

Forecasting Demand for Labour and Skills with an AGE-model in Finland

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Abstract

Coping with the effects of an ageing population is among the foremost policy challenges in most industrialised countries. It has important fiscal implications, as increasing age-related expenditure needs to be met with taxes collected from a stagnant or diminishing working-age population. It may also have major implications for the labour markets and the educational system. The present study aims at identifying the medium- and long term implications of ageing for labour demand and the demand for skills in Finland.

The study uses VATTAGE, a dynamic, applied general equilibrium model of the Finnish economy, to forecast structural changes in the Finnish economy up to the year 2025. The study is the first of its kind for a European country and is intended to provide the basis for the anticipation of medium term policy challenges by several ministries.

We base our forecast on a historical simulation of the development of the Finnish economy from the mid-1990s on. This gives us information on trends in industry-level technology parameters and commodity-level demand parameters that we utilize in our forecasting. We also link our forecast closely to commonly used Europe-wide long term forecasting exercises, notably, the work done by the EU Ageing Working Group.

On the basis of our analysis, we can identify some key challenges for the labour markets and the educational system. Our main findings are that the ageing of the Finnish population will entail a marked increase in the GDP share of health care and social service provision that affects the industry structure of the whole economy. Because of the increased demand for labour in these sectors, productivity growth especially in the service industries proves crucial for the overall development of the economy. The development of manufacturing industries is likely to be affected by labour shortages, but it is also affected by climate policies, which tend to accelerate structural change in the economy.

Introduction

Well-functioning labour markets and availability of skilled employees are important factors of economic performance. Therefore it is not surprising, that scenarios for future development of labour demand and skill capacity of the workforce have so often attracted a following of policy makers. For example, in Finland national foresight processes have evolved considerably over the last two decades and the foresight work has focused mainly on the future development of labour markets and educational system. The basic formula has been simple: the predicted future development of labour demand has set targets for the planning of education.

Central administration has been an active promoter of novel foresight practices that have also been mobilised in practice. The latest reform of the foresight system took place in 2009. The main contribution of the reformation was the introduction of the Finnish CGE-model for forecasting future labour demand. Hitherto, forecasts for labour demand had been conducted in growth accounting framework. The results of the first CGE-model simulations as well as the procedures and presuppositions of the forecasting process are presented in this paper. Previously, similar kind of studies has been implemented in Australia. (e.g. Meagher 1997, Meagher et. al 2000).

The forecasting process builds on a detailed analysis of Finnish economic history. History is analysed both qualitatively and quantitatively. The quantitative analysis is based on a historical simulation of the observed development of the Finnish economy from the mid-1990s on. This simulation provides information on trends in industry-level technology parameters and commodity-level demand parameters that are utilized in actual forecasting simulations. The qualitative historical analysis examines basic structures of Finnish economy from mid-70s on and provides an overview of economic dynamics peculiar to Finnish economy. The gathered information can be utilized in evaluation of the results of trend simulations and exogenous presumptions.

One of the major future challenges for Finnish economy is the fast growing share of aged population. In addition to the fiscal implications arising from the increase of age-related government expenditure and the decreasing amount of tax collected from a diminishing working-age population, changes in population structure may also have considerable implications for the labour markets and hence the educational system. Although the aim of this study is to examine the development of Finnish economic structure as a whole, specific attention is directed towards the medium- and long term implications of ageing.

The paper is organized as follows. Section 2 gives an outline of the VATTAGE model and shows the principles on using the model to study historical developments with an AGE model. The third section reports the results of the historical analysis. The fourth section outlines the macroeconomic assumptions of the forecasting simulations and presents the industry results for value added and employment for main industry aggregates. Fifth section concludes.

An outline of the VATTAGE model

The forecast of labour demand of Finnish economy has been conducted with VATTAGE model¹. VATTAGE is a dynamic, applied general equilibrium (AGE) model of the Finnish economy. VATTAGE is based on the dynamic model developed at the Centre of Policy Studies in Monash University. MONASH-type models are used in countries ranging from China and South Africa to the United States (Dixon and Rimmer, 2002) In Europe, models based on MONASH have been developed for Denmark, Finland, and the Netherlands.

The model is based on an extensive database that describes the transactions between different agents in the economy. In the core of the model are optimization problems of the agents that result in the demand and supply functions of goods and primary factors. The transactions covered by the database and the model are illustrated in Figure 2.1.

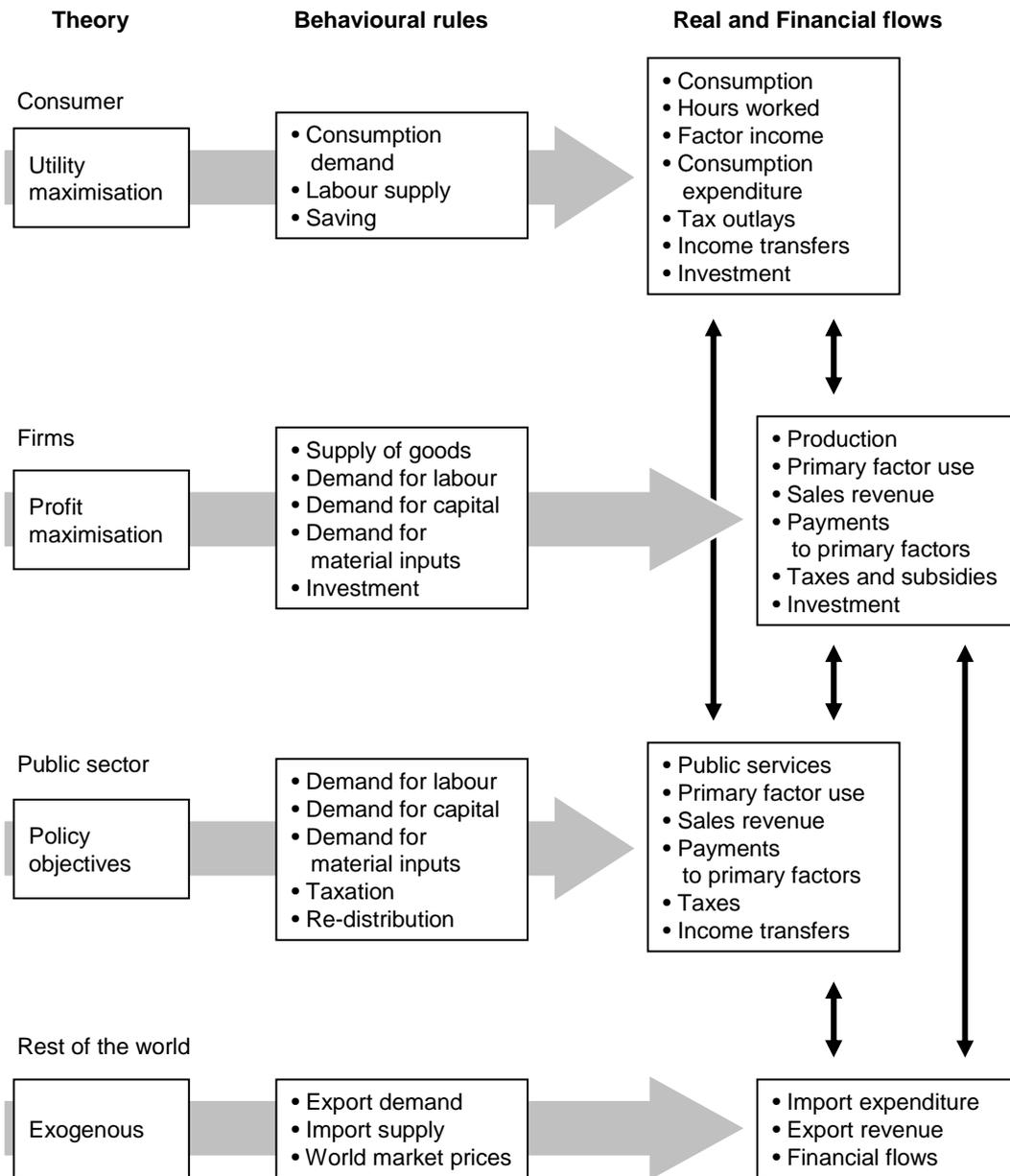
The VATTAGE database collects information about the structure of the Finnish economy derived from the national accounts, arranged in a presentation reflecting the theoretical structure of the model. The database also contains the behavioural parameters that are used to operationalise the behavioural assumptions made in the model. A large part of the database consists of input-output data that captures the structure of demand for intermediate goods and primary factors by industries, the final good consumption by consumers, the public sector, and the rest of the world. However, input-output data does not contain data on income flows, which must be obtained from other sources in national accounts.

A large part of the transactions in the economy take place between the institutional sectors of the economy. In the database, transactions take place both between domestic sectors, and between domestic and foreign sectors. The domestic sectors are divided into three domestic subcategories whereas the foreign sectors represent foreign countries and multinational and international organisations. These institutional sectors are mutually exclusive and their role in the economy can thus be unequivocally presented. For example, export demand is final demand for domestic goods and services by the foreign sectors.

VATTAGE models production with conventional, nested production functions. The idea behind industrial classification is to group activities whose production processes or the products they make are similar. However, VATTAGE also allows for multi-production of commodities. The VATTAGE database uses the national industrial classification TOL 2002, basing on NACE 2002 and ISIC Rev. 3.1, to classify industries, and the CPA-classification to group products. The detailed data on commodities allows us to study the production of goods almost at a process level.

¹ For detailed description of VATTAGE model see Honkatukia 2009.

