APPENDIX

A. APPENDIX TO CHAPTER 3

A.1 The Time Series

A.1.1 List of Variables

Table A.1: List of Variables

Abbreviation	Explanation	Source
AT_CPI	Austrian consumer price index	OECD
AT_WTX	Weight of Austria in Spain's goods exports	Calculation by the author based on MINECO data
BE_CPI	Belgian consumer price index	OECD
BE_WTX	Weight of Belgium in Spain's goods exports	Calculation by the author based on MINECO data
CFC	Spain: consumption of fixed capital	Calculation by the author based on OECD data
CGOV	Spain: government consumption expenditure (current pr.)	INE
CGOV95	Spain: government consumption expenditure (constant pr.)	INE
COE	Spain: compensation of employees	INE
CP	Spain: private consumption expenditure (current pr.)	INE
CP95	Spain: private consumption expenditure (constant pr.)	INE
CPI	Spain: consumer price index	OECD

Abbreviation	Explanation	Source
CPIEWU	Weighted average consumer price index of EMU excl. Spain	Calculation by the author based on OECD data, weights: IMF data
DE_CPI	German consumer price index	OECD
DE_WTX	Weight of Germany in Spain's goods exports	Calculation by the author based on MINECO data
DK_CPI	Danish consumer price index	OECD
DK_WTX	Weight of Denmark in Spain's goods exports	Calculation by the author based on IMF data
ECU	Pesetas per ECU	Calculation by the author based on Bundesbank data
EE	Spain: employees	INE
EP	Spain: labour force (total employment + unemployed)	INE
ERAT	Nominal external value of the Peseta vis-á-vis the Austrian Schilling (index)	Calculation by the author based on Bundesbank data
ERBE	Nominal external value of the Peseta vis-á-vis the Belgian franc (index)	Calculation by the author based on Bundesbank data
ERDE	Nominal external value of the Peseta vis-á-vis the Deutsche Mark (index)	Calculation by the author based on Bundesbank data
ERDK	Nominal external value of the Peseta vis-á-vis the Dnish krone (index)	Calculation by the author based on Bundesbank data
ERFI	Nominal external value of the Peseta vis-á-vis the Finmark (index)	Calculation by the author based on Bundesbank data
ERFR	Nominal external value of the Peseta vis-á-vis the French franc (index)	Calculation by the author based on Bundesbank data
ERGR	Nominal external value of the Peseta vis-á-vis the Greek drachma (index)	Calculation by the author based on Bundesbank data

Abbreviation	Explanation	Source
ERIE	Nominal external value of the Peseta vis-á-vis the Irish pound (index)	Calculation by the author based on Bundesbank data
ERIT	Nominal external value of the Peseta vis-á-vis the Italian lira (index)	Calculation by the author based on Bundesbank data
ERNL	Nominal external value of the Peseta vis-á-vis the Dutch guilder (index)	Calculation by the author based on Bundesbank data
ERPT	Nominal external value of the Peseta vis-á-vis the Portuguese escudo (index)	Calculation by the author based on Bundesbank data
ERSE	Nominal external value of the Peseta vis-á-vis the Swedish krona (index)	Calculation by the author based on Bundesbank data
ERUK	Nominal external value of the Peseta vis-á-vis the pound sterling (index)	Calculation by the author based on Bundesbank data
ES	Spain: self-employed	INE
ET	Spain: total employment (es_es+es_ee)	INE
EWUOES_ DTOT	Euro area excluding Spain: total demand (GDP+imports at constant prices)	Calculation by the author based on data from Eurostat, EC, OECD
FI_CPI	Finland: consumer price index	OECD
FI_WTX	Weight of Finland in Spanish exports of goods	Calculation by the author based on MINECO data
FR_CPI	France: consumer price index	OECD
FR_WTX	Weight of France in Spanish exports of goods	Calculation by the author based on MINECO data
GDP	Spain: GDP at current prices	INE
GDP95	Spain: GDP at constant prices	INE
GR_CPI	Greece: consumer price index	OECD
GR_WTX	Weight of Greece in Spanish exports of goods	Calculation by the author based on MINECO data

Abbreviation	Explanation	Source
ICON95	Spain: gross fixed cap. formation: construction (constant pr.)	INE
ICON95PR	Spain: gross fixed cap. formation: construction (constant pr.), private	Calculation by the author based on INE and OECD data
ICON95PU	Spain: gross fixed cap. formation: construction (constant pr.), government	Calculation by the author based on INE and OECD data
ID0001	Impulse dummy: = 1 in 2000Q1 and 0 otherwise	Generated by the author
ID0004	Impulse dummy: = 1 in 2000Q4 and 0 otherwise	Generated by the author
ID8202	Impulse dummy: = 1 in 1982Q2 and 0 otherwise	Generated by the author
ID8301	Impulse dummy: = 1 in 1983Q1 and 0 otherwise	Generated by the author
ID8401	Impulse dummy: = 1 in 1984Q1 and 0 otherwise	Generated by the author
ID8601	Impulse dummy: = 1 in 1986Q1 and 0 otherwise	Generated by the author
ID8701	Impulse dummy: = 1 in 1987Q1 and 0 otherwise	Generated by the author
ID8801	Impulse dummy: = 1 in 1988Q1 and 0 otherwise	Generated by the author
ID9003	Impulse dummy: = 1 in 1990Q3 and 0 otherwise	Generated by the author
ID9004	Impulse dummy: = 1 in 1990Q4 and 0 otherwise	Generated by the author

Abbreviation	Explanation	Source
ID9103	Impulse dummy: = 1 in 1991Q3 and 0 otherwise	Generated by the author
ID9201	Impulse dummy: = 1 in 1992Q1 and 0 otherwise	Generated by the author
ID9203	Impulse dummy: = 1 in 1992Q3 and 0 otherwise	Generated by the author
ID9204	Impulse dummy: = 1 in 1992Q4 and 0 otherwise	Generated by the author
ID9301	Impulse dummy: = 1 in 1993Q1 and 0 otherwise	Generated by the author
ID9302	Impulse dummy: = 1 in 1993Q2 and 0 otherwise	Generated by the author
ID9501	Impulse dummy: = 1 in 1995Q1 and 0 otherwise	Generated by the author
ID9701	Impulse dummy: = 1 in 1997Q1 and 0 otherwise	Generated by the author
ID9703	Impulse dummy: = 1 in 1997Q3 and 0 otherwise	Generated by the author
IE_CPI	Ireland: consumer price index	OECD
IE_WTX	Weight of Ireland in Spanish exports of goods	Calculation by the author based on MINECO data
IFC	Spain: Gross fixed capital formation (current pr.)	INE
IFC95	Spain: Gross fixed capital formation (constant pr.)	INE
IMEQ95	Spain: gross fixed cap. formation: machinery, equipment, others (constant pr.)	INE

Abbreviation	Explanation	Source
IS	Spain: change of stocks and net acquisition of valuables (current pr.)	INE
IS95	Spain: change of stocks and net acquisition of valuables (constant pr.)	INE
IT_CPI	Italy: consumer price index	OECD
IT_WTX	Weight of Italy in Spanish exports of goods	Calculation by the author based on MINECO data
KT9201	Broken trend: 0 until 1991Q4, positive trend afterwards	Generated by the author
KT9201i	Broken trend: negative trend until 1991Q4, 0 afterwards	Generated by the author
KT9301i	Broken trend: positive trend until 1992Q4, 0 afterwards	Generated by the author
KT9404	Broken trend: negative trend until 1994Q3, 0 afterwards	Generated by the author
M	Spain: Imports of goods and services (current prices)	INE
M95	Spain: Imports of goods and services (constant prices)	INE
NAWUS	Spain: Nominal external value of the Peseta vis-á-vis the US dollar (index)	Calculation by the author based on Bundesbank data
NL	Spain: long-term interest rates	OECD
NL_CPI	Netherlands: consumer price index	OECD
NL_WTX	Weight of the Netherlands in Spanish exports of goods	Calculation by the author based on MINECO data
NS	Spain: 3 month interbank rate (from 1999: euro area)	OECD, ECB
OIL$	Oil price (Brent) in US dollars	IMF

Abbreviation	Explanation	Source
OSMIN	Spain: Net operating surplus and mixed income	Calculation by the author based on data from OECD, INE
PC	Spain: private consumption deflator	INE
PCGOV	Spain: government consumption deflator	INE
PGDP	Spain: GDP deflator	INE
PGDPPM	Spain: ratio of GDP deflator over import prices	INE
PIFC	Spain: deflator of gross fixed capital formation	INE
PM	Spain: import price deflator	INE
PRODET	Spain: productivity (es_gdp/es_et)	INE
PT_CPI	Portugal: consumer price index	OECD
PT_WTX	Weight of Portugal in Spanish exports of goods	Calculation by the author based on MINECO data
PVAT	Spain: relative price level: Spain/ Austria (CPI)	Calculation by the author based on OECD data
PVBE	Spain: relative price level: Spain/ Belgium (CPI)	Calculation by the author based on OECD data
PVDE	Spain: relative price level: Spain/ Germany (CPI)	Calculation by the author based on OECD data
PVDK	Spain: relative price level: Spain/ Denmark(CPI)	Calculation by the author based on OECD and IMF data
PVEWU	Spain: relative price level: Spain/ EMU (CPI, excl. exchange rate)	Calculation by the author based on OECD data
PVFI	Spain: relative price level: Spain/ Finland (CPI)	Calculation by the author based on OECD data

Abbreviation	Explanation	Source
PVFR	Spain: relative price level: Spain/ France (CPI)	Calculation by the author based on OECD data
PVGR	Spain: relative price level: Spain/ Greece (CPI)	Calculation by the author based on OECD data
PVIE	Spain: relative price level: Spain/ Ireland (CPI)	Calculation by the author based on OECD data
PVIT	Spain: relative price level: Spain/ Italy (CPI)	Calculation by the author based on OECD data
PVNL	Spain: relative price level: Spain/ Netherlands (CPI)	Calculation by the author based on OECD data
PVPT	Spain: relative price level: Spain/ Portugal (CPI)	Calculation by the author based on OECD data
PVSE	Spain: relative price level: Spain/ Sweden (CPI)	Calculation by the author based on OECD data
PVUK	Spain: relative price level: Spain/ UK (CPI)	Calculation by the author based on OECD data
PX	Spain: export price index	INE
RAW	Spain: real effective exchange rate	OECD
RAWAT	Spain: real effective exchange rate of the Peseta vis-á-vis the Austrian Schilling	Calculation by the author based on data from Bundesbank, OECD
RAWBE	Spain: real effective exchange rate of the Peseta vis-á-vis the Belgian franc	Calculation by the author based on data from Bundesbank, OECD
RAWDE	Spain: real effective exchange rate of the Peseta vis-á-vis the Deutsche Mark	Calculation by the author based on data from Bundesbank, OECD

Abbreviation	Explanation	Source
RAWDK	Spain: real effective exchange rate of the Peseta vis-á-vis the Dnish krone	Calculation by the author based on data from Bundesbank, OECD
RAWEWU	Spain: real effective exchange rate of the Peseta vis-á-vis euro area currencies	Calculation by the author based on data from Bundesbank, OECD, IMF
RAWFI	Spain: real effective exchange rate of the Peseta vis-á-vis the Finmark	Calculation by the author based on data from Bundesbank, OECD
RAWFR	Spain: real effective exchange rate of the Peseta vis-á-vis the French franc	Calculation by the author based on data from Bundesbank, OECD
RAWGR	Spain: real effective exchange rate of the Peseta vis-á-vis the Greek drachma	Calculation by the author based on data from Bundesbank, OECD
RAWIE	Spain: real effective exchange rate of the Peseta vis-á-vis the Irish pound	Calculation by the author based on data from Bundesbank, OECD
RAWIT	Spain: real effective exchange rate of the Peseta vis-á-vis the Italian lira	Calculation by the author based on data from Bundesbank, OECD
RAWNL	Spain: real effective exchange rate of the Peseta vis-á-vis the Dutch guilder	Calculation by the author based on data from Bundesbank, OECD
RAWPT	Spain: real effective exchange rate of the Peseta vis-á-vis the Portuguese escudo	Calculation by the author based on data from Bundesbank, OECD

Abbreviation	Explanation	Source
RAWREU	Spain: Real effective exchange rate vis-á-vis the EU15 outside EMU (index)	Calculation by the author based on data from Bundesbank, IMF
RAWSE	Spain: real effective exchange rate of the Peseta vis-á-vis the Swedish krona	Calculation by the author based on data from Bundesbank, OECD
RAWUK	Spain: real effective exchange rate of the Peseta vis-á-vis pound sterling	Calculation by the author based on data from Bundesbank, OECD
RAWUS	Spain: real effective exchange rate of the Peseta vis-á-vis the US dollar	Calculation by the author based on data from Bundesbank, OECD
RESTROW	= reel effective exchange rate/ es_cpi	Calculation by the author based on OECD data
REU_ DTOT95	EU-15 outside EMU: total demand at constant prices	Calculation by the author based on data from Eurostat, Bundesbank
RWEE	Real wage (deflated with private consumption deflator)	Calculation of the author based on INE data
RWEEPGDP	Real wage (deflated with GDP deflator)	Calculation of the author based on INE data
SC	Social security contributions of households	Calculation by the author based on data from OECD, INE
SD0101	step dummy: =0 until 2000Q4, =1 afterwards	Generated by the author
SD9101	step dummy: =0 until 1990Q4, =1 afterwards	Generated by the author

Abbreviation	Explanation	Source
SD9201	step dummy: =0 until 1991Q4, =1 afterwards	Generated by the author
SD9201i	step dummy: =1 until 1991Q4, =0 afterwards	Generated by the author
SD9301	step dummy: =0 until 1992Q4, =1 afterwards	Generated by the author
SD9901	step dummy: =0 until 1998Q4, =1 afterwards	Generated by the author
SE_CPI	Sweden: consumer price index	OECD
SE_WTX	Weight of Sweden in Spanish exports of goods	Calculation by the author based on IMF data
SPREAD	ES_LANG-ES_3m	Calculation by the author based on data from OECD, ECB
TD	Direct taxes paid by households	Calculation by the author based on data from OECD, INE
TIND	Taxes less subsidies on production and imports	Calculation by the author based on data from OECD, INE
TRR	Transfers received by households	Calculation by the author based on data from OECD, INE
U	Spain: unemployed persons	Calculation by the author based on data from OECD, INE
UK_CPI	UK: consumer price index	OECD
UK_WTX	Weight of the UK in Spanish exports of goods	Calculation by the author based on IMF data

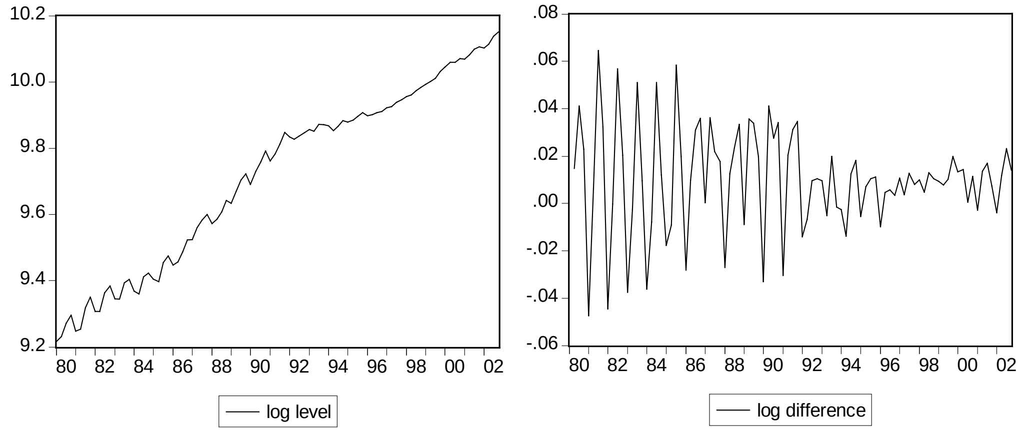
Abbreviation	Explanation	Source
ULC	Spain: unit labour cost (es_gyeee/es_prodet)	Calculation of the author based on INE data
UR	Spain: unemployment rate (percent)	OECD
UR1	Spain: unemployment rate (decimals)	OECD in % /100
US_CPI	USA: consumer price index	OECD
US_DTOT95	USA: total demand at constant prices (=GDP+imports)	Eurostat
USD	Exchange rate of the Peseta vis-á-vis the US dollar	Bundesbank
WEE	Spain: compensation of employees per employee	INE
X	Spain: exports of goods and services (current prices)	INE
X95	Spain: exports of goods and services (constant prices)	INE
XG95	Spain: exports of goods (constant prices)	INE
XG95EWU	Spain: exports of goods to the EMU (constant prices)	Calculation by the author based on data from INE, IMF
XG95REU	Spain: exports of goods to the EU-15 outside EMU (constant prices)	Calculation by the author based on data from INE, IMF
XG95ROW	Spain: exports of goods to the rest of the world (constant prices)	Calculation by the author based on data from INE, IMF
XG95US	Spain: exports of goods to the United States of America (constant prices)	Calculation by the author based on data from INE

Abbreviation	Explanation	Source
XGICON95	Spain: sum of good exports and construction investment (constant prices)	Calculation by the author based on data from INE
XM	Spain: net exports of goods and services (current pr.)	Calculation by the author based on INE data
XM_RATIO	Spain: net exports of goods and services (% of GDP)	Calculation by the author based on INE data
XM95	Spain: net exports of goods and services (constant pr.)	Calculation by the author based on INE data
XS95	Spain: exports of services (constant prices)	INE
YD	Spain: disposable income of households (current prices)	Calculation by the author based on data from OECD, INE
YD95	Spain: disposable income of households (constant prices)	Calculation by the author based on data from OECD, INE
Z1	centred seasonal dummy variable	Generated by the author
Z1SD	centred seasonal dummy variable multiplied by step dummy SD9201i	Generated by the author
Z2	centred seasonal dummy variable	Generated by the author
Z2SD	centred seasonal dummy variable multiplied by step dummy SD9201i	Generated by the author
Z3	centred seasonal dummy variable	Generated by the author
Z3SD	centred seasonal dummy variable multiplied by step dummy SD9201i	Generated by the author

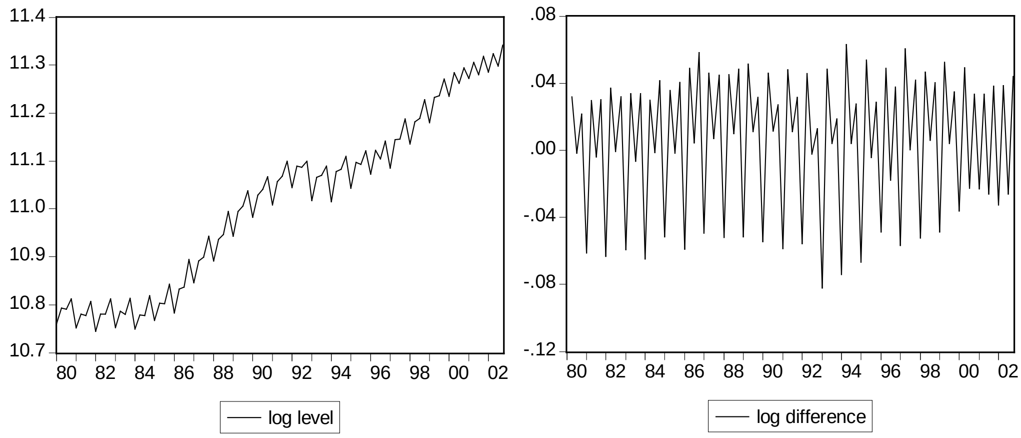
A.1.2 Graphs of the Variables

In this section graphs of all series tested for unit roots are presented in levels and their differences or log levels and log differences, as specified in the unit root tests and model equations. The presentation follows the order in the tables in Section 3. Therefore the series that exhibit structural breaks and were therefore tested with the Perron test, can be found at the end of this section.

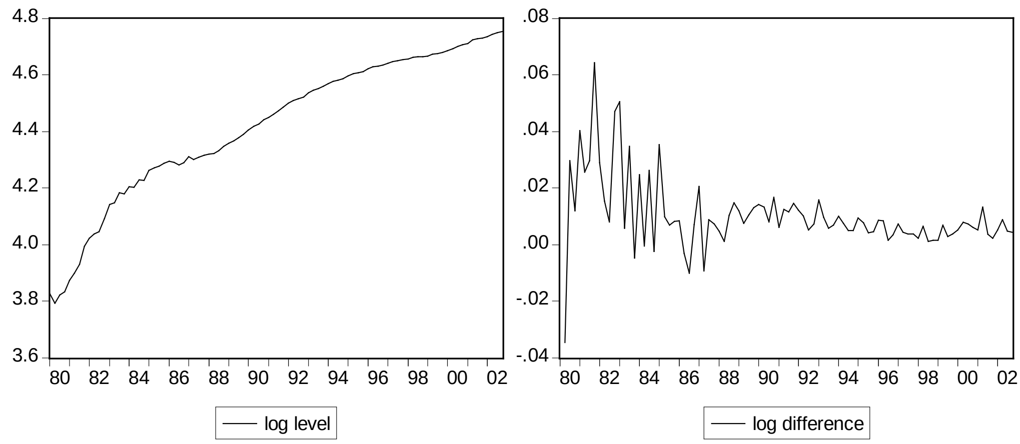
Government consumption at prices of 1995 (CGOV95)



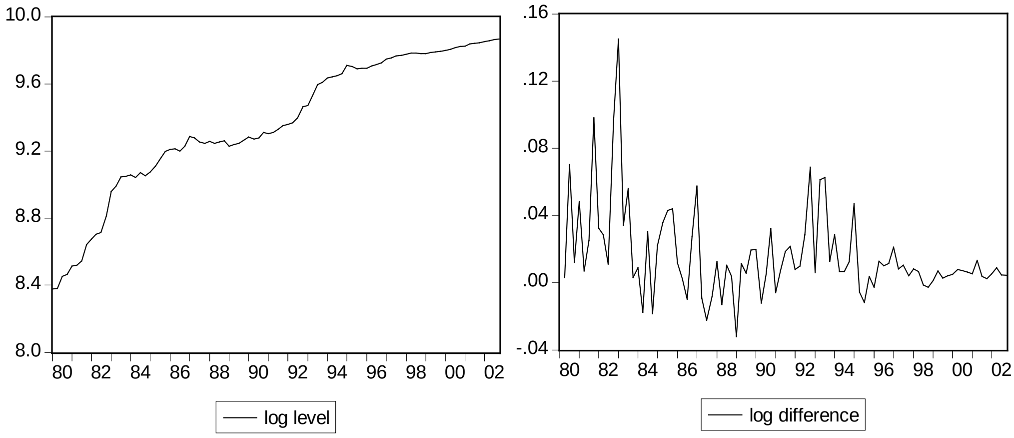
Final private consumption expenditure at constant prices of 1995 (CP95)



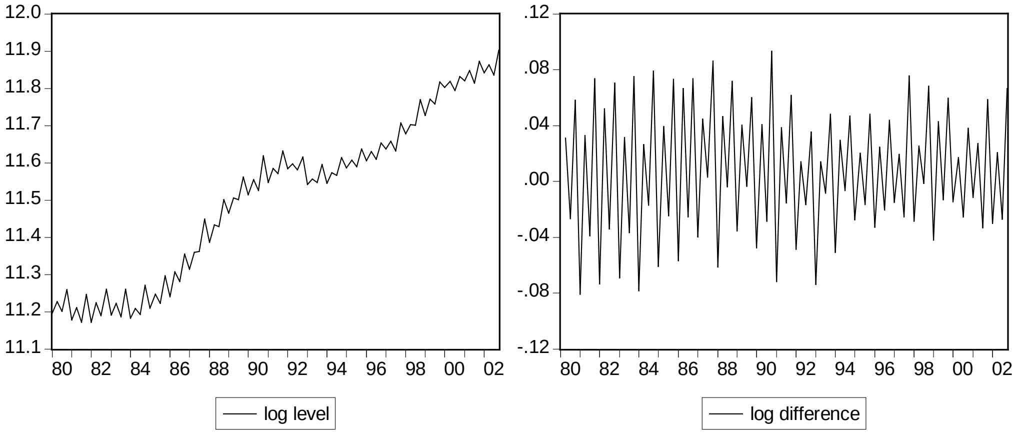
Consumer price index (weighted with share in Spain's exports, CPIEWU)



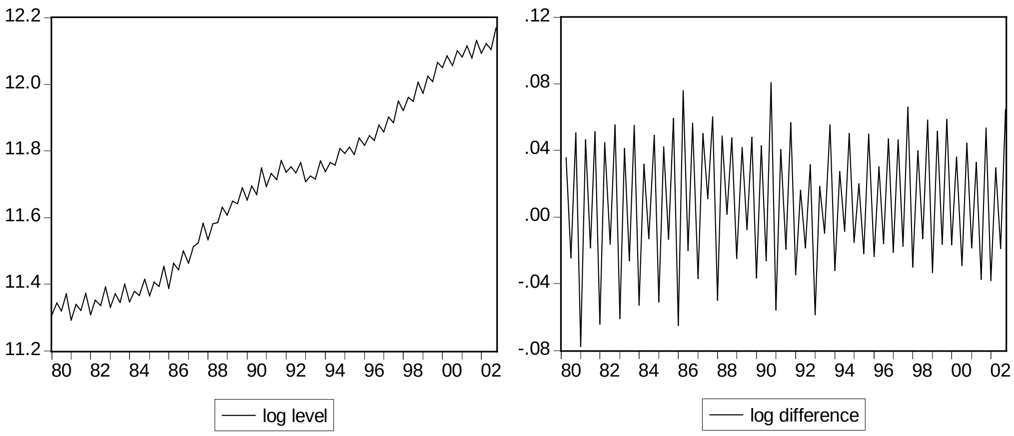
Weighted CPI of euro area countries multiplied by ECU exchange rate (CPIEWU*ECU)

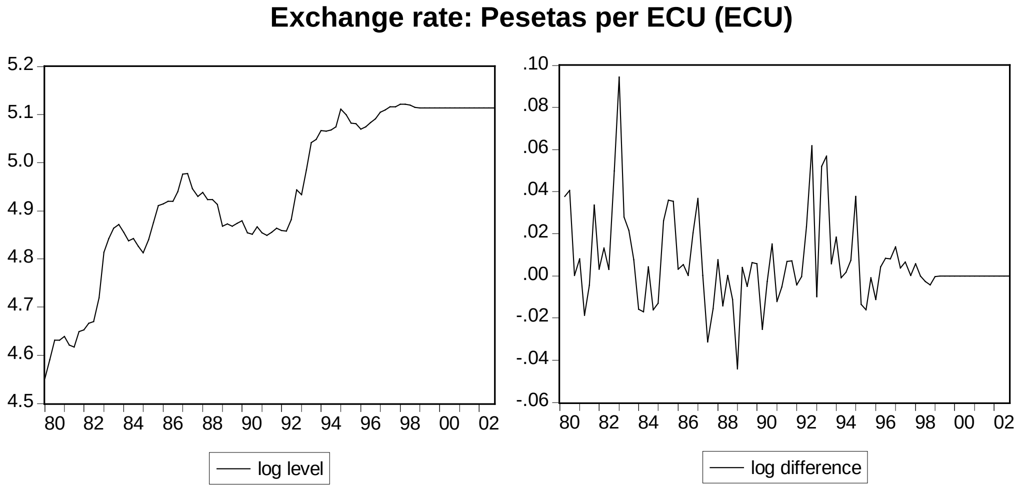


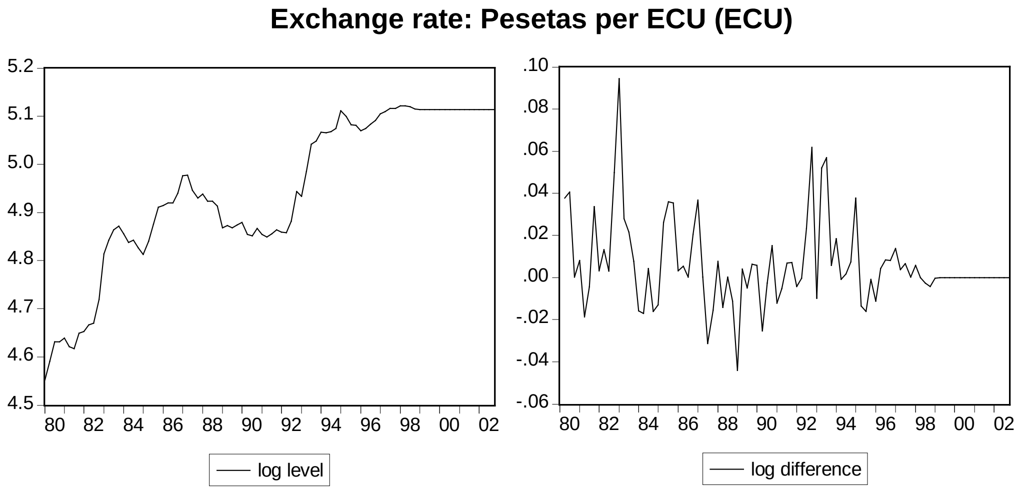
Domestic demand at prices of 1995 (DD95)

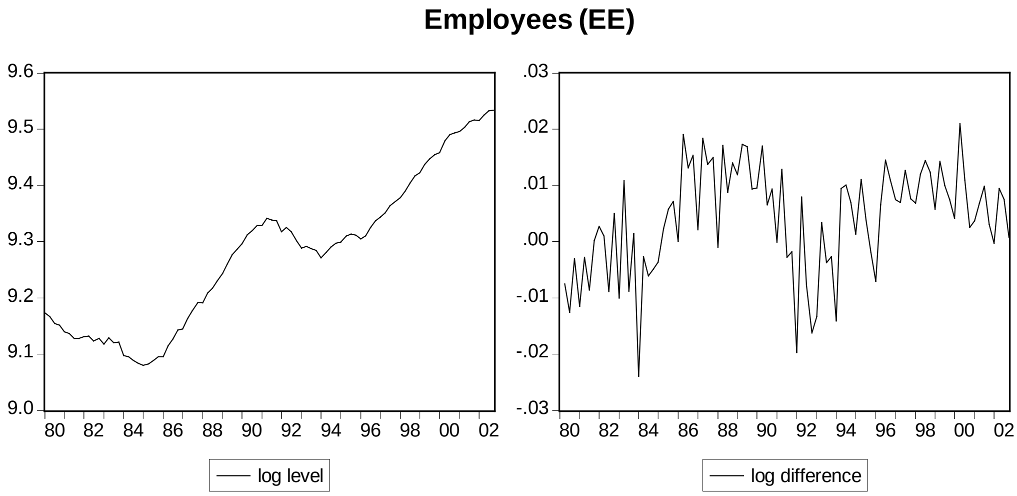


Total demand at prices of 1995 (DTOT95)

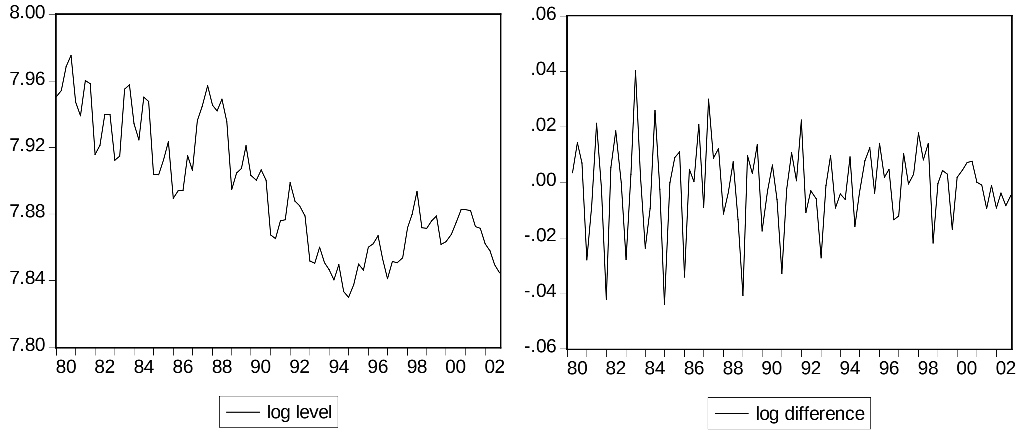



Exchange rate: Pesetas per ECU (ECU)
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
80 82 84 86 88 90 92 94 96 98 00 02
log level
.10
.08
.06
.04
.02
.00
-.02
-.04
-.06
80 82 84 86 88 90 92 94 96 98 00 02
log difference

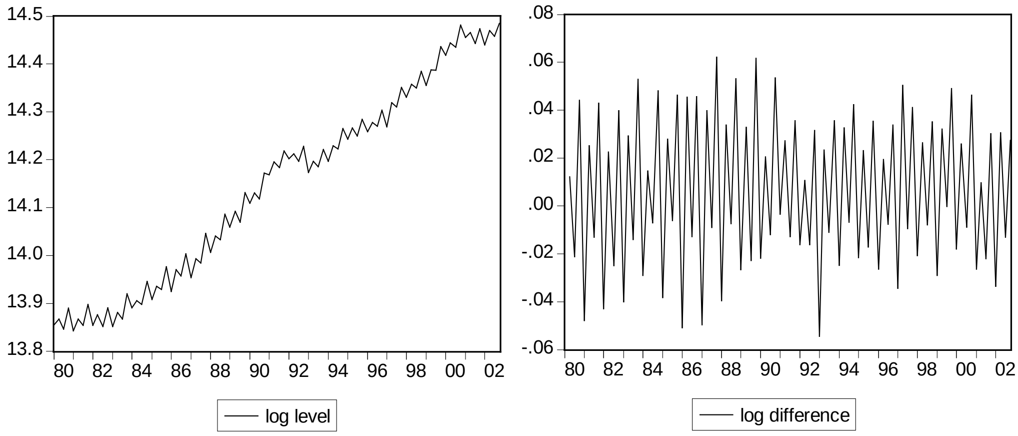

Exchange rate: Pesetas per ECU (ECU)
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
80 82 84 86 88 90 92 94 96 98 00 02
log level
.10
.08
.06
.04
.02
.00
-.02
-.04
-.06
80 82 84 86 88 90 92 94 96 98 00 02
log difference


Employees (EE)
9.6
9.5
9.4
9.3
9.2
9.1
9.0
80 82 84 86 88 90 92 94 96 98 00 02
log level
.03
.02
.01
.00
-.01
-.02
-.03
80 82 84 86 88 90 92 94 96 98 00 02
log difference

