GROWTH AND BUSINESS CYCLES FOR THE SWEDISH ECONOMY 1963 – 1999

Bharat Barot
bharat.barot@konj.se
National Institute of Economic Research (NIER)
Box 3116 S-10362 Stockholm

Abstract

This paper consists of two parts. In the first part we carry out a traditional growth accounting exercise for the private business sectors of the Swedish economy. We search for structural breaks during the sample period, using Chow tests, using a dynamic specification of Total Factor Productivity (TFP) growth rates. Granger-causality tests are carried out for the nine sub-sectors of the private business sectors of the Swedish economy. We combine the growth rates of value added and hours worked and calculate labour productivity for the period 1960-1999. In order to facilitate comparisons we compare the results of this study with Swedish and international studies. To a large extent we are able to replicate the Swedish results. The slow down in TFP growth rates in the 1970s can be identified with the first and the second oil shocks in 1973 and 1979. The other structural breaks occurred in the early 1990s and could possibly be identified with the Tax Reform of the Century in 1991 and the severest of recession in the Swedish economy. The Granger-causality test indicate that growth rates in investment Granger cause growth rates in TFP for Agriculture and financial institutions, real estate and other business, while TFP growth rates in mining and quarrying, and manufacturing Granger cause growth rates in investment.

The second part of the paper I Hodrick-Prescott filter the data, and calculate cross correlation's of detrended output, hours, investment and TFP at different leads and lags. The results indicate that investment leads TFP for agriculture, hunting, forestry and fishing, electricity gas and water, and for education, health and social work and community social and personal services. Investment lags TFP for the mining and quarrying, manufacturing industry, and for financial institutions and insurance companies, real estate renting and business service companies. Hours worked lead the TFP cycle for mining and quarrying, manufacturing and wholesale/retail trade. The decomposition of TFP into trend and cyclical component historical dates the business cycle. Standard deviations of the cyclical components of value added, hours worked, TFP, and gross investment reveals that the most volatile variables are gross investment, followed by TFP, GDP and hours worked.

The contribution of this part of the paper lies in the disaggregated data set containing annual information for the period 1963-1999, and in the application of several analytical tools to the growth accounting exercise results. In addition such an extensive growth accounting exercise has not been carried out for the private business sectors of the Swedish economy. The data set used in this study can be used for replication purposes.

Keywords: growth accounting, labour productivity, total factor productivity, growth dynamics, Granger-causality, recursive Chow tests, cross correlations, Hodrick-Prescott filtering, leads and lags, new economy.

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Part 1 GROWTH

Part 2 BUSINESS CYCLES

1. Introduction

This is an empirical study on growth accounting and the business cycle for the private business sectors of the Swedish economy. It consists of two parts. In the first part we carry out a traditional growth accounting analysis for the nine sub-sectors of the Swedish private business sectors for the sample period 1963 - 1999. The Cobb-Douglas production function, which is so central to the decomposition of output growth into contribution from physical capital, labour and Total Factor Productivity (TFP) is applied. The slow down of TFP growth observed in the 1970s and the acceleration in the 1980s and the mids 1990s are discussed. A search for structural breaks is conducted using Chow tests with a dynamic specification of TFP growth rates for the nine sub-sectors of the Swedish economy. The Granger-causality tests are applied in order to determine if TFP growth rates Granger cause investment or vice versa. We combine the growth rates of value added and hours worked and calculate labour productivity for the period 1960 -1999.

In the second part of the paper for the sake of comparison with the Real Business Cycle (RBC) literature we use the standard practice of taking logs and Hodrick-Prescott filtering the data. We calculate cross correlations and standard deviations of detrended output, hours, investment and TFP at different leads and lags.

The basic questions that orient this study are as follows:

(1) Has there been a slow down of TFP growth rate in the 1970s and an acceleration in the 1980s and the mid 1990s?

(2) Have there been structural breaks in the Swedish economy and can we date them to the first and second oil price crisis in 1973 and 1979, the deregulation of the financial markets in 1985, the 'Tax Reform of the Century' in1991 and the change in the exchange rate regime in 1992?

(3) Does investment growth rate Granger-cause TFP growth or vice versa? Does TFP growth in one sector Granger-cause TFP growth rate in another sector?

(4) Does the growth in TFP lead or lag investment, hours worked and the growth rate in value added?

(5) Are TFP growth, output growth, TFP growth and growth in hours worked, output growth and growth in capital stocks procyclical or countercyclical?

(6) Which are the most volatile sectors of the Swedish economy?

(7) Do we have a *new economy* in Sweden?

There has been a debate about the economic causes and consequences of technological progress over the last decade. The sectors of the *new economy* are concentrated in the field of information technologies and telecommunication. The links between technology and productivity have been scrutinised in a number of recent OECD studies (2000).

The term "*new economy*" has been used extensively to describe the working of the US economy and in particular the part of its economy that is linked to information and communications technology (ICT). It reflects a view that something has changed and that the economy now works differently than it did in the recent past.

The *new economy* has been characterized in the following ways:

(1) The new economy leads to a rise in the trend rate of economic growth. Hence the increase in trend growth would come from higher productivity growth, due to more efficient business practices as a result of greater (ICT) use. In addition, falling prices in certain parts of the economy would limit inflationary pressures and thus enable strong growth over prolonged periods.

(2) The *new economy* dampens the business cycle[1]. Proponents of this view argue that ICT, in combination with globalisation, has led to a lower NAIRU (non-accelerating inflation rate of unemployment). This implies that the economy can expand for a longer period without inflationary pressures emerging. According to this view, ICT is putting downward pressures on prices, while greater global competition is keeping wages in check.

(3) The sources of growth are different in the new economy. This view suggests that certain sources of growth are now more important than they were in the past and that certain parts of the economy benefit from increasing returns, to scale network effects and externalities.[2]

The internal adaptation of a society to growth potentials, afforded by the stock of knowledge has been the chief concern of economic theory concerning the problems of growth. It is in this area that the discipline of economic analysis has made its greatest contribution.

Is growth ultimately attributable to the accumulation of capital or to the accumulation of knowledge (technological progress)? It is commonly argued that while both of these forces contribute positively to growth in the short run, only the rate of technological progress matters in the long run. Hence capital accumulation at best plays a positive role, supporting, the levels of output, not its rate of growth. Although the growth rate of an economy's output will ultimately be the same as that of the capital stock, the ultimate driving force determining both growth rates is technological progress. Why does the source of growth matter? The neo-classical growth model, with its main assumption of diminishing returns in physical capital provides the answer. If this assumption is correct - and the large empirical growth literature tends to support it - capital accumulation cannot sustain long-term growth while (TFP) [3] can, (see Senhadji, 1999).

The contribution of the present paper lies in the disaggregated data set containing annual information for the period 1963 – 1999, and in the application of several analytical tools to the growth accounting exercise results. In addition such an extensive growth accounting exercise has not been carried out for the private business sectors of the Swedish economy. In Appendix 1 we print the data set for replication studies.

2. Review of earlier studies

International studies on growth accounting were presented in Solow (1957), Kendick (1961), Denison (1962), Jorgenson and Griliches (1967). Griliches (1997) study is useful because it provides an overview of the intellectual history with particular emphasis on the development of the Solow residual.

[1] The new economic paradigm by no means implies the end of the business cycles.
[2] See forth coming OECD report for details. A new economy?- The role of innovation and information technology in recent OECD economic growth. See DST\IND\STP\ICCP(2000) 1\REV1
[3] Often even called Multifactor Productivity Growth.

A considerable literature already exists on output and productivity growth across industries. Recent examples include Jorgenson (1988) for the United States, Cameron (1997), Bean and Crafts (1996), and Oulton and O'Mahony (1994) for the United Kingdom, and Bernard and Jones (1996a,b) for cross-country studies.

In the Swedish context studies regarding growth accounting are included in the Expert Report number.3 to the Productivity Commission (1991). This Expert Report includes four interesting papers by Bentzel, Walfridson and Hjalmarsson, Hansen and finally Anxo and Sterner. Bergman and Hultz (1993) study puts the focus of analysis in calculating TFP growth rates and scrutinises the manufacturing sector. Swedberg (1999) which gives an overview of the empirical work in this area. More recent studies on growth are included in Swedish Economic Policy Review (2000). NIER publishes estimates and forecasts of TFP growth rates for the industrial and the private business sectors of the economy in almost every report published (see, The Swedish Economy, March 2000).

3. The main objectives of the study

Given that much of the theoretical and empirical attention in the 1990s has been on the performance of *countries*, with a respectable amount of work devoted to the performance of *firms*; it is not surprising that *industry* level studies have been slightly neglected. The first part of this paper analyses the productivity performance of nine sub-sectors of the private business sectors of the Swedish economy and conducts the traditional growth accounting exercise.

The private business sectors of the Swedish economy that are under scrutinisation (with sector notation numbers within parenthesis according to the New European System of National Accounts ESA95) are: Agriculture hunting, forestry and fishing (01-05)[4], Mining and quarrying (10-14), Manufacturing industry (15-37), Electricity, gas and water (40-41), Construction industry (45), Wholesale and retail trade (50-52), aggregated with Hotels and restaurants (55), Transport, storage and communcation (60-64), Financial institutions and insurance companies (65-67), aggregated with Real estate, renting and business service companies (70-74) and finally Education health and social work (80-85) aggregated with Community, social and personal service establishments and private households with employed persons (90-95).

Through national income accounts concepts, economies affect the measurement of data variables, and theory models influence the choice of the data to examine and the classes of models and functional forms to use, as well as suggesting what parameterisation are of interest. Conversely, a major objective of a study in economics may be to test the validity of some theoretical propositions. See Hendry (1993).

A number of economic hypotheses can be advanced for the changing fortunes of the different sectors of the Swedish economy during the period of the study (including for example, oil price crisis 1974 and 1979), deregulation of the financial market 1985, the Tax Reform of the Century in 1991, and finally the change in the exchange rate regime 1992. Neverthless, these hypotheses often pay insufficient regard to the interesting variation in economic performance across different sectors of the private business sectors.

A first step in the formulation of testing such hypotheses must be a detailed understanding of the nature of economic growth at a disaggregated level between the different sectors of the

[4] The old notation according to System of National Accounts (SNA 68) for sector 01-05 = 1000, 10-14 = 2000, 15-37 = 3000, 40-41 = 4000, 45 = 5000, 50-52 plus 55 = 6000, 60-64 = 7000, 65-67 aggregated with 70-74 = 8000, 80-85 aggregated with 90-95=9000.

Swedish economy. It is just such an understanding that the present study seeks to facilitate. We deliberately step back from framing economic hypothesis in order to characterize the raw data that such hypotheses must explain. Hence this study remains mainly *data based* [5] but also *theory based* (on the neo-classical growth theory[6]) on the interepretation of the empirical results obtained from the study.

The accounting exercise is viewed as a preliminary step for the analysis of fundamental determinants of growth. The final step involves the relations of factor growth rates, factor shares, and technological change (the residual) to elements such as government policies, household preferences, natural resources, initial level of physical and human capital etc. We refrain from this aspect in this study.

The complementary objective, interrelated to this study, is to identify the sectors which can be further dissaggregated and incorporated into the new annual model *MICMAC,* built by the model group in the research department at (NIER.).

The first part of the study is organised in the following sections. Section 4 presents the framework of growth accounting and the Cobb-Douglas production function. In Section 5 we present the data and outline some problems in measuring output and productivity. Section 6.1.1. presents the results with respect to the share of value added in total value added. Section 6.1.2. presents the growth dynamics with respect to value added that reflect the dynamics of growth of the private business sectors of the economy. In section 6.1.3. we presents result with respect to the simplest measures of labour productivity; i.e. value added per hour worked across sectors of the economy.

Two alternative measures of productivity growth are then considered: labour productivity and TFP. With regard to the second of these measures, growth accounting techniques that follow Solow are used to decompose the rate of growth of value added into the contributions of physical capital accumulation, increased labour input, and a residual**,** TFP growth. The same decomposition may then be used to evaluate the contributions of capital accumulation and TFP growth to labour productivity growth, so that the two measures of productivity growth may be explicitly related to one another[7]. We compare the results of our study with other Swedish and international studies. Section 7, presents results of growth accounting for the private business sectors of the Swedish economy for the sub-sample periods 1963-1969, 1970-1979, 1980-1989, 1990-1999, 1994-1999 and 1963-1999, and discusses the productivity acceleration respective deceleration for TFP growth rate. The results from the growth accounting are presented in Tables 5.1 to 5.12. Section 5.1 describes testing for structural breaks in the dynamic equation, specified for TFP growth. In Section 7.1.1. we test for structural breaks using Chow test. Section 7.1.2. presents results with respect to Granger-causality both for whether the TFP growth rates in one of the sectors Granger-causes TFP growth in another sector and if TFP growth Granger causes investment growth or vice versa. Section 8 concludes the first part of this study. In Appendix A we print the data set for replication studies.

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[5] Data-driven approaches imply that models are developed just to describe the data. However in this study we merge inference from data with guidelines from economic theory, see Hendry (1993).

[6] An important step in the theory of economic growth has been the development of models that endogenise the process of technological progress. These models not only have the potential for accommodating the stylised facts of growth but also provide more realistic mechanisms for technological progress. See Mankiw (1995), and Romer (1986). Romer was very much a catalyst for much of the endogenous growth theory as he suggested a mechanism to counteract diminishing returns to capital.

[7] See Cameron et al. (1997) for details.

4. Theoretical framework

Assume the representative 'neoclassical' aggregate production function for the Swedish economy based on both micro and macro fundaments take the following functional form[8]:

$$Y = Y(K, L). \tag{1}$$

$$Let \quad \dot{Y} = \frac{dY}{dt} \; ; \quad \dot{K} = \frac{dK}{dt} \; ; \; \dot{L} = \frac{dL}{dt} \, . \tag{2}$$

Then differentiating the production function with respect to time, yields

$$\dot{Y} = Y_K \dot{K} + Y_L \dot{L} \tag{3}$$

$$Hence \quad \frac{\dot{Y}}{Y} = Y_K \frac{K}{Y}\frac{\dot{K}}{K} + Y_L \frac{L}{Y}\frac{\dot{L}}{L} \tag{4}$$

Thus the rate of growth of output is a weighted average of the rate of growth of the inputs. The weights are the elasticities of output with respect to each input, which in competitive conditions are measured by their factor shares. In the later 1950s, there developed a "*growth accounting*" concept in which this formula was applied to explain the long-term growth of the U.S. economy.

The simplest concept of technical change[9] is to suppose that it increases the output from given inputs without in any way affecting the way the inputs interact. Hence the production function for period t then becomes

$$Y_t = A(t) \, \mathrm{f}(K_t, L_t) \tag{5}$$

$$\frac{\dot{Y}}{Y} = f(\mathrm{K_t}, \mathrm{L_t})\frac{\dot{A}}{Y} + Af_K \frac{K}{Y}\frac{\dot{K}}{K} + Af_L \frac{L}{Y}\frac{\dot{L}}{L} \tag{6}$$

$$= \frac{\dot{A}}{A} + Y_K \frac{K}{Y}\frac{\dot{K}}{K} + Y_L \frac{L}{Y}\frac{\dot{L}}{L} \, .$$

The residual[10] is now simply the rate of growth of *A*, or, if you like, the rate of growth of the economy's efficiency parameter. It is called the growth in "*total factor productivity*". TFP

[8] See Layard and Walters (1978).

[9] Technical progress can either be Hicks or Harrod neutral. However, this requires that the production function be Cobb-Douglas type. Labour productivity is measured as production per hour. See Layard and Walters (1978) for details.

[10] Measuring technology has always been one of the most perplexing problems facing empirical economics. One tradition, epitomised by Solow (1957), is to measure technology as a residual from a production function. The problem is that the residual, no matter how cleverly constructed, is rather like a statistical dust bin holding a lot of trash as well as a few nuggets of gold. See Bloom and Reenen WP 00/2.

growth is defined here as that portion of real output growth, which is not accounted for by an increase in inputs of labour and capital, the two most fundamental factors of production.

TFP growth is a measure of the gains in the efficiency of production, i.e. over the medium and longer term it can be taken as a measure of technological progress, but over the shorter periods it can also be affected by other factors as managerial efficiency, capacity utilisation, work habits and weather (see, Solow 1957). Note that this decomposition, though informative, yields no conclusion about causality: for example, even if capital accumulation is ultimately induced by increases in TFP.