Figure 1. The structure of an Applied General Equilibrium model



VATTAGE is a dynamic model that allows the economy to adjust over time to changes in the economic environment or in policies. The most important determinant of this adjustment process is the accumulation of physical capital via investment or disinvestment, and the accumulation of financial assets over time. However, sluggish wage adjustment can also be specified, and there may be an element of sluggishness in policy responses to changes in employment.

In each year of year-to-year simulations, we assume that industries' capital growth rates (and thus investment levels) are determined according to functions which specify that investors are willing to supply increased funds to a certain industry in response to increases in its expected rate of return. However, investors are cautious. In any year, the capital supply functions in VATTAGE limit the growth in the capital stock of industry so that disturbances on its rate of return are eliminated only gradually. Hence, The VATTAGE treatment of capital and investment in year-to-year simulations can be compared with that in models recognizing costs of adjustment (see, for example, Bovenberg and Goulder 1991).

Financial assets – liabilities and deficits – provide another inter-temporal link in VATTAGE. The model recognises current account deficits, with the related foreign liabilities, and public sector deficits, which in turn are related to government debt.

VATTAGE allows for different treatments of the labour markets. The labour market equations relate population and population of working age, and define unemployment rates in terms of demand and supply of labour. In dynamic simulations, labour supply is typically taken as exogenous, while wages adjust only gradually and unemployment is determined endogenously. In a dynamic setting, it is not unreasonable to assume that there is an element of sluggishness in real wage adjustment. In Finland, this was very much the case until very recently, when wage setting has become more decentralised. The basic set-up of VATTAGE captures the idea that wage setting may be centralised.

An integral part of dynamic applications of VATTAGE is the baseline, or forecast, scenario of the economy. The baseline forms the reference, to which the effects of changes in policies are compared. In most applications, the baseline is formed on the basis of medium term forecasts and long run scenarios of the development of the macroeconomy that stem from outside of the model. The baseline uses forecasts for industry-specific historical trends in productivity, taste changes and the like that stem from the process of updating the model's database. This latter process in effect ensures that the model traces the development of the economy during the past few years. However, in constructing the baseline, it is also possible to introduce industry-specific expert forecasts for particular industries, a feature that has often been used for the large export industries, for the energy sector, and for the sectors producing public services.

In dynamic mode, VATTAGE contains hundreds of thousands of equations. It is not practical to solve directly equations systems of this size. The problem is made manageable in two ways: by omitting arrays of exogenous variables that are not shocked and by substituting out arrays of endogenous variables that are not of interest. The arrays that are targeted for these treatments typically have large numbers of components.

The concept of closure is central to simulations performed with GEMPACK. By closure we mean the specification of variables as exogenous and endogenous. The need for a closure specification arises from several reasons. First, VATTAGE does not contain explicit equations for all of its variables. For example, shifts in technology or tastes are typically treated as exogenous. Secondly, closure changes provide a practical way of modifying the model to suit to specific applications.

VATTAGE recognises four types of closures:

- decomposition closure,
- historical closure,
- forecasting closure and
- policy closure.

In a decomposition closure, all naturally exogenous variables are included in the exogenous set, that is variables not normally explained in a AGE model. These may be observable variables, such as tax rates, or unobservables, such as technology and preference variables.

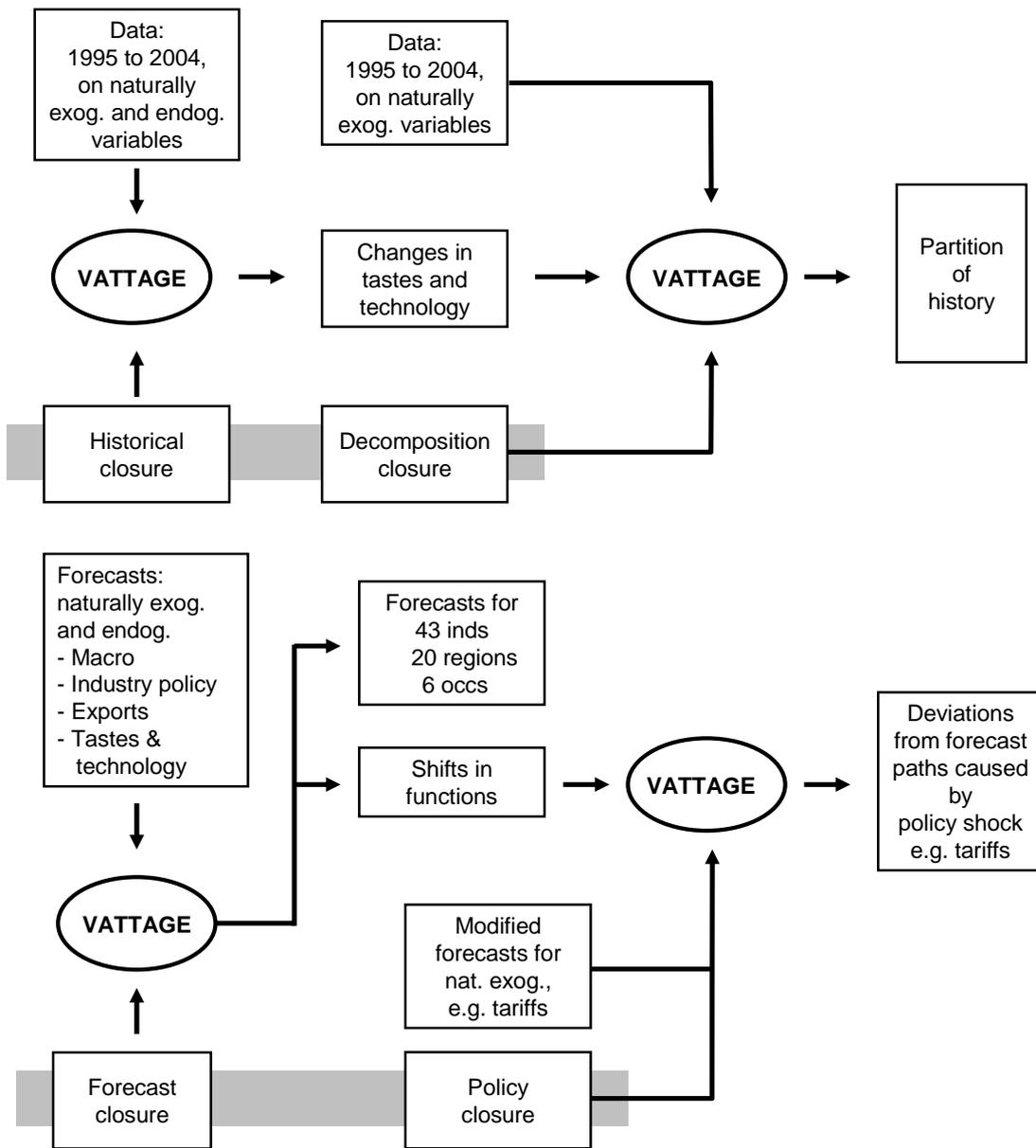
Historical closures include in their exogenous set two types of variables: observables and assignables. Observables are those for which movements can be readily observed from statistical sources for the period of interest. Historical closures vary between applications depending on data availability but typically include a wide array of macro and industry variables, as well as intermediate input flows between industries.

Forecasting closures are close in philosophy to historical closures. Instead of exogenising everything that is known about the past, in forecasting closures we exogenise everything that we think we know about the future. Thus in forecasts, we exogenise numerous naturally endogenous variables, including, for example, export volumes (where outside forecasts or scenarios are available), and most macro variables (where medium and long term forecasts prepared by ministries or the EU can be used). To allow these variables to be exogenous, a number of naturally exogenous variables need to be endogenised, for example the positions of foreign demand curves, the positions of domestic export supply curves, and many macro coefficients such as the average propensity to consume.

Policy closures are similar to the decomposition closures. In policy closures naturally endogenous variables, such as exports and macro variables, are endogenous, since they must be allowed to respond to the policy change under consideration. Correspondingly, in policy closures naturally exogenous variables, such as the positions of foreign demand curves, the positions of domestic export supply curves and macroeconomic coefficients, are exogenous, and are set at the values that they have in the forecasts.

The relationship between forecasting and policy simulations is similar to that between historical and decomposition simulations. Historical simulations provide values for exogenous variables in corresponding decomposition simulations. Similarly, forecasting simulations provide values for exogenous variables in corresponding policy simulations. However there is one key difference between the relationships. An historical simulation and the corresponding decomposition simulation produce the same solution. This is because all the exogenous variables in the decomposition simulation have the values they had (either endogenously or exogenously) in the historical solution. In a policy simulation, most, but not all, of the exogenous variables have the values they had in the associated forecast solution. The policy variables of interest are set at values that are different from those they had in the forecasts. Thus policy simulations generate deviations from forecasts. The relationship between the forecast and policy simulations is illustrated in Figure 3.4.

Figure 2. *Historical and Decomposition Simulations*



Results from the historical analysis

This section presents the main results of the historical analysis behind the forecasting simulation. The analysis is divided in two parts. The first part gives a qualitative outlook of historical development of Finnish economy by analysing changes in the structures of demand and supply at aggregate level and structures of production and employment at industry level. The second part introduces results of historical simulation where the observed changes in the Finnish economy are explained with the help of the model.

Historical development of Finnish economy

The analysis of historical development of basic structures of the economy is vital for forecasting process. The old wisdom holds true, that is, to know your future you must know your past. The following review of recent economic history is based on an analysis of Finnish national accounts that also provide the basis for the database of VATTAGE model. Thus, the analysis sheds some light on database which is a substantial part of the model.

The overall evolution of the economy can be studied from two points of view, namely, supply and demand sides. Total supply consists of GDP and imports of goods and services. Total demand, on the other hand, is covered by private and public demand for goods and services, investment demand, stocks, and exports.