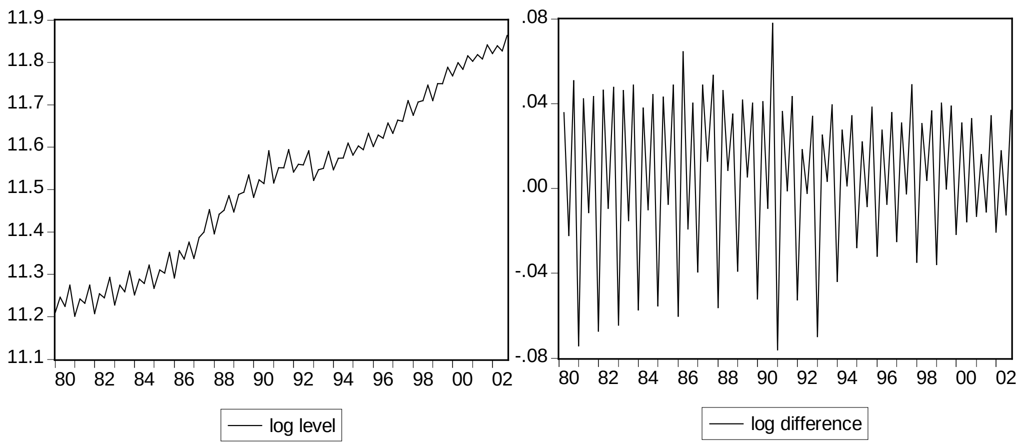
Self-employed persons (ES)



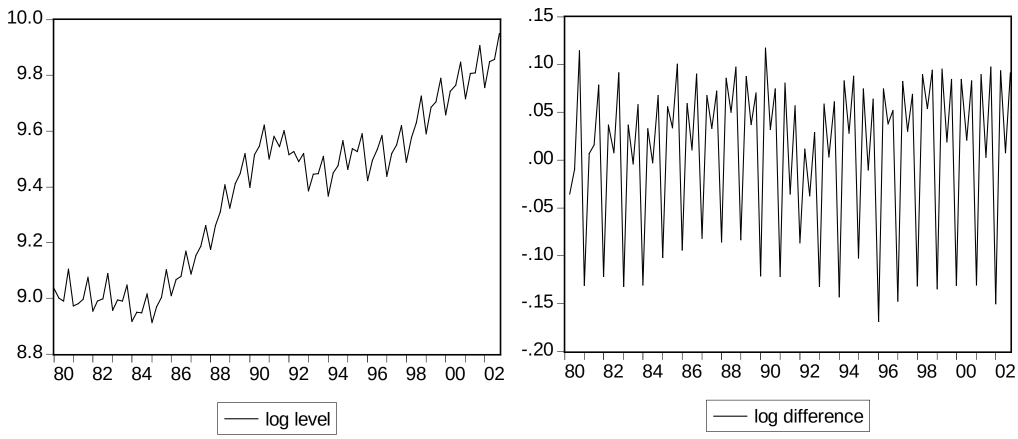
Total demand of euro area excl. Spain at prices of 1995 (EWU-DTOT95)



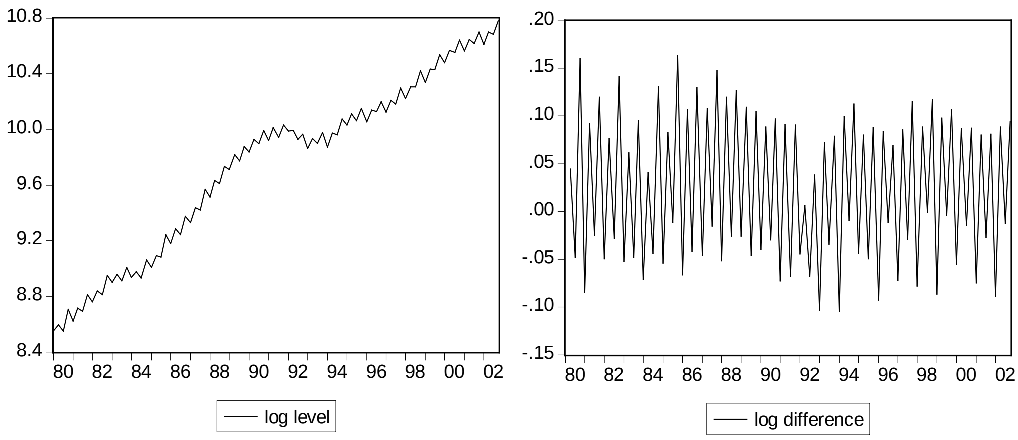
Gross domestic product at prices of 1995 (GDP95)



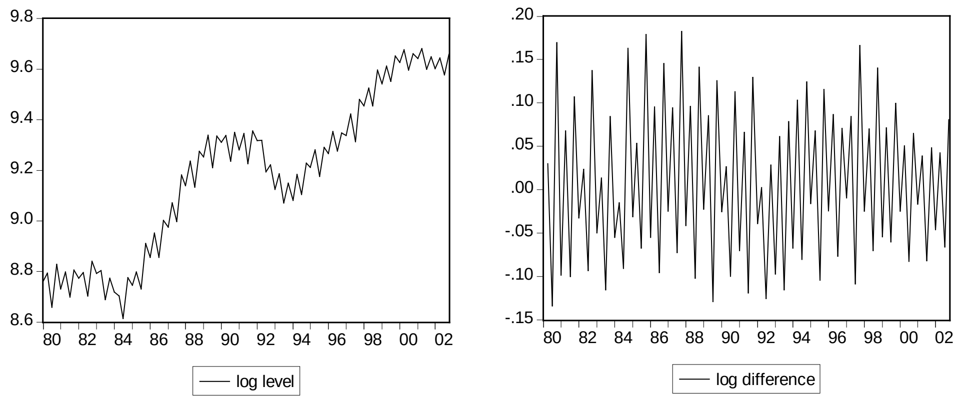
Gross fixed capital formation: construction at prices of 1995 (ICON95)



Gross fixed capital formation at current prices (IFC)

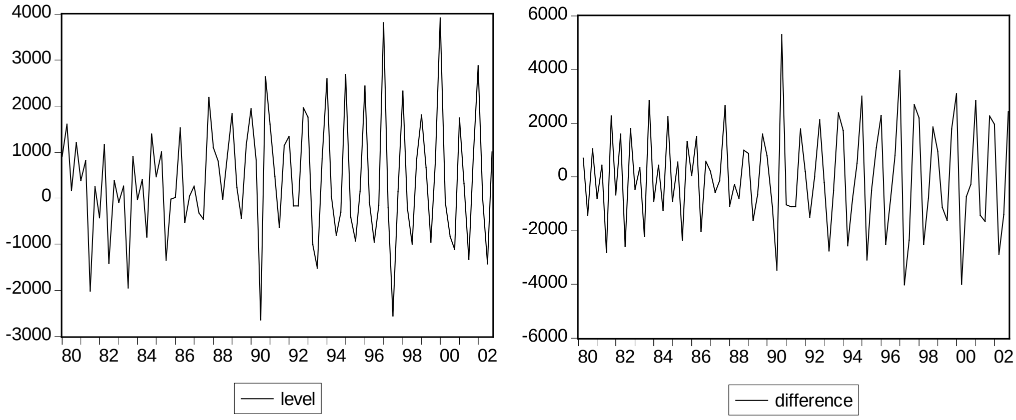


Gross fixed capital formation: machinery and equipment* at prices of 1995 (IMEQ95)

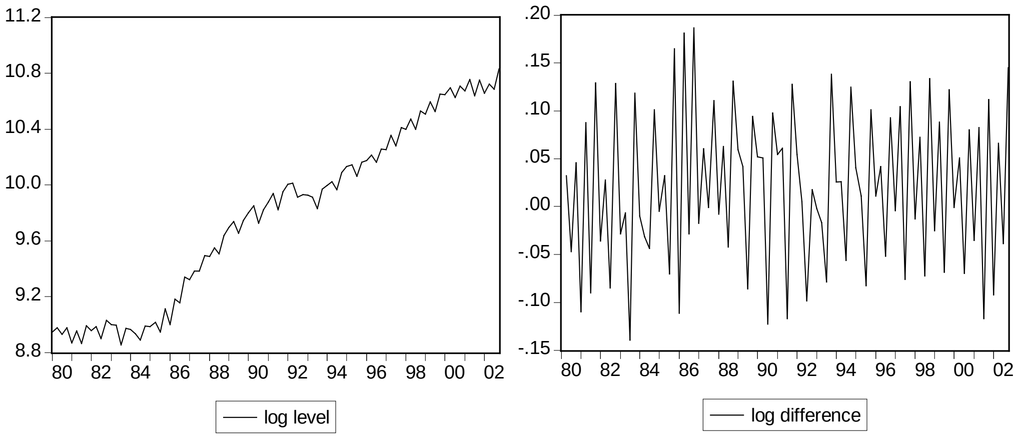


* including investment into agricultural and other products

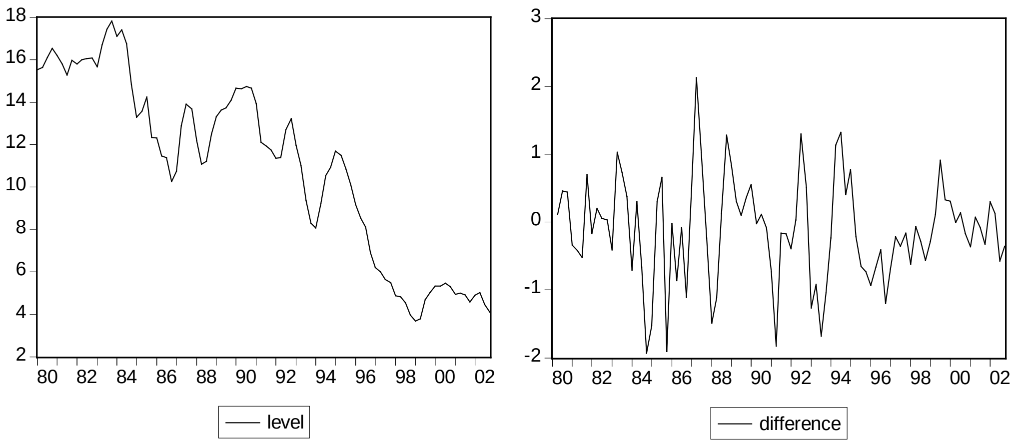
Changes in inventories and net acquisition of valuables at prices of 1995 (IS95)



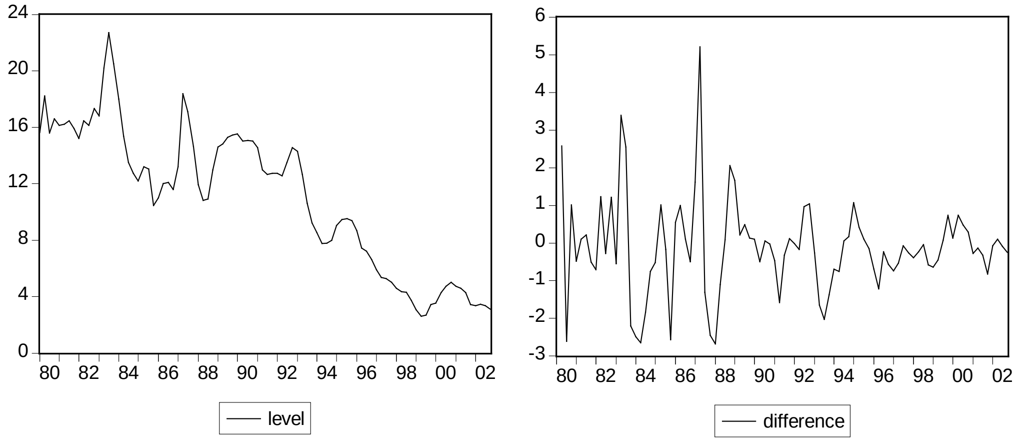
Imports of goods and services at prices of 1995 (M95)



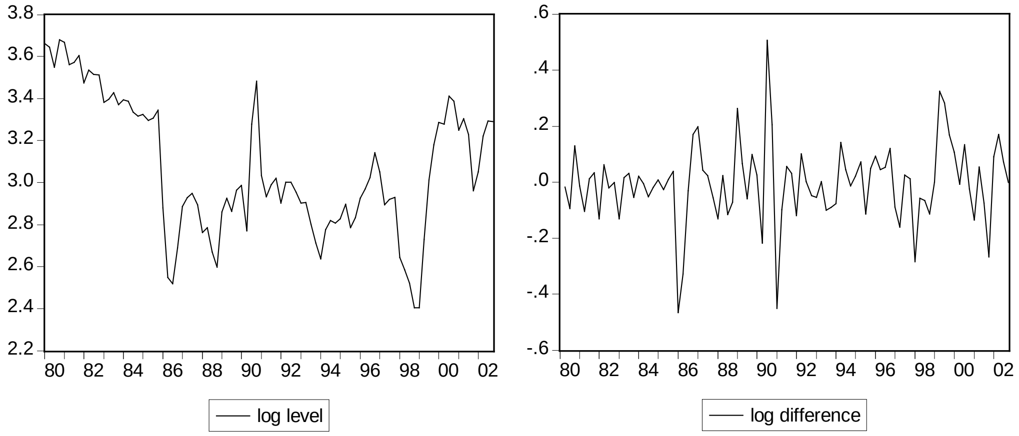
Nominal long-term interest rate of the euro area (NL)



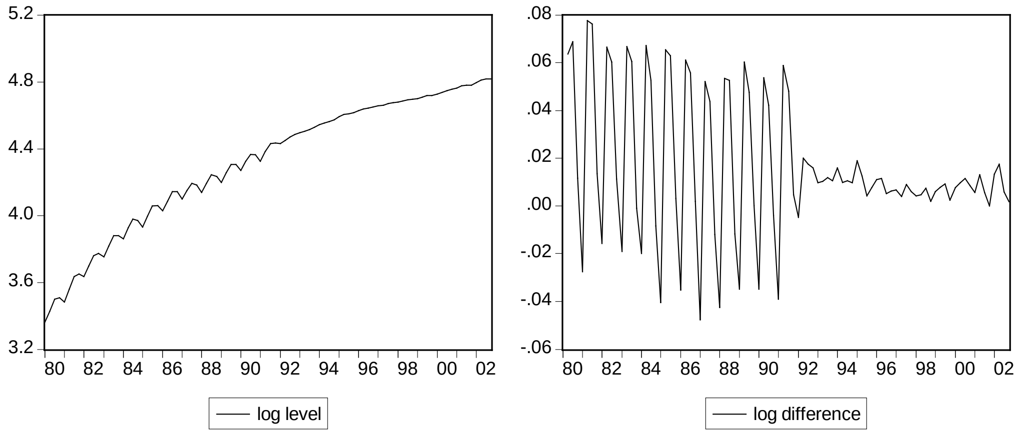
Nominal short-term interest rate of the euro area (NS)



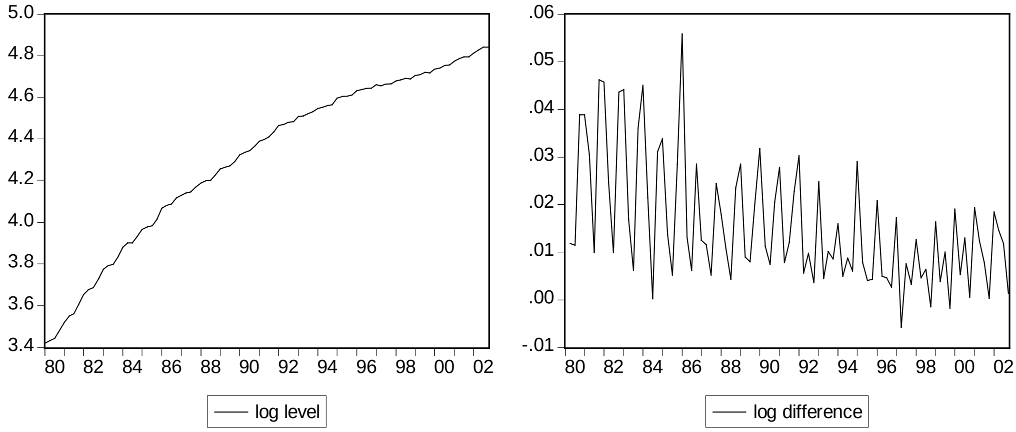
Oil price (Brent) in US dollars (OIL$)



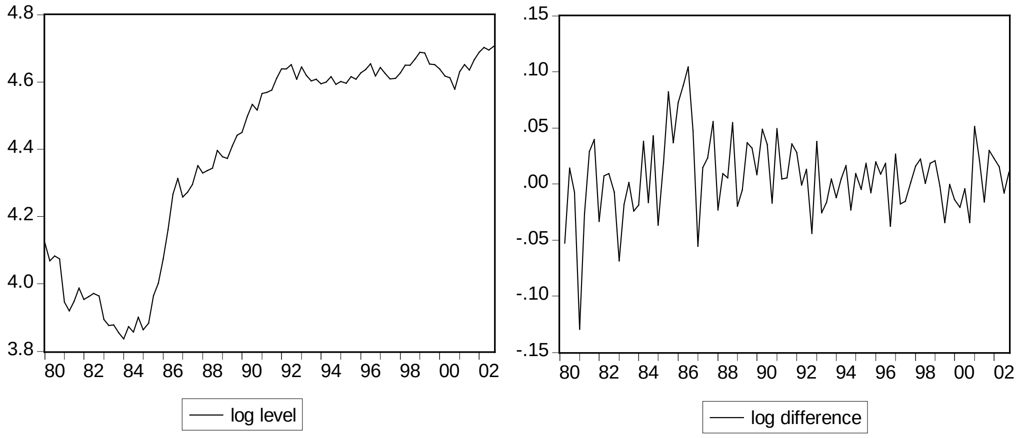
Private consumption deflator (PC)



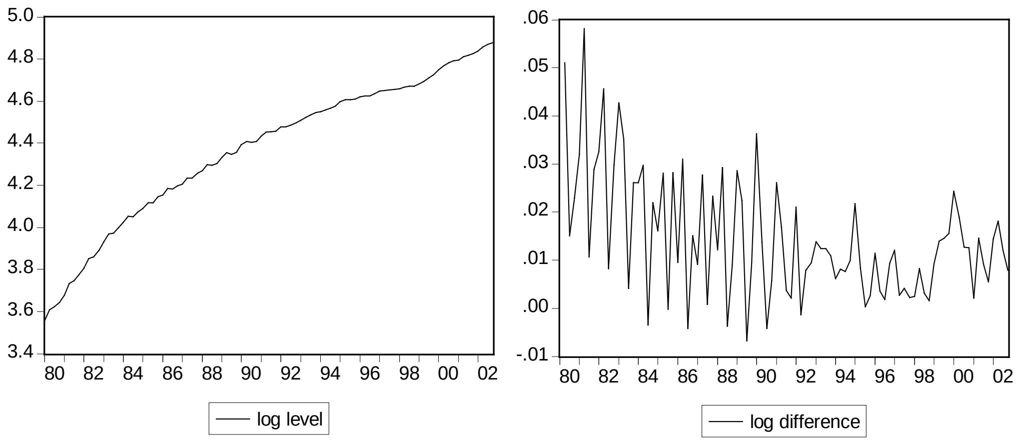
GDP deflator (PGDP)



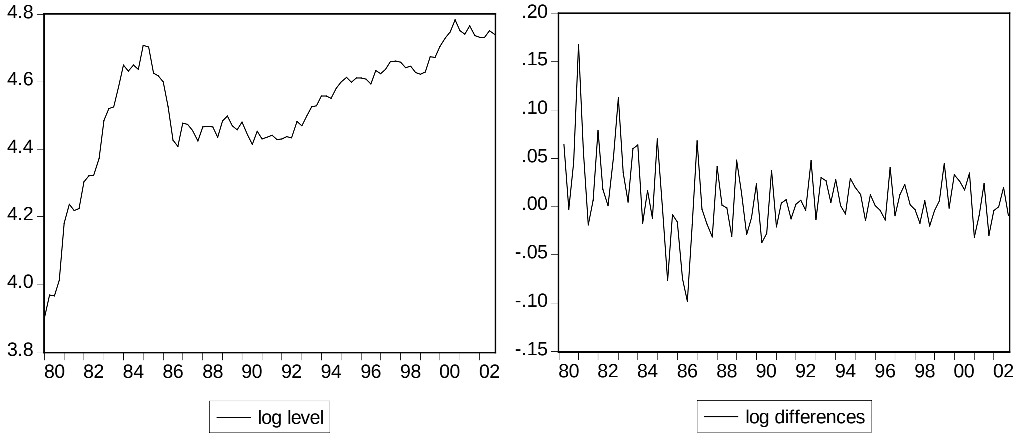
Ratio: GDP deflator / import deflator * 100 (PGDPPM)



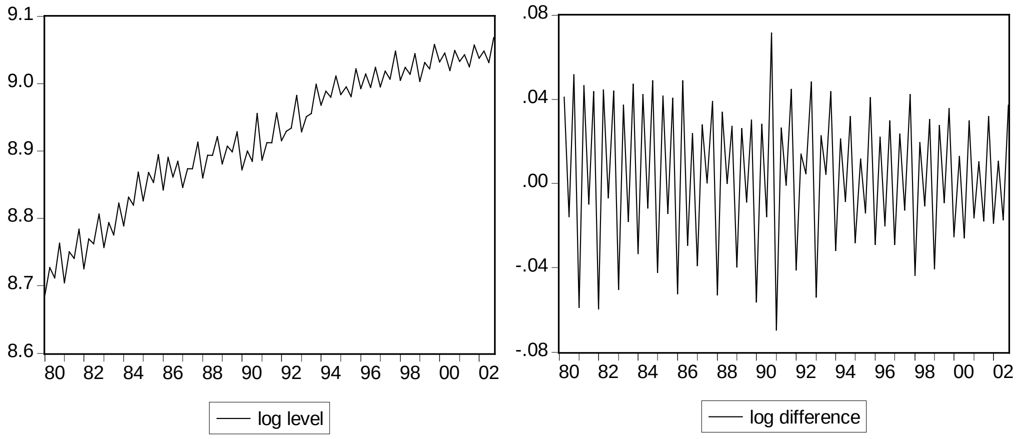
Deflator of gross fixed capital formation (PIFC)



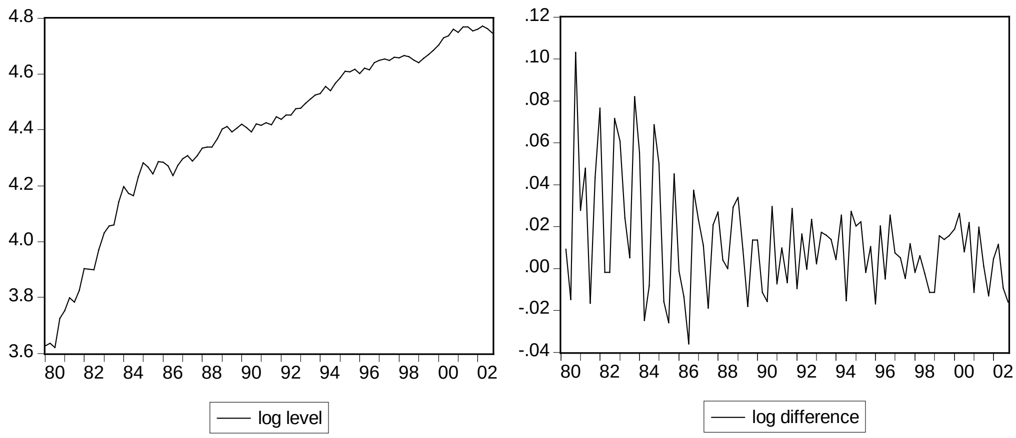
Import deflator (PM)



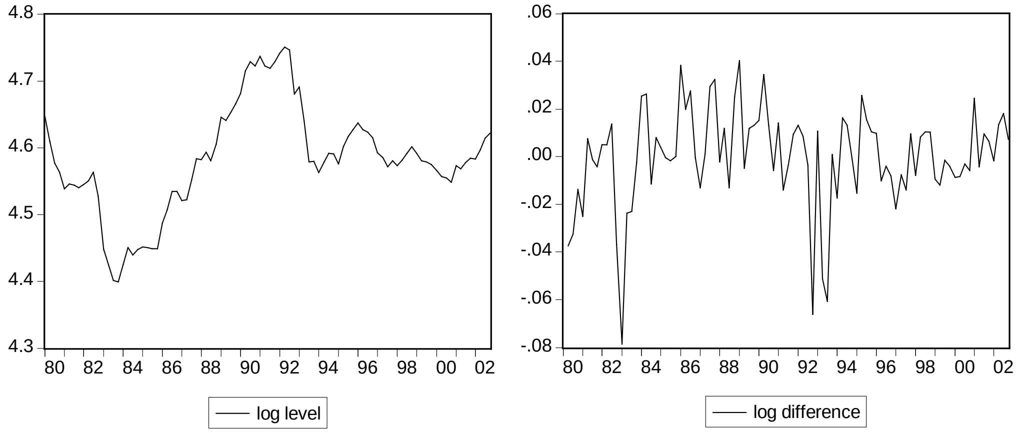
Labour productivity (PRODET)



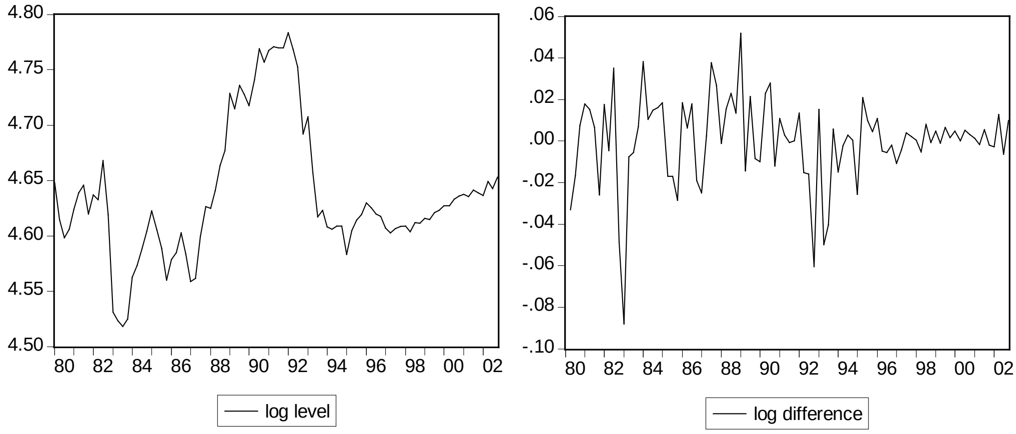
Export deflator (PX)



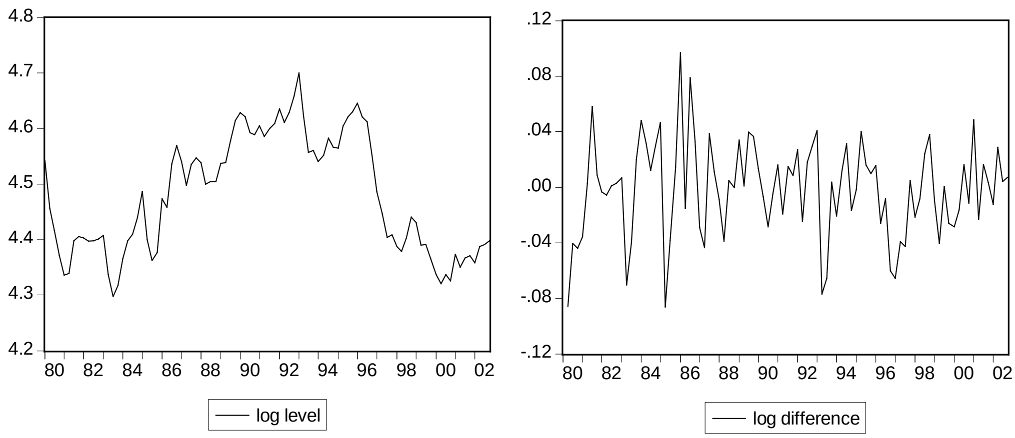
Real effective exchange rate of the Peseta (RAW)



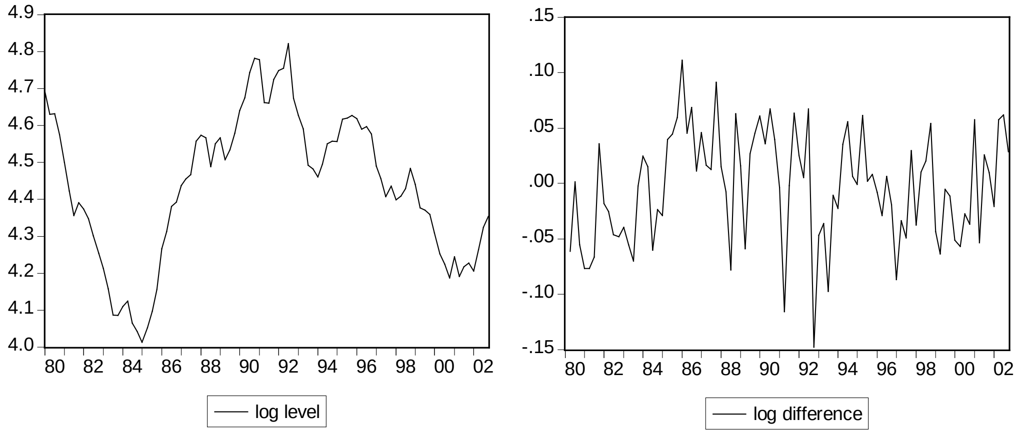
Real effective exchange rate of the Peseta against the currencies of the euro area (RAWEWU)



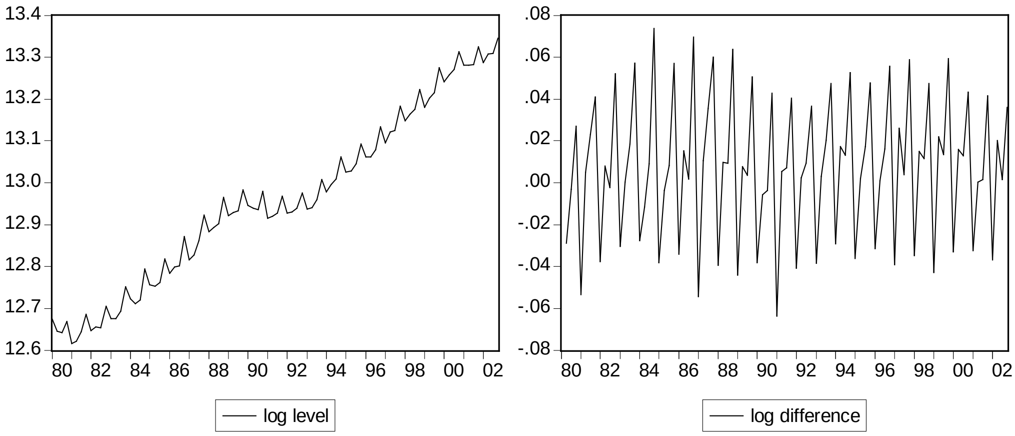
Real effective exchange rate of the Peseta against the currencies of the rest of the EU-15 (RAWREU)



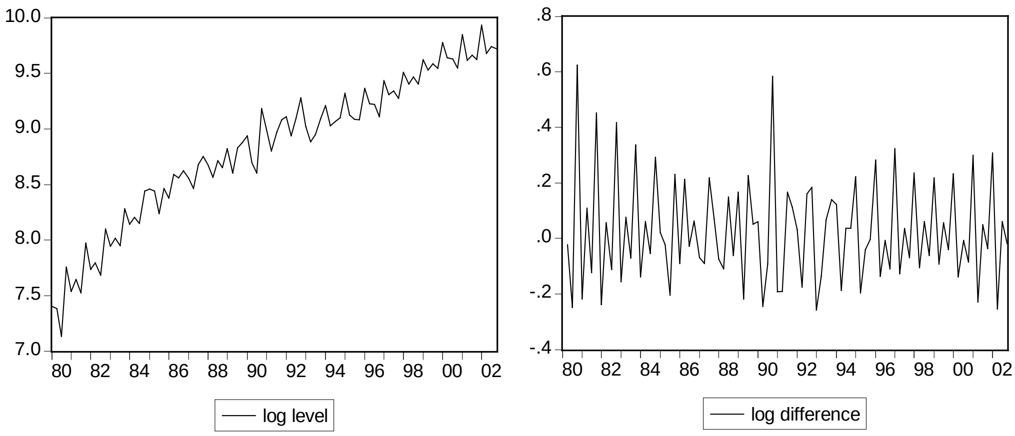
Real exchange rate of the Peseta against the US dollar (RAWUS)



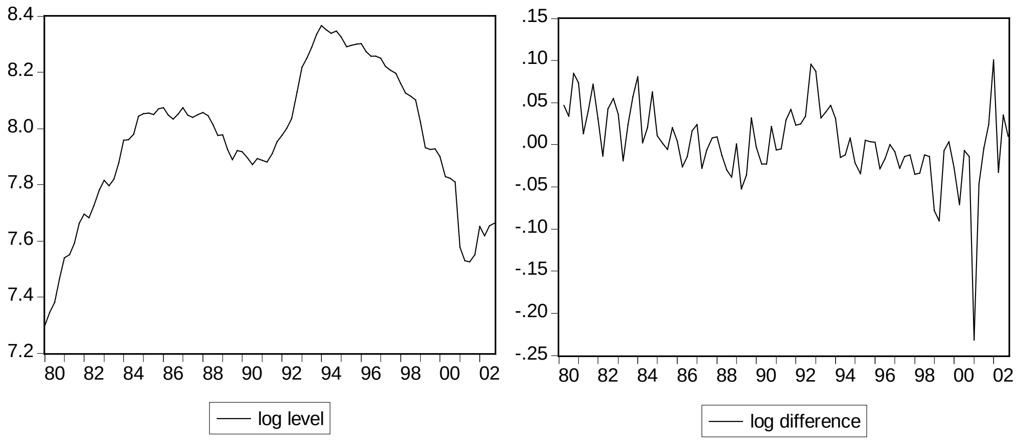
Total demand of EU-15 countries outside the euro area (REU-DTOT95)



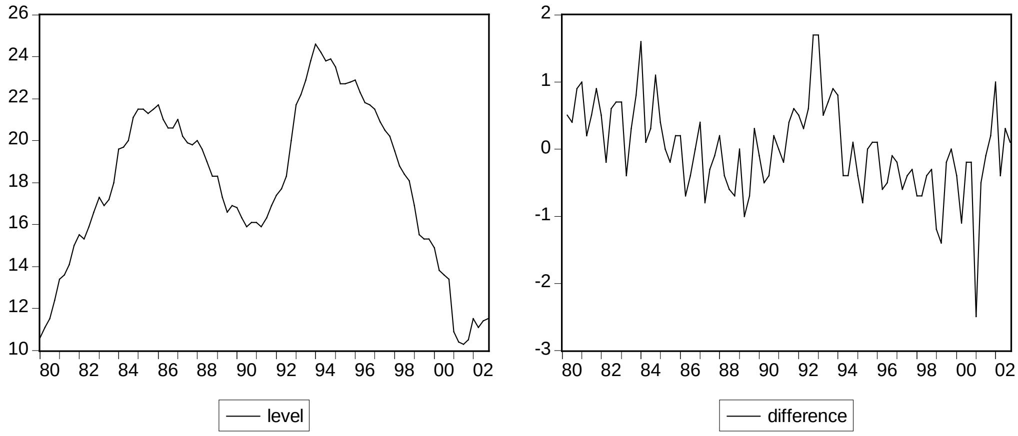
Indirect taxes less subsidies (TIND)



