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Valtion taloudellinen tutkimuskeskus
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Abstract

In this report we present a new version of the VATTAGE AGE (Applied General Equilibrium) model, which enables distributional analysis of policy changes. We also report estimation results of LES consumption function for eight socioeconomic groups. We use climate policy as an example for the distributional effects. Our model results show that the planned climate policy measures are not very regressive in their nature. In contrast, they seem to distribute the costs of climate policy rather evenly. An exception to this rule is farmer households, the real consumption of which seems to reduce less than that of other groups.

Key words: redistributive effects, environmental taxes, computable general equilibrium models, econometric model estimation

JEL classification numbers: C51, C68, H23

Tiivistelmä

Tässä raportissa esitellään uusi VATTAGE-mallin versio, joka mahdollistaa politiikkamuutosten tulonjakovaikutusten analyysin. Lisäksi raportoidaan LES-kulutusfunktion estimaatit kahdeksalle sosioekonomiselle ryhmälle. Tulonjakoanalyysin esimerkkinä käytetään ilmastopaketin tulonjakovaikutuksia. Mallitulokset osoittavat, että suunnitellut toimenpiteet eivät olisi luonteeltaan erityisesti alempia tuloluokkia rasittavia, vaan ilmastopaketin kustannukset näyttäisivät vähentävän eri sosioekonomisten ryhmien kulutusmahdollisuuksia sangen tasaisesti. Poikkeuksen muodostavat maatalousyrittäjät, joiden reaaliset kulutusmahdollisuudet näyttäisivät vähenevän muita ryhmiä vähemmän ilmastopolitiikan seurauksena.

Asiasanat: tulonjakovaikutukset, ympäristöverotus, YTP-mallit, ekonometrinen estimointi

JEL-luokittelu: C51, C68, H23

Yhteenveto

Tässä raportissa esitellään VATTAGEn malliversio, joka mahdollistaa politiikkamuutosten tulonjakovaikutusten arvioinnin eri sosioekonomisille kotitaloustyypeille yhdistämällä makrotaloudellinen ja tulonjakoanalyysi samaan mallikehikkoon: mallin sisään luodaan erityyppisiä kotitalouksia sisältävä tulonjakomoduuli. VATT:n TUJA-mikrosimulaatiomalliin sekä muihin suomalaisiin mikrosimulointimalleihin verrattuna tulojen, verotuksen ja tulonsiirtojen kuvaus on VATTAGEssa huomattavasti karkeammalla tasolla. Toisaalta VATTAGEn etuna on, että samaan analyysiin saadaan sisällytettyä politiikan vaikutukset niin yleisen tulotasoon ja tuloeroihin, työllisyyteen kuin kulutukseenkin, mikä yllä mainituilla malleilla ei ole mahdollista, koska ne eivät sisällä taloudellisten toimijoiden reaktioita politiikka- ja hintamuutoksiin. Koska ilmastopolitiikkaan liittyy olennaisesti erilaisten hyödykeverojen käyttö, on niiden huomioon otto tärkeää. Samaten erot kulutustottumuksissa eriyttävät politiikkatoimenpiteiden vaikutukset kotitalouksien kulutukseen. VATTAGE tulonjakomoduuleineen antaa mahdollisuuden tällaiseen analyysiin.

Raportissa esitellään myös LES-kulutusfunktion estimointitulokset eri kotitaloustyypeille. Mallianalyysi toteutetaan estimoiduilla kulutusparametreilla.

Mallin tuottamat tulokset osoittavat, että ilmastopolitiikan vaikutukset ovat sangen samansuuruisia erityyppisille kotitalouksille, tosin maanviljelijäkotitalouksien reaalisten kulutusmahdollisuuksien muutokset muodostavat poikkeuksen tästä säännöstä. Kun kotitalouksia tarkastellaan niiden tulotason mukaisessa järjestyksessä näyttäisi saatujen tuloksien valossa, että ilmastopolitiikka ei olisi ainakaan vahvasti regressiivistä, vaan ilmastopolitiikan kustannukset näyttäisivät jakautuvan sangen tasaisesti. Ilmastopolitiikka muuttaa talouden kaikkia hintasuhteita epäsuorien panos-tuotoskytkentöjen vuoksi, mikä tasaa vaikutuksia eri sosioekonomisten ryhmien kesken.

Ilmastopolitiikan tulonjakoanalyysia voisi tulevaisuudessa laajentaa monin tavoin. Ensinnäkin olisi mahdollista jakaa kotitaloudet esim. tulodesiileihin ja tehdä nykyisen kaltainen tulonjakomoduuli, joka eroaisi lähinnä vain kotitalouksien luokitteluperusteen osalta. Toiseksi VATTAGEn voisi yhdistää olemassa oleviin mikrosimulointimalleihin ja käyttää VATTAGEn työllisyys- ja tulotietoja mikrosimulointimallien lähtötietoina vero- ja etuisuusparametrien muutosten ohella.

Contents

1. Introduction

The European Union has committed to cutting its greenhouse gas emissions by an average of 20 per cent by the year 2020. In addition, there is a commitment to increasing the share of renewable energy within EU to 20 per cent of energy consumption, also by the year 2020. Finally, energy saving is also given a 20 per cent target by 2020. The European Council accepted the Energy and Climate package in December 2008, making the targets binding for all member countries.

The effects of the energy package on Finland have been analysed by Honkatukia and Forsström (2008), who use both engineering models of the energy sector and an AGE model of the economy to evaluate the effects of the full climate and energy package. While their results indicate that the macroeconomic effects of the energy package lie roughly between one and two per cent of GDP by 2020, they also show that energy policies accelerate structural change in the Finnish economy, which also has regional implications. Their study does not cover distributional effects, however.

The current study introduces a new tool for the analysis of distributional effects and applies it to study the distributional effects of the EU energy package in Finland. We find that the distributional effects of the energy package are surprisingly small, contradicting many previous studies on the distributional effects of energy taxes. We argue that this is due to the all-encompassing nature of energy package. The package increases the costs of not only energy, but also of energy-intensive services, distributing the costs of the package more evenly than mere energy taxes might do.

Methodologically, the study contributes to the growing literature on integrated micro- and AGE-simulation models (Buddelmeyer et al., 2009; Thurlow, 2008; Lofgren et al., 2008; Llambí et al, 2009). Typically, AGE-models consider income taxes and income transfers at a more aggregated level than microsimulation models, such as the Finnish TUJA-model (Viitamäki, 2008). However, AGE-models usually contain very detailed data on indirect taxes, such as energy taxes. They also have the advantage of covering behavioural links, as well as the general equilibrium links between consumption and income, employment and investment over time, which the microsimulation models do not include.

The study is organised as follows. The second section gives a brief introduction to the basic VATTAGE model and describes the new module for distributional analysis. The third section reports the estimation of the parameters of used in the analysis of distributional effects. The fourth section gives our main results, and the final section concludes.

2. VATTAGE model

2.1 The basic VATTAGE model

VATTAGE is a dynamic applied/computable general equilibrium model that has been applied above all to tax policy and energy and environmental policy analysis, as well as to elaboration of long term scenarios for the Finnish economy (see e.g. Honkatukia, 2009; Honkatukia et al., 2009).

VATTAGE is a dynamic, applied general equilibrium (AGE) model of the Finnish economy. It can be applied to study the effects of a wide range of economic policies. The VATTAGE database contains detailed information about commodity and income taxes as well as the expenditures and transfers of the public sector and thus covers most policy instruments available to the government.

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 and Finland.

Several factors explain the popularity of MONASH. The main ones are the advanced and user-friendly software packages that facilitate data handling and the set-up for complicated policy simulations that also allow a very detailed post-simulation analysis of the simulation results. MONASH-type models are also very adaptable to the analyses of different types of policies and different time frames. In forward-looking policy analysis, MONASH-type models offer a disciplined way to forecast the baseline development of the economy. Last, but not least, they also allow the user to replicate and explain the historical development of an economy in great detail, which is not the case for most AGE models.

VATTAGE contains many advanced, dynamic features. There are three types of inter-temporal links connecting the consecutive periods in the model: (1) accumulation of fixed capital; (2) accumulation of financial claims; and (3) lagged adjustment mechanisms, notably in the labour markets. Different fiscal rules for the balancing of the public sector budgets can also be specified. The model can be run either in a recursive mode or under forward-looking (rational) expectations.

The dynamics of the model lead to gradual adjustment away from the baseline as due to policies or external shocks to the baseline development of the economy. The speed of this adjustment depends on several parameters: 1) the rates of depreciation of capital at the industry level; 2) the rate of adjustment of returns to capital; and 3) the rate of adjustment of real wages (when sluggish wage adjustment is assumed). These parameters can be derived from national accounts data and econometric studies of, notably, the labour markets. Policies can also affect the rate of adjustment. For example, if it is assumed that the government is willing to run deficits during the adjustment period of the economy to, say, an external shock to raw material prices, the parameter controlling this adjustment process will affect the speed at which the economy converges to a new equilibrium growth path.

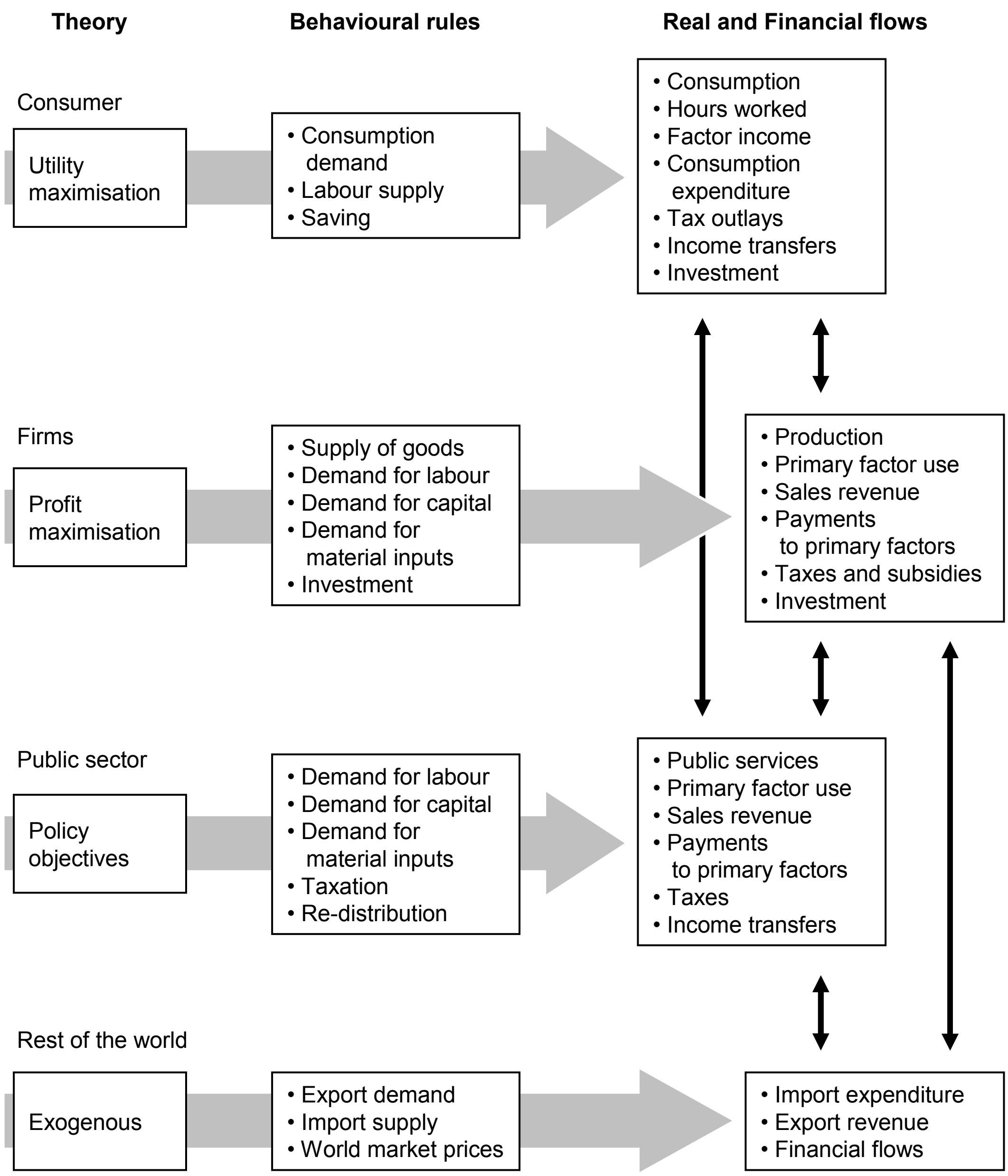
This chapter gives a general outline of VATTAGE. The chapter is divided into three sections. In section 2.2, we describe the VATTAGE database. Section 2.3 gives an overview of the AGE theory behind demand, government finances and labour demand. Section 2.4 is devoted to the dynamic mechanisms of VATTAGE. Section 2.4.1 explains the theory of investment over time, section 2.4.2 asset dynamics, section 2.4.3 deals with the (optional) sluggish wage mechanism, and section 2.4.4 shows how and budgetary rules can be introduced in the model. Section 2.5 then contains a description of the new module for the analysis of distributional effects. Section 2.6 deals with assumptions on population growth and ageing.

2.2 The VATTAGE database

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. National accounts collect data on the use goods and services by industry and by product, but it also contains accounts for production as well as financial positions by institutional sector. (Eurostat 1997, 1.) The institutional sectors are viewed as independent decision-makers (Tilastokeskus 2000, 11.), and it is the behaviour of these decision-makers that the model parameters and coefficients derived from the data describe and control.

Figure 2.1. The structure of an Applied General Equilibrium model



A large part of the database uses input-output data to capture the structure of demand for intermediate goods and primary factors by industry, final good consumption by the 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.

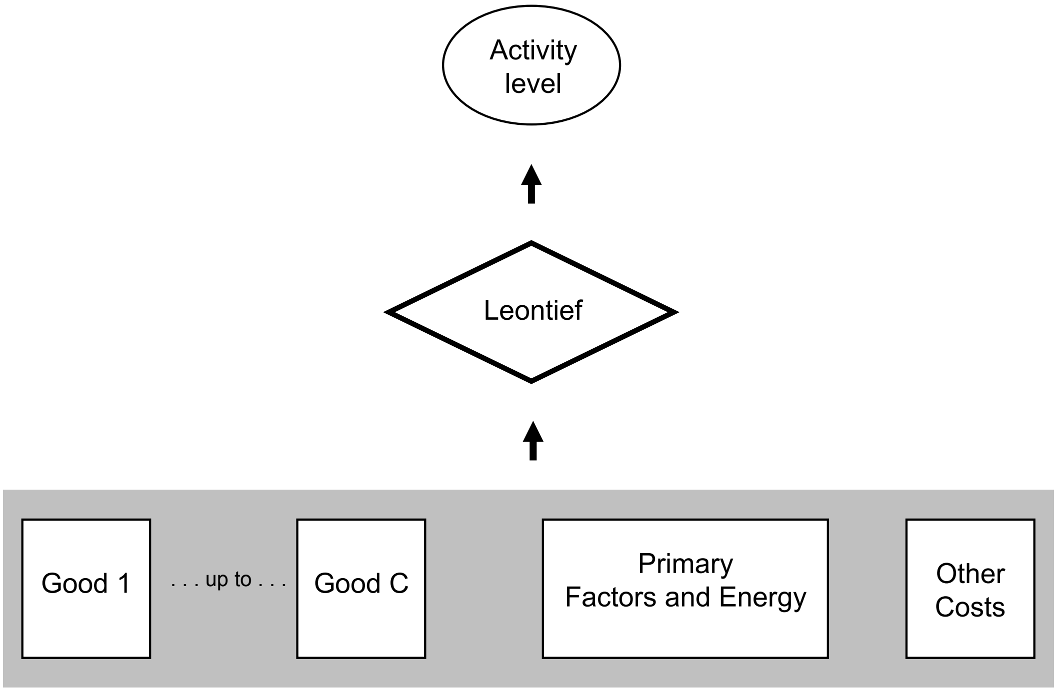
VATTAGE models production with conventional, nested production functions. The idea behind industrial classification is to group activities whose production processes or the products they make are similar. However, VATTAGE also allows for multi-production of commodities. The VATTAGE database uses the 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.

