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Contribution of skills to growth, employment and productivity

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- 2. Methodology adopted**
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Background

EEA Labour force projections at 1990's

Sources of growth Solow, Denison, Jorgenson et al.

Demand and supply of labour and sources of growth, Finland

Skills network, Cedefop, demand and supply, occupational structure, retirement skill needs, new labour force need

Klems and sources of growth

1. Rationale and the main task

There is a well established literature on the sources of growth and there is also methodology for the contribution of education and skills on which is used in EU KLEMS-project. On the other side in European Skills network (R. Wilson et al) the approach is focussed primarily on the analyses of the skill needs and a demand and supply framework is used for medium term projections.

Connection to head line average targets/EU 2020

1. Raise the employment rate of the population aged 20-64 from the current 69% to at least 75%.
2. Reduce the share of early school leavers and increase the share of the population completed tertiary education.
3. Reduce the number of Europeans living below national poverty lines, lifting people out of poverty.
4. Achieve the target of investing 3% of GDP in R&D.
5. Reduce greenhouse gas emissions, increase the share of renewable energy, and achieve increase in energy efficiency.

These targets are intercorrelated and a part of broader issue of sources of growth and better employment. So broader frame work is needed and head line targets will be analysed in this frame work.

Contribution of skills, knowledge and education

Skills upgrading is important issue because it contributes on economic growth and promotes labour supply so that it's structure corresponds demand and quality of labour compensates quantity. Here proposed method produces index which measures education and skills contribution on growth.

The basic idea is multiply shares of different education levels in employment by earnings levels in these same different education levels. When the shares of higher education levels are increasing, the index which is as result is increasing. Relative changes in this index are multiplied by income share of labour as the part of total income (or production) and so the result is contribution on growth which can be presented as an index and percents. This kind of calculation can be made for the future and this is here basic task.

Growth accounting as a part of European skillsnet framework

The current *Model Framework in Skills network* comprises various key elements includes on the demand side:

- **Module 1:** a set of multi-sectoral macroeconomic forecasts, based around the E3ME macroeconomic model;
- **Module 2:** an occupational model, focused on explaining expansion demand within sectors;
- **Module 3:** a qualifications module focussing on the implications for qualification intensities within occupations (demand) rather than the supply side;
- **Module 4:** a replacement demand module recognising the crucial importance of considering changing occupational employment levels and also the need to replace those leaving the workforce because of retirement, migration and mortality and on the supply side.
- **Module 5:** macroeconomic model which tries capture secondary impacts (for example, higher economic output may cause higher employment levels, but higher employment is also likely to lead to increased output);
- **Module 6:** aggregate labour supply model
- **Module 7:** qualification model (stocks);
- **Module 8:** qualification model (flows).

Here it could be discussed if another module 9 could be increased. This is

• **Module 9:** contribution on growth, productivity and employment module and in broader sense impact module. Here the idea is to benefit the growth, employment and labour quality projections the supply side limiting demand growth. Then capital projections are increased and weights so that we can calculate the total input including labour and capital and total factor productivity or combined productivity of production factors which increases production more than only input increasing. So we can analyse factors of growth and use the analysis for European growth and employment strategy. So we have link, or bridge between skills net work and European growth and employment strategy. Also other impacts can be analysed. The same idea can be applied for global growth and employment strategy but this is not the task yet. Sustainability aspect can however be analysed.

2. Methodology adopted

The basic idea can be presented by using simple equation

$$\frac{\dot{Q}}{Q} = \frac{\dot{T}}{T} + \frac{rK}{Q} \frac{\dot{K}}{K} + \frac{wH}{Q} \frac{\dot{H}}{H} = \frac{\dot{T}}{T} + v_K \frac{\dot{K}}{K} + v_L \frac{\dot{H}}{H}$$

Here K is capital and H is working hours. T is a variable describing technological development. It measures technical changes with shifts of production function. Q is a fixed price production. Here r is return on capital, w is wage and v_K and v_L are shares of labour and capital in such way that they will sum up to one. Dot above letters describes continuous time but in calculations discrete time is used, This we call the basic equation of total factor productivity calculations. The growth of production per working hours is

$$\frac{\dot{Q}}{Q} - \frac{\dot{H}}{H} = \frac{\dot{T}}{T} + v_K \left[\frac{\dot{K}}{K} - \frac{\dot{H}}{H} \right]$$

The use of the discrete time series data in the calculation of Divisia indices, which are based on continuous time, requires approximation.

