AEIOU

Towards a new Austrian INFORUM model

by

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1. Introduction

The new Austrian macroeconomic interindustry model AEIOU is based on the general philosophy of INFORUM modelling. It relies on the common software and it is the intention to build a model that possesses the crucial properties to be included in the INFORUM system of macroeconomic models.

AEIOU is an acronym first used by Emperor Frederick III, who reigned from 1440 to 1493 (!!) and can be found on many famous buildings and objects in Austria. Its exact meaning is unknown and heavily disputed among historians. The usual interpretation is that it stands for "Austria erit in orbe ultima" (Austria will be forever). Although it is absolutely sure that the Austrian INFORUM model AEIOU will not be forever it was chosen as a name.

In accordance with the general INFORUM philosophy the model is based on the input-output identities: "That use assures absolute accounting consistency, on the product side, among final demands, intermediate use, and production of products and, on the price side, among prices of products, the costs of materials used and the value-added generated in making them" (ALMON 1991).

The approach is bottom up: Macroeconomic totals are built from commodity and industry detail. It does not rely on an aggregate macro-model driver. A high level of disaggregation is seen as crucial in order to analyze structural developments. Shocks and political measures affecting only one group of commodities or one economic branch can be examined in a consistent manner in their effects on other goods or industries as well as on the whole economy. The possible degree of details is limited by the availability of input-output data and adequate and consistent time series.

Also in accordance with the general INFORUM philosophy the model is not based on a single economic theory. Instead of "As we know from literature" economic reality is primarily perceived through the eyes of the statistical system of the country. AEIOU is data oriented and tries to make utmost use of all empirical evidence available in Austria.

Many resources were put into the establishment of a sound and detailed statistical basis and to ascertain consistency within this data basis. Within the limits given by data and resources use is made of regression analysis to describe the behaviour of consumers and industries as investors and employers. These econometrically estimated equations reduce the number of exogenous variables. "Without these behavioural equations, the model would be a framework with little content; without the identities, the content could be self-contradictory" (GRASSINI 2005).

The model is build with no specific application in mind. It is rather meant to be a flexible, general purpose instrument. On the other hand some properties of the model are inspired by a number of applications and experience already gained with other INFORUM models. In order to allow for energy and environment related analyses the utility industries are treated on a more disaggregated basis than in the standard classification. In order to allow for investigations in the future impact of the aging of the society and on the health care system in particular, public consumption was broken down into collective and individual consumption.

The work on the new model was made possible by grant 11144 from the Oesterreichische Nationalbank (Austrian National Bank). The Institute for Industrial Research, Vienna provides the organisational background. Bernhard Böhm (TU Vienna) is the project leader, Josef Richter the continuous element in the work.

So far major contributions to the project were made by Nina Engelputzeder (preparation of the data set for private consumption, first estimates for the consumer expenditure system), Alexander Filler (employment equations), Dominik Freund (import equations), Georg Görg (investment equations), and Wolfgang Koller (data preparation, purification of matrices). Additional research assistance by Bernhard Mahlberg is acknowledged.

Without the substantial contributions of Clopper Almon and Reelika Parve, who both worked more than one week each on the Austrian model, it would have been impossible to get started.

The project is also particularly indebted to Erwin Kolleritsch of Statistics Austria for providing additional data and background information.

This paper gives a short outline of some of the specific properties of AEIOU. It should be seen as an incomplete report on work in progress. A lot needs still to be done.

2. Accounting framework and data

2.1 Input-output core

As all INFORUM models AEIOU is based on an input-output core, the base year being 2001. According to „REGULATION (EC) No 1267/2003 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL governing the time schedule for the transmission of national accounts" Statistics Austria published supply and use tables for this year in the standard European classification, but no "input-output table". In many respect the data situation is more favourable than in other member countries of the European Union.

In addition to the mandatory supply table at producer prices and use tables at purchasers' prices, Statistics Austria also publishes use tables and final demand at producers' prices. Detailed tables of margins, commodity taxes, commodity taxes and imports (in the same breakdown as the use and final demand tables) are also made available every year. This data set is almost consistent with the time series information from national accounts.

What is missing is the cross classification of production account by industry and sectors. According to the Transmission Programme of Regulation No 1267/2003 this information should at least be made available every five years. Therefore an important link between value added by industries and sector accounts (at least the one for private households) had to be established by own estimates.

Statistics Austria publishes all the data in the standard A (activity) 60 and P (product) 60 level of disaggregation. The make table and the use table at purchasers' prices are also available on the more disaggregated basis of 75 activities and commodities.

As already discussed in a previous contribution to an INFORUM Conference (RICHTER 2004) the European Statistical System is not designed according to the needs of model builders. The standard classifications that have to be used are good examples. The aggregates that are formed are neither homogeneous with respect to technology, nor homogeneous with respect to labour input. Vertical integration – with all its negative consequences for IO analysis – can also be found quite frequently in the standard classification.

Despite these undesired properties the Austrian model – like most of the other European models – had to be based on the standard classification. It was only possible to make a few modifications. In two cases (fishery and water transportation) commodity groups and activities were aggregated with other commodity groups and activities (agriculture, land transport) since the size of these groups in Austria is very small.

Because of analytical reasons much effort was put into the isolation of electricity as a commodity group and as a separate industry. In the standard European classifications electricity is shown together with gas, steam and hot water. Table 1 provides an overview of the disaggregation by product groups.

Table 1 Commodity classification of AEIOU

	CPA	
1	01, 05	Products of agriculture and fishing
2	02	Products of forestry
3	10	Coal and lignite
4	11, 13	Crude petroleum, natural gas, metal ores
5	14	Other mining and quarrying products
6	15	Food products and beverages
7	16	Tobacco products
8	17	Textiles
9	18	Wearing apparel, furs
10	19	Leather and leather products
11	20	Wood and products of wood
12	21	Pulp, paper and paper products
13	22	Printed matter and recorded media
14	23	Coke, refined petroleum products
15	24	Chemicals, chemical products
16	25	Rubber and plastic products
17	26	Other non-metallic mineral products
18	27	Basic metals
19	28	Fabricated metal products
20	29	Machinery and equipment n..c.
21	30	Office machinery and computers
22	31	Electrical machinery and apparatus
23	32	Radio, TV and communication equipment
24	33	Med., precision, opt. instruments, watches, clocks
25	34	Motor vehicles, trailers and semi-trailers
26	35	Other transport equipment
27	36	Furniture other manufactured goods n..c.
28	37	Recovered secondary raw materials
29	40.1	Electrical energy
30	40.2, 40.3	Gas, steam and hot water
31	41	Water, distribution services of water
32	45	Construction work
33	50	Trade and repair services of motor vehicles etc.
34	51	Wholesale and comm. trade serv., ex. of motor vehicles
35	52	Retail trade serv., repair serv., ex. of motor vehicles
36	55	Hotel and restaurant services
37	60, 61	Land and water transport and transport via pipeline services
38	62	Air transport services
39	63	Supporting transport services travel agency services
40	64	Post and telecommunication services
41	65	Financial intermediation services (ex. insurance serv.)
42	66	Insurance and pension funding services
43	67	Services auxiliary to financial intermediation
44	70	Real estate services
45	71	Renting services of machinery and equipment
46	72	Computer and related services
47	73	Research and development services
48	74	Other business services
49	75	Public administration services etc.
50	80	Education services
51	85	Health and social work services
52	90	Sewage and refuse disposal services etc.
53	91	Membership organisation services n.e.c.
54	92	Recreational, cultural and sporting services
55	93	Other services
56	95	Private households with employed persons
57		Commodity taxes
58		Commodity subsidies

On the basis of the set of modified use tables and the modified make table a product to product table was derived relying on hybrid technology assumptions, but primarily using a slightly modified version of the ALMON purification approach. For details see the paper by KOLLER to this conference.

2.2 Final demand

2.2.1 Private Consumer Expenditure

Private Consumer Expenditures (PCE) are broken down by commodities and by three different categories:

- Nationals (Austrian in Austria)
- Foreigners (Tourism)
- Private non profit institutions

Two main considerations stand behind the distinction between PCE by residents and PCE by tourists.

