Technological Waves and Economic Growth - Sweden in an International Perspective 1850-2005

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Abstract

This paper presents a model of long waves and an empirical analysis of Swedish growth since 1850. The model emphasises the creation of new complementarities around macro innovations. The growth process is periodised in two main parts. The first period is characterised by transformation when development is uneven and unbalanced. The second period is characterised by rationalisation when the economy is made more homogenous with growth accelerating in a wider context. With a Swedish Schumpeterian concept the complementarities around innovations form development blocks at the centre of the growth process. The process of innovation, diffusion and structural change is analysed. In periods of more rapid transformation, regions and nations react differently. Diffusion is more rapid to regions and nations favoured by new demands – due to their resource endowments, their institutional characteristics and their social capability. Over time however competencies, infrastructures and institutions will be more generally adapted to the new complementarities. Hence the development blocks will be more widely diffused. In that diffusion process, the favourable position of the leaders is undermined while laggards will improve their position. Diminishing returns will however shift profitability between established and emerging complementarities that pave the way for crisis and new structural transformation.

Keywords: growth, development blocks, long waves, economic history, Sweden.

Technological Waves and Economic Growth - Sweden in an International Perspective 1850-2005.

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Swedish growth in an international perspective

Swedish growth since the mid-19th century is largely a success story. At about 1850 the Swedish income level was close to the global average, the latter according to Maddison. In a European perspective, though, Sweden was a rather poor country. By the 1970s, however, the Swedish income level was more than three times the global average and among the highest in Europe. The Swedish advance is illustrated in figure 1. In the relation to the world economy, Sweden forged ahead steadily over the period 1850-1970 with certain acceleration from the 1930s. In relation to the Western world, Swedish improvement is largely confined to the period 1890-1950.

(Figure 1 about here)

To some extent this was a catch-up story. Sweden was able to take advantage of the technological and organisational innovations that were made in Western Europe and in North America. Furthermore, Scandinavian countries with resource bases such as Sweden and Finland had been rather disadvantaged as long as agriculture was the main source of income. The shift to industry inflated the resource base and industrial development directed both to a growing domestic market but even more to a widening world market became the main lever of growth from the late 19th century.

Catch-up is not the whole story, though. In many industrial areas Swedish companies took a position at the technological frontier from an early point in time. Thus, in certain sectors there was also forging ahead,[1] quickening the pace of structural change in the industrialising economy. This was particularly so over the period 1890-1950. Furthermore, during a century

of fairly rapid growth new conditions arose that required profound adaptation and renewal of entrepreneurial activity as well as of economic policies.

The slow down in Swedish growth from the 1970s may be considered in that perspective. While in most other countries growth from the 1970s fell only in relation to growth rates in the golden post-war ages, Swedish growth fell clearly below the historical long run growth trend. It also fell to a very low level internationally. The 1970s certainly meant the end to a number of successful growth trajectories in the industrial society. At the same time new growth forces appeared with the electronic revolution as well as with the advance of a more service based economy. It may be the case that this structural change hit the Swedish economy harder than most other economies, at least of the industrial capitalist economies. Sweden was forced to a transformation of its industrial economy and of its political economy in the 1970s and the 1980s that was more profound than in most other Western economies. The upward turn in comparative Swedish performance, that is noticeable from the 1990s (also in table 1), may indicate that this adaptation has been carried through rather successfully.

Table 1. Annual growth rates per capita 1971-2005

År	Sweden	Rest of Nordic countries	Rest of Western Europe	USA	World Economy
1971/1975-1991/1995	1,2	2,1	1,8	1,6	1,4
1991/1995-2001/2005	2,4	2,5	1,7	2,1	2,1

Sources: Maddison (2006); Krantz/Schön (2007); Groningen Growth and Development Centre, www. ggdc.com.
Note: Rest of Nordic countries = Denmark, Finland and Norway. Rest of Western Europe = Belgium, France, Italy, the Netherlands, Switzerland, Great Britain, Germany, Austria.

[1] Cf. Abramovitz (1986)

In this paper the long term growth pattern is discussed in relation to a periodisation of structural epochs with different settings of growth factors in the Swedish economy. This, in turn, is related to the concept of development blocks characterising different periods and to the idea of major innovative transformations labelled industrial revolutions. The paper will also present indications of technological waves through these epochs, interacting with the economy in a long cyclical fashion.

Transformation, complementarity and cyclical change – a Swedish perspective

There is a Swedish tradition of long term, structural analysis based on the concept of *development blocks* formed by complementary activities around innovations, formulated by Erik Dahmén more than fifty years ago in his analysis of Swedish industrial development. Within the development block new relations arose in the economy with new demand and supply functions that created imbalances which attracted further entrepreneurial activity and investments. Dahmén saw innovations as the primary source of transformation and growth. With a Schumpeterian perspective, he also perceived the innovating entrepreneur as the strategic element in the economy forming the development blocks.[2]

The quality of complementarity adds strength to the structures created by development blocks. This perspective has been elaborated into a model of long cyclical change.[3] Important innovations with the ability of forming development blocks have driven periods of strong technological change and structural transformation of the economy. The advent of innovations such as the steam engine, the electrical motor, the combustion engine or the microelectronics

[2] Dahmén, *Svensk industriell företagarverksamhet.*
[3] The model is elaborated in e.g. Schön, 'Development blocks and transformation pressure', Schön, 'Industrial Crises' and Schön, 'Electricity, Technological Change'.

creating new General Purpose Technologies[4] and the diffusion of infrastructures (railways, automobiles, general electrification, and maybe Internet) based on these technologies have been particularly important in reforming complementarities.

Periods of breakthrough and early diffusion of development blocks have, however, had other characteristics than periods of structural stabilisation. These differences may be analysed from the point of view of two fundamental behaviours behind the growth process. To improve utilisation of human resources in relation to human needs you have basically two possibilities - either you become more efficient in your old career and decrease your resource utilisation or you do something new and different that better fits to resources and needs. In a wider economic context, these possibilities of behaviour are two distinct processes that we may call rationalisation and transformation.