The main techniques to examine aggregate economic growth are growth accounting exercises and cross-country growth regressions. Growth accounting[11] exercises have a long tradition, seminal calculations were made as early as in the 1950s (e.g. Solow, 1957). Cross-country growth regressions are a more recent avenue of research due to the significant developments of databases by Summers and Heston (see Summers and Heston, 1991) and seminal work by Barro and Sala-Martin (1991).

The most straightforward approach is to apply time-series data for labour and capital to a Cobb-Douglas production function with constant returns to scale. Then the difference between growth of output implied by this calculation and the actual growth is the unexplained component. The Cobb-Douglas production function is convenient because the required parameters, the partial output elasticities of capital and labour (assuming perfect competition), are easily calculated by taking average income shares over the time period in question. A variant of this approach is to assume that the shares in output change over time, based on observation of long-term trends. A more sophisticated approach is to regress output against a production factor, typically with the addition of a time-trend. The estimated time-trend, plus the residual from the regression then represent the Solow residual (see OECD, 2000a).

In contemporary research on estimation of production functions, Error Correction Models (ECM) are often used. The Cobb-Douglas production function can either be estimated with the first difference of logs. One drawback of this procedure, however, is that it results in a loss of "long-run information" in the data. In light of these issues, the production function can be estimated in levels. One can also combine differences (short run dynamics) with levels (the long run) using an ECM model.

The approach we adopt to approximate the Cobb-Douglas function is original because it accommodates time varying shares going to the factors of production. Our approach for the calculation of the Solow residual as a time series is outlined below.

Using a standard neo-classical growth accounting framework and following Solow (1957), we assume that the value-added in an individual sector of the Swedish private business sector j, where j = 1, …n, and where n are the nine sub-sectors of private business , is produced with the following neoclassical production function,

$$Y_{j,t} = A_{j,t} L_{j,t}^{\alpha_{j,t}} K_{j,t}^{1-\alpha_{j,t}} \qquad (7)$$

[11] There is a dual approach to growth accounting, whereby the Solow residual is computed from growth rates of factor prices, rather than factor quantities, see Oliner and Sichel (Fall 2000). This idea goes back at least to Jorgenson & Griliches (1967). See Barro (1998) for details.

where $Y_{j,t}$ is value-added from sector *j* at time *t*, $L_{j,t}$ is hours worked from sector *j* at time *t*, $K_{j,t}$ is the stock of capital from sector *j* at time *t*, and finally $A_{j,t}$ is the TFP for sector *j* at time *t*. This equation may be expressed more conveniently in logarithmic form as:

$$\ln(Y_{j,t}) = \ln(A_{j,t}) + \alpha_{j,t} \ln(L_{j,t}) + (1-\alpha_{j,t}) \ln(K_{j,t}) \quad , \qquad (8)$$

The properties of the Cobb-Douglas production function are well known. α and (1 - α) measure the elasticities of output with respect to labour and capital. The sum of α and (1 - α) gives information about returns to scale, i.e. the response of output to a proportionate change in the inputs. If there are constant returns to scale doubling the inputs will double the output. Differentiating totally both sides of equation (8) yields:

$$\Delta \ln y_{j,t} = \Delta \ln a_{j,t} + \alpha_{j,t} \Delta \ln l_{j,t} + (1-\alpha_{j,t}) \Delta \ln k_{j,t} \quad , \qquad (9)$$

Where $\alpha_{j,t}$ is the ratio of the total wage plus employers contribution to social security, to value added at factor values for sector *j* at time *t*, (i.e. the share going to labour) and (1 - $\alpha_{j,t}$) is the share going to capital for sector *j* at time *t*. The lowercase variables with a "Δ" correspond to the growth rate of the uppercase variables described in equation (8).

5. Data definitions and sources

The annual data used in this study covers the Swedish private business sector for the period 1963-1999, and has been collected from several Statistics Sweden publications. For the period 1963-1980 the data used in the study has been collected according to 1968 Systems of National Accounts (SNA 68), while for the period (1980-1999) the European System of National Accounts (ESA95) has been used. The variables used in this study are the sum of total wages, employers' contribution to social security, hours worked, and value added both at producer and factor prices. The variables are in current and constant prices. The measurement of capital K_t is based on a perpetual inventory stock calculation method.

See Table 1 lists the private business sectors studied both according to the SNA68 and the ESA95 systems.

Table 1. Swedish national accounts

Sectors	**SNA 68**	**ESA95**
Agriculture hunting forestry and fishing (AHFF)	1000	01-05
Mining and quarrying (MQ)	2000	10-14
Manufacturing industry (M)	3000	15-37
Electricity, gas and water (EGW)	4000	40-41
Construction industry (C)	5000	45
Wholesale and Retail trade, Hotels and restaurants (WRTHR)	6000	50-52, 55
Transport, storage and communication (TSC)	7000	60-64
Finance, insurance Real estate and business services (FIREBS)	8000	65-67,70-74
Education, health, social work and community social and personal services (EHSW)	9000	80-85, 90-95
Producers of goods (PG)	1000-5000	01-45
Producers of services (PS)	6000-9000	50-95
The Private Business sector (PBS)	1000-9000	01-95

A comprehensive and consistent method was used to splice the data from available historical series so as to maximise their comparability to the most recent data revisions.

5.1.1. Value added at constant prices

Value added can be defined as the difference between total revenue of a sector and the cost of material, services and components purchased. Thus it measures the value the sector has added to these purchased materials services and components by its process of production. The gross domestic product by kind of economic activity, basic values, industries inclusive domestic services for the years 1950-1974 has been collected from Statistical Reports Nr. N 1975:98, Appendix 4, pp.52-53, Statistics Sweden. The value-added figures for the year 1950-1963 are in 1959 prices, while the figures for the period 1963-1974 are in 1968 prices collected from the same source. The value added figures for the period 1970-1985 in 1980 prices have been collected from Production and Factor income, Appendix 4, N10 SM8601, Table 4:4 pp. 23-31, National accounts, Statistics Sweden. The value added statistics for the period 1980-1996 have been collected from National accounts 1980-1996, N10 SM 9701, Table 2:3, pp. 82-91, in 1991 prices, Statistics Sweden. The new figures for the years 1980-1993 have been delivered by Statistics Sweden.The figures of value added at basic prices for the period 1995-2000 have been collected from National Accounts NR 10 SM 0101. Value added at current prices for the period 1950-1999, has been collected from the same sources mentioned above from Statistics Sweden.

5.1.2. Hours worked

Hours worked denotes the data for the nine sub-sectors of the private business sectors of the Swedish economy. Employment here means the total labour input, measured in hours. The number of hours worked measures consequently, apart from possible estimation errors, all work regardless of whether it has been carried out as over-time, full time or part-time, by permanently or temporarily employed persons, by entrepreneurs, by persons partially or completely able to work etc. The data for hours worked in millions for the period 1960-1974 have been collected from Statistics Sweden, National Accounts Nr. N 1975:98 Appendix 5, pp. 52-57. Data for the period 1963-1980 for the same variable for the period 1963-1980 is from Statistics Sweden, Statistical Reports N 1981: 2.5, Appendix 5, pp. 56-61. The data for the period 1980-1996 has been collected from National Accounts 1980-1996, N 10 SM 9701, Tables 2:3 pp.74-85. The hours worked are reported in 10000 of hours worked. Hours worked for the period 1993-1999 are from National Accounts, NR 10 SM 0101 and are reported in 10000 hours on pp. 33-37.

5.1.3. The wage sum

The wage sum is the sum of total wages for sectors 1000 – 9000 is in current prices. The total wages are defined as the compensation of employees by functional sector divided into wages and salaries and employers contributions to social security, private pensions etc. by kind of economic activity, industries and households. The figures for the year 1950-1974 have been collected from Statistical Reports, Nr. N 1975:98 Appendix 4, Production and Factor Income from Table 4 AA pp. 86-113. The figures for 1970-1980 are from Statistical Reports N 1981:2.5 Appendix 5. The data for the period 1980-1996 for the variables wages and employers contribution to social security are from Statistics Sweden, National Accounts number N 10 SM 9701 from Table 2:2 pp. 56-73. The statistics for the same variables for the period 1993-1998 is from the new yearly National Accounts (1993-1999) 2000-11-20, pp. 5-18.

5.1.4. The capital stock

The measurement of capital K_t is based on a perpetual inventory stock calculation method. The gross stock at the beginning of period *t* is a weighted sum of past investments. Generally, estimates of the physical capital stock are considered unreliable because of lack of information about the initial physical capital stock and the rate of depreciation. Hansson (1989) bases the construction of capital stocks that have been used in this study on an application of the Hulten-Wykoff studies. The figures for the respective sectors of the private business sectors for the period 1963-1987 in 1980 prices have been collected from Hansson. The stocks have been extended using the same method for the period 1980-2000 in 1995 prices. The two different series have hence been spliced.

5.2. Measurement problems

There are two problems in the construction of aggregate output data. First, there is the problem of aggregation bias; this arises because the index of aggregate output may not be invariant to changes in the shares of output produced by the individual sectors that compose the index. Second, there is a problem of how to measure output itself; this arises because of differences in the way aggregate output data are collected and the economic concept they attempt to measure. With respect to measurement of inputs labour varies over the business cycle. However, since firms that under-utilise labour still pay their workers for a normal week, under-utilisation cannot be observed directly. Muellbauer (1984) suggests a method of deducing the average utilisation rate from shifts in the upper tail of the distribution of utilisation data on overtime hours. For details see Muellbauer. The measurement issue with respect to capital stock is whether it should be adjusted for cyclical utilisation. According to Denison (1974), it is not appropriate to adjust capital for cyclical utilisation. Muellbauer (1991) suggests to fit time trends with linear splines allowing slope to occur at times when, on a priori grounds, one would expect a great deal of unobserved scrapping.

In order to assess the impact of labour and capital on output and productivity growth rates, proper account should be taken of the role that each factor plays as input in the production process. In the case of labour input, the simple count of hours worked is only a crude approximation since workers show great differences in education, experience, sector of activity and other attributes that greatly affect their marginal productivity. In particular, a measure of labour input in efficiency units can be obtained by weighting types of labour by their marginal contribution to the production activity in which they are employed. Since these productivity measures are generally not observable, information on relative wages by characteristics is used to derive the required weights to aggregate types of labour. The resulting measure of labour input can be quite different from a simple aggregate of total hours to total persons (see Dean et. al., 1996). Hence the difference between the weighted and unweighted series yields an index for the compositional change of labour input, i.e. its quality. In this study we have used hours worked. With respect to labour productivity for the Swedish economy it is better to have another measure, i.e. GDP per person of working age (15-64). See Lindbeck (2000) for details.

Besides, measurement of output and productivity is problematic issue: when seen in the perspective for and against a new economy because of the following two reasons:

(1) If a change has occurred it is recent and economic data take time to materialise.

(2) Output is extremely difficult to measure in the service sector, which is a heavy user of ICT.

6. Presentation of the results

6.1.1. Share of value-added in total value-added

The growth of the Swedish economy 1950-1999 and the accompanying structural changes are usually results of productivity increases in the economy, and are computed as the ratio of the share of value added from the respective sector to the total value added in current prices. The results are presented in Table 2.

Table 2. Structural changes, according to the shares of sectoral value added in total

Sectors	**Periods**				
	1950 – 1959	**1960 –1969**	**1970-1979**	**1980-1990***	**1990 –1999***
AHFF	11%	7%	5%	5%	3%
MQ	2%	1%	1%	1%	1%
M	34%	34%	34%	29%	29%
EGW	2%	3%	3%	4%	4%
C	11%	13%	11%	8%	8%
WRTHR	12%	13%	16%	16%	16%
TSC	8%	8%	9%	9%	10%
FIREBS	15%	16%	15%	25%	25%
EHSW	4%	5%	6%	3%	3%
Sum	**100%**	**100%**	**100%**	**100%**	**100%**

Note: * denotes the new National Accounts ESA95. The shares have been calculated in current prices as the ratio of each sector value added to the sum of value added of all the sectors.

The major shifts in the structure of the Swedish economy have been in both the Agriculture hunting forestry and fishing (AHFF), Manufacturing industry (M) and Financial institutions and insurance companies, Real estate renting and business service companies (FIREBS). The share in total value added for the AHFF sector has declined by more than 50%, while the decline in the MQ sector is marginal.

There has been a 5% decrease in the Manufacturing industry (M), which is an important sector of the Swedish economy. The share of the sector Electricity, gas and water (EGW) has increased by 2%. The share of the Construction industry (C) sector has declined by 3%. Wholesale and Retail trade, and Restaurants and hotels (WRTHR), Transport, Storage and Communication (TSC) have increased by 4% and 2% respectively. The Financial Institutions and Insurance companies aggregated together with Real Estate Renting and Business Service companies has increased dramatically from 15% to 25% in the last two sub-periods of the study.

6.1.2. Growth rates in value-added

In Table 3, we present the growth rates in value-added. The growth rate in constant price gives us the growth dynamics for the private business sectors for the different sub-periods. As it is clear from Table 3, there were considerable variations in rates of growth of value-added.

By scrutinising the growth rates for the 1950s and 1960s sub-periods, we note that almost all of the sectors experienced positive growth rates with the exception of the AHFF sector, EGW, MQ and finally the Manufacturing industry enjoyed the highest annul rates of growth (7.9%, 7.1% and 6.5% respectively), with AHFF and EHSW experiencing the slowest (-0.5% and 1.1% respectively).

The Swedish economy was in the "*golden age*" of growth during this period. During the 1970s there was deceleration in the growth rates in almost all of the private business sectors of the economy. This was perhaps mainly due to the 1974 oil price crisis.

During the 1980s growth rates in value added started accelerating once again because of stable oil prices. In the beginning of the 1990s the Swedish economy experienced the severest post-war recession. Between 1990-1993, GDP fell by more than 5%, unemployment rose to 12% (including those enrolled in various market programs), asset prices fell dramatically and residential activity came virtually to a standstill.

Table 3. Annual growth rates (%) in value added for the private business sectors

Periods	**Sectors**									
	AHFF	MQ	M	EGW	C	WRTHR	TSC	FIREBS	EHSW	PBS
1950-59	-0.5	4.6	3.7	6.2	3.8	3.5	3.3	4.1	1.4	3.3
1960-69	0.8	7.1	6.5	7.9	5.1	4.3	5.1	3.8	1.1	4.5
1970-79	-0.1	-0.5	1.9	6.5	0.7	2.1	4.1	2.4	1.6	2.1
1980-89*	2.1	-0.5	2.1	4.7	1.9	2.5	3.5	2.8	1.8	2.5
1990-99*	0.1	1.7	3.5	0.2	-1.5	2.9	3.2	2.3	2.7	2.4
1994-99*	0.7	3.5	7.2	0.4	0.5	5.2	4.5	2.6	5.3	4.2
1963-1999	**0.5**	**2.4**	**3.5**	**5.1**	**2.0**	**3.0**	**3.9**	**3.1**	**1.7**	**3.0**

Notes: * denotes the new national accounts. The averages are the means of the percentage changes in value added (growth rates) for the sectors. In the last column PBS denotes the private business sector (aggregation of all the nine sectors of private business sector of the economy).

This aggregated picture of the economy is partly reflected in the disaggregated picture for the sectors. Since the mid 1990s the Swedish economy has once again enjoyed high growth rates, but they are not as high as in the golden age of the 1950s and 1960s.

6.1.3. Labour productivity growth

By combining rates of growth of value added and rates of growth of hours worked, one obtains information about the first and simplest of our measures of productivity growth, i.e. labour productivity, defined by the rate of growth of value-added per hour worked, shown in Table 4. This measure of productivity growth has the advantage of imposing no theoretical restrictions on the data.

However, it suffers the disadvantage of being the measure of the productivity of only one factor of production. In contrast the second measure of productivity, TFP[12], evaluates the efficiency with which all factors of production are employed.

[12] For details on the link between labour productivity and TFP, see Cameron et al (1997).