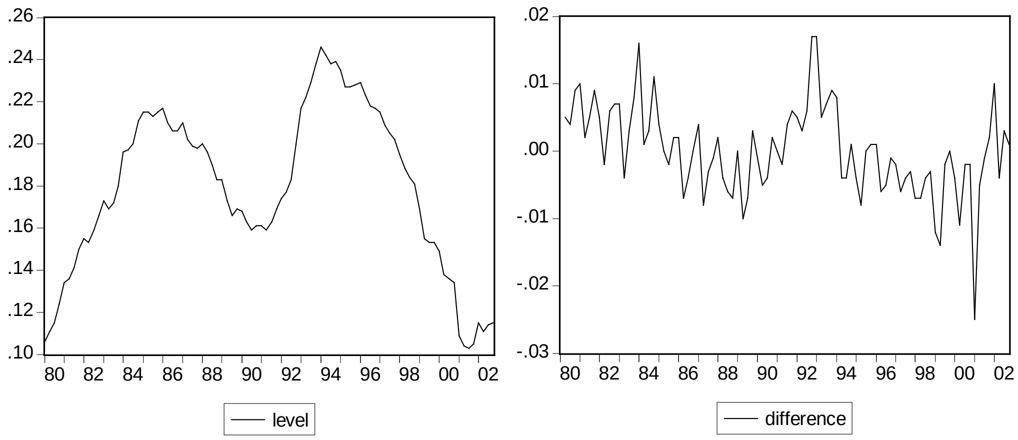
Unemployed persons (U)



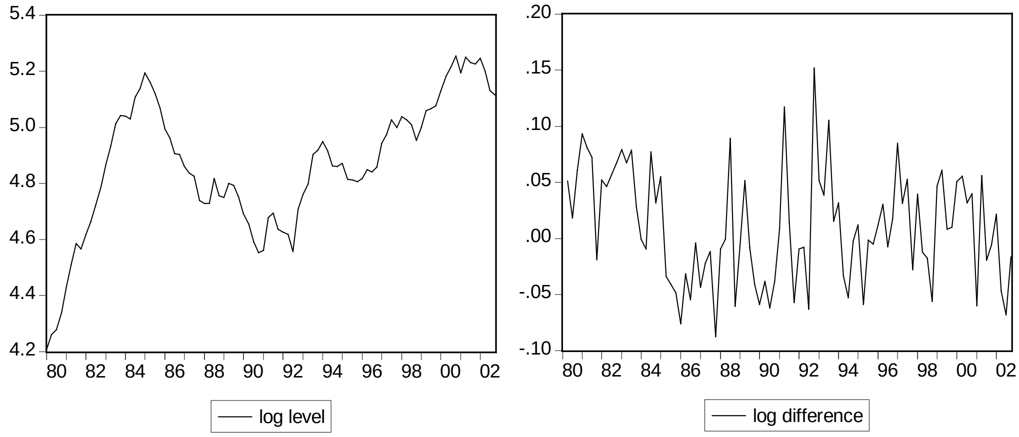
Unemployment rate (%; UR)



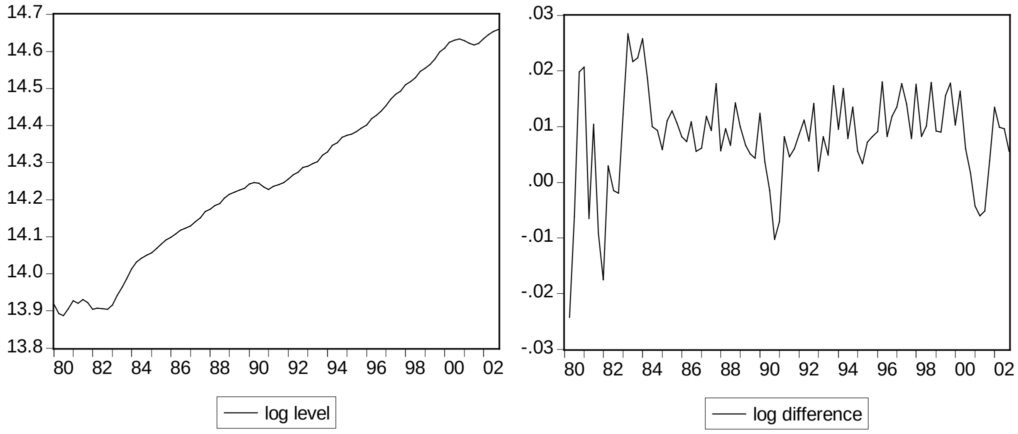
Unemployment rate (decimals; UR1)



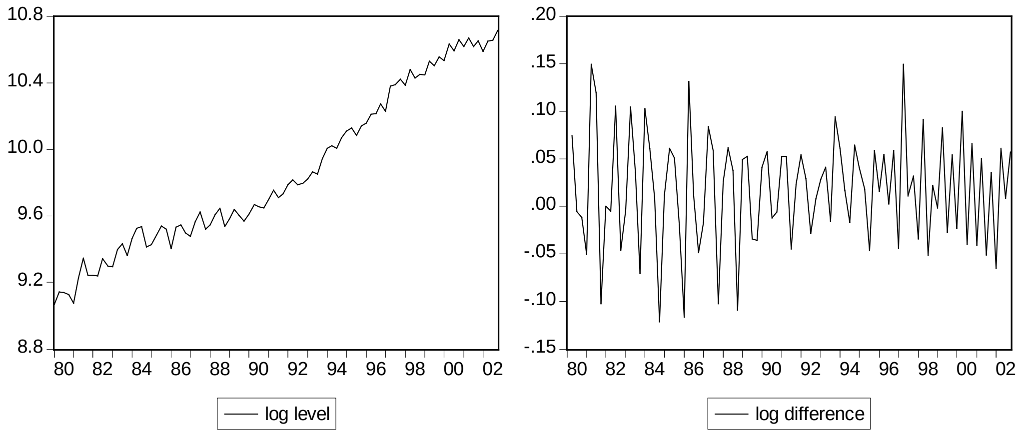
Pesetas per US dollar (USD)



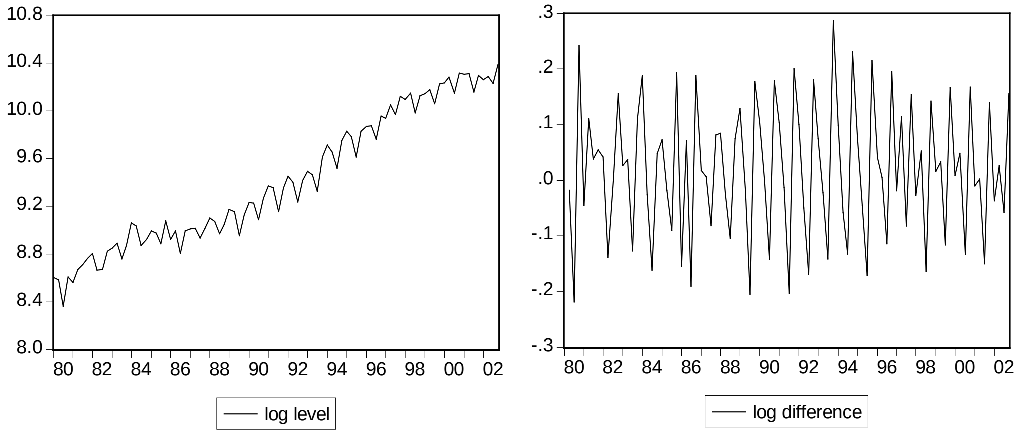
Total demand of the United States of America (US-DTOT95)



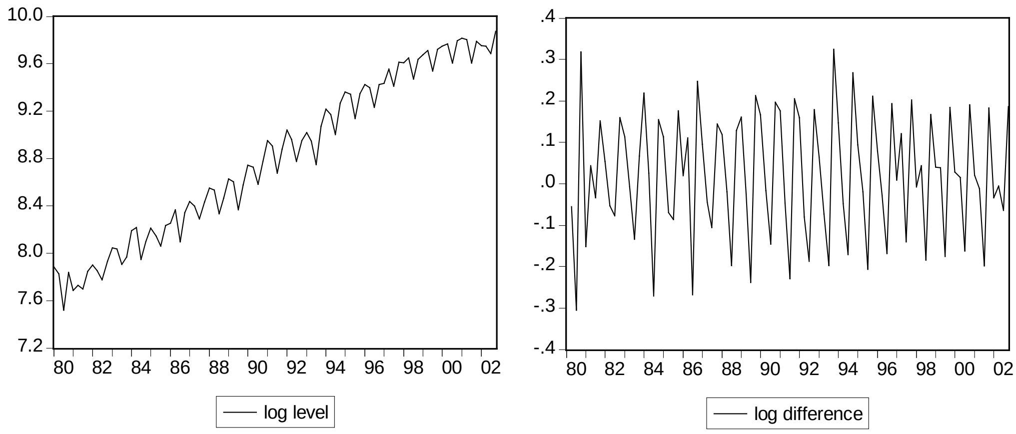
Exports of goods and services at prices of 1995 (X95)



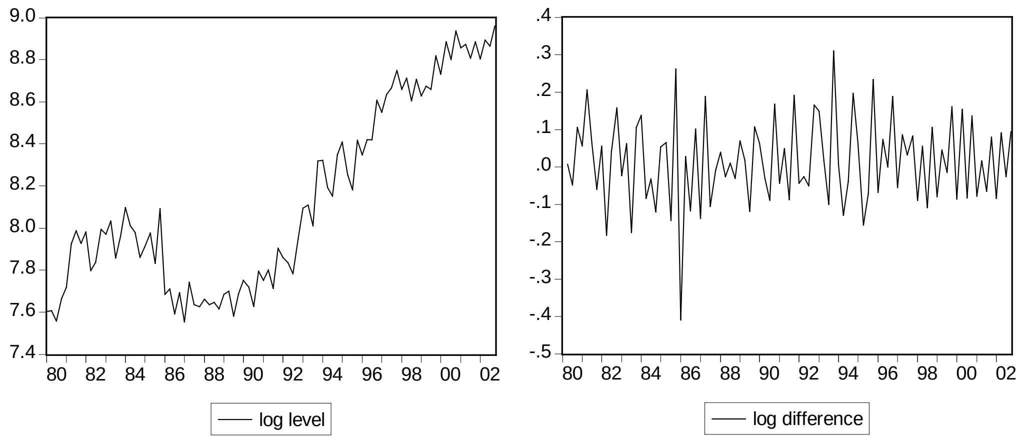
Exports of goods at prices of 1995 (XG95)



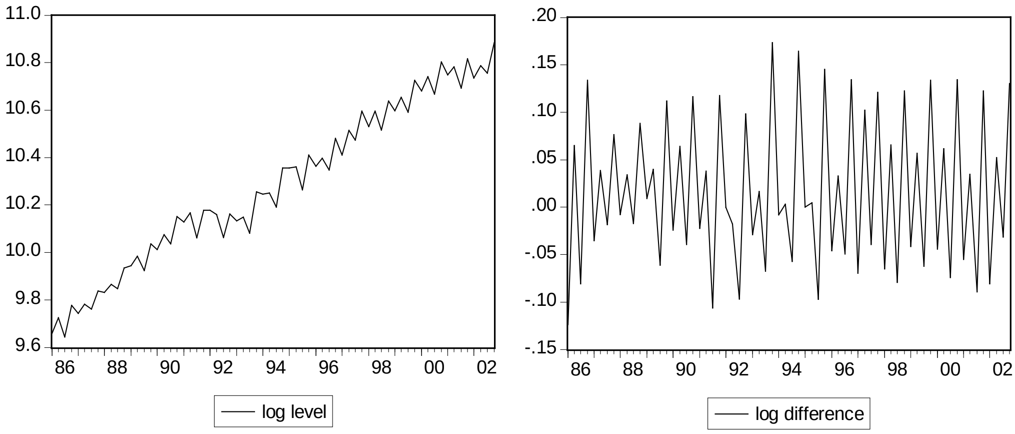
Exports of goods to the euro area at prices of 1995 (XG95EWU)



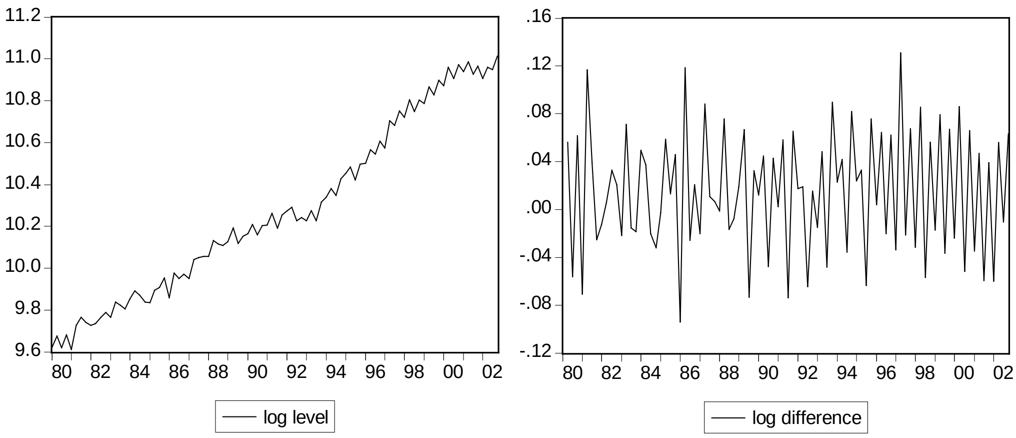
Exports of goods to the rest of the world at prices of 1995 (XG95ROW)



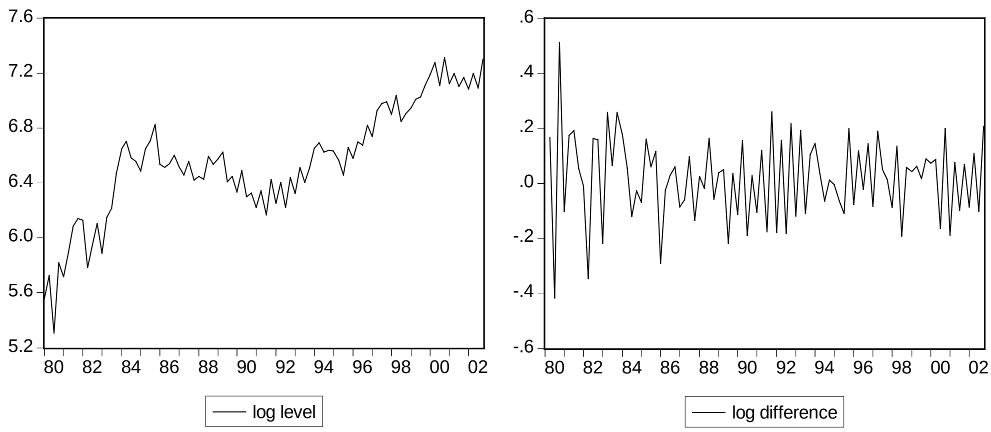
Sum of goods exports and construction investment (XGICON95)



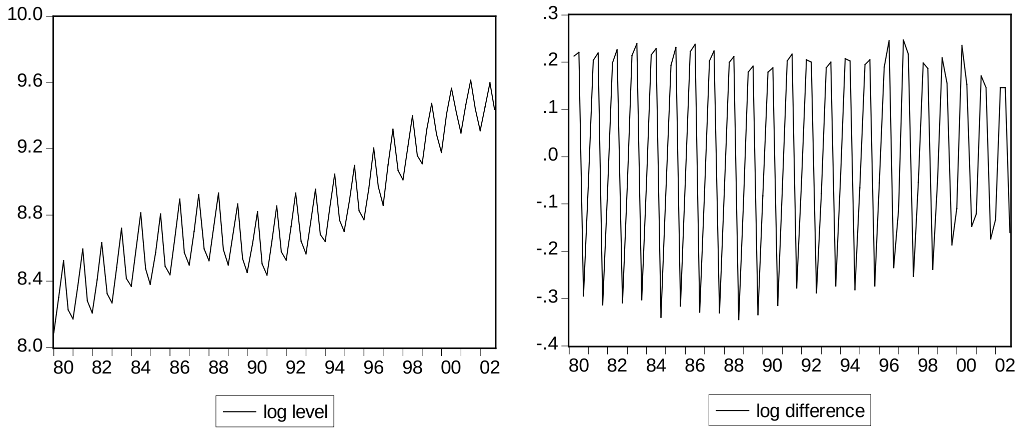
Total exports plus investment into machinery and equipment at constant prices of 1995 (XIMEQ95)



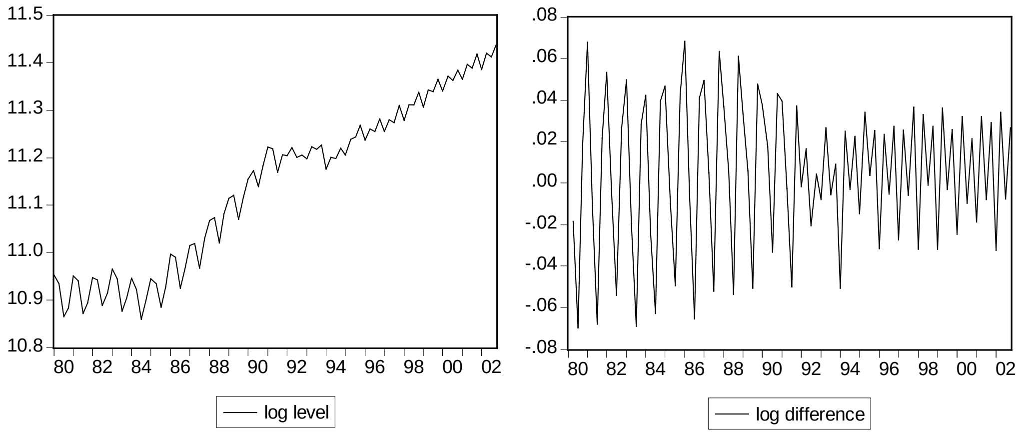
Exports of goods to the United States of America at prices of 1995 (XG95US)



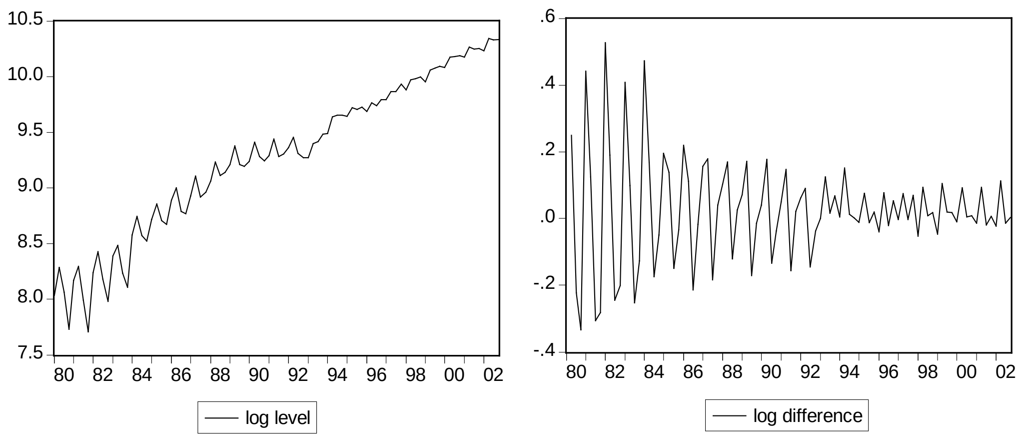
Exports of services at prices of 1995 (XS95)



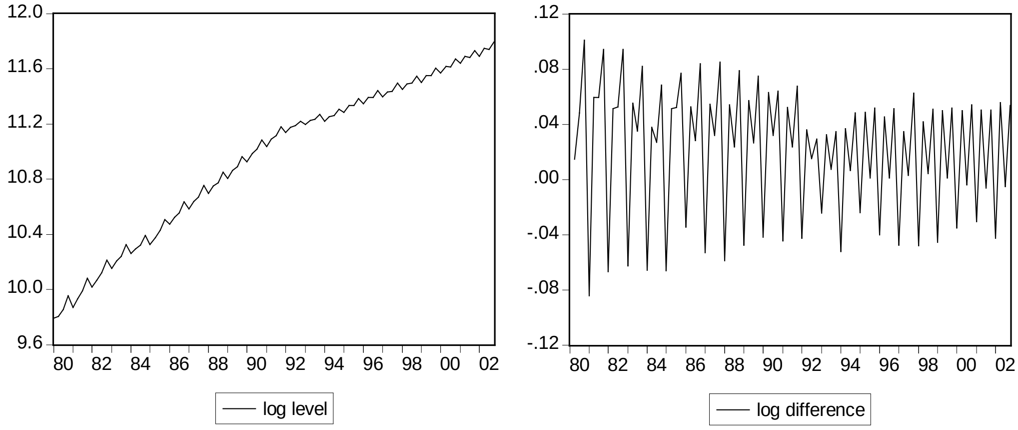
Disposable income of households at prices of 1995 (YD95)



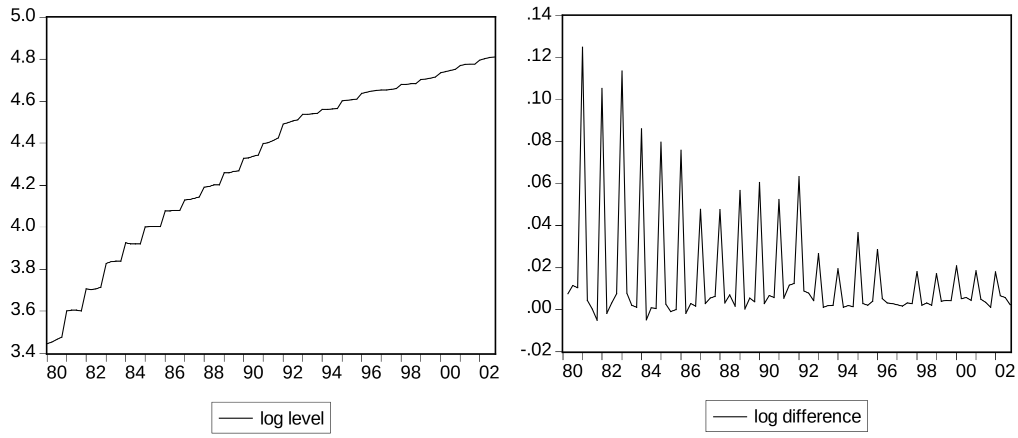
Consumption of fixed capital (CFC)



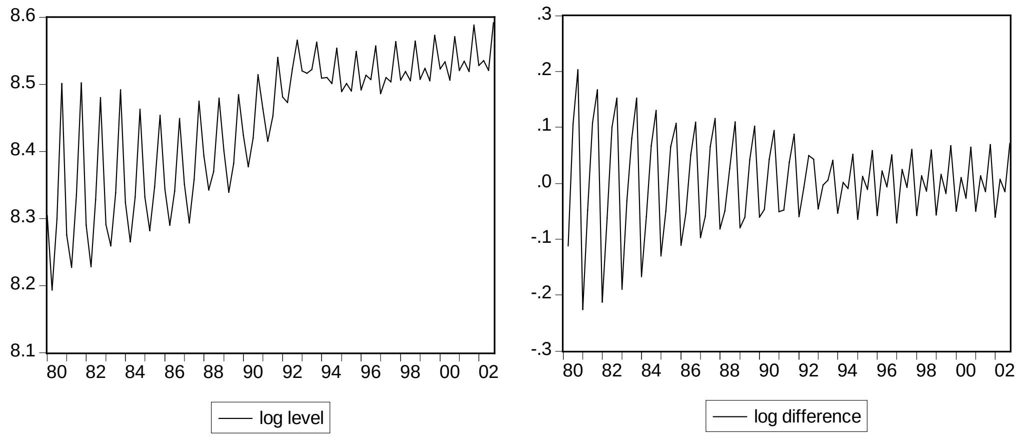
Compensation of employees plus operating surplus and mixed income (COEOSMIN)



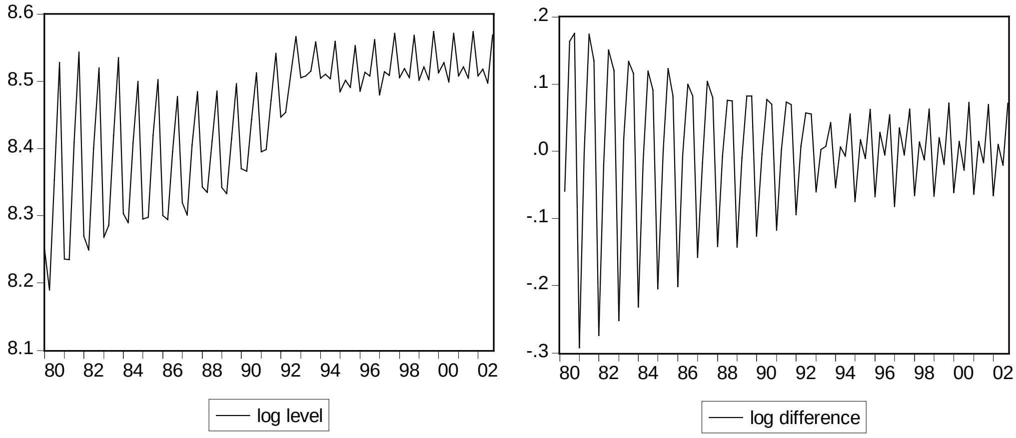
Government consumption deflator (PCGOV)



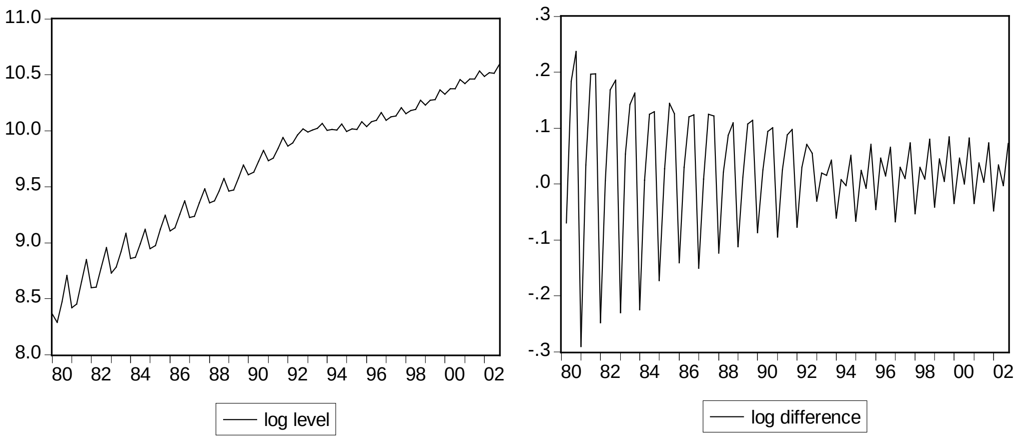
Real compensation per employee (deflated with the consumption deflator; RWEE)



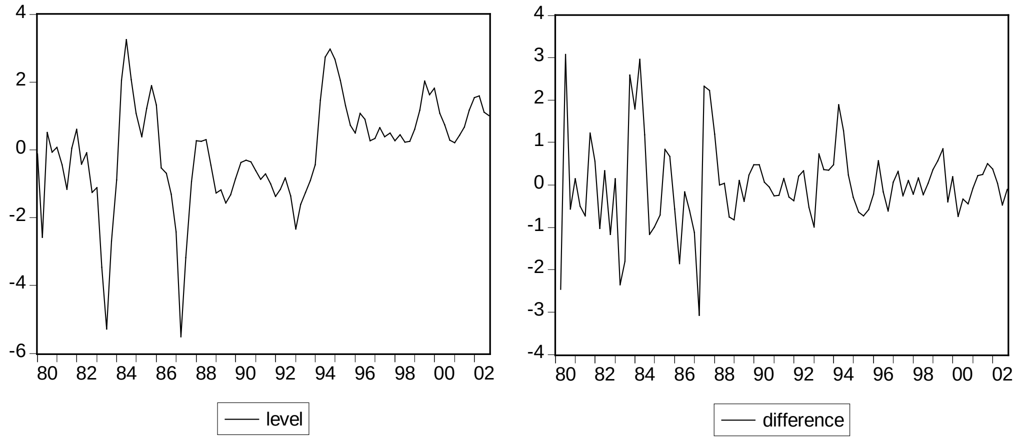
Real compensation per employee (deflated with the GDP deflator; RWEEPGDP)



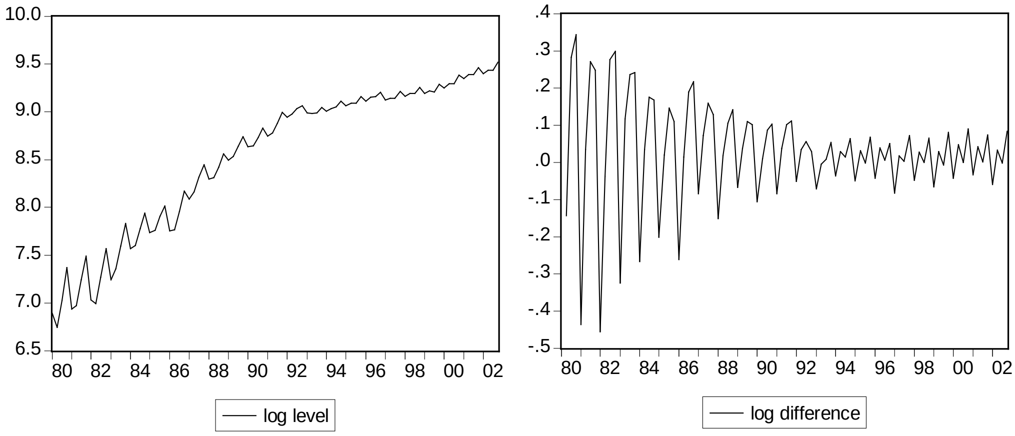
Social security contributions of households (SC)



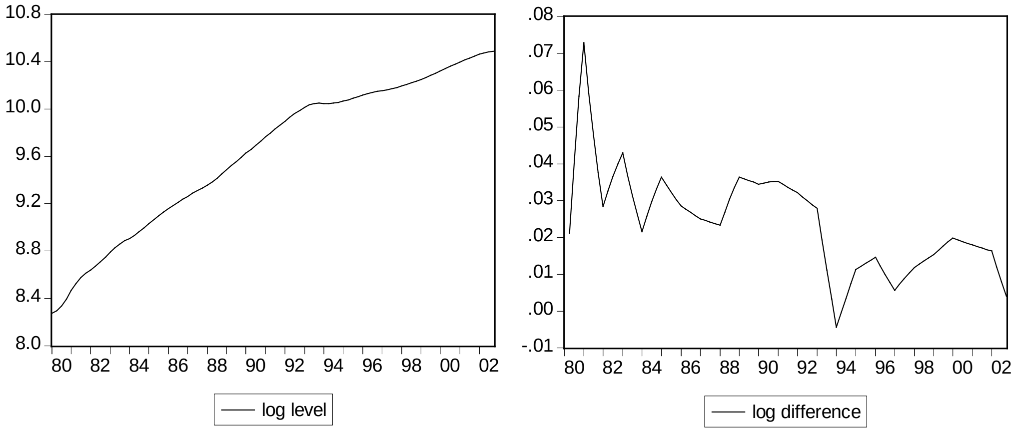
Interest rate spread (SPREAD)



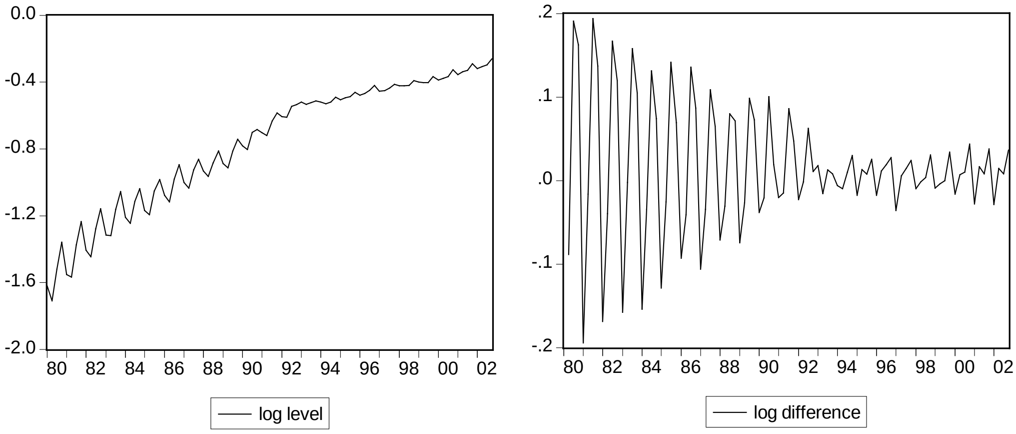
Direct taxes paid by households (TD)



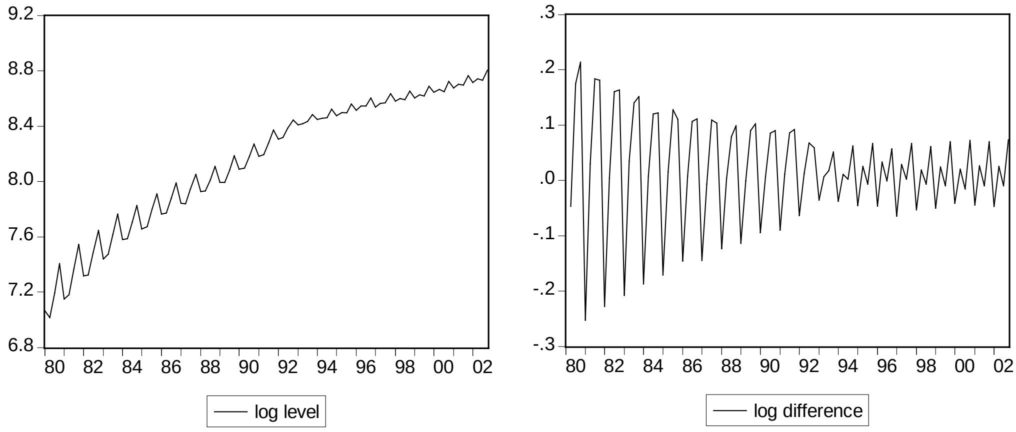
Transfers received by households (TRR)



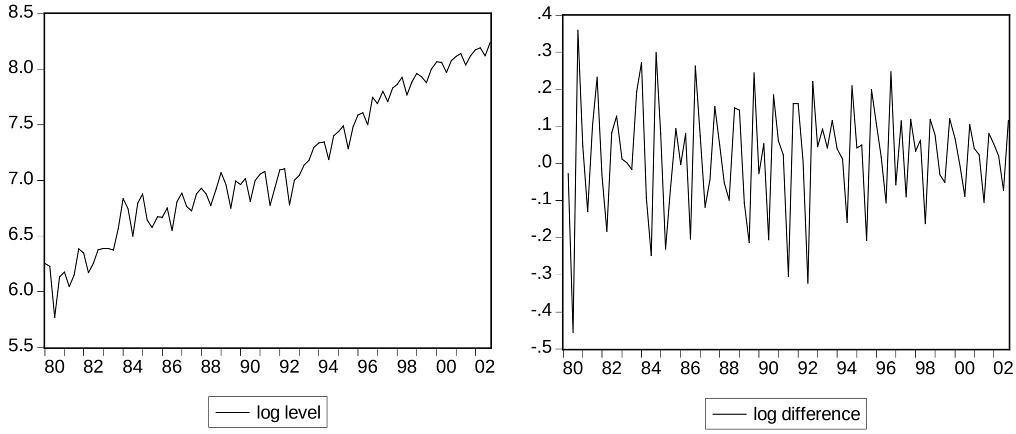
Unit labour cost (ULC)



Compensation per employee (WEE)



Exports of goods to the EU-15 countries outside the euro area at prices of 1995 (XG95REU)



A.2 Unit Root Test Methodology

In the current data set we can distinguish four different types of series:

- Stationary series: series that fluctuate around a constant mean with bounded variance. This is why they are also called "mean-reverting". In formal language they are referred to as I(0) series.
- Trend-stationary series: these series are stationary with respect to a deterministic trend. They fluctuate around a constant, if they are adjusted for the trend.
- Series integrated of order one: these series become stationary by differencing once. They are denoted by I(1).
- Series integrated of order two: these series need to be differenced twice before they become stationary. These series are denoted by I(2). This stochastic property is often found in nominal data and price indices.

