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From productivity to profitability: the case of Finland

Invited Paper submitted by Statistics Finland*

Introduction

1. This paper presents the productivity measures utilized by Statistics Finland's national accounts, and some alternative profitability calculations. The Perpetual Inventory Method used in Finland is described in the annex.

Productivity measures

2. Whereas Finnish national accounts has calculated labour productivity since the late 1970´s (and published it since the late 1980´s) it wasn't until 1996 that multi-factor productivity figures were published. In 1999 the productivity calculations were completely revised. The main changes being due to the national accounts implementation of ESA95 and the change of base year to 1995.

3. Relative labour productivity is calculated as the change in the ratio of value added at constant prices to the amount of hours worked by industry (see eq. 1). When summing the hours worked they are assumed to be equally effective – thus they aren't weighted with e.g. hourly wages – and they include both employees' and self-employed persons' hours.

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$$RLP_t = \ln\left(\frac{Y_t / L_t}{Y_{t-1} / L_{t-1}}\right) \qquad \text{Eq. (1)}$$

RLP is relative labour productivity, Y value added and L hours worked.

4. Relative capital productivity is calculated as the change in the ratio of value added at constant prices to average gross capital stock at constant prices by industry (see eq. 2). Gross capital stock is the value of fixed assets at "as new" prices, regardless of the assets age or condition. Thus gross stocks don't take into account the efficiency decline that takes place in assets, but are nevertheless a better measure than net stocks, which are wealth measures.

$$RKP_t = \ln\left(\frac{Y_t / \overline{K}_t}{Y_{t-1} / \overline{K}_{t-1}}\right) \qquad \text{Eq. (2)}$$

RKP is relative capital productivity, Y value added and $\overline{K}$ average gross capital stock.

5. Multi-factor productivity is calculated as a translog index of the two partial productivity measures (see eq. 3). The relative changes in labour and capital productivity are weighted with their value shares. The value share of labour is the share of compensation of employees (i.e. wages, salaries and employers' social contributions) of nominal value added. Capital's value share is the residual of labour's value share. Thus the change in relative multi-factor productivity is calculated as a weighted geometric average of the changes in relative labour and capital productivities.

$$\ln\left(RMFP_t\right) = a \ln\left(\frac{Y_t / L_t}{Y_{t-1} / L_{t-1}}\right) + (1-a)\ln\left(\frac{Y_t / \overline{K}_t}{Y_{t-1} / \overline{K}_{t-1}}\right) \qquad \text{Eq. (3)}$$

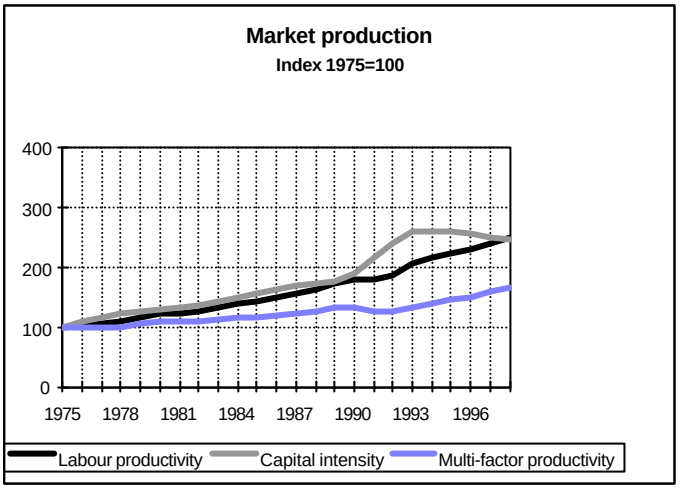
RMFP is relative multi-factor productivity, á is the value share of labour and (1- á) is the value share of capital.

Productivity in Finland

6. As can be seen from figure 1, the productivity in market production has grown rapidly after the economic depression of the early 1990´s. The average annual growth in labour productivity in the years 1993-98* was 3,9%, in capital productivity 4,9% and in multi-factor productivity 4,4%. Only labour productivity has previously grown faster. In the period 1990-93 the annual growth in labour productivity averaged 4,7%. From the capital intensity

(gross capital stock per hours worked) can be seen, that the underutilization of the capital stock (as was the case during the depression) has ceased, and that capital intensity has dropped near its long-term trend.