When time series are used methodology developed by Dale Jorgenson and other and used in EURO KLEMS –project is useful. The basic equation can be now written in form

$$\begin{aligned} \bar{v}_t^i = & \ln Z_{i,t} - \ln Z_{i,t-1} - \bar{v}_X^i \sum_x \bar{v}_{Xx}^i [\ln X_{xi,t} - \ln X_{xi,t-1}] \\ & - \bar{v}_J^i \sum_j \bar{v}_{Jj}^i [\ln J_{ji,t} - \ln J_{ji,t-1}] - \bar{v}_M^i \sum_c \bar{v}_{Mc}^i [\ln M_{ci,t} - \ln M_{ci,t-1}] \end{aligned}$$

Here Z refers to production, t is time, (superscript or subscript) i refers to an industry, while X, J, and M denote intermediate products, capital and labour. Relative changes based on continuous time are replaced by approximate values.

The work of Jorgenson et al. is replete with logarithmic approximation. Using the averages of new and old value shares as weights we obtain Divisia-Törnqvist indices which are useful here and very unbiased.

After calculation logarithmic numbers are changed to indices. So we get basic indices which describe the contribution on growth of each variable.

Contribution of skills, knowledge and education

In the basic equation variable M includes working hours H and quality of labour LQ. The labour input index is here calculated as the product of its volume and quality components H and LQ, which in turn are compiled as the product of their subcomponents. These variables are calculated as indices and multiplied by each other. So we get

$$M = H \times LQ = \prod_c M_c$$

which is used in basic equation.

The point in calculation can be presented by simple numerical example.

-Education level Earnings level Shares of employed, %

	Earnings level	Shares of employed, %		
		t	t+10	t+20
A.	95	90	85	75
B.	130	8	10	15
C.	200	2	5	10
All	100	100	100	100
Education index		100	103.8	110.8