Of course, higher orders of integration may exist from a theoretical point of view, but they are hardly ever encountered in economic analysis. This is why we consider cases with two unit roots at the most. The four different cases enumerated above, cover almost all macroeconomic time series. Most series are I(1).

So far we have assumed no structural breaks in the series. However, these are quite frequent in macroeconomic data. Therefore, we have to take into account level shifts or changes in the trend slope. As we shall see below they have particular implications.

Any estimation equation needs to be balanced. This means that the order of integration of the regressors as a whole has to be compatible with the order of integration of the dependent variable. Before we can estimate a balanced equation, we therefore have to know the stochastic properties of the data. For this purpose a unit root test is carried out. If there are no obvious structural breaks in the series, the Augmented Dickey-Fuller (Dickey and Fuller 1979) test is applied. It is the most common and widely used unit root test.

In contrast to the original Dickey-Fuller test it is suitable in cases where the DGP is a higher-order auto-regressive process of the form:

$$Y_t = X_t'\delta + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + ... + \alpha_k Y_{t-k} + u_t \tag{A.1}$$

where X_t denotes a set of exogenous variables, such as the constant, a deterministc trend as well as seasonal dummies and other deterministics. As the objective here is to illustrate the approach of the ADF test in a general form, the details of the deterministics are not discussed for the time being. u_t is a white noise process. The data generating process is an AR of order k.

By adding and subtracting

$\sum_{i=2}^{p} \alpha_i Y_{t-1}$, $\sum_{i=3}^{p} \alpha_i Y_{t-2}$,...,$\sum_{i=p-1}^{p} \alpha_i Y_{t-p}$, $\alpha_p Y_{t-p+1}$

on the right hand side we obtain the test equation:

$$Y_t = X_t'\delta + \rho Y_{t-1} + \sum_{j=1}^{p-1} a_j \Delta Y_{t-j} + u_t \quad \text{(A.2)}$$

Here $\rho = \sum_{i=1}^{p} \alpha_i$ and $a_j = -\sum_{i=j+1}^{p} \alpha_i, j = 1, 2, ..., \rho - 1$.

Subtracting Y_{t-1} on both sides yields:

$$\Delta Y_t = X_t'\delta + (\rho - 1)Y_{t-1} + \sum_{j=1}^{p-1}(a_j \Delta Y_{t-j}) + u_t \quad \text{(A.3)}$$

,

The null hypothesis is that $(\rho - 1) = 0$, which is equivalent with a unit root in the series. If $(\rho - 1)$ is significantly smaller than zero, the null hypothesis can be rejected.

The relevant test statistic is the t-value of $(\rho - 1)$. However, it has to be noted that the t-value follows a Dickey-Fuller-Distribution. The critical values are provided in various sources (Dickey and Fuller 1979, MacKinnon 1991). Besides the number of observations they depend on the deterministics chosen. Whereas the use of seasonal dummies (which are stationary time series) is irrelevant for the critical values (Lütkepohl 2004, p.55), different critical values apply, depending on whether an intercept and/or deterministic trend is included.

As we have seen in the preceding graphs (c.f. Appendix A.1.2) many time series show some kind of a structural break like a change in the trend slope or a level shift. In some cases there is even a combination of both. For such time series the ADF-Test sometimes reports spurious results, because the null hypothesis of a unit root cannot be rejected. In these cases a procedure proposed by Perron (1989) is a more suitable approach.

Perron distinguishes three different models of structural breaks:

- Model A: level shift

- Model B: change of slope of the trend
- Model C: combination of Model A and Model B

Perron's procedure consists of two steps:

1. The variable is regressed on all relevant deterministics (e.g. trend, constant, seasonal dummies, step dummy, broken trend)

2. An augmented Dickey-Fuller Test is carried out on *the residuals*.

Critical values for Models A and C are taken from Perron(1989). Perron and Vogelsang(1993) provide corrected critical values for Model B. In this thesis only additive abrupt structural changes are taken into account.

A.3 Temporal Disaggregation of Annual Data

A.3.1 Disposable Income

Most of the series used in the model are available from official statistical sources with monthly or quarterly frequency. However, this does not apply to disposable income of households. The INE offers only annual data from 1995 onwards within the framework of the European System of Accounts 1995 (ESA 1995). The Organisation for Economic Cooperation and Development (OECD) has extrapolated this series backwards until 1980 on the basis of the European System of Accounts 1979 (ESA79). To obtain quarterly data a method of temporal disaggregation must be adopted by the author. The most appropriate approach is the method of Chow and Lin (1971) as it is incorporated into ECOTRIM, a software package developed by Eurostat and applied in Eurostat's estimation of EU-12 and EU-15 aggregates (Barcellan 1994). The idea is to use an indicator series in the inter- and extrapolation of annual time series. For a series like disposable income, which is the total of several sub-aggregates there are two possible approaches: a direct one and an indirect one. Whereas the former would mean temporal disaggregation of disposable income with just one appropriate indicator series, the latter would derive quarterly disposable income as the total of the temporally disaggregated sub-series. This approach is followed here.

As disposable income is composed of several very different series from compensation of employees to transfers from the government, it is sensible to temporally disaggregate these sub-series using a *different* indicator series each time. Fortunately, the subseries accounting for the largest share of disposable income (i.e. compensation of employees) is provided by the statistical office on a quarterly basis and thus does not have to be disaggregated.

As the whole model of which the consumption function forms a vital part is estimated with the seasonally unadjusted quarterly national accounts data, it is desirable that the quarterly disposable income series to be constructed should equally show a plausible seasonal pattern. Thus, a simple temporal disaggregation without indicator series is generally ruled out, because it would produce some kind of a trend-cycle component of the respective series. This seems acceptable only in cases, where no seasonal pattern is expected or, when no appropriate indicator is available as in the case of social transfers. It has to be emphasised that within the framework of national accounts it has to be ensured that subseries add up.

Table A.2 gives an overview of the sub-series of disposable income and the indicator series used. All annual data were taken from the OECD Economic Outlook 74. For periods for which INE data exist these are identical. Indicator series were taken from the INE's quarterly national accounts[1].

	Annual series	Indicator series	in % of F (average: 1980-2002)
A	compensation of employees	- (quarterly series exists)	73.6
+B	property income and other income (net)	operating surplus and mixed income (gross)	37.6
+C	social transfers	no indicator	30.8
-D	direct taxes	compensation of employees	-10.9
-E	social security contributions	compensation of employees	-31.1
=F	disposable income	- (total of sub-series)	100.0

Table A.2: Temporal disaggregation of household disposable income

As the annual data is given, the long-run properties of the quarterly series cannot be distorted by the process of temporal disaggregation. However, the short-term dynamics will be affected by the choice of indicators or the choice between the direct and the indirect approach.

To obtain real disposable household income nominal disposable income is deflated by the the private consumption deflator. The latter is calculated as the quotient of nominal over real private final consumption expenditure[2] multiplied by 100. The use of the private consumption deflator produces some statistical problems, which become obvious at the sight of the series.

The series shows strong seasonal fluctuations until the end of 1991. Then, suddenly, the seasonal pattern vanishes. Most probably this reflects problems in the compilation of national accounts data according to the European System of Accounts 1995 (ESA 1995) rather than an abrupt change in the economy. The consequence of the use of this

[1] These were published for the period until 2002 fourth quarter in early 2003.

[2] In both cases the official quarterly national accounts data from the Spanish National Statistical Institute, INE, were used for the period from 1980 until 2002.

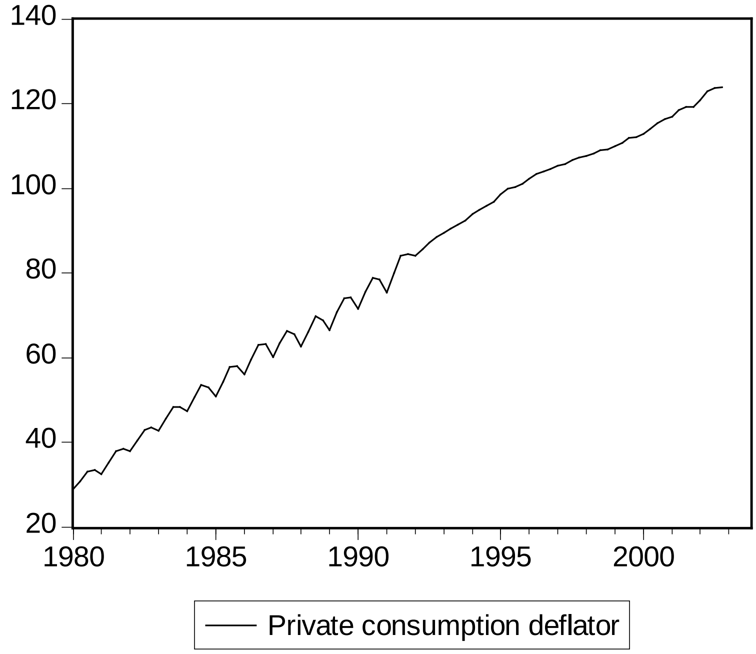


Figure A.1: Private final consumption deflator

series for deflation is that real disposable income of households equally shows a changing seasonal pattern. This problem could only be overcome by changing either nominal or real private consumption. As both series are official data, however, such an approach is rejected.

Strictly speaking quarterly disposable income is an estimate. Does this mean that critical values in the estimation of the consumption function have to be different? A strong argument against the application of adjusted critical values is the fact that the quarterly series is produced with an approach very similar to that of statistical offices. In the end all data are "estimates". The INE also uses temporal disaggregation as conceived by Chow and Lin for the production of all raw quarterly national accounts data [3]. Thus, the estimate of real disposable income here is quite similar to what the INE might have produced. An additional argument may be that the series has not been estimated freely as the annual figures are given.

[3] For details see Quilis (2001).

A.3.2 Other Computations of Time Series Involving Temporal Disaggregation

Total demand of euro area countries

Total demand of the other euro area countries (except for Luxembourg) at constant prices of 1995 (EWUOES_DTOT) is one of the regressors in the equation of exports of goods to the euro area (XG95EWU). This series has been calculated as the sum of total demand (GDP plus imports) of the ten individual countries[4]. The data have been aggregated by simply adding up the series converted into euros at the fixed conversion rate. For Germany and Austria the author extended the series backward using ESA 1995 data for West Germany in the case of the German series (source: Statistisches Bundesamt) and ESA 1979 data in the case auf Austria (source: WIFO, Vienna). As Greece, Portugal and Ireland offer only insufficient quarterly data. The annual GDP and import series of these countries were temporally disaggregated using the method of Chow and Lin (1971) as it is incorporated into ECOTRIM, Eurostat's temporal disaggregation software package. The industrial production index and the import volume of goods as published by the OECD in its Main Economic Indicators were used as indicators for GDP and total imports, respectively.

Government construction investment

In its Economic Outlook (No. 74) the OECD publishes an annual time series of the government investment volume. This aggregate includes both construction and machinery and equipment. In most countries the share of construction in government investment is above 80 %. As no detailed breakdown of government investment is available from 1980 onwards it is assumed that the government invests only into construction, which in the case of Spain, which receives considerable funds for infrastructure investment from Brussels, is all the more plausible. The quarterly series is derived in the following way. The annual government investment is subtracted from the annual total construction. The difference yields private construction investment, which - fluctuating between 60 and 85 % of total construction investment - is the larger aggregate. Therefore it is sensible to apply the temporal disaggregation method to private construction investment using

[4] Germany, France, Italy, Netherlands, Belgium, Austria, Finland, Greece, Portugal, Ireland

total construction investment as an indicator series. Quarterly government construction is then obtained as the difference between total (quarterly) construction investment and private (quarterly) investment.

A.4 Regional Disaggregation of Export Data

For the model the quarterly national accounts have been chosen as a consistent data framework. Consistency of the data set is the sine qua non in macroeconometric modelling. If the information of other data sources outside the national accounts is to be used, it has to be made consistent with the quarterly national accounts. This task has become much easier with the introduction of the ESA 1995, which also brought national accounts data more in line with balance of payments and government financial statistics. Thus, in the case of exports, total nominal exports of goods as given in the national accounts hardly differ from trade statistics.

For the macroeconometric model of the Spanish economy this means that the *nominal* exports in million euros can be broken down by destinations using the (variable) weights of the respective countries/regions in the trade statistics, which are published by the Spanish Ministry of the Economy (among others). The regions of interest are: the euro area, the rest of the EU-15 (i.e.UK, Sweden, Denmark), the United States of America and the rest of the world.

Some difficulties arise, when the exports *in real terms* are to be derived. For this purpose, the nominal series would have to be deflated with the relevant price index. However, there are no export price indices by destination. It is therefore assumed that the individual deflators are identical with the deflator of total exports of goods. In several respects this assumption is problematic:

- The assumption implies that the prices of exports to the different regions depend only on domestic prices in Spain, i.e. there are no pricing-to-market strategies.
- Even if the above were true, the price indices would still be different due to the different weights of individual goods in the exports to each region.

The author has chosen this approach despite its drawbacks, because there is no superior alternative. The estimation results appear quite plausible. In particular, demand variables of the respective regions as well as the respective real effective exchange rates of the Peseta seem to explain the regionally disaggregated real export series quite well, which suggests, that the share of a specific region in Spain's real exports is not too different from its share in nominal exports.

A.5 Calculation of Real and Nominal Effective Exchange Rates

There is a wide range of options for calculating nominal and real effective exchange rates. For the weighting alone numerous possibilities exist: the bilateral indices can be weighted together arithmetically or geometrically. Weights can be constant or vary over time. Third market effects can be taken into account or ignored. For the real effective exchange rates there are several appropriate price indices, the most common being the CPI, the PPI and unit labour cost.

The Bundesbank (Deutsche Bundesbank 1998) has defined the following prerequisites for indicators of international cost competitiveness:

- they should refer to those sectors of the economy which are subject to international competition i.e. refer to tradable goods,

- they should reflect the price and cost situation of the respective sector,

- they should rely on an internationally comparable data-base.

Whereas the PPI generally fulfils the first two conditions, there is no internationally uniform methodology. Some countries publish a wholesale price index rather than the PPI and coverage also varies significantly between countries ranging from just manufacturing to industry including energy, mining and water.

Unit labour cost is problematic, because it is not available on a quarterly basis for a number of countries including Portugal, which since 1998 has been Spain's third most important export market (after France and Germany), and there are either no good indicator series with sufficient observations available that could be used as indicator series in temporal disaggregation or - as in the case of Portugal - even annual time series have an insufficient length. Even the OECD Economic Outlook No. 74 offered annual data of compensation of employees for Portugal only from 1995 onwards.

Thus, the CPI is used here, although it includes prices of non-tradeables. Data are taken from the OECD. As the series of the harmonised index of consumer prices usually begin only after 1990, the national concepts are referred to.

Weights of the euro area countries are based on trade statistics from the Spanish Ministry of the Economy (MINECO). As the shares of some countries in Spanish exports to the euro area have changed significantly over time, the weights reflect the actual weight of the respective country in each period. Weights of the EU-15 countries were calculated using annual IMF data from the Direction of Trade Statistics (DOTS), as trade data for the Sweden and Denmark could not be obtained from the MINECO.

For the time being the real effective exchange rate index includes only the price indices and exchange rates of the importing countries in the euro area, although third market effects may exist. Real and nominal effective exchange rates are calculated as weighted *geometrical* averages. The real effective exchange rate vis-à-vis Belgium is weighted with the weight of Belgium and Luxembourg, which formed a currency union before the introduction of the Euro. The CPI of Luxembourg is not taken into account.

B. APPENDIX TO CHAPTER 4

B.1 Cointegration and Error-Correction

The estimations rely on the concept of cointegration. This means that two or more integrated variables are driven by common stochastic trends[1]. In other words there exists at least one linear combination of the time series which yields a stationary time series. The existence of cointegrating relationships implies that an error correction model can be estimated and vice versa. The equivalence of cointegration and error correction is known as *Granger representation theorem* (Engle and Granger 1987).

The error correction equation consists of two parts:
- a long-term "equilibrium" relationship in levels in the sense of a steady state relation
- short-term dynamics in differences (complemented by further stationary variables)

The error-correction equation for the dependent variable y typically takes the following form (for simplicity only one explanatory variable is assumed):

$$\Delta y_t = \lambda(y_{t-1} + \beta_1 x_{t-1} + det.) + \sum_{i=1}^{k} \beta_{2i} \Delta y_{t-i} + \sum_{j=1}^{l} \beta_{3j} \Delta x_{t-j} + u_t \qquad \text{(B.1)}$$

y_t is the dependent variable, x_t is the explanatory variable, $det.$ stands for "deterministics", i.e the constant, a step dummy or a deterministic trend[2], u_t, the error term, is white noise. In the long run the variables evolve around their common stochastic trend(s), but in the short run there may be deviations from this trend. The error-correction-mechanism means that, whenever deviations occur, the variables return to their long-run steady state. The size of the coefficient λ gives an idea about the speed of adjustment. The larger the absolute value of λ the faster is the adjustment process. The estimation of the error-correction equation also serves as a cointegration test. If

[1] For simplicity we concentrate on the case of I(1) variables.

[2] Of course, the term "deterministics" also covers seasonal dummies. As these are stationary variables, however, they are not part of the error-correction term, but belong to the short term dynamics. For simplicity, they are neglected in this section.

the t-statistic of λ is sufficiently negative, the null hypothesis of no cointegration can be rejected (Banerjee, Dolado, and Mestre 1998).

The stable long-run relationship expressed by the error-correction term is a great advantage for forecasts over a longer time horizon. Estimations in differences usually work well in the short term, as in the case of a so-called *flash estimate* i.e. a one period ahead "forecast" of the most recent quarter based on economic indicators. In contrast there is some evidence that error-correction models *can* improve the forecast performance for *medium-term* forecasts. However, this does not always hold. In the very long run or in the case of a structural break in the cointegrating relation, forecasts based on differenced series can outperform forecasts based on error correction models[3].

Before the estimation of an error-correction equation it is advisable to establish the existence of cointegration. Two procedures are most often applied for this purpose:

- the two-step approach of Engle and Granger (1987),
- the Johansen cointegration test (Johansen 1995).

The former is a fairly simple technique based on a single-equation estimation. Cointegration between two or more series means that a linear combination of these series yields a stationary series. Thus, in this approach a static regression in levels is run. If the series in the regression are cointegrated the residuals must be stationary. This is tested by a simple ADF-Test on the residuals. However, as the residuals are an estimated time series, the critical values, which have been applied in section 3 cannot be used here. Critical values for this cointegration test were simulated by MacKinnon (1991) and can be found in Hassler (2004, p.111). In choosing the correct critical values, the properties of the data have to be taken into account. If there is a deterministic trend in the data, which is not included in the equation, the correct critical values are those which allow for a trend in the cointegrating relationship at n-1, where n is the number of stochastic I(1) regressors.

If cointegration is established the estimated regression equation reflects the long-term relationship and the estimated coefficients can be incorporated into the error-

[3] For a summary of the literature on the relative forecast performance of error-correction models see Hassler and Wolters (2001).

correction term. The procedure of Engle and Granger is easy to apply and easily understood. However, it has some drawbacks, especially, when the number of variables is higher than 2. It offers no information about the number of cointegrating relationships and the result of the analysis may depend on the variable on the left hand side in the regression[4].

For these reasons the Johansen cointegration test[5], which overcomes most of these disadvantages has become the most popular method of testing for cointegration. It allows to identify the number of cointegrating relations. It is based on a VAR-model including n I(1) variables, which may or may not be cointegrated. For an illustration we look at a the case of a lag length of 1 in levels.

$$X_t = AX_{t-1} + \varepsilon_t \tag{B.2}$$

X_t and ε_t are $(n \cdot 1)$ vectors. A is an $(n \cdot n)$ matrix.
This is equivalent to the following VECM:

$$\begin{aligned} \Delta X_t &= (A - I)X_{t-1} + \varepsilon_t \\ &= \Pi X_{t-1} + \varepsilon_t, \end{aligned} \tag{B.3}$$

where I is the $(n \cdot n)$ identity matrix and $\Pi = (A - I)$.

Equation B.3 is the n-variable equivalent of the Dickey-Fuller unit-root test. If the matrix Π consists of only zeros, i.e. its rank $r = 0$, then all the individual series x_{it} are unit root processes and no cointegrating relationship exists. If Π has full rank $(r = n)$, we obtain a contradiction to the assumption above that all variables are I(1), because a full rank of Π means that all variables of X_t are stationary.

The rank (r) of the matrix Π indicates the number of cointegrating vectors. So we need a methodology to allow us to determine the rank of the matrix Π. For this purpose we now look at the generalisation allowing for lagged variables.

This is done in the following way:

We run two regressions:

[4] Cf. Enders (2004).
[5] A compact summary of the method complemented by extensive intuitive explanations can be found in Enders (2004, Chapter 6)

$$\Delta X_{t-1} = b_1 \Delta X_{t-1} + b_2 \Delta X_{t-2} .... b_{k-1} \Delta X_{t-k+1} + \epsilon_{1t} \quad \text{(B.4)}$$

and

$$X_{t-1} = c_1 \Delta X_{t-1} + c_2 \Delta X_{t-2} .... c_{k-1} \Delta X_{t-k+1} + \epsilon_{2t} \quad \text{(B.5)}$$

We define $S_{ij} = T^{-1} \sum_{t=1}^{T} \epsilon_{1t} \epsilon_{2t}$
then the n eigenvalues can be computed as the solutions to

$$\det \left(\lambda_i S_{22} - S_{12} S_{11}^{-1} S_{12}' \right) = 0 \quad \text{(B.6)}$$

The eigenvectors, v_i, are obtained from:

$$\lambda_i S_{22} v_i = S_{12} S_{11}^{-1} S_{12}' v_i \quad \text{(B.7)}$$

($v_j' S_{22} v_i = 1$ if $i = j$)
The eigenvalues are then ordered, beginning with the largest, so that
$1 > \lambda_1 > \lambda_2 > \lambda_3 > ... > \lambda_n$.

The Johansen test is carried out to find out how many of the eigenvalues are significantly different from zero. This number of eigenvalues corresponds to the rank of the matrix Π and thus the number of cointegrating vectors.

There are two test statistics, which can be used in the procedure:
- the trace statistic

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} ln(1 - \hat{\lambda}_i), \quad \text{(B.8)}$$

- the maximum eigenvalue statistic

$$\lambda_{max}(r, r+1) = -T ln(1 - \hat{\lambda}_{r+1}), \quad \text{(B.9)}$$

where T is the number of observations used in the test and $\hat{\lambda}_i$ is the estimated value of the respective eigenvalue. The test statistics can be adjusted for small samples. In this case T is replaced by $T - rn$. These alternative statistics are routinely provided in PC-Give 10.1 (Doornik and Hendry 2001) and are used for the Johansen cointegration tests reported here.

For the trace statistic the null hypothesis is that the rank of Π/the number of cointegrating vectors is less than or equal to r. The alternative hypothesis is the rank of Π/the number of cointegrating vectors is larger than r.

The null hypothesis of the maximum eigenvalue statistic is that the rank of Π/the number of cointegrating vectors is equal to r. The alternative hypthesis is that it is $r+1$.

Using each of the statistics a sequence of hypotheses can be tested. This is now illustrated for the trace statistic, which is chosen as the relevant test statistic for this thesis. First the null hypothesis $H_0 : r = 0$ is tested. If this hypothesis cannot be rejected, the test is finished. We can then assume that the variables of the VAR are not cointegrated. If the null hypothesis is rejected , we proceed to the next step. This time the null hypothesis $H_0 : r \leq 1$ is tested. If we cannot reject, the procedure is finished, if we can reject the null hypothesis we continue the test sequence until we cannot reject any more or until we reject the last null hypothesis: $H_0 : r \leq n$. The latter result would tell us that all series are stationary.

Critical values depend on r, the deterministics as well as the number of exogenous integrated variables. For testing restrictions it is convenient to express the matrix Π as $\Pi = \alpha\beta'$, where both α and β are of dimension $(n \cdot r)$, where n is the number of variables and r is the rank of Π. This decomposition is useful for testing restrictions as we can interpret α as the matrix of speed of adjustment parameters and β as the matrix of cointegrating parameters. In β we can set restrictions and compare the test statistics under the restriction to the test statistic with no restriction. On the basis of Equation B.7 we can estimate β as follows:

$$\hat{\beta} = (\hat{v}_1, \hat{v}_2, ...\hat{v}_r) \tag{B.10}$$

For the current analysis, all critical values for the trace statistic are taken from Pesaran, Shin and Smith (2000), which allow for exogenous I(1) variables. They are presented according to the five cases, which represent the restrictions set on the deterministics:

- Case I: intercept, but no trend in the data; no intercept or trend in the cointegrating relationship,

- Case II: intercept, but no trend in the data; intercept in the cointegrating relationship,
- Case III: trend in the data, but no trend in the cointegrating relationship,
- Case IV: trend in the data and in the cointegrating relationship,
- Case V: quadratic deterministic trend in the data, linear trend in the cointegrating relationship.

B.2 Tests of Residuals and Stability Tests

B.2.1 Residual tests

A minimum requirement for the estimated equations is that the residuals should be well behaved. This means that they should be normally distributed (normality test), free of autocorrelation (LM test) and homoskedastic (ARCH test, White's heteroskedasticity test). In the following an overview of the test statistics and their null hypotheses is given. The description largely follows the Eviews 4 User's Guide (Quantitative Micro Software, LLC 2001). It has been noted that the description of test statistics and test equation differs for different sources. In this situation it makes most sense to describe what the software package actually does.

Normality test: The null hypothesis of normally distributed residuals is tested with the Jarque-Bera statistic. It is calculated as follows:

$JB = \frac{T-k}{6} * (S^2 + \frac{(K-3)^2}{4})$

T is the number of observations, k is the number of estimated coefficients, K is the kurtosis and S stands for skewness.

In case of a normal distribution the skewness is zero and the kurtosis is three. Consequently, in this case the term in parentheses becomes zero. The more different the distribution is from the normal distribution the larger the test statistic becomes. The critical values are taken from the χ^2-distribution with two degrees of freedom.

Breusch-Godfrey LM test: The null hypothesis is that there is no autocorrelation in the residuals up to the specified order l. To perform the LM test a regression of the residuals is run on all the regressors of the estimated model as well as lagged residuals up to lag l. For large numbers of observations, the test statistic equals the number of observations multiplied by R^2 has been shown to be distributed approximately χ^2. Alternatively an F-test can be applied.

ARCH test: The ARCH test is carried out to examine whether there is autoregressive conditional heteroskedasticity in the residuals up to order l, i.e. whether their conditional variance is time dependent. The null hypothesis of the test is no ARCH. The test equation consists in a regression of the squared residuals on a constant and lagged squared residuals up to lag r. The test statistic is calculated as the R^2 of the regression multiplied by the number of observations. Critical values are taken from the χ^2-distribution.

White's heteroskedasticity test: The null hypothesis of this test is no heteroskedasticity in the residuals. The test is based on a regression of the squared residuals on all regressors and squared regressors of the estimated equation. The test statistic is calculated as the R^2 of the regression multiplied by the number of observations. Critical values are taken from the χ^2-distribution.

B.2.2 Specification and Stability Tests

Ramsey's RESET (Regression Specification Error Test) is a general specification test that detects the following specification errors:

- omitted variables,
- incorrect functional form,
- correlation between the regressors and the residual

Ramsey's original approach (Ramsey 1969) was a regression of the residuals on a constant and powers of the dependent variable.

If we have estimated the equation:

$y_t = \alpha + \beta x_t + u_t,$

the RESET test equation is:

$\hat{u}_t = \gamma + \sum_{j=2}^{h} (\delta_j \hat{y}_t^j) + v_t$

As $\hat{u}_t = y_t - \hat{y}_t$ the equation can easily be transformed into:

$y_t = \alpha + \beta x_t + \sum_{j=2}^{h} (\delta_j \hat{y}_t^j) + v_t$

This is the test equation used in EVIEWS 4.0, which is applied here. Lütkepohl (2004, p.47) recommends $h = 2$ or $h = 3$ as sufficient for testing for the deficiencies mentioned above. The null hypothesis is that the δ_j are jointly zero.

In the case of a mis-specification the inclusion of powers of the fitted values in the regression can be expected to improve the estimate. If they are jointly significant the log likelihood ratio is high and the null hypothesis can be rejected.

CUSUM test: The test statistic is the cumulative sum of the recursive residuals relative to the standard error of the regression for the whole estimation period. It is calculated according as follows:

$CUSUM_t = \sum_{r=k+1}^{t} \frac{R_r}{S}$,

where t=k+1,....T, R is the recursive residual, S is the standard error of the regression. If the coefficients remain constant, $E(CUSUM_t) = 0$, but if they change $CUSUM_t$ will be different from zero. Any values outside the 5% significance lines can be interpreted as a significant departure from the expected value.

CUSUM of squares test: One drawback of the CUSUM test is that the effects of several shifts in the parameters might cancel each other out in the CUSUM test statistic. A parameter instability might therefore remain undetected, if only the CUSUM test is applied (Lütkepohl 2004, p.53). In these cases the CUSUM of squares test is more reliable. It is based on the following statistic:

$CUSUMSQ_t = \frac{\sum_{r=k+1}^{t} R_r^2}{\sum_{r=k+1}^{T} R_r^2}$,

where t=k+1,....,T and R is the recursive residual.

Parameter instability is diagnosed, if the statistic moves outside the 5% significance lines.

B.3 Stability of the Individual Equations

This section of the appendix provides the graphic results of the CUSUM and CUSUM of squares stability tests. If the CUSUM and CUSUM of squares statistic remain between the 5% confidence lines the estimated parameter can be assumed to be stable.