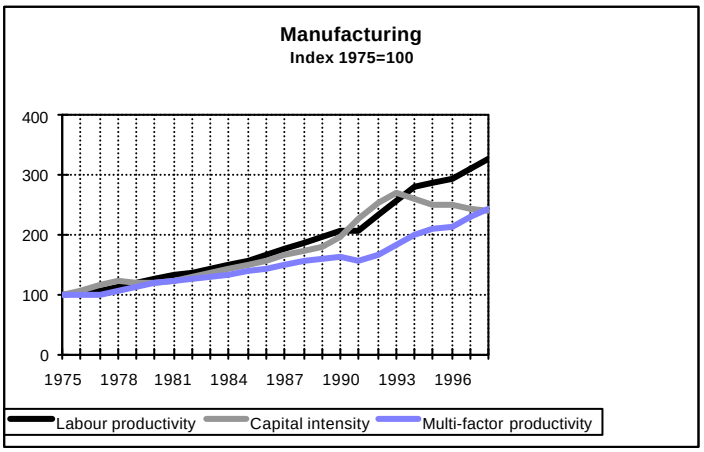
Figure 1: Productivity in market production 1975-98*.



Average annual growth, %	1975-90	1990-93	1993-98*
Labour productivity	4,0	4,7	3,9
Capital productivity	-0,4	-5,5	4,9
Multi-factor productivity	1,9	0,0	4,4

7. In manufacturing the recent productivity development is even better than in market production as a whole. The average annual growth in labour productivity in the years 1993-98* was 5%, in capital productivity 7,5% and in multi-factor productivity 6,1%. From figure 2 can be seen, that the capital intensity is declining after the depression. This probably reflects ongoing structural change, i.e. a move from capital intensive production towards production with emphasis on intangible assets.

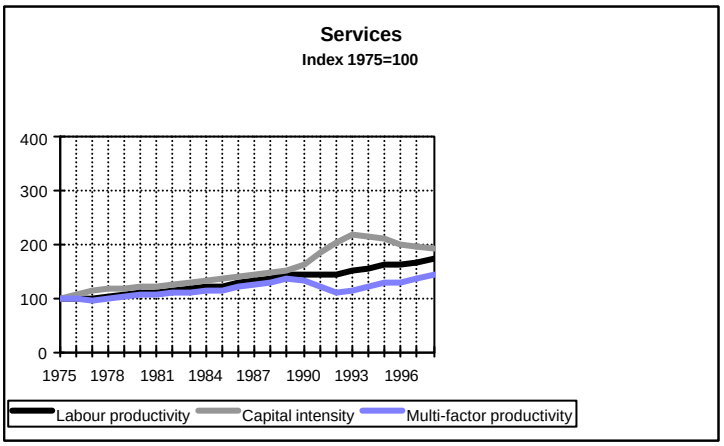
Figure 2: Productivity in manufacturing 1975-98*.



Average annual growth, %	1975-90	1990-93	1993-98*
Labour productivity	5,0	7,6	5,0
Capital productivity	0,3	-3,1	7,5
Multi-factor productivity	3,3	3,9	6,1

8. In services productivity growth hasn't been as rapid as in manufacturing. The average annual growth in labour productivity in the years 1993-98* was 3,1%, in capital productivity 5,9% and in multi-factor productivity 5%. The capital intensity in services has followed a similar pattern to market production's capital intensity as a whole, i.e. the early 90´s underutilization of the capital stock has ceased, and capital intensity has dropped near its long-term trend (see figure 3).

Figure 3: Productivity in services 1975-98*.



Average annual growth, %	1975-90	1990-93	1993-98*
Labour productivity	2,5	1,2	3,1
Capital productivity	-0,8	-8,3	5,9
Multi-factor productivity	1,8	-5,2	5,0

Problems with the productivity measures

9. One of the weaknesses with our multi-factor productivity calculations is that intermediate consumption isn't included as an independent variable in the production function. Implicitly intermediate consumption is considered, since value added is used as the production function's output instead of output per se. However, if there are structural differences in how an industry's intermediate consumption and value added change, these changes aren't captured by our productivity calculations. Another problem is the use of a fixed base year. The use of chain-indexes (i.e. yearly changing base year) is probably preferable, since they better take into account changes in input- and output-structures. Finland's national accounts is going to start using chain-indexes in 2005 at the latest.