Transformation means changes of industrial structures, where resources are reallocated between industries, and diffusion of basic innovations within industry that provides new bases for such reallocation. *Rationalisation* means concentration of resources to the most productive units within the branches and measures to increase efficiency in the different lines of production.

There are differences in the investment behaviour involved in the processes of transformation and rationalisation. In transformation, investments are generally directed to increased capacity in new areas of production. Those investments are of a long-term character and in the short run they are of a rather resource demanding character. Their effect on productivity is delayed due to e.g. shortages in the supply of competence and to the need of learning processes at

[4] Bresnahan&Trajtenberg (1995).

different levels. In rationalisation, on the other hand, investments are directed to reduce costs in existing capacity. They are short term in character and resource saving and have a more direct effect upon productivity, growth and real income.

Rationalisation and transformation are certainly processes that to a large extent take place simultaneously in an economy. If one actor rationalises and reduces his need of resources, another actor may find scope for long-term, capacity increasing investments. It is a commonplace, though, that capacity-increasing and cost-reducing activities are unevenly distributed over the ordinary business cycle. It is however the argument of this paper that trends of behaviour in industry shift between transformation and rationalisation and that there, accordingly, have been long term shifts of such emphasis. These shifts in behaviour are in turn related to properties of complementarity and inertia in the economy and society. Blocks of mutually reinforcing factors are created in the transformation phase, which come to fruition when the complementarities are realised. These blocks create considerable expansion force but also an increasing inertia and resistance to change.

Periods of transformation and rationalisation affect the economy in many ways – not only in rates of productivity growth. In relation to income one may hypothesise that periods of transformation mean a more unequal distribution. Innovations make capital or company specific knowledge comparatively more productive than labour and technology-skill complementarities make the competence of skilled workers more remunerative than unskilled labour. The distance between average productivity and marginal productivity of labour widens which favours capital. With the shift to rationalisation, competence is diffused and technologies are standardised, which squeezes the value of company specific knowledge and of skills. Marginal productivity is drawn closer to average productivity reducing profits and

dispersion of wages. As it were, the economy shifts from a Schumpeterian to a neoclassical position.

It is furthermore the argument, that these shifts between transformation and rationalisation have occurred with considerable regularity within a long structural cycle of approximately 40 years characterized of some 25 years of emphasis on transformation and some 15 years of emphasis on rationalisation. Crises have formed particular sequences in these long cycles.

This framework of analysis has clear similarities with the techno-economic paradigm perspective of Christopher Freeman and Carlotta Perez, evolving in long waves.[5] The present analysis is however more focussed upon economic indicators and the economics of structural change with the cumulative dynamics in the development blocks that are formed around innovations.

Structural Epochs in Swedish growth since 1850

Within this perspective one may discern structural epochs with certain characteristics in macroeconomic conditions, economic policy and growth at the branch and firm level.
There is one indication of structural epochs from the relation between the capital stock and GDP (the capital-output ratio) in Sweden 1850-2000 (figure 2). The ratio shows quite distinct features. During two long periods the capital stock rose strongly in relation to output; i.e. 1850-1890 and 1940-1975. That was periods characterised by the development of infrastructures – the construction of a railway network and early urbanisation in the first case and the modernisation of society with construction of roads, residential complexes and public

[5] Freeman & Perez (1988)

services in the second. In the periods following the 1890s and the 1970s respectively the relationship between the capital stock and production output was roughly constant.

(figure 2 about here)

In the decades from the 1890s and the 1970s the Second and the Third Industrial Revolutions gained momentum. These as well as the First Industrial Revolution were all concentrated upon innovations in the sphere of production – at the heart of them there were the steam engine in the factory system, the motors in the new industrial production and the microelectronics in industry and services. These innovations were to become General Purpose Technologies. While the production sector was transformed in these revolutions through the diffusion of basic innovations, capital consuming investments in infrastructure were modest. A new tension arose, however, between the modernisation of certain productions sectors and the rest of the society. This tension or imbalance was released during the following epoch of infrastructural development. Thus, from the mid 19th and 20th centuries the social transformations widened with the development of infrastructures based on these prime motors; the railway system in the 19th century and the automobile and general electrification in the 20th century.

From analogy of historical experience, one may assume that a new period of expansive infrastructural development, based on the innovations of the Third Industrial Revolution, is ahead of us, within the next decades.

The shifting trends in the capital/output-ratio provide a periodization of Swedish economic growth that fits some broader characterisations taken from the historiography.[6] The upswing of infrastructural, as well as industrial, investments from the 1850s was linked to the breakthrough of mechanised factories in Sweden, the modernisation of steel processes and the construction of railways. It was also a period of increased utilisation of Swedish natural resources for an expanding export trade with an integration of the Swedish economy into the expanding western European markets. The expansion was of course dominated by the British economic growth. British demand drove Swedish exports of oats, iron and sawn wood, while Swedish investments focused on the transfer of British innovations, primarily the steam engine, railways and factory machinery.

From the 1890s, the modern industrial society had its breakthrough. Investments went increasingly to a more sophisticated urban industry in machinery and new consumption goods. In the centre of development, there was a diffusion of new motors, electrical or combustion engines, with a widening scope for mechanisation within industry. In Sweden, electricity got a particularly important position due to factors such as energy-intensive industry, shortage of fossil fuel and abundance of hydropower. Thus, Swedish industry became a proactive part of the Second Industrial Revolution. A new cohort of Swedish firms appeared, founded within the decades 1880-1910. They were highly specialised and knowledge intensive based upon innovations within the realms of chemistry and engineering, such as AGA, Asea (ABB), Ericsson, Separator (Alfa Laval) and SKF. Ideas behind innovations as well as technological transfers flew much more than before from the expanding

[6] This trend determination is made from a visual inspection of the capital-output series. One may add though that a strict econometric test of trend breaks at the GDP level - within a unit root framework - identifies structural breaks around 1850, 1890, 1930 and 1975.
Lobell/Krantz/Schön, *Swedish Historical National Accounts - a new generation* (submitted 2008).