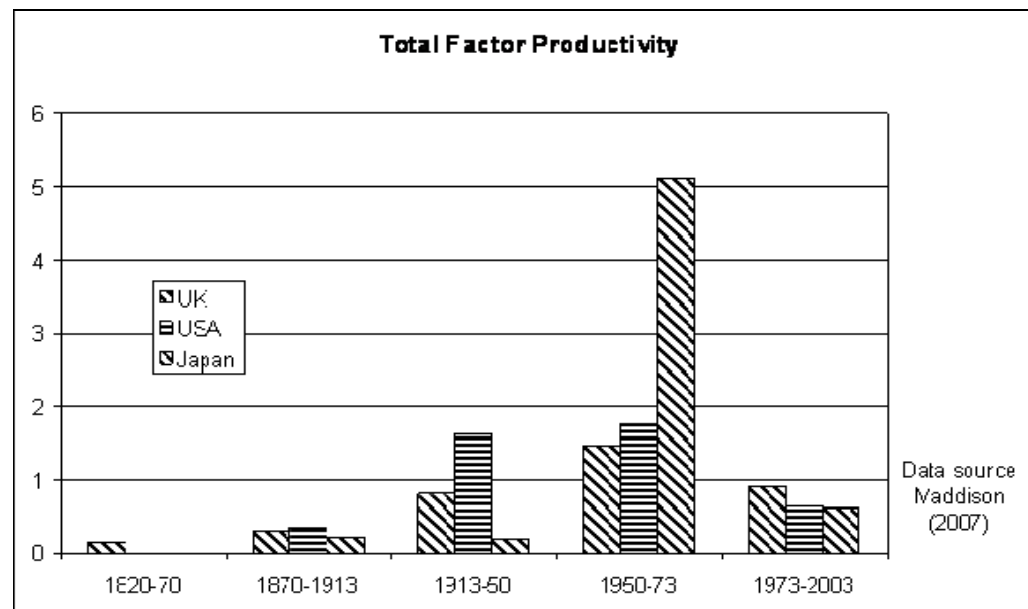
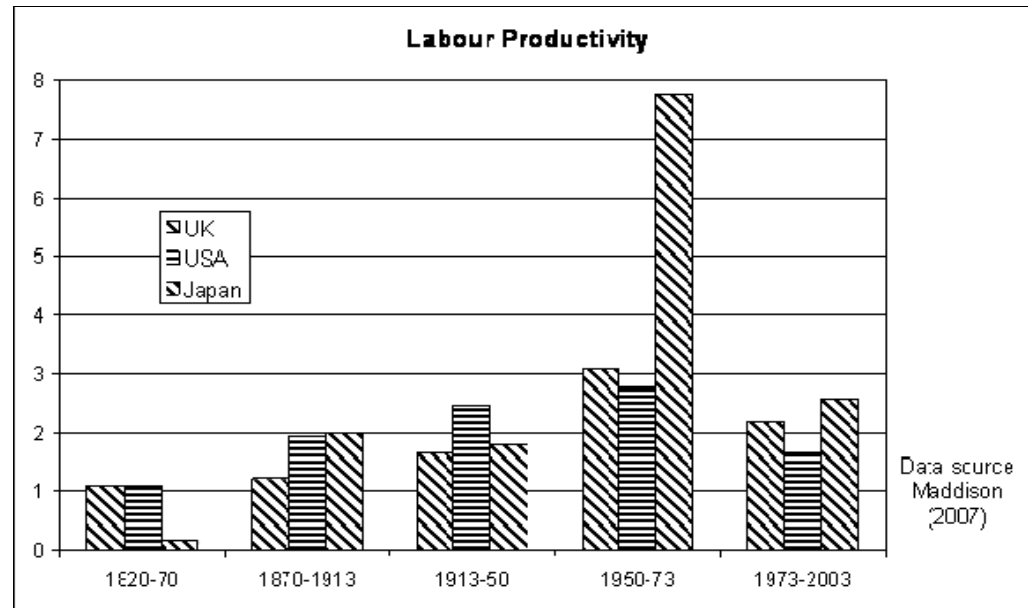
In the calculation example above, A., B. and C are educational levels. t refers to the point of time. Levels of earnings have been related to the average so that the average level of earnings is 100. For example at time t+20 the index point is $95 \times 75 + 130 \times 15 + 200 \times 10 = 110.8$. In the corresponding fashion we calculate the effect of index and sex structure. By multiplying the separate indices for different quality factors we obtain quality index.

3. Empirical description and examples of results

Global level, US, UK, Japan examples

In the Long-Term Model application in the standard application, the change in the variation relationship of the GNP is reflected by using labour productivity concept. Here we however have also total factor productivity concept and an example at aggregate level.

Chart 1. Labour and Total Factor Productivity: UK, USA and Japan, 1820-2003



Finland as example

Next we have a calculation for Finland.

The contribution of total factor productivity had been large throughout the post-World War II period. In 1900-48 its share of total growth was 38 %, in 1948-85 60 %, and in the period of 1900-1985 its share was 51 %. In 1975-85 its share was 90 % but in 1985-90 only 40 % (Tiainen, 1994). In the recessions during the second half of the seventies and at the beginning of the nineties, the growth of the total factor productivity had not slowed down dramatically. After the recession at the beginning of last decennium the total factor productivity growth accelerated but employment also increased. In the future on knowledge, skills, total factor productivity and full employment basing growth is the target and give also possibilities to ecologically sustainable development.

