuries*, CERE Working paper: 2014:1
- McLaughlin, E., Greasley, D., Hanley, N., Oxley, L., Warde, P. (2012). *Testing for Long- Run Sustainability: Genuine Savings Estimates for Britain, 1760-2000*, Stirling: Stirling Economics Discussion Paper
- OECD (2001). *Measuring Capital. OECD Manual Measurement of capital stocks, consumption of fixed capital and capital services*.
- Petty, W. (1664). *Verbum Sapienti*. 26 pp. Published as an addendum to Petty, W., 1691. *The Political Anatomy of Ireland*. London, 266 pp. Reprinted in *The Economic Writings of Sir William Petty*, Hull, C.H. (Ed.), 2 vols., Cambridge University Press, 1989.
- Piketty, T. & Zucman, G. (2014). Capital is Back: Wealth-Income Ratios in Rich Countries 1700-2010, *The Quarterly Journal of Economics*, 129:3, 1255-1310.
- Piketty, T. (2014). *Capital in the Twenty-First Century*, Cambridge: Harvard University Press
- Prado, S. (2008). *Aspiring to a higher rank: Swedish factor prices and productivity in international perspective, 1860-1950* (diss.) Göteborg: University of Gothenburg
- Sandberg, L.G. (1978). Banking and economic growth in Sweden before World War I. *Journal of Economic History*, 38:3, 650-680.
- SCB (1981). SM N 1981:2.5 appendix 2
- SCB (1984). SM N 1984:5.5 appendix 2
- SCB (1992). *National Wealth and Stocks of Fixed Assets 1980-1990*, Stockholm, Statistiska Centralbyrån.
- SCB (1995). *Nationalräkenskaper 1980-1995. Appendix 3. Realkapitalstock och nationalförmögenhet 1980-1995*. N 10 SM 9501, Stockholm: Statistiska Centralbyrån
- Schön, L. & Krantz, O. (2012). "Swedish Historical National Accounts 1560—2010" Lund Papers in Economic History 123, Lund: Lund University.

- 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. (2012). *An Economic History of Modern Sweden*. London: Routledge.
- SOU 1992:19. Bil 19, *Nationalförmögenheten* [The National wealth]. Bilaga till långtidsutredningen, Stockholm: Fritzes, 1992.
- SOU 2002:118 *Utveckling och förbättring av den ekonomiska statistiken Bilaga 3 Beräkningsrutiner för nationalräkenskaperna*, Stockholm: Fritzes, 2002.
- United Nations (2009). *System of National Accounts 2008*, New York: European Communities, International Monetary Fund, Organization for Economic Co-operation and Development, United Nations, World Bank.
- Waldenström, D. (2016). The national wealth of Sweden, 1810–2014, *Scandinavian Economic History Review*, 64, pp. 36-54.
- 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, Umeå: Umeå University.
- World Bank (2006). *Where is the Wealth of Nations. Measuring Capital for the 21st Century*, Washington DC: The World Bank.
- Östlund, L. (1992). Förändringar i det boreala skogslandskapet. Vireksförrådets utveckling 1850-1991. [Changes in the boreal forest landscape. The development of the standing timber volume 1850-1991]. In Björlund, J./Östlund, L (eds.), *Norrländsk skogshistoria. Människan, skogen och industrin*. Umeå: Umeå University, 25-33.