10. The biggest problem has to do with the capital input. Neither the SNA93/ESA95 gross nor net capital stocks are well suited for use in productivity calculations. The flow of capital services should be used instead of stocks as capital input in the production function.

11. There have been much consensus in the literature on the importance of taking into account land and inventories in the production function. Professor Diewert showed very recently (Diewert & Lawrence 1999) how the omission of land and inventories lead to a decline in average total factor productivity (TFP) growth rates in Canada of about 0,1% per year. This is a lot in relative terms, since the average growth rate for TFP in Canada averaged 0,5-0,6% over the years 1963-96.

12. Clearly we have a need to improve on the methodology we use to calculate productivity in Finland, and therefore we have ongoing work intent on developing productivity measures along the lines of professor Jorgenson's KLEMS-methodology[1] (see Jorgenson et al (1987) & BLS (1997)).

From productivity to profitability

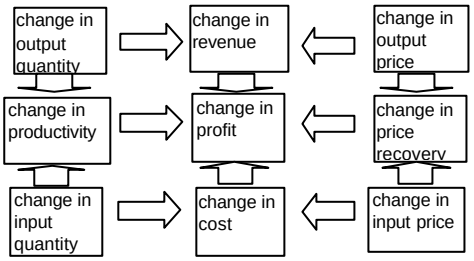
13. Productivity is an efficiency measure. We calculate how much the volume of output per input(s) changes, and – assuming constant returns to scale – what we get are the productivity figures. To be able to take the step from productivity to profitability, also the output and input prices have to be taken into account. Pineda (Pineda 1990) presents the American Productivity and Quality Center's (APQC) model for productivity measurement as follows:

Profitability ratio = Productivity ratio x Price recovery ratio Eq. (4)

14. Price recovery is the ratio of output prices to input costs. Figure 4 shows graphically the interactions between productivity, price recovery and profitability.

Figure 4: Interactions between profitability, productivity and price recovery

(adapted from Loggerenberg & Cucchiaro 1982).



[1] See 'International Productivity Comparisons Project' at http://www.conference-board.org/expertise/frames.cfm?main=econ.cfm, for further information.

Profitability measures

15. In the following profitability is defined as return on capital employed. Modifying eq. 4, the relative change in profitability equals the relative change in capital productivity times the relative change in price recovery. Eq. 5 shows the formula for calculating the relative change in profitability(the return on capital):

$$\ln\left(RPR_t\right) = \ln\left(\frac{Y_t / \overline{K}_t}{Y_{t-1} / \overline{K}_{t-1}}\right) + \ln\left(\frac{KOP_t / KOP_{t-1}}{KIP_t / KIP_{t-1}}\right) \qquad \text{Eq. (5)}$$

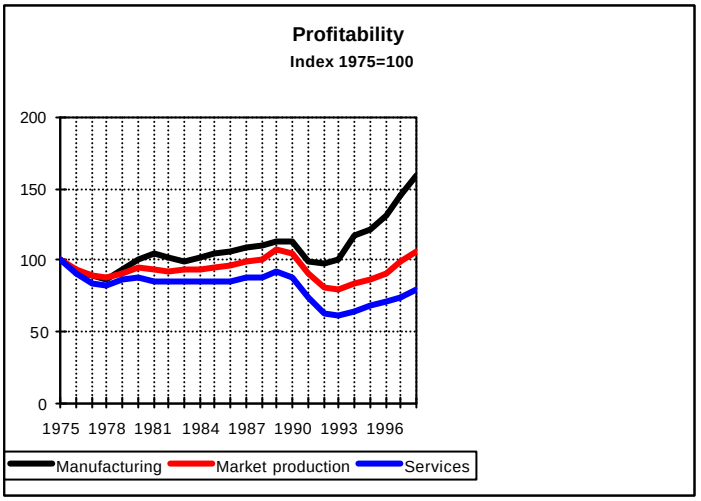
RPR is relative profitability, KOP is capital output price, KIP is capital input price.