2.3 An overview of the AGE theory of VATTAGE

2.3.1 Demand for intermediate goods and primary factors

VATTAGE models production as consisting of two broad categories of inputs: intermediate inputs and a primary factor-energy bundle (referred to as the KLE-bundle). Firms are assumed to choose the mix of inputs which minimises the costs of production for their level of output. They are constrained in their choice of inputs by a three-level nested production technology. At the first level, intermediate-input bundles and primary-factor bundles are used in fixed proportions to output. These bundles are formed at the second level. Intermediate input bundles are combinations of international imported goods and domestic goods. The VATTAGE recognises two sources for imports, namely, the EU and the rest of the world. The primary-factor bundle is a combination of labour, capital, energy and land. At the third level, the input of labour is formed as a combination of inputs of labour from five different occupational categories.

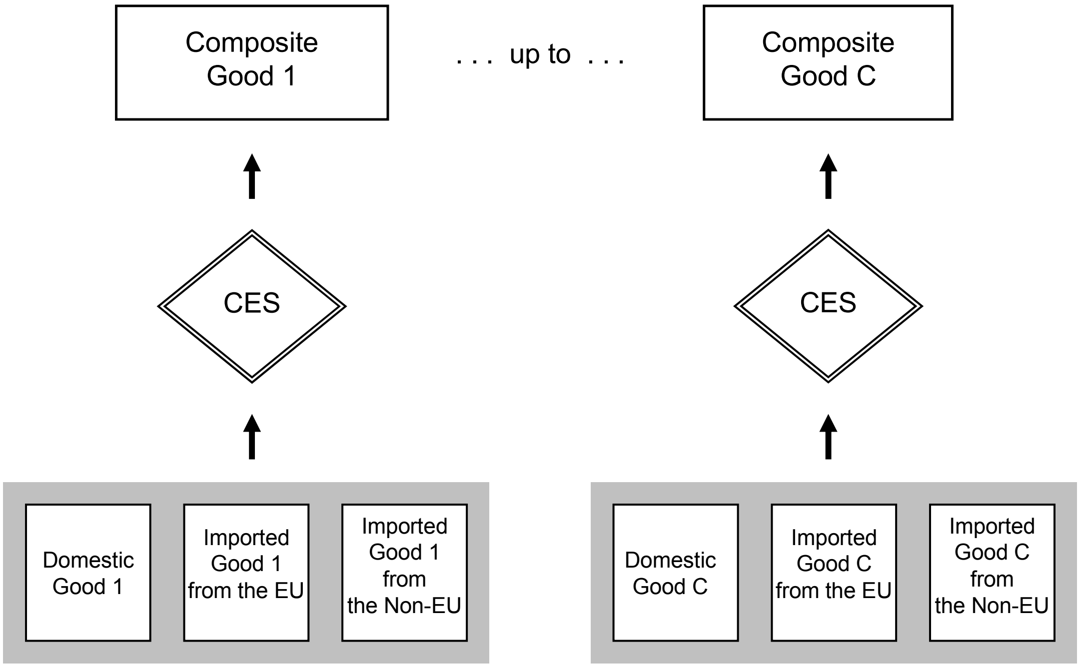
Figure 2.2. Top-level of the input mix



At the bottom level of the intermediate good nest are the demands for commodities from various sources. The firms decide on their demands for the domestic commodities and the foreign imported commodities under a CES assumption, which amounts to the standard Armington assumption that where domestic commodities are imperfect substitutes to foreign varieties. Figure 2.3 illustrates the structure giving rise to the demand for the composite goods and individual commodities. We use the well-known GTAP-database as a source for the Armington elasticities (Badri and Walmsley, 2008).

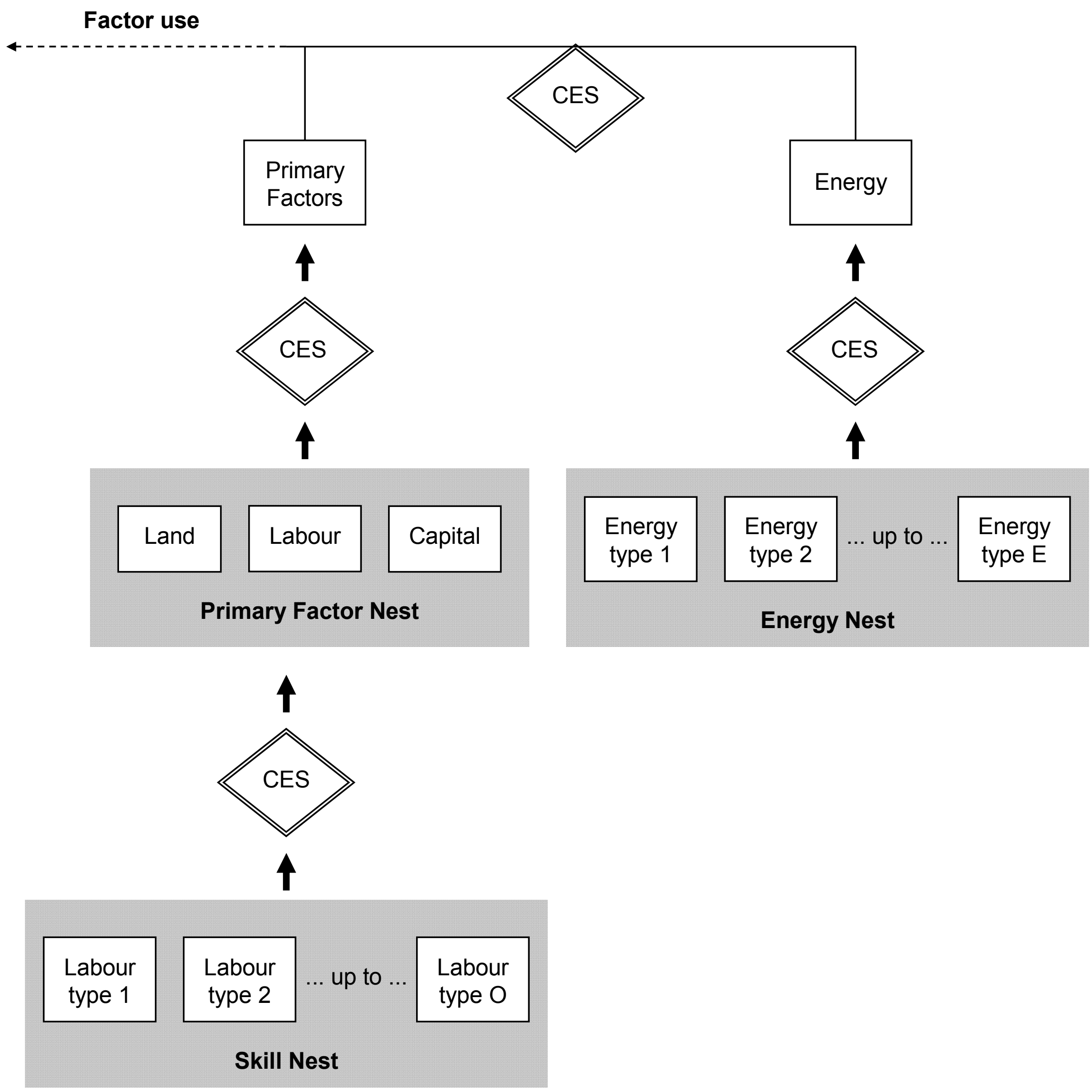
In figure 2.2, an item called other cost tickets is also included. Other costs are costs not related to the use of primary factors or material and energy inputs. In industries with high profitability they often explain profits not directly related to rates of return to capital.

Figure 2.3. The sourcing of inputs in VATTAGE



The demand for primary factors and energy composite are determined by the top nest in figure 2.2. Primary factors and energy are assumed to be combined with energy to form a primary factor-energy nest, often called the KLE-nest, as depicted in figure 2.4 below. The demands for labour of different skills, capital, and energy are derived from this structure. An important characteristic of this structure is that energy and primary factors can be substituted for each other in many industries. Without this assumption, it would be pointless to study policies involving changes in the relative prices of energy and other inputs. At the same time, it is clear the elasticities summarising this substitutability have a potentially large impact on the model's results. We rely on literature for substitution elasticities. The elasticity of substitution between primary factors has been covered in a number of Finnish studies. We follow Jalava et al. (2005) who find very low elasticities for Finland; for energy-primary factor elasticities and inter fuel elasticities we use the GTAP data.

Figure 2.4. The primary factor-energy composite in VATTAGE



2.3.2 Multiproduct industries and multi-industry products

In the VATTAGE database, many goods are produced by several industries and many industries also produce multiple commodities. This is most notably the case for energy products, where petroleum products stem from refining and where the relative price of the products affects the output mix. There are also some products, such as wood and wood residue used for heating and energy production that can stem from several industries.

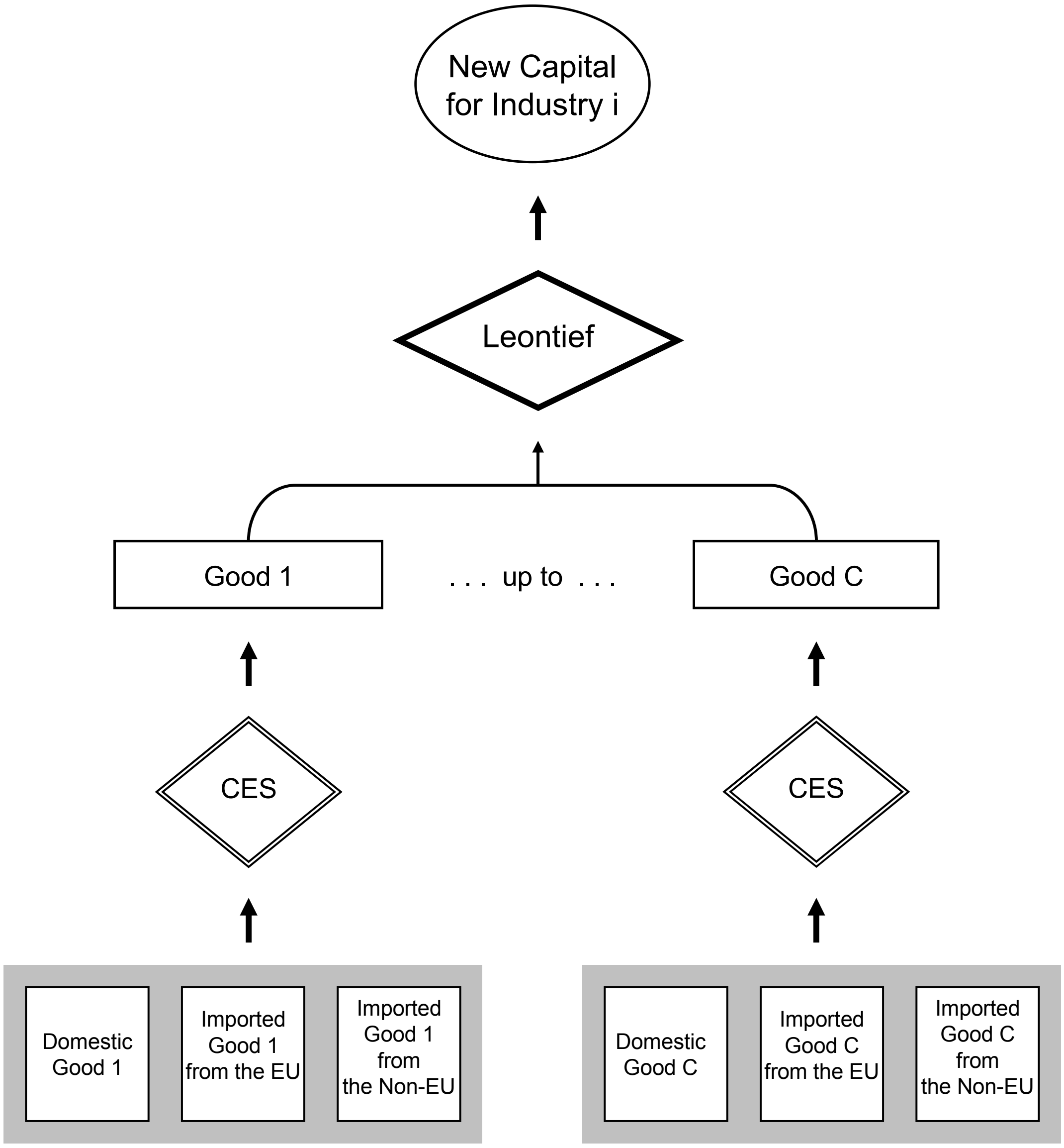
The sourcing of goods from industries raises from national accounts data. The model allows for the possibility that industries are affected by relative prices when deciding their output mix. This decision is modelled as a profit maximisation problem under the assumption of CET transformation technologies between possible outputs.

2.3.3 Demands for inputs to capital creation and the determination of investment

VATTAGE follows standard AGE practice in modelling the production of capital goods with an investment sector, whose task it is to combine inputs to form units of capital. In choosing these inputs they minimise costs subject to a Leontief technology. Figure 2.5 shows the nesting structure for the production of new units of fixed capital.

Capital is produced with inputs of domestically produced and imported commodities. No primary factors are used directly as inputs to capital formation. The use of primary factors in capital creation is recognised through inputs of the commodities, for example, construction services. Where VATTAGE differs from most AGE models is the description of the capital goods themselves. In VATTAGE, capital is genuinely sector specific, in other words, the commodity inputs for capital to each industry are unique. This means that capital is not malleable but that it will only adjust slowly, over time.