- Disposable income of Austrian residents is the main driving force behind consumer expenditures of Austrian in Austria and abroad. The expenditures of foreign tourists in Austria are affected by the income situation in the countries of their origin and by the competitive position of Austria compared to other destinations of tourists. It would be a major shortcoming to make total demand of consumer expenditure for transport services and hotels and restaurants solely dependent upon income of Austrian residents.

- The obvious deviations of the shares by categories from the average share of tourists in domestic consumption is the second reasons for distinguishing two different categories of final demand and for modelling these two subcategories in a different way.

As it becomes evident from Table 2 the share of foreign households (tourists) in total domestic consumption in Austria differs significantly by COICOP categories. In some important groups categories like rents and social services Austrian residents are dominating as consumers. In one category - transportation services – consumer expenditures by foreigners are even higher than the ones by Austrians. This category includes not only the traditional expenditures of tourists for trains, cable railways and ski lifts but also the expenses of foreigners for gasoline and diesel in Austria. Since the price of gasoline is at times significantly lower in Austria compared to Germany and Italy these expenditures are quite important, but also highly dependent on this specific price relation, primarily caused by differences in taxes between countries. The high shares of consumption expenditures of foreigners in Austria in total consumer expenditure for hotels and restaurants and for cultural events are not a big surprise.

Like in most European countries the Austrian statistical system provides information on total domestic private consumption in a breakdown by COICOP categories only. Consumption of Austrians abroad and consumption of foreigners in Austria are given as totals.

PRIVATE CONSUMER EXPENDITURE IN AUSTRIA 2001 **Table 2**

Shares in total PCE in Austria; selected COICOP groups

COICOP		Austrians in Austria	Foreigners in Austria
1,1	Food	0,94	0,06
1,2	Non-alcoholic beverages	0,94	0,06
2,1	Alcoholic beverages	0,94	0,06
2,2	Tobacco	0,92	0,08
3,1	Clothing	0,93	0,07
4,1	Actual and imputed rentals for housing	1,00	0,00
5,1	Furniture, carpets and other floor coverings	0,97	0,03
7,3	Transport services	0,44	0,56
9,1	Audiovisual, photographic and information processing equipment	0,93	0,07
9,2	Other major durables for recreation and culture	0,97	0,03
9,4	Recreational and cultural services	0,64	0,36
11,1	Catering services	0,53	0,47
11,2	Accommodation services	0,53	0,47
12,1	Personal care	0,88	0,12
12,4	Social protection	1,00	0,00
12,5	Insurance	1,00	0,00
	Total	**0,89**	**0,11**

In order to have two separate columns in final demand and time series for consumer expenditures of Austrians and by foreigners in Austria in a breakdown by COICOP categories, a special sub-research project was launched. The results of this project (ENGELPUTZEDER 2005) are a major contribution to a firm empirical foundation of the model. The time series by COICOP were estimated in nominal terms and in constant prices under the assumption that the price movement by commodity is the same for Austrians and foreigners. The resulting time series served as the basis for the estimation of the consumer expenditure system (see Chapter 3).

Among the main statistical sources was the consumer survey by Statistics Austria for Austrian household and a specific expenditure survey among foreign tourists in Austria carried out every three years. In the case specific Austrian data was lacking, the analysis also relied on information for Slovenia and Switzerland.

Special emphasis was laid on the attempt to incorporate all the effects of structural shifts in tourist's expenditure in Austria. Use was made of the information on the shares of business trips, one day trips, foreign students, foreigners as owners of a second home in Austria and "standard tourists" (staying at least one night in Austria) in total tourism. In addition the available data on arrivals and stays by seasons, by average length of stay and by country of origin of the tourist provided additional hints for the estimation. For some commodity groups of special relevance it was possible to find direct information on the shares of tourism in total domestic expenditure. This favourable situation was given for expenditures for cable cars, some health services, railway, leasing of cars.

In addition use was made of the GLOBEMI model developed by the Technical University Graz describing the expenditure (and its determinants) of foreigners for gasoline and diesel in

Austria (BUNDESMINISTERIUM FÜR LAND- UND FORSTWIRTSCHAFT, UMWELT UND WASSERWIRTSCHAFT 2004). In a later stage of the development of AEIOU it is planned to incorporate some of the models behind the data generating process into AEIOU directly.

The consumption expenditures of Austrians abroad are treated on an aggregate level. The calculation of these expenditures is necessary to derive total personal consumer expenditures of Austrian residents which are the "counterpart" to total disposable income of Austrians as calculated in the accountant.

2.2.2 Public Consumption

In public consumption the following distinction is made:
- Individual Consumption
- Collective Consumption

2.2.3 Gross Capital Formation

The data situation for modelling capital formation in Austria is quite favourable. The following information from national accounts is published:

Time series for total capital formation broken down by six categories, in nominal terms and in the form of volume indices (chained Laspeyres):
- Residential buildings
- Other buildings
- Transportation equipment
- Other machinery and equipment
- Productive livestock
- Intangible fixed assets

From the standard set of input-output data provided by Statistics Austria the following data was available:

- Full matrices of capital formation broken down by commodities (CPA) and by investing industries (NACE) in purchasers´ prices for each of the six categories of investment mentioned before.

- Wholesale trade margins
- Retail trade margins
- Transport margins
- Commodity taxes
- Commodity subsidies

for each of the six categories of investment. This information allows to bridge from a valuation in purchasers´ prices to a valuation in producers´ prices.

In addition Statistics Austria made time series of capital formation by investing industries (NACE), for each of the six investment categories separately; both in nominal terms and volume indices available. This data set is not published generally. Given this empirical background a decision had to be made between three main alternatives for modelling capital formation:

a) By investment categories (6)
b) By investing industries with no distinction as far as the category of investment is concerned (56)
c) By investing industries and by categories (56*6)

Alternative a) has the advantage of relative stability as far as the composition of total investment by commodities is concerned. On the other hand no link to the output level by investing industries can be established.

In the second alternative this link can easily be guaranteed. On the other hand it cannot be assumed that the structure of investment by commodities in each of the industries remains stable. One of the main sources of instability over time must be seen in the fact that the shares of the three main components (investment in construction, investment in vehicles and investment in equipment) in total investment by industries varies considerably. This is the case especially in small industries with a limited number of units.

The third alternative provides a maximum of disaggregation, but probably by far too many details. Many of the columns in this data set are more or less empty, stability over time of the relationships cannot be assumed.

In order to make full use of the information content given in the data set, a number of preparatory analyses were carried out to find a manageable breakdown of total capital formation. The following criteria were applied:

- Relevance
- Form aggregates big enough to make sure that the investment decision of a single agent does not play a too dominant role in the aggregate
- Form clusters of investing industries which are characterized by the similarity in the commodity structure of the investment.

According to these criteria 15 categories of capital formation were identified:

1. Residential buildings
2. Other buildings
3. Machinery and equipment by activities NACE 01 to 37, NACE 45 (agriculture, manufacturing, construction)
4. Machinery and equipment by activities NACE 40 and 41 (utilities)
5. Machinery and equipment by activities NACE 50 to 55 (trade, hotel, restaurants)
6. Machinery and equipment by activities NACE 60 to 64 (transportation)
7. Machinery and equipment by other activities
8. Transportation equipment by activities NACE 01 to 05 (agriculture, forestry)
9. Transportation equipment by activities NACE 10 to 55 (manufacturing, trade)
10. Transportation equipment by activities NACE 60 + 61 (transportation land, water)
11. Transportation equipment by activities NACE 62 (transportation air)
12. Transportation equipment by other activities
13. Productive livestock
14. Intangible fixed assets by NACE 92
15. Intangible fixed assets by all other activities

Residential buildings are treated separately, because there is only one investor - industry NACE 70.

In the case of "Other construction" aggregation is done over all investing industries. The share of CPA commodity 45 ("Construction") is dominating (around 80%) in all industries. There are only a few exceptions, namely utilities (water supply in particular, only 52% CPA 45 "Construction") and banking and insurances (less than 70% CPA 45 "Construction"). In view of the very low share of investment in these industries in total investment in "Other construction" (water supply 0,4%, financial services 1,6% ; insurances 0,7%) it was decided to treat these industries not separately.

The most labour intensive part was to find meaningful aggregations over industries to describe investment in equipment and vehicles. Table 3 describes the solution for investment in equipment.