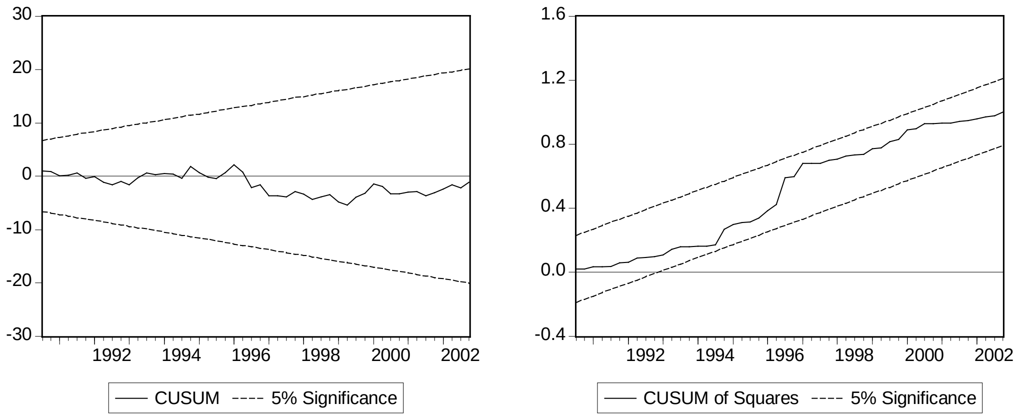


Figure B.1: Stability tests: private final consumption (Equation 4.5)

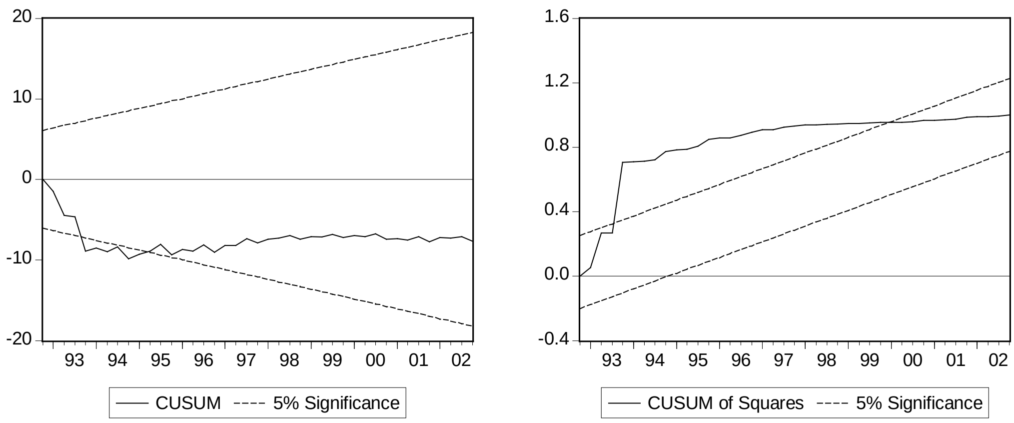


Figure B.2: Stability tests: government consumption (Equation 4.7)

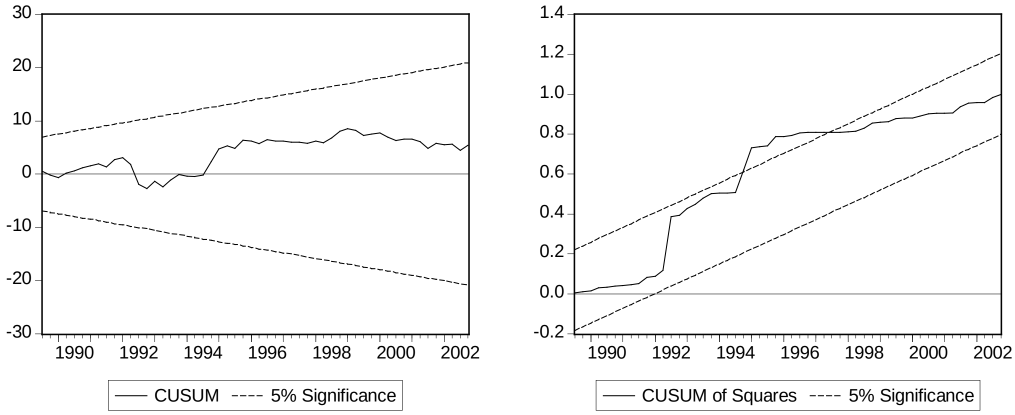


Figure B.3: Stability tests: private construction investment (Equation 4.15)

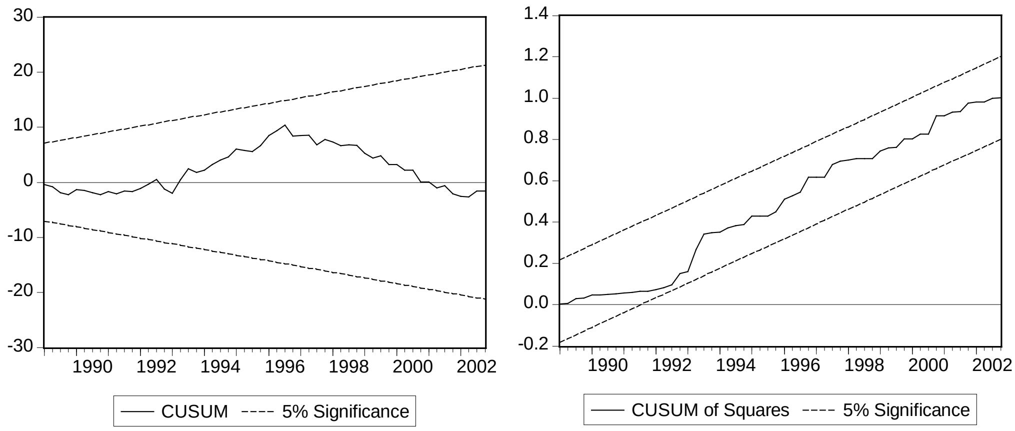


Figure B.4: Stability tests: investment into machinery and equipment (Equation 4.16)

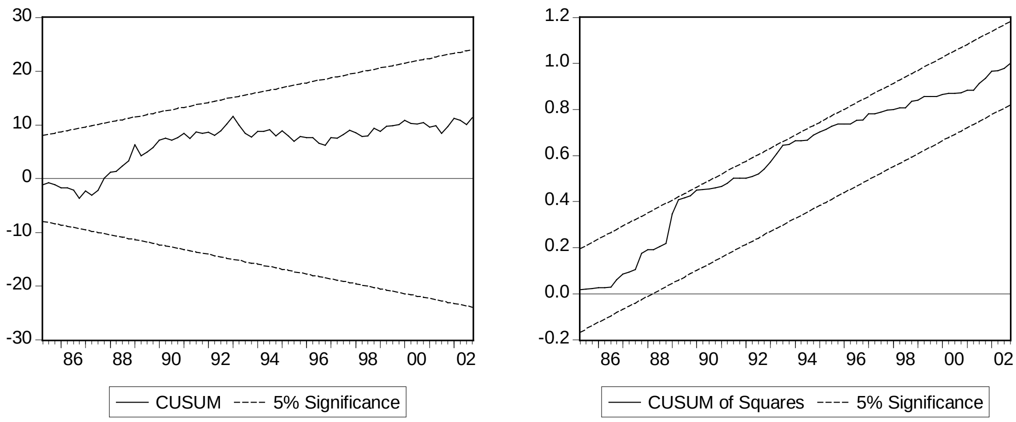


Figure B.5: Stability tests: change of inventories (Equation 4.17)

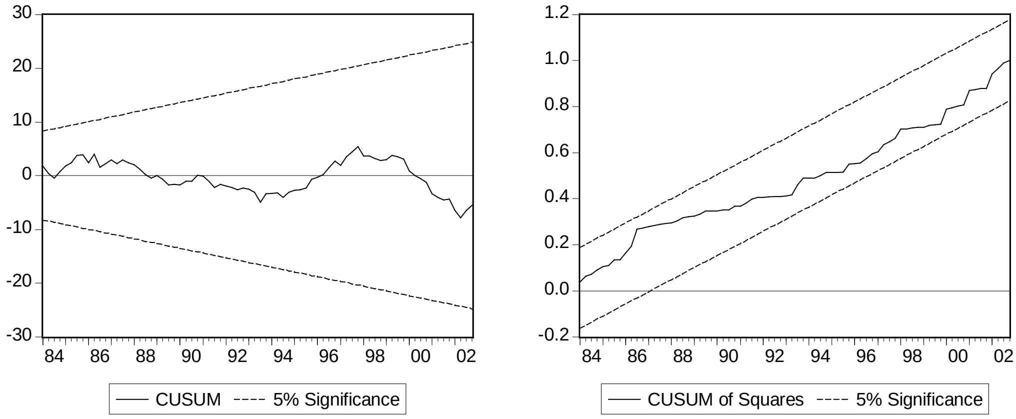


Figure B.6: Stability tests: exports of goods to the euro area (Equation 4.20)

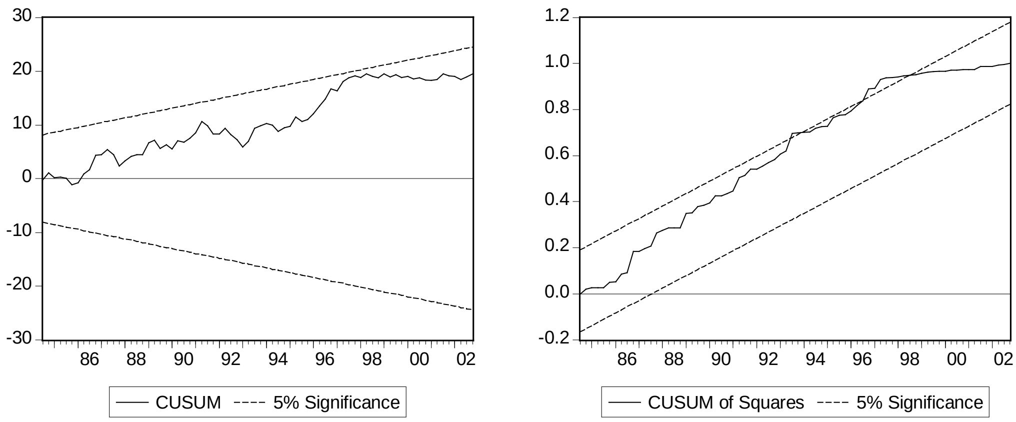


Figure B.7: Stability tests: exports of goods to the rest of the EU15 (Equation 4.22)

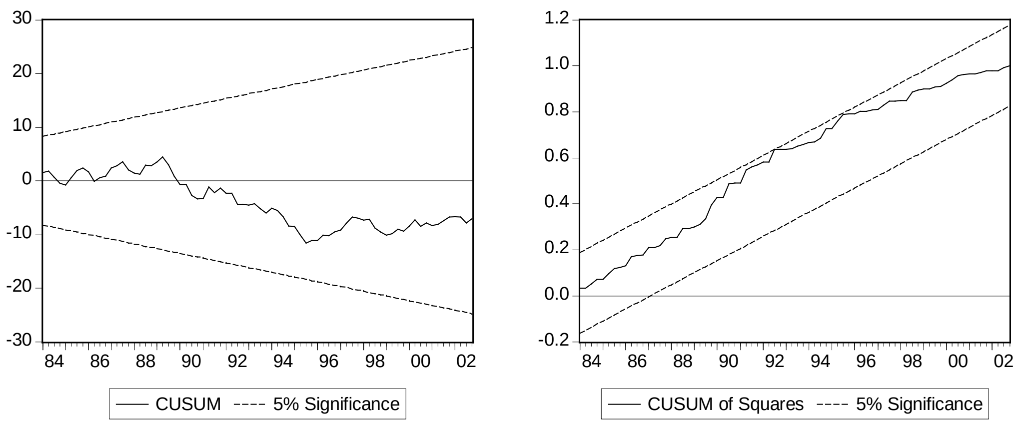


Figure B.8: Stability tests: exports of goods to the United States of America (Equation 4.24)

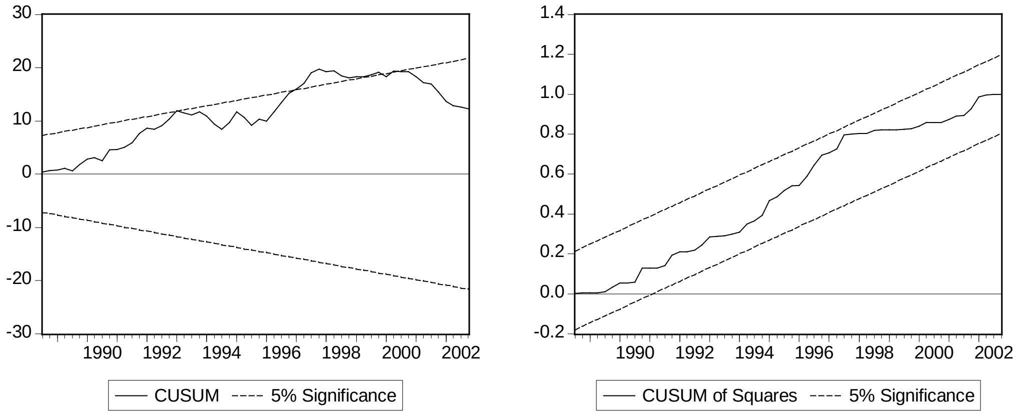


Figure B.9: Stability tests: exports of goods to the rest of the world (Equation 4.26)

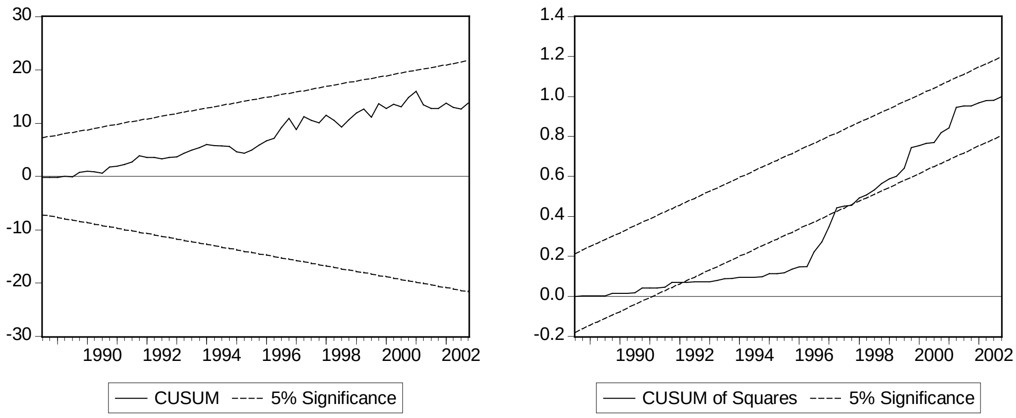


Figure B.10: Stability tests: exports of services (Equation 4.28)

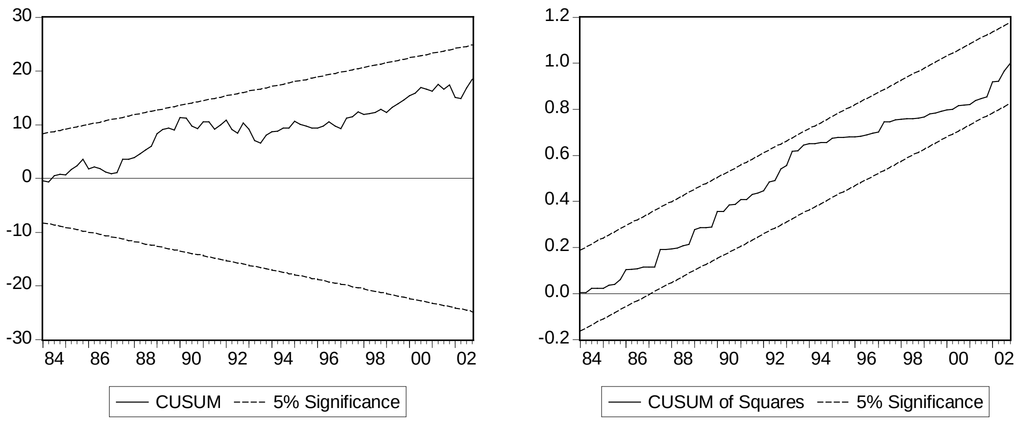


Figure B.11: Stability tests: imports of goods and services (Equation 4.31)

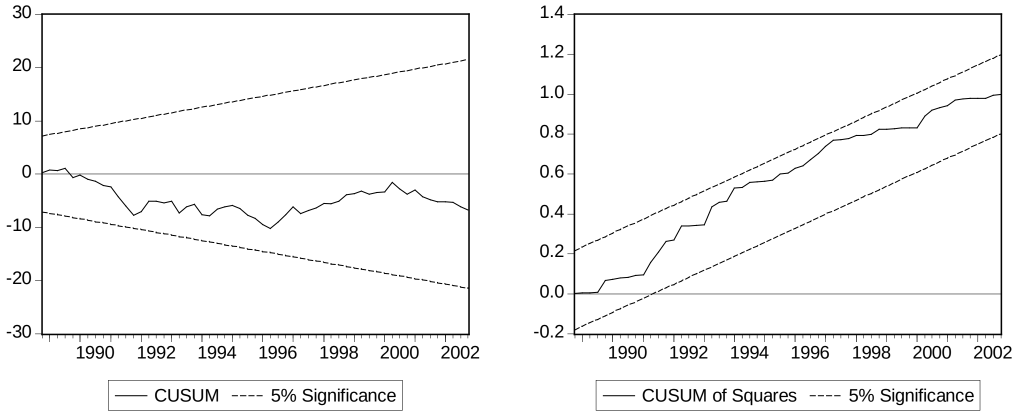


Figure B.12: Stability tests: employees (Equation 4.33)

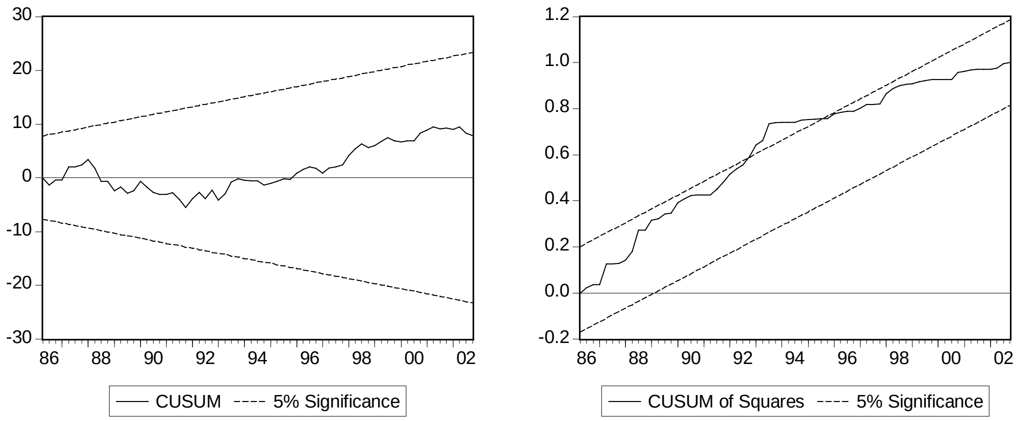


Figure B.13: Stability tests: self-employed persons (Equation 4.34)

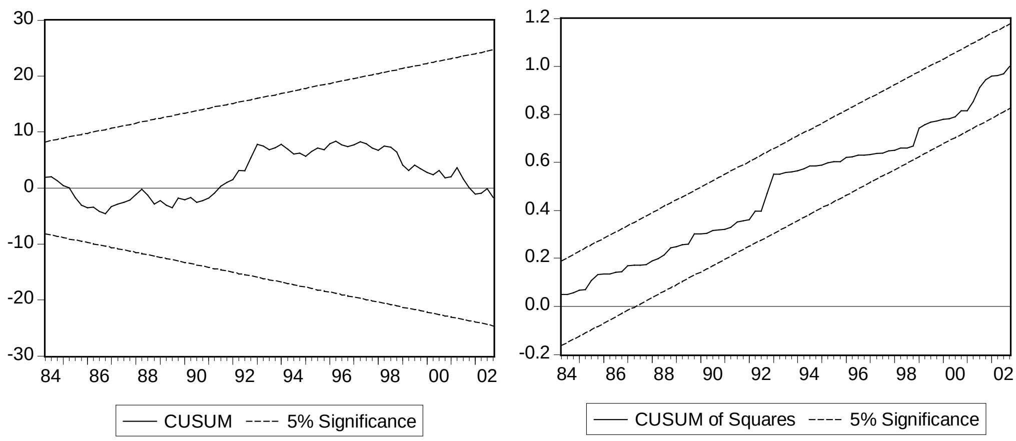


Figure B.14: Stability tests: unemployed persons (Equation 4.36)

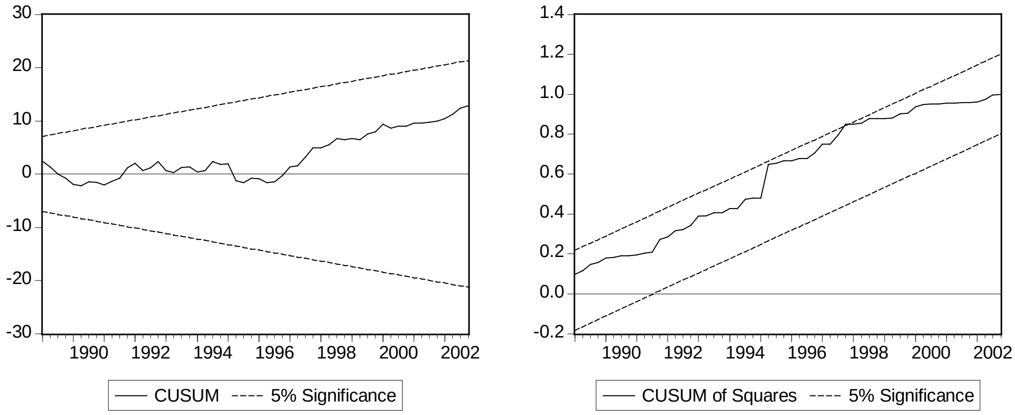


Figure B.15: Stability tests: consumption of fixed capital (Equation 4.38)

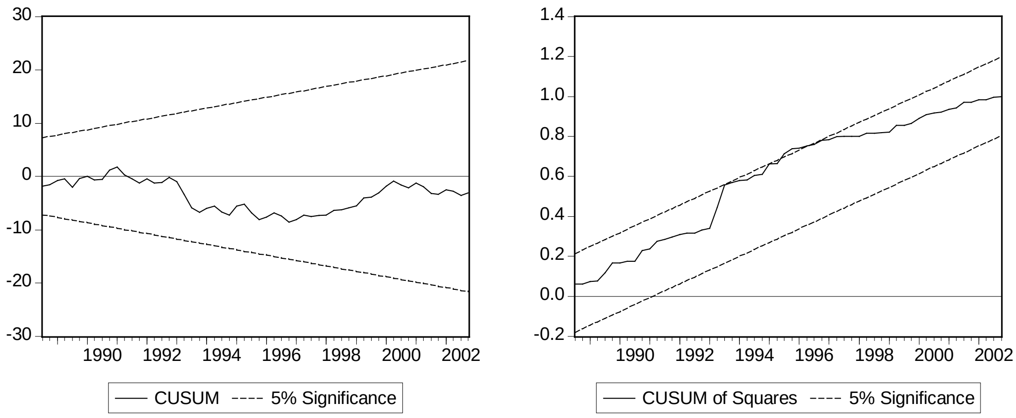


Figure B.16: Stability tests: taxes less subsidies on production and imports (Equation 4.40)

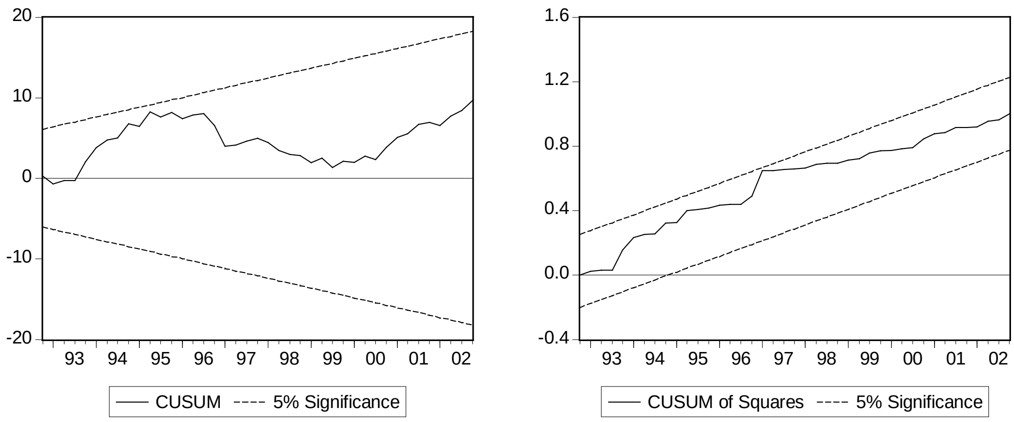


Figure B.17: Stability tests: direct taxes on households' income (Equation 4.42)

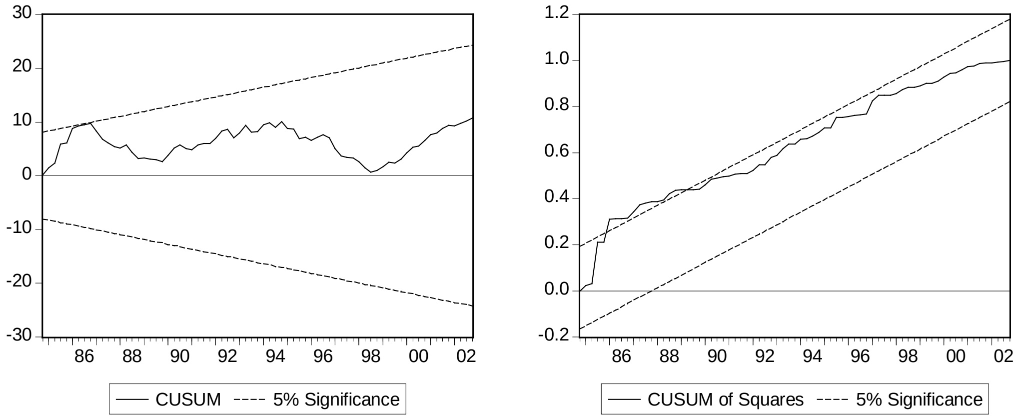


Figure B.18: Stability tests: social contributions of households (Equation 4.44)

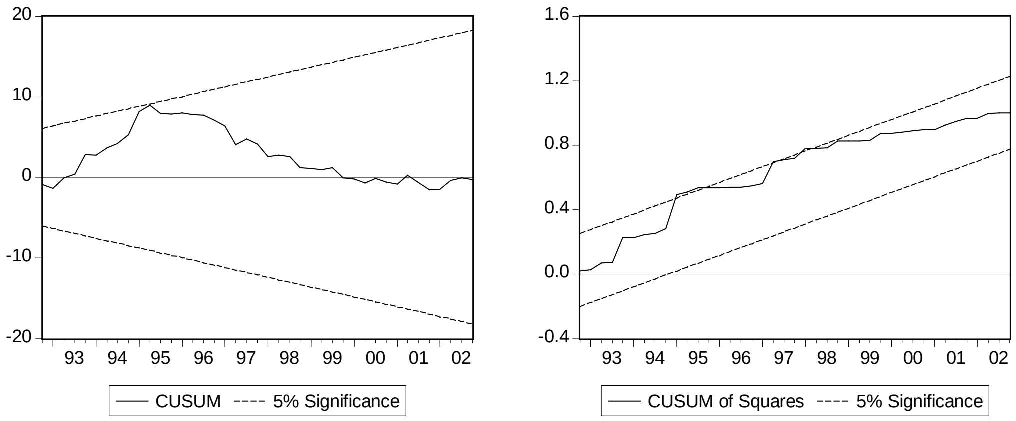


Figure B.19: Stability tests: GDP-Deflator (Version 1, Equation 4.46))

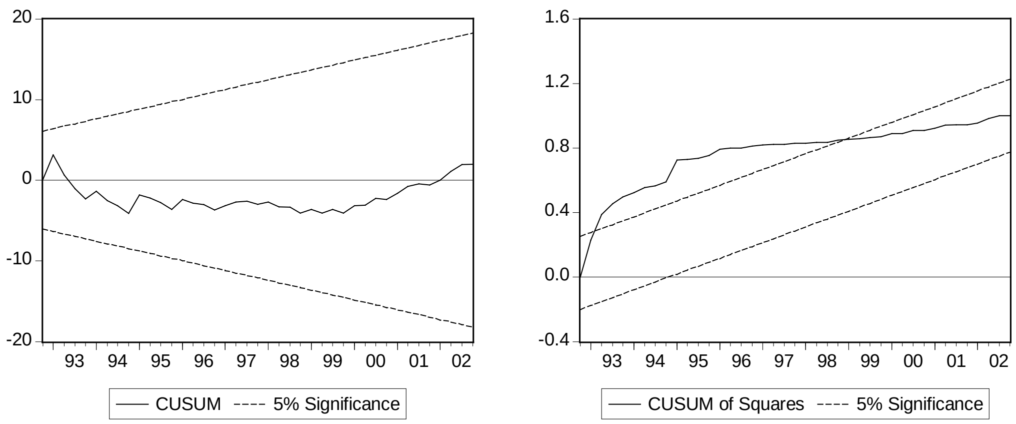


Figure B.20: Stability tests: GDP-Deflator (Version 2, Equation 4.48))

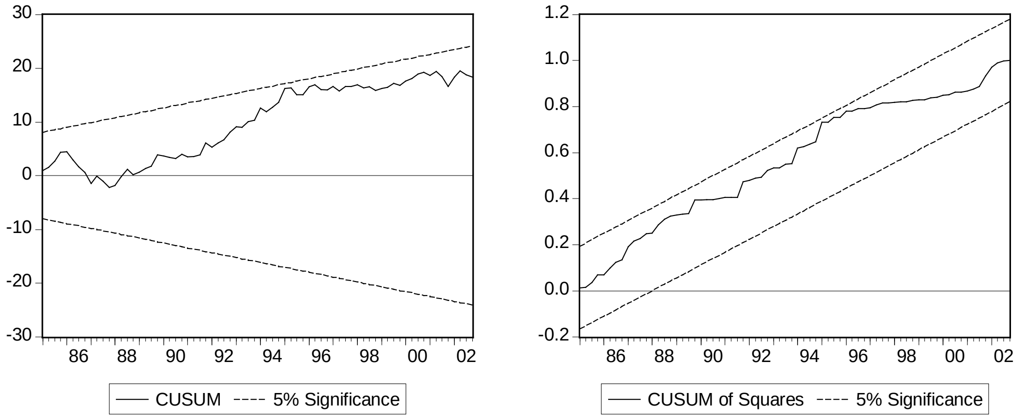


Figure B.21: Stability tests: private consumption deflator (Equation 4.49)

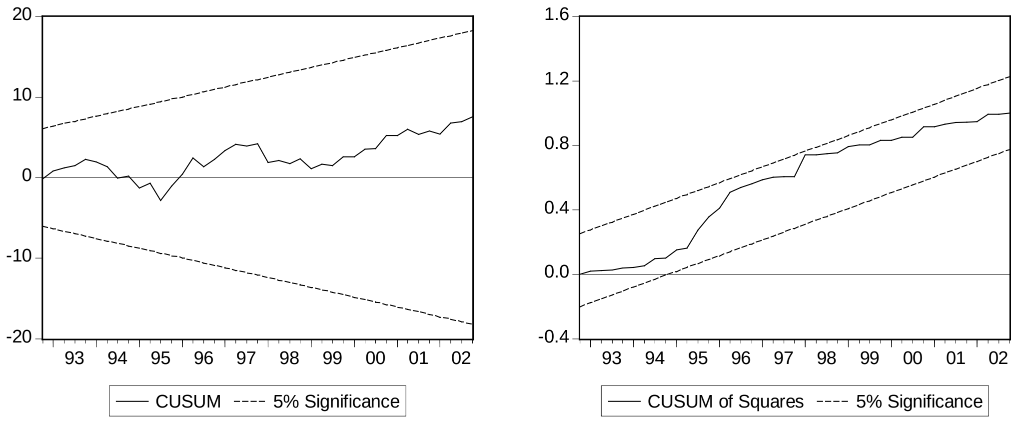


Figure B.22: Stability tests: government consumption deflator (Equation 4.51)

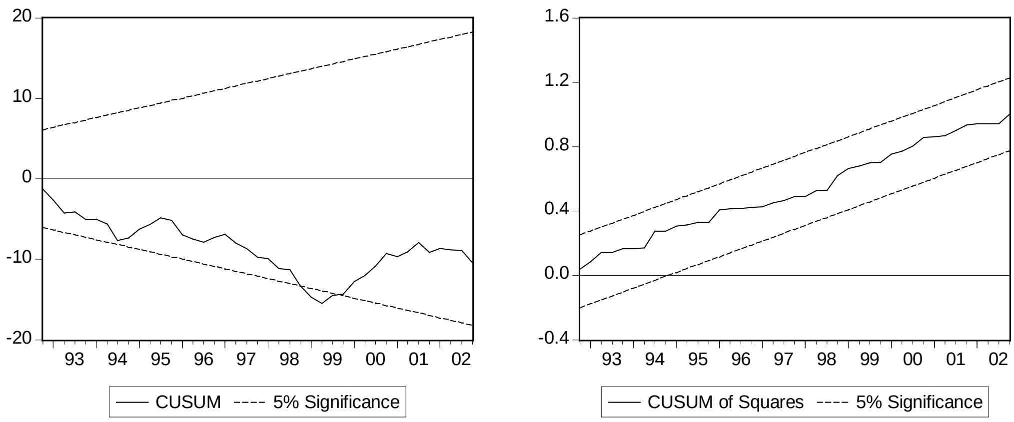


Figure B.23: Stability tests: export deflator (Equation 4.53)

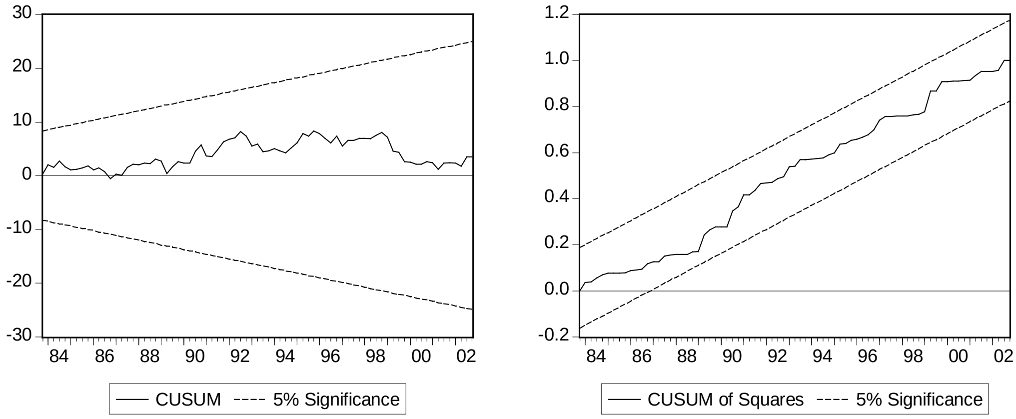


Figure B.24: Stability tests: import deflator (Equation 4.55)

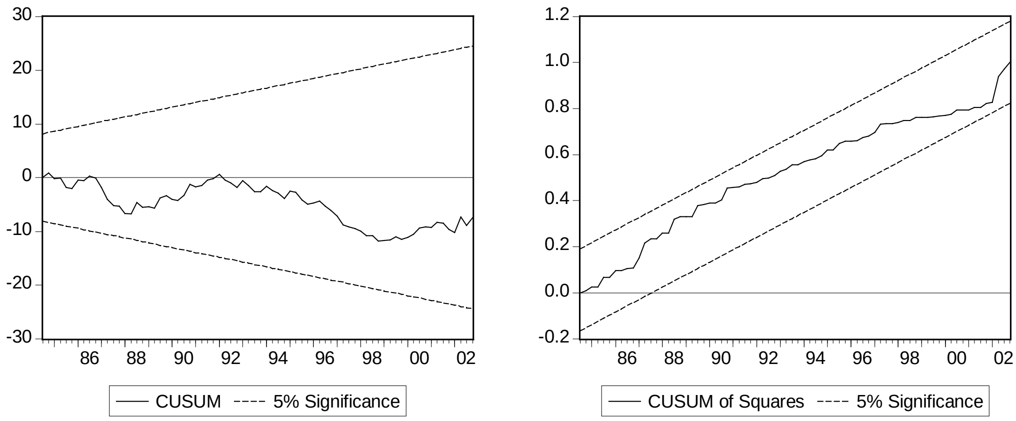


Figure B.25: Stability tests: consumer price index (Equation 4.56)

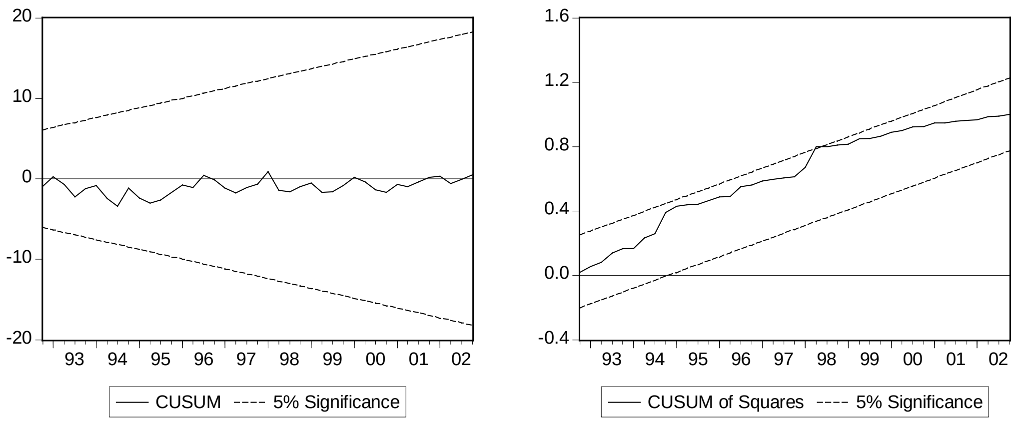


Figure B.26: Stability tests: real wage (Equation 4.59)

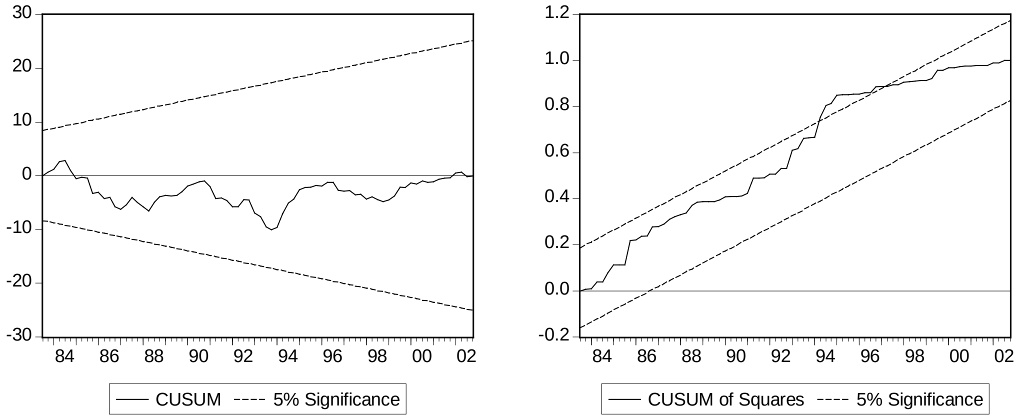


Figure B.27: Stability tests: long-term nominal interest rate (Equation 4.61)

B.4 Forecast Performance of the Individual Equations

The current section documents the forecast performance of the estimated equations in a single equation framework.