German economy with a structure similar to the Swedish. Also in social and institutional arrangements, Germany provided the main inspiration. This was a German epoch in Swedish growth.

From the 1930s, and still more marked after the Second World War, new development blocks were created around a widening of electrification and the diffusion of automobiles. In both these cases, there were waves of investments in the development of an infrastructure that was based upon the radical innovations of the preceding epoch. In the case of electricity, a much broader spectrum of applications was created ranging from the processing of electrosteel to small motors in handicraft and household. In combination with the diffusion of the motorcar, new styles in living and consumption developed in the cycle. In the interwar years and during the 1940s a new cohort of firms appeared with innovations that were based on new socioeconomic conditions. New logistic and new appliances both in businesses and in households and new forms of distribution characterised firms such as Volvo, Saab, Electrolux, Tetra Pac, IKEA and H&M. Ideas flew from the American mass consumption society. Sweden became early on probably the most Americanised economy in Europe - this was the American period in Swedish growth.

From the mid-1970s, especially with the appearance of the microprocessor, electronics became centre in new development blocks. The use of knowledge and information in production of goods and services advanced with leaps, marking new directions of growth, which coincided with a shift in employment from industry to services. As noted in the introduction, this coincided with a slow-down in Swedish growth in absolute and in relative terms.

The diffusion of development blocks has clearly put new demands on other sectors and institutions. Thus, complementarities have been wider than only within the market economy. Innovations have come along with institutional changes and reorientation of economic policies.[7] Successful growth has certainly been dependent upon flexible institutional adaptation to new circumstances and needs. Broadly speaking, the decades following the upswing of the 1850s saw liberalisation of markets both internally in Sweden and internationally favouring integration at much lower costs. From the 1890s, the industrial society became more firmly organised at different levels. In particular the two main interests in industry, labour and capital, organised themselves nationally and came to establish new rules at the labour market through a series of conflicts. Furthermore, new financial and industrial blocks emerged with closer cooperation between banks and industrial firms, notably run by the Wallenbergs. The 1930s meant a radical reorientation in economic policies with the breakthrough of Keynesian theories that became more applied during and after the Second World War. After the war the so-called Swedish model was established. Centralised negotiations and a solidaristic wage policy came to steer the wage formation and large parts of the capital market were regulated. In that sense, the Swedish model introduced more planning, directing funds to the infrastructural modernisation of the industrial society. At the same time, the export sector and world market conditions were to determine the wage level, so the model was also orientated to integration and growth. After the crisis of the 1970s the Swedish model broke down - the central wage formation withered and the capital market was liberalised. This was part of a greater international movement that thwarted the aspirations of the national state to intervene in the market processes.

[7] Institutional change as part of the structural framework is discussed in Schön, *From War Economy* and Lundh, *Spelets regler*.

The investment ratio and a structural cycle.

Focussing more narrowly on the manufacturing sector, the periodisation appears in a number of factors that also present long cyclical patterns. This behaviour is particularly evident in the industrial investment ratio, i.e. investments in relation to value added in industry.[8] Since investments are cyclically very sensitive, the ratio rises in upswings and falls in downswings of the business cycle. Hence, the investment ratio in Swedish industry (i.e. investment in fixed capital in relation to value added in industry in fixed prices) expresses the ordinary business cycle distinctly all through the long period 1850-2000. (Figure 3). There is, however, also a pronounced long-term cyclical pattern with low points in the early 1890s, early 1930s and early 1980s. These lower turning points coincide with international crises - actually, the start of this data series is preceded by an international crisis in the late 1840s. From these crises followed periods of roughly 25-30 years with a rising investment ratio to peaks in the mid-1870s, the late 1910s and the early 1960s. It seems that a new such peak occurred at the turn of the century 2000. From the peaks followed some 15 years of falling ratio to the troughs in the years of crisis.

(Figure 3 about here)

Thus, the crises in the 1890s, 1930s and 1970s all gave way to new trends within industry and institutions. They became watersheds in economic and social development, which afford the denomination of structural crisis. The simultaneity also indicates a broad complementarity between technological and organisational change at the industrial level, on one hand, and

[8] The presentation of the structural model is largely from Schön, 'Industrial Crises' and 'Electricity, Technological Change'.

changes in the rules of the game on the labour market and in economic policy, on the other hand.

This is a Swedish pattern that without doubt corresponds strongly to international trends. Of course, there are some particularities in the timing and in the course out of the crises. In the 1930s, Sweden was largely on the positive side of the crisis and fared better than most countries. Swedish industry went quite rapidly from crisis to new expansion. In the last period, Sweden was more in the opposite corner when the crisis occurred. The international crisis appeared in the mid-1970s but it was delayed and prolonged a few years in Sweden. The fixed capital investment ratio gives however a certain bias since part of the reaction to the crisis was a shift from material to immaterial investments (in R&D). R&D rose from an equivalent of 20 up to 50 percent of material investments between 1975 and 1985. If R&D is included in investments, the investment ratio had its trough in the late 1970s. Thus, we can date the crisis to the period 1975/80, which coincided with a turning point in investment behaviour.

The investment ratio gives a periodisation of Swedish industrial development in cycles of 40-50 years running from crisis to crisis between 1845/50 - 1890/95 - 1930/35 - 1975/80. During the first 25-30 years of these periods investment has risen faster than output, while in the last 10-15 years investment has risen slower than output. These characteristics express differences in the investment behaviour between the upswing and downswing periods that indicate more general differences in the economic activity and climate.

The two phases of the long cycle in the investment ratio seem to reflect different behaviour that corresponds to the concepts of transformation and rationalisation. In the phase of rising ratio, investments have been relatively long term in character and thus had a longer time lag in

their impact on production. Investments have been directed towards increasing the *development power* of industry. In the phase of declining ratio, the reverse has been the case with more short-term investments directed towards a more efficient use of existing capacity. Investments have been directed towards increasing the *competitive power* of industry.[9]

This periodisation with a long-cyclical pattern of crisis-transformation-rationalisation fits also with the broader pattern of industrial growth. Not only did the investment ratio rise and turn over to long term investments after the crises, but new growth branches and new development blocks appeared as well. .