Table 4. Labour productivity annual growth (1960-1999). (%) annual rates

Periods	**Sectors**									
	AHFF	MQ	M	EGW	C	WRTHR	TSC	FIREBS	EHSW	PBS
	Y/L	*Y/L*	*Y/L*	*Y/L*	*Y/L*	*Y/L*	*Y/L*	*Y/L*	*Y/L*	*Y/L*
1960-69	7.9	10.3	7.5	7.4	5.1	4.5	4.5	-0.9	0.7	5.7
1970-79	4.1	1.8	4.1	6.2	3.8	2.8	4.5	-0.2	1.6	3.6
1980-89*	5.2	2.6	2.6	4.5	1.2	1.7	2.5	-0.8	-0.5	2.0
1990-99*	2.4	4.0	4.5	0.2	1.1	3.2	3.6	0.2	-1.0	2.6
1994-99*	2.4	3.4	5.0	0.4	0.5	3.9	4.7	-1.5	1.1	2.5
1960-1999	**4.8**	**4.5**	**4.6**	**4.5**	**2.7**	**3.0**	**3.8**	**-0.4**	**0.2**	**3.5**

Notes: Y/L denotes Labour productivity growth measured by the rate of growth of value added per hour worked.
* Denotes the new national accounts. PBS denotes the private business sector.

As is clear from Table 4, there are considerable variations in the rates of labour productivity across the private business sector of the Swedish economy. Despite the decline in the overall size of the AHFF, and the Manufacturing industry and an increase in FIREBS, the nine sectors experienced positive growth rates in labour productivity with the exception of FIREBS and EHSW.

Looking at Table 4 we once again see that during 1960s sub-sample period's labour productivity experienced faster growth for almost all the sectors. The average growth rate for the private business sector was 5.7%. The MQ and the Manufacturing industry enjoyed the highest annul rates of labour productivity growth (10.3% and 7.5% respectively), with FIREBS and EHSW experiencing the slowest (-0.9% and 0.7% respectively).

Labour productivity growth has declined gradually both for the total private business sector and for each individual sectors since the 1960s. During the 1970s there was a fall in labour productivity for both the individual and aggregated business sector of the Swedish economy. This "*productivity slowdown*" of the 1970s continued in the eighties for all the sectors with the exception of the AHFF and MQ sectors. The growth of labour productivity rebounded 1994 -1999, as we see that the Swedish economy has been under a period of economic boom. For labour productivity, the recovery during the 1990s was so strong within the Manufacturing sector that during 1994 -1999 period, Sweden had recovered the productivity losses since 1980. Neverthless this does not apply to all sectors. All sectors experienced a fall in hours worked, but again there were substantial variations across sectors. The value added for most of the sectors was growing faster than hours worked.

According to the calculations of labour productivity growth measured by the rate of growth of value added per hour worked has declined rapidly over the different sub-periods and is on the increase over the last sub-period 1990 - 1999, for MQ, the Manufacturing industry, WRTHR, TSC companies and lastly the FIREBS.

Comparing our results with Lindbeck (2000) with respect to labour productivity for the Manufacturing industry for the sub-sample periods (1960-1970), (1970 -1980), (1980-1990), and (1990-1998) we get the results presented in Table 4.1.

Table 4.1. Comparison of labour productivity for the Swedish Manufacturing industry (%) changes at annual rates

Studies	Years			
	1960-1970	**1970-1980**	**1980-1990**	**1990-1998**
Lindbeck	6.7	3.4	2.5	5.0
Barot	7.5	3.8	2.5	4.6

Note: The results are comparable and not contradictory, with the only reservation that we use both old and new national accounts (SNA68 and ESA95) published by Statistics Sweden, while Lindbeck uses data only from the old national accounts (SNA 68).

The results of TFP estimates disaggregated for the private business sector for Sweden are presented in Table 4.2, which facilitates comparisons with earlier Swedish studies. In order to have a fair comparison we use the old national accounts. The reason why the estimates of TFP growth rates are not identical is mainly due to utilisation of different capital stocks.

Table 4.2. Swedish TFP historical comparisons. (Percentage changes at annual rates)

Sectors	**Years**										
	1970-1975			1975-1980			1980-1985			1985-1990	
	BB	**BH**	**SCB**	**BB**	**BH**	**SCB**	**BB**	**BH**	**SCB**	**BB**	**SCB**
AHFF	6.9	6.1	6.1	-0.2	2.4	2.4	3.4	2.8	1.4	2.2	1.4
MQ	-1.7	-2.0	-3.1	1.2	1.5	1.4	2.1	-0.2	3.3	3.9	3.3
M	3.7	3.1	2.9	1.5	1.0	0.6	2.5	2.2	3.0	0.6	0.3
EGW	2.8	3.4	2.8	1.1	1.9	0.7	5.7	5.0	4.8	1.7	0.0
C	1.5	4.1	4.2	0.7	1.5	0.7	1.1	1.1	2.5	0.6	1.3
WRTHR	1.2	3.2	3.3	0.9	1.6	-1.4	0.5	2.2	1.3.	0.9	1.0
TSC	4.2	NC	4.2	3.1	NC	-2.1	-0.5	NC	NC	2.7	4.7
FIREBS	-0.7	NC	-0.7	-0.1	NC	0.9	2.0	NC	0.9	2.1	-0.6
EHSW	0.2	NC	5.1	0.8	NC	0.9	-1.7	NC	1.0	-3.6	-2.8

Notes: BB denotes Bharat Barot, BH denotes Bengt Hansson (1991) and finally SCB is Statistics Sweden. BH and SCB use 0.6 and 0.4 values going to labour and capital, while the shares used in this study have been calculated from the National Accounts. NC denotes not calculated.

In order to facilitate comparisons of TFP for the private business sector with international results, we present them in Table 4.3. Looking at Table 4.3. we see once again that Sweden performed well during the 1960s. In the 1970s TFP declined by 50% but never to rise again at the same growth rate as in the 1960s.

Table 4.3. TFP in the Private Business Sector. (Percentage changes at annual rates)

Studies	Years			
	1961-1970	**1971-1980**	**1981-1990**	**1991-1995**
USA	2.5	0.6	0.8	0.4
Japan	6.1	1.8	1.8	-0.3
European Union	3.3	1.7	1.4	0.9
OECD	3.3	1.3	1.2	0.5
Sweden	3.1*	1.5	1.3	1.7

Notes: * Our estimates for the period (1961-1970) begin in 1963. See OECD, Economic Outlook 60.

In Table 4.4. we compare our results with OECD's Minilink Model estimates for labour productivity for USA, Japan, European Union and OECD, as a whole for periods (1961-1970), (1971-1980), (1981-1990 and (1991-1995). We once again see that during 1960s, as a whole labour productivity was high for all the countries. There was a deceleration in it during the 1970s and 1980s and a rise in it merely for Sweden during the 1990s.

The major differences between Gordon's analysis (2000) and this study is that he focuses on trend productivity while we explain developments in actual productivity growth.

Table 4.4. Labour productivity in the USA, Japan, European Union, OECD, and Sweden, Private Business Sector. Percentage changes at annual rates

Countries	Years			
	1961-1970	1971-1980	1981-1990	1991-1995
USA	2.6	0.9	1.1	0.6
Japan	9.2	3.7	2.9	0.7
European Union	5.4	3.1	2.2	1.5
OECD	4.8	2.3	1.8	1.0
Sweden*	5.5	3.6	1.9	3.0

Notes: See, OECD Economic outlook 60. * Indicates the calculations of this study.

The international comparisons are affected by the on going transition from the 1968 System of National Accounts (SNA68) to the 1993 System of National Accounts (SNA93), developed under the auspices of the United Nations, and from the 1979 European System of National Accounts (ESA79) to the 1995 system (ESA95). According to Gust et al. (2000) the switch to the new accounting system raises both the level and growth rates of GDP relative to the old accounting system.

7. Results from growth accounting

Using equation (9), we compute the growth rates for TFP for the private business sectors. Tables 5.1 to Table 5.12 presents the results of the growth accounting exercise (in percentage changes in annual rates). ΔGDP, ΔTFP, ΔHH, and ΔKK denotes percentage changes in annual rates for value added, total factor productivity, hours worked and capital stocks. α and (1-α) are the shares going to the respective factor of production labour and capital. The first column of Table 5.1 shows the output growth rate to be explained, by growth rate in TFP (second column) and the contributions from the factors of production labour and capital (columns 4 and 5). While the third column is the Solow residual.The last column contains the value of the share going to the production factor labour.

From the decomposition of growth rates of the private business sectors of the Swedish economy for the different sub periods one notices that after a decade of high productivity growth in 1960's, we observe a significant slowdown of productivity growth in the 1970s following the first oil shock in 1973 for all the sectors of the private business sector with the exception of EHSW. The private business sector, the producers of goods and services all display a dramatic decline respectively both in growth rates in value-added and TFP.

Table 5.1. Growth Accounting Agriculture, hunting, & forestry, fishing Sector (AHFF)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	1.12	2.02	-2.38	1.48	0.30
1970-1979	-0.08	-0.63	-1.21	1.76	0.30
1980-1989	2.07	2.30	-0.90	0.67	0.30
1990-1999	0.08	1.38	-0.69	-0.60	0.30
1994-1999	0.71	2.04	-0.49	-0.84	0.30
1963-1999	0.58	1.03	-1.20	0.75	0.30

Table 5.2. Growth Accounting Mining and quarrying Sector (MQ)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	7.29	6.85	-2.09	2.53	0.56
1970-1979	-0.53	-0.59	-1.40	1.47	0.56
1980-1989	-0.51	2.23	-1.81	-0.93	0.56
1990-1999	1.71	2.39	-1.17	0.49	0.56
1994-1999	3.53	2.56	0.13	0.83	0.56
1963-1999	1.45	2.40	-1.65	0.71	0.56

Table 5.3. Growth Accounting Manufacturing sector (M)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	6.26	6.29	-1.22	1.19	0.72
1970-1979	1.90	2.49	-1.51	0.91	0.72
1980-1989	2.12	2.09	-0.37	0.40	0.72
1990-1999	3.47	3.49	-0.69	0.67	0.72
1994-1999	7.17	4.87	1.48	0.82	0.72
1963-1999	3.17	3.33	-0.91	0.75	0.72

Table 5.4. Growth Accounting Electricity, gas and water (EGW)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	7.09	3.57	0.14	3.38	0.25
1970-1979	6.53	3.09	0.08	3.36	0.25
1980-1989	4.68	3.22	0.05	1.40	0.25
1990-1999	0.24	0.38	0.01	-0.16	0.25
1994-1999	0.36	0.75	-0.01	-0.38	0.25
1963-1999	4.34	2.43	0.07	1.84	0.25

Table 5.5. Growth Accounting Construction sector (C)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	5.23	2.92	1.03	1.28	0.76
1970-1979	0.73	2.53	-2.18	0.38	0.76
1980-1989	1.90	0.67	0.53	0.71	0.76
1990-1990	-1.46	0.02	-1.89	0.41	0.76
1994-1999	0.50	0.70	0.05	-0.25	0.76
1963-1999	1.37	1.64	-0.90	0.63	0.76

Table 5.6. Growth Accounting Wholesale/ retail trade and Hotels & restaurants (WRTHR)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	4.43	2.91	-0.30	1.82	0.76
1970-1979	2.07	1.68	-0.49	0.88	0.76
1980-1989	2.47	0.99	0.55	0.93	0.76
1990-1999	2.85	2.56	-0.29	0.58	0.76
1994-1999	5.20	3.93	0.93	0.34	0.76
1963-1999	2.84	1.97	-0.10	0.97	0.76

Table 5.7. Growth Accounting Transport and communication sector (TSC)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	4.81	3.91	-0.13	1.04	0.66
1970-1979	4.11	2.76	-0.24	1.58	0.66
1980-1989	3.51	2.09	0.66	0.77	0.66
1990-1999	3.17	2.47	-0.30	1.01	0.66
1994-1999	4.51	3.63	-0.10	0.97	0.66
1963-1999	3.79	2.68	0.01	1.11	0.66

Table 5.8. Growth Accounting Financial intermediation, Real estate & business (FIREBS)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	3.96	-0.82	1.25	3.53	0.30
1970-1979	2.43	-1.02	0.74	2.70	0.30
1980-1989	2.83	-0.40	1.12	2.12	0.30
1990-1999	2.34	0.41	0.69	1.24	0.30
1994-1999	2.58	1.10	1.25	0.23	0.30
1963-1999	2.77	-0.47	0.96	2.27	0.30

Table 5.9. Growth Accounting Education, health & social work & Community, social and personal service (EHSW)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	0.20	-5.59	0.08	5.71	0.66
1970-1979	1.62	-4.28	0.06	5.85	0.66
1980-1989	1.78	-2.91	1.51	3.18	0.66
1990-1999	2.67	-2.29	2.50	2.46	0.66
1994-1999	5.34	0.17	2.83	2.33	0.66
1963-1999	1.77	-3.50	1.14	4.14	0.66

Table 5.10. Growth Accounting Producers of goods (PG)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	5.43	4.75	-1.96	1.28	0.66
1970-1979	1.65	2.21	-1.69	1.13	0.66
1980-1989	2.21	2.14	-0.42	0.49	0.66
1990-1999	2.12	2.75	-0.96	0.33	0.66
1994-1999	4.99	3.96	0.70	0.33	0.66
1963-1999	2.57	2.95	-1.14	0.76	0.66

Table 5.11. Growth Accounting Producers of services (PS)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	3.87	1.47	0.10	2.30	0.53
1970-1979	2.48	0.56	0.02	1.90	0.53
1980-1989	2.75	0.45	0.85	1.46	0.53
1990-1999	2.59	1.16	0.42	1.02	0.53
1994-1999	3.70	2.07	1.14	0.49	0.53
1963-1999	2.82	0.82	0.39	1.61	0.53

Table 5.12. Growth Accounting The Private Business sector (PBS)

Decade	ΔGDP	ΔTFP	$\alpha*\Delta HH$	$(1-\alpha)*\Delta KK$	α
1964-1969	4.56	3.60	-0.89	1.85	0.60
1970-1979	2.10	1.49	-0.86	1.47	0.60
1980-1989	2.51	1.26	0.28	0.97	0.60
1990-1999	2.38	1.84	-0.14	0.68	0.60
1994-1999	4.20	2.78	1.01	0.42	0.60
1963-1999	2.73	1.92	-0.37	1.18	0.60

One of the most likely explanations of the deceleration of productivity growth is the oil price shock that we observed in the 1970s, especially 1974 and 1979. The increases in the price of imported raw materials lead to lower value added and GDP for any given quantity of capital and labour, so it's not surprising that sharp increases in oil prices were associated with the productivity decline. For the 1970s, most of the sectors with the exception of EGW and Construction industry were below their averages.

One notices that in the 1980s when oil prices were stable or even declining, productivity growth picked up. Sweden experienced a period of boom in 1980, 1984, and 1987-1989. During the end of 1990s the Swedish economy was overheated due to a boom, and there was a shortage of labour. During the first half of 1990's the Swedish economy began to slide into recession. First, interest rates escalated due to a rising budget deficit, then the rising unemployment signalled greater uncertainty about the future, and brought a radical decline in GDP. However, since 1996 there has been acceleration in the sectors of the Swedish economy.

It is implausible that negative TFP growth estimates for AHFF, MQ, WRTHR reflect technological regress. There are a number of problems in measuring the capital stock (see, for example, Muellbauer 1991), and these negative estimates for TFP growth may reflect measurement error. However, as argued earlier, it is important to realise that TFP growth is

essentially a residual. Once one recognises this fact, negative TFP growth estimates for certain time periods and industries actually become quite plausible.

In addition, the new national accounts were introduced in May 1999 and hence new data were produced for the years 1993-1999. These new data brings new grounds to argue that we had entered in a new era of sustained productivity growth; and hence one heard a lot of talk about a "New Economy" where a "New Paradigm" of high growth and low inflation holds. Taking a look at the period 1994-1999 and calculating the TFP growth for the private business sector to be 2.8%, goods producing sectors to be 4.0% and finally the aggregated service sector to be 2.4% respectively.

The slowdown in TFP growth in the 1970's and the speedup in the 1980s was widespread in the private business sector and affecting all the sectors with the exception of the EGW sector. At an aggregated level, both the producers of goods and services were affected by the productivity slowdown. In addition, the aggregated private business sectors TFP were substantially decreased. The data show that TFP growth at the aggregate level reflects TFP growth in the individual sectors rather than sectorial shifts towards fast growing sectors. This speed up in the second half of the 1990s has continued for all the sectors (including producers of goods and services and the private business sector).