Finland is an exceptionally open economy and thus the share of exports and imports are large compared to most other OECD countries. As illustrated in figure 2, in 2008, 70 per cent of total supply stemmed from domestic production, with imports making up the remaining 30 per cent. The share of imports in total supply has been steadily rising, reflecting increased openness both in final consumption and an increased dependency on imported intermediate goods in the production of domestic goods. This trend towards more openness is in no way unique to Finland, of course, and has been observed in all developed economies (Das 2008). Nevertheless, it shows that an increasing share of total demand is directed abroad.

Changes in total demand mirror the changes in total supply. Increased openness shows as an increasing share of exports, which reached a peak of 33 per cent of total demand in 2008, whereas the share of investment has fallen. The share of public consumption has changed little, but the share of private consumption fell from the mid-1990s on. The growth of the share of exports petered out in the early part of the 2000's, however, and the share of consumption started to rise. These changes tend to point to the globalization of production even in the Finnish case; and indeed, the large trade and current account surpluses from the mid-1990s on show that the country was not only benefitting from increased openness, but has also been investing heavily abroad during the period. At the same time, the dependence of Finnish economy on the global markets has clearly increased. Thus, while increased exports were a key factor in Finland's recovery from the deep recession of the early 1990s (Kiander 2001), the resulting structure has also made national economy vulnerable to the down-turn in the global economy that occurred from 2008 on.

Figure 3. The structure of total supply in Finnish economy between 1975 and 2008.

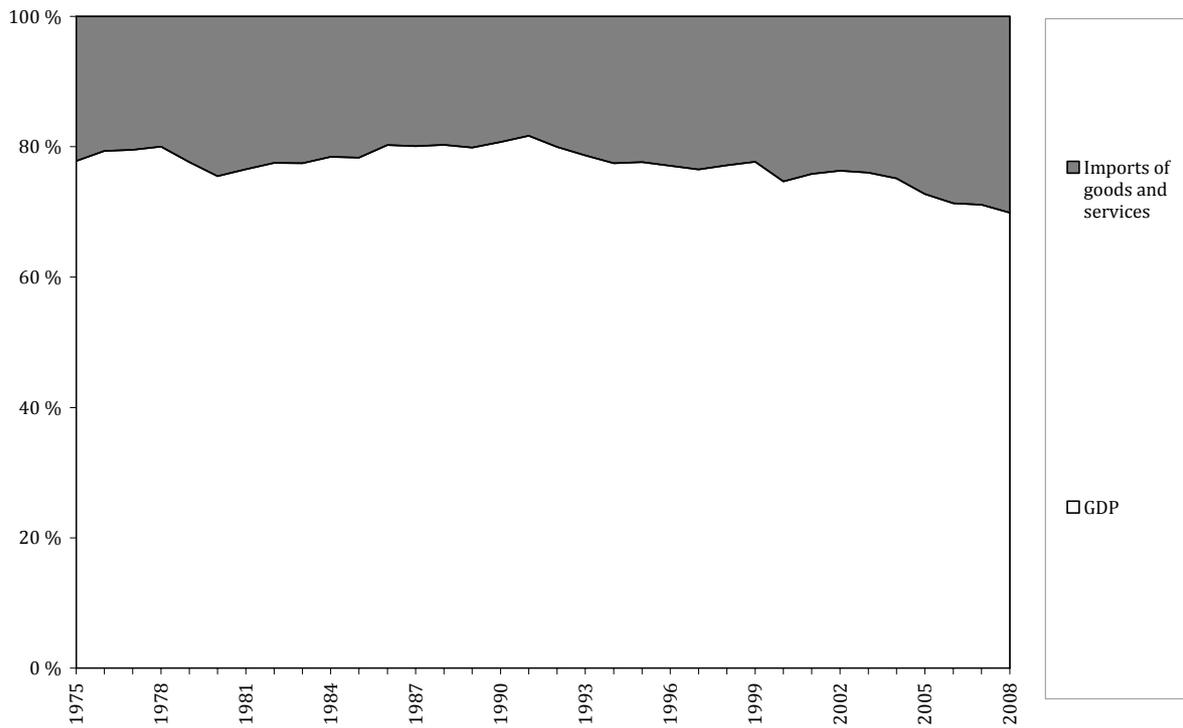
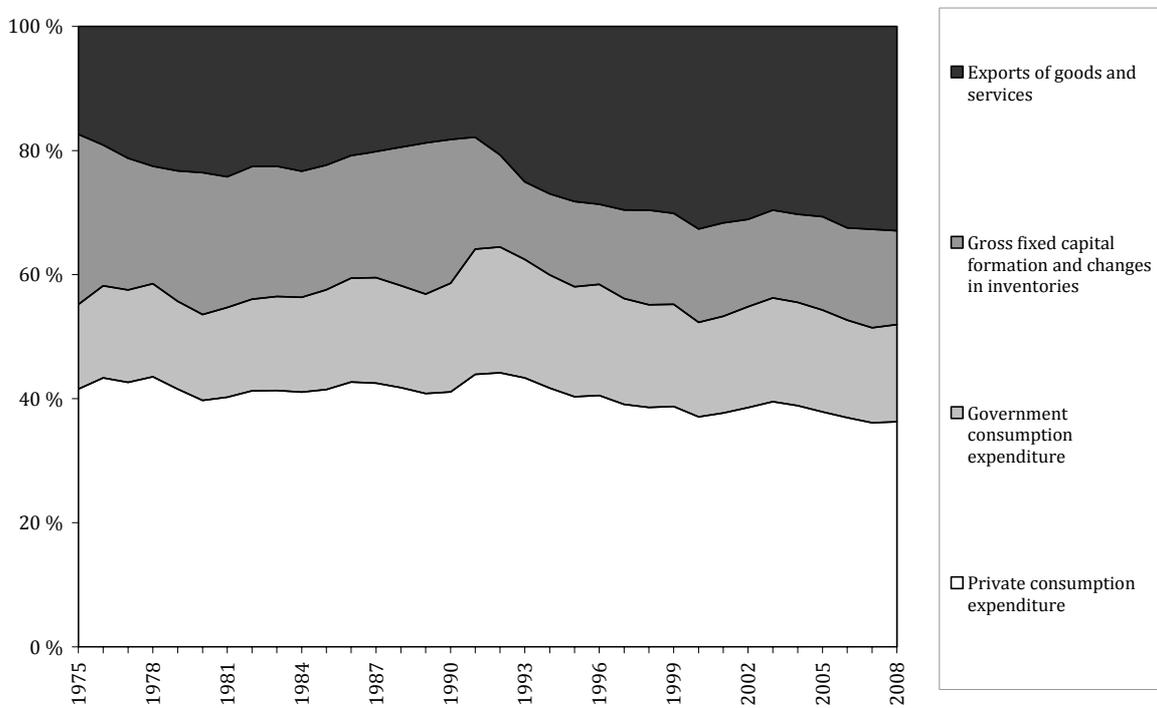


Figure 4. The structure of total demand in Finnish economy between 1975 and 2008.



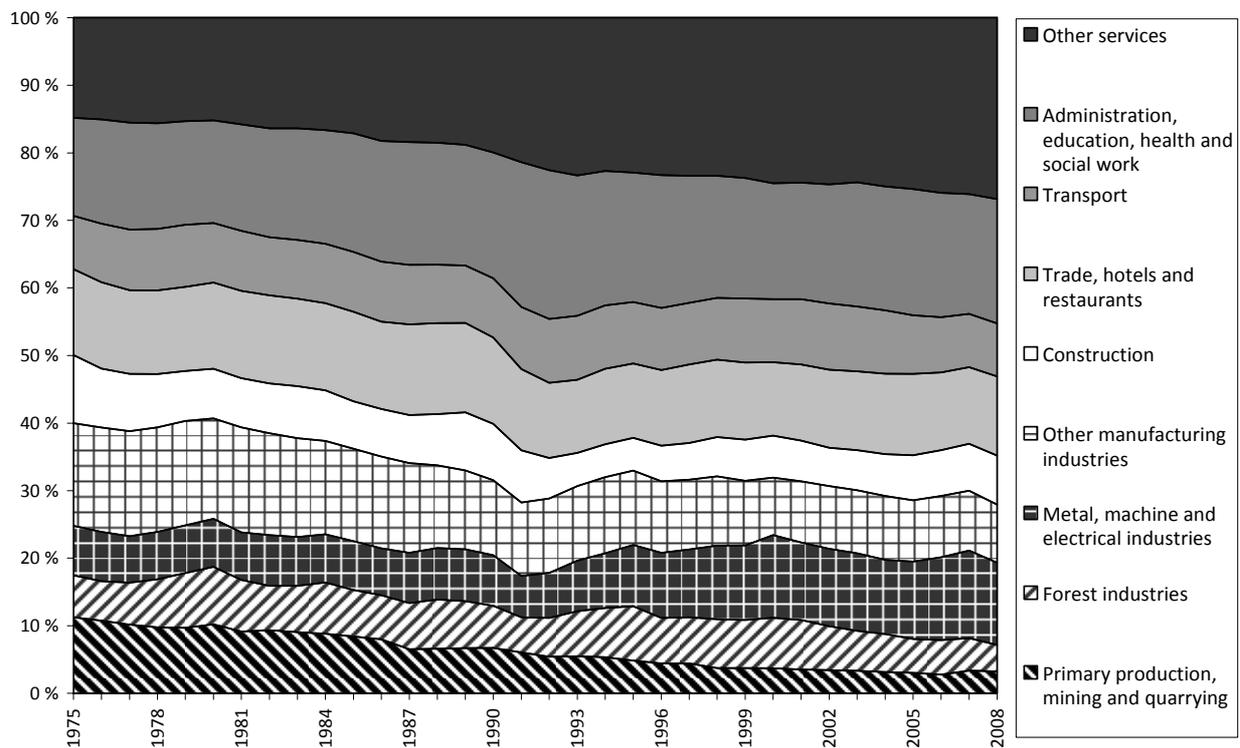
The historical development of Finnish economy has differed significantly between different industries. Hence, the production structure of Finnish economy has changed considerably

during the last decades. Basic trend has been a movement from primary production and manufacturing to services. Figure X presents the development of the Finnish production structure measured by nominal value added between 1975 and 2008.