Chart 2. Labour and Total Factor Productivity in Finland in 1860-2030, yearly changes

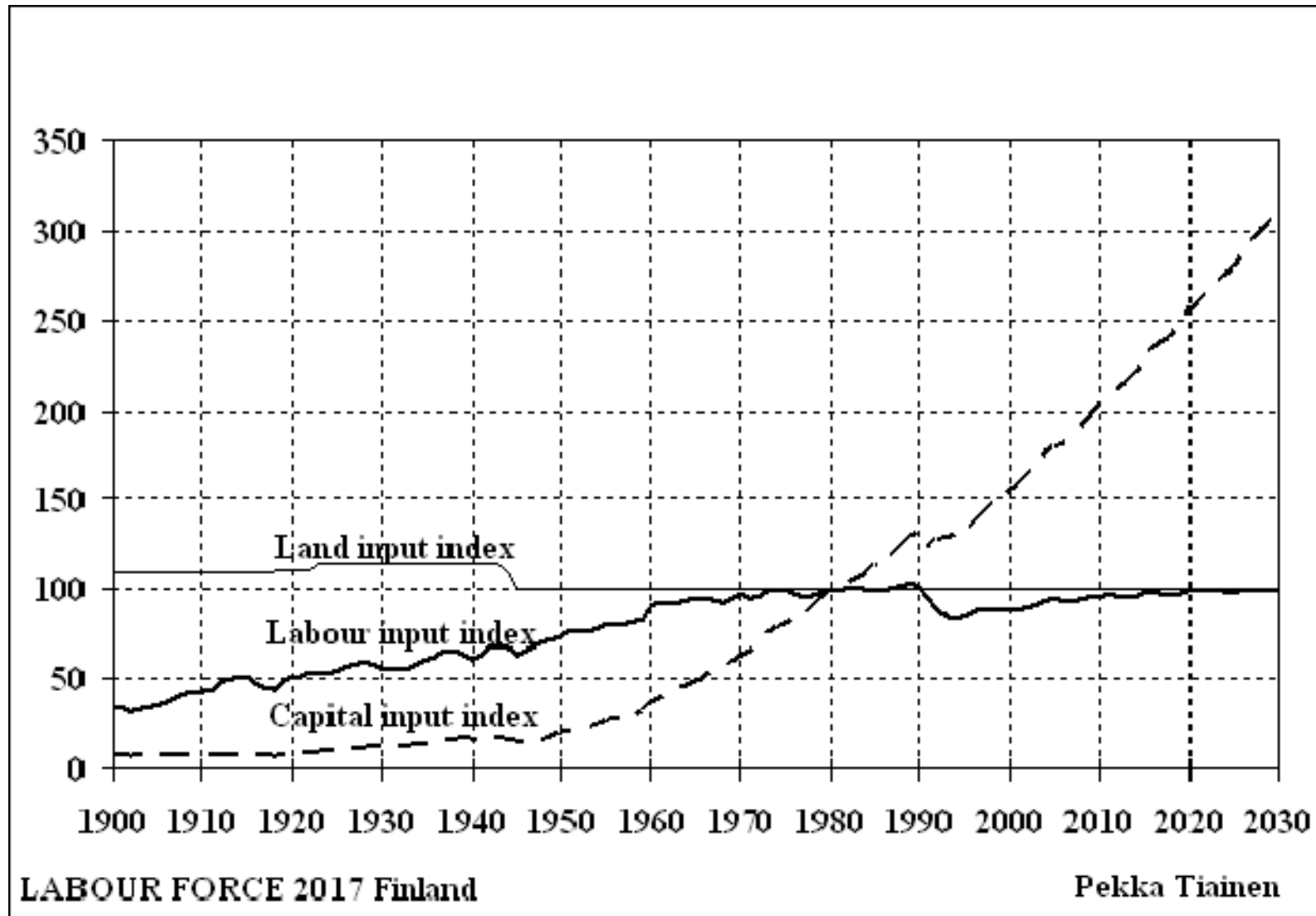


Chart 3. Labour and Total Factor Productivity in Finland in 1860-2030, yearly changes,%