Our results on growth accounting for the period 1994-1999 indicate that TFP growth has recovered in the information-intensive service industries (which are heavy users of ICT): - WRTHR, TSC and FIREBS companies with TFP growth rates of 4.0%, 3.6% and 1%, respectively.

Turning to the growth rates in Sweden TFP during the 1990s, the aggregated private business sector has been growing at 1.8% much below the average growth rates we had in 1960s. The Manufacturing sector is growing at a high TFP growth rate of 3.5% together with the WRTHR growing at 2.6%. The answer to the question whether Sweden's private business sectors will continue to grow at the high growth rates characterised of the mid 1990s will depend on several factors which are exogenous to Sweden.

The US economy has been the engine of world growth. The US economy grew at about 5 per cent in 2000, while the world economy grew by just over 4 per cent. This has provided the world with a comforting sense of economic security. Unfortunately now US is in danger of turning into a source of instability. A recession in the US economy would cause a sharp slowing in global growth, severely damaging growth everywhere. Cycles work with leads and lags and a global recession could affect Sweden i.e. if USA sneezes Sweden takes a new breath.

While on the other hand the Swedish economy can keep on growing with high demand on exports, increased disposable income, low interest rates, strong consumer confidence and falling unemployment. Separating cycle from trend is always difficult in the midst of an expansion, and it is particularly challenging now because the current expansion is tending to conform to cyclical norms. For reasons why Sweden grew faster than all the European countries and why Sweden lags behind see Lindbeck (2000).

In the international debate concerning of the total productivity, there are essentially two views: According to Krugman (1997), the Asian economic "miracle" was not due to TFP growth but rather to intensive use of factors of production. This view was very controversial since it implied that very little TFP growth had taken place in Asia. According to the

advocates of this view the Asian growth was not sustainable in the long run given the expected fall in the rate of employment and the expected reduction of investment rates. The second view was on the contrary that the Asian miracle was due to TFP implying that the growth rate would be sustainable.

Turning now to the role that ICT plays in the economy, directly as a producer of final consumption and investment goods, and indirectly via the utilisation of these investment goods in the production process, it should be observed that the contribution of the information and communcation technology to output and productivity growth can take three main forms:

(i) Acceleration of productivity growth in the ICT-producing sectors themselves and an increase of their weight in the economy;

(ii) Capital accumulation driven by rapid investment in ICT equipment; and

(iii) ICT-using sectors enhancing their efficiency by harnessing new technology.

The Quality-Ladders Models by Aghion and Howitt (1992) are more appropriate models of technological change. In this theoretical framework, technological progress consists of improvement in the quality of intermediate inputs. We refrain from this aspect in this study.

Is there a new economy? The business cycle is dead; and all the old skills are obsolete; only new companies can survive; the rules of economics have all changed. These statements are all false. However, there has been a wave of innovation, a great part of it tied to the IT sectors, driving greatly improved economic performance in this expansion. In this context there is a new economy. There is much about the new economy that remains uncertain, and therefore, we look forward to learn over the next few years.

The exercises we have performed with this growth accounting framework have some limitations. First, they capture only the approximate sources of output growth: namely the accumulation of capital and labour, plus TFP. In particular, this framework does not model the underlying technical improvements that have driven the accumulation of growth. In addition the growth accounting framework is static by its nature, failing to capture the dynamic features of capital accumulation.

7.1.1. Chow test and structural breaks

In order to identify structural breaks in TFP growth rate we recursively run equations with a dynamic specification (i.e. including lags) of TFP growth rates. A sudden break in the recursive least squares estimates of a parameter may suggest a point at which the parameter value has changed. Using a recursive Chow test may test the significance of such a break. The results are presented in the Table 5.13.

The results indicate structural breaks for the AHFF sector, the Construction industry and the TSC sectors due to the 1973-oil price crisis. The second oil price crisis was in 1979 and this particular structural break is indicated merely for the Construction industry. During the 1980s, there are structural breaks for the C industry, and for EGW sector. In context of the severe recession in the Swedish economy during 1990s the results indicate structural breaks for the following sectors: the Manufacturing industry, WRTHR, FIREBS and finally for the EHSW. Chow test indicates structural breaks for the Private Business sector 1993 and for the Producers of Services for the years 1992, 1993, and 1994.

Table 5.13. Recursive Chow tests on structural break on TFP growth rates

Sectors	Years of structural breaks
Δ AHFF	1973*, 1974*
Δ MQ	(-)
ΔM	1993*
Δ EGW	1986*, 1987*, 1988*
Δ C	1972 *, 1976 *, 1977 *, 1978 *, 1979 *, 1980 *
Δ WRTHR	1992 *,
Δ TSC	1974 *,
Δ FIREBS	1992 *,1993 *
Δ EHSW	1993 *, 1994 *,
Δ PG	(-)
Δ PS	1992 *, 1993 *, 1994 *
Δ PBS	1993 *

Notes: *****Indicates significance at 5% level using an F-test. PBS denotes the Private Business sector, while PG is Producers of Goods sectors and finally PS are the Producers of Services sectors. (-) Denotes no structural breaks were found. Δ is the first-difference of the logarithm of the Solow residual**.** Recursive Chow tests imply small samples.

7.1.2. Granger causality

A time series Y_t Granger causes another time series X_t if present value of X can be better predicted by using past values of Y than by not doing so, considering also that that other relevant information (including the past values of X) are used in either case. The standard Granger-causality test can be expressed as in equation (10) and (11) below without $\mu_{t-1.}$ But if the variables are cointegrated, μ_{t-1} is necessary. Therefore, more specifically, X_t is said to cause Y_t provided some β_i in equation (10) is non-zero. Similarly, Y_t is causing X_t if some δ_i is not zero in equation (11). If both this feed back effects occur, there is a feedback effect present.

$$\Delta Y_t = \theta_y \mu_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_i \Delta X_{t-j} + \varepsilon_{1t} \qquad (10)$$

$$\Delta X_t = \theta_x \mu_{t-1} + \sum_{i=1}^{n} \delta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \phi_i \Delta X_{t-j} + \varepsilon_{2t} \qquad (11)$$

Our null hypothesis is that $\beta_1 = \beta_2 = \beta_3 = 0$. Our alternative hypothesis is that $\beta_1 \neq$

$\beta_2 \neq \beta_3 \neq 0$ in (10).The number of lags while conducting the Granger-causality test is arbitrary.

We first test explicitly whether certain sector changes in TFP growth rates precede other sector growth rates. For this we perform Granger causality tests. Table 5.14 presents the results.

Table 5.14. Granger-Causality tests for Δ TFP between sectors (1963 - 1999)

Dependent Variable			χ^2test value
ΔTFP for AHFF	←	ΔTFP for FIREBS *	$\chi^2(3) = 8.2$, P[0.04]
ΔTFP for MQ	←	ΔTFP for M*	$\chi^2(3) = 6.9$, P[0.07]
ΔTFP for (M)	←	ΔTFP for FIREBS*	$\chi^2(3) = 16.2$, P[0.00]
	←	ΔTFP for TSC*	$\chi^2(3) = 18.2$, P[0.00]
ΔTFP for EGW	←	ΔTFP for EHSW*	$\chi^2(3) = 8.9$, P[0.02]
ΔTFP for C	(-)		
ΔTFP for WRTHR	←	ΔTFP for EGW*	$\chi^2(3) = 10.8$, P[0.01]
		ΔTFP for TSC*	$\chi^2(3) = 8.7$, P[0.03]
ΔTFP for TSC	←	ΔTFP for FIREBS*	$\chi^2(3) = 8.2$, P[0.04]
		ΔTFP45 for C*	$\chi^2(3) = 10.4$, P[0.02]
ΔTFP for FIREBS	←	ΔTFP for M*	$\chi^2(3) = 5.4$, P[0.04]

Notes: * Indicates significance at 5%. Wald test has been used to test the null hypothesis. ← Indicates causes in the Granger sense. The Wald test used for linear restrictions is χ^2 distributed with three linear restrictions imposed. (-) denotes no Granger causality. The figures in brackets are the probabilities. The hypothesis is tested using a Wald test.

The results indicate that an increase in growth rate in TFP in FIREBS, Granger-causes changes in TFP growth rates in the AHFF sector, the Manufacturing industry, and finally in TSC sector. This implies that the TFP growth rates are inter-linked and interdependent between some sectors. The results can be interpreted analogously for the other sectors.

To test explicitly whether certain sectoral growth rates in TFP precede changes in gross investment rates, we perform Granger causality tests. Table 5.15 presents the results. We conclude from the results that the changes in investment in the AHFF sector Granger causes TFP growth rate in the same sector. The change in investment in FIREBS Granger causes the change in TFP growth rate in the same sector. While for the MQ and the manufacturing industry the TFP growth rate causes the changes in gross investment. The results that TFP growth rates Granger-cause the growth rate in investment are in accord with the neo-classical growth theory. In the steady state investment will grow at the same rate as labour and capital.

Table 5.15. Granger-Causality tests for growth rate in TFP Granger causes growth rate in investment

Dependent Variable			χ^2test value
ΔTFP for AHFF	←	ΔINV for AHFF *	$\chi^2(3)$ 8.95, P[0.03]
ΔTFP for MQ	→	ΔINV for MQ*	$\chi^2(3)$11.5, P [0.01]
ΔTFP for M	→	ΔINV for M *	$\chi^2(3)$ 7.0, P[0.07]
ΔTFP for EGW	(-)	ΔINV for EGW	
ΔTFP for C	(-)	ΔINV for C	
ΔTFP for WRTHR	(-)	ΔINV for WRTHR	
ΔTFP for TSC	(-)	ΔINV for TSC	
ΔTFP for FIREBS	←	ΔINV for FIREBS *	$\chi^2(3)$ 11.8, P[0.01]
ΔTFP for EHSW	(-)	ΔINV for EHSW	

Notes: * Indicates significance at 5%. Wald test has been used to test the null hypothesis. Δ denotes growth rate in the respective variables. ΔTFP is the growth rate in total factor productivity, while ΔINV is the growth rate in gross investment.

With technological improvement, therefore, it will be feasible, in a succession of steady state, to have more amount of capital equipment available to labour with a concomitant rise in productivity.

8. Conclusions

The first part of this paper has been concerned with a detailed analysis of the nature of growth in the private business sector of the Swedish economy during the years 1963-1999. The increases and decline in both constant price value-added and hours worked in all the sectors of the private business sectors was found to conceal considerable heterogeneity across sectors.

Looking at the structural changes in the Swedish economy for the period 1950-1999, with respect to the share of value added of each private business sector to the total value added for all of the private business sectors of the Swedish economy, we conclude that there has been a shift in the structure of the Swedish economy. The share of value added from the Agriculture, hunting forestry and fishing sector has declined from 11% to 3%, while the share of Financial institutions and insurance companies, Real estate renting and business service companies has increased from 15% to 25%. The Manufacturing industry, an important sector for Sweden, has declined from 34% to 29%. The Construction sector has fallen from 11% to 8%.

By combining the rates of growth of value-added and rates of growth of hours worked, one obtains information about the simplest of measures of productivity growth i.e. labour productivity. Results indicate that there have been considerable variations in the rate of growth of value added and hours worked across the private business sectors of the Swedish economy. Our results do not contradict the domestic or international results.

The results from the growth accounting exercise indicate that after a high decade of productivity growth in 1960s we observe a significant slowdown in the 1970s for almost all sectors of the Swedish economy. One of the explanations is the oil price shock we observed in the 1970s. One notices that in the 1980s, when oil prices were stable or even declining, productivity growth increased. After the severe crisis in the beginning of the 1990s, both growth rates in output and TFP has accelerated.

Our recursive Chow tests on structural breaks on the TFP growth rates indicates structural breaks for the Agriculture, hunting forestry and fishing sectors for the years 1973 and 1974. Structural breaks for the Construction industry are mainly concentrated during the 1970s. Transport storage and communication had a structural break in 1974. The Electricity gas and water sector has structural breaks for the years 1986, 1987, and 1988.

For the first half of 1990s, there are structural breaks for growth rates in TFP for the following sectors: Manufacturing industry, Wholesale/retail trade aggregated with Hotels and restaurants, Financial institutions and insurance companies, Real estate renting and business service companies and Education health and social work and Community social and personal services. The Chow test indicates structural breaks both in the aggregated Private business sector and aggregated Services during the year 1993 and 1992, 1993, and 1994 respectively.

Granger causality tests indicate that TFP growth in Manufacturing Granger-causes TFP growth rate in the Mining and quarrying sector, while the TFP growth rate in the Finance, Insurance Real estate Granger causes TFP growth rate in Agriculture, hunting, forestry and fishing, the Manufacturing industry and in the Transport sector, storage and communication sectors.

Granger-causality tests with respect to growth rates in TFP and investment indicate that gross investment in the Agriculture, hunting, forestry and fishing sectors and Finance, Insurance Real estate Granger causes TFP growth rates for the same sectors while TFP growth in the Mining and quarrying and the Manufacturing industry Granger causes the Manufacturing and the Mining and quarrying gross investments.

Is there a new economy? The business cycle is dead; and all the old skills are obsolete; only new companies can survive; the rules of economics have all changed. These statements are all false. However, there has been a wave of innovation, a great part of it tied to the IT sectors, driving greatly improved economic performance in this expansion. In this context there is a new economy.

In this study we have applied the standard growth-accounting exercise in order to generate a Solow residual, which is traditionally considered as a measure of technological progress. The recent developments in the theory of growth, particularly the theory of endogenous growth provides us with a richer perspective with respect to the residual. In this set up, the residual can be interpreted accommodating increasing returns and spillovers. These aspects can be nested and provides a framework where the Solow residual can be analysed in context of Research and Developments (R&D) outlays and public policies.

The exercises we have performed with this growth accounting framework have some limitations. First, they capture only the approximate sources of output growth: namely the accumulation of capital and labour, plus TFP. In particular, this framework does not model the underlying technical improvements that have driven the accumulation of growth. In addition the growth accounting framework is static by its nature, failing to capture the dynamic features of capital accumulation.

Part 2 Business cycles

Abstract

The second part of the paper, we Hodrick-Prescott filter the data, and calculate cross correlation's of detrended output, hours, investment and TFP at different leads and lags. The results indicate that investment leads TFP for Agriculture, hunting, forestry and fishing, Electricity gas and water, and for Education, health and social work and Community social and personal services. Investment lags TFP for the Mining and quarrying, Manufacturing industry, and for financial institutions and insurance companies, Real estate renting and business service companies. Hours worked lead the TFP cycle for Mining and quarrying, Manufacturing and Wholesale/retail trade. The decomposition of TFP into trend and cyclical component dates the business cycle. Standard deviations on the cyclical components of value added, hours worked, TFP, and gross investment reveals that the most volatile variables are gross investment, followed by TFP, GDP and hours worked.

Keywords

Hodrick-Prescott filter, trend, cycle, cross correlations, standard deviation, hours worked, output, investment, leads and lags

1. Introduction

The reason why macroeconomists care about fluctuations in TFP is because productivity yields information about the aggregate production of goods and services in the Swedish economy. Secondly, productivity analysis may provide information about the firm and sector behaviour e.g., the mark-up and its cyclicality, the prevalence of increasing returns to scale, and the factors determining the level of utilisation. At an aggregate level, the appropriate measure of output in national expenditure on goods and services i.e. GDP, which is the sum of consumption, investment, government purchases, and net exports. GDP and value-added measure the quantity of goods available to consume today or invest for tomorrow. See Basu (2000) for details.

Lucas (1977) defined the business cycle as the co-movements between the deviations from the trends. Following Lucas, we define a business cycle in aggregated time series to be *procyclical* (*countercyclical*) if the cross correlations of time series are *positive* or *negative*, respectively. In our production data set we present descriptive results on simple cross correlations between the growth rates of our basic variables value added and hours worked, value added and capital stocks, value added and the growth in TFP, value added and α and (1-α). In addition it might be of interest to separate the direction from the magnitude of change. The correlation analysis takes both elements into account, but it may deny the existence of a significant relation between two series that move consistently in the comovements.