From 1975 to 2008 the share of service sector in total value added has grown from 50 per cent to 65 per cent. At the same time the share of manufacturing industries has declined from 39 to 32 per cent and the share of primary production and mining from 11 to 3 per cent. Although the basic trend has been rather straightforward there has still been some noticeable deviations from it. The global recession in early 1990's turned to a debt driven depression in Finland causing major economic and social turbulences. The unemployment rate rocketed and numerous firms went bankrupt. The depression affected particularly on the manufacturing sector where global and domestic demand was sliced simultaneously.

During the depression the share of public services rose considerably although extensive counter-cyclical economic policies were not utilised. However, the large welfare system constructed after the Second World War and especially in the 1960's and 1970's acted as an automatic stabilizer. The public demand was kept on a stable level and deficits were financed by government debt. After the depression the share of public services in total value added has declined constantly.

Figure 5. The production structure of Finnish economy between 1975 and 2008



As the struggle of the manufacturing sector was one of the main reasons behind the deep depression also the upturn of Finnish economy relied heavily on manufacturing industries. This development shows also in the production structure. The devaluation of the Finnish currency and the recovery of international demand boosted export dependent industries already from 1992 onwards. Especially the forest industry, metal industry and electrical

industry benefited from these circumstances and gained highly desired price competitiveness against international competitors.

The favorable development of the Finnish export sector continued through the 1990's. The main reason for the continuous success was the ICT revolution and the progress of Finnish electrical industry. The "Nokia phenomenon" in the mid-90's provided unparalleled productivity gains for the electrical industry and the international competitiveness of vital export sector endured and even improved. As a result the share of metal, machine and electrical industries rose to 12 per cent of total value added from the average of 7 per cent of previous decades.

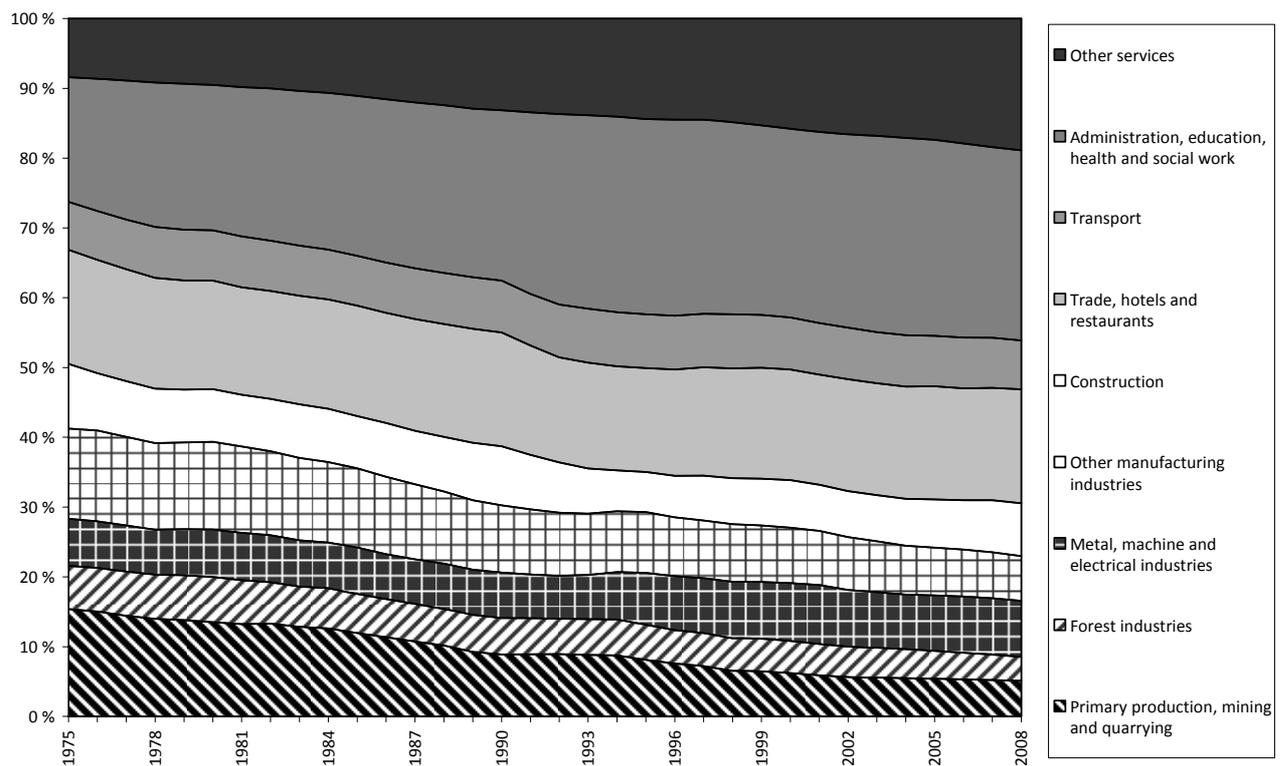
During the first years of the 21st century the days of an enormously fast growth pace of electrical industry were suddenly brought to an end. After the burst of global dot com bubble and the consequential recession the productivity growth of the sector has been only moderate. However, as can be seen from figure X the share of metal, machine and electrical industries has continued to expand after the recession. This expansion has emerged mostly due to favorable development of metal and machine industries after 2005. Global demand for the investment goods was extremely high in the years preceding the global financial crisis and Finnish metal and machine industries got their fair share of the investment demand boom.

Production shares of historically important forest industry and other manufacturing industries have depreciated during the period under review and especially after the depression of early 90's. For Finnish forest industry last five years have been seriously troubled and a considerable part of production capacity has been wound down. Therefore, the future of the Finnish forest industry appears rather gloomy. Also the share of construction industry in the production structure has declined after the depression which has much to do with the diminished investment rate of Finnish economy.

Within the service sector the growth has been fastest at public services and other services whereas the growth of trade and transportation industries has been somewhat sluggish specifically after the depression. Other services include financial intermediation, business activities and real estate activities that all are essential industries of the rising service economy. The rapid growth of the sector is a strong implication of a structural change and a transition of Finnish economy towards more service-intensive production structure.

As expected, the employment shares of different industries have developed mostly in the same direction as production shares. Figure X. presents employment shares of Finnish economy between 1975 and 2008. A comparison between production and employment structures brings forth some peculiarities that should be discussed further. The employment shares of primary production and public services are notably higher than production shares of these industries. Thus, the productivity of labour seems to be considerably low within public activities, agriculture, forestry and extractive industry.

Figure 6. The employment shares of different industries between 1975 and 2008



In the future especially the productivity development of health and social work will be pivotal for the Finnish economy. The rapid growth of elderly population in the coming decades will promote demand for health and social sector services leading to a fast growth of these industries. With near zero or even negative productivity growth the demand for employees at health and social sector will expand significantly. Furthermore, the rising share of elderly population will affect negatively on the size of labour force opening possibilities for labour shortages at the industry level.

The foresight of Finnish production and employment structure are presented in the following section which provides one possible scenario for the future development of Finnish economy. The next part of this section presents the results of the historical simulation. These results are utilized on the actual foresight simulation.

The historical simulation for the years 1995 to 2004

In historical simulation, the observed changes in the economy are explained with the help of the model. The observed changes can then be decomposed into effects stemming from different sources (Harrison, Horridge and Pearson 2002). These sources are here divided into sets:

- Momentum; effects stemming from wealth and assets
- Foreign demand and import prices; changes in world markets and prices
- Domestic prices; effects stemming from domestic price level

- Indirect taxes; changes in indirect taxation
- Technical change; changes in output mix, and in intermediate and primary factor productivity
- Household tastes; changes in domestic consumption patterns
- Import / domestic preferences; changes towards domestic or imported commodities
- Employment growth; changes due to increased use of labour inputs
- Rates of return; here, shifts in taxes affecting the rate of return
- Macro variables; shifts in investment to capital ratio and the average propensity to save

The second set in the above list describes changes in international trading conditions. Finland is a small open country and it has to adapt to e.g. changes in international business cycles, inflation and relative prices in the rest of the world. Variables related to these changes are included in second column. Because imports and exports are interrelated, those are analysed simultaneously.

The third set includes the effects of the overall domestic price level. This set is included mostly to distinguish between foreign market and domestic effects.

The fourth set includes variables related to changes in net indirect taxes. Indirect taxes consist of three types of taxes; product taxes, product subsidies and value added taxes. Also tariffs are included. This column is important for analysing indirect effect of taxes in total economy.

The fifth set describes technical changes in the Finnish economy. To be exact, it consist variables describing industry specific commodity input demand in current productivity and capital formation, industry specific primary factor productivity, technical changes in effecting capital/labour ratio and shifts in export technology.

The sixth set includes taste changes basing on used consumption variables from household utility function (see Honkatukia, 2009; Honkatukia, et al. 2009). In the historical simulation, price and volume changes combined with estimated parameter values from household behaviour are used to calculate shifts in household tastes towards specific commodities. The decomposition simulation includes tastes as endogenous.