Technological change and productivity growth

When innovations first appear, they are generally comparatively expensive to implement and have a narrow range of application. Thus their impact upon industry is initially quite limited and diverse. Furthermore, when new development blocks are created they require organisational changes to be performed, new skills to be supplied and new complementarities to be met. Therefore, diffusion is a time-consuming process. Since old structures and old relations are broken down or weakened, productivity growth may even slow down in such a period of profound technological change (a phenomenon once phrased as a productivity paradox). Both the supply of new machinery and the productivity performance show long-term characteristics that fit into the pattern of transformation and rationalisation.

The availability of efficient capital equipment at reasonable prices is one crucial prerequisite for new development blocks to be formed around the innovations and for their ability to cause

[9] On these concepts, see Dahmén, ‘Development blocks’ and Schön ‘Development blocks and

crisis in old structures as well as expansion in new investments. Thus, a broad impact and a broad diffusion require that the new technology becomes competitive within a wide range of use. It is, furthermore, quite reasonable that the impact of basic innovations is felt primarily in the construction of machinery and then successively on the output side of that machinery. Accordingly, the price of machinery equipment in relation to the price of industrial output may indicate whether there has been any discontinuous effect from radical innovations or from technological pushes in conjunction with the structural crises.[10]

The price relation between the machinery, that is invested, and the output of industrial consumption goods can give such an indication of technological changes.[11] This price relation shows a characteristic long-term pattern (see figure 4). Since 1850, the relative price of machinery has fallen close to one percent annually on average. This long-term price fall is however concentrated to four decades of discontinuous drops in the level - namely to the second half of the 1860s, the 1900s, the 1940s and the 1980s! It is remarkable that the price fall has repeated itself with an interval of 40 years and approximately 10 years after the structural crisis or after the beginning of the new rise in the investment ratio. Thus, more distinctive breakthroughs of equipment in the new technologies have occurred some decade after the crises.

We are also able to characterise the innovative activities in the capital goods industries of these periods. In the 1860s new engineering workshops arose in combination with new steel

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transformation pressure'

[10] The calculation is presented in Schön, *Omvandling och obalans*. The price-indices are the respective deflators in the national accounts, prior to 1950 constructed in Schön, *Historiska nationalräkenskaper* with individual price-series constructed by Ljungberg, *Priser och marknadskrafter*

qualities and the construction of railways. In the years following the turn of the century 1900 a first generation of competitive electrical motors and combustion engines appeared on the market with drastic price reductions. After the Second World War a new generation of these power devices and machinery was diffused with a much wider application, catching also a backlog of innovations from the war period. In mid-1980s new electronic equipment, notably the PC, had a decisive impact upon the price structure.

The largely stable price relationship between machinery and industrial consumption goods for the periods of three decades following the price falls, i.e. 1870-1900, 1910-1940 and 1950-1980, does not mean that innovative activity should have disappeared from the industrial sector. The stability rather means that focus has shifted from the introduction of new equipment to increased efficiency in the use of that equipment which is the aim of the rationalisation process. Thus there is a shift from product innovation on the capital goods side to process innovations and to consumption goods innovations. The impact of the technological change is then diffused within the economy and the society, which is the ultimate goal of such advance.

The process innovations may seem to be of minor importance in the growth process, but they have a dual significance. They raise efficiency and productivity and they can at a later stage, after a structural crisis, prove to be basic within new development blocks in new structures. Electricity and electronics were both parts of rationalisation processes to increase efficiency in the 1880s and in the 1960s, but became central in new product innovations in the following decades.

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[11] Thus the prices of industrially produced inputs for further processing in industry is not within the calculation, since it is on both sides of the ratio and to a large extent reflect prices of primary products.

Labour productivity growth also shows characteristic differences between periods of transformation and rationalisation. During the first two decades upon the crises productivity growth within the branches has been comparatively weak overall but with large differences. Productivity increases due to reallocation of labour to branches with higher levels of value added per worker have, on the other hand, been comparatively strong. Thus, development has diverged indicating that the conditions for adopting the new technology have varied between the branches. In the following two decades up to the crises, development has shown the opposite characteristics. While the contribution from the reallocation of resources has been negligible, productivity increase within branches has accelerated. Furthermore, productivity growth has been widespread and growth rates have converged. One reason may be that new productivity-raising techniques have become more standardised and adapted to all branches, making the industrial structure more homogenous - a quality that rationalisation contributes to. Similarly, knowledge and competence have diffused among the employees, leading to improved conditions for technological diffusion. This is also indicated by a marked acceleration in total factor productivity during the phase of rationalisation.

Table 2. Labour productivity and total factor productivity in Swedish manufacturing industry 1890-2000. Annual percentage change.

	Labour productivity	Total factor productivity
1890-1910	1.7	0.4
1910-1930	1.9	1.0
1930-1950	1.0	0.4
1950-1970	4.8	2.1
1970-1990	2.5	1.8
1990-2000	5.2	3.1

Sources: Schön 2004

Note: Labour productivity is calculated internal to the branches, i.e. net of structural change. TFP is adjusted for human capital contribution and for quality improvement in capital assessed from the energy/machinery-ratio, see Schön 2004.

(Figure 4 about here)

The structural changes indicated by the allocation of labour in relation to productivity levels also show a marked time-pattern similar to the discontinuous change in the price-structure of equipment (see figure 4). Thus, the reallocation of labour has been strongly concentrated to a few years following upon the relative price-fall of machinery, i.e. some 15-20 years after the crisis. Structural change has been concentrated to the end of the transformation period. These were the years of intensive “creative destruction”. At this point a new structure of growth has been fully established.

The time-pattern may be summarised as follows: A structural crisis gives way to increasing investments in new areas that after 10 years releases a new generation of machinery equipment forming new development blocks that in a few years time has a fundamental impact on the allocation of labour and on growth rates in industry. This sequence of events spans over approximately 20 years.