In the second part of the paper we decompose the log of TFP into the trend and the cyclical components for the private business sub-ectors of the economy. We proceed to Hodrick-Prescott filter the production data set, and calculate cross correlation's and standard deviations of detrended output, hours, investment and TFP at different leads and lags.

The second part of this paper is organised in the following sections. In section 2 the Hodrik Prescott filter (HP) is presented. The decomposition of the log level of TFP into trend and cyclical component using the HP filter are illustrated in Figures 1-9. Cross correlations and standard deviation of the cyclical components of TFP, value-added, hours worked, and

investment for the private business sectors of the Swedish economy using leads and lags are also presented in section 3. Section 4 concludes the main results of the second part of this study.

2. The Hodrik - Prescott Filter

The decomposition of TFP into cyclical and trend components has important implications for macroeconomic analysis. Historical decompositions give us the possibilities of dating the business cycle (peaks and troughs), while so called real time decompositions make it possible to judge the current phase of the cycle, increasing the reliability of economic predictions.

The decomposition and the distinction between transitory and permanent components in TFP is useful when judging the success of structural reform programmes or assessing the sustainability of current productivity levels. In fact the measurement of trend productivity and output could possibly be used to calculate output gaps which contribute to the understanding of the fiscal stance and, when interpreted as deviations from potential, are expected, to determine many important macroeconomic variables, such as wage and price inflation, and hence providing an important input for conducting research in monetary policy.

There exist various methods to extract cyclical components in the time series. We follow the standard practice of taking logs and HP filtering the data. HP filter is an exponential smoothing procedure. The HP filter helps to decompose an observed shock into a supply (permanent) component and a demand (temporary) component - the identifying differences being that the supply shocks have lasting, permanent effects, while demand shocks have only transitory effects.

The choice of HP filter to detrend the data has been subject to criticism. (See Cogley and Nason (1992), Harvey and Jaeger (1993), and King and Rebelo (1993). Following the Real Business Cycle (RBC) literature we follow the standard practice of taking logs and HP filtering the data. By doing so, we follow the majority of the RBC, and quote standard deviations and cross-correlations of the cyclical components. All time series were subject to a log transformation and were detrended using a HP filter which essentially fits a smooth, time-varying trend to the data.

The HP[13] filter is derived by minimising the sum of squared deviations of output from its trend subject to a smoothness constraint that penalizes deviations in the trend. The Hodrick-Prescott filter formula is:

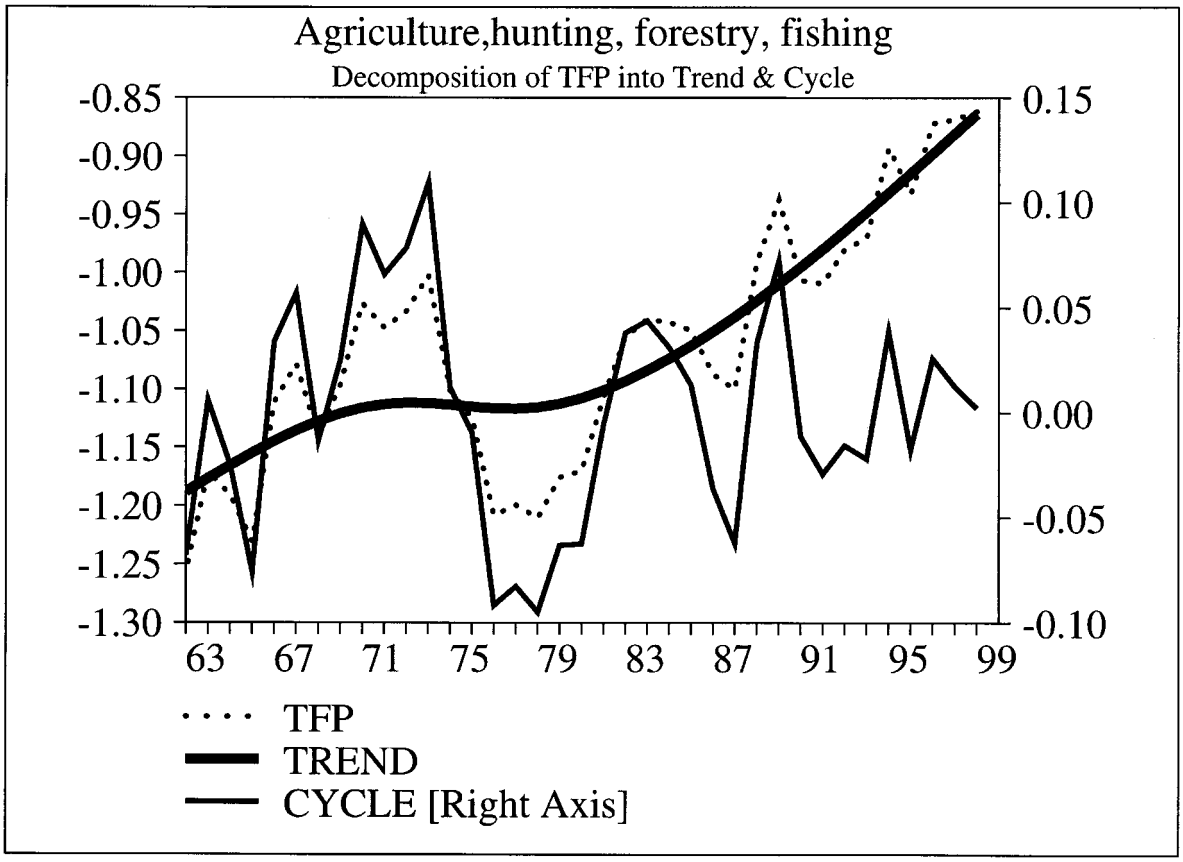
$$\sum_{t=1}^{T} (y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1} ((s_{t+1} - s_t) - (s_t - s_{t-1}))^2 \qquad (12)$$

where y_t is the raw series, s_t is the smoothed series, λ is the penalty parameter controlling smoothness. Kydland and Prescott (1990) simply argued that the penalty parameter could be 1600 for quarterly data and 400 for annual data.

See Figures 1 to Figures 9 for the decomposition of level of TFP into Trend and the cycle for dating the business cycles (peaks and troughs) for the private business sectors of the Swedish economy.

[13] See Eviews version User's guide p. 191

Figure 1 and Figure 2



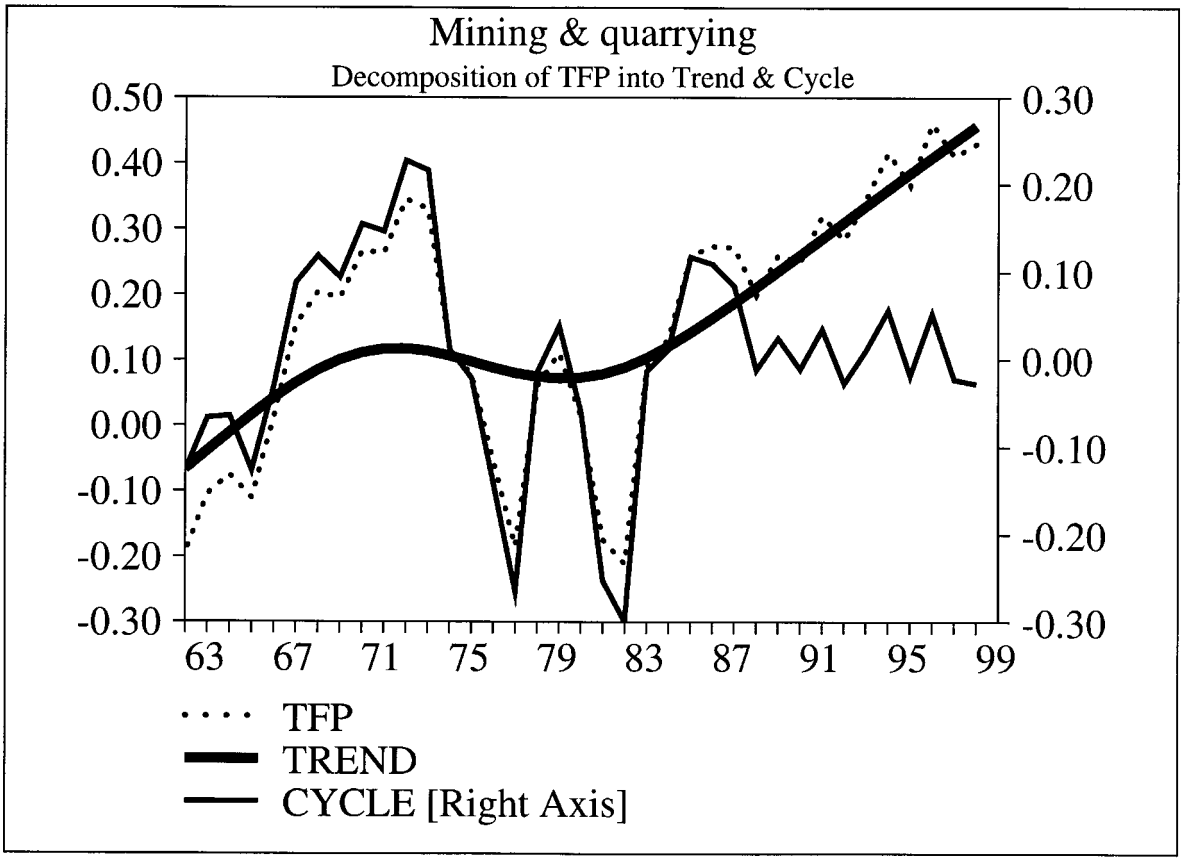
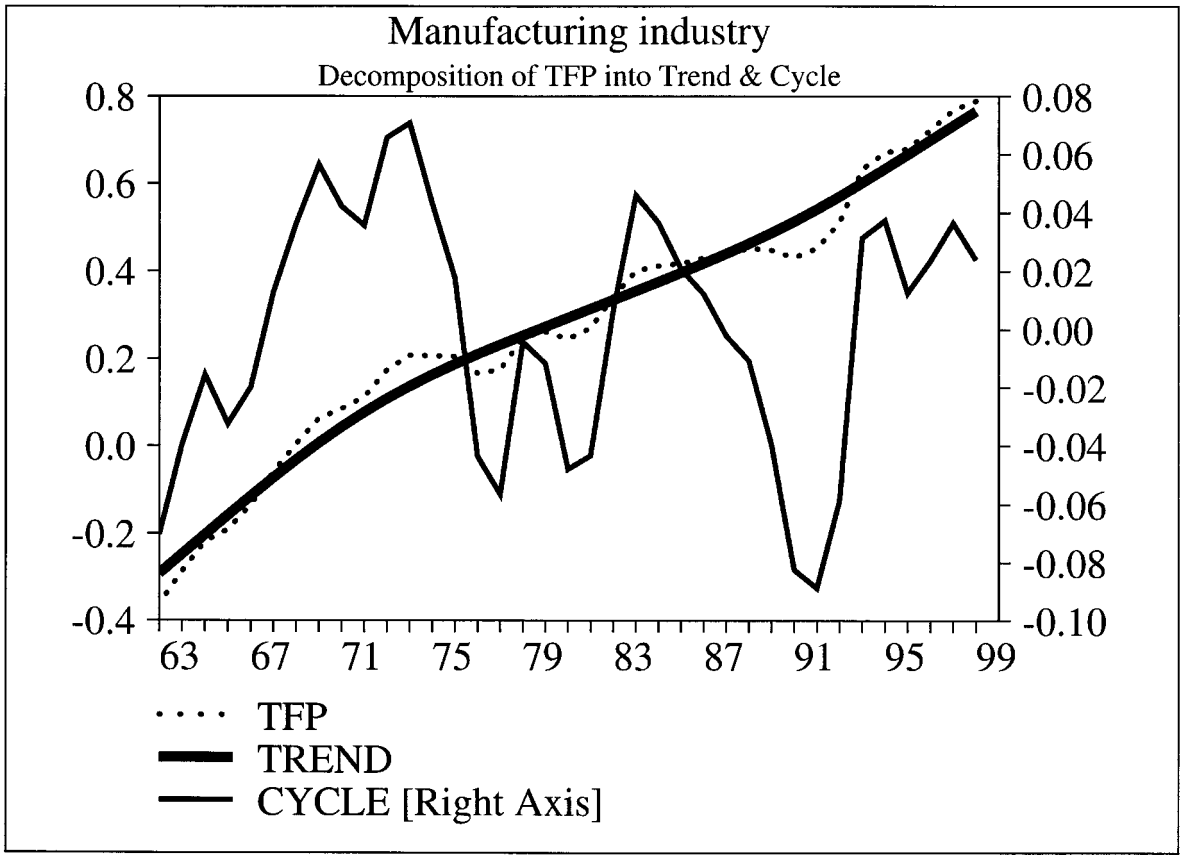


Figure 3 and Figure 4



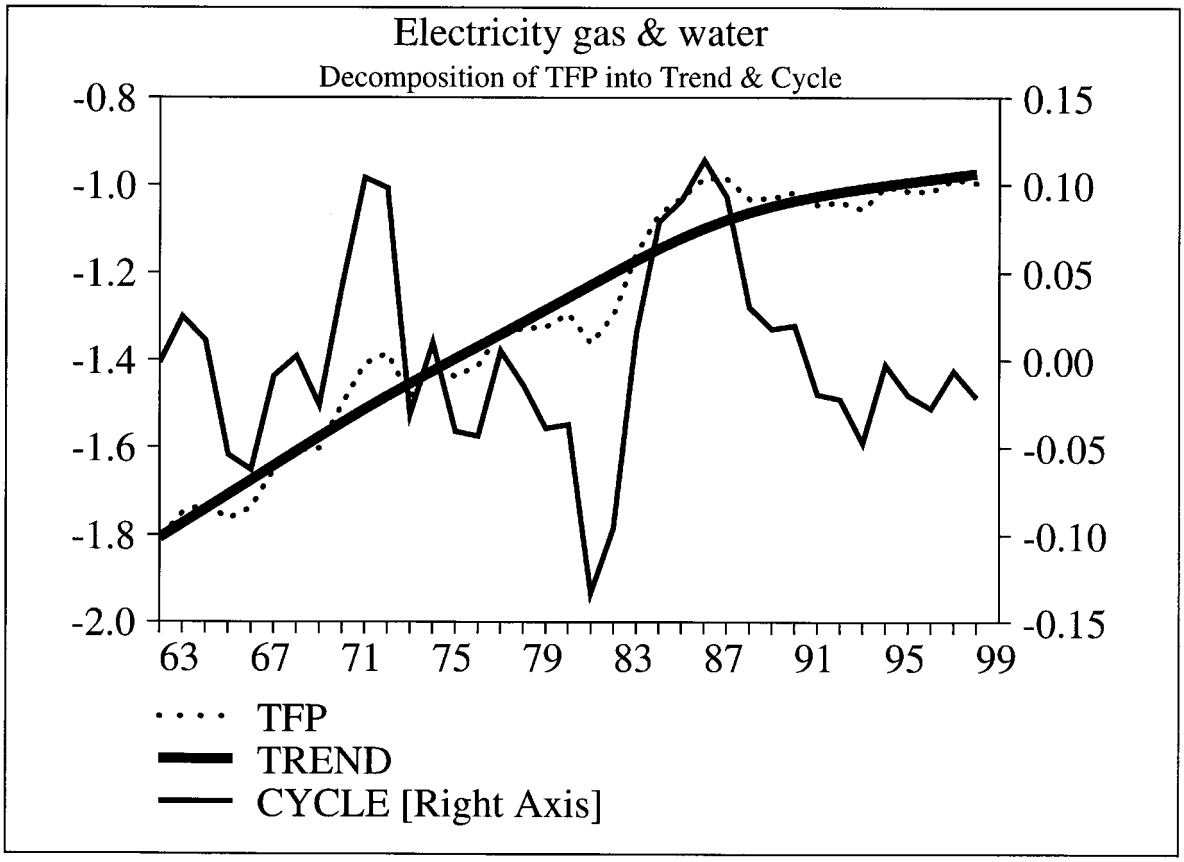
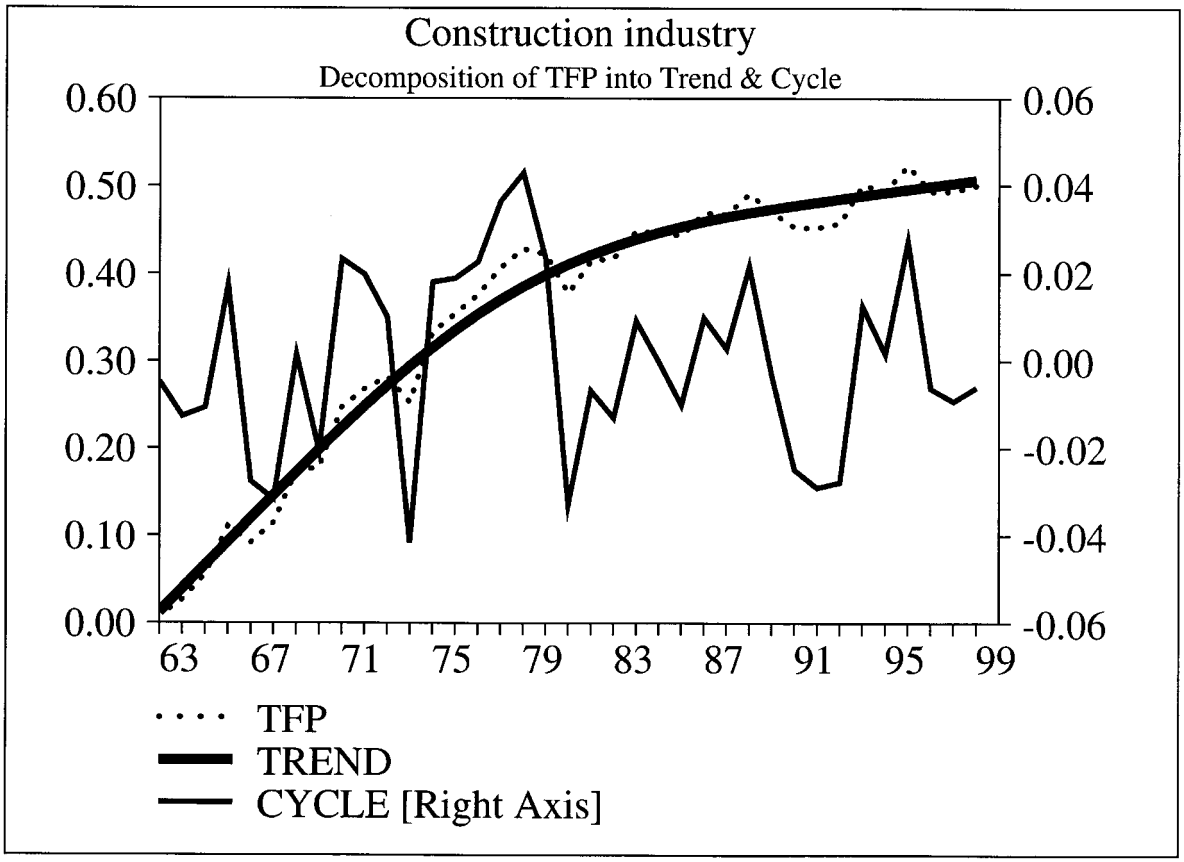