The shifts between import and domestic preferences are included in seventh set. Imports are divided in two sources; imports from EU members and imports from non-EU countries different Domestic preferences and technical change in current productivity, primary factor productivity by industry.

The eighth set isolates variables related to employment and population growth over the simulation period.

The decomposition of rates of return is presented in the ninth set. It includes exogenous variables affecting the rates of return, here, mainly changes in production subsidies.

The last set includes a miscellaneous group of variables affecting the economy at the macroeconomic level. For example, it contains aggregate shifts in the investment capital ratio, aggregate shifts in government demand, and shifts between public and private consumption..

Finally, the first set shows momentum effects. It explains what would have happened to Finnish economy if there had not been any changes in the exogenous variables. Primarily, it includes the effects of returns to financial assets, which would have affected the economy regardless of other changes.

The decade from 1995 on was a turbulent one for the Finnish economy. The country was recovering from the worst recession in decades, and the structure of the economy underwent major structural changes. This resulted in one of the fastest sustained growth periods in Finnish history.

Table 1 illustrates changes that took place in the Finnish economy between 1995 and 2004. The first column in the table gives the total change in each of the macroeconomic variables during the decade. As can be seen, imports and exports increased rapidly during the period. Total exports grew by 82.6 per cent from year 1995 to 2004, or at an average 6.9 per cent annually. Imports increased by 74 per cent, or at an annual trend of 6.3 per cent. The rapid growth in exports pulled the domestic economy to healthy growth rates as well. Household consumption grew by 31.8 per cent, or at annual rate of 3.2 per cent, whereas investment grew at a whopping annual rate of 5.3 per cent, and closer to 60 per cent overall. Employment also grew rapidly, especially in the latter part of the 1990's.

The consequent columns give the decomposition of the underlying factors for each of the variables. From the table, it can be seen that GDP grew by 37.3 per cent from 1995 to 2004. The largest contribution to this change stemmed from employment, which alone would have explained a 15.7 per cent increase in GDP. Technological change – mainly primary factor productivity growth – explains an 8.3 per cent GDP growth. Trade and domestic prices together explain more than 10 per cent's worth of GDP growth.

Household demand grew by 31.8 per cent. Again, employment is the largest factor behind this growth. Investment contributed to a growth in GDP by almost 60 per cent. Here, there are several explaining factors. Trade and prices together explain half of investment growth, and employment half of the remainder. Technology contributed negatively, however, which is due mainly to a tendency towards more labour intensive production in many industries. Macroeconomic variables played a major role in investment. Chief among them was an overall rise in investment capital ratio in the economy. Public consumption grew by close to 16 per cent. Since it is closely related to employment and population growth, these explain two thirds of public consumption growth.

The rapid growth of the Finnish economy coincided with an expansion of the world economy and world trade. Arguably, trade facilitated the marked productivity improvements in many industries, which was reflected in falling prices in many of Finland's export products. This is reflected in the very rapid export growth from 1995 to 2004.. Technological change and increased employment contributed largely to this, as did rapid

growth in the world market demand for most exports. At the same time, imports of intermediate goods also increased rapidly, benefiting from falling prices elsewhere. There was a trade-favouring shift also in household demand, which shows up both in exports and in the rapid growth of imports.

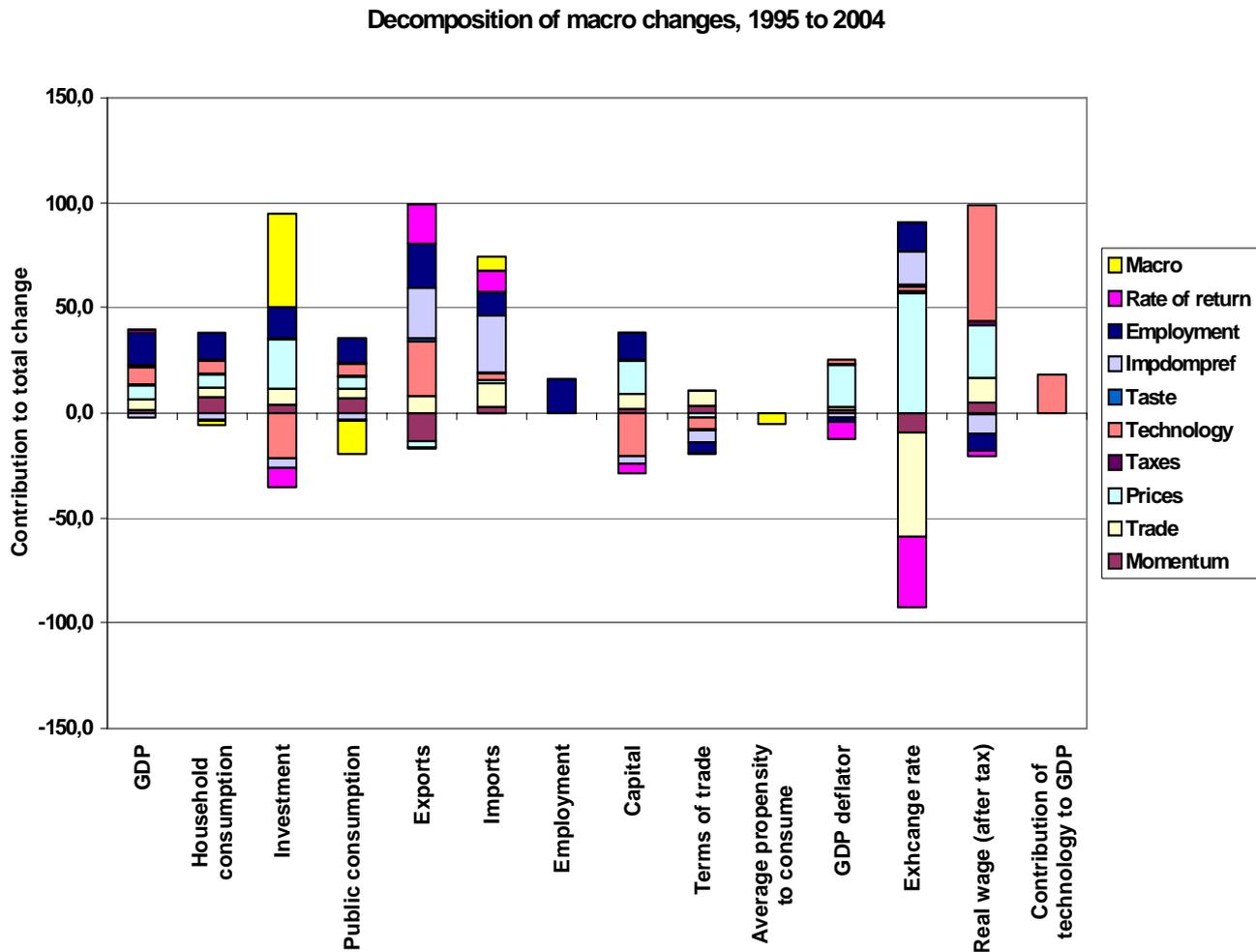
An interesting change that occurred in the decade starting in 1995 was also the deterioration of the terms of trade, which can be attributed partly to technology, partly to changes in the trade patterns. At the same time, real wages increased, also due mainly to technology – rapid productivity growth. Technology contributed directly close to a quarter to GDP growth, while the contribution of employment explains about 40 per cent of GDP growth. However, technology also contributed indirectly, via changes in product and input mixes, and when these changes are accounted for, the actual contribution of technological change to GDP was 18 per cent. That is, half of GDP growth can be explained by productivity growth alone, with employment, and to a lesser extent, trade, accounting for most of the rest.

Table 1. Decomposition of changes in macro variables, 1995 to 2004

	Total	Momentum	Trade	Prices	Taxes	Technology	Taste	Impdompr	Employme	Rate of ret	Macro
GDP	37,3	1,5	4,6	6,6	0,6	8,3	1,0	-2,3	15,2	1,4	0,3
Household consumption	31,8	7,4	4,6	5,9	0,6	6,0	0,9	-3,4	12,4	-0,5	-2,1
Investment	59,2	3,9	7,8	23,2	0,0	-21,5	0,5	-4,5	15,0	-9,4	44,2
Public consumption	15,8	6,9	4,5	5,6	0,6	5,3	0,8	-3,2	11,6	-0,5	-15,9
Exports	82,6	-13,6	8,0	-3,2	0,0	26,1	1,2	24,4	20,6	19,0	0,3
Imports	74,0	2,7	11,3	1,8	-0,4	2,9	0,4	27,1	11,2	10,4	6,6
Employment	16,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	16,2	0,0	0,0
Capital	9,3	2,0	6,8	15,8	0,2	-20,6	0,7	-3,4	12,5	-4,7	0,1
Terms of trade	-9,2	3,3	7,2	-2,4	0,0	-5,6	-0,3	-5,7	-4,8	-0,9	0,0
Average propensity to consume	-5,2	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-5,2
GDP deflator	13,1	1,3	1,4	19,9	0,5	2,5	-0,1	-2,4	-2,0	-7,9	0,0
Exhcange rate	-2,1	-9,4	-49,5	57,0	0,9	2,1	0,8	16,1	13,6	-33,8	0,1
Real wage (after tax)	78,0	5,1	11,2	25,2	2,0	55,0	-0,4	-9,5	-8,1	-2,5	0,0
Contribution of technology to GDP	18,1	0,0	0,0	0,0	0,0	18,1	0,0	0,0	0,0	0,0	0,0

The decomposition can also be applied to the individual elements of GDP. Figure 4.1. shows the changes in the key macroeconomic variables. The largest changes occurred in exports, imports and investment. The sources for the changes varied remarkably, however. Export growth can be explained by changes in technology and changes in the structure of domestic and export demand, with employment and high rates of return also contributing significantly. Investment growth, on the other hand, can be explained by the improving macroeconomic situation over the period than by trade, for example. Interestingly, during the period under review technological change favoured employment over capital in the rapidly growing industries, which shows up as a negative contribution of technology to investment. The figure also shows that domestic purchasing power benefitted from technological change and also from a favourable price development, and grew almost as rapidly as exports.