INVESTMENT IN EQUIPMENT **Table 3**

Relative importance of groups of investors

Aggregation	**Investors**	Share 2001 in %
NACE 01 to NACE 37 plus NACE 45	Agriculture, Manufacturing, Construction	40
NACE 40,41	Utilities	6
NACE 50 to NACE 55	Trade, Hotel & Restaurants	13
NACE 60 to NACE 64	Transports	15
NACE 65 pp	Others	26
	Total	100

As might be depicted from Table 4 the main reason for forming these groups can be found in the different commodity composition of the demand for capital goods by these industries.

INVESTMENT IN EQUIPMENT **Table 4**

Column Shares of Final demand (Purchaser Prices) 2001

		Investors				
CPA	Most important commodity groups	NACE 01 to 37 and 45	NACE 40,41	NACE 50 b 55	NACE 60 b 64	NACE 65 pp
17	Textiles	0,000	0,000	0,001	0,000	0,001
25	Rubber and plastic products	0,002	0,007	0,006	0,002	0,005
26	Other non-metallic mineral products	0,001	0,011	0,006	0,002	0,001
27	Basic metals	0,001	0,014	0,000	0,004	0,000
28	Fabricated metal products	0,128	0,147	0,084	0,090	0,033
29	Machinery and equipment	0,668	0,157	0,186	0,118	0,280
30	Office machinery and computers	0,063	0,009	0,223	0,032	0,281
31	Electrical machinery and apparatus	0,029	0,365	0,022	0,151	0,013
32	Radio, TV and communication equipment	0,014	0,003	0,035	0,455	0,048
33	Med., precision, opt. instruments, watches, clocks	0,056	0,201	0,059	0,050	0,157
34	Motor vehicles, trailers and semi-trailers	0,000	0,000	0,000	0,000	0,000
35	Other transport equipment	0,000	0,000	0,000	0,000	0,001
36	Furniture other manufactured goods	0,038	0,013	0,372	0,037	0,181
	Others	0,001	0,072	0,006	0,058	0,001
	Total	1,000	1,000	1,000	1,000	1,000

Machinery plays a dominant role in the investment in equipment in the manufacturing sector but only a modest role in utilities and in the service sectors. In the utilities expenditures in electrical machinery and in precision instruments have very high shares; the share of these commodities in the other industries is comparably low. Furniture is an important investment

good in trade and in the tourisms sector but is not of relevance in the investment demand in the manufacturing and the transportation industries. Commodity group CPA 32 (mainly communication equipment) is only important in the transportation industries.

The share of the service industries as investors is much higher in the case of investment in vehicles than in the case of investment in equipment. The investigation of the column coefficients by industries led to an entirely different "clustering" of industries.

INVESTMENT IN VEHICLES **Table 5**

Relative importance of groups of investors

Aggregation	**Investors**	Share 2001 in %
NACE 01 to NACE 05	Agriculture, Forestry	7
NACE 10 to 55	Manufacturing, Trade, Hotels	15
NACE 60, 61	Transportation land	20
NACE 62	Transportation air	5
NACE 63 pp	Others	53
	Total	100

Investment in vehicles is concentrated on an even more limited number of commodities, compared to investment in equipment. The "commodity mix" again differs significantly by groups of investors.

INVESTMENT IN VEHICLES **Table 6**

Column Shares of Final demand (Purchaser Prices) 2001

		Investors				
CPA	Most important commodity groups	NACE 01 to 05	NACE 10 to 55	NACE 60, 61	NACE 62	NACE 63 pp
29	Machinery and equipment	0,939	0,000	0,000	0,000	0,000
34	Motor vehicles, trailers and semi-trailers	0,060	0,974	0,485	0,002	0,967
35	Other transport equipment	0,002	0,006	0,498	0,998	0,019
50	Trade and repair services of motor vehicles etc.	0,000	0,018	0,016	0,000	0,014
	Others	0,000	0,003	0,001	0,000	0,001
	Total	1,000	1,000	1,000	1,000	1,000

Because of the dominance of machinery (tractors and harvesting machinery are classified under CPA 29 "Machinery") in investment demand of agriculture and forestry, these industries are treated separately although the share of their investment in vehicles in total investment in vehicles is only 7%. The motivation to treat industry NACE 62 "Air transport services" separately is a similar one. In contrast to the other investors they invest in aircraft only, classified under CPA 35. Because industry NACE 62 is dominated by one single enterprise, investment in vehicles by this industry is treated exogenously.

Investment in productive livestock causes no problems. This category of capital formation is very small, there is only one investor (agriculture) and one commodity (agricultural products) involved.

Investment in intangible fixed assets can be observed in almost all industries, with one exception all investment is in software.

INVESTMENT IN INTANGIBLE FIXED ASSETS **Table 7**

Relative importance of groups of investors

Aggregation	Investors	Share 2001 in %
NACE 92	Recreational, cultural and sporting services	11
All other industries	All other industries	89
	Total	100

Only industry NACE 92 "Recreational, cultural and sporting services" invests a lot in licences classified under CPA 92, as might be seen from Table 8. Because of this peculiarity industry NACE 92 is treated separately as an investor.

INVESTMENT IN INTANGIBLE FIXED ASSETS **Table 8**

	Column Shares of Final demand (Purchaser Prices) 2001	Investors	
CPA	Most important commodity groups	NACE 92	Others
72	Computer and related services	0,105	1,000
92	Recreational, cultural and sporting services	0,895	0,000
	Others	0,000	0,000
	Total	1,000	1,000

The estimation of the investment equations is done in this breakdown by 15 categories. The resulting global demand for investment is then split up into commodity specific demand (valued at purchasers´ prices) using 15 specific bridge matrices. Tables 4, 6 and 8 show part of the information contained in these matrices. In the next step six different valuation transformation matrices (for equipment, vehicles, etc.) are applied to arrive at a valuation in producers´ prices. All the category and commodity specific data on wholesale trade margins, retail trade margins, transport margins, commodity taxes and commodity subsidies was used to construct these matrices.

Information or assumptions on changes in margins and particularly in commodity taxes (non deductible VAT!) can be introduced by fixing the appropriate elements of the six valuation transformation matrices.

2.2.4 Other final demand, margins, commodity taxes and subsidies

In addition to the already mentioned final demand categories, the following components are distinguished:

- Acquisitions less disposals of valuables
- Changes in inventories
- Exports, goods
- Exports, services

Special emphasis is put on the detailed treatment of margins, taxes and subsidies. In order to make full use of the input-output framework as a detailed weighting scheme, specific matrices were constructed to bridge from the various final demand categories in purchasers' prices to final demand categories (broken down by commodities) in producers' prices.

Trade margins (distinguishing wholesale trade from retail trade and three different margins), transport margins (with a distinction of four different transportation services and transportation insurance), commodity taxes and commodity subsidies are treated commodity specific and with respect to the final demand category under consideration.

2.3 Value added, employment

Value added is broken down into six components:

- Compensation of Employees
- Social Security Contributions of employers
- Other Taxes on Production
- Other Subsidies on Production
- Depreciations
- Operating Surplus, net

As regards employment, data is available both in full time equivalents and in number of jobs. In addition a distinction is made between total labour force and employees.

From the statistical system this data is available by activities. For the base year 2001 a second data set was estimated in a disaggregation by commodities (KOLLER 2006).

2.4 Time series data

In the European Union national accounts aggregates in real terms are primarily used for Community policy purposes and, in particular, for the supervision of the stability and growth pact. Therefore the compilation of statistical data in real terms is to a high degree standardized and regulated. According to the European legislation volume measures available at the elementary level of aggregation shall be aggregated using the Laspeyres formula to obtain the volume measures of all national accounts aggregates, using weights derived from the **previous** year (COMMISSION DECISION of 30 November 1998 clarifying Annex A to Council Regulation (EC) No 2223/96 on the European system of national and regional accounts in the Community as concerns the principles for measuring prices and volumes).

Statistical agencies in the European Union have to provide data with these characteristics. Usually the form of publishing no absolute numbers but only chain volume indices is chosen. In most cases (also in Austria) no attention is paid to the recommendation of the SNA, that "disaggregated constant price data should be compiled and published in addition to the chain indices for the main aggregates. The need to publish two sets of data that may appear to conflict with each other should be readily appreciated by analysts engaged in macroeconomic modelling and forecasting" (SNA 1993, 16.75).