The closing years of this sequence in the formation of the new growth structure - 1865/70, 1905/10, 1848/53, 1988/93 - have even more cyclical characteristics in common. They all represent years of peak and downswing in building cycles in Sweden. The rhythm in the transformation and rationalisation of industry is shaped in an interaction with building cycles or *long swings*.

This rhythm of long swings (or *Kuznets cycles* of 15-25 years of length[12]) is hardly created by any intrinsic quality in the development of technology or of industry alone. It is more likely that there is an interaction with the economy and society at large. The building-cycle involves an interaction between economic change, demographic movements and financial factors that influences the supply of labour and capital to industry.[13]

Cyclical change in the distribution between profits and wages

Cyclical change in income distribution is very much connected with the centennial *Kuznets curve* of income distribution which is one of the grand generalisations in economic history. According to Kuznets, the upheavals of the industrial revolution created an income inequality that adhered also to the income distribution between labour and capital. The industrial innovations made capital more productive and the capital share of income increased. The higher rates of return to plant and equipment encouraged capitalists to reinvest profits and to accumulate wealth. Hence, the new industrial technique and the factory system induced accumulation responses both by skilled labour and by capitalists that were likely to reinforce the existing income inequality. In the long run, however, the effects of these accumulation responses were the adverse. Inequality decreased both within the labour force and between capital and labour when the equilibrating supply responses devoured the initial imbalances of the industrial revolution.

To Kuznets, the industrial revolution was a technological and social shock that took half a century or more to digest. One may ask, however, whether the first industrial revolution was

[12] Kuznets, Secular Movements.

an extraordinary event in relation to the functioning of the market economy or if these long term imbalances and shifts in demand and supply factors occur repetitiously in the modern growth process. In that latter case the shifts in income distribution most certainly are interwoven with other cyclical factors in growth. Kuznets himself was inclined to make this interpretation of the curve in income distribution. He emphasised its possible interaction with secular swings in other important components of growth such as population growth, the proportion of savings or capital formation to total economic product and the relation between government activity and the market forces. Kuznets concluded that "the suggestions already made suffice to indicate that the long swing in income inequality must be viewed as part of a wider process of economic growth, and interrelated with similar movements in other elements."[14]

In the short term there is a variation in the income distribution over the business cycle. In the upswing phase of the business cycle the profit share rises while the wage share rises in the culmination and downswing phase of the cycle. This is easily understood as a shift in demand from company products in the early upswing phase, raising profits, to labour in the business cycle culmination, raising wages and reducing profits. Svennilson once noted that this variation in the profit level was of great importance to economic growth and to the transformation of the economy. Since transformation meant both the introduction of new elements and the disclosure of old, profits had to be high to stimulate new ventures and low to

[13] The mechanism of the building-cycle with economic change, demographical response and residential construction was elaborated by Easterlin, *Population, Labor Force and Long Swings*.
[14] Kuznets, 'Economic growth and income inequality', p 20.

drive out old combinations. According to Svennilson, this business cycle variation in profits solved a basic dilemma of industrial capitalism.[15]

In Svennilson's epochal analysis of the European interwar period, the stagnation and even retrogression in Europe between the two world wars was to a large extent caused by the unstable business cycle fluctuations that had irrational results on the transformation of the economy. With strong shifts between inflationary and deflationary processes the survival or the death of enterprises was decided haphazardly in relation to their long-term growth prospects.

In the very long run, i.e. during the last 130 years, the distribution of income between capital and labour within Swedish manufacturing has changed rather little. Over the hundred-year period 1890-1990 there was a weak long run tendency for an increase in the wage share of income, though. Real product wages (i.e. wages deflated by a product price index) increased by 3.5 percent annually while labour productivity (products per working hour at constant prices) increased by 3.3 percent. Thus, labour tended to increase its share of output and income. This can be interpreted as a growing importance of human capital to material capital or better as a growing importance over time to labour specific knowledge in relation to company (capital) specific knowledge. This tendency was however thwarted in the last decade.

[15] Svennilson, *Growth and stagnation.* This perspective was very central for the macro-micro relation in the economic policies of the post-war period. On one hand, very strong and unstable cyclical fluctuations at the macroeconomic level were considered a disturbance to the transformation of the economic structure that should sustain the growth process. Svennilson's analysis of the European economy in the inter-war period was fundamental to this perspective. On the other hand, if the Keynesian macroeconomic stabilisation was too successful, the profit-induced transformation of the economy threatened to be dampened much too effectively. Thus, in the Swedish model the ordinary workings of the market

(Figure 5 about here)

The long run tendency in the distribution between profits and wages is rather weak, however. Fluctuations in the income distribution, both short-term and medium-term, are stronger and more conspicuous. Thus, since modern industrial development took off in Sweden in the late nineteenth century, the distribution of income between profits and wages in the manufacturing sector has varied substantially.

Periods, decades long, of relatively high capital shares have varied with periods of high wage shares. This variation has even appeared to occur regularly in a cyclical fashion - with the wage share largely inverse to the investment ratio. Thus, there are long term fluctuations with culmination in the wage shares in the 1890s, 1930s and 1970s. These occurred not only in conjunction with business cycle downswings but in years that were crises-stricken in Swedish industry as well as internationally. The peaks in the wage share, or troughs in the profit share, were followed by very pronounced redistribution of income in favour of capital. Furthermore, these crises marked the beginning of more profound transformation of the industry and naturally one may ask what role the changes in income distribution have played in this structural development.

The alterations in income distribution have been particularly dramatic around the structural crises with very high wage share (or low profit share) in the early 1890s, early 1930s and mid 1970s. These movements in the wage share indicate a basic characteristic of the structural crises. The profit level in industry was generally very low in these crises – the profit share had

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economy were supplanted by a set of institutional instruments to stimulate or direct

been squeezed already before the crises during the process of rationalisation. It was not possible to meet these crises with further rationalisation of industry. A more encompassing restructuring was necessary. Severe crises have occurred at other points of the structural cycle, particularly in connection with the first building cycle downswing (1907/8 and 1991/93) and with the culmination in investments (1878/79, 1921/23 and perhaps 2000/2002) but these crises were more financial in character. There was probably a greater dispersion of profit levels creating more scope for growth to continue by rationalisation and by concentration of resources to the more profitable unit and areas and by extending their markets.