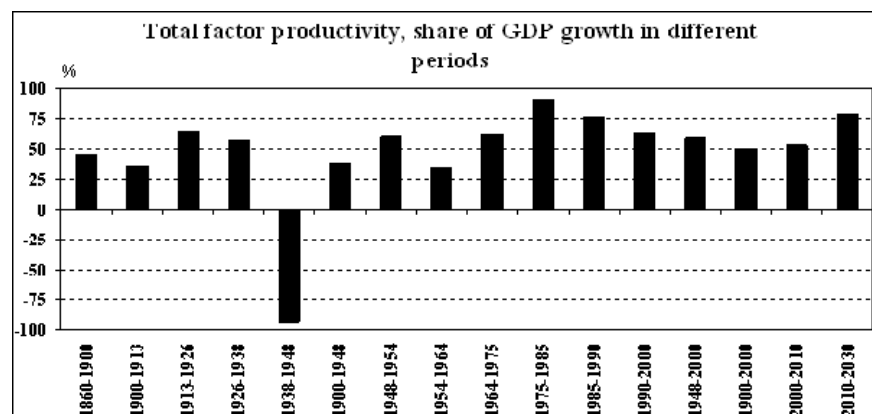
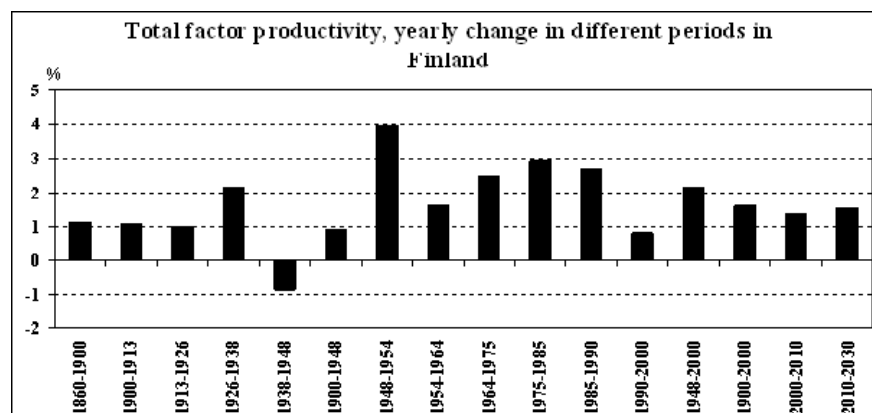
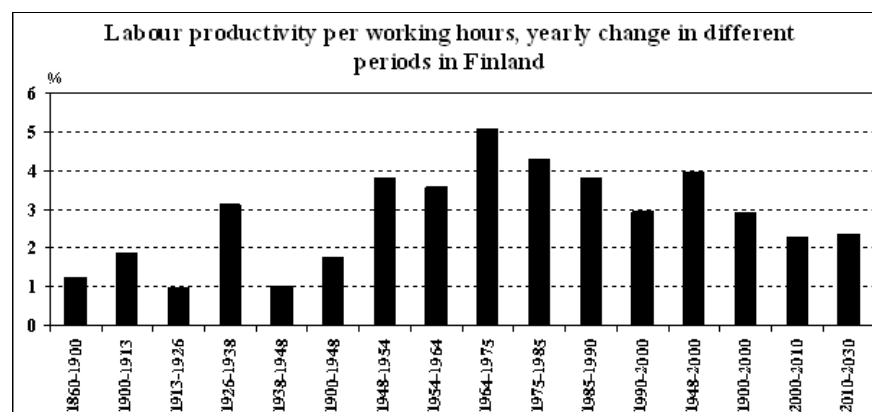
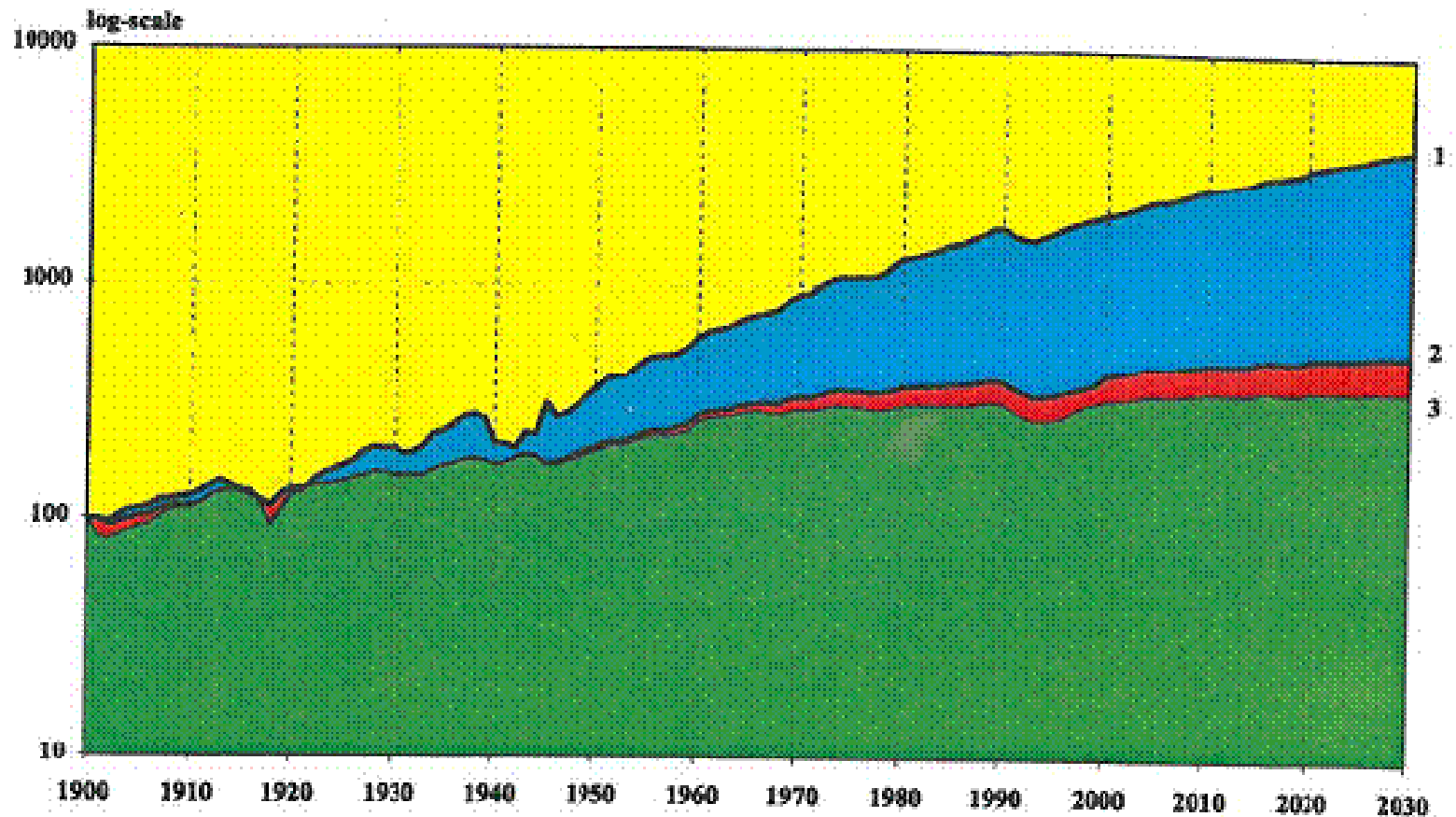


Chart 4. Growth contribution of production factors weighted by shares of net domestic production in basic values, as indices, 1900 = 100



1 Net GDP at production cost prices as an index 2 Total factor input incl. labour, capital and land 1-2 Total factor productivity, incl. terms of trade impact
3 Total factor input excl. efficiency and quality factors in labour input

4. Conclusions and next steps

Here we have presented index based growth accounting projections methodology including measurement of total factor productivity and inputs. We have presented also the methodology in anticipation of middle and long term labour force and employment developments and future skill needs analysis used in European Skills network and in long term labour force projections (LTM Model). We have presented how to build bridge from this kind of analysis to growth accounting calculations in using them in analysis of future sources of growth.