What is missing in Austria is a set of constant price time series with adding up properties. Since it was not possible to convince Statistics Austria to compile a second set of data using a fixed base year as in previous times, we had to produce a set of "own" national accounts time series at constant prices, using 2001 (the year of our modified input-output table) as the base year of our own calculations.

Most of the data published by Statistics Austria comes in the form of volume indices with the reference year 2000 = 100. The standard procedure was to rebase these indices to a reference year 2001 = 100 and to link the indices to the respective nominal values of 2001. This procedure was done on the lowest level of detail available. Totals and subtotals were then calculated by aggregation.

The standard length of our time series covers 1976 – 2004. Only the time series of consumption expenditures ends with 2003. Time series of the foreign trade variables in constant prices start with 1995.

3. Behavioural Equations

3.1 Private Consumption

Private consumption expenditures have been disaggregated into three components: expenditures by Austrian residents, by foreigners in Austria, and by private non profit service institutions. The last component is treated as exogenous because of its relative unimportance. Consumption expenditures by Austrians are disaggregated into 37 COICOP commodity groups and one group containing consumption expenditures by Austrians abroad. The 38 groups are modelled in the spirit of the PADS approach by ALMON (1979, 1998).

We define the following variables:

Pce(i)	Real consumption expenditures by Austrian residents, i = 1, …, 37 i = 38 real consumption expenditures by Austrians abroad
Pcen(i)	Nominal consumption expenditures of Austrians on group i

As explanatory variables in the consumption equations we use:

Totpce	Sum over all real private consumption expenditures of Austrian residents
ppce(i) =	pcen(i) / pce(i) chained price index for group i = 1, …,37; (2001 = 1)
tppce	Chained price index of Totpce (2001 = 1)
ppceg(j)	Chained group price indices of major COICOP-groups (j = 1, …, 13)

In addition dummy variables for various years and periods are included. The trend variable is specified to start with 0 in 1976. Occasionally a quadratic trend is included to improve the fit over the sample period.

Table 9

Group	Consumption expenditure group (COICOP Classification)
1	Food (01.1)
2	Non-alcoholic beverages (01.2)
3	Alcoholic beverages (02.1)
4	Tobacco (02.2)
5	Clothing (03.1)
6	Footwear (03.2)
7	Actual and imputed rentals for housing, water supply and misc. services related to dwelling (04.1+2+4)
8	Maintenance and repair of dwellings (04.3)
9	Electricity, Gas, and other fuels (04.5)
10	Furniture, carpets and other floor coverings (05.1)
11	Household textiles (05.2)
12	Household appliances (05.3)
13	Glassware, tableware, and household utensils (05.4)
14	Tools and equipment for house and garden (05.5)
15	Goods and Services for routine household maintenance (05.6)
16	Medical products, appliances and equipment (06.1)
17	Outpatient Services (06.2)
18	Hospital Services (06.3)
19	Purchase of vehicles (07.1)
20	Operation of personal transport equipment (07.2)
21	Transport services (07.3)
22	Communication (08)
23	Audiovisual, photographic and information processing equipment (09.1)
24	Other major durables for recreation and culture (09.2)
25	Other recreational items and equipment, gardens, and pets (09.3)
26	recreational and cultural services (09.4)
27	Newspapers, books, and stationery (09.5)
28	Package holidays (09.6)
29	Education (10)
30	Catering services (11.1)
31	Accommodation services (11.2)
32	Personal care (12.1+2)
33	Personal effects n.e.c. (12.3)
34	Social protection (12.4)
35	Insurance (12.5)
36	Financial services n.e.c. (12.6)
37	Other services n.e.c. (12.7)
38	Total private consumption expenditures of Austrian citizens abroad (13)

The specification of the typical consumption equation follows the basic ideas of the PADS approach (using q_i to denote quantities, p_i for individual commodity prices and y for total expenditures and P for its price index). 12 price indexes of subgroups of commodities (P_G) are considered which will be explained by regression equations dependent on their respective commodity price indexes (which thus enter their group price indexes with constant weights). The standard equation can be written

$$q_i = \left(a_i + b_i \frac{y}{P} + c_i t \right) \left(\frac{p_i}{P_G} \right)^{-\lambda_{Gi}} \left(\frac{p_i}{P} \right)^{-\lambda_{0i}}$$ for all commodities i in group G, G = 1,…,13.

We have experimented with a number of alternative specifications and restrictions. In the linear part also lags of the dependent variable have been introduced. Occasionally a quadratic

trend was found useful to improve the fit. However, in view of the forecast properties of the model it could be substituted by a different dynamic specification. Concerning economy of estimated price parameters it has turned out that the most restricted version with $\lambda_{0i} = \lambda_{0j}$ for all i and j was rejected by the data. This was partly also the case for restricted group price effects for commodities in the same group. Therefore we have opted for a relatively general set of estimates permitting a certain flexibility in the dynamic specification and unrestricted price effects.

As examples we present some estimated equations for those consumption groups with the largest shares in total consumption of Austrians. The following Table 10 gives the shares of the ten largest groups. We shall present estimated equations for the first five of them.

Table 10

COICOP		Average share	Share in 2003
4.1	Rent, water etc	0.1439	0.1426
1.1	Food	0.1160	0.0927
3.1	Clothing	0.0734	0.0586
13	Consumption abroad	0.0665	0.0728
7.2	operation of vehicles	0.0636	0.0562
11.1	catering	0.0505	0.0497
4.3	housing maintenance	0.0409	0.0380
7.1	purchase of vehicles	0.0392	0.0430
5.1	furniture etc	0.0391	0.0348
12.4	insurance	0.0314	0.0385

Selected estimated equations

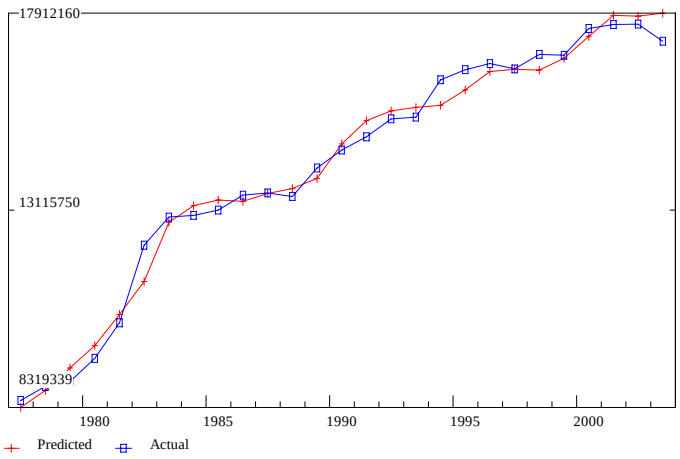
Consumption expenditures by Austrians - Actual and imputed rentals for housing, water supply and misc. services related to dwelling (04.1+2+4)
limits 1977 2003

nlp pce7 = (a0+a1*Totpce+a2*pce7[1])*@pow(ppce7/ppceg4,a3)

Param	Coef	T-value	StdDev
a0	-4198033.000000	-22.15	189521.437500
a1	0.091535	9.18	0.009970
a2	0.638043	9.73	0.065545
a3	-0.789460	-7.35	0.107377

SEE = 333515.093750

Consumption - rent, water etc (04.1+2+4)



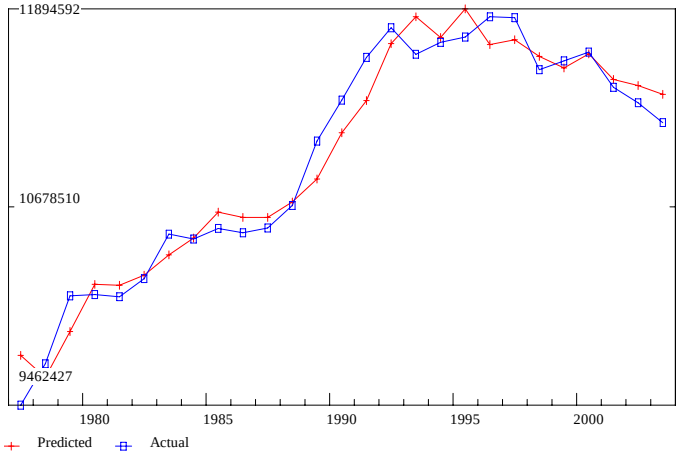
Consumption expenditures by Austrians - Food (01.1)
limits 1977 2003

nlp pce1 = (a0+a1*Totpce+a2*pce1[1])*@pow((ppce1/tppce),a3)*@pow((ppce1[1]/tppce[1]),a4)