Figure 7. The decomposition of the macroeconomic changes,



The decomposition analysis is actually applied at the level of commodities and industries. This analysis provides us some of the most important starting points for the scenario work, namely, trends in productivity growth and export demands. The trends for export demands are illustrated in figure 8, and they show that the overall growth of industrial exports to the EU was very rapid with the exception of some of the forest industry products as well as transport equipment). Exports to other countries have grown less rapidly, which may also partly be explained by the changing membership of the EU.

There were large differences between industries. Growth was fastest in the manufacturing of machinery and equipment, and markedly slower for the traditional export industries (forest industries, manufacturing of metals). The growth of service exports was also very rapid for some of the industries. Overall, exports were still dominated by industrial goods, which accounted for 60 per cent of all exports in 2004.

After 2004, the pace of export growth has petered out significantly. In our subsequent analysis, we have utilised available export data for 2004-2008 and forecasts for 2009 to take this effect into account. It seems clear that the share of exports in total demand will not

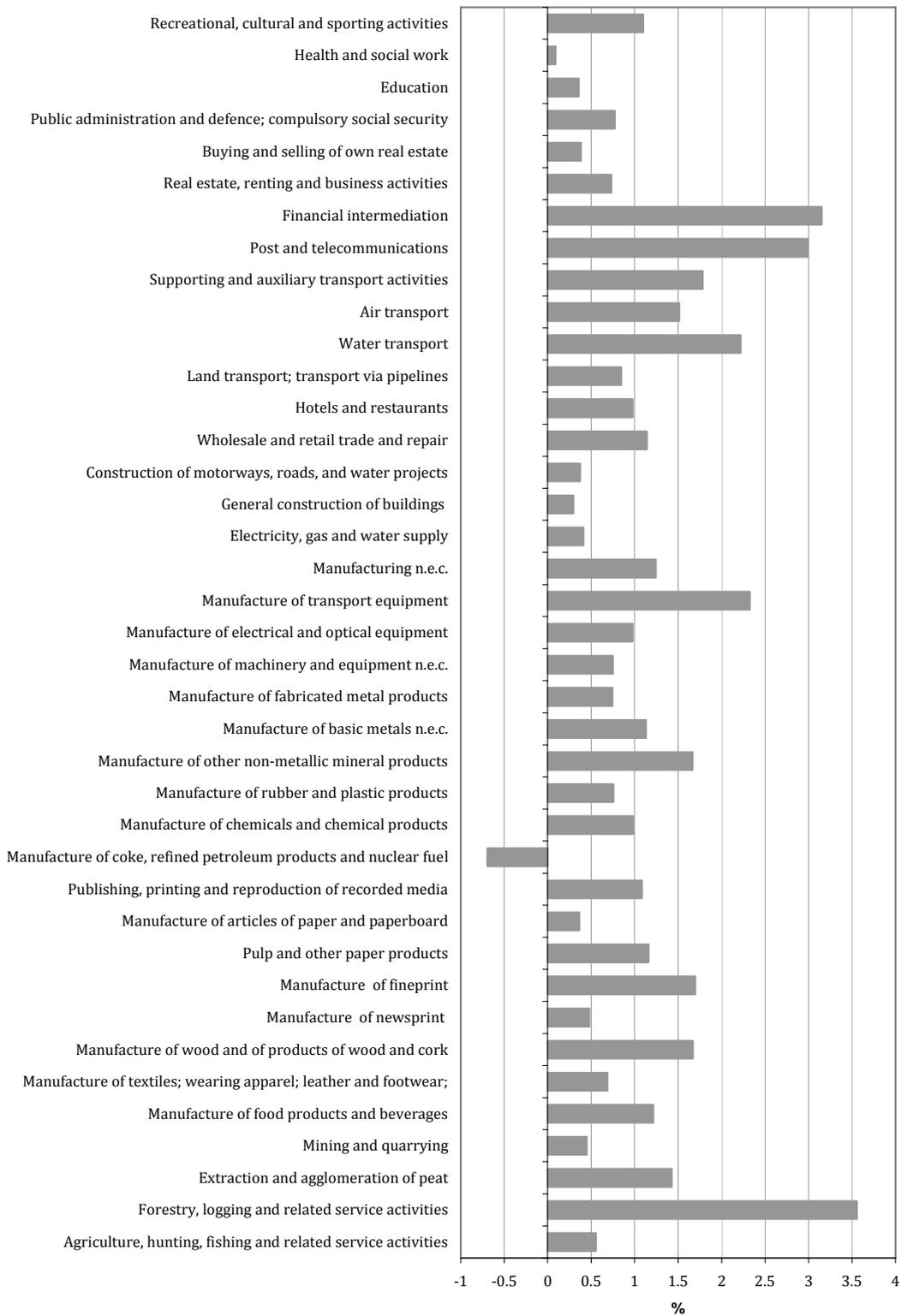
reach the levels of ten or five years ago, but this is due not only to anticipated slower growth of global demand, but also to structural, supply side trends.

The second set of results stemming from industry level historical analysis we utilise concerns productivity growth and changes in labour/capital ratios. Productivity growth appears as the central driver of growth at the industry level. Figure 9 shows productivity trends for key industries in the years 1995 to 2004. As explained earlier, total technological change encompasses changes in product and input mixes as well as factor productivity. This is illustrated by one industry in particular, namely, the manufacturing of electrical equipment and communications goods. While factor productivity rose very rapidly in that industry, its use of intermediate goods also increased at a phenomenal rate; thus, the contribution of technological change was not as high as would appear by studying factor productivity alone. In other words, productivity calculated from total output is smaller than productivity calculated from value added alone. The manufacturing of metals provides another interesting example, where total technological change is negatively changes in output mix, with factor productivity grew remarkably well.

Figure 8. Growth of export demand by industry between 1995 and 2004



Kuvio 9 Growth of total factor productivity by industry between 1995 and 2004



The baseline scenario for 2005-2025

This section reports the main findings of the industry level scenarios. Our strategy for developing the scenario relies on macroeconomic forecasts, which are used for the early years of the scenario, and population and age-related expenditure forecasts, which are used for the whole scenario. The development of the structure of the economy is determined by the forecast trends for productivity and export demands, as well forecasts for public demands stemming from our historical analysis, from statistics for the period 2005-2008, and from OECD (2009) and IEA (2009) forecasts for global market prices. Use has also been made of available Finnish industry-level forecasts especially in the case of key export industries (ETLA). These do not generally extend to the whole scenario period, but have been applied to catch anticipated effects in industry-level exports and employment especially for the years 2009 to 2013.

The main macroeconomic assumptions in our scenario are shared with the medium term forecast of the Ministry of Finance and the EU Ageing Working Group study on the effects of ageing on the economy, the latter also providing a benchmark for potential GDP growth in the long run (European Commission 2009). In the AWG scenario, population growth is at the core of the estimate for GDP growth as well as estimates on long-term age-related expenditures.

The AWG assumptions on population growth are summarized in figure 10, showing a very rapid change in Finnish population structure from the early 2010s on, as well as an impending decline in the working age population and overall employment.

Figure 10. The annual of growth rate of population, aged population, labour force and employment between 2005 and 2025