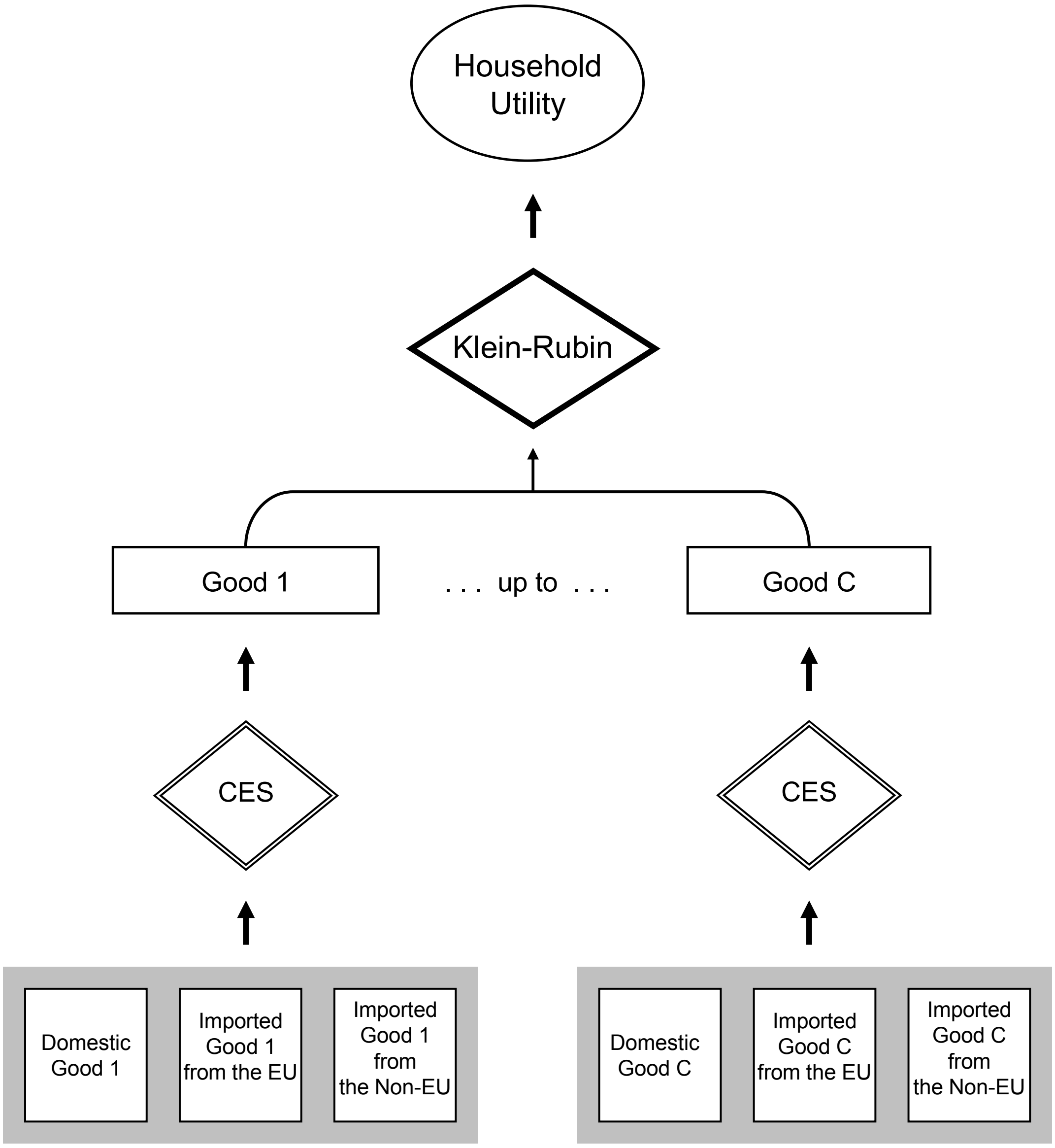
Figure 2.5 Production of investment goods in VATTAGE



2.3.4 Household demand

In VATTAGE, households are assumed to be the recipients of factor incomes. However, they also possess assets and liabilities abroad and domestically, which implies that a part of domestic incomes will be channelled abroad. A Keynesian consumption function then determines the level of household expenditure as a function of household disposable income, while the demands for individual goods are modelled as a utility maximisation problem subject to a household expenditure constraint. Whether we treat the average propensity to consume as constant depends on the application. When the model is used to accommodate an outside forecast for the macro economy, for example, the propensity to consume is endogenous, allowing the model to capture the forecast path of household consumption, whereas in policy applications is usually exogenous. However, there are also instances where outside information on changes in the propensity to consume, stemming from studies of consumption patterns, can be used in the construction of baseline scenarios. The structure of the utility function is shown in figure 2.6.

Figure 2.6. The structure of household demand in VATTAGE



2.3.5 Export demand

Export demand is modelled by price-sensitive export demand functions. However, there are several possibilities to refine this basic set-up in VATTAGE.

First, export demands in VATTAGE can be used to distinguish between traditional and collective exports. For traditional export sectors, each export good faces its own downward-sloping foreign demand curve. Thus a shock that improves price competitiveness of an export sector will result in increased export volume, but at a lower world price. The non-traditional, or collective, exports, on the other hand, face a single export demand function, that is, these exports move together. The composition of collective export demand is also exogenous. The distinction between traditional and collective exports can be used to rule out feedbacks from world prices to domestic prices, which may be of relevance for the service sectors. However, most commodities are modelled with the individual export demand functions. Finally, the supply decision to domestic and exports markets can also be modelled as being price dependent on the relative prices in these markets under the assumption of a CET technology.

2.3.6 Governments' demands for commodities

Commodities are demanded by the government (sectors). There are several ways of handling these demands, including: (i) endogenously, by a rule such as moving government expenditures with household consumption expenditure or with domestic absorption; (ii) endogenously, as an instrument which varies to accommodate an exogenously determined target such as a required level of government deficit; and (iii) exogenously, by assuming they follow forecasts stemming from outside of the model. In VATTAGE baseline simulations, the last assumption is often used, with official estimates of government spending giving the path that government expenditures take.

2.3.7 Indirect taxes and margin demands

In VATTAGE, supply and demand of commodities are determined through optimising behaviour of agents in competitive markets. The assumption of competitive markets implies equality between the producer's price and marginal cost in each regional sector. Demand is assumed to equal supply in all markets. However, indirect taxes and margins affect the purchaser’s prices.

The government imposes ad valorem sales taxes on commodities, income and payroll taxes on labour incomes, and capital taxes on capital income. The government also sets production taxes and collects tariffs from imports. These taxes place wedges between the prices paid by purchasers and prices received by the producers. The model recognises margin commodities (e.g., retail trade and road transport freight) which are required for each market transaction (the movement of a commodity from the producer to the purchaser). The costs of the margins are included in purchasers' prices.

2.4 An overview of VATTAGE dynamics

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. The dynamic structure of VATTAGE follows the MONASH model.

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 macro economy 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.

2.4.1 Capital stocks, investment and the inverse-logistic relationship

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 industry j in response to increases in j's expected rate of return. However, investors are cautious. In any year, the capital supply functions in MONASH limit the growth in industry j's capital stock so that disturbances in j's rate of return are eliminated only gradually.

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). In costs-of-adjustment models, industry i's capital growth (and investment) in any year is limited by the assumption that the costs per unit of installing capital for industry i in year t are positively related to the i's level of investment in year t. In the MONASH treatment, we assume (realistically) that the level of i's investment in year t has only a negligible effect (via its effects on unit costs in the construction and other capital supplying industries) on the costs per unit of i's capital. Instead of assuming increasing installation costs, we assume that i's capital growth in year t is limited by investor perceptions of risk. In the MONASH theory, investors are willing to allow the rate of capital growth in industry i in year t to move above i's historically normal rate of capital growth only if they expect to be compensated by a rate of return above i's historically normal level.

The evolution of the capital stock in year-to-year simulations starts follows the familiar equation:

$$K_{i,t+1} = (1 - D_i)*K_{i,t} + I_{i,t} \qquad (2.1)$$

where

$K_{i,t}$ is the capital stock at the beginning of year t in industry i;

$K_{i,t+1}$ is the capital stock at the end of year t in industry i;

$I_{i,t}$ is investment during year t in industry i; and

D_i is a parameter giving the rate of depreciation in industry i.

In computations for year t, $K_{i,t}$ is set exogenously to reflect i's end-of-year capital stock in year t–1.

In baseline computations, investments in the reference year are given by the data for that year, whereas for the following years in a baseline forecast, they are determined by the returns to capital.

2.4.2 Asset dynamics

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. These deficits are described in detail, and the dynamics depicting the accumulation of the related financial assets.

Accumulation of financial assets and liabilities is modelled with inter-temporal links of the form:

$$D_{q,t+1} = D_{q,t,t} * V_{q,t,t+1} + \left(\frac{D_{q,t} + D_{q,t+1}}{2} \right) * R_{q,t} + J_{q,t} * V_{q,tm,t+1} , \qquad (2.2)$$

where

$D_{q,t}$ is the level of asset or liability of type q at the beginning of year t

$R_{q,t}$ is the average rate of interest or dividend rate for asset or liability of type q during year t

$J_{q,t}$ is the active accumulation of q during year t

$V_{q,t,t+1}$ is the factor translating the value of q from the beginning of year t to beginning of year t+1

and

$V_{q,tm,t+1}$ is the factor translating the value of q from the middle of year t to the beginning of year t+1.

The factors *V* take into account the effects of exogenous changes in exchange rates and the like. For example, since VATTAGE deals separately with the EU and non-EU countries, the effects of an appreciation of the US dollar can be taken into account when the debt portfolio is known.

Active accumulation means here new borrowing or investment beyond accumulation of interest and dividends. For example, in a simple foreign debt equation a deficit on the balance of trade is active accumulation while accrued interest and valuation effects are passive accumulation. While accounting for assets makes the model more complex, it brings with it considerable benefits. For example, by recording the assets and liabilities, VATTAGE is able to generate results for the wealth of Finns which can be taken into account in welfare analysis.

2.4.3 Labour market dynamics

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.

VATTAGE allows for different specifications of the labour markets. 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.

Specifically, we assume that real, after tax wages are sticky in the short run and flexible in the long run. In this labour market specification, policy shocks generate short-run changes in aggregate employment and long-run changes in real wages. Algebraically, we assume that

$$\left(\frac{W_t}{W_t,old}-1\right)=\left(\frac{W_{t-1}}{W_{t-1},old}-1\right)+\alpha_1\left[\left(\frac{W_{t-1}}{W_{t-1},old}-1\right)-\left(\frac{E_t}{E_t,old}-1\right)^{\alpha_2}\right] \tag{2.3}$$

In this equation, *old* indicates a base case forecast value. $W_{t,old}$ and $E_{t,old}$ are the real wage rate and the level of employment in year t in the base case forecasts, and W_t and E_t are the real wage rate and the level of employment in year t in the policy simulation. Under this specification, the adjustment of the real wage rate depends on deviations from the expected real wage development and on the deviation of employment from the expected employment growth. The speed of adjustment is controlled by parameter α_1, whereas α_2 determines whether employment returns to its expected growth path after a policy shock. The real wage equation is close to NAIRU-theories of unemployment, and its parameters have been estimated for Finland is studies such as Alho (2002) and McMorrow and Roeger (2000).

2.4.4 Government finances

VATTAGE contains a detailed database on indirect taxes, payroll taxes and income taxes. Indirect taxes on commodities are modelled as *ad valorem* rates of tax levied on the basic price of the underlying flow. The basic price is the price received by the producer. VATTAGE allows for differentiation of indirect taxes to environmental taxes and other taxes for certain commodities. Production taxes are modelled as part of value added, while payroll taxes are directly levied on wages. Income taxes are levied on labour and capital incomes. Finally, import duties are levied as ad valorem taxes on imports.

VATTAGE includes revenue equations for income taxes, sales and excise taxes, taxes on international trade and for receipts from government-owned assets. As described already, the model accounts for public expenditures on commodities (or services). It also contains outlay equations for transfer payments to households (e.g., pensions, sickness benefits and unemployment benefits). The specification in VATTAGE of government finances makes the model a suitable tool for analysing the effects of changes in the fiscal policies.

In VATTAGE, it can be assumed that the government may wish to relax its fiscal stance if unemployment is higher than expected/targeted. It can then be assumed that the government is willing to run a deficit until employment returns to forecast, which can be captured by imposing the following equation:

$$\left(\frac{NSS_t}{NSS_t,old}-1\right)=\beta_1\left(\frac{NSS_{t-1}}{NSS_{t-1},old}-1\right)+\beta_2\left(\frac{E_t}{E_t,old}-1\right), \qquad (2.4)$$

where

NSS_t is the share of national savings of GDP in the policy simulation

NSS_t,old is the share of national savings of GDP in the baseline simulation

E_t is the level of employment in the policy simulation

E_t,old is the level of employment in the baseline simulation,

β_1 is less than one in value.

Under this specification, the government allows national savings to fall if employment is lower than expected and continues to do so, until employment returns to forecast/baseline (the term with β_2).

This can take place in several ways, but in a typical policy simulation concerning changes in taxes it would imply that a reduction in one tax is only partly compensated by increases in another during the first years of the policy. However, as employment returns to the forecast, fiscal policy is adjusted to return the national saving ratio to its forecast value.

2.5 The new income distribution module of VATTAGE

In the basic version of the model, there is only a representative household. In the version used in this report, we introduce a consumption and income distribution module, where we divide households into eight types according to the socioeconomic grouping of the reference person of the household (i.e. the person with the highest earnings). The modular approach does not necessitate changes within the main model, and its data needs are relatively modest. Yet it is a powerful tool that provides new insights.

The household types covered by the model are (with the classification code of Statistics Finland given in brackets):

- Farmer (10)
- Entrepreneur (20)
- Upper-level employee (30)
- Lower-level employee (40)
- Manual worker (50)
- Student (60)
- Retired (70)
- Unemployed and others (80&90).

The income distribution module utilises the main model results concerning prices and total consumption volumes, and distributes income and consumption by household type, so that each income type and consumption good adds up to the aggregate level. This approach is often referred to as a top-down modelling solution. But whereas the usual top-down analysis of distributional effects covers mainly the direct effects of price changes, our approach also contains links between the effects of policies and disposable income.

In VATTAGE, household income is divided into six classes: capital income, land rents, wages and salaries, unemployment benefits, old-age benefits, and other transfers. The same division is applied within the income distribution module as well.

Due to the fact that we only have one type of each primary factor (capital, labour, land) within the main model, we have to assume that e.g. wages and capital income change as much for each and everyone. The differences in the composition of the total income nevertheless lead to varying income growth between household types. In addition, we have to assume that the relative changes for each tax rate is the same for each household type. However, the base tax rates differ across households.

The model uses data from several statistics from Statistics Finland: income distribution statistics, national accounts, as well as household-level data of the 2006 private consumption study. The different sources are fit into the model data base by using aggregate data as the starting point, with information from outside the core model database providing the distribution of income and consumption between household types.

Apart from differences in income and in tax structure, the households differ in the composition of their consumption and in their consumption function parameters. Therefore, price and income changes do not lead to same consumption reactions within all the households. In what follows, we use the real volume of consumption as a proxy for household welfare. In practice, this indicator is close to the equivalent variation measure, although not equal (see. e.g. Mas-Colell et al., 1995).

2.6 Population growth and changes in socioeconomic groups

Once the idea of multiple households is introduced, changes in population become an issue. In particular, as the model is used to analyse distant future, it becomes necessary to make assumptions regarding the demographic changes of each socioeconomic grouping.

We have assumed that the change in the population of each group is partly exogenous (i.e. not depending on the results of the model) driven by the changes in the age structure, and partly endogenous, depending on the development of the labour market. The population projection 2007 of the Statistics Finland gives us the aggregate growth of each age cohort. We calculated from the underlying household-level data of the weighted income distribution statistics 2005 (around 28,000 observations) a socio-economic distribution for each one-year age cohort of 0–97+ years according to the grouping of the reference person. We multiplied the base-year cohorts with annual changes calculated from the population forecast, after which we summed the number of people in each socioeconomic group. In addition, the socioeconomic population shares react endogenously to changes in the unemployment level.

On top of these components, we estimated a relationship between the numbers of those employed and those studying to changes in the number of unemployed and outside the labour market (groups 80&90). This resulted in an elasticity of 0.76 in the number of students when the share of employed goes down by one percent. Finally, all the changes in the group shares are scaled to add up to the aggregate population change. The share of farmers and retired are assumed not to react to labour market conditions.