Figure 5 and Figure 6



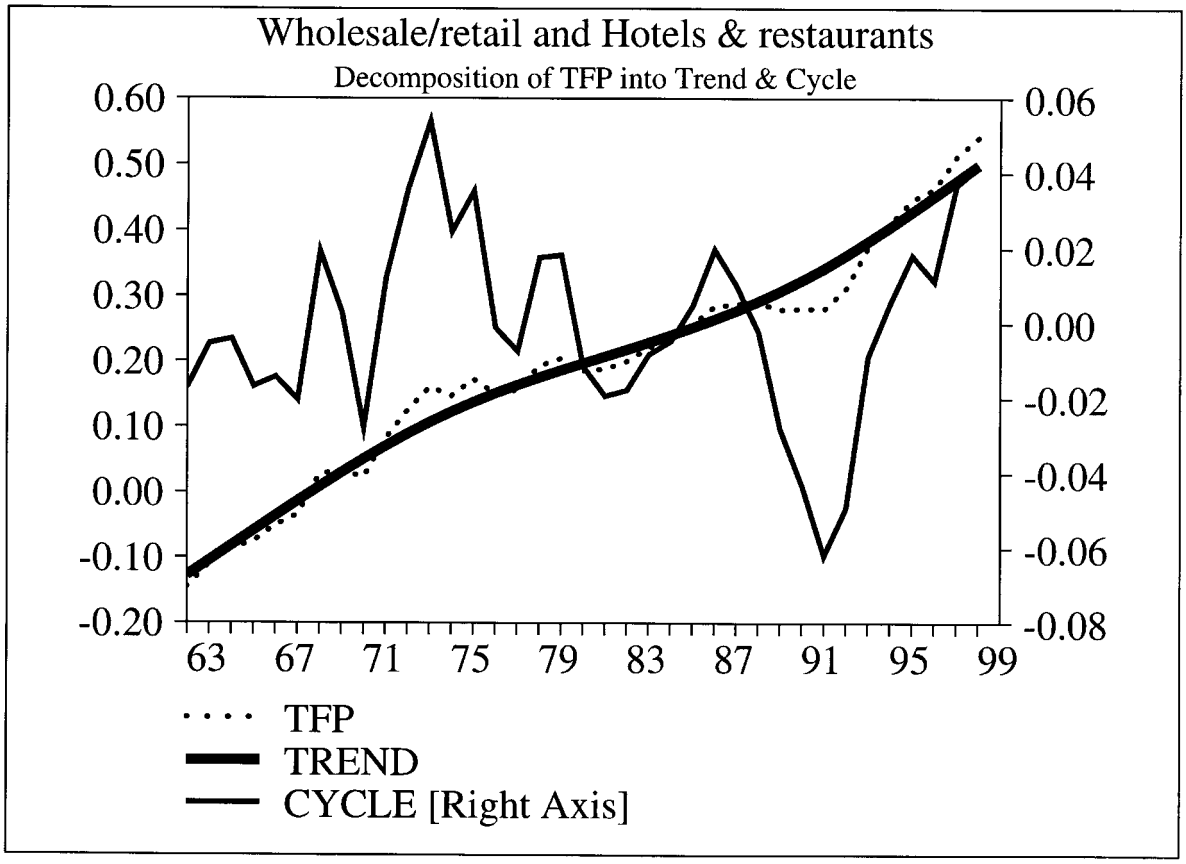
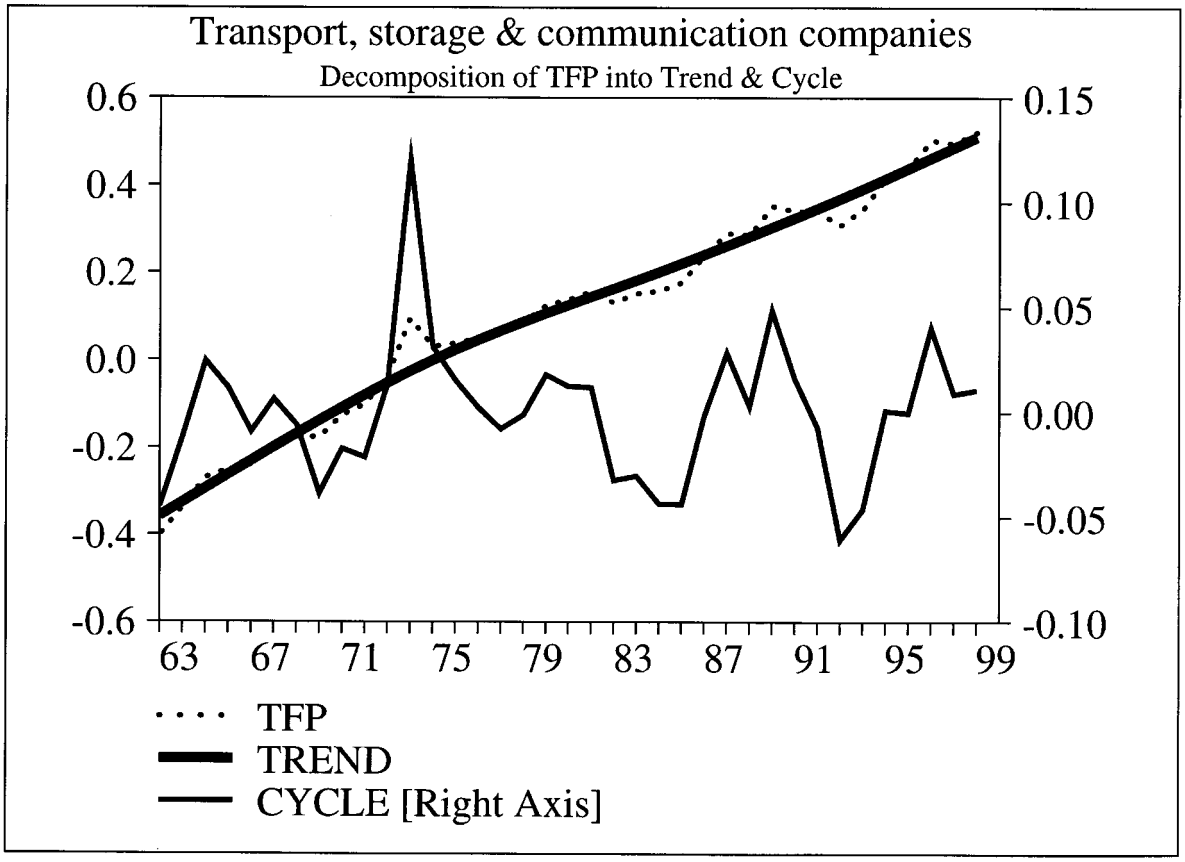


Figure 7 and Figure 8



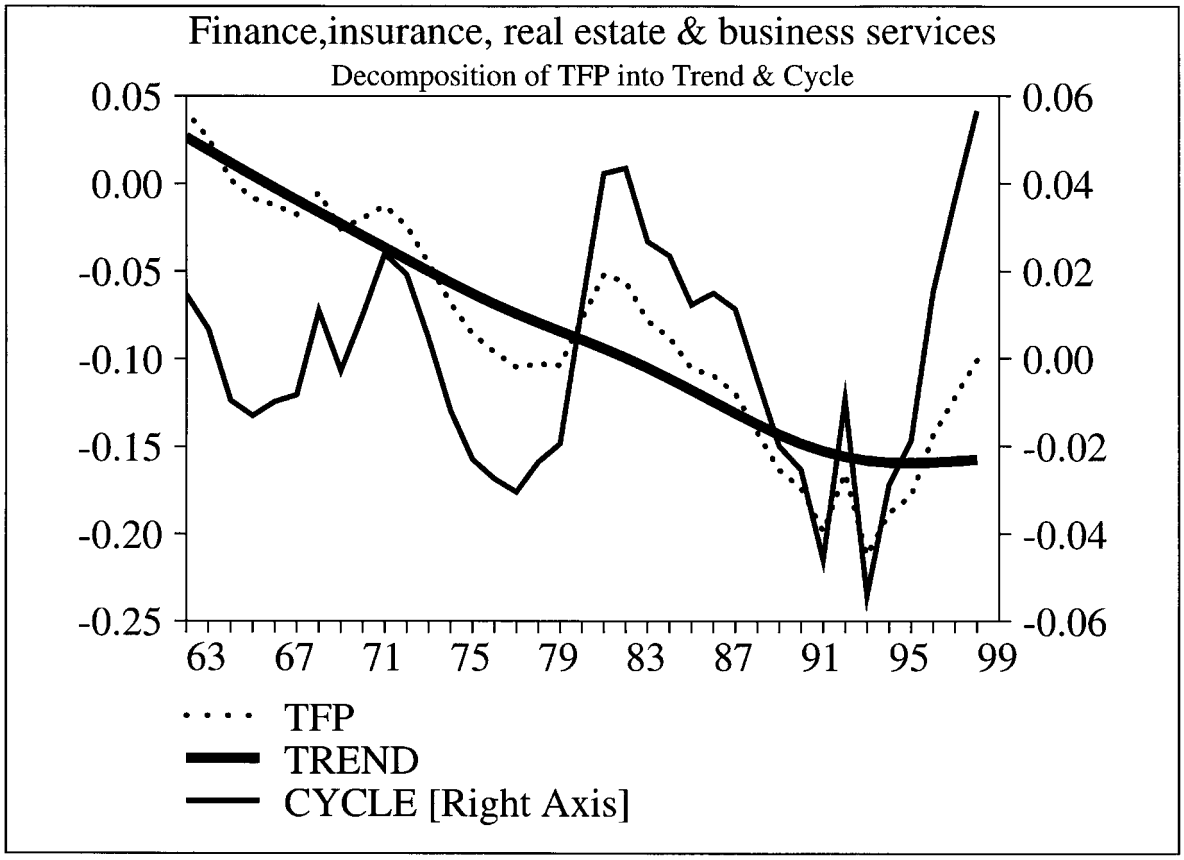
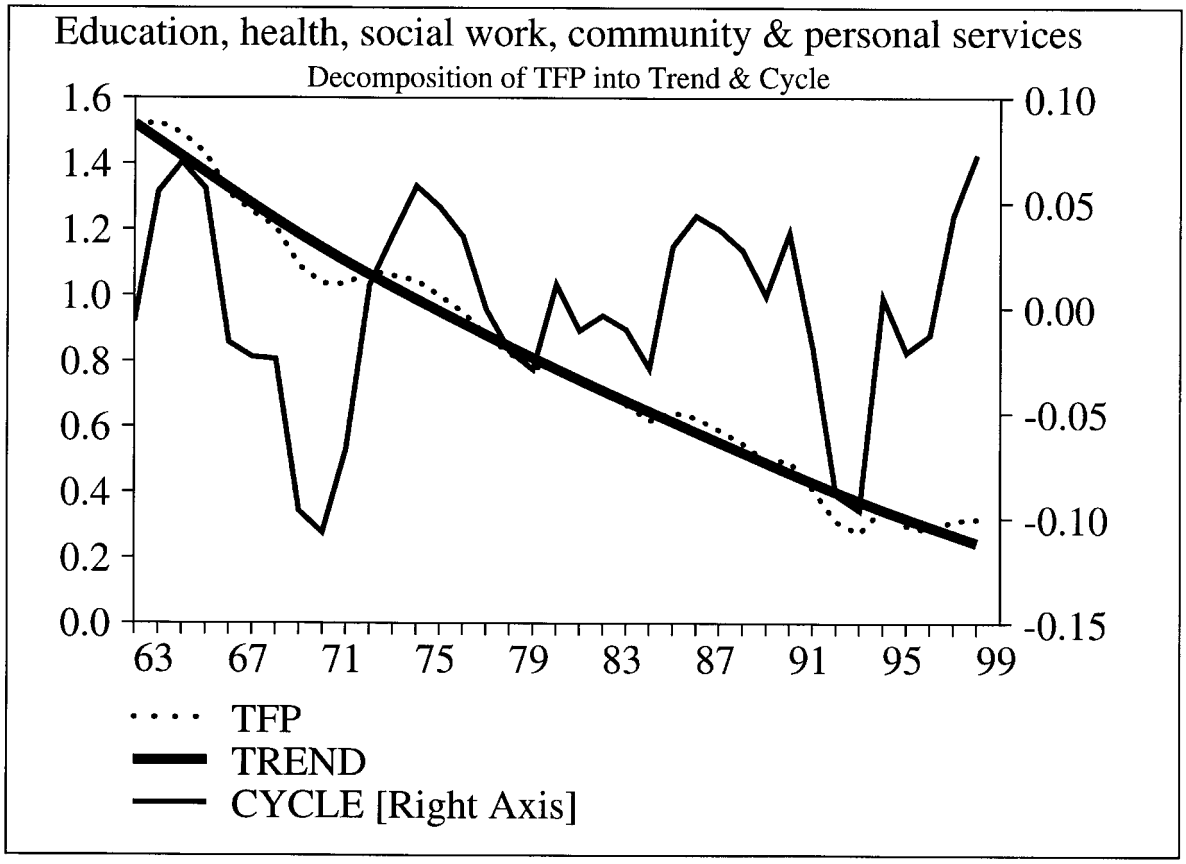


Figure 9



The first part is the global distance (the trend), while the second term represents the fluctuating dominantly transitory component, mainly due to demand disturbances. The choice of the smoothing parameter, the multiplicator for the second term that penalises deviations, plays a key role. Defining a cycle in the interval of five to six years the HP filter decomposition captures quite well the historical cycles that the Swedish economy has undergone.