The question is here, though, what might occasion the fluctuations in the wage share. Here primarily two aspects of this question are addressed. Firstly, why were there such profit-enhancing reactions to the structural crises in the 1890s, 1930s and 1980s? Secondly, what was behind the rising wage share and the squeeze of the profit share through the cycle up to the structural crises?

It is clear that the structural crises drastically released a very strong negative pressure on industry but also served to restore profitability. Since these crises have posed a severe threat to the position of private enterprise and the market economy, political reactions have been firm. Macroeconomic measures to shift the income distribution in favour of capital have been taken. Tariffs in the 1890s and depreciation/devaluation in the 1930s and 1970/80s have been particularly important as such measures to provide scope for restructuring industry. Furthermore, the shock of the crisis with unemployment in its wake has also had a more

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investments into branches that were considered to have positive long-term growth prospects.

lasting effect on wage negotiations. Thus, political reactions to the crises have created scope for new trends and long-term investments in industry.

At the same time, the crises have worked its way through industry. The most unprofitable units have been eliminated or profoundly restructured. Firms with wage shares close to, or even surpassing, 100 percent have disappeared. The drastic changes in the market conditions have favoured new combinations of the factors of production - notably a more intensive development of innovations of the preceding decades that have a greater potential than only of rationalising old establishments. New development blocks have been formed.

Through the combination of elimination of old units with low profitability and the concentration to more sophisticated and innovating branches of industry, the share of profits is raised. A higher degree of sophistication and innovation means that capital specific or firm specific knowledge becomes more important. At the same time the shift in technology means a higher degree of capital-skill complementarity, that is a more specific unit of new technology and more distinguished competence is created. This shift favours demand for the relatively skilled labourer, while at the same time the disclosure of old units disfavours the demand for the relatively less skilled labourer. Thus, there is not only redistribution between capital and labour but also redistribution within the class of wage earners.

Over the decades, this set of forces is reversed, however. The profit share is squeezed up to the crises. It seems reasonable that this squeezing of profits reflects developments both on the markets of goods and on the labour market that places industry in circumstances of more fierce competition and that interact with the changeover in investment behaviour from long-term capacity-increasing transformation to cost-reducing rationalisation.

With the diffusion of innovations, competition on markets increases. The diffusion is facilitated by continuing adaptations of the new technology to different areas and conditions, and that is accomplished in a combined process of standardisation and specialisation. The process is further strengthened through a geographical widening of markets and a diffusion of industrialisation to new countries.

The diffusion to new countries plays a particular role up to the structural crisis. When the basic transformation of leading industrialised countries is accomplished and productivity and real income increases while investments stagnate, the flow of capital increases to new industrialising countries with higher growth rates as well as rising investment ratios. Thereby high overall growth rates are sustained. But the ensuing debt-ties become important in the emerging structural crises. Successively, new debt-burdened countries may have to restrict their demand and increase exports. If they succeed in their export efforts, the downward pressure on prices augments and the structural crises of the industrial countries are aggravated. If on the other hand the new countries fail, the financial system is put under pressure and an international debt crisis emerges. The structural crises have had both features.[16]

Thus, a downward pressure on prices is one component in the change in income distribution in industry up to the structural crises. The other pressure comes from the labour market when wages do not follow the overall income development of industry. Two questions will be posed here: Primarily, why have wages not been flexible downwards and, secondly, what role have wages played in the structural crises and in the pressure towards transformation.

[16] This feature of the structural cycle is more elaborated in Schön, *From War Economy*

One answer to the first question could be that wages have been sluggish in downward price movements due to "money illusion". The falling wage-share in the onset of investment cycles has been generated by measures that have raised the price of industrial goods (devaluations or tariffs or inflationary pushes from exports) rather than reduced the wages. With the diffusion of innovation, market integration and increased competition such measures are not available as in the crises. Secondly, standardisation and diffusion of innovations make knowledge less specific to the firm, while human competence and human capital is accumulated more broadly. There is a compression of the spread of productivity levels in the economy durng rationalisation, where marginal productivity comes closer to average productivity affecting the income distribution between capital and labour. There is also a compression of wages in this phase of rationalisation.[17] This factor is particularly strong in the latter part of the structural cycle. Thirdly, one can assume that resistance to wage-cuts has grown over the cycle due to e.g. stronger organised labour interests. Presumably, the stabilised institutional circumstances that prevail in the later part of the cycle have favoured labour in negotiations, in spite of the very different institutional frameworks of the wage-bargaining process in the 1880s, 1920s and 1960s.

The wage share could have risen also due to the growth of other sectors or areas during the cycle that may have given rise to increased competition for labour. Thus, the service sector has grown in relation to industry in all these decades of rationalisation. That in turn may be due to complementarities between infrastructure and industry, on one hand, and the service sector, on the other hand. The fulfilment of these complementarities may have contributed to the rationalisation of industry as well as to raising demand for labour in services. Shifts in

consumer demand towards services, due to increases in income, may also have augmented demand for labour in that sector.

The second question concerned the role of rising wage share in long-term economic growth and development. The situation of new and widening markets, rising consumer demand and profit squeeze in industry have had a double function in the structural development. On one hand, cost-reducing rationalisation has been reinforced leading ultimately to structural crises. On the other hand, new market conditions have been created for the ensuing cycle. This applies to markets for both consumer goods and machinery. Thus, the shift of income distribution to consumers in combination with accelerated growth of real income per capita leads to a more rapid transformation of every day life and of consumption patterns; i.e. when the industrial structure is stabilised and rationalised, the social environment of industry is transformed. The 1880s, the 1920s and the 1960s share these characteristics. New products appear that to a large extent may be a fruition of the earlier basic innovations but also entail elements of new technology. Furthermore, in the hunt for cost-reducing rationalisation innovations are introduced within the existing industrial structure that at a later stage prove to have wider potentials of their own. The widening of markets and the arrival of new competitors mean, at last, shifts in the price- and cost-structures that give new prerequisites for further growth.