Param	Coef	T-value	StdDev
a0	301835.437500	2.80	107737.750000
a1	0.013584	1.53	0.008855
a2	0.833943	9.34	0.089292
a3	-0.356845	-2.02	0.176616
a4	0.550673	2.85	0.193033

SEE = 143452.406250

Consumption - Food (01.1)



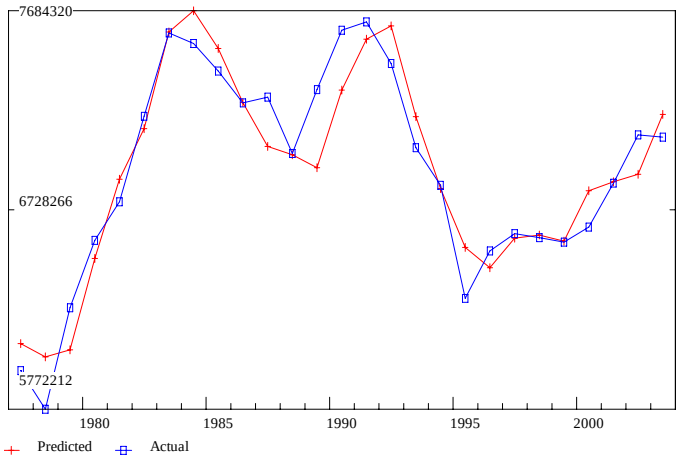
Consumption expenditures by Austrians - Clothing (03.1)
limits 1977 2003

nlp pce5 = (a0+a1*Totpce+a2*Trend+a3*pce5[1])*@pow((ppce5/tppce),a4)

Param	Coef	T-value	StdDev
a0	-3777241.000000	-12.22	309219.843750
a1	0.085925	25.38	0.003386
a2	-192216.734375	-85.70	2242.819580
a3	0.790711	15.28	0.051760
a4	-0.977611	-6.48	0.150956

SEE = 156840.671875

Consumption - clothing (03.1)



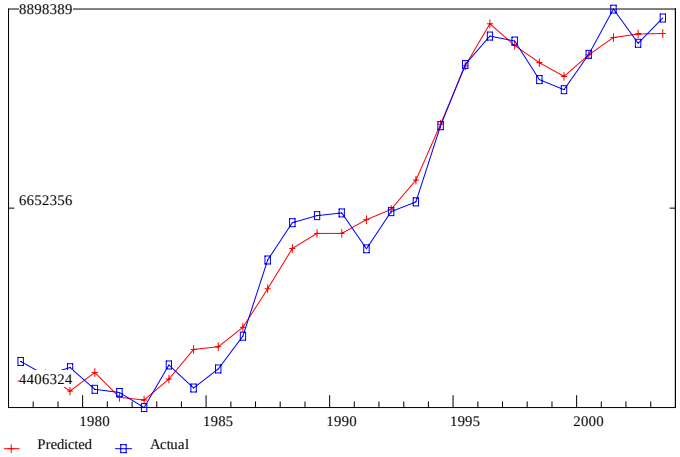
Consumption expenditures by Austrians, Total priv. consumption expenditures of Austrian residents abroad (13)
limits 1977 2003

nlp pceabr = (a0+a1*Totpce+a2*@sq(Trend)+a3*pceabr[1])*@pow((ppceabr/tppce),a4)

Param	Coef	T-value	StdDev
a0	1364269.000000	3.06	445775.593750
a1	0.020776	2.78	0.007485
a2	3010.447510	5.37	561.005676
a3	0.341805	3.39	0.100785
a4	-1.648484	-5.85	0.282017

SEE = 204362.531250

Consumption of Austrians abroad



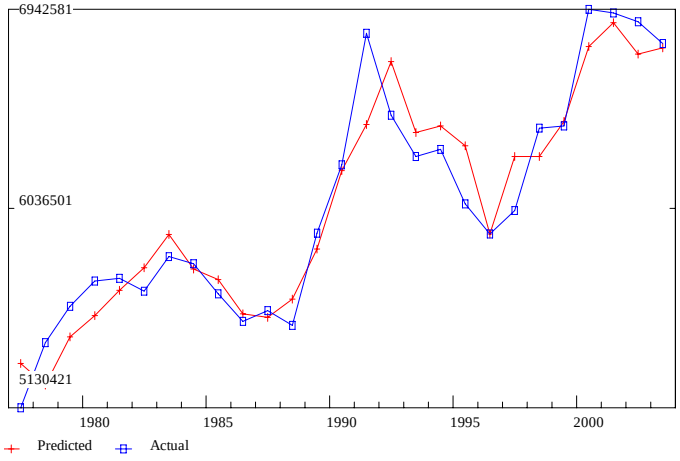
Consumption expenditures by Austrians - Operation of personal transport equipment (07.2)
limits 1977 2003

nlp pce20=(a0+a1*Totpce+a2*Trend+a3*pce20[1]+a4*dummy96)*@pow(ppce20/tppce,a5)

Param	Coef	T-value	StdDev
a0	-1925879.000000	-2.93	656725.562500
a1	0.082692	7.70	0.010738
a2	-129546.414062	-8.40	15428.270508
a3	0.322382	2.36	0.136461
a4	-530139.187500	-16.07	32982.878906
a5	0.224417	1.78	0.125832

SEE = 152741.234375

Consumption - Operation of personal transport equip. (07.2)



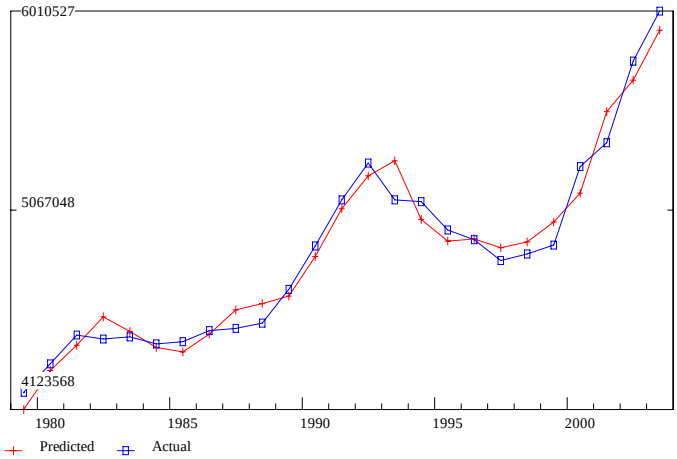
Consumption expenditures by Austrians - Catering services (11.1)
limits 1979 2003

nlp pce30=(a0+a1*Totpce+a2*pce30[1]+a3*pce30[3])*@pow(ppce30/tppce,a4)

Param	Coef	T-value	StdDev
a0	1434737.250000	4.19	342616.062500
a1	0.013267	3.95	0.003359
a2	1.028510	9.95	0.103342
a3	-0.596140	-5.25	0.113560
a4	0.562240	1.67	0.337171

SEE = 81366.523438

Consumption - Catering services (11.1)



3.2 Investment

Investment equations are estimated for the categories of capital goods described in detail above. The specification follows essentially the accelerator hypothesis amended by the influence of real user costs or other financial variables. Appropriately aggregated output and output price variables of the respective investing activities have been constructed. For specific categories we have also used a cyclical variable to represent regular fluctuations typical for the capital goods in question. Due to the lack of appropriate capital stock data the stock adjustment process cannot be modelled.

We define the following variables:

totcap(j)R	Real investment expenditures for category j (chained to reference year 2001)
totcap(j)	Price index of investment expenditures of category j (chained, 2001 = 1)
outc(j)ag	Real gross production of r j (chained to 2001)
outp(j)ag	Price index of gross production of activity j (chained to 2001=1)
zins	Interest rate in percent*100
totcap(j)d	Depreciation rate of capital good j (= 1/ period of use in years)
cap(j)co	User costs of capital (nominal) for category j defined by totcap(j)P*(zins/100+totcap(j)d-@d(totcap(j)P)/totcap(j)P[1])

Log-transformed variables have a “l” as prefix.