3. Estimation of consumption parameters

The estimation of the consumption function parameters was conducted with the Statistics Finland 2006 consumption study household-level data that was weighted with scaled sample weights (i.e. having a mean equalling one). The product classification of the consumption study 2006 of Statistics Finland differs from that of the national accounts; therefore our first task was to reclassify the data according to our model classification (see description of the study at http://www.stat.fi/til/ktutk/index_en.html). There was no reclassification key readily available, so one was constructed on the basis of the key made for the 2001 study by Statistics Finland. Some of the products and product groups used in VATTAGE were not available in the consumption study, or there were so few observations on them that we aggregated them to their "neighbouring" products. There are also conceptual differences between the definition of private consumption (e.g. in treatment of interest payments on loans), as well as in the definition of institutional sectors (in VATTAGE, non-profit institutions serving households, NPISHs, are included in private consumption). The product classification of VATTAGE is listed in appendix 1.

In VATTAGE, we assume the utility function of the consumers to be of Stone-Geary type, which leads to the Linear Expenditure System (LES) for the representative consumer of the basic model:

$$p_i x_i = p_i \gamma_i + \beta_i \left(y - \sum_j p_j \gamma_j \right) \tag{3.1}$$

where x_i is the consumption volume of the product i, p_i is its price, and γ_i is the subsistence consumption of the same. y is the total value of consumption, and β_i is the marginal budget share of product i.

The estimation was conducted in two phases. First, a linear system of equations of following form was estimated for each household type:

$$p_i x_i = C_i + \beta_i * y, \quad i = 1,..,m-1 \tag{3.2}$$

where:

$$C_i = p_i \gamma_i - \sum_j p_j \gamma_j \tag{3.3}$$

The results of estimation for the eight groups are shown in Appendix 2. The characteristics of the system of equations is such that the marginal budget shares β_i sum up to one, whereas the constants C_i sum up to zero (this can be seen to hold by summing up the equations (3.2) and (3.3) over i). With the help of this insight, we can define the parameter values of the left-out variable m of the system (this was done to avoid linear dependence of the system). In estimating the subgroups, manual workers (40) were used as a reference group. A major part of the estimated parameters were statistically significant.

The linear system of equations does not provide us with all the necessary parameters, though, as the constants C_i contain and hide the values of γ_i. From the characteristics of the equations we know that (see e.g. Blonigen et al., 1997):

$$p_i \bar{x}_i = C_i + \beta_i * \bar{y} \tag{3.4}$$

where $\bar{x}_i$ is the mean value of consumption x_i and $\bar{y}_i$ is the mean value of total consumption. Product prices p_i are assumed to equal unity.

By using equations (3.3) and (3.4) we can set up an optimization problem, in which we have as many equations as unknowns, providing us with a unique solution for γ_i numerically.

The econometric results are utilized in VATTAGE for two sets of parameters: group- and product-i-specific income elasticities EPS_i and group-specific *FRISCH* parameters. All the rest of the consumption parameters are derived from these two. Equation (3.5) below clarifies the relationship between these two and the estimated parameters.

$$EPS_i = \frac{\beta_i * \bar{y}}{p_i * \bar{x}_i}, \quad FRISCH = -\frac{\bar{y}}{\bar{y} - \sum_j p_j * \gamma_j} \tag{3.5}$$

VATTAGE is built and calibrated in such a way that income elasticities EPS_i have to be positive. In three cases of the sub-group estimations, the estimated β_i was slightly negative, which would result in negative income elasticities. In those cases, the results of the representative consumer were used in the final calibration.

A problem arises with the slight incompatibilities of the consumption survey data with the main data base, implying aggregation problems. These are solved by rescaling the parameters to ensure that they comply with the Engel rule as follows:

$$\sum_i \alpha_i * EPS_i = 1 \tag{3.6}$$

where $\alpha_i = \frac{p_i * x_{i,2004}}{y_{2004}}$ is the consumption share according to the base year data of VATTAGE. The scaling parameter θ can be defined as follows:

$$\theta = \sum_i \left(\frac{EPS_i(initial) * p_i * x_{i,2004}}{y_{2004}} \right) \qquad EPS_i(final) = \frac{EPS_i(initial)}{\theta}$$

The required scaling was at most 11 per cent. The final parameter values used in the model are listed in appendix 3 (including for the representative consumer).

4. The distributional effects of the EU climate and energy policy package: results

As explained in the introduction, the EU energy package is composed of targets for emission reductions, increases in the use of renewables, and energy saving. While Honkatukia and Forsström (2008) analyse these targets incrementally, here, we concentrate on the combined effects of the policies necessary to achieve the three targets.

In our analysis, the parameters concerning the representative consumer have been changed according to estimation results. In addition, demographic parameters have been adjusted to comply with the calculations done for this report. Due to these changes there are minor differences in our results compared to Honkatukia and Forsström (2008).

The effect of climate policy on the macro variables is presented in figure 4.1. The change in GDP from the base scenario is around 0.8 per cent negative by 2020, whereas private consumption declines by little less than two per cent. Employment is reduced by less than half a per cent, but investments increase finally faster than under base scenario, due to growth in renewable energy production. The contribution of different GDP expenditure items to economic growth compared to the base scenario is depicted in figure 4.2.

According to conventional wisdom climate policies are regressive in nature (see e.g. Kemppi and Lehtilä, 2002; Kiander, 2008), that they would, in other words, affect low-income households relatively more severely. The reason for this view can be seen from figure 4.3, which shows the direct CO_2 intensity of consumption calculated as the amount of emissions from consumers' direct fuel consumption in relation to total consumption. According to the figure, the direct CO_2 intensity of consumption tends to be low among entrepreneurs and students, whereas it is high among lower-level employees and manual workers. This may explain why earlier studies regard CO_2 taxes regressive. However, such analysis may neglect many of the non-energy products and services, whose manufacturing is energy intensive. Figure 4.4 shows the share of energy inputs in each product group's production costs, indicating that several non-energy products have relatively high energy content. Therefore, their prices will be affected by energy policies. The potential of the prices of these products to affect consumption can be easily demonstrated. This is done in Figure 4.5, where we have calculated the direct and indirect, or embedded, energy costs within each socioeconomic group's consumption baskets. We see that the energy cost for students and entrepreneurs would – again – be lowest, while it would be highest for farmer households.

Figure 4.1 Changes in GDP expenditure items, per cent from base scenario

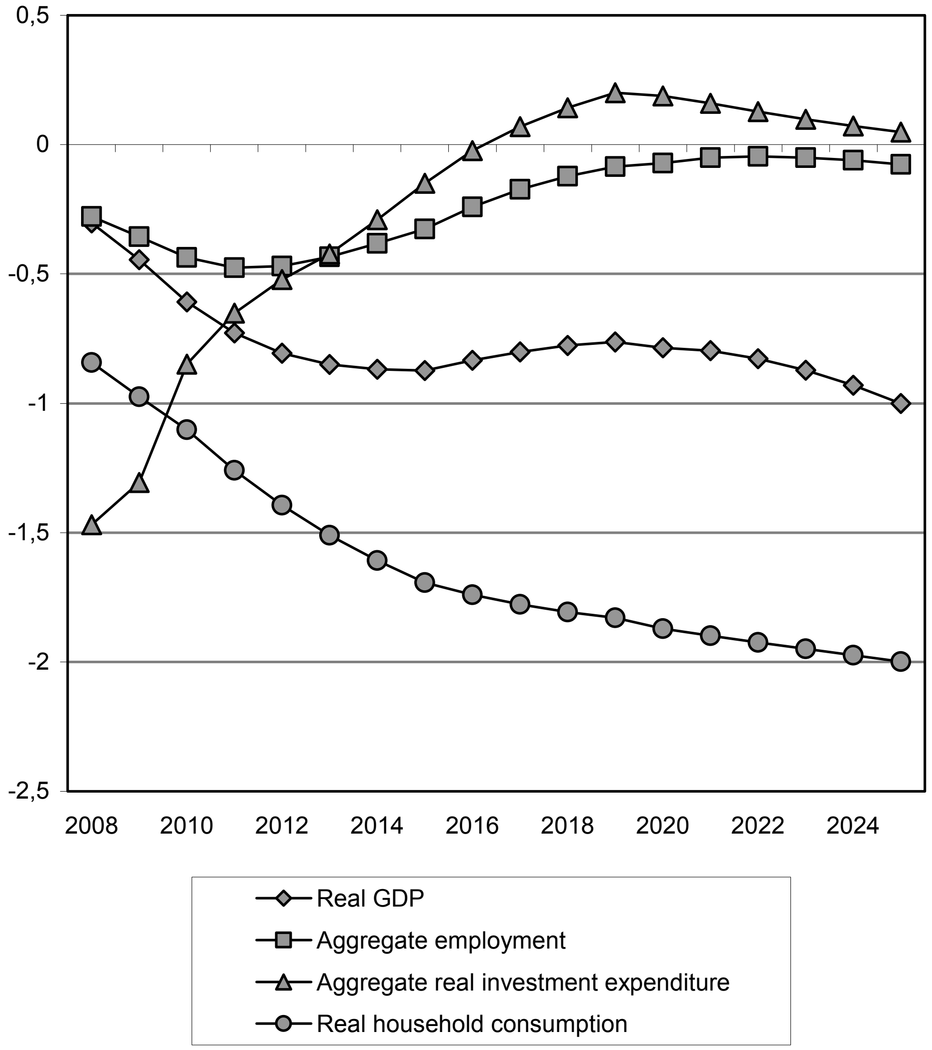
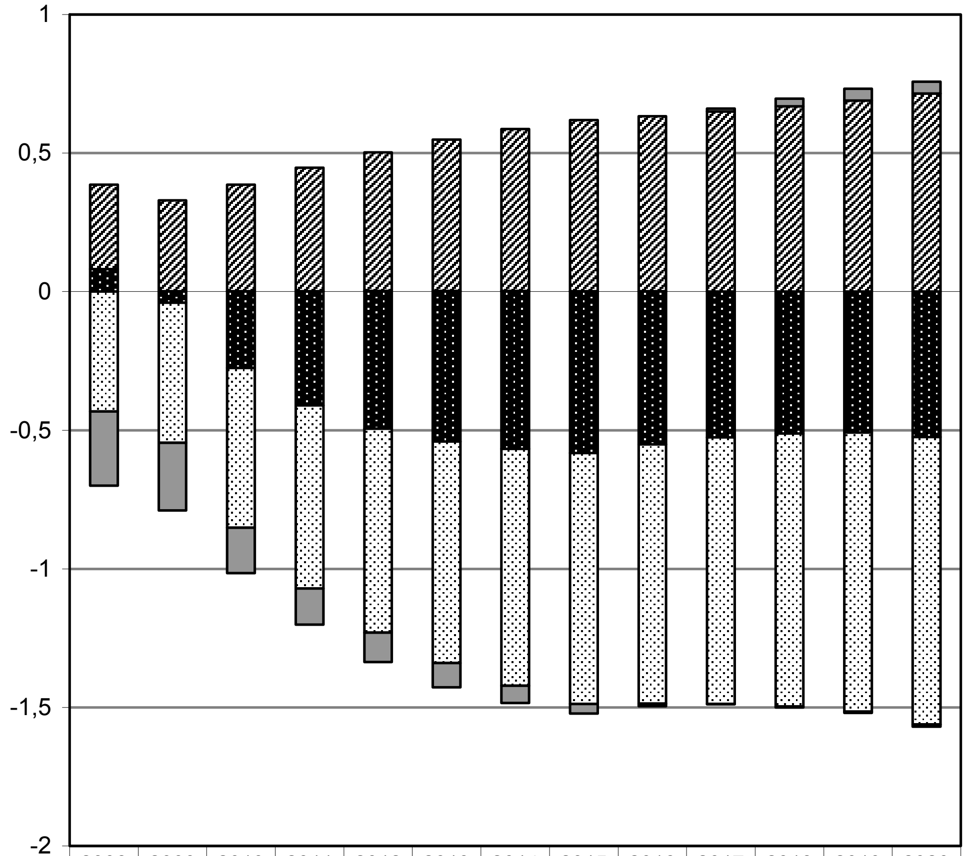


Figure 4.2 Contribution of expenditure items to the total GDP change, per cent



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Investment	-0,268	-0,243	-0,164	-0,13	-0,106	-0,087	-0,062	-0,035	-0,009	0,011	0,027	0,042	0,043
Imports	0,305	0,328	0,384	0,445	0,5	0,546	0,584	0,617	0,632	0,65	0,669	0,69	0,715
Government	0	0,001	0,002	0,002	0,003	0,003	0,003	0,002	0,001	-0,001	-0,003	-0,005	-0,008
Consumption	-0,432	-0,506	-0,576	-0,661	-0,735	-0,799	-0,855	-0,904	-0,935	-0,962	-0,985	-1,006	-1,036
Exports	0,081	-0,04	-0,275	-0,41	-0,495	-0,541	-0,567	-0,583	-0,551	-0,526	-0,512	-0,509	-0,525

Exports   Consumption   Government   Imports   Investment

Figure 4.3 CO_2 emissions from consumption of energy goods in relation to total consumption in year 2020 under base scenario, index, all households = 100