The role of labour resisting wage-cuts in the period before the structural crises should be emphasised in a long-term perspective of structural change. Had, e.g., wages been flexible enough downwards to preserve profitability in industry, old interests would have been able to withstand the pressure towards transformation longer, while market conditions for new

[17] In particular, there is a narrowing of female to male wages in periods when production

industrial enterprises would have been less favourable. After the crises, however, relative wage-cuts have played another role. For some decades, redistribution of income in favour of capital has been part and parcel of a structural and institutional transformation.

At the end of this reasoning one should add a few warnings to any simple interpretation from structural change to income distribution. There are certainly more factors involved, such as for instance international market integration or globalisation. One may compare the impact from the Second and the Third Industrial Revolutions on the wage share. Both occurred in periods of very intensive global market integration and both had a strong impact upon the Swedish industrial structure. The shift in income distribution was however much stronger in the latter case. Taking into account, however, the workings of globalisation – making the relative abundant factor in the economy more valuable – the Swedish position was the opposite in these two instances. In the Second Industrial Revolution Sweden was still a rather labour abundant economy and globalisation worked in favour of rising real wages. In the Third Industrial Revolution, however, capital had become more abundant and globalisation widened the spectrum of profitable options. The much stronger shift in the distribution between wages and profits in this latter case indicate that both structural change and globalisation worked in the same direction, while these forces were counteractive in the Second Industrial Revolution.

This is also to emphasize that the impact of the structural changes from the late 1970s onwards was very strong in Sweden. It involved reorientation both of the economy and of political institutions, resulting in a severe slowdown of growth over nearly two decades. The revival of productivity increases and rapid growth – with a doubling of the GDP growth trend

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processes are standardised, see Svensson, *Closing the Gender Gap*.

from the early 1990s – may indicate that a more profound adaptation has been accomplished to the new technological wave of ICT and globalisation.

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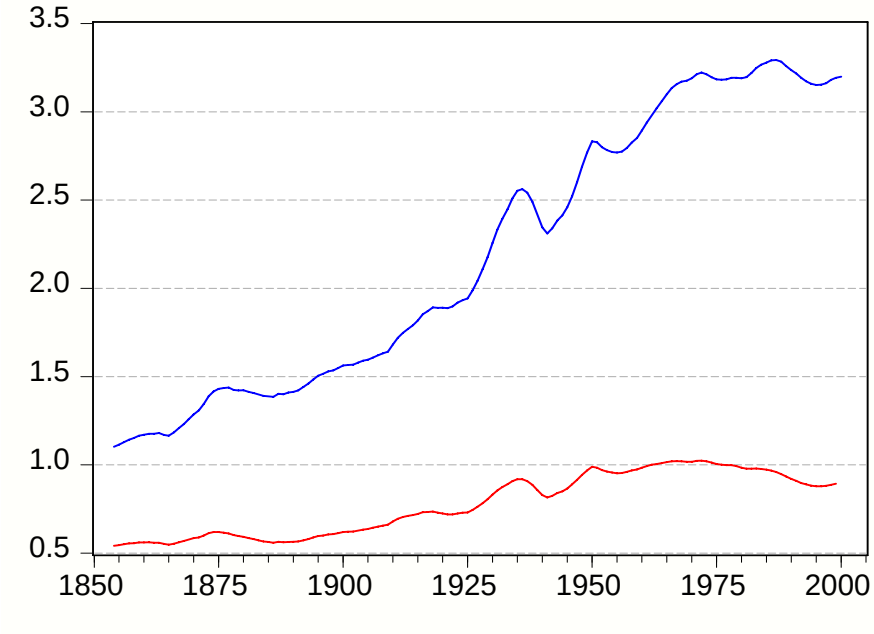
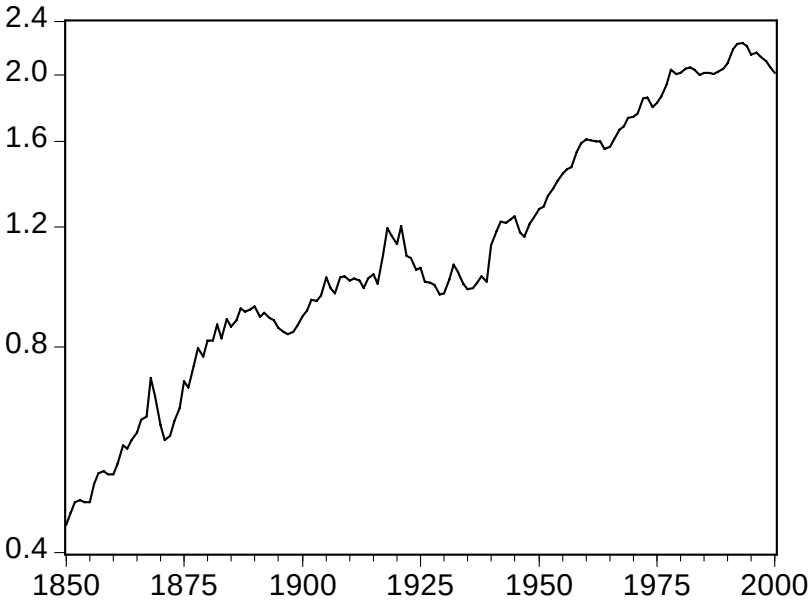
Figure 1. Swedish GDP per capita in relation to World GDP per capita and OECD GDP per capita 1870-2004. Nine years moving averages.