In addition to the Trend (starting with 0 in year 1976) and dummy variables the following cyclical variables are defined:

cos10, sin10	(Co)sinus with period of 10 years
cos2_29, sin2_29	(Co)sinus with period of 29/2 years
cos5, sin5	(Co)sinus with period of 5 years

Roughly 60% of total investment is spent on construction. For predictive purposes it will be important that the two equations modelling building investments perform well. Both equations are estimated in levels and are seen to depend on reasonably long lags of the appropriately aggregated outputs of the investing activities. Autoregressive effects are distributed over a wider time span for residential buildings than for other buildings. While real user costs have the expected negative impact on residential construction there is no significant immediate effect of them for other buildings.

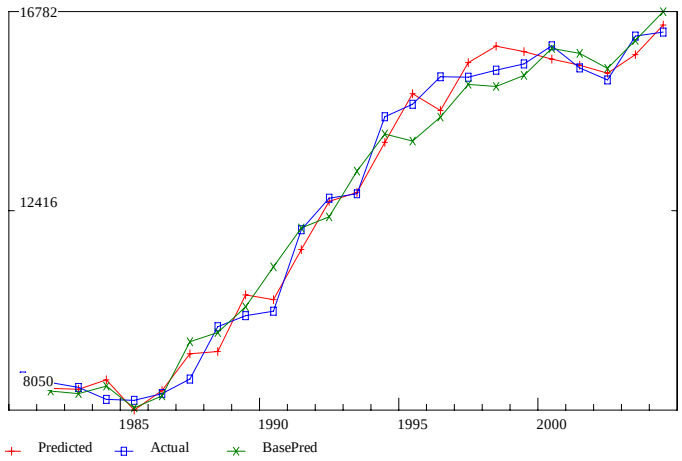
Investment - Residential buildings
limits 1981 2004

r totcap1R = totcap1R[1],totcap1R[3],totcap1R[5],outc1ag[4],cap1co/outp1ag

	name	Reg-Coef	t-value	Elas	Mean
0	totcap1R	-	-	-	12407.21
1	intercept	1709.22145		0.14	1.00
2	totcap1R[1]	0.54574	3.866	0.53	12085.69
3	totcap1R[3]	0.63289	3.062	0.58	11453.11
4	totcap1R[5]	-0.58943	-4.132	-0.51	10828.91
5	outc1ag[4]	0.25376	3.722	0.38	18417.71
6	cap1co/outp1ag	-25813.8765	-2.903	-0.12	0.06

SEE = 353.42 RSQ = 0.9870 RHO = -0.34 Obser = 24
SEE+1 = 331.48 RBSQ = 0.9834 DurH = -2.32 DoFree = 18 MAPE = 2.45

Investment - Residential buildings

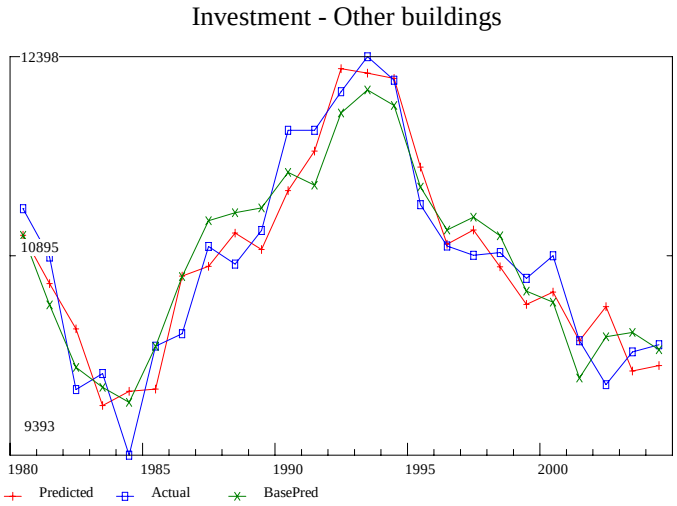


Investment - Other buildings
limits 1980 2004

r totcap2R=totcap2R[1], outc2ag[2], outc2ag[4], cap2co[2]/outp2ag[2], dummy01

	name	Reg-Coef	t-value	Elas	Mean
0	totcap2R	-	-	-	10860.14
1	intercept	1456.09464		0.13	1.00
2	totcap2R[1]	0.80574	9.571	0.81	10918.31
3	outc2ag[2]	0.02963	2.619	0.70	256337.78
4	outc2ag[4]	-0.03385	-2.742	-0.75	241987.79
5	cap2co[2]/ outp2ag[2]	21696.46947	4.642	0.11	0.06
6	dummy01	-767.49481	-2.255	-0.00	0.04

SEE = 274.12 RSQ = 0.8736 RHO = -0.31 Obser = 25
SEE+1 = 258.76 RBSQ = 0.8403 DurH = -1.72 DoFree = 19 MAPE = 2.17



About 30% of investment expenditures go into machinery and equipment. The largest share is obviously spent by the manufacturing industries, but their proportion is diminishing. We observe a strong cyclical movement which is captured very well by two pairs of sinusoid components. This is accompanied by a negative autoregressive effect and a production effect also lagged two years. The influence of the nominal long term interest rate is positive, quite contrary to usual expectations.

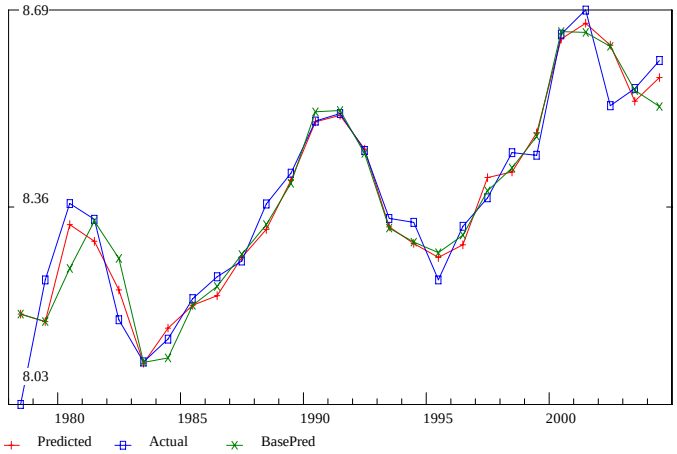
Investment in machinery and equipment (NACE 01 to 37, 45)
limits 1978 2004

r ltotcap3R = ltotcap3R[2], loutc3ag[2], lzins, sin10, cos10, sin2_29,cos2_29

	name	Reg-Coef	t-value	Elas	Mean
0	ltotcap3R	-	-	-	8.37
1	intercept	-5.88140		-0.70	1.00
2	ltotcap3R[2]	-0.48808	-2.632	-0.49	8.33
3	loutc3ag[2]	1.52341	6.791	2.11	11.60
4	lzins	0.33837	2.834	0.08	1.89
5	sin10	0.05088	2.278	0.00	0.00
6	cos10	-0.07951	-3.448	0.00	-0.10
7	sin2_29	-0.03818	-2.381	0.00	-0.02
8	cos2_29	0.05400	3.048	-0.00	-0.07

SEE = 0.05 RSQ = 0.9240 RHO = -0.11 Obser = 27
SEE+1 = 0.04 RBSQ = 0.8960 DurH = -2.10 DoFree = 19 MAPE = 0.39

Investment in machinery and equipment (NACE 01 to 37, 45



For the other investing activities a similar cyclical pattern is observed. Output lags of up to four years, real user costs and the interest rate are among the major explanatory variables. Investment in transportation equipment also shows the typical cyclical movements. As example we present the investments of the industry “Land transport” which accounts for about two percent of total investments.