3. Cross correlations and standard deviations

In Table 6.1 our descriptive results of contemporary cross correlations between growth rates in value added and TFP has positive cross correlations indicating that they are *procyclical* for all the sub-sectors of the Swedish private business.

Table 6.1. Contemporaneous correlation's for growth rates for PBS (1963 - 1999)

Sectors	*GDP & HH*	*GDP&KK*	*GDP &TFP*	*GDP &α*	*GDP &(1-α)*
AHFF	0.32	-0.04	0.70	-0.65	0.65
MQ	0.52	-0.09	0.47	-0.27	0.16
M	0.72	-0.10	0.29	-0.44	0.39
EGW	-0.13	0.55	0.35	-0.15	0.18
C	0.72	0.36	0.32	-0.18	0.15
WRTHR	0.64	0.08	0.09	-0.12	0.07
TSC	0.47	0.26	0.48	-0.24	0.24
FIREBS	0.19	0.10	0.32	-0.14	0.11
EHSW	0.23	-0.29	0.29	-0.23	0.10

Notes: *HH* = Hours worked, *KK* = Capital stocks, *TFP* = Total factor productivity, α = is the share going to labour, (1 - α) is the share going to capital.

Even hours worked and GDP have positive correlations and hence are *procyclical* (with the exception for the EGW sector). GDP and the capital stocks are *procyclical* with the exception for the following sectors: AHFF, MQ, and the Manufacturing industry. GDP and the share going to capital are *procyclical* for all the sectors while the share going to labour is *countracyclical*. TFP is *procyclical*, productivity rises in booms and falls in recessions.

In the first set of results, we calculate the detrended cycles for the private business sectors of the Swedish economy using the Manufacturing industry as the "reference sector" at different leads and lags[14]. The Manufacturing industry has traditionally been regarded as very cyclical. A sector is said to confirm to the reference cycle if the direction of its changes is largely the same as the direction of the changes in the reference cycle. We calculate cross correlations with leads at time *t-1* up to *t-4* and lags from *t+1* to *t+4*. The results with respect to cross correlations between the cyclical components of TFP between sectors indicate that the AHFF, MQ, WRTHR, and FIREBS are confirming to the reference cycle, while the cycles in the remaining sectors are not confining to the reference cycle[15]. If there is no connection between sectors, there is no reason for the cycles to be the same in any sectors.

Table 6.2. Correlation's of the cyclical components of levels of TFP with leads and lags using "Manufacturing sector" as the reference sector

	Leads to the reference series					Lags to the reference series			
Sector	***t-4***	***t-3***	***t-2***	***t-1***	***t***	***t+1***	***t+2***	***t+3***	***t+4***
AHFF	0.07	0.19	0.33	0.50	0.58	0.41	0.23	0.07	-0.21
MQ	-0.08	0.06	0.16	0.34	0.58	0.52	0.29	0.13	-0.03
M	-0.08	0.08	0.32	0.75	1.00	0.75	0.32	0.08	-0.08
EGW	-0.47	-0.31	-0.12	0.12	0.27	0.38	0.40	0.32	0.20
C	-0.22	-0.30	-0.24	-0.01	0.15	0.21	0.21	0.19	0.30
WRTHR	-0.39	-0.32	-0.10	0.36	0.69	0.67	0.50	0.39	0.31
TSC	-0.21	-0.33	-0.29	-0.20	0.12	0.29	0.30	0.39	0.37
FIREBS	-0.17	0.05	0.34	0.45	0.33	0.32	0.29	0.20	-0.03
EHSW	-0.44	-0.50	-0.55	-0.44	-0.13	0.13	0.28	0.39	0.44

Reference cycle patterns provide an instructive device for describing the movements of a series during the business cycle. The cross correlations of leads and lags with the reference series are presented in Table 6.2.

We proceed to calculate cross correlations with different leads and lags between levels of TFP and gross investment. We want to confirm if TFP growth induces subsequent investment or vice versa. The calculations of cross correlations[16] at different leads and lags are presented in Table 6.3. The results indicate that investment leads TFP for AHFF, EGW, Construction industry, and EHSW. Investment lags TFP for the MQ, Manufacturing industry, and for FIREBS. For WRTHR, and TSC it is indecisive.

[14] For example if the highest correlation between a variable and GDP occurs when the variable is shifted backwards (forwards) relative to GDP, then the variable is defined as leading or lagging.

[15] A positive value indicates that the cycle of a series *X* leads the cycle of the reference series *Y* with that many years.

[16] High degree of covariability between *X* and *Y* implies that they vary in the same direction, and the covariance Cov (*X*,*Y*) is large and positive. If *X* and *Y* vary in the opposite direction, the covariance Cov (*X*,*Y*) is large and negative. The 5% significance level is at 0.34.

Table 6.3. Correlations for cyclical components of level of TFP and gross investment

	Leads of Investment						Lags of Investment		
Sectors	***t-4***	***t-3***	***t-2***	***t-1***	***t***	***t+1***	***t+2***	***T+3***	***t+4***
AHFF	-0.80	-0.51	-0.41	-0.53	-0.31	0.21	-0.22	-0.01	0.67
MQ	-0.85	-0.63	-0.53	-0.43	0.65	0.80	0.82	0.76	0.64
M	0.12	0.17	-0.11	-0.02	0.46	0.69	0.62	0.66	0.67
EGW	-0.31	-0.54	-0.51	-0.49	-0.44	-0.15	0.01	-0.15	-0.37
C	-0.68	-0.04	0.21	-0.05	-0.18	-0.63	-0.12	0.10	0.46
WRTHR	-0.11	0.03	-0.53	-0.42	-0.05	-0.25	0.02	0.51	0.13
TSC	0.12	-0.01	-0.40	-0.53	0.01	-0.16	-0.78	-0.51	0.21
FIREBS	-0.27	-0.01	0.25	0.27	0.09	0.66	0.74	0.63	0.13
EHSW	0.75	0.58	0.33	0.06	0.51	0.32	-0.08	-0.39	-0.55

The results of cross correlations between detrended TFP and hours worked presented in Table 6.3. indicates that hours lead the TFP for MQ, Construction industry, WRTHR, and FIREBS. Hours worked lag TFP for EGW, Manufacturing industry, and TSC.

Table 6.3. Correlation's for cyclical components of detrended TFP and hours worked between sectors

	Leads of hours worked					Lags of hours worked			
Sectors	***t-4***	***t-3***	***t-2***	***t-1***	***t***	***t+1***	***t+2***	***t+3***	***t+4***
AHFF	-0.03	-0.22	-0.21	-0.34	-0.26	-0.21	-0.28	-0.12	-0.08
MQ	-0.07	-0.14	-0.17	-0.05	0.16	0.09	-0.06	-0.09	-0.04
M	-0.38	-0.47	-0.49	-0.19	0.34	0.63	0.56	0.37	0.26
EGW	0.15	0.08	0.02	-0.21	-0.27	-0.02	0.22	0.33	0.41
C	-0.00	-0.13	-0.32	-0.37	-0.20	-0.01	-0.01	0.04	-0.00
WRTHR	0.07	0.06	0.16	0.15	0.20	0.19	0.17	0.17	0.17
TSC	-0.20	-0.37	-0.30	-0.06	0.17	0.48	0.43	0.26	-0.00
FIREBS	-0.64	-0.52	-0.40	-0.25	-0.09	0.27	0.28	0.02	-0.21
EHSW	0.07	-0.00	-0.15	-0.16	-0.21	-0.14	-0.09	0.05	0.09

The cross correlation's with respect to detrended TFP and GDP at different leads and lags indicate that value added lags TFP for the AHFF, MQ, Manufacturing industry and EGW, WRTHR, TSC sectors, FIREBS and finally EHSW. While for the, the Construction industry value added leads TFP. The results are presented in Table 6.4.

Table 6.4. Correlation's of cyclical components of detrended TFP and value added

	Leads of Value added						Lags of Value added		
Sector	***t-4***	***t-3***	***t-2***	***t-1***	***t***	***t+1***	***t+2***	***t+3***	***t+4***
AHFF	-0.11	0.10	0.13	0.45	0.95	0.41	0.08	0.02	-0.26
MQ	-0.15	-0.05	0.16	0.55	0.96	0.62	0.24	0.02	-0.03
M	-0.25	-0.20	-0.04	0.41	0.86	0.86	0.58	0.35	0.18
EGW	-0.28	-0.03	0.24	0.36	0.98	0.65	0.28	0.04	-0.19
C	-0.00	-0.17	-0.27	-0.25	0.18	0.03	-0.06	-0.09	-0.09
WRTHR	-0.16	-0.18	-0.10	0.29	0.75	0.70	0.45	0.21	-0.03
TSC	-0.52	-0.43	-0.17	0.28	0.88	0.50	0.20	-0.14	-0.40
FIREBS	-0.55	-0.50	-0.17	0.05	0.47	0.41	0.47	0.31	0.25
EHSW	-0.38	-0.22	0.03	0.55	0.91	0.59	0.23	0.09	-0.13

A simple measure of volatility is the standard deviation. We calculate standard deviations for the cyclical components of GDP, TFP, hours worked, and finally investment. Looking at Table 6.5, the cyclical components of GDP indicate that the MQ, the Manufacturing industry, EGW, the Construction industry, TSC are sectors with relative high standard deviations and hence volatile. With respect to hours worked the MQ, Manufacturing industry, the Construction industry are the most volatile sectors. The cyclical components of TFP indicate that the MQ, the Manufacturing industry, and the EHSW are the most volatile sectors. Finally the cyclical components of investment indicate that the most volatile of sectors are TSC, EGW, followed closely by the Construction and the Manufacturing industry.

From Table 6.5, we find the following stylised business cycle facts:

(1) The cyclical volatility of hours worked is approximately of the same magnitude as the volatility in value-added for some sectors, suggesting that 'an understanding of aggregate labour market fluctuations is a prerequisite for understanding how business cycles propagate over time', see Kydland (1994).

Table 6.5. Standard deviation in percentages 1963 - 1999

	Variables			
Sectors	***GDP***	***TFP***	***HH***	***INVESTMENT***
AHFF	5%	5%	3%	15%
MQ	12%	12%	5%	16%
M	6%	4%	4%	17%
EGW	6%	5%	2%	21%
C	5%	2%	6%	19%
WRTHR	3%	3%	2%	15%
TSC	4%	3%	3%	35%
FIREBS	2%	3%	3%	16%
EHSW	4%	5%	2%	11%

(2) Gross investment displays the largest volatility across the business cycle.

(3) TFP for the private business sector is more volatile than value added.

4. Conclusions

Filtering the production data set using the HP decomposition and calculating cross correlations at different leads and lags for the cyclical components of the production data set indicates that with respect to detrended cycles using the Manufacturing sector as the reference cycle that, the Agriculture, hunting, forestry and fishing, the Mining quarrying, Wholesale/retail trade together with Hotels and restaurants sectors are simultaneous with the reference cycle, while the remaining sectors do not confirm to the reference cycle.

The results with respect to the cycles both in TFP and investment indicate that TFP both leads and lags investment for the Agriculture, hunting, forestry and fishing, Mining and quarrying, Electricity, gas and water, Wholesale/retail trade, Hotels and restaurants and Transport, storage and communication. While for the remaining sectors TFP lags the cycle.

The results specific to TFP and hours worked indicate that the TFP cycle leads hours worked for the Agriculture, hunting, forestry and fishing, Mining and quarrying, Wholesale/retail trade together with Finance, Insurance Real estate and business services. While for the remaining sectors it's on the contrary.

The volatility of hours worked is approximately of the same magnitude as the volatility in value-added for some sectors. Gross investment displays the largest volatility over the business cycle. *MICMAC* can be disaggregated into two sectors, the goods and the service producing sectors.

Appendix 1.
Value added: at market producers and producers for own final use. 1995 Reference prices, Million SEK. For the nine sectors of the Private Business Sectors:

	gdp1(AFHH)	gdp2(MQ)	gdp3(M)	gdp4 (EGW)	gdp5(C)
1950	32830	2492	79582	4326	28657
1951	33260	2847	84850	4619	27813
1952	34179	3252	82606	4787	28481
1953	32460	3202	84432	5109	32199
1954	33200	2901	88206	5844	33948
1955	30562	3360	92115	5820	34137
1956	31217	3673	96940	6324	34681
1957	32817	3742	101981	6660	34687
1958	32380	3615	104138	7044	36756
1959	31184	3623	110014	7375	39827
1960	32552	4171	118454	8057	39689
1961	33438	4576	126481	8984	42544
1962	33478	4541	136077	10098	44554
1963	31468	4695	142789	10463	47946
1964	34203	5259	156603	11402	51202
1965	33508	5622	168810	12296	55385
1966	31890	5485	173712	12296	60306
1967	35399	5969	179629	13035	59200
1968	35770	6743	190661	14608	59664
1969	33200	7111	205196	15727	64793
1970	34921	6969	219288	16326	64229
1971	37126	7623	220702	18844	64056
1972	35729	7466	222034	21358	66151
1973	36214	8385	237748	22939	65749
1974	37857	8395	250598	21511	61050
1975	34384	6855	251432	23855	65480
1976	34400	6663	251492	24031	68335
1977	32115	5685	237077	25454	68220
1978	32675	4705	230668	28143	67857
1979	32535	6118	245511	29119	69195
1980	33680	6202	246466	29488	69703
1981	33732	5543	239118	30910	66997
1982	35907	4384	239907	29705	69028
1983	37874	4134	255178	32398	67195
1984	38618	5569	275170	37969	71314
1985	38295	5863	279754	42388	71572
1986	38022	6348	282736	44568	72214
1987	35874	6133	289714	47043	75511
1988	35358	5853	298376	47052	76811
1989	39526	5293	301524	45150	83064
1990	41864	5534	299287	46044	83443
1991	38278	5382	282813	46461	82469
1992	37582	5544	271768	45243	77196
1993	37982	5053	276812	45228	69103
1994	37722	5372	318357	43974	68798
1995	40086	5801	348979	45809	69843
1996	37642	5461	356203	45149	69399
1997	39452	5962	375033	45023	66314
1998	39183	5995	401049	46359	67000
1999	38777	5596	428915	47366	70274

Appendix 1 continues,
Value added:at market producers and producers for own final use. 1995-Reference Prices, Million SEK.For the nine sectors of the private business sectors:

	gdp6(WRTHR)	gdp7(TSC)	gdp8(FIREBS)	gdp9(EHSW)
1950	52610	22718	96138	23865
1951	52518	24392	101179	24878
1952	53215	24188	106364	24838
1953	54621	23640	109596	25189
1954	58997	25279	114973	26188
1955	61157	27009	119021	26269
1956	64265	26925	123950	26904
1957	65579	27719	127598	27201
1958	68082	28852	132014	26863
1959	71727	30216	138463	26944
1960	73007	33972	144688	27809
1961	77463	34605	150000	28552
1962	80103	36216	155761	28592
1963	83771	37489	159905	29646
1964	88474	40109	168669	30525
1965	92259	42829	175187	30888
1966	94277	44730	182910	31036
1967	96204	45410	190151	30109
1968	100706	47952	194862	30062
1969	108547	49636	201851	29977
1970	110746	49976	205466	29024
1971	110551	52766	213972	29006
1972	114987	53860	222345	29884
1973	120913	58134	228636	31146
1974	127803	67949	233272	32044
1975	128323	65171	239911	33886
1976	132521	66875	244530	34450
1977	128652	68288	249706	34990
1978	126558	69705	252773	34724
1979	132713	73351	256451	35117
1980	133441	78479	262684	35342
1981	130882	80467	273144	37172
1982	131400	82190	286829	36745
1983	134228	79692	292812	36664
1984	138791	81549	294614	36488
1985	141626	83593	300996	36664
1986	147657	87765	308683	39915
1987	156508	94741	319963	41439
1988	162860	101579	331353	41659
1989	169034	103108	338790	41709
1990	168827	116266	345369	41866
1991	166389	114796	352942	43154
1992	163366	113599	351654	41623
1993	164422	107039	366301	39428
1994	177382	110157	357813	41675
1995	185568	116347	374608	46184
1996	192637	120872	383356	45233
1997	196582	129820	398889	45734
1998	208958	131623	410639	50019
1999	221475	138622	426583	55207