For the out-of-sample forecasts, the equation is re-estimated for four different periods. Each beginning in 1986Q1 and ending in 1998Q4, 1999Q4, 2000Q4 and 2001Q4, respectively. A genuine dynamic out-of-sample forecast is then carried out for the remaining quarters until 2002Q4. This means that a one-step forecast is carried out for the first quarter of the forecast period. The second quarter is predicted with a two-step forecast. This is followed by a three-step forecast for the third quarter and so on. Generally, the dynamic forecast for a period of h quarters is a series of 1-,2-,3-.. and h-step forecasts. For the lagged dependent variables in the forecast period the predicted values are used instead of the actuals. All other variables have their actual values.

In some cases, where dummy variables appear in the forecast periods, the range of the forecasts was restricted.

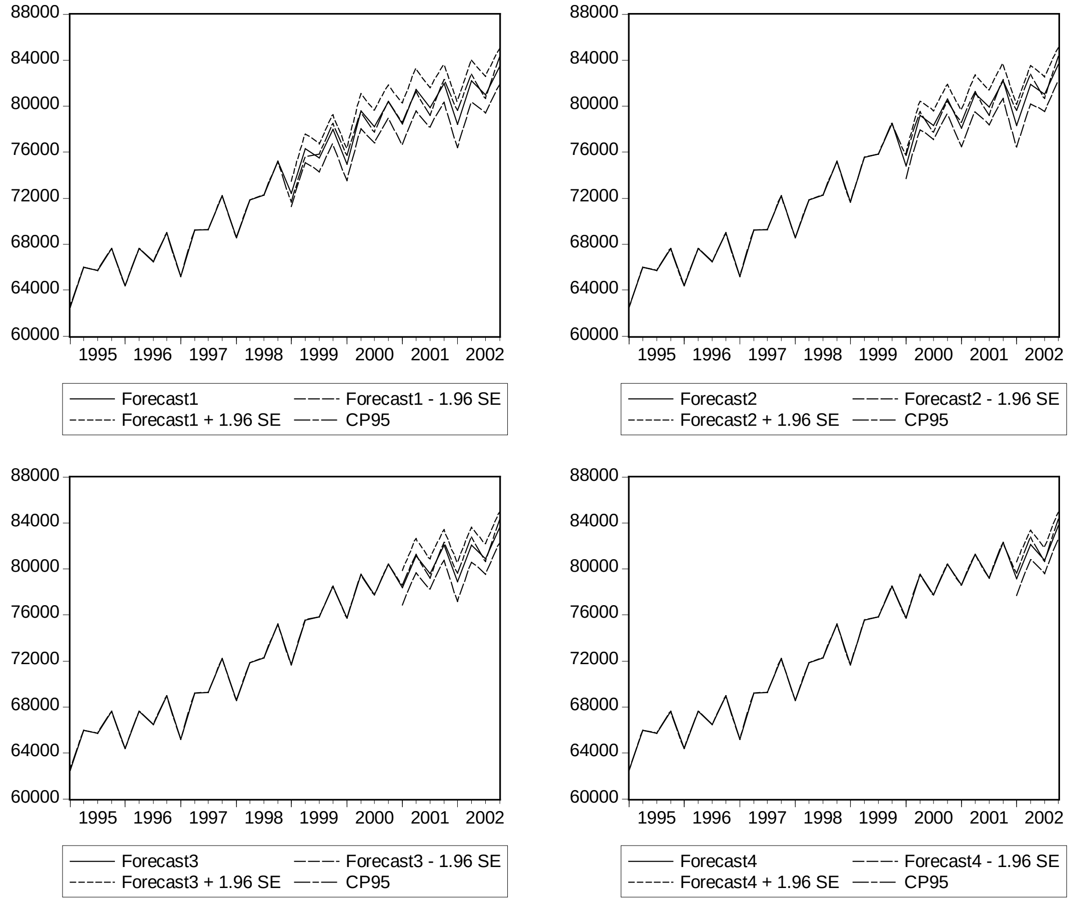


Figure B.28: Out-of-sample forecasts: private consumption expenditure (Equation 4.5)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1986Q1-1998Q4	1986Q1-1999Q4	1986Q1-2000Q4	1986Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	597.48	677.00	484.03	511.23
Mean abs. error	501.94	576.44	416.54	458.11
Mean abs. % error	0.64	0.72	0.51	0.56
Theil inequality coeff.	0.004	0.004	0.003	0.003
Bias proportion	0.030	0.157	0.290	0.662
Variance proportion	0.109	0.001	0.108	0.061
Covariance proportion	0.862	0.842	0.602	0.277

Table B.1: Performance of out-of-sample forecast: private consumption expenditure (Equation 4.5

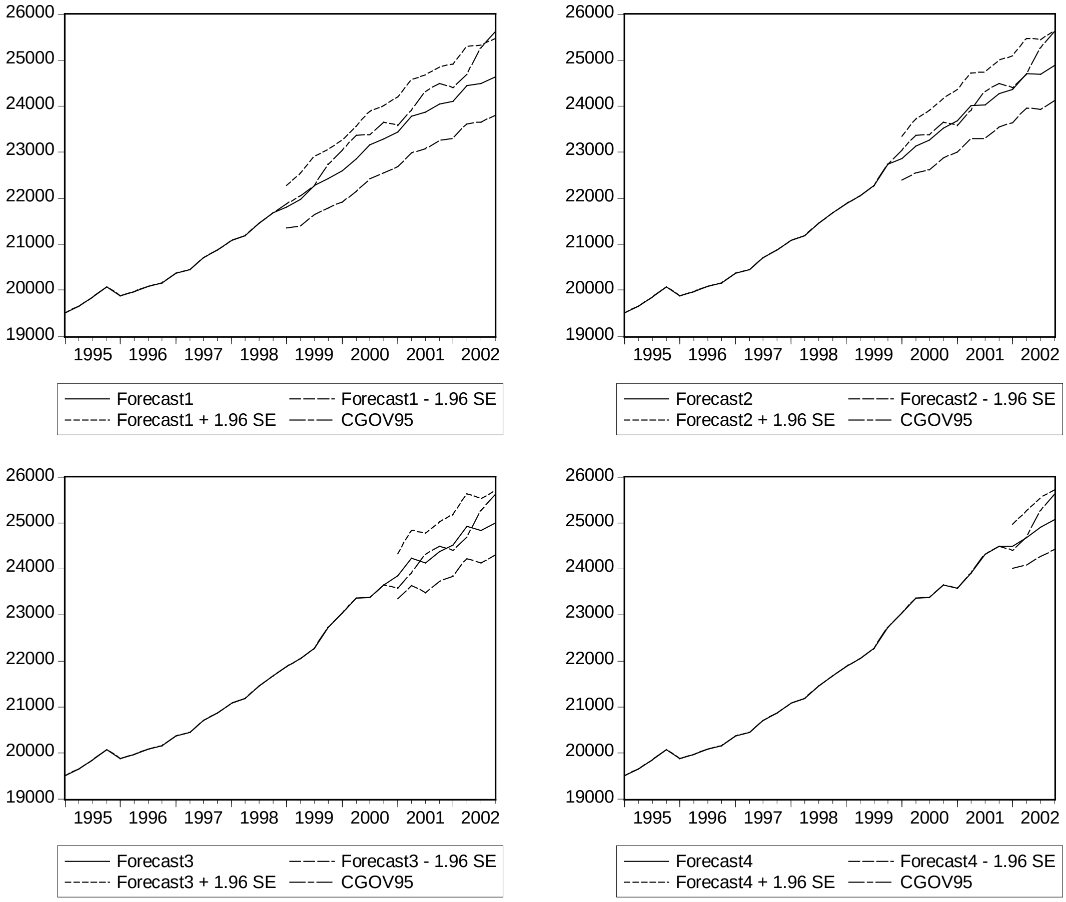


Figure B.29: Out-of-sample forecasts: government consumption expenditure (Equation 4.7)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	427.14	311.01	330.11	334.50
Mean abs. error	343.28	228.32	288.43	256.30
Mean abs. % error	1.42	0.93	1.17	1.01
Theil inequality coeff.	0.009	0.006	0.007	0.007
Bias proportion	0.646	0.380	0.025	0.387
Variance proportion	0.166	0.172	0.519	0.607
Covariance proportion	0.188	0.448	0.456	0.006

Table B.2: Performance of out-of-sample forecast: government consumption expenditure (Equation 4.7)

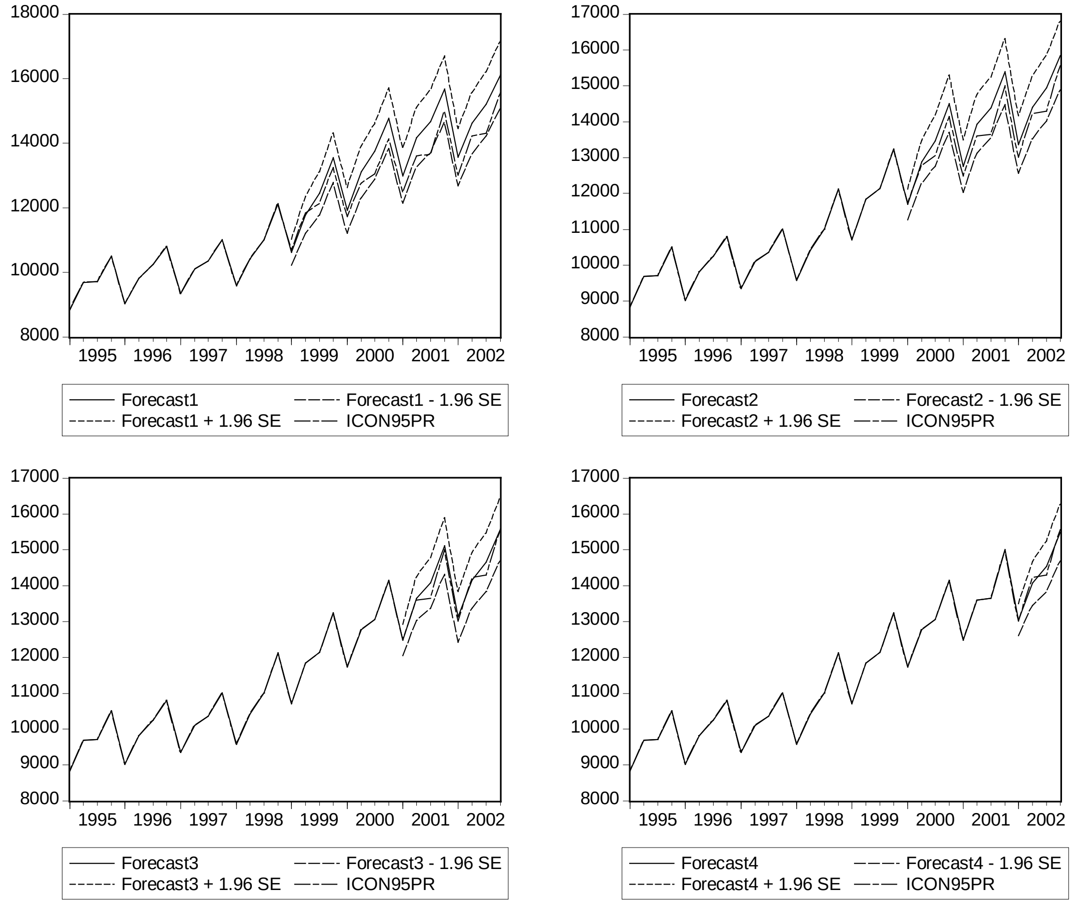


Figure B.30: Out-of-sample forecasts: private construction investment (Equation 4.15)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	556.68	392.82	207.89	150.13
Mean abs. error	489.77	343.05	141.60	130.25
Mean abs. % error	3.60	2.49	1.02	0.91
Theil inequality coeff.	0.021	0.014	0.007	0.005
Bias proportion	0.717	0.736	0.357	0.003
Variance proportion	0.159	0.060	0.001	0.035
Covariance proportion	0.124	0.204	0.642	0.962

Table B.3: Performance of out-of-sample forecast: private construction investment (Equation 4.15)

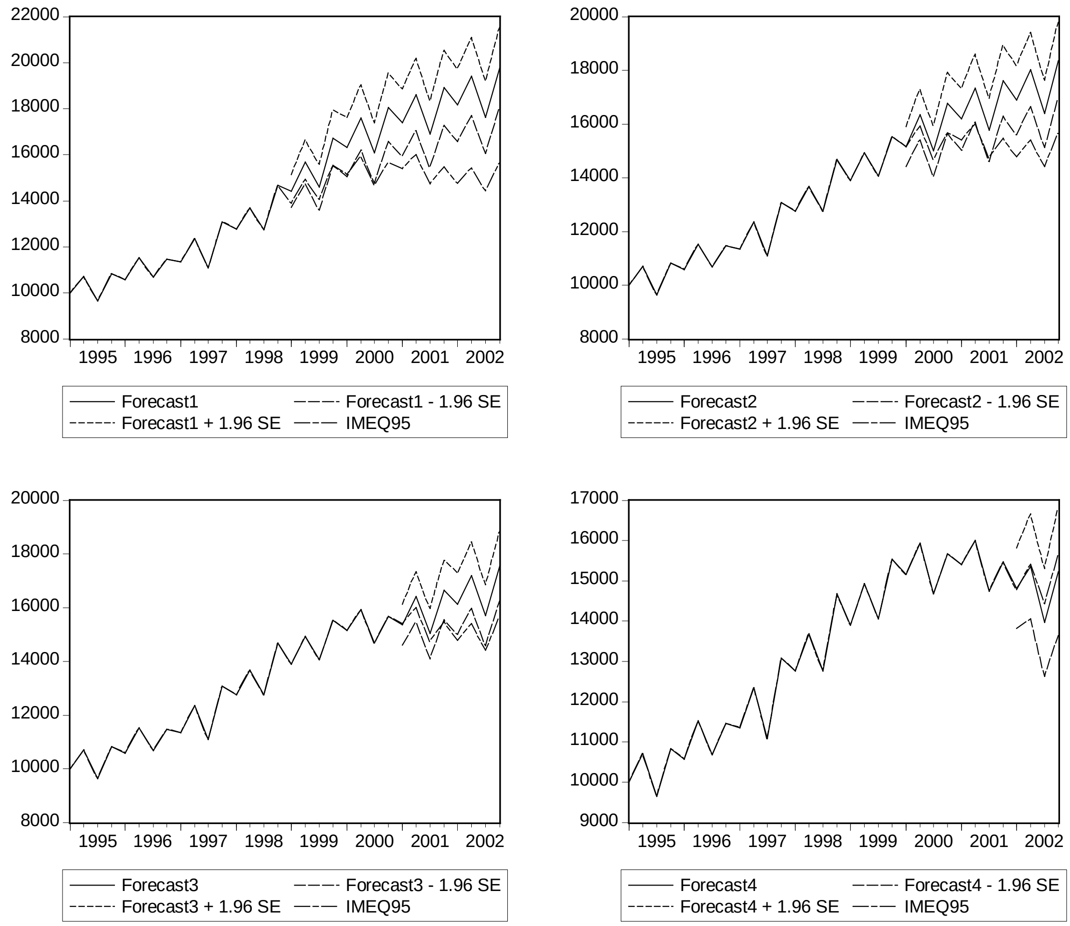


Figure B.31: Out-of-sample forecasts: investment into machinery and equipment (Equation 4.16)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	3742.66	2588.27	1668.38	313.28
Mean abs. error	3319.86	2225.53	1390.96	243.14
Mean abs. % error	21.81	14.60	9.16	1.62
Theil inequality coeff.	0.111	0.079	0.052	0.010
Bias proportion	0.787	0.739	0.687	0.509
Variance proportion	0.150	0.119	0.095	0.034
Covariance proportion	0.064	0.141	0.218	0.457

Table B.4: Performance of out-of-sample forecast: investment into machinery and equipment (Equation 4.16)

Forecasts 1,2 and 3 excluding step dummy for third quarter of 2001.

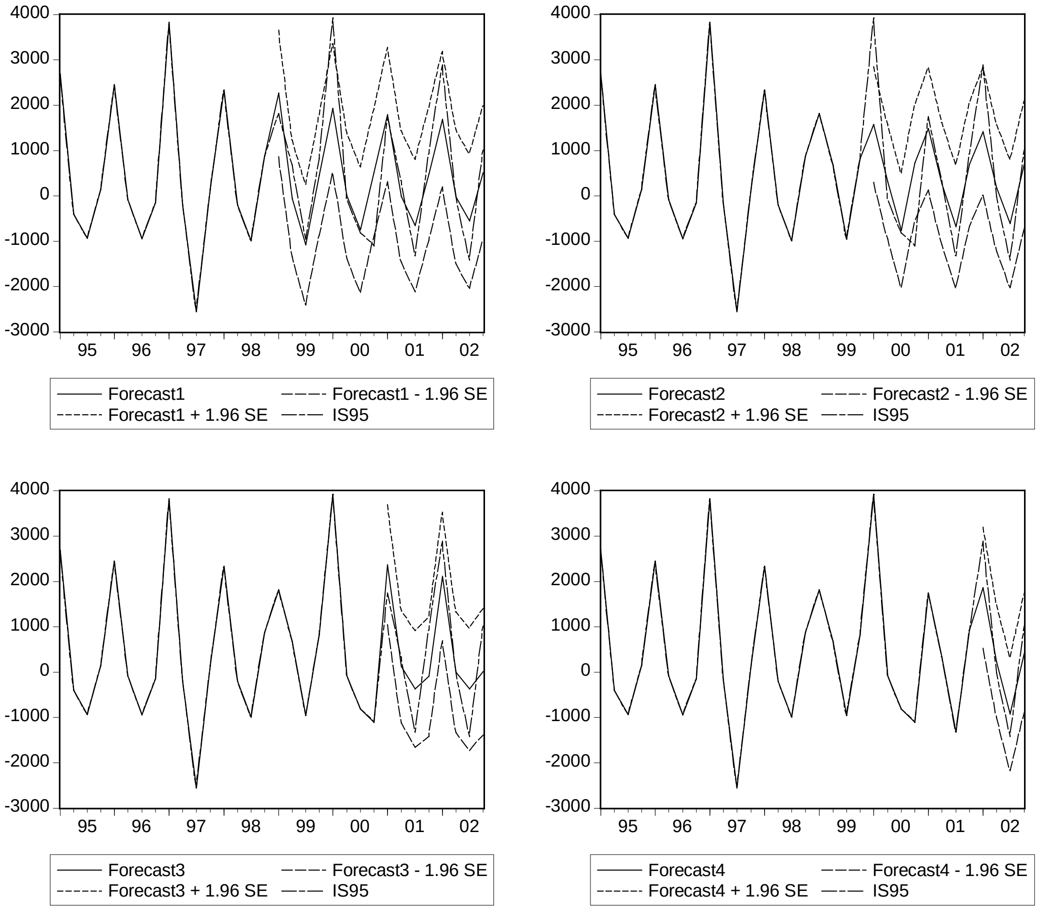


Figure B.32: Out-of-sample forecasts: change of inventories and net acquisition of valuables (Equation 4.17)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	816.45	1020.18	797.64	652.54
Mean abs. error	595.05	718.38	704.34	589.12
Mean abs. % error	58.14	184.47	67.51	435.93
Theil inequality coeff.	0.309	0.394	0.307	0.237
Bias proportion	0.021	0.004	0.003	0.113
Variance proportion	0.368	0.660	0.174	0.787
Covariance proportion	0.611	0.336	0.822	0.101

Table B.5: Performance of out-of-sample forecast: change of inventories and net acquisition of valuables (Equation 4.17)

Forecasts 1 and 2 excluding impulse dummies for 2000.

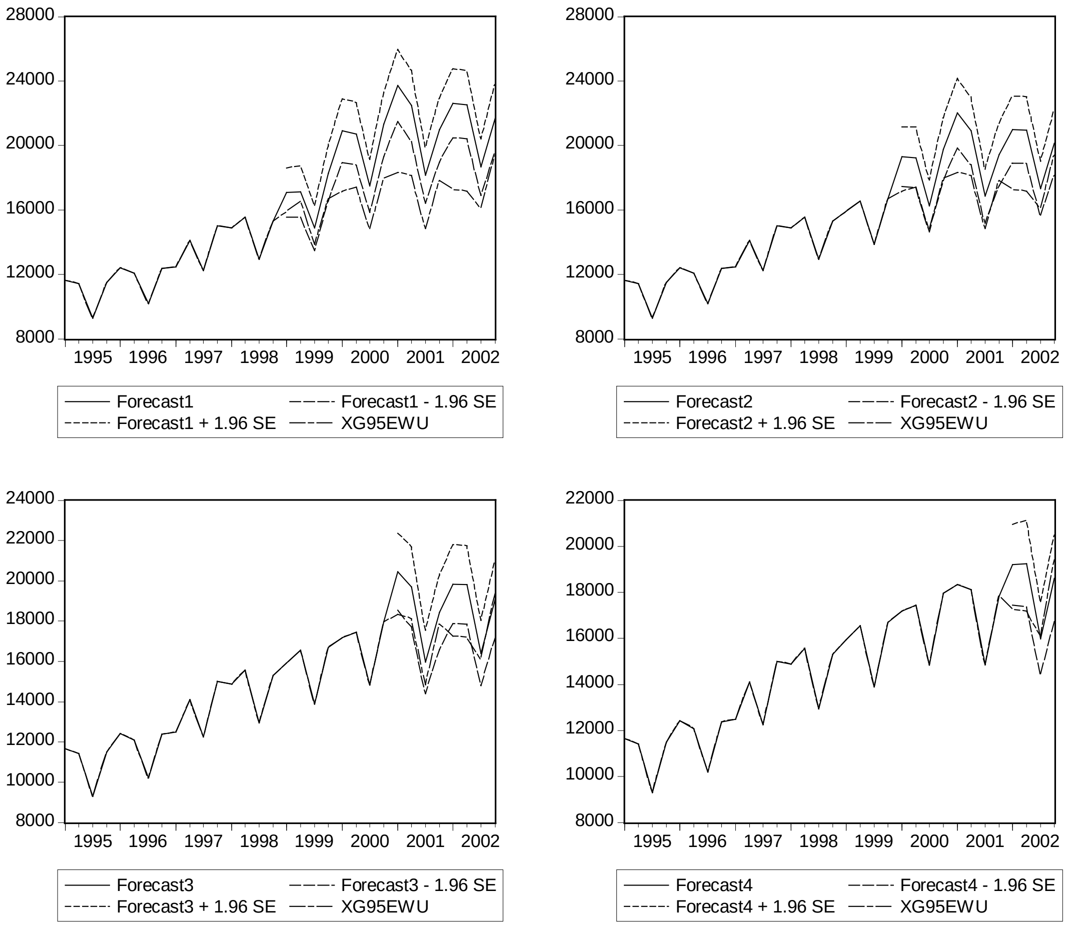


Figure B.33: Out-of-sample forecasts: exports of goods to the euro area (Equation 4.20)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	3412.29	2432.30	1666.46	1472.53
Mean abs. error	3069.96	2223.60	1401.47	1236.37
Mean abs. % error	17.99	12.93	8.09	7.06
Theil inequality coeff.	0.09	0.066	0.046	0.041
Bias proportion	0.81	0.836	0.630	0.268
Variance proportion	0.10	0.029	0.022	0.009
Covariance proportion	0.09	0.135	0.349	0.723

Table B.6: Performance of out-of-sample forecast: exports of goods to the euro area (Equation 4.20)

Forecast 1 excluding step dummy for first quarter of 1999.

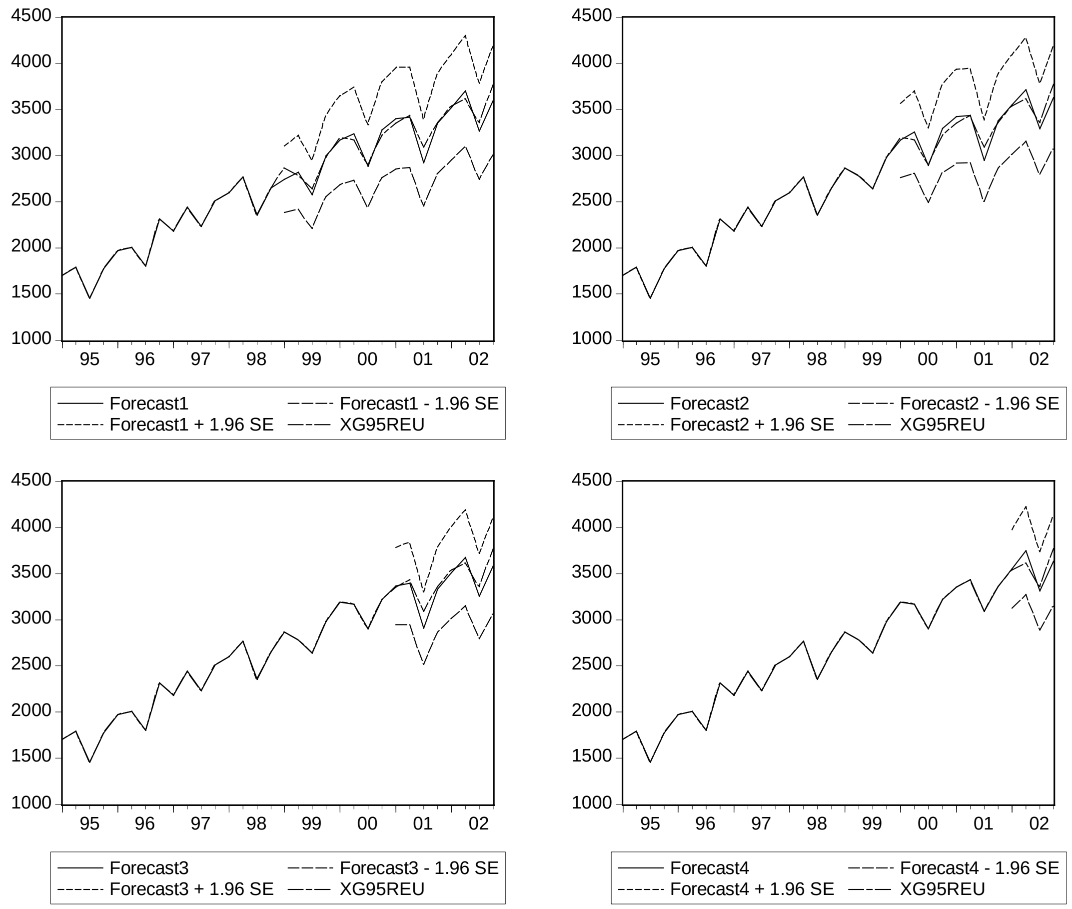


Figure B.34: Out-of-sample forecasts: exports of goods to the rest of the EU15 (Equation 4.22)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	82.41	79.89	104.00	99.89
Mean abs. error	63.97	62.30	80.41	82.97
Mean abs. % error	1.99	1.85	2.35	2.28
Theil inequality coeff.	0.01	0.012	0.015	0.014
Bias proportion	0.08	0.001	0.360	0.010
Variance proportion	0.01	0.011	0.075	0.014
Covariance proportion	0.91	0.988	0.565	0.976

Table B.7: Performance of out-of-sample forecast: exports of goods to the rest of the EU15 (Equation 4.22)

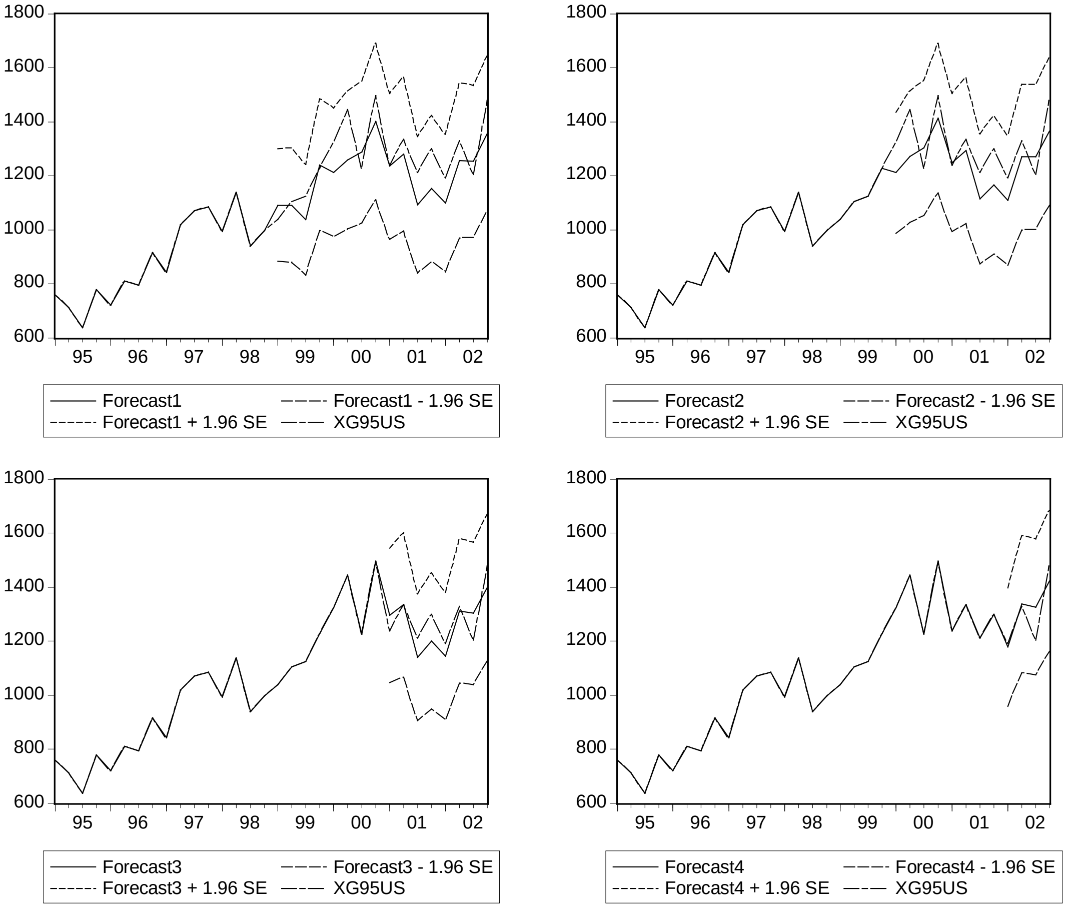


Figure B.35: Out-of-sample forecasts: exports of goods to the United States of America (Equation 4.24)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	94.10	97.16	68.41	68.76
Mean abs. error	80.46	88.04	59.49	50.34
Mean abs. % error	6.21	6.64	4.68	3.96
Theil inequality coeff.	0.04	0.038	0.027	0.026
Bias proportion	0.38	0.409	0.085	0.049
Variance proportion	0.07	0.027	0.001	0.175
Covariance proportion	0.55	0.564	0.914	0.776

Table B.8: Performance of out-of-sample forecast: exports of goods to the United States of America (Equation 4.24)

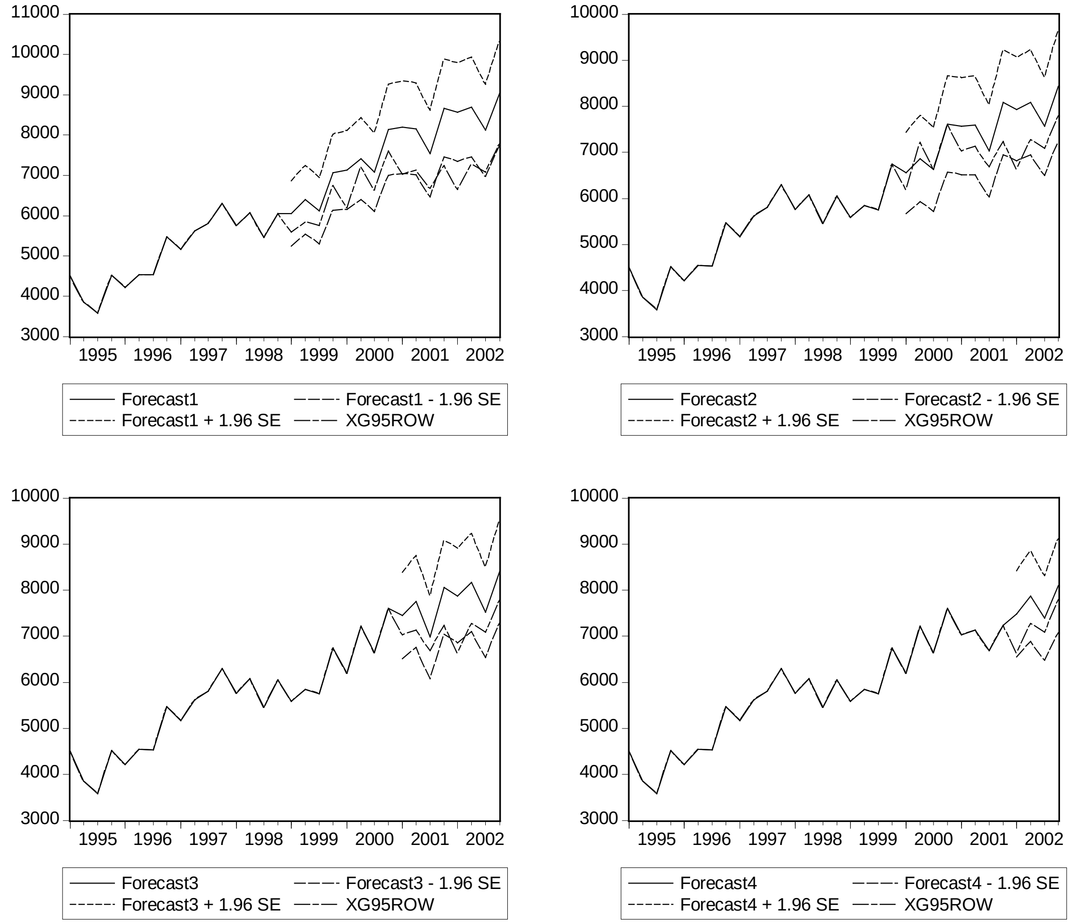


Figure B.36: Out-of-sample forecasts: exports of goods to the rest of the world (Equation 4.26)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	988.80	614.99	725.55	559.74
Mean abs. error	868.44	511.62	667.73	512.67
Mean abs. % error	12.67	7.29	9.43	7.28
Theil inequality coeff.	0.07	0.042	0.049	0.038
Bias proportion	0.77	0.536	0.847	0.839
Variance proportion	0.08	0.064	0.015	0.050
Covariance proportion	0.15	0.400	0.138	0.111

Table B.9: Performance of out-of-sample forecast: exports of goods to the rest of the world (Equation 4.26)

Forecast 1 excluding step dummy for first quarter of 1999.