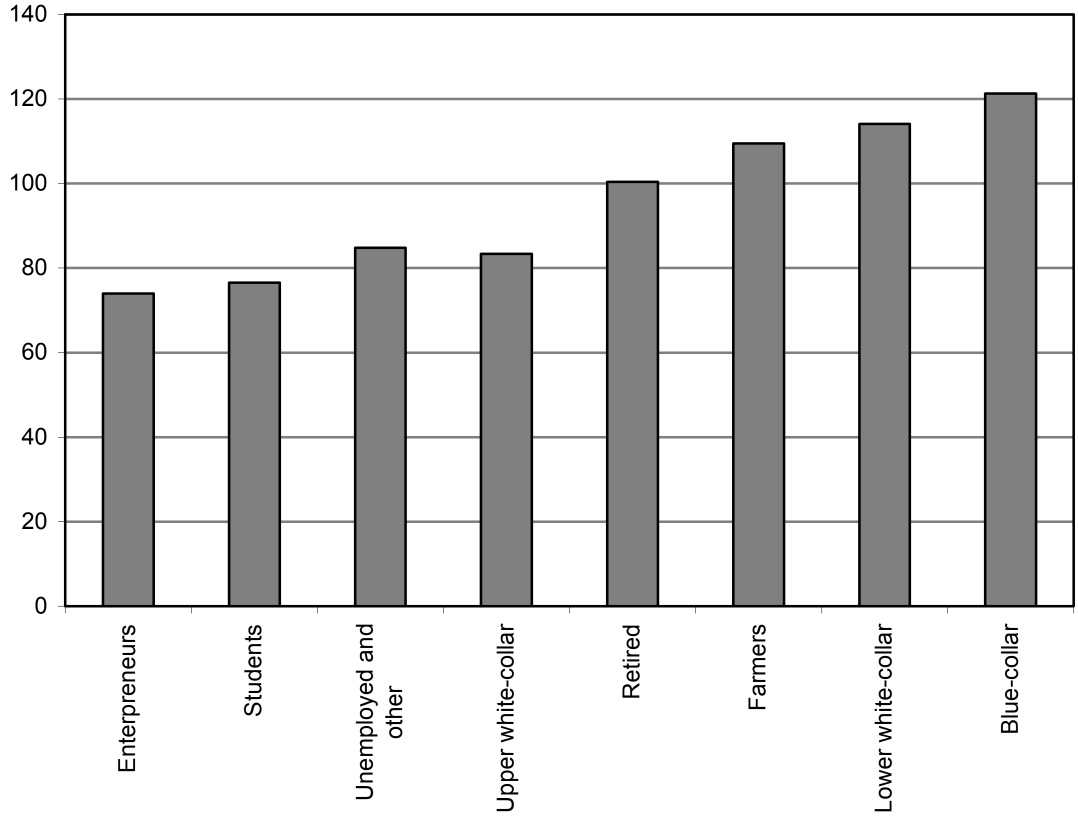


Figure 4.4 The cost share of energy by product in year 2005, per cent

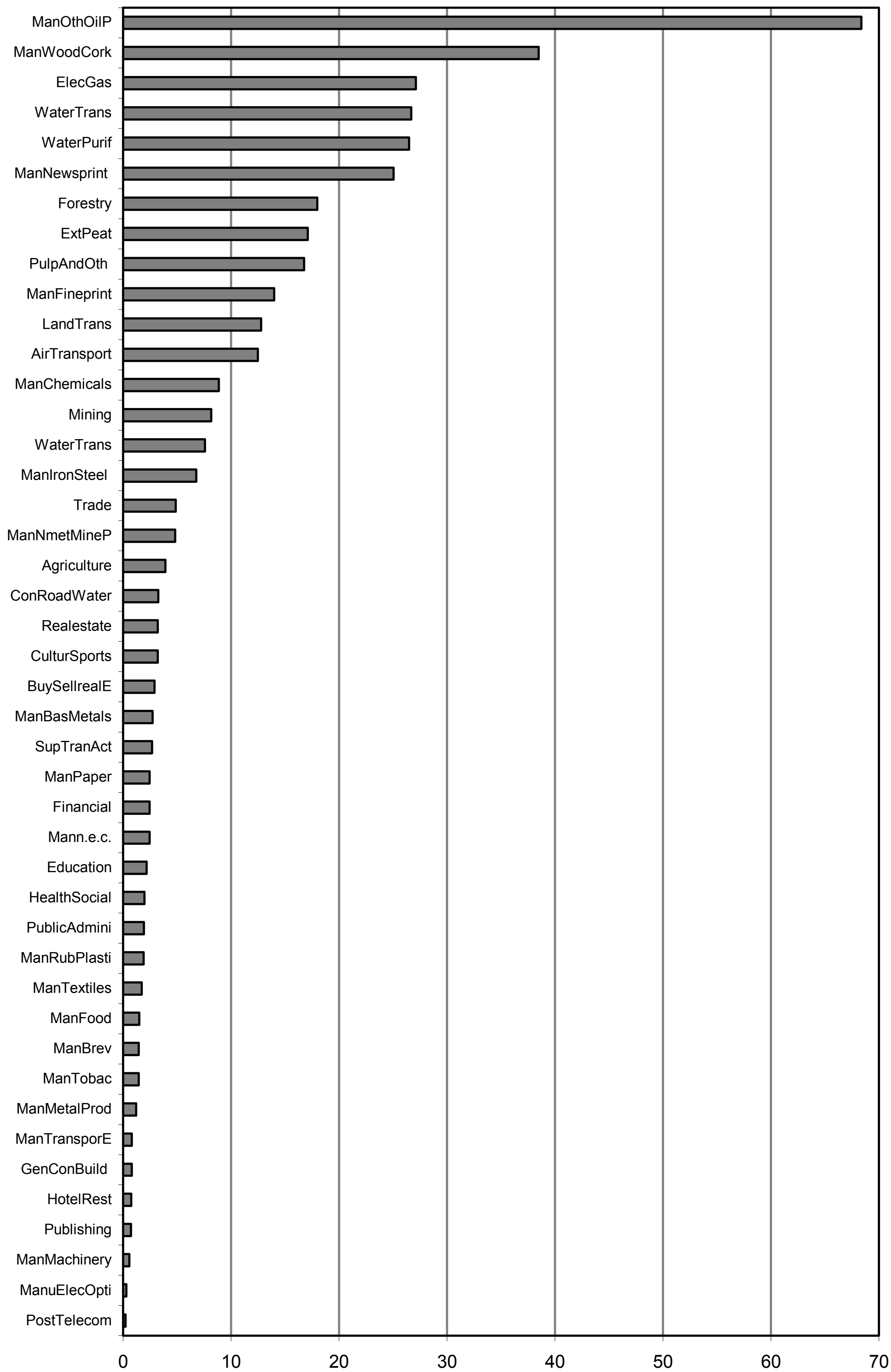
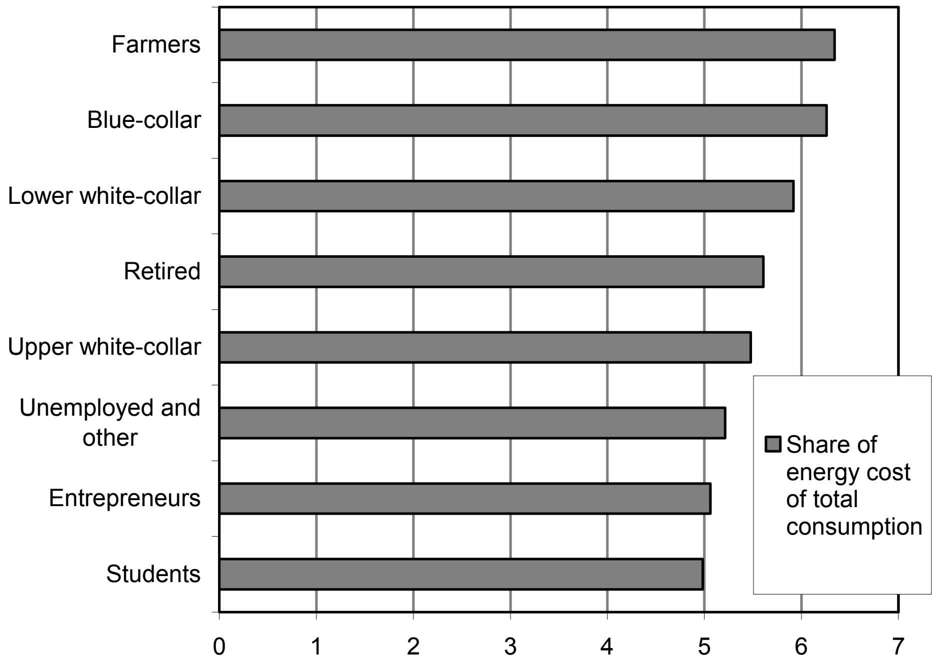


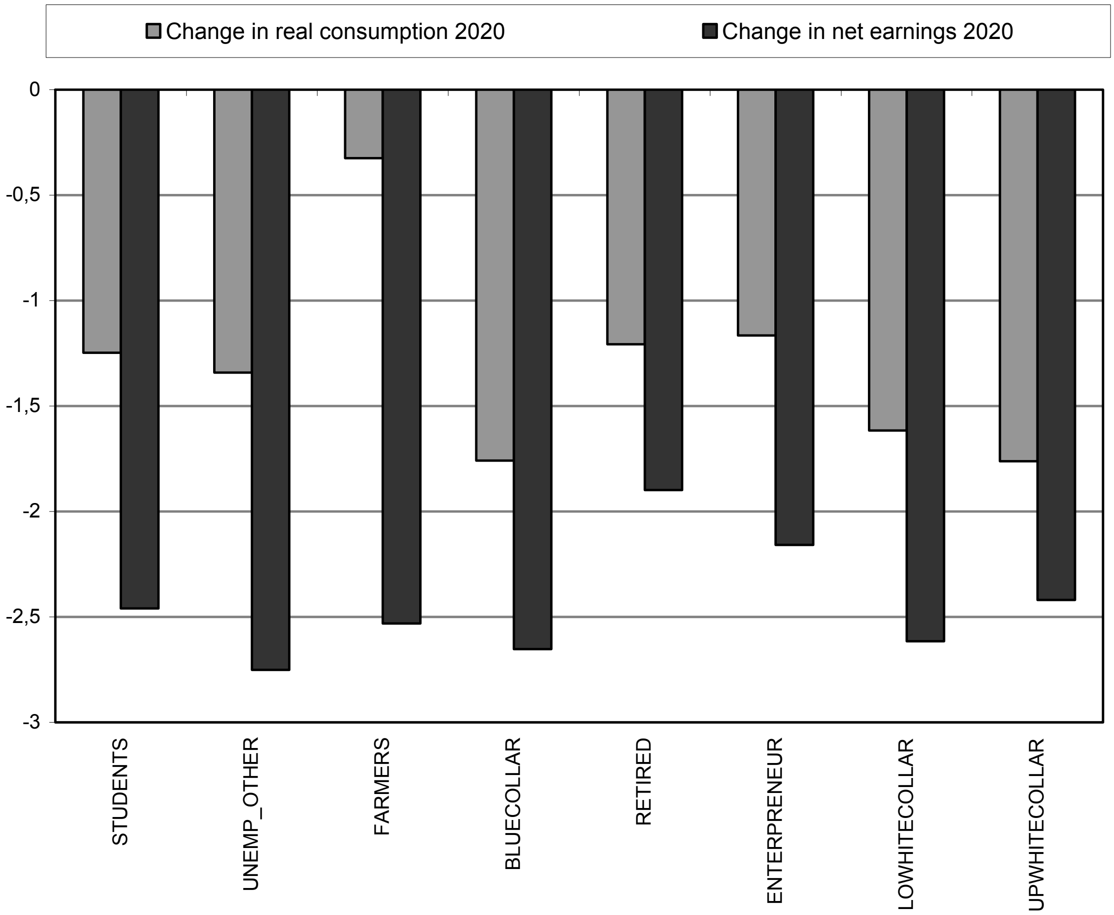
Figure 4.5 Consumption share of direct and indirect energy use in year 2005, per cent



One of the innovations of the new distributional analysis module is that it not only takes into account price changes but also tracks the income effects due to the policies. In figure 4.6 we show the change in net income and real consumption volume compared to baseline. The socioeconomic groups are ordered by their initial taxable income.

We notice that neither the magnitude of changes in disposable income nor in real consumption volume follow the initial income level ordering. Changes in income level are typically higher for households that are active in the labour market, while those obtaining a larger share of income from transfers seem to be less affected. We see that the price changes caused by the policy seem to affect different groups in similar ways, as the changes in consumption seem to follow changes in income rather well, rather than the initial income level.

Figure 4.6 Change in income and real consumption in year 2020, per cent from base scenario, ordered by income level

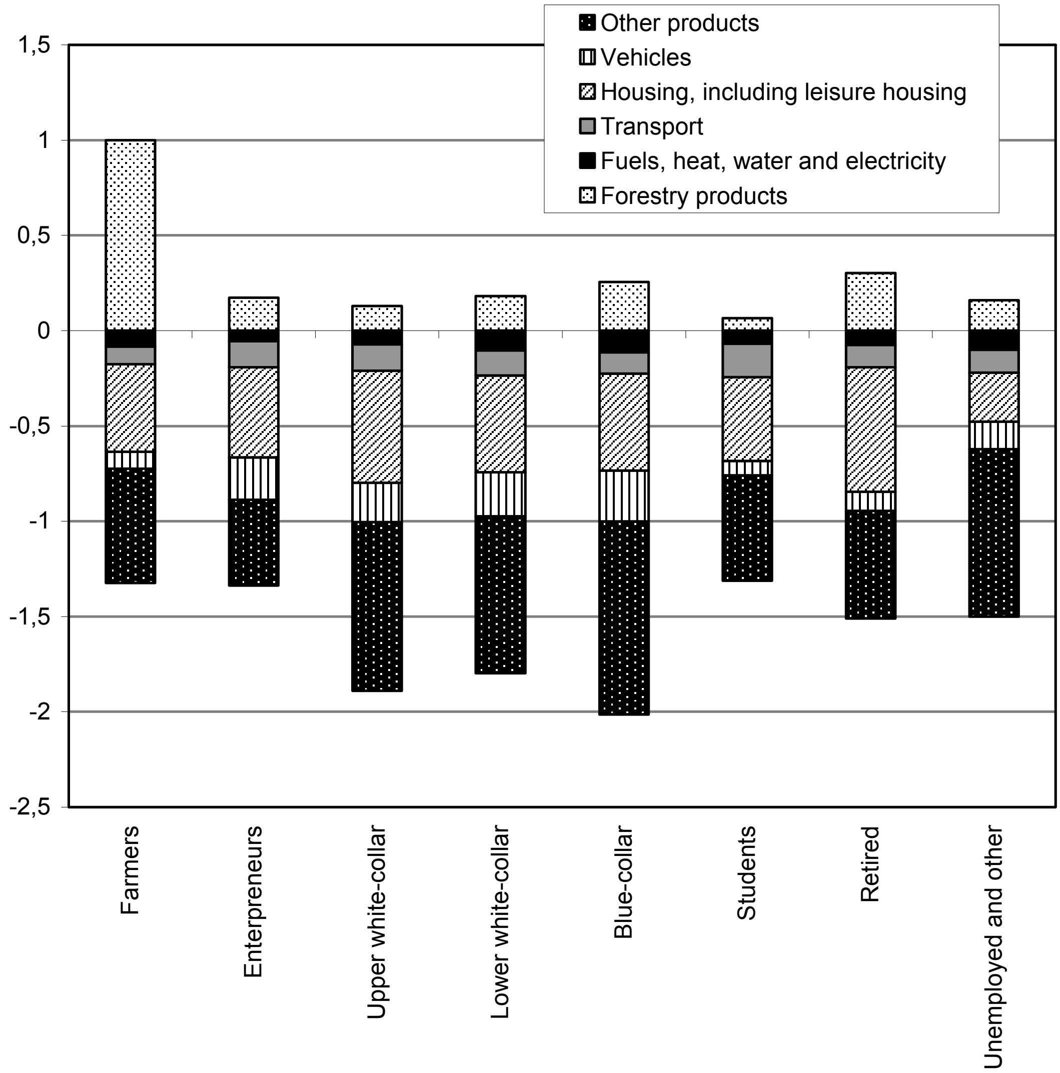


In figure 4.7, the contribution of different products to change in real consumption volume is illustrated. We can see that the policy-induced price and income changes affect many products, and that the direct use of energy contributes little to the total change in real consumption volume.

The importance of consumption-induced income effects is clearly illustrated by the one socio-economic group, farming households, that is less affected than others. This is due to the fact that the forestry sector is being heavily subsided under the renewable energy policies, and forest products have a larger weight in farmers' consumption basket than in other socio-economic groups'.

In summary, our results do not seem to support the hypothesis of regressive nature of climate policies. The indirect price effects of climate policy seem rather to even out the welfare effects, as we study the households according to their socioeconomic status.

Figure 4.7 Contribution of different product groups to the total change in consumption volume in year 2020



5. Conclusions

In this report we have presented a new version of VATTAGE that enables the analysis of distributional effects of policy changes by combining macroeconomic modelling with distributional analysis. Different households are introduced within the model as a top-down distributional module. In contrast to TUJA the microsimulation model of VATT and other Finnish microsimulation models, the description of income, taxation and transfers is much more aggregated in VATTAGE. On the other hand, the advantage of VATTAGE is the inclusion of changes in income levels, income distribution, employment and consumption, which is not possible with traditional microsimulation models.

Our results show that the effects of climate policy are broadly of the same order of magnitude for different household types, with the exception of farmer households, which seem to be less affected than others. As we study socioeconomic groups by their income level, it seems in the light of our results that the costs of climate policy would be distributed rather evenly among households. The climate policy package changes all the price relations within the economy through input-output linkages, which evens out the effects among the socioeconomic groups. However, while socioeconomic groups can be ordered by income level, the groups contain considerable variation within them which is not taken into account here. Thus the answer to the regressivity question might appear different if households were to be divided by income level.

Some of our results also depend on assumptions about other policies. This applies especially to our finding that households with a larger share of income coming from transfers seem to be less affected by the policy. While reassuring, the result is an artifact of the assumption that transfer rules are not affected by the macroeconomic realities of climate policies.