Profitability in Finland

16. The cost of capital (or capital output price as it is written in eq. 5) equals the sum of depreciation, return to capital and capital gains. Depreciation (consumption of fixed capital) is directly available from national accounts data. Return to capital was for the purposes of this paper defined as net operating surplus. The implicit price index was constructed by simply dividing the sum of nominal depreciation and nominal net operating surplus by the sum of real depreciation and real net operating surplus. (As Finnish national accounts only publishes the nominal net operating surplus, I had to calculate the real net operating surplus as the residual of the real net value added subtracted with real wages & salaries[2], real employers' social contributions and real other taxes on production. To this was added other subsidies on production in real terms.) Data on capital gains was not available. As capital input price I used the relevant price indexes of gross fixed capital formation. Figure 5 shows the profitability in manufacturing, market production and services graphically.

[2] I deflated the nominal wages & salaries and nominal employers' social contributions with the price index of value added of the relevant industry.

Figure 5: Profitability in manufacturing, market production and services 1975-98*.



Average annual growth, %	1975-90	1990-93	1993-98*
Manufacturing	0,8	-3,9	9,7
Market production	0,3	-9,2	6,0
Services	-0,8	-11,5	5,5

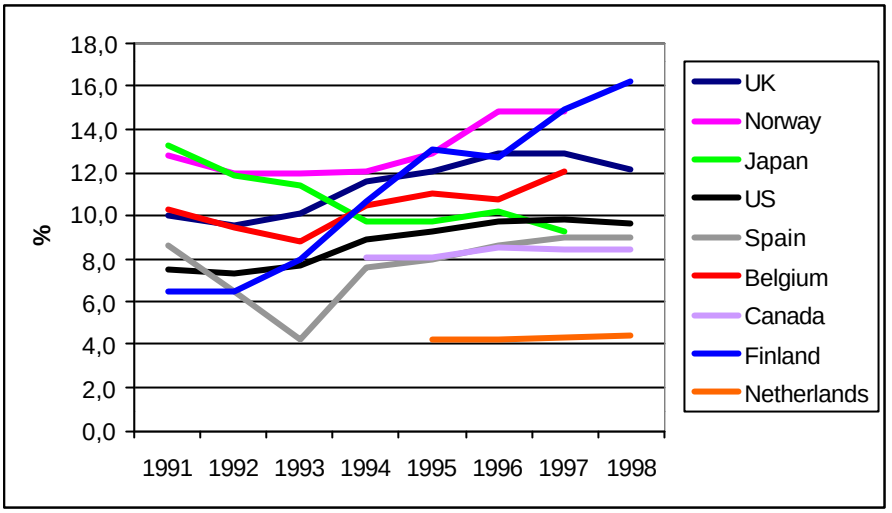
17. The profitability in manufacturing is growing at a fast pace, the average increase per year over the years 1993-1998 being 9,7%. The profitability in services hasn't been growing as rapidly as in manufacturing or in market production as a whole, but even there the average annual growth in the period 1993-1998 was 5,5%. And it actually went up to almost 8% according to the preliminary figures for 1998.

Alternative profitability calculations

18. Alternatively profitability or the net rate of return can be defined as the ratio of nominal net operating surplus to nominal net capital stock plus nominal stock of inventories. This is the more orthodox national accounts definition of profitability, but by definition also the APQC-formula should produce the same results.

19. Walton (Walton 2000) has made an international comparison of the profitability (defined as the ratio of profits to capital employed) between certain countries (see figure 6).

Figure 6: The net rates of return for non-financial companies in selected countries.



Sources: Walton 2000 and Statistics Finland.

20. Figure 6 reinforces the view of an upward trend in Finnish companies' profitability after the early 1990´s, even in an international context. These figures reflect both real differences in profitability and national differences in the methodology of calculation. For instance, the Finnish net operating surplus includes some of the household sector's mixed income, and the Norwegian net operating surplus contains labour income of self-employed persons; this will give the rates of return an upward bias for both Finland and Norway.

21. Table 1 shows Norway's, the UK's and Finland's rates of returns in manufacturing and services. It wasn't until 1997 that the Finnish rates of return overpassed those of Norway and the United Kingdom.