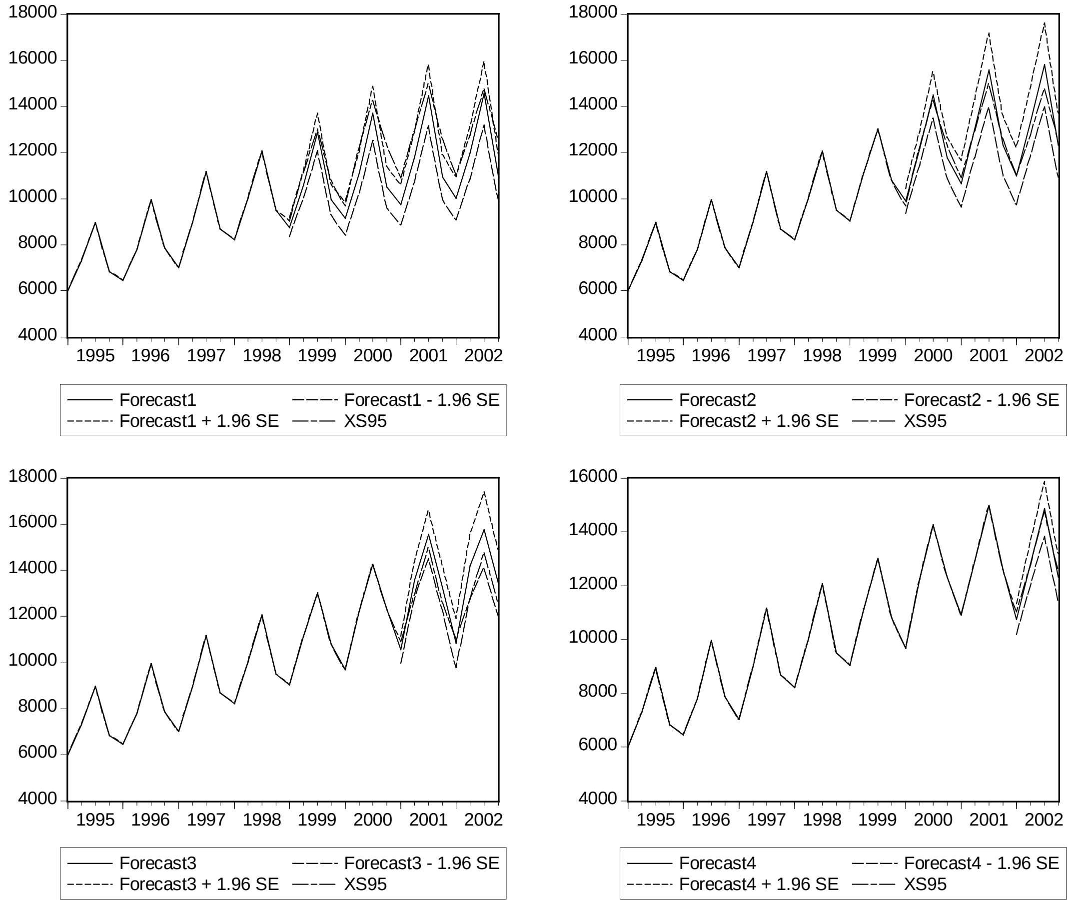


Figure B.37: Out-of-sample forecasts: exports of services (Equation 4.28)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	1010.02	443.27	791.71	195.48
Mean abs. error	872.76	351.65	705.73	169.68
Mean abs. % error	7.26	2.69	5.42	1.40
Theil inequality coeff.	0.04	0.017	0.030	0.008
Bias proportion	0.75	0.060	0.517	0.243
Variance proportion	0.01	0.368	0.250	0.489
Covariance proportion	0.24	0.572	0.232	0.269

Table B.10: Performance of out-of-sample forecast: exports of services (Equation 4.28)

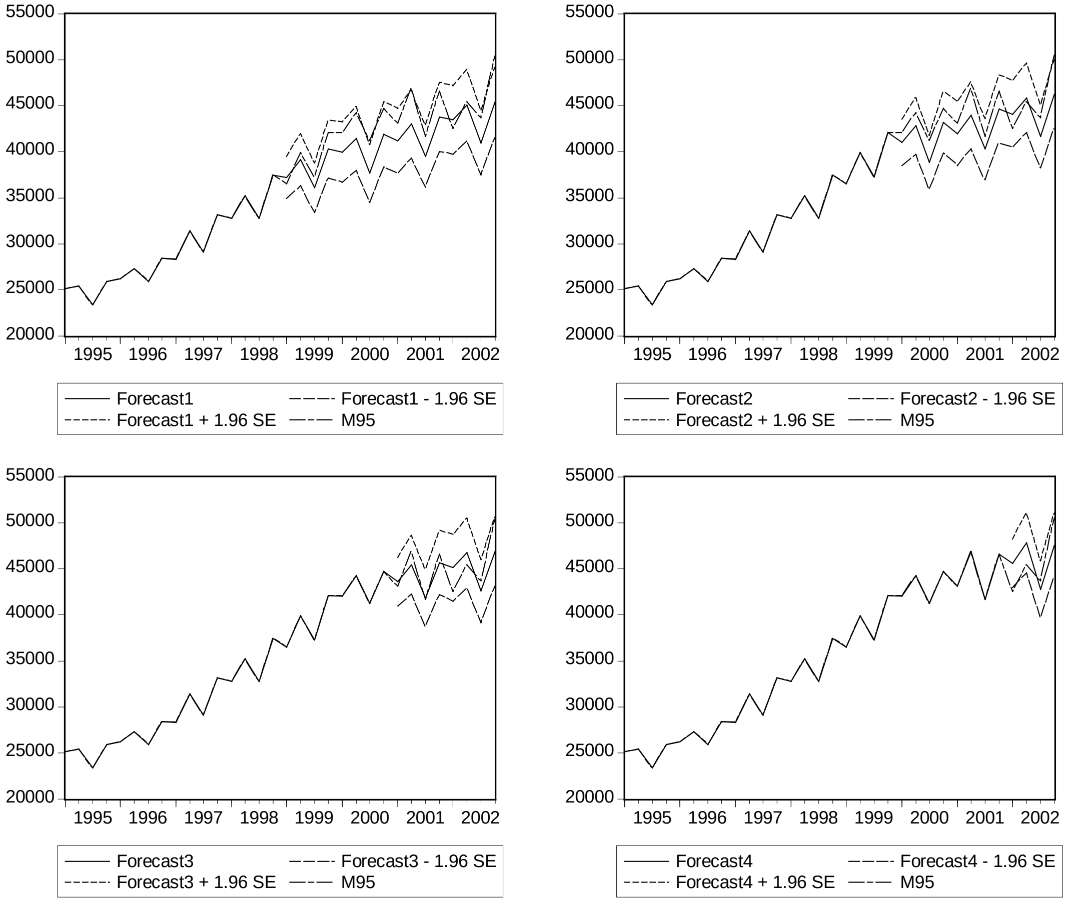


Figure B.38: Out-of-sample forecasts: imports of goods and services (Equation 4.31)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	2553.52	2079.29	1788.17	2500.47
Mean abs. error	2226.01	1839.25	1445.10	2344.32
Mean abs. % error	5.05	4.08	3.13	5.13
Theil inequality coeff.	0.030	0.024	0.020	0.027
Bias proportion	0.630	0.533	0.032	0.025
Variance proportion	0.092	0.041	0.285	0.177
Covariance proportion	0.279	0.426	0.683	0.799

Table B.11: Performance of out-of-sample forecast: imports of goods and services(Equation 4.31)

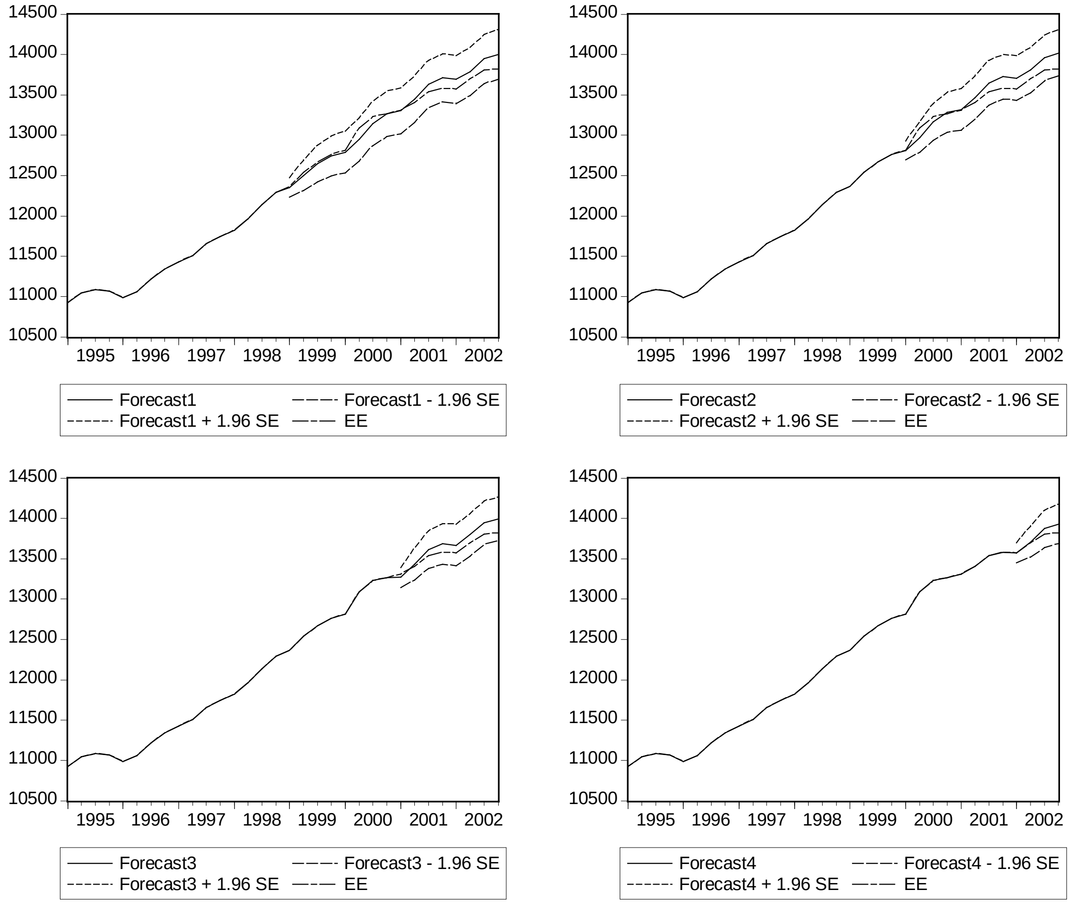


Figure B.39: Out-of-sample forecasts: employees (Equation 4.33)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	90.98	110.65	104.30	65.58
Mean abs. error	71.82	93.09	94.16	46.51
Mean abs. % error	0.53	0.69	0.69	0.34
Theil inequality coeff.	0.003	0.004	0.004	0.002
Bias proportion	0.091	0.315	0.638	0.503
Variance proportion	0.523	0.531	0.335	0.404
Covariance proportion	0.386	0.154	0.028	0.093

Table B.12: Performance of out-of-sample forecast: employees (Equation 4.33)

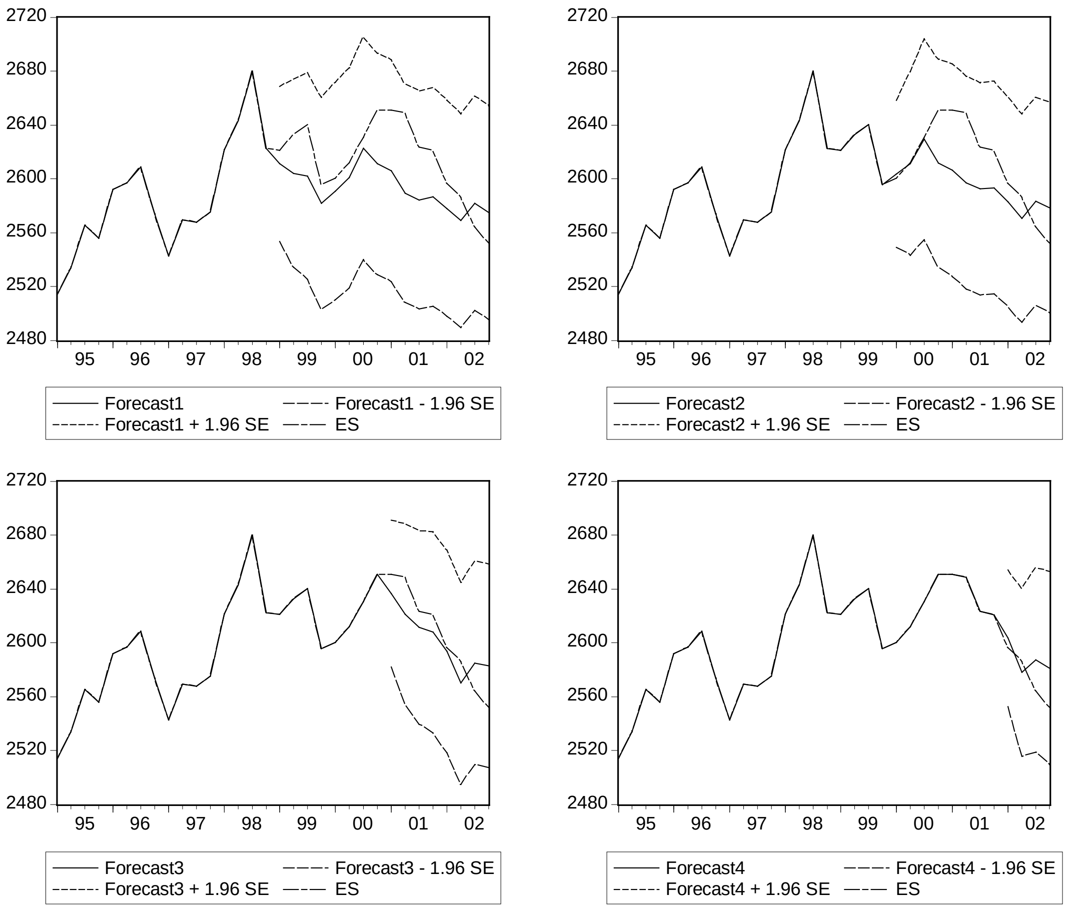


Figure B.40: Out-of-sample forecasts: self-employed persons (Equation 4.34)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	29.80	28.03	19.08	19.36
Mean abs. error	25.89	22.82	17.15	16.86
Mean abs. % error	0.99	0.87	0.66	0.66
Theil inequality coeff.	0.006	0.005	0.004	0.004
Bias proportion	0.490	0.277	0.052	0.438
Variance proportion	0.224	0.305	0.519	0.159
Covariance proportion	0.286	0.418	0.430	0.403

Table B.13: Performance of out-of-sample forecast: self-employed persons (Equation 4.34)

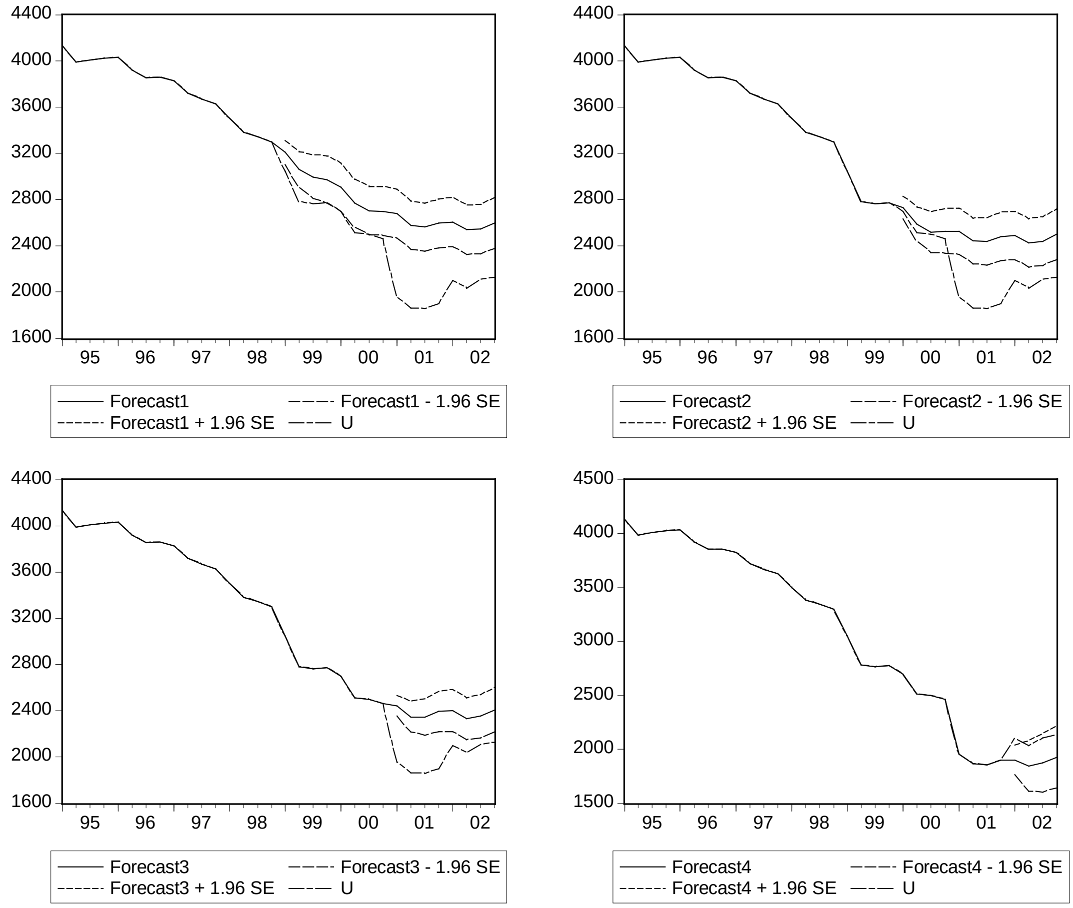


Figure B.41: Out-of-sample forecasts: unemployed persons (Equation 4.36)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	457.08	397.58	399.37	204.94
Mean abs. error	408.19	331.58	385.31	204.33
Mean abs. % error	19.27	16.70	19.66	9.76
Theil inequality coeff.	0.089	0.085	0.091	0.051
Bias proportion	0.797	0.696	0.931	0.994
Variance proportion	0.149	0.248	0.031	0.001
Covariance proportion	0.054	0.057	0.038	0.005

Table B.14: Performance of out-of-sample forecast: unemployed persons (Equation 4.36)

Out-of-sample forecasts excluding step dummy for the fourth quarter of 2001.

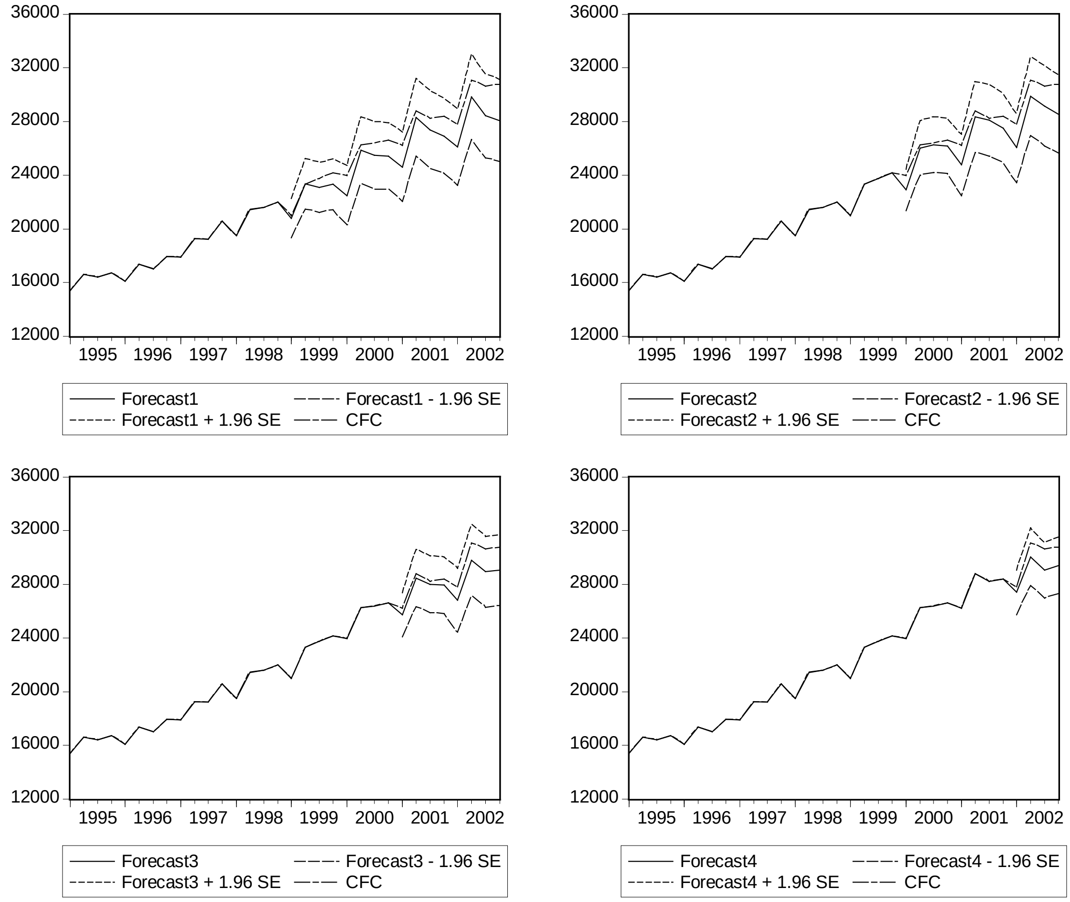


Figure B.42: Out-of-sample forecasts: consumption of fixed capital (Equation 4.38)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	1318.98	1148.77	1054.03	1172.09
Mean abs. error	1118.13	942.78	881.72	1073.16
Mean abs. % error	4.05	3.33	2.97	3.52
Theil inequality coeff.	0.025	0.021	0.018	0.020
Bias proportion	0.713	0.674	0.700	0.838
Variance proportion	0.093	0.024	0.132	0.099
Covariance proportion	0.194	0.303	0.169	0.063

Table B.15: Performance of out-of-sample forecast: consumption of fixed capital (Equation 4.38)

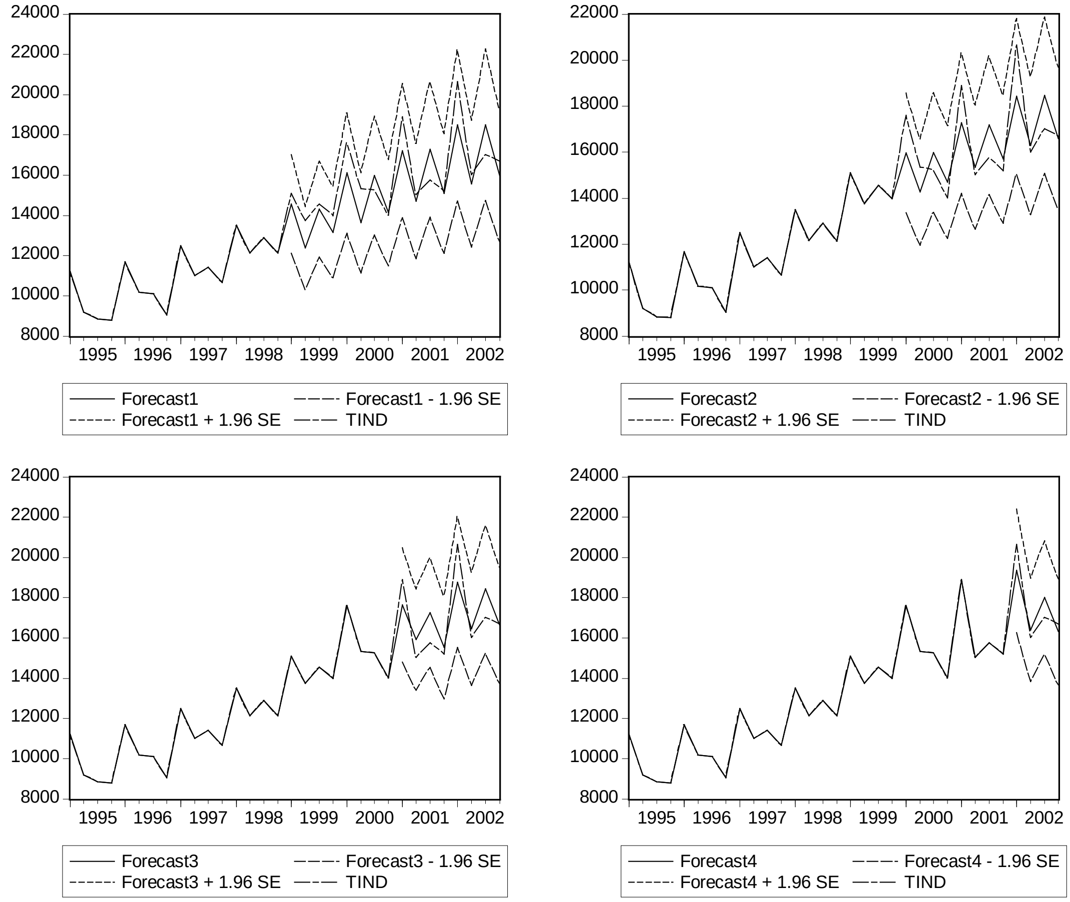


Figure B.43: Out-of-sample forecasts: taxes less subsidies on production and imports (Equation 4.40)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	1158.78	1191.65	1143.23	864.68
Mean abs. error	965.50	1005.22	976.58	770.29
Mean abs. % error	5.87	5.90	5.63	4.24
Theil inequality coeff.	0.037	0.036	0.034	0.025
Bias proportion	0.174	0.008	0.023	0.007
Variance proportion	0.004	0.190	0.417	0.396
Covariance proportion	0.822	0.802	0.560	0.597

Table B.16: Performance of out-of-sample forecast: taxes less subsidies on production and imports (Equation 4.40)

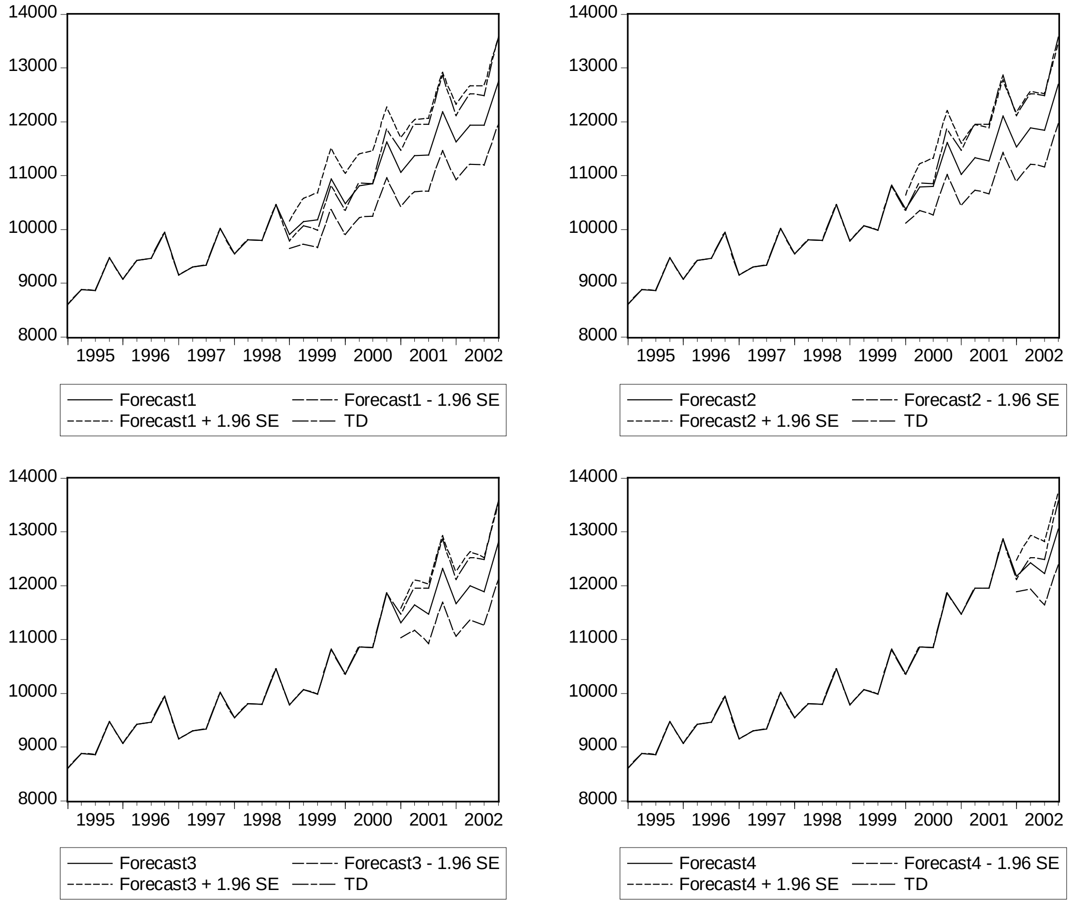


Figure B.44: Out-of-sample forecasts: direct taxes on households' income (Equation 4.42)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	434.50	551.09	511.60	296.67
Mean abs. error	351.76	471.96	482.95	233.37
Mean abs. % error	2.91	3.82	3.85	1.79
Theil inequality coeff.	0.019	0.024	0.021	0.012
Bias proportion	0.397	0.726	0.891	0.466
Variance proportion	0.525	0.219	0.085	0.431
Covariance proportion	0.079	0.055	0.023	0.103

Table B.17: Performance of out-of-sample forecast: direct taxes on households' income (Equation 4.42)

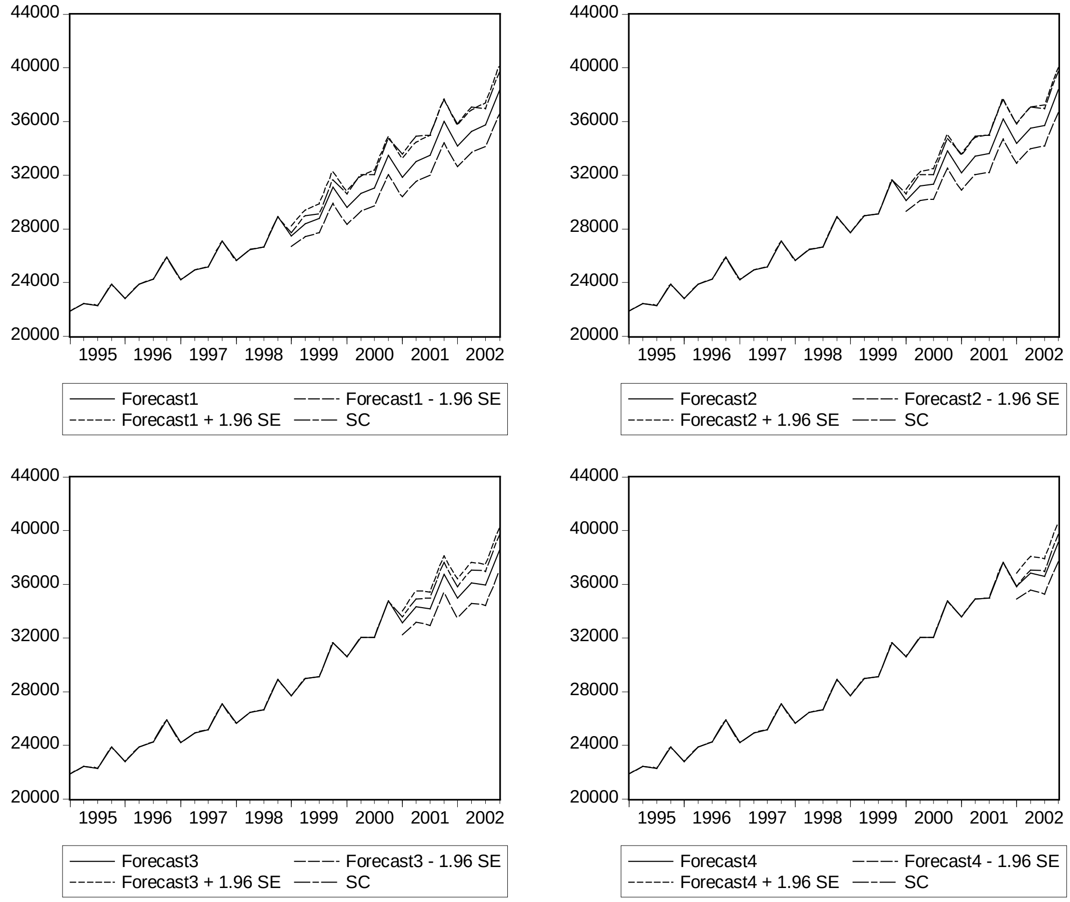


Figure B.45: Out-of-sample forecasts: social contributions of households (Equation 4.44)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	1296.35	1232.50	847.70	353.78
Mean abs. error	1191.79	1184.86	822.06	291.83
Mean abs. % error	3.46	3.35	2.24	0.76
Theil inequality coeff.	0.020	0.018	0.012	0.005
Bias proportion	0.845	0.924	0.940	0.614
Variance proportion	0.083	0.041	0.048	0.328
Covariance proportion	0.072	0.035	0.012	0.058