In the future, distributional analysis of the climate policies could be developed in many ways. First, it would be possible to divide households into income deciles and to make a distributional model within VATTAGE with similar characteristics than the current one. Second, the volume and price results of VATTAGE could be passed on to an existing micro simulation model. There are plenty of international examples from such analyses (see e.g. Buddelmeyer et al., 2009; Thurlow, 2008; Lofgren et al., 2008; Llambí et al, 2009).

In order to get as useful results as possible from VATTAGE for microsimulation analysis, it would be advantageous to include a more detailed description of different labour types and their division into households. A part of this work has already been done or is in the pipeline, so it would not be such a big effort to do this.

Last, the new income and consumption distribution module could naturally be used in other policy analyses as well. It would be particularly useful in studies where changes in income taxation are combined with changes in indirect taxes.

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NACE (Nomenclature Générale des Activités Economiques dans les Communanautés Européennes) is statistical industry classification used in European Union.

ISIC (International Standard Industrial Classification of All Economic Activities) is a statistical industry classification confirmed by United Nations.

CPA (Statistical classification of products by activity in the European Economic Community) is used by the European Union in national and regional accounts for input-output analysis.

Appendix 1. Product Classification Used within VATTAGE vs. Products Used in LES Estimation

Used in LES estimation	Code	ShortName	Commodities name
yes	C_01	Agriculture	Agriculture, hunting, fishing and related service activities
yes	C_02	Forestry	Forestry, logging and related service activities
no private consumption	C_101	MiningCoal	Mining and agglomeration of hard coal
no private consumption	C_103	ExtPeat	Extraction and agglomeration of peat
no private consumption	C_11101	ExtPetroleum	Extraction of crude petroleum
no private consumption	C_11102	ExtGas	Extraction of natural gas
no private consumption	C_13_4	OthMining	Mining and quarrying
yes	C_15	ManFood	Food Products
yes	C_159	ManBrev	Beveages
yes	C_16	ManTobac	Tobacco
yes	C_17_9	ManTextiles	Manufacture of textiles; wearing apparel; leather and footwear;
yes	C_20	ManWoodCork	Manufacture of wood and of products of wood and cork
no private consumption	C_21121	ManNewsprint	Manufacturing of newsprint
no private consumption	C_21125	ManFineprint	Manufaturinf of fineprint
no private consumption	C_21129	PulpAndOth	Pulp and other paper products
yes	C_212	ManPaper	Manufacture of articles of paper and paperboard
yes	C_22	Publishing	Publishing, printing and reproduction of recorded media
yes	C_232011	ManPetrol	Gasoline
no, C_232011 value used	C_232012	ManDiesel	Diesel oil
yes (for most groups)	C_232013	ManLightOil	Light fuel oil
no, C_232011 value used	C_232014	ManHeavyOil	Heavy fuel oil
yes	C_23209	ManOthOilP	Other oil products
yes	C_24	ManChemicals	Manufacture of chemicals and chemical products
yes	C_25	ManRubPlasti	Manufacture of rubber and plastic products
yes	C_26	ManNmetMineP	Manufacture of other non-metallic mineral products
no private consumption	C_271	ManIronSteel	Manufacture of basic iron and steel and of ferro-alloys
no, C_28 value used	C_279	ManBasMetals	Manufacture of basic metals n.e.c.
yes	C_28	ManMetalProd	Manufacture of fabricated metal products, except machinery and equipment
yes	C_29	ManMachinery	Manufacture of machinery and equipment n.e.c.
yes	C_30_3	ManuElecOpti	Manufacture of electrical and optical equipment
yes	C_34_5	ManTransporE	Manufacture of transport equipment
yes	C_36_7	Mann.e.c.	Manufacturing n.e.c.
yes	C_4011	WaterPurif	Electricity
no private consumption	C_4012	WaterTrans	Electricity,distribution
yes	C_403	ElecGas	Steam and hot water supply services
no private consumption	C_4501	GenConBuild	General construction of buildings
no private consumption	C_4502	ConRoadWater	Construction of motorways, roads, and water projects
yes	C_50_2	Trade	Wholesale and retail trade; repair of motor vehicles, motorcycles etc.
yes	C_55	HotelRest	Hotels and restaurants
yes	C_60	LandTrans	Land transport; transport via pipelines
no, C_60 value used	C_61	WaterTrans	Water transport
no, C_60 value used	C_62	AirTransport	Air transport
yes	C_63	SupTranAct	Supporting and auxiliary transport activities
yes	C_64	PostTelecom	Post and telecommunications
yes	C_65_7	Financial	Financial intermediation
yes	C_702	Realestate	Real estate, renting and business activities
yes	C_70_4	BuySellrealE	Buying and selling of own real estate
yes	C_75	PublicAdmini	Public administration and defence; compulsory social security
yes	C_80	Education	Education
yes	C_85	HealthSocial	Health and social work
yes	C_92_5	CulturSports	Recreational, cultural and sporting activities

Appendix 2. Estimation results

Name	Coefficient	Std.Err.	t-ratio	P-value	Name	Coefficient	Std.Err.	t-ratio	P-value
G01	163.952	9.35417	17.5271	0.00000	B15_70	-0.0039311	0.000871	-4.51563	0.00001
G01_10	-182.202	27.6198	-6.5968	0.00000	B15_89	0.0380805	0.001678	22.6946	0.00000
G01_20	303.598	16.6457	18.2388	0.00000	G159	23.69	12.3252	1.92207	0.05460
G01_30	-93.0005	12.9773	-7.16642	0.00000	G159_10	42.2633	36.3924	1.16132	0.24551
G01_50	-9.81633	12.7473	-0.77007	0.44126	G159_20	175.545	21.9327	8.00381	0.00000
G01_60	-242.19	19.2924	-12.5536	0.00000	G159_30	190.408	17.0991	11.1356	0.00000
G01_70	-29.5964	10.7712	-2.74772	0.00600	G159_50	210.195	16.7961	12.5145	0.00000
G01_89	-225.73	15.5797	-14.4887	0.00000	G159_60	4.75069	25.42	0.186888	0.85175
B01	0.016438	0.000257	64.0116	0.00000	G159_70	-188.521	14.1924	-13.2832	0.00000
B01_10	0.0106258	0.00065	16.3458	0.00000	G159_89	419.43	20.5281	20.432	0.00000
B01_20	-0.007973	0.000361	-22.0978	0.00000	B159	0.0209705	0.000338	61.9766	0.00000
B01_30	0.002065	0.000312	6.62001	0.00000	B159_10	-0.0129884	0.000857	-15.1638	0.00000
B01_50	-0.001892	0.000359	-5.27789	0.00000	B159_20	-0.0062027	0.000475	-13.0476	0.00000
B01_60	0.0014724	0.000836	1.76149	0.07815	B159_30	-0.0052506	0.000411	-12.7749	0.00000
B01_70	0.0076103	0.000335	22.7247	0.00000	B159_50	-0.0061031	0.000472	-12.9191	0.00000
B01_89	0.0103464	0.000645	16.029	0.00000	B159_60	0.0050489	0.001101	4.58433	0.00000
G02	-0.001995	3.24633	-0.00061	0.99951	B519_70	0.0044269	0.000441	10.0324	0.00000
G02_10	135.083	9.58537	14.0927	0.00000	B159_89	-0.0149255	0.000851	-17.5491	0.00000
G02_20	129.206	5.77685	22.3662	0.00000	G16	87.9905	7.96636	11.0453	0.00000
G02_30	-4.36116	4.50372	-0.96835	0.33287	G16_10	53.2647	23.5221	2.26445	0.02355
G02_50	18.5789	4.42392	4.19965	0.00003	G16_20	241.689	14.1761	17.049	0.00000
G02_60	-53.6345	6.69536	-8.0107	0.00000	G16_30	-6.43722	11.0519	-0.58245	0.56026
G02_70	39.2694	3.73812	10.5051	0.00000	G16_50	131.172	10.8561	12.0828	0.00000
G02_89	1.04394	5.40688	0.193076	0.84690	G16_60	-31.3713	16.4301	-1.90937	0.05621
B02	0.0025666	8.91E-05	28.7992	0.00000	G16_70	-39.6725	9.17319	-4.32483	0.00002
B02_10	0.0095543	0.000226	42.35	0.00000	G16_89	37.7635	13.2683	2.84616	0.00443
B02_20	-0.002319	0.000125	-18.5235	0.00000	B16	0.0059067	0.000219	27.0082	0.00000
B02_30	-0.000625	0.000108	-5.77133	0.00000	B16_10	-0.0057043	0.000554	-10.3036	0.00000
B02_50	0.0005759	0.000124	4.62853	0.00000	B16_20	-0.0069683	0.000307	-22.6784	0.00000
B02_60	0.0011067	0.00029	3.81517	0.00014	B16_30	-0.0038326	0.000266	-14.427	0.00000
B02_70	3.25E-05	0.000116	0.279387	0.77995	B16_50	-0.0019139	0.000305	-6.26788	0.00000
B02_89	0.0017905	0.000224	7.99297	0.00000	B16_60	-0.0014436	0.000712	-2.02795	0.04257
G15	858.79	24.3165	35.3172	0.00000	B16_70	-0.0016745	0.000285	-5.87103	0.00000
G15_10	-47.1239	71.7986	-0.65634	0.51161	B16_89	0.003473	0.00055	6.31771	0.00000
G15_20	1240.99	43.2711	28.6795	0.00000	G179	-507.843	34.8929	-14.5543	0.00000
G15_30	379.362	33.7348	11.2454	0.00000	G179_10	-181.173	103.027	-1.7585	0.07866
G15_50	197.56	33.1371	5.9619	0.00000	G179_20	874.345	62.0918	14.0815	0.00000
G15_60	-820.36	50.1512	-16.3577	0.00000	G179_30	-1602.55	48.4077	-33.1054	0.00000
G15_70	117.326	28.0002	4.1902	0.00003	G179_50	-218.952	47.55	-4.60467	0.00000
G15_89	-460.287	40.4999	-11.3651	0.00000	G179_60	536.862	71.9644	7.4601	0.00000
B15	0.0787935	0.000668	118.033	0.00000	G179_70	325.275	40.1788	8.0957	0.00000
B15_10	0.0208175	0.00169	12.3191	0.00000	G179_89	249.175	58.1153	4.2876	0.00002
B15_20	-0.026323	0.000938	-28.0659	0.00000	B179	0.0660501	0.000958	68.9526	0.00000
B15_30	-0.016539	0.000811	-20.3958	0.00000	B179_10	-0.0079924	0.002425	-3.29604	0.00098
B15_50	0.0018858	0.000932	2.02336	0.04304	B179_20	-0.0271073	0.001346	-20.1415	0.00000
B15_60	0.0144188	0.002173	6.63597	0.00000	B179_30	0.0411118	0.001164	35.3324	0.00000

Appendix 2. cont. #1

Name	Coefficient	Std.Err.	t-ratio	P-value	Name	Coefficient	Std.Err.	t-ratio	P-value
B179_50	-0.00153	0.001337	-1.14404	0.2526	B22_20	0.0078397	0.000417	18.8086	0.0000
B179_60	-0.020427	0.003118	-6.5514	0.0000	B22_30	0.0114377	0.00036	31.7391	0.0000
B179_70	-0.029016	0.001249	-23.2274	0.0000	B22_50	-0.0003763	0.000414	-0.90857	0.3636
B179_89	-0.019758	0.002408	-8.20588	0.0000	B22_60	0.0013688	0.000966	1.41753	0.1563
G20	-4.19531	2.75551	-1.52252	0.1279	B22_70	2.399E-05	0.000387	0.061997	0.9506
G20_10	-213.854	8.13611	-26.2846	0.0000	B22_89	-0.0029857	0.000746	-4.00388	0.0001
G20_20	30.9923	4.90342	6.32056	0.0000	G2321	-347.86	19.3471	-17.98	0.0000
G20_30	-10.9151	3.82278	-2.85528	0.0043	G2321_10	764.404	57.1257	13.3811	0.0000
G20_50	-24.7227	3.75505	-6.58385	0.0000	G2321_20	984.829	34.4282	28.6053	0.0000
G20_60	-7.25839	5.68306	-1.2772	0.2015	G2321_30	1018.57	26.8407	37.9488	0.0000
G20_70	-22.072	3.17294	-6.95633	0.0000	G2321_50	325.48	26.3652	12.3451	0.0000
G20_89	-1.31126	4.58939	-0.28572	0.7751	G2321_60	-358.106	39.9022	-8.97459	0.0000
B20	0.000781	7.56E-05	10.3247	0.0000	G2321_70	137.298	22.278	6.16292	0.0000
B20_10	0.0061608	0.000191	32.1724	0.0000	G2321_89	47.1905	32.2233	1.46448	0.1431
B20_20	-0.000473	0.000106	-4.45291	0.0000	B2321	0.0543871	0.000531	102.399	0.0000
B20_30	0.0004225	9.19E-05	4.59748	0.0000	B2321_10	-0.0238068	0.001345	-17.7066	0.0000
B20_50	0.0008812	0.000106	8.34386	0.0000	B2321_20	-0.0397412	0.000746	-53.2559	0.0000
B20_60	0.0004661	0.000246	1.89302	0.0584	B2321_30	-0.0316235	0.000645	-49.0159	0.0000
B20_70	0.0014149	9.87E-05	14.343	0.0000	B2321_50	-0.0045722	0.000742	-6.16571	0.0000
B20_89	-5.25E-05	0.00019	-0.2763	0.7823	B2321_60	0.0175649	0.001729	10.1603	0.0000
G212	73.0318	3.5039	20.843	0.0000	B2321_70	-0.0172032	0.000693	-24.8368	0.0000
G212_10	10.9711	10.3459	1.06043	0.2889	B2321_89	-0.0041525	0.001335	-3.11038	0.0019
G212_20	36.1904	6.23518	5.80423	0.0000	G2323	-70.3978	7.49071	-9.39802	0.0000
G212_30	0.261594	4.86104	0.053814	0.9571	G2323_10	255.782	22.1176	11.5646	0.0000
G212_50	-19.0812	4.77491	-3.99613	0.0001	G2323_20	336.025	13.3297	25.2087	0.0000
G212_60	-62.2451	7.22657	-8.61337	0.0000	G2323_30	68.7465	10.392	6.6153	0.0000
G212_70	-38.0807	4.0347	-9.4383	0.0000	G2323_50	74.1336	10.2079	7.26236	0.0000
G212_89	-84.6966	5.83586	-14.5131	0.0000	G2323_60	66.2545	15.4491	4.28856	0.0000
B212	0.0033221	9.62E-05	34.5365	0.0000	G2323_70	-9.03679	8.62548	-1.04769	0.2948
B212_10	-0.002559	0.000244	-10.5095	0.0000	G2323_89	45.0688	12.476	3.61243	0.0003
B212_20	-0.001066	0.000135	-7.88618	0.0000	B2323	0.0057322	0.000206	27.8748	0.0000
B212_30	4.472E-05	0.000117	0.382742	0.7019	B2323_10	-0.0040373	0.000521	-7.75565	0.0000
B212_50	0.0010778	0.000134	8.02546	0.0000	B2323_20	-0.0060216	0.000289	-20.8418	0.0000
B212_60	0.0009528	0.000313	3.04315	0.0023	B2323_30	-0.0021506	0.00025	-8.60937	0.0000
B212_70	-0.000574	0.000125	-4.57457	0.0000	B2323_50	-0.001439	0.000287	-5.01193	0.0000
B212_89	0.0060288	0.000242	24.9346	0.0000	B2323_60	-0.0054402	0.000669	-8.12761	0.0000
G22	203.039	10.8065	18.7885	0.0000	B2323_70	0.0075278	0.000268	28.0703	0.0000
G22_10	-301.612	31.9082	-9.45249	0.0000	B2323_89	-0.0018987	0.000517	-3.67323	0.0002
G22_20	-244.887	19.2302	-12.7345	0.0000	G2329	-8.19465	1.99818	-4.10106	0.0000
G22_30	-249.778	14.9922	-16.6605	0.0000	G2329_10	-5.20102	5.89997	-0.88153	0.3780
G22_50	-7.99093	14.7266	-0.54262	0.5874	G2329_20	16.8513	3.55576	4.73914	0.0000
G22_60	-166.086	22.2878	-7.45186	0.0000	G2329_30	23.3847	2.77212	8.43566	0.0000
G22_70	16.4178	12.4436	1.31937	0.1870	G2329_50	-18.7672	2.72301	-6.8921	0.0000
G22_89	-80.7791	17.9987	-4.48806	0.0000	G2329_60	14.6941	4.12112	3.56555	0.0004
B22	0.0124587	0.000297	41.9953	0.0000	G2329_70	7.84717	2.30088	3.4105	0.0006
B22_10	0.0140225	0.000751	18.6719	0.0000	G2329_89	6.46932	3.32804	1.94388	0.0519