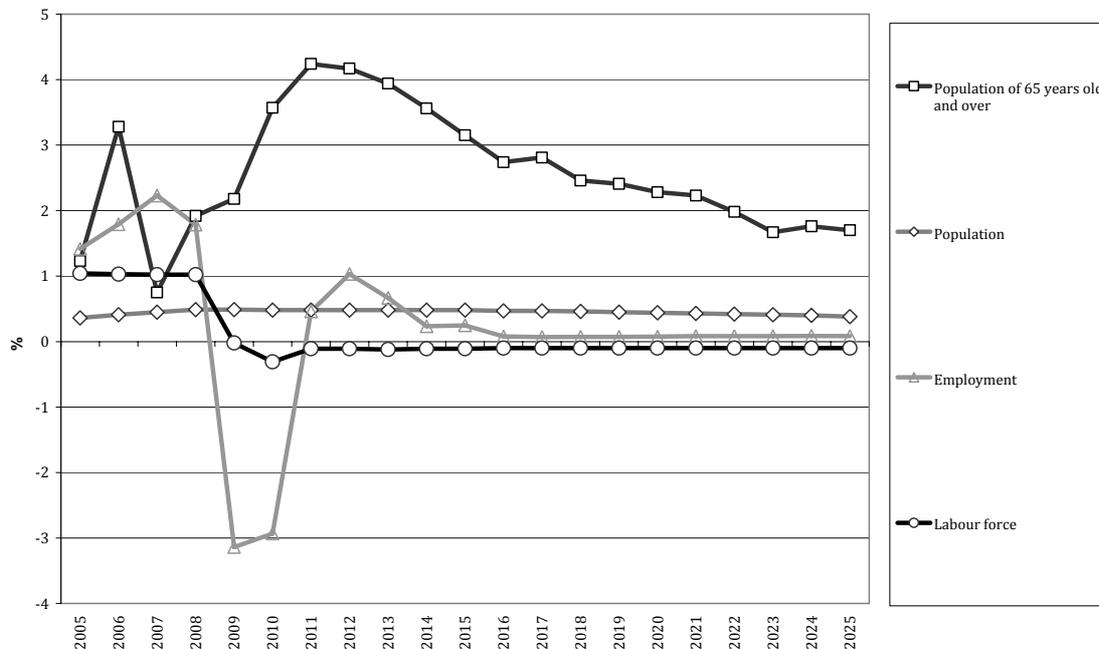
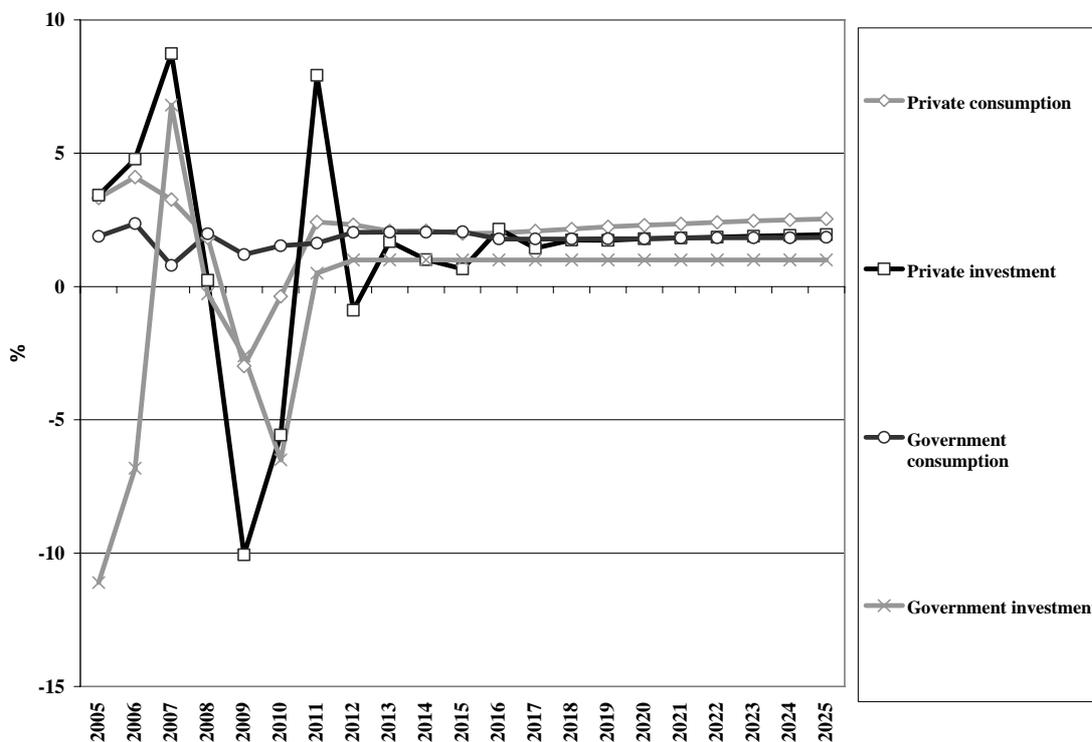


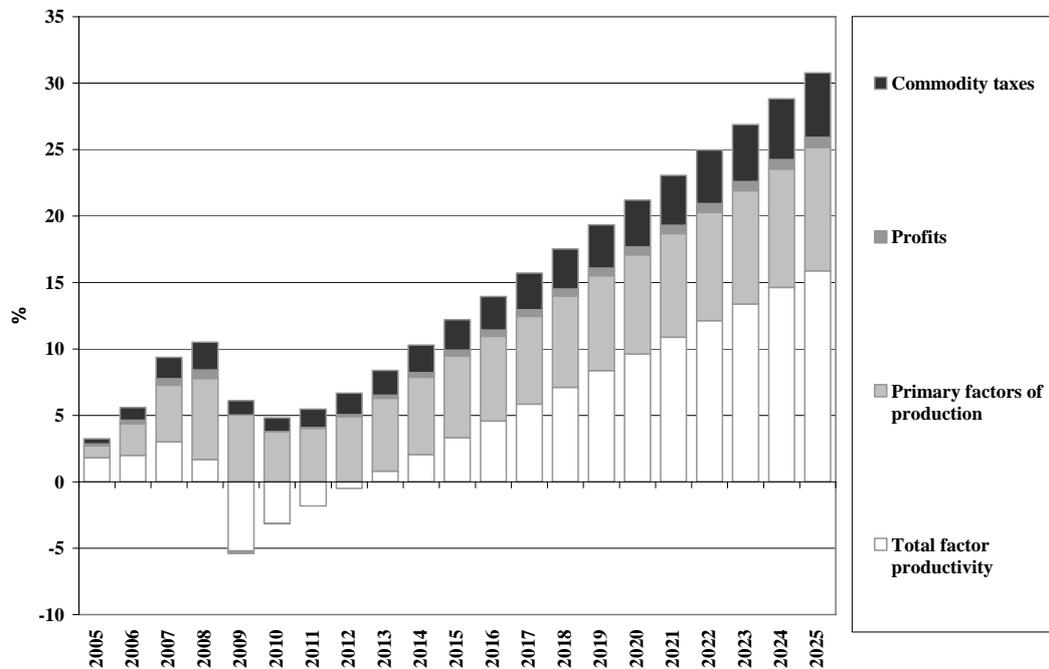
Figure 11 illustrates the medium term assumptions for the key demand components of the economy until 2015. According to the scenario, the economy starts recovering from the recession in 2010 and 2011, and by 2015, employment has returned to the pre-recession growth path. Thereafter, the figure actually reports the VATTAGE results for the economy and shows that GDP growth settles at 1.7 to 1.8 per cent per annum. This is very nearly the AWG estimate for potential GDP growth. As with the AWG scenarios, with aggregate employment starting to deteriorate during the latter half of the decade, growth can only stem from capital deepening and productivity growth.

Figure 11. The foresight of domestic demand development between 2005 and 2025



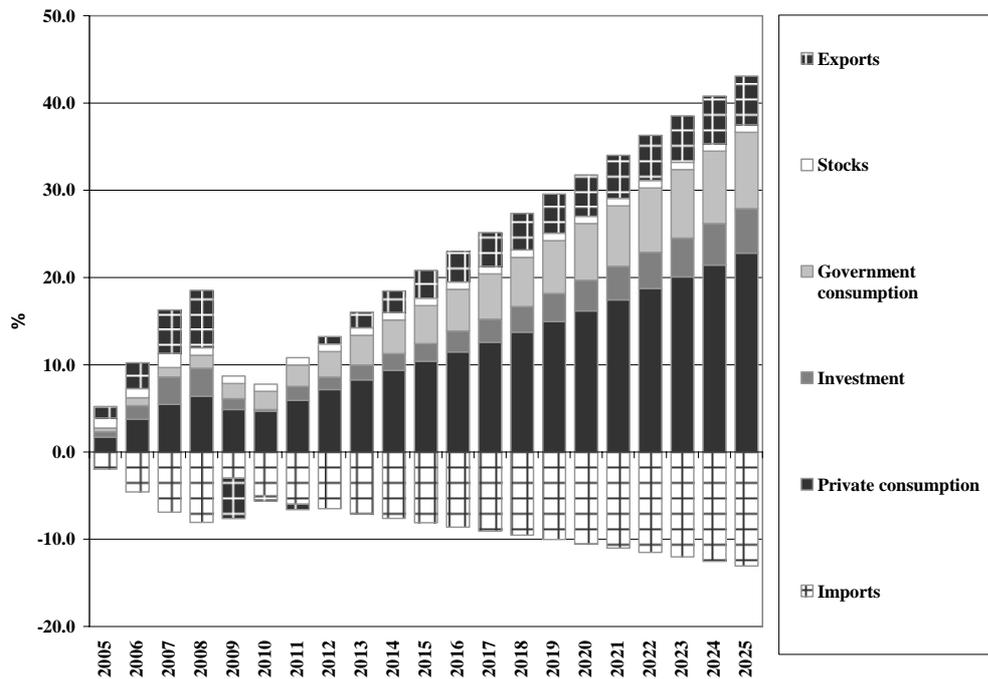
The decomposition of GDP growth of the baseline scenario can be produced from both supply and demand side. The supply side decomposition is presented in figure 12. As expected the productivity growth explains the major part of the future GDP growth of Finnish economy. As the growth of primary factors has been the engine of economic growth in the past the shrinking labour force enforces the economy to adjust for a new growth regime. The recovery from the recession following global financial crisis is build on the outstandingly fast productivity growth. The average annual productivity growth rate from 2010 to 2025 is over 1.2 per cent whereas the growth rate of primary factors is only 0.3 per cent.

Figure 12. Contributions to GDP growth: Cumulative development of supply factors between 2005 and 2025



The demand side decomposition presented in figure 13 shows that major changes is about happen between 2005 and 2025 also in the demand side of the economy. As the export demand was the main component of GDP growth in the years preceding the global financial crisis, the recovery from the crisis will be built on the growth of domestic demand. Both private and government consumption are contributing heavily to the GDP growth. In addition to moderate export demand growth also the investment demand growth is sluggish after the crisis. Along the forecast results the trade balance of the Finnish economy will turn negative before 2020 as imports grow faster than exports. This development will have negative implications for GDP growth also.