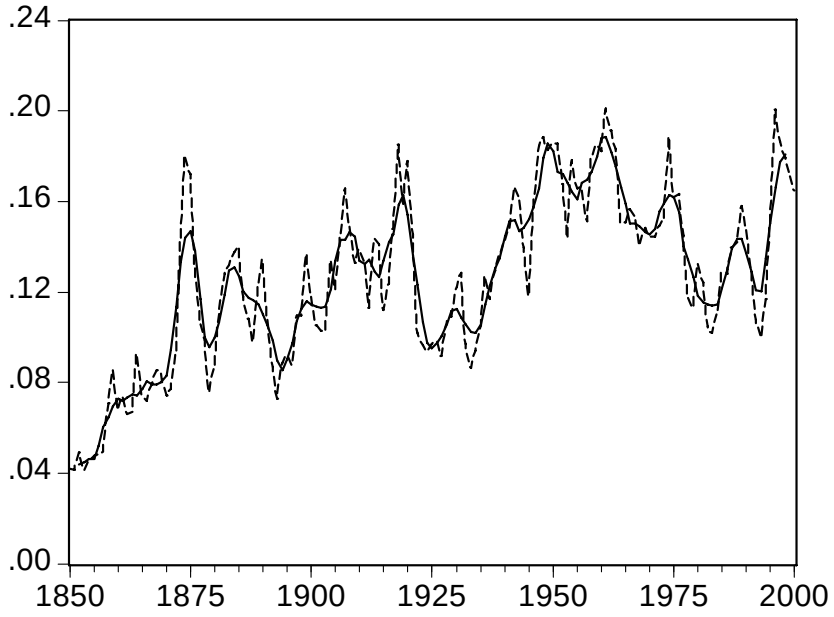
Sources: Maddison (2006); Krantz/Schön (2007).
Note. The annual variation in world production between Maddison's benchmarks 1870, 1913 and 1950 is estimated from his supply of annual country series.

Figure 2. The capital-output ratio in the Swedish economy 1850-2000. Fixed prices. Index 1910/12=1.



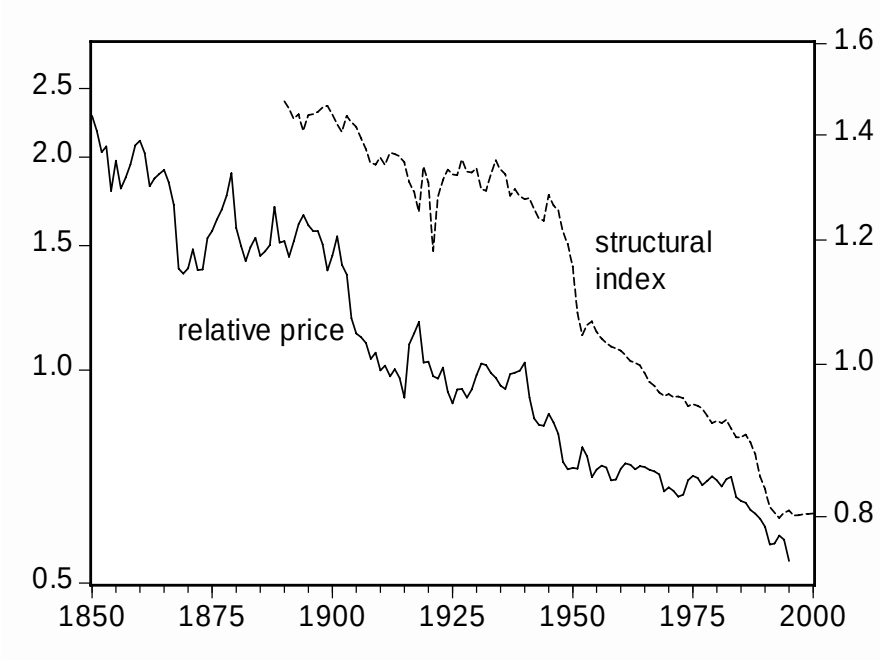
Source: Krantz/Schön (2007).

Figure 3. The ratio of investments to value added in Swedish industry 1850-2000. Fixed prices. Annual and five-year moving averages.



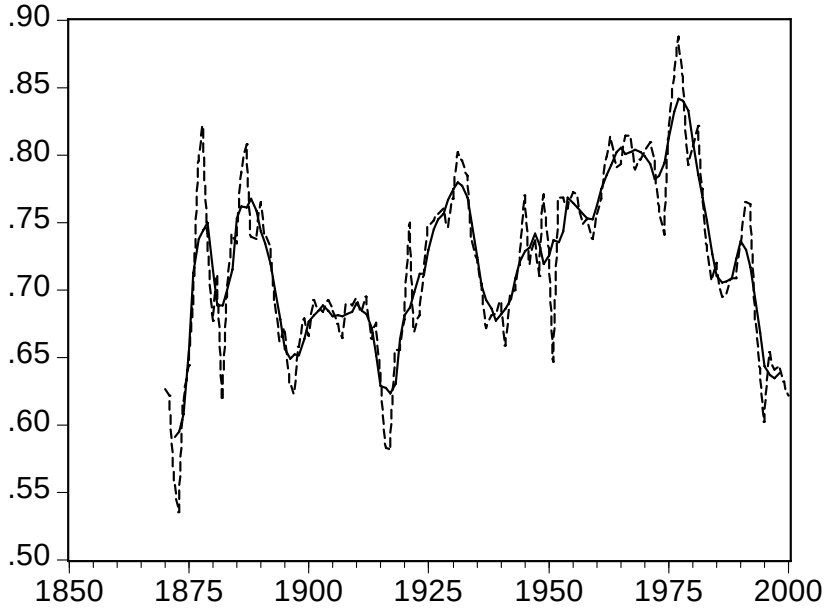
Source: Schön 1994: National accounts.

Figure 4. Relative price index of machinery 1850-1995 (1910/12=1; left axis) and structural index of labour in manufacturing industry 1890-2000 (1969/70=1; right axis).



Sources: Schön (1998); Statistics Sweden.

Figure 5. The wage share in Swedish industry 1870-2000. Annual and fiveyear moving averages.



Sources: Schön 1994; National Accounts

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