Appendix 2. cont. #2

Name	Coefficient	Std.Err.	t-ratio	P-value	Name	Coefficient	Std.Err.	t-ratio	P-value
B2329	0.0010469	5.49E-05	19.0854	0.0000	B26	0.0024875	0.000139	17.866	0.0000
B2329_10	0.0004363	0.000139	3.14196	0.0017	B26_10	0.0019916	0.000352	5.6505	0.0000
B2329_20	-0.000873	7.71E-05	-11.3235	0.0000	B26_20	-1.277E-05	0.000196	-0.06526	0.9480
B2329_30	-0.000639	6.66E-05	-9.58374	0.0000	B26_30	0.0017576	0.000169	10.3925	0.0000
B2329_50	0.0011111	7.66E-05	14.507	0.0000	B26_50	0.0003	0.000194	1.54331	0.1228
B2329_60	-0.000878	0.000179	-4.91479	0.0000	B26_60	0.001293	0.000453	2.85312	0.0043
B2329_70	-0.000482	7.15E-05	-6.73879	0.0000	B26_70	0.0011195	0.000182	6.1654	0.0000
B2329_89	-0.00064	0.000138	-4.6388	0.0000	B26_89	0.0030181	0.00035	8.62382	0.0000
G24	301.169	15.7234	19.1543	0.0000	G28	-61.2176	6.57824	-9.30608	0.0000
G24_10	-253.698	46.426	-5.46457	0.0000	G28_10	324.226	19.4234	16.6925	0.0000
G24_20	377.201	27.9797	13.4812	0.0000	G28_20	134.092	11.706	11.455	0.0000
G24_30	-11.2787	21.8134	-0.51705	0.6051	G28_30	-39.3886	9.12616	-4.31601	0.0000
G24_50	-83.6437	21.4269	-3.90368	0.0001	G28_50	-106.748	8.96446	-11.9079	0.0000
G24_60	-415.434	32.4285	-12.8108	0.0000	G28_60	24.6316	13.5672	1.81552	0.0694
G24_70	31.4284	18.1053	1.73587	0.0826	G28_70	42.9652	7.57478	5.67214	0.0000
G24_89	-457.924	26.1878	-17.4861	0.0000	G28_89	8.61002	10.9563	0.785851	0.4320
B24	0.0153112	0.000432	35.4713	0.0000	B28	0.0076146	0.000181	42.165	0.0000
B24_10	0.0010624	0.001093	0.972237	0.3309	B28_10	-0.0066726	0.000457	-14.5959	0.0000
B24_20	-0.010426	0.000606	-17.1914	0.0000	B28_20	-0.0054194	0.000254	-21.3593	0.0000
B24_30	-0.001109	0.000524	-2.11591	0.0344	B28_30	-4.454E-05	0.000219	-0.20306	0.8391
B24_50	-0.001216	0.000603	-2.01735	0.0437	B28_50	0.0029317	0.000252	11.6275	0.0000
B24_60	0.0163827	0.001405	11.6604	0.0000	B28_60	-0.0019413	0.000588	-3.30261	0.0010
B24_70	0.0070573	0.000563	12.537	0.0000	B28_70	-0.002738	0.000236	-11.626	0.0000
B24_89	0.0149143	0.001085	13.746	0.0000	B28_89	-0.0018123	0.000454	-3.99239	0.0001
G25	-36.1823	4.91492	-7.36172	0.0000	G29	-55.1602	10.5763	-5.21543	0.0000
G25_10	-154.669	14.5122	-10.6579	0.0000	G29_10	-131.415	31.2285	-4.20816	0.0000
G25_20	138.034	8.7461	15.7824	0.0000	G29_20	239.303	18.8206	12.715	0.0000
G25_30	28.465	6.81859	4.17462	0.0000	G29_30	-139.227	14.6728	-9.48878	0.0000
G25_50	41.9006	6.69778	6.2559	0.0000	G29_50	-38.8645	14.4129	-2.69651	0.0070
G25_60	-16.6956	10.1367	-1.64704	0.0995	G29_60	10.8978	21.8131	0.4996	0.6174
G25_70	1.96506	5.65948	0.347216	0.7284	G29_70	63.9923	12.1786	5.25451	0.0000
G25_89	-18.6563	8.18597	-2.27906	0.0227	G29_89	24.0359	17.6153	1.36449	0.1724
B25	0.0054519	0.000135	40.406	0.0000	B29	0.0147862	0.00029	50.9255	0.0000
B25_10	0.0046067	0.000342	13.4871	0.0000	B29_10	0.006856	0.000735	9.3279	0.0000
B25_20	-0.004403	0.00019	-23.2252	0.0000	B29_20	-0.0043847	0.000408	-10.7484	0.0000
B25_30	-0.000393	0.000164	-2.39993	0.0164	B29_30	0.0016581	0.000353	4.70125	0.0000
B25_50	0.0003408	0.000188	1.80929	0.0704	B29_50	0.0045511	0.000405	11.2269	0.0000
B25_60	0.0007778	0.000439	1.77096	0.0766	B29_60	-0.0022311	0.000945	-2.36079	0.0182
B25_70	0.0001138	0.000176	0.646662	0.5179	B29_70	-0.0059039	0.000379	-15.5922	0.0000
B25_89	0.0037477	0.000339	11.05	0.0000	B29_89	-0.0045127	0.00073	-6.18335	0.0000
G26	16.0287	5.07171	3.16042	0.0016	G345	-5118.22	82.1674	-62.2902	0.0000
G26_10	-89.3393	14.9751	-5.96585	0.0000	G345_10	2268.13	242.613	9.34873	0.0000
G26_20	16.6894	9.02511	1.84921	0.0644	G345_20	-9198.57	146.217	-62.9105	0.0000
G26_30	-66.5445	7.03611	-9.45757	0.0000	G345_30	-275.219	113.993	-2.41436	0.0158
G26_50	-27.0375	6.91145	-3.91199	0.0001	G345_50	457.962	111.973	4.08993	0.0000
G26_60	-42.2129	10.4601	-4.03561	0.0001	G345_60	3233.91	169.465	19.0831	0.0000
G26_70	-44.1837	5.84003	-7.56567	0.0000	G345_70	2701.01	94.6149	28.5474	0.0000
G26_89	-59.7776	8.44711	-7.07669	0.0000	G345_89	2872.36	136.853	20.9887	0.0000

Appendix 2. cont. #3

Name	Coefficient	Std.Err.	t-ratio	P-value	Name	Coefficient	Std.Err.	t-ratio	P-value
B345	0.250409	0.002256	111.011	0.0000	B403	0.0009036	0.000127	7.10842	0.0000
B345_10	-0.076684	0.00571	-13.4293	0.0000	B403_10	0.0010221	0.000322	3.1761	0.0015
B345_20	0.163293	0.003169	51.5244	0.0000	B403_20	0.0004105	0.000179	2.29845	0.0215
B345_30	-0.031328	0.00274	-11.4333	0.0000	B403_30	-7.315E-05	0.000154	-0.47371	0.6357
B345_50	0.0098813	0.003149	3.13753	0.0017	B403_50	-0.0001815	0.000177	-1.02244	0.3066
B345_60	-0.077742	0.007342	-10.5884	0.0000	B403_60	0.0075169	0.000414	18.1667	0.0000
B345_70	-0.06988	0.002942	-23.7551	0.0000	B403_70	-0.000612	0.000166	-3.69161	0.0002
B345_89	-0.079244	0.00567	-13.9762	0.0000	B403_89	-0.0010684	0.00032	-3.34371	0.0008
G367	-105.951	17.6954	-5.98748	0.0000	G502	-167.379	20.7521	-8.06566	0.0000
G367_10	433.524	52.2489	8.29729	0.0000	G502_10	197.931	61.2742	3.23025	0.0012
G367_20	-283.276	31.489	-8.99604	0.0000	G502_20	164.458	36.9283	4.45343	0.0000
G367_30	-335.836	24.5493	-13.6801	0.0000	G502_30	-39.5198	28.7899	-1.3727	0.1698
G367_50	15.7517	24.1144	0.653207	0.5136	G502_50	-130.638	28.2798	-4.61948	0.0000
G367_60	-49.8735	36.4958	-1.36656	0.1718	G502_60	-40.9737	42.7999	-0.95733	0.3384
G367_70	-33.0503	20.3761	-1.62201	0.1048	G502_70	124.669	23.8958	5.21717	0.0000
G367_89	118.016	29.4724	4.0043	0.0001	G502_89	152.751	34.5633	4.41946	0.0000
B367	0.0258116	0.000486	53.1334	0.0000	B502	0.0141099	0.00057	24.7671	0.0000
B367_10	-0.011701	0.00123	-9.51478	0.0000	B502_10	-0.0034396	0.001442	-2.38505	0.0171
B367_20	0.0078726	0.000683	11.5345	0.0000	B502_20	-0.0062296	0.0008	-7.78287	0.0000
B367_30	0.0142234	0.00059	24.1039	0.0000	B502_30	-0.0018219	0.000692	-2.63266	0.0085
B367_50	-0.001603	0.000678	-2.36391	0.0181	B502_50	0.0036906	0.000795	4.63996	0.0000
B367_60	0.0237371	0.001581	15.0121	0.0000	B502_60	0.0038718	0.001854	2.08797	0.0368
B367_70	-0.005082	0.000634	-8.02225	0.0000	B502_70	-0.0041551	0.000743	-5.5927	0.0000
B367_89	-0.006999	0.001221	-5.73218	0.0000	B502_89	-0.0114594	0.001432	-8.00242	0.0000
G4011	50.2206	9.79491	5.12721	0.0000	G55	141.215	21.5957	6.53901	0.0000
G4011_10	-430.218	28.9212	-14.8755	0.0000	G55_10	-307.691	63.7652	-4.82538	0.0000
G4011_20	364.849	17.43	20.9322	0.0000	G55_20	924.312	38.4296	24.0521	0.0000
G4011_30	234.33	13.5887	17.2444	0.0000	G55_30	941.369	29.9603	31.4206	0.0000
G4011_50	152.383	13.348	11.4162	0.0000	G55_50	-68.6743	29.4295	-2.33352	0.0196
G4011_60	-99.1276	20.2014	-4.90697	0.0000	G55_60	125.467	44.5399	2.81695	0.0048
G4011_70	151.821	11.2787	13.4609	0.0000	G55_70	-230.07	24.8673	-9.25192	0.0000
G4011_89	-89.3458	16.3138	-5.47672	0.0000	G55_89	-37.8748	35.9684	-1.053	0.2923
B4011	0.016591	0.000269	61.7002	0.0000	B55	0.0434334	0.000593	73.2605	0.0000
B4011_10	0.0344691	0.000681	50.6383	0.0000	B55_10	-0.0146783	0.001501	-9.78038	0.0000
B4011_20	0.0001915	0.000378	0.50679	0.6123	B55_20	-0.0219444	0.000833	-26.3451	0.0000
B4011_30	-0.00557	0.000327	-17.0526	0.0000	B55_30	-0.0091353	0.00072	-12.6853	0.0000
B4011_50	-0.002722	0.000375	-7.24967	0.0000	B55_50	-0.0040486	0.000828	-4.89113	0.0000
B4011_60	-0.004181	0.000875	-4.77661	0.0000	B55_60	0.0117228	0.00193	6.0749	0.0000
B4011_70	0.0014414	0.000351	4.11046	0.0000	B55_70	-0.0175758	0.000773	-22.7326	0.0000
B4011_89	0.0092764	0.000676	13.7246	0.0000	B55_89	-0.0154169	0.00149	-10.3455	0.0000
G403	90.7065	4.63061	19.5885	0.0000	G60	299.583	12.0389	24.8846	0.0000
G403_10	-130.229	13.6727	-9.52476	0.0000	G60_10	-330.824	35.5469	-9.3067	0.0000
G403_20	-4.71677	8.24016	-0.57241	0.5670	G60_20	-59.3481	21.4232	-2.77028	0.0056
G403_30	15.5921	6.42415	2.42711	0.0152	G60_30	125.015	16.7018	7.48511	0.0000
G403_50	13.033	6.31033	2.06534	0.0389	G60_50	-114.86	16.4059	-7.00114	0.0000
G403_60	-127.667	9.55034	-13.3678	0.0000	G60_60	-6.95317	24.8294	-0.28004	0.7794
G403_70	-20.5164	5.3321	-3.84772	0.0001	G60_70	-174.935	13.8626	-12.6192	0.0000
G403_89	-24.5952	7.71244	-3.18903	0.0014	G60_89	-107.733	20.0512	-5.37292	0.0000