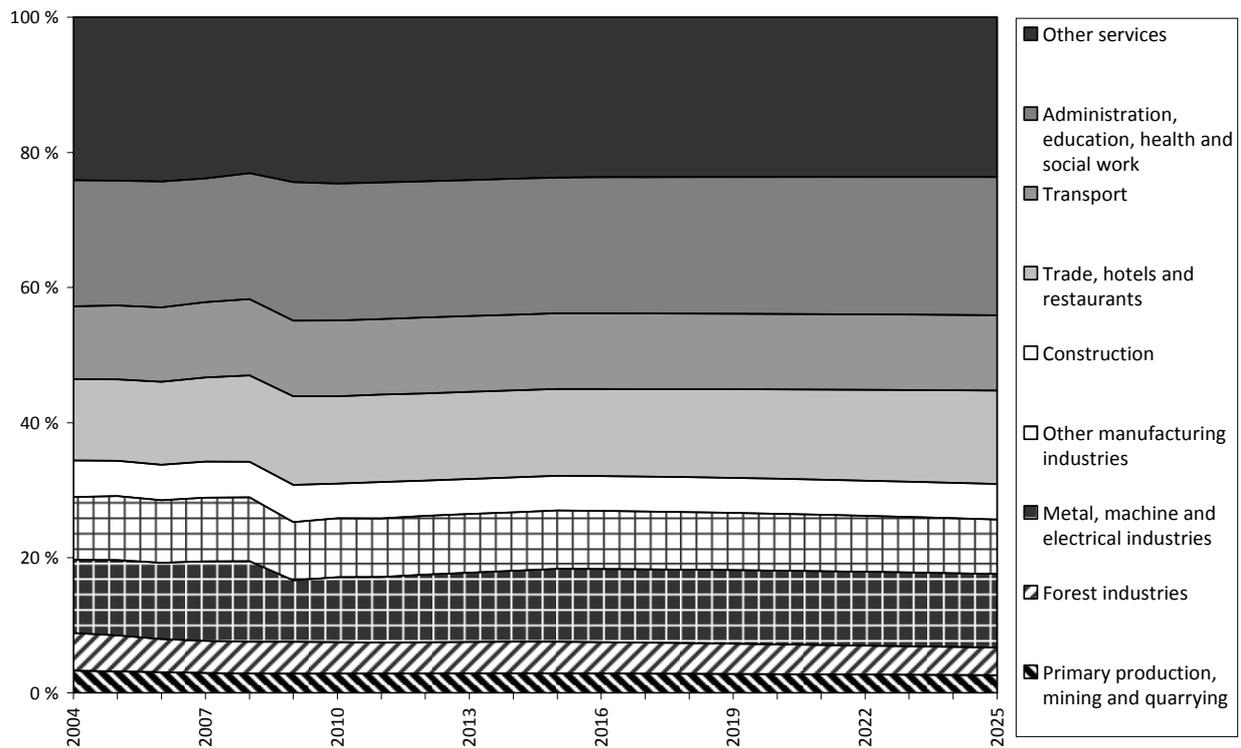
Figure 13. Contributions to GDP growth: Cumulative development of demand factors between 2005 and 2025



Forecasting results concerning the production structure are presented in figure 14. Results cover a time span between 2004 and 2025, the base year for VATTAGE model being 2004. Results indicate that the production structure measured by nominal value added alters only little during the period under review. However, the global financial crisis produces a similar kind of shock for the production structure than did the depression of early 90's. Thus, the share of manufacturing industries diminishes considerably between 2008 and 2009 while the service sector as a whole increases its share. In the years following the crisis especially the growth of metal, machine and electrical industries is fairly rapid but the production share prior the crisis is not achieved.

The main reason for the sluggish growth of manufacturing industries is the dying export demand. While in the late 90's and during the first years on new millennium the export demand was the engine of growth of Finnish economy is the situation totally different after 2015. That is, the growth rate of domestic demand tops the growth rate of export demand. The majority of the growing domestic demand is directed to public services and particularly to the health care and social services as the growth rate of education and administration lag behind of those industries. Also the growth of other services lags behind the growth of health and social work.

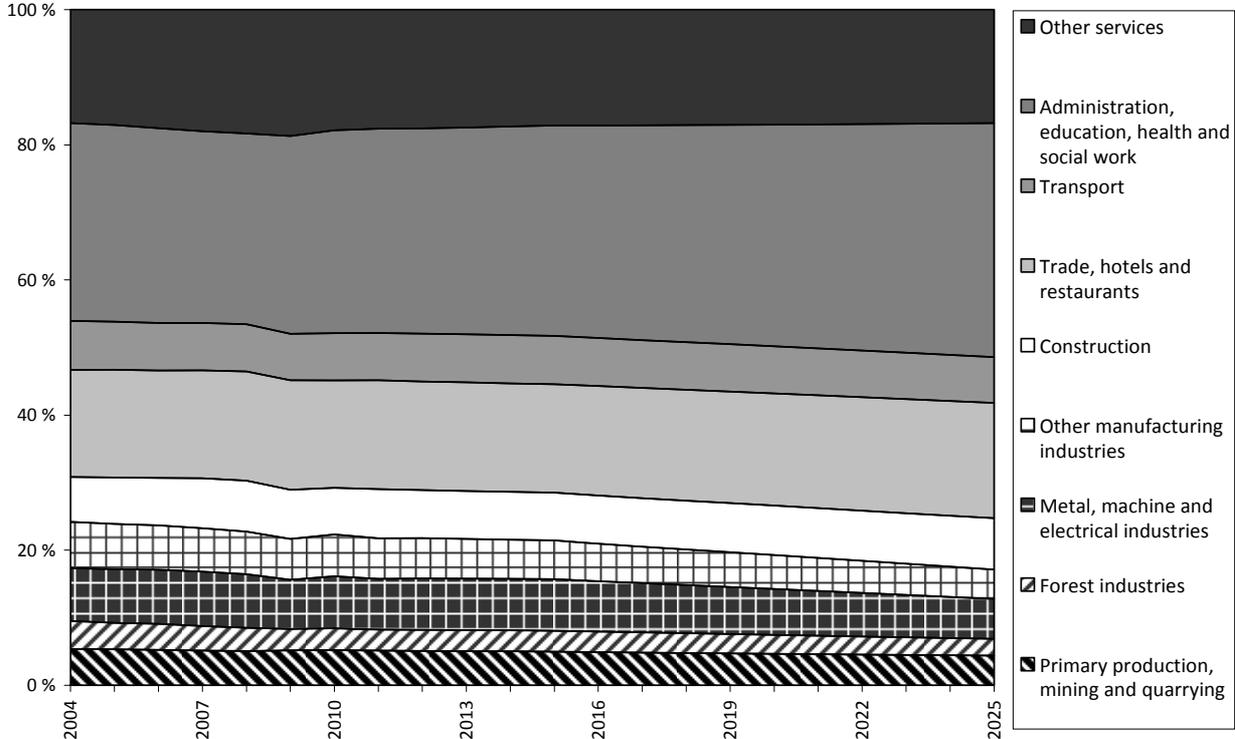
Figure 14. The foresight of production structure of Finnish economy between 2004 and 2025



Although, changes in the production structure seem rather minor the future development affects greatly on the employment structure. Figure 15 presents the forecasting results concerning the employment shares of different industries. Labour demand growth is notably faster at the public services and especially at health care and social services. The low productivity of these industries leads to a considerable employment increase although the share in value added increases only moderately. Thus, the demand for age related social services and health care stimulates labour demand substantially more than the demand of other services and produced goods.

Labour demand of other services, trade, hotels and restaurants and transport continues to grow faster than labour demand of manufacturing industries and primary production. Employment shares of the latter two continue to decline following the long term trend. The capital deepening and relatively rapid productivity growth is enables these sector to add value almost at the same pace before although employment shares of these industries decline considerably.

Figure 15. The foresight of employment shares of different industries between 2004 and 2025



Conclusions

To be completed

Literature

- Bovenberg A.L. & Goulder L.H. (1991): Introducing Intertemporal and Open Economy Features in Applied General Equilibrium Models, in H. Don, T. van de Klundert & J. van Sinderen (Eds.): Applied General Equilibrium Modeling. Dordrecht: Kluwer Academic Publishers.
- Das D.K. (2008): The evolving global trade architecture. Northampton, MA, US: Edward Elgar Publishing.
- Dixon P. & Rimmer M. (2002): Dynamic General Equilibrium Modelling for Forecasting and Policy. Contributions to Economic Analysis 256, Amsterdam: North-Holland Publishing Company.
- European Commission (2009): The 2009 Ageing Report: economic and budgetary projections for the EU-27 Member States (2008-2060). European Economy 2/2009.
- Honkatukia J. (2009): VATTAGE – A Dynamic, Applied General Equilibrium Model of The Finnish Economy. Research Reports 150, VATT, Helsinki.
- Honkatukia J, Kinnunen, J. & Marttila, K.. (2009): Distributional effects of Finland's climate policy package - Calculations with the new income distribution module of the VATTAGE model. Working Papers 11, VATT: Helsinki.
- IEA (2009): World Energy Outlook 2009. Paris.
- Kiander J. (2001): Lessons of the Depression. Causes and consequences of the Finnish economic crisis of 1990's (In Finnish). VATT-publications 27:6. Helsinki.
- Meagher, G.A. (1997): Changes in the Demand for Labour in Australia, in Changing Labour Markets: Prospects for Productivity Growth. Industry Commission, Melbourne.
- Meagher, G.A., Adams, P.D. and Horridge, J.M. (2000): Applied General Equilibrium Modelling and Labour Market Forecasting. Working Paper IP-76. Centre of Policy Studies, Monash University, Melbourne.
- OECD (2009): Economic Outlook. Preliminary Edition. Volume 2009/2. No. 86, November. Paris.

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