Table 1: The Rates of Return in services and manufacturing in Finland, Norway and UK, 1991-1998*.

Rate of Return		1991	1992	1993	1994	1995	1996	1997	1998
Services	Finland	6.0	5.7	6.5	9.2	11.3	13.1	15.7	16.7
	Norway	14,7	13,4	13,1	13,1	12,9	12,7	12,5	
	UK	13,8	12,4	12,9	14,4	14,0	14,3	15,0	14,0
Manufacturing	Finland	3,3	5,5	9,4	11,4	14,1	11,2	13,9	16,2
	Norway	8,0	8,7	10,9	11,4	14,0	11,5	10,5	
	UK	4,3	4,7	5,2	7,7	9,2	10,1	10,8	11,0

Sources: ONS, Statistics Norway & Statistics Finland.

Conclusion

22. The rate of return (profitability) calculated as productivity times price recovery, or as net operating surplus divided by capital stock plus inventory stock should theoretically be the same. In the calculations done for this paper that wasn't the case. One major reason is probably the different (gross/net) capital stocks used. Secondly, inventories and land haven't been taken into account in the productivity calculations, and thirdly, capital gains should also be a included in the cost of capital. Clearly there is need for further research into both productivity and profitability at the industry level.

References:

Bureau of Labour Statistics (1997): *BLS Handbook of Methods,* Washington,

Diewert, W.E. & Lawrence, D.A. (1999): *Progress in Measuring the Price and Quantity of Capital,* paper "published" on the Canberra-group's (expert group on capital measurement) Electronic Discussion Group.

ESA95 (1996): *European System of Accounts*, Eurostat,

Jorgenson, D.W., Gollop, F. & Fraumeni, B. (1987): *Productivity and U.S. Economic Growth,* Cambridge, Massachusetts: Harvard University Press.

Loggerenberg, B. & Cucchiaro, S. (1982): *Productivity Measurement and the Bottom Line,* National Productivity Review.

SNA93 (1993): *System of National Accounts 1993,* UN, OECD, EU, IMF, World Bank.

Walton, R. (2000): *International Comparisons of Profitability,* Economic Trends, January 2000.

Annex 1: The Perpetual Inventory Method used in Finland

Finland - as well as all other OECD countries - uses the perpetual inventory method (PIM) to generate an estimate of the capital stocks by accumulating long series of gross fixed capital formation over their estimated service lives. Price indexes and assumptions of service lives, survival functions and depreciation patterns are also needed.

The survival function of the share of year T's investments still in use at the end of year t, is assumed to be:

$$w_{t-T} = \exp\left\{-\left[\frac{\Gamma(1+(1/a))}{E}t\right]^a\right\}, \qquad \text{Eq. (1)}$$

where s=t-T+0.5, E is average service life and a is a shape parameter.

Thus the gross capital stock at the end of year t is:

$$GCS_t = \sum_{T \geq t-J_t+1} w_{t-T} I_t \,, \qquad \text{Eq. (2)}$$

where $T \geq t-J_t+1$, and I_t is the gfcf of year T. $J_t=\max\{1.5h_t,100\}$, i.e. the capital assets maximum service life is assumed to be 1.5 times the average service life, but maximally 100 years.

The net capital stock at the end of year t is calculated using the 'straight line' assumption:

$$NCS_t = \sum_{T \geq t-J_t+1} w_{t-T} I_T d_{t-T} \,, \qquad \text{Eq. (3)}$$

where $d_{t-T}=0$, when $T \leq t-L_t+0.5$,

and $d_{t-T}=1-(1/E)(t-T+0.5)$ otherwise.

Average service lives used by Statistics Finland

AN.1111	Dwellings	50 years
AN.11121	Non-residential build.	20-50 years
AN.11122	Civil engineering etc.	20-70 years
AN.11131	Transport equipment	6-25 years
AN.11132	Other mach. and equipment	5-27 years[3]
AN.1121	Mineral exploration	10 years
AN.1122	Computer software	5 years
AN.1123	Entertainment, literary or artistic originals	10 years
AN.211	Improvement of land	30-70 years

[3] C, D and E industries: yearly diminishing service lives (since 1990 0,4-0,5% per year).