Appendix 2. cont. #4

Name	Coefficient	Std.Err.	t-ratio	P-value	Name	Coefficient	Std.Err.	t-ratio	P-value
B60	0.0017656	0.000331	5.34205	0.0000	B657	0.0279684	0.000261	107.1	0.0000
B60_10	0.0033219	0.000837	3.97054	0.0001	B657_10	0.0118065	0.000661	17.8598	0.0000
B60_20	0.0032376	0.000464	6.97244	0.0000	B657_20	-0.0135392	0.000367	-36.9014	0.0000
B60_30	0.0011602	0.000401	2.89005	0.0039	B657_30	-0.0094544	0.000317	-29.8048	0.0000
B60_50	2.007E-05	0.000461	0.043497	0.9653	B567_50	-0.00065	0.000365	-1.78274	0.0746
B60_60	0.004905	0.001076	4.55965	0.0000	B657_60	0.0057724	0.00085	6.79113	0.0000
B60_70	0.002331	0.000431	5.40815	0.0000	B657_70	-0.0062146	0.000341	-18.2484	0.0000
B60_89	0.0027845	0.000831	3.35177	0.0008	B657_89	-0.003872	0.000656	-5.89884	0.0000
G63	4.85256	3.1942	1.51918	0.1287	G704	-18.6049	24.1729	-0.76966	0.4415
G63_10	48.9614	9.43145	5.19129	0.0000	G704_10	-264.713	71.3747	-3.70879	0.0002
G63_20	-55.382	5.68408	-9.74336	0.0000	G704_20	-499.686	43.0156	-11.6164	0.0000
G63_30	-2.58507	4.4314	-0.58335	0.5597	G704_30	-639.127	33.5356	-19.0581	0.0000
G63_50	34.2271	4.35288	7.86309	0.0000	G704_50	95.1809	32.9415	2.88939	0.0039
G63_60	-15.9049	6.58785	-2.41428	0.0158	G704_60	42.2489	49.8551	0.847433	0.3968
G63_70	15.3042	3.67809	4.16091	0.0000	G704_70	-239.199	27.8348	-8.5935	0.0000
G63_89	29.2432	5.32006	5.49678	0.0000	G704_89	-259.014	40.2608	-6.43342	0.0000
B63	0.0017078	8.77E-05	19.475	0.0000	B704	0.0293022	0.000664	44.1555	0.0000
B63_10	-0.000451	0.000222	-2.03341	0.0420	B704_10	-0.0054396	0.00168	-3.2381	0.0012
B63_20	0.0019842	0.000123	16.1051	0.0000	B704_20	0.0242598	0.000932	26.0196	0.0000
B63_30	0.000146	0.000107	1.37108	0.1704	B704_30	0.0239824	0.000806	29.7514	0.0000
B63_50	-0.000928	0.000122	-7.57841	0.0000	B704_50	-0.0073503	0.000927	-7.93326	0.0000
B63_60	0.0006639	0.000285	2.32609	0.0200	B704_60	-0.0230201	0.00216	-10.6574	0.0000
B63_70	-0.000336	0.000114	-2.93731	0.0033	B704_70	-0.0011545	0.000865	-1.33405	0.1822
B63_89	0.0004745	0.00022	2.15256	0.0314	B704_89	-0.0025643	0.001668	-1.5373	0.1242
G64	428.6	8.57276	49.9955	0.0000	G702	3916.52	43.3385	90.3705	0.0000
G64_10	-123.105	25.3126	-4.86339	0.0000	G702_10	-353.544	127.964	-2.76283	0.0057
G64_20	106.833	15.2552	7.00305	0.0000	G702_20	978.716	77.1207	12.6907	0.0000
G64_30	12.7422	11.8932	1.07139	0.2840	G702_30	-152.765	60.1245	-2.54081	0.0111
G64_50	-26.2068	11.6825	-2.24326	0.0249	G702_50	-452.435	59.0592	-7.6607	0.0000
G64_60	-182.415	17.6808	-10.3171	0.0000	G702_60	-1508.66	89.3829	-16.8786	0.0000
G64_70	-246.171	9.87145	-24.9377	0.0000	G702_70	-1302.44	49.9038	-26.099	0.0000
G64_89	-311.979	14.2782	-21.85	0.0000	G702_89	-1581.2	72.1817	-21.9058	0.0000
B64	0.014513	0.000235	61.6668	0.0000	B702	0.0953452	0.00119	80.1382	0.0000
B64_10	0.0069959	0.000596	11.7428	0.0000	B702_10	0.042816	0.003012	14.2161	0.0000
B64_20	-0.00174	0.000331	-5.26124	0.0000	B702_20	0.0121408	0.001672	7.26302	0.0000
B64_30	-0.002363	0.000286	-8.26492	0.0000	B702_30	0.0137798	0.001445	9.53486	0.0000
B64_50	0.0012624	0.000329	3.84199	0.0001	B702_50	0.0034962	0.001661	2.10471	0.0353
B64_60	0.0025796	0.000766	3.36743	0.0008	B702_60	0.0342654	0.003873	8.84824	0.0000
B64_70	0.0018794	0.000307	6.12339	0.0000	B702_70	0.0827052	0.001552	53.3042	0.0000
B64_89	0.0209333	0.000592	35.3864	0.0000	B702_89	0.070532	0.002991	23.5848	0.0000
G657	40.9577	9.51245	4.3057	0.0000	G75	-93.3037	13.9237	-6.70107	0.0000
G657_10	-341.716	28.0872	-12.1663	0.0000	G75_10	449.659	41.1121	10.9374	0.0000
G657_20	504.729	16.9274	29.8173	0.0000	G75_20	361.001	24.7772	14.5699	0.0000
G657_30	324.572	13.1969	24.5947	0.0000	G75_30	469.518	19.3167	24.3064	0.0000
G657_50	102.723	12.963	7.92432	0.0000	G75_50	222.462	18.9744	11.7243	0.0000
G657_60	-242.622	19.6188	-12.3668	0.0000	G75_60	-15.0742	28.7168	-0.52493	0.5996
G657_70	-73.6856	10.9535	-6.72713	0.0000	G75_70	1.24798	16.033	0.077838	0.9380
G657_89	-120.037	15.8433	-7.57651	0.0000	G75_89	29.0217	23.1904	1.25146	0.2108

Appendix 2. cont. #5

Name	Coefficient	Std.Err.	t-ratio	P-value	Name	Coefficient	Std.Err.	t-ratio	P-value
B75	0.0281973	0.000382	73.7679	0.0000	G30_3	220.244	13.5654	16.2357	0.0000
B75_10	-0.009665	0.000968	-9.98828	0.0000	G30_3_10	-514.631	40.0542	-12.8484	0.0000
B75_20	-0.005277	0.000537	-9.82639	0.0000	G30_3_20	-297.46	24.1396	-12.3225	0.0000
B75_30	-0.010986	0.000464	-23.6613	0.0000	G30_3_30	221.176	18.8196	11.7524	0.0000
B75_50	-0.006119	0.000534	-11.4653	0.0000	G30_3_50	-63.6537	18.4862	-3.44332	0.0006
B75_60	-0.01242	0.001244	-9.98252	0.0000	G30_3_60	263.787	27.9778	9.42845	0.0000
B75_70	-0.000593	0.000498	-1.18975	0.2341	G30_3_70	-314.336	15.6204	-20.1234	0.0000
B75_89	-0.004294	0.000961	-4.46952	0.0000	G30_3_89	-132.579	22.5936	-5.86796	0.0000
G80	7.99442	5.9234	1.34963	0.1771	B30_3	0.0212771	0.000372	57.1339	0.0000
G80_10	-675.96	17.4899	-38.6486	0.0000	B30_3_10	0.0121355	0.000943	12.8729	0.0000
G80_20	-22.9237	10.5407	-2.17478	0.0296	B30_3_20	0.0045771	0.000523	8.74784	0.0000
G80_30	18.0519	8.21768	2.19672	0.0280	B30_3_30	-0.0007877	0.000452	-1.74122	0.0816
G80_50	-12.2607	8.07208	-1.5189	0.1288	B30_3_50	0.006348	0.00052	12.209	0.0000
G80_60	-16.0597	12.2167	-1.31457	0.1887	B30_3_60	-0.0071754	0.001212	-5.91951	0.0000
G80_70	-4.4612	6.82074	-0.65406	0.5131	B30_3_70	0.0014037	0.000486	2.8902	0.0038
G80_89	-80.4864	9.86563	-8.15826	0.0000	B30_3_89	-0.0010118	0.000936	-1.08089	0.2797
B80	0.0026511	0.000163	16.3031	0.0000	G92_5	91.552594	41.84214	2.188	0.0287
B80_10	0.0239892	0.000412	58.2764	0.0000	G92_5_10	-663.21961	116.245	-5.705	0.0000
B80_20	0.0044328	0.000228	19.402	0.0000	G92_5_20	1368.3196	61.58925	22.217	0.0000
B80_30	0.0008176	0.000198	4.13939	0.0000	G92_5_30	-152.98807	40.23528	-3.802	0.0001
B80_50	0.0003346	0.000227	1.47391	0.1405	G92_5_50	-69.238247	38.73667	-1.787	0.0739
B80_60	0.003588	0.000529	6.77878	0.0000	G92_5_60	341.96609	75.47437	4.531	0.0000
B80_70	-0.001903	0.000212	-8.97516	0.0000	G92_5_70	-1416.8333	23.88779	-59.312	0.0000
B80_89	0.0075446	0.000409	18.4581	0.0000	G92_5_89	47.99135	55.7303	0.861	0.3892
G85	-205.381	22.9396	-8.95311	0.0000	B92_5	0.1067234	0.001149	92.909	0.0000
G85_10	288.862	67.7333	4.2647	0.0000	B92_5_10	0.1032414	0.002671	38.648	0.0000
G85_20	411.536	40.821	10.0815	0.0000	B92_5_20	0.0839926	0.001134	74.091	0.0000
G85_30	62.6859	31.8247	1.96972	0.0489	B92_5_30	0.1260621	0.000792	159.15	0.0000
G85_50	-571.253	31.2608	-18.2738	0.0000	B92_5_50	0.0959481	0.001119	85.73	0.0000
G85_60	210.792	47.3116	4.45539	0.0000	B92_5_60	0.1092728	0.003558	30.712	0.0000
G85_70	426.242	26.4148	16.1365	0.0000	B92_5_70	0.1612734	0.000962	167.726	0.0000
G85_89	4.80876	38.2067	0.125862	0.8998	B92_5_89	0.087319	0.003108	28.091	0.0000
B85	0.026463	0.00063	42.021	0.0000					
B85_10	-0.011253	0.001594	-7.05904	0.0000					
B85_20	-0.004488	0.000885	-5.07249	0.0000					
B85_30	0.0009921	0.000765	1.29696	0.1946					
B85_50	0.0210792	0.000879	23.974	0.0000					
B85_60	-0.012303	0.00205	-6.00179	0.0000					
B85_70	-0.003204	0.000821	-3.90157	0.0001					
B85_89	0.0021163	0.001583	1.33692	0.1812					

Note: Gxxx_yy codes refer to constants C_i of equation (2), and its xxx's refer to product codes, whereas _yy's refer to socio economic group codes. Bxxx_yy's refer to β_i 's of equation (2) in the similar fashion. The parameters without _yy's refer to the reference group 40 (lower white-collar workers). The estimation results for C_92_5, the omitted variable, were obtained by using WALD procedure within LIMDEP. The estimation of parameters was conducted in five separate regressions due to high dimensionality of the problem (the maximum length of the LIMDEP code is 2.500 characters).

Appendix 3. Parameter values used within VATTAGE

Expenditure elasticity EPS by socioeconomic group

		10	20	30	40	50	60	70	80&90	All hhds
1 C_01	Agriculture	0.979	0.512	0.972	0.820	0.789	1.403	0.838	1.224	0.781
2 C_02	Forestry	0.744	0.092	1.109	1.070	0.889	5.719	0.614	1.053	0.678
3 C_101	MiningHardCoal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4 C_103	ExtPeat	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5 C_11101	ExtPetroleum	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 C_11102	ExtGas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7 C_13_4	OtherMining	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8 C_15	ManFood	0.792	0.601	0.732	0.802	0.745	1.037	0.652	0.896	0.695
9 C_159	ManBrev	0.790	0.865	0.810	1.034	0.703	1.000	1.561	0.210	0.929
10 C_16	ManTobac	0.050	0.422	0.564	0.735	0.383	0.621	0.685	0.610	0.398
11 C_17_9	ManTextiles	1.395	0.927	1.865	1.400	1.659	1.025	1.404	1.550	1.610
12 C_20	ManWoodCork	5.417	0.390	1.458	1.281	2.402	2.175	2.561	1.845	1.694
13 C_21121	ManNewsprint	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14 C_21125	ManFineprint	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15 C_21129	PulpAndOth	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16 C_212	ManPaper	0.248	0.549	0.712	0.639	0.759	0.930	0.658	1.147	0.730
17 C_22	Publishing	1.065	1.163	1.101	0.714	0.697	0.923	0.574	0.620	0.936
18 C_232011	ManPetrol	0.709	0.578	0.638	1.331	1.074	2.344	1.474	1.602	1.018
19 C_232012	ManDiesel	0.709	0.578	0.638	1.331	1.074	2.344	1.474	1.602	1.018
20 C_232013	ManLightOil	0.709	1.136	1.065	1.716	1.030	5.085	1.507	1.690	1.072
21 C_232014	ManHeavyOil	0.709	0.578	1.065	1.716	1.030	5.085	1.507	1.602	1.018
22 C_23209	ManOthOilP	1.259	0.541	0.579	1.408	1.769	0.338	1.100	1.397	1.072
23 C_24	ManChemicals	0.893	0.282	0.726	0.668	0.707	1.328	0.618	1.501	0.577
24 C_25	ManRubPlasti	1.910	0.363	1.091	1.343	1.026	2.015	1.524	1.598	1.104
25 C_26	ManNmetMineP	1.682	0.869	1.429	0.894	1.212	1.729	1.723	1.916	1.331
26 C_271	ManIronSteel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27 C_279	ManBasMetals	0.116	0.652	1.492	1.420	2.169	1.657	1.305	2.159	1.369
28 C_28	ManMetalProd	0.116	0.652	1.492	1.420	2.169	1.657	1.305	2.159	1.369
29 C_29	ManMachinery	1.242	0.808	1.426	1.208	1.255	1.321	1.017	1.284	1.214
30 C_30_3	ManuElecOpti	1.250	1.188	0.714	0.812	0.895	0.364	1.337	0.859	1.001
31 C_34_5	ManTransporE	1.685	4.194	2.309	2.863	2.494	2.712	3.074	3.981	2.518
32 C_36_7	Mann.e.c.	0.598	1.474	1.393	1.224	1.202	1.287	1.585	1.030	1.441
33 C_4011	WaterPurif	1.194	0.729	0.671	0.979	0.720	1.360	0.690	1.165	0.773
34 C_4012	WaterTrans	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 C_403	ElecGas	2.078	0.466	0.275	0.263	0.188	1.405	0.084	0.392	0.386
36 C_4501	GenConBuild	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37 C_4502	ConRoadWater	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38 C_50_2	Trade	0.894	1.121	1.678	1.681	2.292	3.000	1.349	1.541	1.496
39 C_55	HotelRest	1.133	0.542	0.621	0.973	0.999	0.836	1.282	0.885	1.050
40 C_60	LandTrans	1.145	0.551	0.251	0.173	0.245	0.308	0.429	0.318	0.503
41 C_61	WaterTrans	1.145	0.551	0.251	0.173	0.245	0.308	0.429	0.318	0.503
42 C_62	AirTransport	1.145	0.551	0.251	0.173	0.245	0.308	0.429	0.318	0.503
43 C_63	SupTranAct	0.453	1.568	1.026	0.984	0.405	1.434	0.621	0.570	0.871
44 C_64	PostTelecom	0.701	0.589	0.585	0.562	0.582	0.588	0.691	0.901	0.635
45 C_65_7	Financial	1.199	0.617	0.734	1.024	0.905	1.592	1.151	1.306	0.980
46 C_702	Realestate	0.574	0.566	0.598	0.474	0.498	0.521	0.622	0.597	0.549
47 C_70_4	BuySellrealE	1.395	1.400	1.449	1.091	0.952	0.877	1.928	2.535	1.638
48 C_75	PublicAdmini	0.639	0.891	0.711	1.191	0.891	1.720	1.274	1.255	1.034
49 C_80	Education	2.799	1.164	0.904	0.980	1.109	1.143	0.867	1.768	1.456
50 C_85	HealthSocial	0.840	0.928	1.190	1.404	2.229	1.039	0.729	1.753	1.105
51 C_92_5	CulturSports	1.116	0.728	1.203	1.122	1.184	1.157	1.996	1.103	1.294

Appendix 3. cont.

Frisch parameter		
10	Farmers	-5.63
20	Enterpreneurs	-3.77
30	Upper white-collar	-2.19
40	Lower white-collar	-2.68
50	Blue-collar	-2.36
60	Students	-5.39
70	Retired	-2.88
80&90	Unemployed and other	-3.73
All hhds	All households	-2.40

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