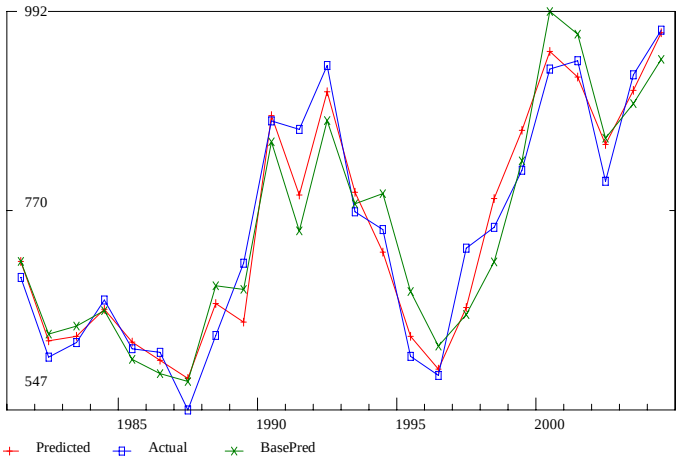
Investment in transportation equipment (NACE 60)
limits 1981 2004

r totcap10R=totcap10R[1],totcap10R[3], outc10ag[2], outc10ag[5], cap10co/outp10ag, cap10co[2]/outp10ag[2], cap10co[3]/outp10ag[3]

	name	Reg-Coef	t-value	Elas	Mean
0	totcap10R	-	-	-	746.91
1	intercept	135.55067		0.18	1.00
2	totcap10R[1]	0.42131	3.088	0.42	736.67
3	totcap10R[3]	-0.54176	-5.529	-0.53	723.87
4	outc10ag[2]	0.14398	4.263	1.72	8920.43
5	outc10ag[5]	-0.08779	-3.021	-0.97	8240.99
6	cap10co/outp10ag	-954.43381	-1.884	-0.18	0.14
7	cap10co[2]/outp10ag[2]	2763.61920	5.985	0.52	0.14
8	cap10co[3]/outp10ag[3]	-881.89678	-1.603	-0.17	0.14

SEE = 32.81 RSQ = 0.9353 RHO = -0.13 Obser = 24
SEE+1 = 32.51 RBSQ = 0.9071 DurH = -0.73 DoFree = 16 MAPE = 3.58

Investment in transportation equipment (NACE 60)



The remaining investment categories are of minor quantitative importance. Investment in software shows a steady increase of approximately 14% on annual average and can be easily explained by a trend equation while investment in licenses has changed the pattern after 1990, probably due to changes in the recording of the data.

3.3 Imports

In analogy to the procedure already chosen in previous Austrian INFORUM models (RICHTER 1991), use is made of the information contained in the detailed import matrices for intermediate demand and final use. The demand pull and structural effects on imports will be treated separately from the impact of changes in commodity and user specific market shares of imports versus domestically produced goods. The first effect is considered by calculating "hypothetical imports", imports that would materialise under constant import shares. The ratio of actual imports to those hypothetical imports is then explained by relative import prices to domestic production prices and other variables of relevance.

The following variables are defined, apart from dummies and a trend variable (which starts with 0 in 1996):

Imp(i)		Real imports chained to 2001
Pim(i)		Index of import prices (2001 = 1)
IK(i)		Import coefficients of NACE group (i)
pdm(i)		Price index of gross production of group i (2001 = 1)
PK(i)	=	pim(i)/pdm(i) relative import prices

Note that time series information on real series is only available from 1996. Despite the shortness of the series it turns out that relative import prices can explain the change in the ration of actual to hypothetical imports very well.

3.4 Labour demand, wages and salaries

The labour market is modelled by exogenous labour supply and equations for labour demand by activities. Employment coefficients are explained by real wage rates and other variables. Nominal wage rates by industries are made to depend on a total wage rate defined by total labour cost per dependent employment in full time equivalents. Total labour costs are the sum of gross wages and salaries and the "social wage", the sum of employer's contributions to social insurance.

The total wage rate defined as the sum of gross wages and salaries per dependent employment in full time equivalents is related to the inflation rate (measured by the consumer price deflator) and the unemployment rate. Dependent employment is calculated by summing over employment by industries calculated by the product of the respective employment coefficient times output.

To get the unemployment rate we deduct self employment from the total labour force yielding the total dependent labour force. The unemployment rate is then defined by the difference between total dependent labour force and total dependent employment relative to the dependent labour force. The relationship between employed full time equivalents and employed persons is given by a definition using the proportion as an exogenous variable.

The components of this model block are the following:

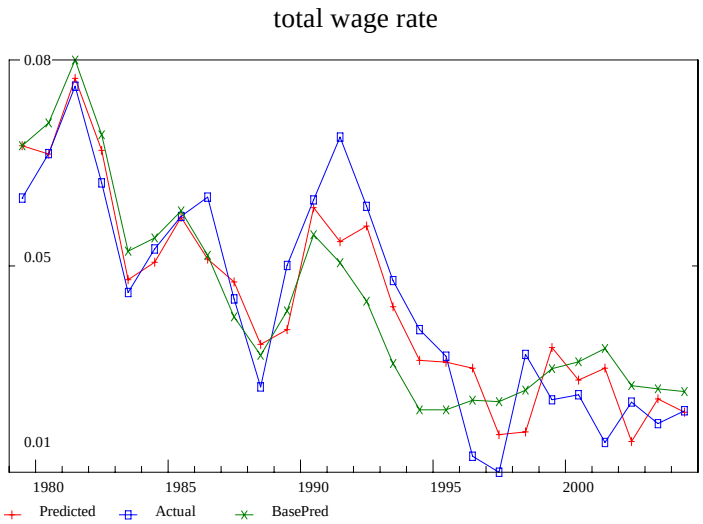
1. The total wage rate (estimated in log differentials)

dln(wagerate) = f (dln(tppce), dln(unemp))
lim 1979 2004

r dlnwagerate = dlntppce, dlnwagerate[1], lnwagerate[2], lnwagerate[3], dlnunemp[1]

	Name	Reg-Coef	t-value	Elas	Mean
0	Dlnwagerate	-	-	-	0.04
1	Intercept	0.09627		2.44	1.00
2	Dlntppce	0.35392	1.920	0.25	0.03
3	dlnwagerate[1]	0.59729	3.388	0.63	0.04
4	lnwagerate[2]	-0.39742	-2.146	-29.83	2.97
5	lnwagerate[3]	0.37244	2.048	27.54	2.92
6	dlnunemp[1]	-0.01765	-0.959	-0.02	0.05

SEE = 0.01 RSQ = 0.8255 RHO = -0.05 Obser = 26
SEE+1 = 0.01 RBSQ = 0.7818 DurH = -0.55 DoFree = 20 MAPE = 21.83



unemp Unemployment rate (dependent employment)
totempvoa Total dependent employment (full time equivalents)
empvoa(i) Dependent employment of activity i (i = 1,…,95) (full time equivalents)
totlabinc = wagerate * totempvoa total wages
totlabcost = totlabinc + totsocsec total labour cost
labcosta(i) Labour cost of activity i (i = 1,…,95)

Social wage: employers' social insurance contributions are linked to total wages
lim 1976 2004

r totsocsec = totlabinc

	Name	Reg-Coef	t-value	Elas	Mean
0	Totsocsec	-	-	-	14566525.24
1	Intercept	-622372.84678		-0.04	1.00
2	Totlabinc	0.25642	81.900	1.04	59234746.97

SEE = 349958.38 RSQ = 0.9960 RHO = 0.81 Obser = 29
SEE+1 = 208776.30 RBSQ = 0.9958 DW = 0.39 DoFree = 27 MAPE = 1.67

2. Labour cost equations by activities (i = 1, …, 95 (NACE)) estimated in log-differentials

dln(labcostarate(i)) = a0(i) + a1(i)*dln(totlabcostrate)

totlabcostrate = (totlabinc + totsocsec)/ totempvoa
labcostarate(i) = labcosta(i)/empvoa(i) labour cost per employee

3. Employment coefficient equations by activites (j = 1,…., 93 number of activity)

empouta(i) = f(rwagva(i), dummies, trend, lags, transformations)

rwagva(i) = labcostarate(i)/pindex(i) real wage per output for activity i

There is no equation for activity 95 as its output is defined by wages earned.

The equations for employment coefficients (empouta) are mostly estimated in log differences, in a few cases also in double differences.

As examples we present the equations for the first three of the five most important activities: The shares refer to the average share of employment in this activity in total dependent employment.