Annex 1 continues,
Hours worked by kind of activity (HH1-HH9) in (10000 hours). for the Private business sectors of the Swedish economy

	HH1(AHFF)	HH2(MQ)	HH3(M)	HH4(EGW)	HH5(C)
1960	114893	4574	204118	5238	63249
1961	111655	4702	207458	5042	62955
1962	106799	4493	207198	5197	64813
1963	98940	4122	205156	5276	61363
1964	94250	4009	205675	5200	63583
1965	89135	3972	204748	5647	66271
1966	81353	3912	201938	5583	67662
1967	72812	3611	192181	5616	66821
1968	64976	3368	185076	5437	65038
1969	60083	3274	184983	5458	66406
1970	59250	3117	184188	5468	64552
1971	56374	3165	177569	5616	58232
1972	51388	2972	170173	5464	58718
1973	48993	2977	169690	5532	57187
1974	48453	2951	171529	5528	53675
1975	45882	2946	169464	5552	52677
1976	45033	2955	166949	5565	53793
1977	42768	2727	159873	5608	51610
1978	40665	2368	151340	5501	49261
1979	39762	2505	149437	5650	49330
1980	38101	2397	147705	5599	50135
1981	36733	2302	144051	5655	50032
1982	35831	2139	139526	5882	49287
1983	34945	2097	138289	5811	47250
1984	34562	2167	141600	5690	48572
1985	32942	2269	142176	5723	48378
1986	32143	2141	141569	5670	48716
1987	29891	2016	142338	5739	49461
1988	29582	1905	144565	5751	49907
1989	29291	1791	141740	5785	52736
1990	28809	1716	138689	6091	52736
1991	26789	1629	129839	5918	51545
1992	26183	1526	119099	5989	46646
1993	25603	1423	113084	5825	40349
1994	25494	1432	116803	5725	38494
1995	24992	1477	125433	5597	40076
1996	23879	1410	125421	5620	38640
1997	23394	1353	124206	5672	37952
1998	22888	1430	125979	5724	38282
1999	23156	1320	125562	5755	40073

Appendix 1 continues,
Hours worked by kind of activity (HH1-HH9) in (10000 hours). for the Private business sectors of the Swedish economy

	HHF6(WRTHR)	HHF7(TSC)	HHF8(FIREBS)	HHF9(EHSW)
1960	115096	46427	23043	19452
1961	117572	46058	24224	19620
1962	116855	46324	25168	19401
1963	117733	46309	27441	19647
1964	117290	45737	29711	19243
1965	116472	44958	30991	19620
1966	115299	45942	32600	19685
1967	111852	45694	33845	19862
1968	114367	45532	34080	19784
1969	114907	45723	34996	19776
1970	115601	45581	37077	20441
1971	115208	44737	37965	20233
1972	111091	43630	40202	19664
1973	110699	43828	41825	19098
1974	112374	44086	41742	19459
1975	113827	44651	42108	19616
1976	113321	44812	42618	19693
1977	110910	44641	43719	19872
1978	106583	43934	44319	19894
1979	107518	44087	44629	19916
1980	105912	44921	44741	19277
1981	105304	45316	45019	19725
1982	105127	45304	47113	20223
1983	105874	44591	48608	20183
1984	106879	44556	50160	20403
1985	106560	45377	51748	21658
1986	107127	46941	54998	22765
1987	109369	47263	57839	23806
1988	112366	47825	60956	24517
1989	115443	48633	64205	24894
1990	114652	51680	66240	25539
1991	110352	50591	66622	25964
1992	106955	49111	65913	27019
1993	103007	46665	62810	28047
1994	105406	46493	66188	31116
1995	106539	45495	70155	31695
1996	106312	45355	73183	32293
1997	106303	44850	73790	32232
1998	107396	45225	76131	33982
1999	110539	46856	81949	36201

Appendix 1 continues,
Capital stock by sector for Private Business sectors of the Swedish economy, in 1995 prices, Million SEK

	KK1(AHFF)	KK2(MQ)	KK3(M)	KK4(EGW)	KK5 (C)
1963	115916	8611	205519	128981	21303
1964	118036	9431	216532	134014	23127
1965	120801	10374	224240	140668	24945
1966	123892	10844	233344	147163	26475
1967	127083	11028	244487	153445	27528
1968	129292	11518	254969	160377	28206
1969	131421	12012	263785	166359	29047
1970	133233	12470	274041	173418	30159
1971	134515	12751	284724	181960	30966
1972	136494	13255	294272	191034	31597
1973	139215	14313	303952	202225	31623
1974	142593	15013	316334	211840	32061
1975	146560	15357	331997	220930	32516
1976	152862	15765	346642	229434	33345
1977	159565	16354	360121	238638	34443
1978	165062	17163	364605	247305	34375
1979	168276	16620	362327	253628	33947
1980	171331	16171	361295	257312	34132
1981	173027	16469	366127	262139	35034
1982	174671	16236	367878	268750	35701
1983	176898	15849	364803	276988	35986
1984	178872	15099	362799	285715	37177
1985	181046	14507	365655	292699	38514
1986	182885	14060	376850	298416	39639
1987	183208	13590	387299	300943	40847
1988	183663	13200	401995	301434	42962
1989	185068	13382	417054	302814	45324
1990	187498	13617	435932	305311	50360
1991	187826	13996	448566	305825	55477
1992	185529	13861	449981	305771	57877
1993	182341	13351	443692	305572	56558
1994	178394	13199	436993	302776	53637
1995	175698	12879	441366	300228	51824
1996	173353	13334	462178	298352	50152
1997	171504	13838	487057	296837	49795
1998	170546	14651	506232	296521	50478
1999	169610	14904	526735	296633	52875

Appendix 1 continues,
Capital stock by sector for Private Business sectors of the Swedish economy, in 1995 prices, Million SEK

	KK6(WRTHR)	KK7(TSC)	KK8(FIREBS)	KK9(EHSW)
1963	52178	81260	321028	769
1964	57353	83796	342190	841
1965	63109	85988	366867	929
1966	68371	88633	387653	1121
1967	73687	90729	405453	1440
1968	77634	93502	421862	1696
1969	80783	97280	430940	1935
1970	84354	100604	443993	2329
1971	88305	105400	461766	2773
1972	90985	109308	471122	3215
1973	95082	112891	490026	3426
1974	98539	119272	520314	3745
1975	101672	124336	557657	4531
1976	106040	130127	584398	5412
1977	110324	135541	604476	6450
1978	113841	143764	619046	7732
1979	115821	153214	628568	9371
1980	118317	160774	650489	11556
1981	120398	163423	660380	12573
1982	121704	164873	669993	13621
1983	123625	167378	684889	14649
1984	126644	168671	703869	15853
1985	130757	172004	725858	16608
1986	139995	175580	751818	17907
1987	149029	180621	778837	19264
1988	158992	186631	812363	20648
1989	169215	191278	846528	22700
1990	179789	198860	884981	25487
1991	189683	206354	924396	27038
1992	194553	212737	957095	28830
1993	196746	216550	987471	30603
1994	194240	212697	998658	32665
1995	194701	211776	1004498	34254
1996	197594	223087	1005506	36171
1997	200713	232688	1009910	39395
1998	204296	243853	1006328	42107
1999	213929	255876	1007260	45535

Appendix 1 continues,
Wage sum: wages and salaries and employers contribution to social security and private pensions. Current prices, Million SEK.

	WW1(AHFF)	WW2(MQ)	WW3(M)	WW4(EGW)	WW5(C)
1950	1300	121	5661	159	1606
1951	1566	140	6868	208	1990
1952	1884	181	7873	252	2463
1953	1716	194	8046	268	2530
1954	1850	204	8609	283	2774
1955	1925	240	9477	308	3043
1956	2026	253	10098	343	3271
1957	2043	284	10783	372	3493
1958	2005	300	11330	396	3687
1959	1913	300	11792	404	3989
1960	2140	337	13244	439	4507
1961	2302	377	14784	470	4900
1962	2383	384	16541	549	5573
1963	2350	412	17383	511	6224
1964	2488	431	19043	558	7068
1965	2584	467	20942	595	8052
1966	2575	500	22619	654	8837
1967	2691	509	23901	710	9503
1968	2602	518	25161	753	10124
1969	2547	541	27329	766	10967
1970	2636	578	31492	909	10697
1971	2767	652	33895	1022	10963
1972	2635	682	36253	1102	11365
1973	2594	744	39886	1190	12099
1974	3038	912	47548	1330	13728
1975	3630	1082	57046	1603	15755
1976	4255	1311	66345	1841	18720
1977	4575	1341	69054	2142	19723
1978	4649	1279	74197	2341	21456
1979	4661	1482	79336	2673	23099
1980	5128	1671	88916	1717	28467
1981	5790	1746	95554	1934	31479
1982	5930	1744	98811	2268	32756
1983	6251	1839	105760	3097	33618
1984	6715	2007	118006	3988	35848
1985	6945	2239	130950	4060	39812
1986	7465	2291	140597	4270	42882
1987	7979	2433	150287	4955	48667
1988	8180	2489	164925	5628	54442
1989	8951	2707	179645	5941	65029
1990	9526	2753	192330	7001	74624
1991	9537	2961	195889	7051	78637
1992	9095	2853	187985	7238	70693
1993	8628	2401	173717	9423	53175
1994	9019	2584	184873	9540	51434
1995	9310	2742	206669	9633	51225
1996	9571	2570	220651	10395	53719
1997	9587	2780	227240	11070	54084
1998	9627	2933	238457	11611	56272
1999	9562	2643	240756	11532	59418

Appendix 1 continues,
Wage sum: wages and salaries and employers contribution to social security and private pensions. Current prices, Million SEK.

	WW6(WRTHR)	ww7(TSC)	ww8(FIREBS)	ww9(EHSW)
1950	1972	1468	531	564
1951	2298	1762	648	690
1952	2665	2073	736	811
1953	2890	2128	778	839
1954	3005	2184	825	880
1955	3332	2424	933	952
1956	3710	2611	1049	1021
1957	4034	2832	1149	1058
1958	4217	2917	1263	1124
1959	4453	2970	1403	1170
1960	4861	3264	1593	1287
1961	5406	3519	1864	1419
1962	6328	3842	2140	1550
1963	6976	4079	2438	2574
1964	7680	4405	2804	2756
1965	8548	4737	3208	2979
1966	9491	5278	3766	3290
1967	10092	5794	4235	3518
1968	11118	6041	4630	3772
1969	12028	6362	5037	4012
1970	12981	7301	5582	5776
1971	14328	7864	6273	6140
1972	15308	8524	6864	6633
1973	16597	9139	7527	7017
1974	19929	10524	8747	8094
1975	24718	12543	10758	9778
1976	28934	14532	12629	11898
1977	31768	16295	14290	13614
1978	34806	17835	16302	15584
1979	37458	19475	18444	16761
1980	46810	23527	24310	6034
1981	50419	25745	26914	6665
1982	52918	27014	28626	6948
1983	57480	28550	32969	7482
1984	63624	31806	38547	8239
1985	72033	34933	42217	9031
1986	77775	39024	47882	10065
1987	86919	42227	54956	11440
1988	96772	44858	62135	12662
1989	108863	50395	71785	14394
1990	118995	56352	82475	16268
1991	121564	60050	89940	17528
1992	118573	59059	88381	19257
1993	113502	64782	102143	24146
1994	119086	66150	110774	28115
1995	125499	67816	118526	31015
1996	132821	72364	129099	33573
1997	137513	74833	135736	33687
1998	144327	78824	148467	37072
1999	148863	82991	127640	39551

Appendix 1 continues,
Value added at at factor values in current prices Current prices, Million SEK.

	vv1(AHFF)	vv2(MQ)	vv3(M)	vv4(EGW)	vv5(C)
1950	3552	382	9190	587	2608
1951	4382	533	12566	691	3107
1952	5885	872	11677	732	3645
1953	4695	891	11819	814	4168
1954	4900	744	12865	924	4403
1955	4797	854	13804	888	4645
1956	5372	1007	14836	1082	4948
1957	5024	1080	16019	1281	5163
1958	5037	984	16651	1473	5557
1959	4678	937	17838	1532	6042
1960	5223	1085	19632	1713	6395
1961	5648	1171	21283	1912	7087
1962	5817	1239	23264	2199	7800
1963	5401	1068	23907	2191	8800
1964	6271	1259	26988	2282	9880
1965	6579	1416	29886	2425	11433
1966	6364	1292	31477	2440	12537
1967	6666	1177	33230	2611	13502
1968	6255	1298	35562	2948	13640
1969	6106	1386	39063	3150	14695
1970	3913	1568	42800	3144	14004
1971	4338	1718	44695	3729	14935
1972	4587	1703	47377	4183	16205
1973	4648	1864	53560	4583	17977
1974	5919	2309	68374	4933	18712
1975	6128	2389	77842	6150	22084
1976	7260	2229	81846	7107	27549
1977	7707	1609	80803	7811	29154
1978	8407	1800	87476	10363	30778
1979	8471	1955	100790	11589	34032
1980	17539	1822	111604	13808	34823
1981	19595	1793	116523	15420	36939
1982	21501	2272	129249	15473	40404
1983	23882	2824	146436	18015	41518
1984	26514	3347	169556	21151	46582
1985	27741	3795	183919	23201	49427
1986	29493	3494	204250	27274	51959
1987	29705	3249	218951	28490	57705
1988	31851	3493	237139	29994	65949
1989	34555	4215	256771	33144	81693
1990	37425	4416	263338	37268	91351
1991	33374	3745	256167	41452	95832
1992	32646	3709	246282	43648	89646
1993	35295	4614	266497	43654	71259
1994	37707	5032	308638	44613	69392
1995	45183	5792	351999	45767	68843
1996	39822	4690	342740	46437	68497
1997	40538	5625	355272	44773	66808
1998	41081	5371	367438	42029	69779
1999	39972	4268	370510	39113	73486

Appendix 1 continues,
Value added at at factor values in current prices (Wages and salaries, employers social contribution, and operating surplus). Current prices, Million SEK.

	vv6(WRTHR)	vv7(TSC)	vv8(FIREBS)	vv9(EHSW)
1950	3087	2028	4043	1073
1951	3389	2705	4200	1224
1952	3940	3017	4565	1336
1953	4264	2994	4979	1424
1954	4405	3150	5435	1505
1955	4940	3463	5845	1572
1956	5323	3757	6604	1695
1957	5965	4094	7104	1817
1958	5995	4199	7900	1922
1959	6268	4334	8679	1972
1960	6498	4808	9327	2135
1961	7369	5125	10086	2301
1962	7996	5318	10416	2460
1963	8894	5652	10843	3744
1964	9839	6180	11983	4176
1965	11137	6817	13392	4591
1966	11939	7331	15436	5005
1967	13037	8171	16702	5357
1968	14383	8875	17780	5835
1969	15060	9433	19350	6235
1970	18439	10936	18341	7379
1971	20254	11882	19911	7831
1972	20798	13566	22120	8611
1973	22622	15407	24554	9053
1974	27385	17196	27238	10161
1975	33920	18488	31741	12384
1976	38138	20537	36735	14695
1977	40003	22826	40944	16657
1978	44452	25620	48453	18963
1979	51043	29121	54351	20838
1980	56609	35107	82492	17649
1981	60146	38663	97537	20829
1982	66823	41774	113972	22302
1983	75767	44454	128743	23807
1984	86846	47632	142301	26315
1985	95175	51846	151443	28958
1986	103512	56664	172298	31819
1987	114072	62501	189264	35092
1988	127258	69569	211562	38686
1989	140856	77471	232787	42633
1990	145971	87125	263104	48321
1991	149175	93509	294853	50799
1992	147955	95708	313210	52879
1993	151596	102920	363596	36223
1994	169221	108251	367613	41020
1995	181528	114940	389163	46880
1996	184012	119832	391389	49568
1997	186976	129639	400258	53096
1998	196059	133878	403442	60792
1999	205377	137622	363208	66224

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