Table 11

Activity	Name	Employment share
45	Construction	0.0886
85	Health	0.0798
75	Public adm.	0.0783
52	Commerce	0.0739
80	Education	0.0684

Employment coefficients - Construction (45)
lim 1978 2004

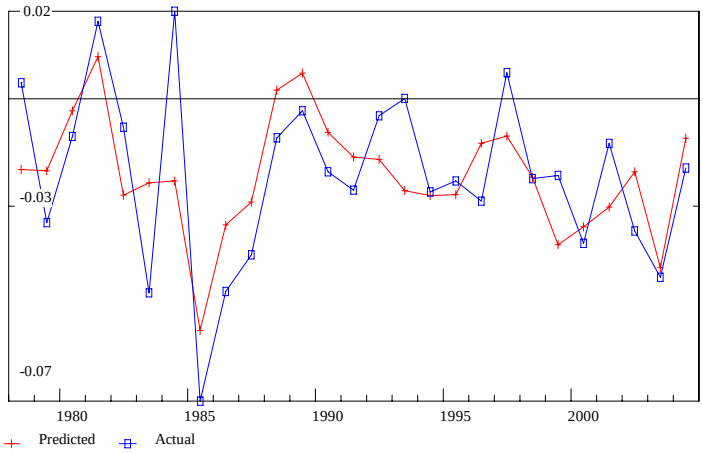
r dlnempouta45 = dlnrwagva45, lnempouta45[1], lnrwagva45[1], lnrwagva45[2], trend

	Name	Reg-Coef	t-value	Elas	Mean
0	dlnempouta45	-	-	-	-0.02
1	intercept	3.20530		-171.80	1.00
2	dlnrwagva45	0.24632	0.717	-0.08	0.01
3	lnempouta45[1]	-0.41749	-2.467	179.46	8.02
4	lnrwagva45[1]	-0.79815	-2.754	145.17	3.39
5	lnrwagva45[2]	0.87797	2.630	-159.35	3.39
6	trend	-0.00886	-3.219	7.60	16.00

SEE = 0.02 RSQ = 0.4496 RHO = -0.25 Obser = 27
SEE+1 = 0.01 RBSQ = 0.3185 DW = 2.50 DoFree = 21 MAPE = 571.83

Employment coefficient (45)

Construction work



Employment coefficients - Health and social work services (85)

lim 1978 2004

r dlnempouta85 = dlnrwagva85, lnempouta85[2], lnrwagva85[2], dummy01

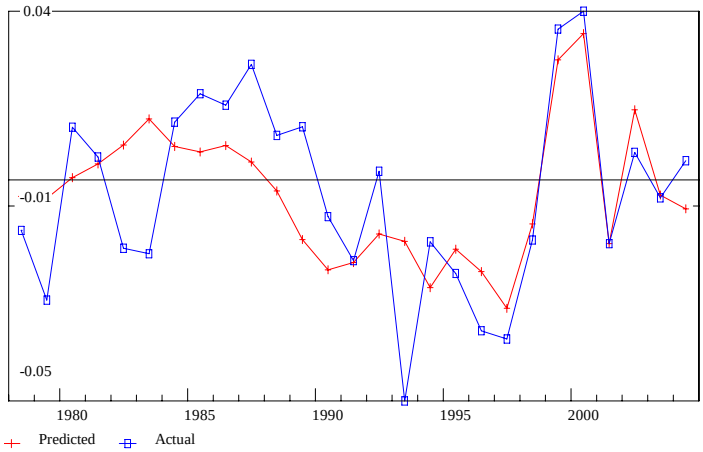
	name	Reg-Coef	t-value	Elas	Mean
0	dlnempouta85	-	-	-	-
1	intercept	0.39902		-128.92	1.00
2	dlnrwagva85	-0.12813	-0.647	-0.00	-0.00
3	lnempouta85[2]	-0.21321	-3.147	554.04	8.04
4	lnrwagva85[2]	0.37853	2.960	-424.65	3.47
5	dummy01	-0.04497	-2.233	0.54	0.04

SEE = 0.01 RSQ = 0.4991 RHO = 0.18 Obser = 27

SEE+1 = 0.01 RBSQ = 0.4080 DW = 1.64 DoFree = 22 MAPE = 102.60

Employment coefficient (85)

Health and social work services

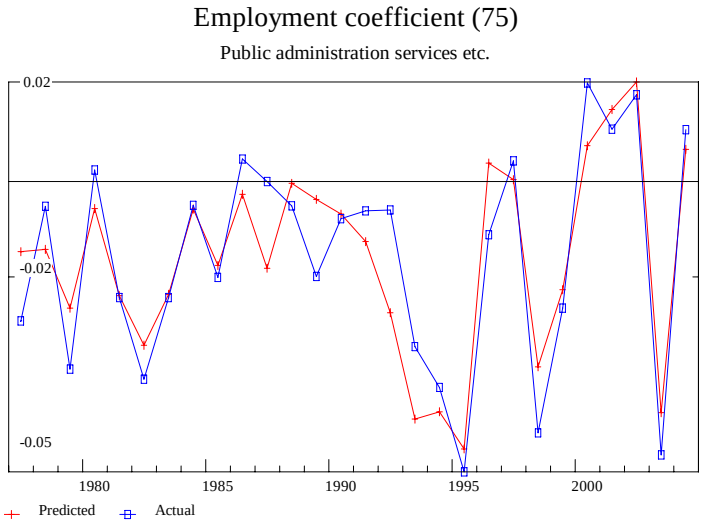


Employment coefficients - Public administration services
lim 1977 2004

r dlnempouta75 = lnrwagva75, lnempouta75[1], lnrwagva75[1]

Variable	name	Reg-Coef	t-value	Elas	Mean
0	dlnempouta75	-	-	-	0.01
1	intercept	5.83940		-481.61	1.00
2	lnrwagva75	-0.91731	-8.734	272.64	3.60
3	lnempouta75[1]	-0.49641	-2.982	324.14	7.92
4	lnrwagva75[1]	0.38535	1.792	-114.17	3.59

SEE = 0.01 RSQ = 0.7994 RHO = 0.11 Obser = 28
SEE+1 = 0.01 RBSQ = 0.7743 DW = 1.78 DoFree = 24 MAPE = 103289.25



4. Additional equations

Employment full time equivalents:
empvoa(i) = (empouta(i)*outc(i))
totempvoa = Sum (empouta(i)*outc(i))

Employment relations:
empP(i) = acoeff(i)* empvoa(i)
empP = Sum (empP(i))

Dependent labour force:
AKP = empP + ARBLOS
ARBLOS Unemployed persons

Total labour force:
ERWPERS = AKP + SELBST

Unemployment rate
Unemp = (AKP – empP)/AKP

3.5 Accountant

In a later stage of the model the intention is to distinguish three institutional sectors in the economy:

- Government
- Households
- Others (corporate and non corporate financial and non-financial)

At the moment only a very simple submodel for the household sector is implemented. A straightforward approach was chosen to calculate private household disposable income from the information available in the value added part.

The following details are available:

	Wages and salaries *)
+	Employers' social contributions *)
+	Mixed income (share in operating surplus of self-employed persons) **)
+	Property income received
-	Property income paid
-	Taxes on income and wealth
-	Social contributions
+	Social benefits
+	Transfers received
-	Transfers paid
+	Net change in claims
=	Disposable Income
-	Private Consumer Expenditure of Austrian residents
=	Personal savings

For the totals marked with *) a more or less direct link to value added is given. Compensation of employees can be derived from value added directly. Operating surplus is disaggregated into income to households (marked **) and other income. Gross property income going to private households is treated as a function of total operating surplus and modelled in a simple fashion.

The personal tax rate is defined as the sum of personal taxes paid by households divided by the sum of the various sources of household income before taxation (compensation of employees, income of self employment and property income). The rate of social security contributions is calculated by dividing the total sum of social security contributions paid by households by the sum of compensation of employees and income of self employment.

At the moment all the rates like the tax rate and the rate of social security are treated exogenously as well are the social benefits and all the transfers. In a later stage attempts will be made to model these relationships econometrically.

4. Concluding remarks

At the moment prices, exports, government demand are treated exogenous. So far no attempt was made to model changes in input-output coefficients, in bridge matrices, etc.

A lot needs still to be done.

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