Table B.18: Performance of out-of-sample forecast: social contributions of households (Equation 4.44)

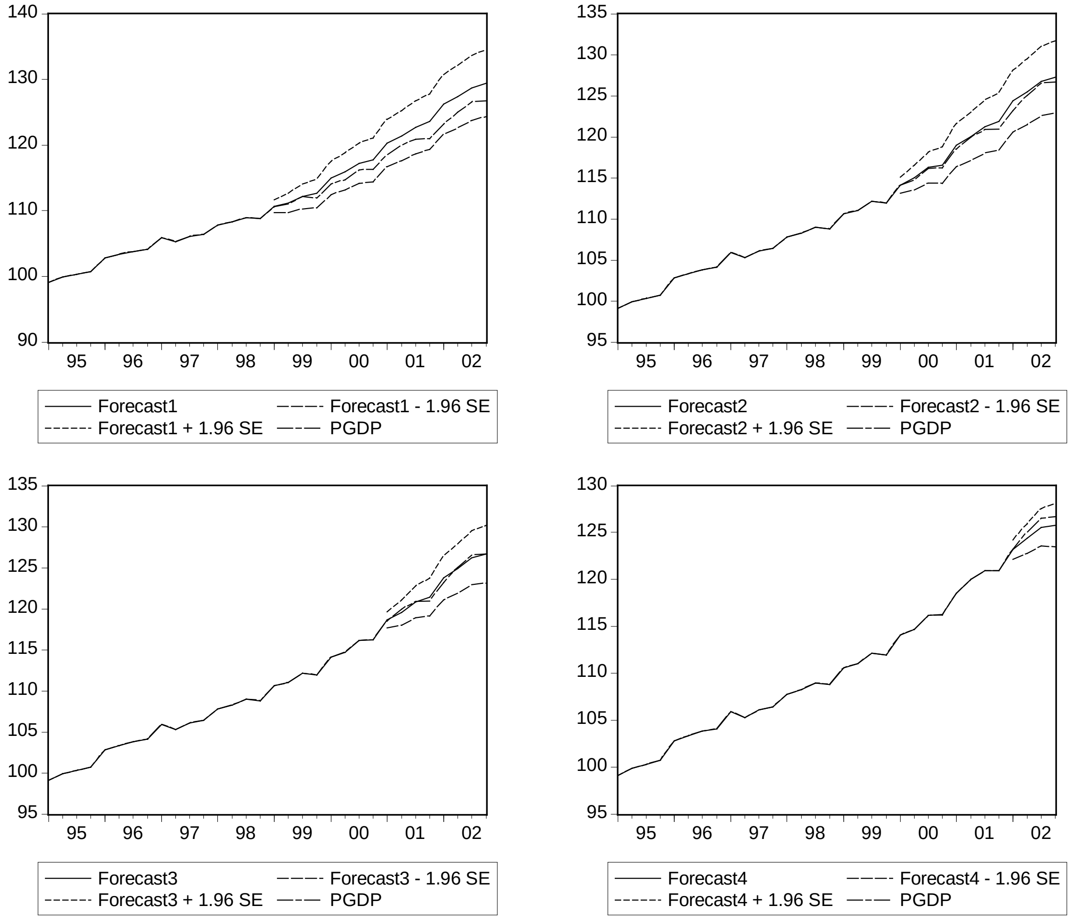


Figure B.46: Out-of-sample forecasts: GDP-Deflator (Version 1, equation 4.46))

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	1.74	0.52	0.33	0.73
Mean abs. error	1.47	0.41	0.27	0.63
Mean abs. % error	1.22	0.34	0.22	0.50
Theil inequality coeff.	0.007	0.002	0.001	0.003
Bias proportion	0.718	0.614	0.006	0.749
Variance proportion	0.242	0.083	0.014	0.239
Covariance proportion	0.039	0.303	0.980	0.012

Table B.19: Performance of out-of-sample forecast: GDP-deflator (Version 1), equation 4.46

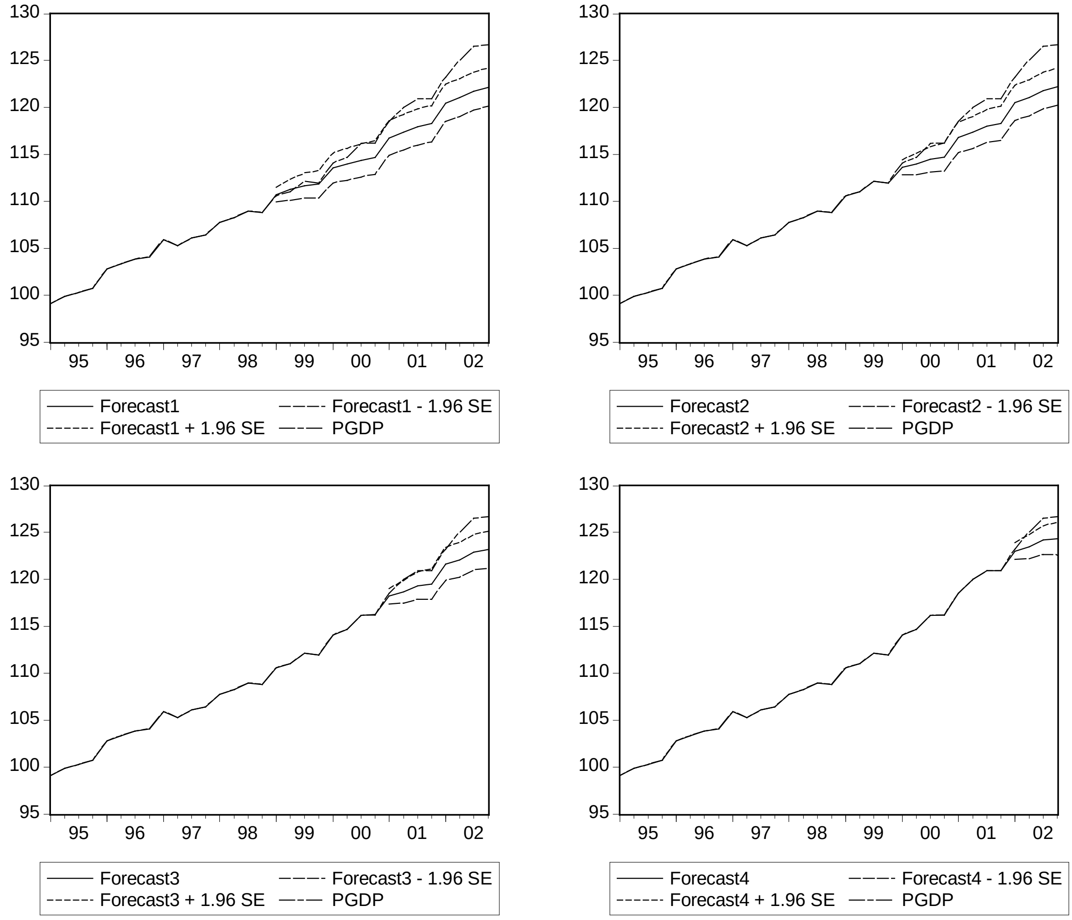


Figure B.47: Out-of-sample forecasts: GDP-Deflator (Version 2, equation 4.48)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	2.50	2.84	2.32	1.83
Mean abs. error	1.98	2.52	2.04	1.61
Mean abs. % error	1.62	2.06	1.64	1.27
Theil inequality coeff.	0.011	0.012	0.010	0.007
Bias proportion	0.602	0.786	0.771	0.770
Variance proportion	0.381	0.199	0.206	0.224
Covariance proportion	0.017	0.015	0.022	0.006

Table B.20: Performance of out-of-sample forecast: GDP-deflator (Version 2, equation 4.48)

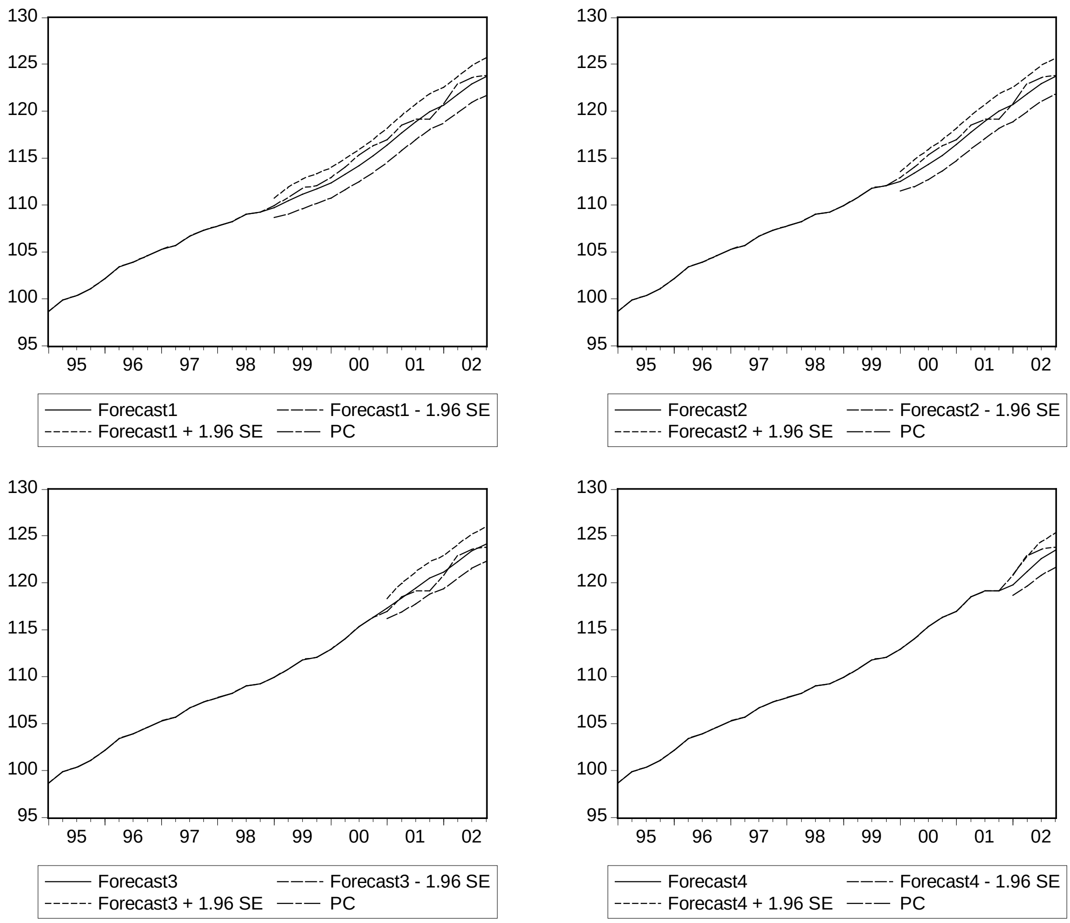


Figure B.48: Out-of-sample forecasts: private consumption deflator (Equation 4.49)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	0.69	0.70	0.58	1.10
Mean abs. error	0.61	0.62	0.45	1.00
Mean abs. % error	0.52	0.52	0.37	0.81
Theil inequality coeff.	0.003	0.003	0.002	0.004
Bias proportion	0.538	0.466	0.144	0.825
Variance proportion	0.003	0.035	0.078	0.026
Covariance proportion	0.459	0.499	0.778	0.149

Table B.21: Performance of out-of-sample forecast: private consumption deflator (Equation 4.49)

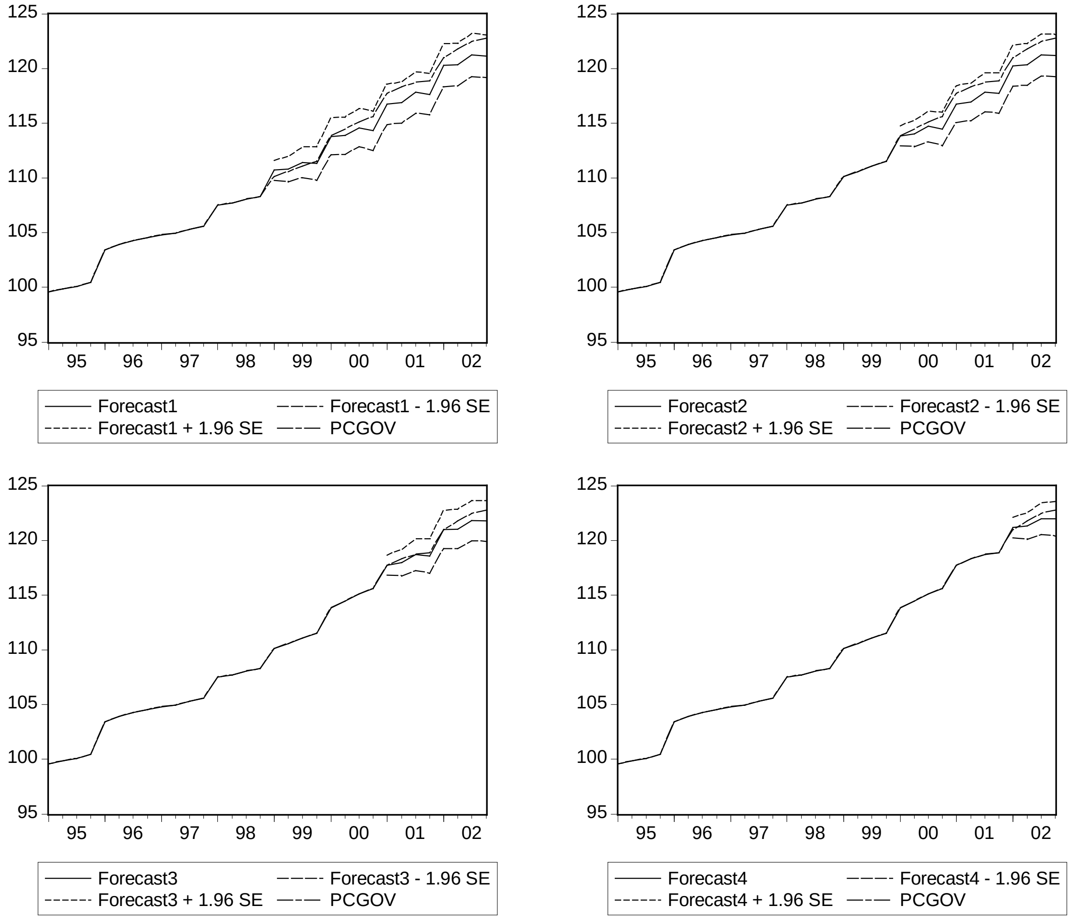


Figure B.49: Out-of-sample forecasts: government consumption deflator (Equation 4.51)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	0.97	1.05	0.51	0.53
Mean abs. error	0.84	0.94	0.38	0.48
Mean abs. % error	0.71	0.79	0.31	0.40
Theil inequality coeff.	0.004	0.004	0.002	0.002
Bias proportion	0.516	0.813	0.543	0.543
Variance proportion	0.351	0.100	0.241	0.357
Covariance proportion	0.133	0.086	0.216	0.100

Table B.22: Performance of out-of-sample forecast: government consumption deflator (Equation 4.51)

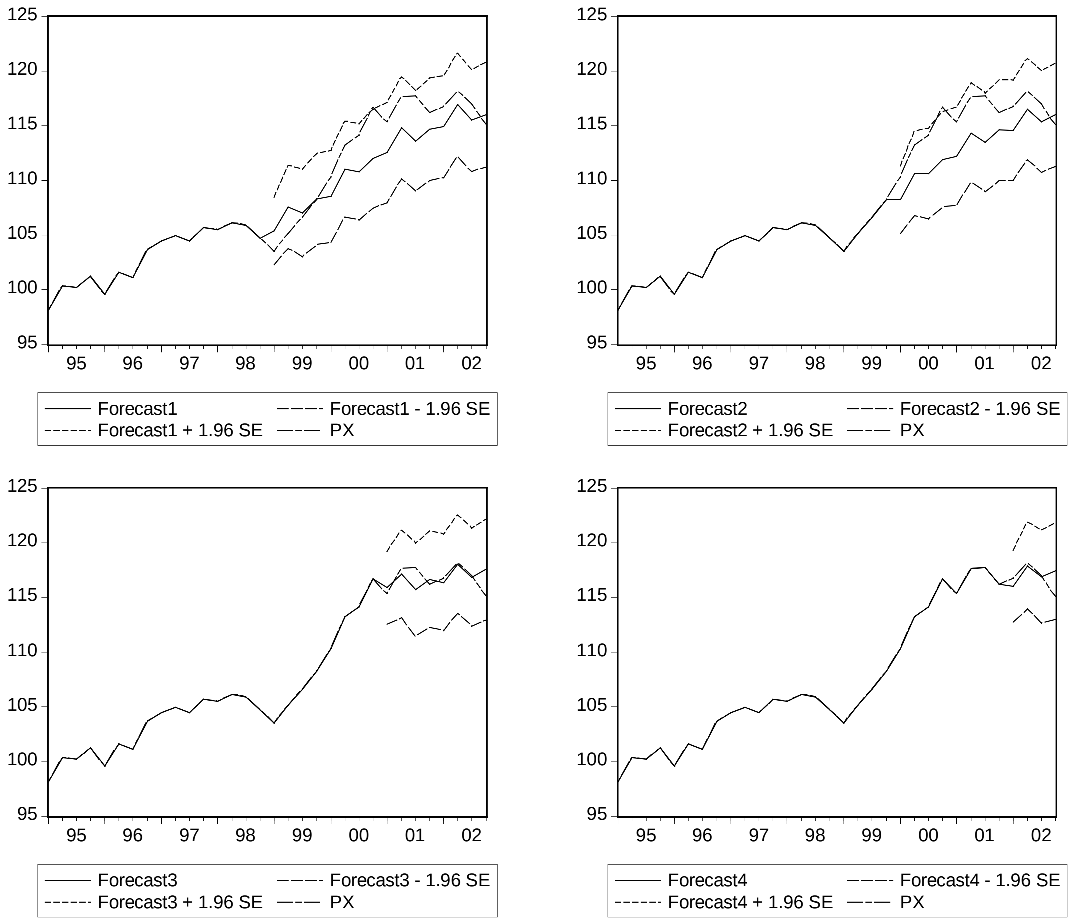


Figure B.50: Out-of-sample forecasts: export deflator (Equation 4.53)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	2.43	2.88	1.17	1.21
Mean abs. error	2.10	2.64	0.82	0.84
Mean abs. % error	1.84	2.28	0.71	0.72
Theil inequality coeff.	0.011	0.013	0.005	0.005
Bias proportion	0.328	0.753	0.001	0.066
Variance proportion	0.257	0.008	0.062	0.099
Covariance proportion	0.415	0.239	0.937	0.836

Table B.23: Performance of out-of-sample forecast: export deflator (Equation 4.53)

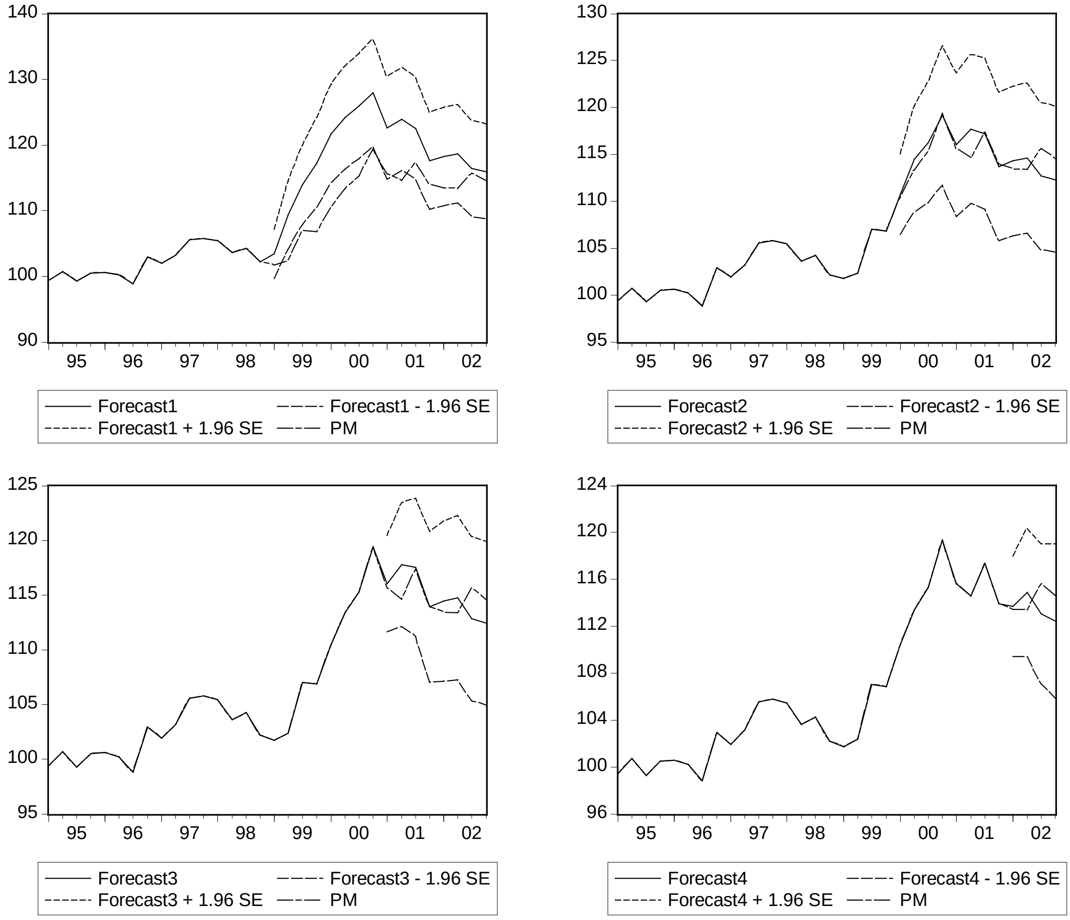


Figure B.51: Out-of-sample forecasts: import deflator (Equation 4.55)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	7.37	1.54	1.80	1.85
Mean abs. error	6.55	1.15	1.39	1.63
Mean abs. % error	5.84	1.01	1.21	1.42
Theil inequality coeff.	0.032	0.007	0.008	0.008
Bias proportion	0.788	0.013	0.006	0.156
Variance proportion	0.024	0.016	0.116	0.000
Covariance proportion	0.188	0.972	0.878	0.844

Table B.24: Performance of out-of-sample forecast: import deflator (Equation 4.55)

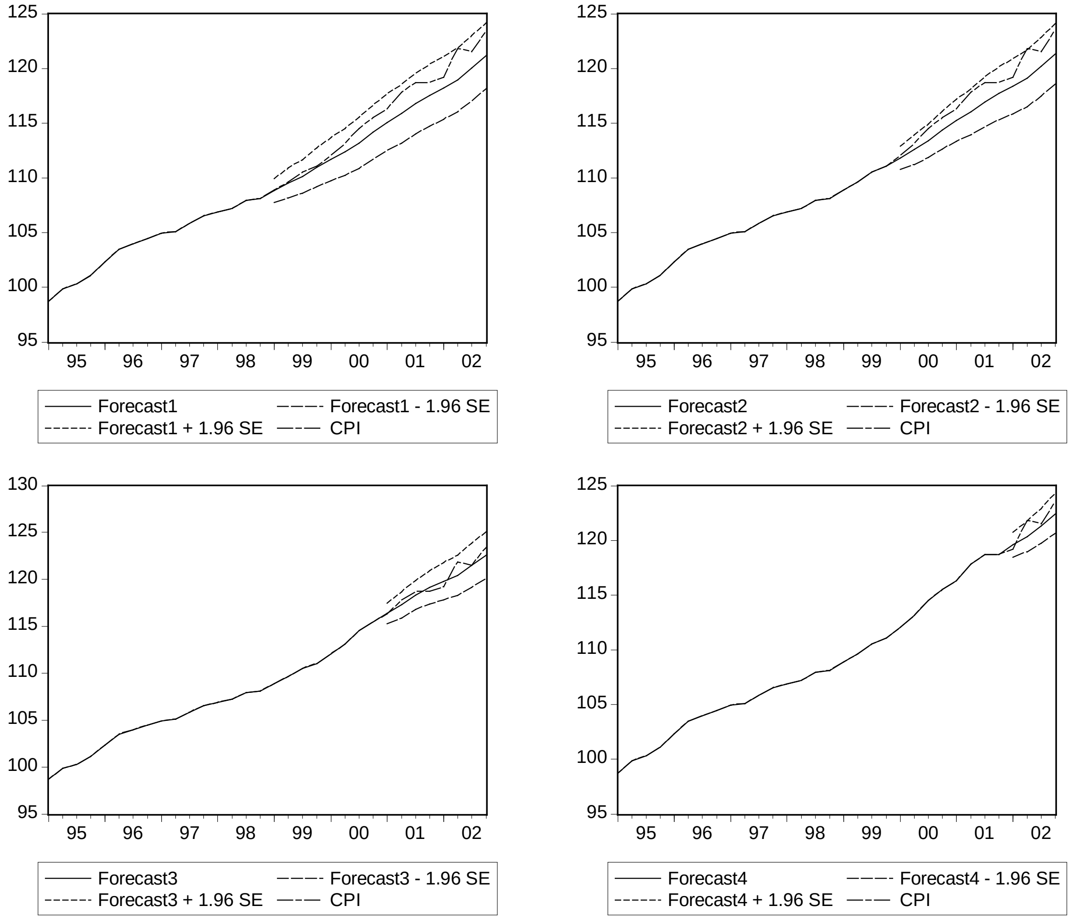


Figure B.52: Out-of-sample forecasts: consumer price index (Equation 4.56)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1- 1998Q4	1981Q1- 1999Q4	1981Q1- 2000Q4	1981Q1- 2001Q4
Forecast	1999Q1- 2002Q4	2000Q1- 2002Q4	2001Q1- 2002Q4	2002Q1- 2002Q4
RMSE	1.40	1.47	0.66	0.91
Mean abs. error	1.15	1.31	0.51	0.76
Mean abs. % error	0.97	1.10	0.43	0.62
Theil inequality coeff.	0.006	0.006	0.003	0.004
Bias proportion	0.669	0.796	0.141	0.399
Variance proportion	0.246	0.109	0.140	0.225
Covariance proportion	0.085	0.095	0.718	0.376

Table B.25: Performance of out-of-sample forecast: consumer price index (Equation 4.56)

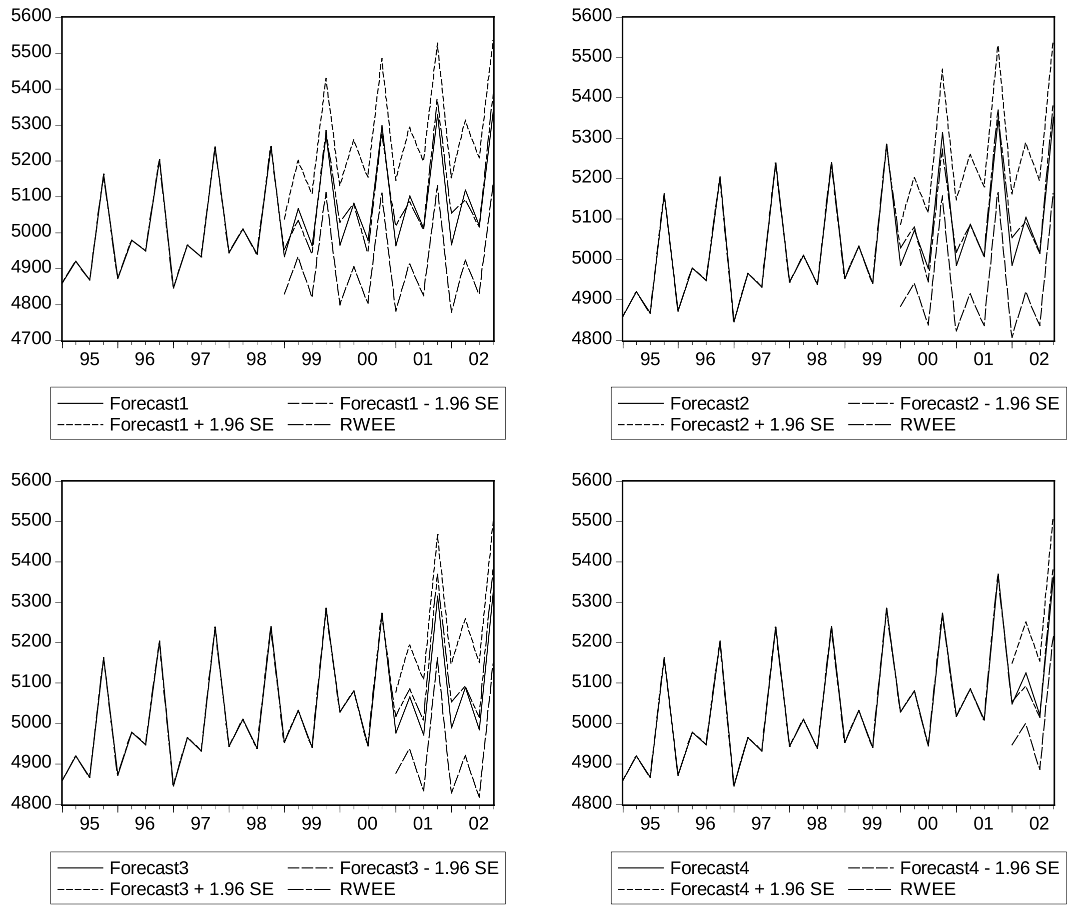


Figure B.53: Out-of-sample forecasts: real wage (Equation 4.59)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	38.75	31.89	43.90	20.60
Mean abs. error	31.03	24.93	38.94	16.80
Mean abs. % error	0.61	0.49	0.75	0.32
Theil inequality coeff.	0.004	0.003	0.004	0.002
Bias proportion	0.074	0.103	0.787	0.016
Variance proportion	0.012	0.002	0.034	0.321
Covariance proportion	0.914	0.895	0.179	0.662

Table B.26: Performance of out-of-sample forecast: real wage (Equation 4.59)

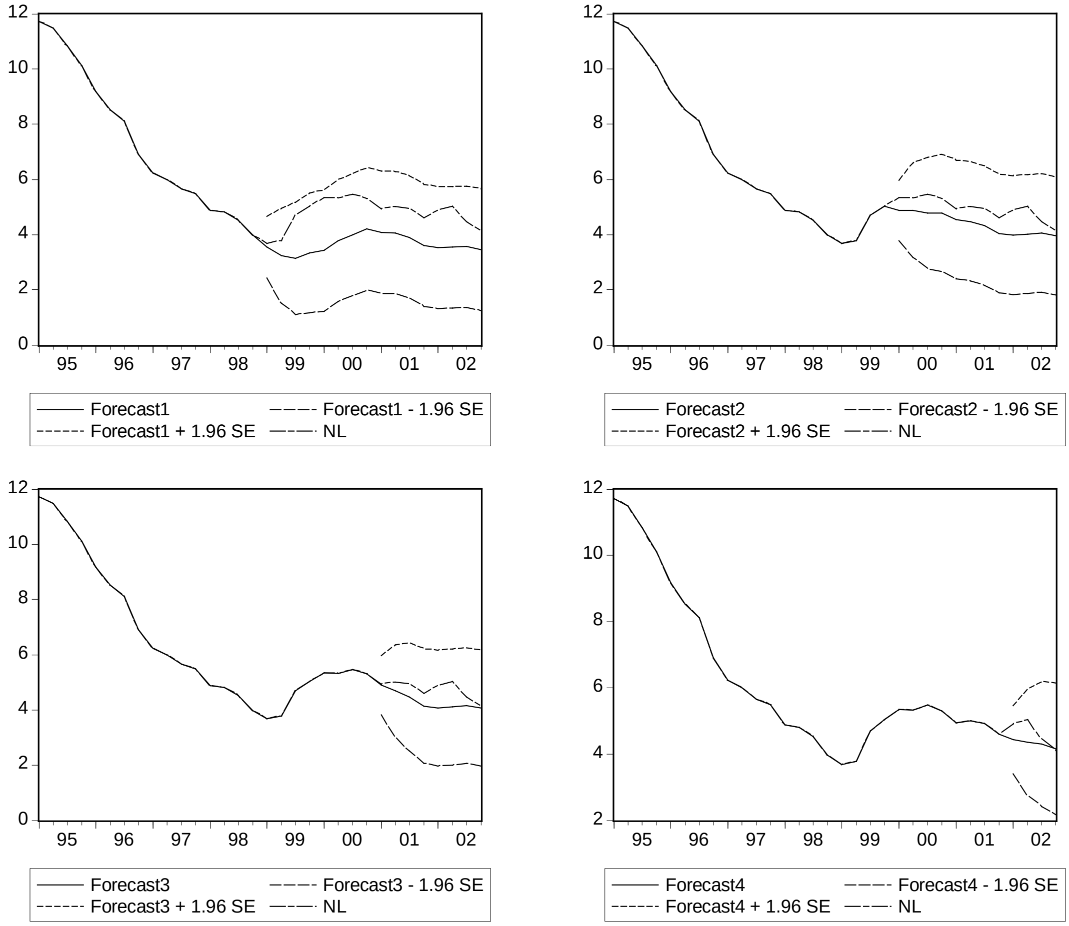


Figure B.54: Out-of-sample forecasts: long-term nominal interest rate (Equation 4.61)

Forecast	Forecast1	Forecast2	Forecast3	Forecast4
Estimation	1981Q1-1998Q4	1981Q1-1999Q4	1981Q1-2000Q4	1981Q1-2001Q4
Forecast	1999Q1-2002Q4	2000Q1-2002Q4	2001Q1-2002Q4	2002Q1-2002Q4
RMSE	1.23	0.60	0.52	0.42
Mean abs. error	1.14	0.56	0.42	0.34
Mean abs. % error	23.15	11.23	8.72	6.90
Theil inequality coeff.	0.145	0.064	0.057	0.047
Bias proportion	0.861	0.867	0.660	0.554
Variance proportion	0.030	0.002	0.000	0.405
Covariance proportion	0.109	0.132	0.340	0.041

Table B.27: Performance of out-of-sample forecast: long-term nominal interest rate (Equation 4.61)

B.5 Definitions of the Model

B.5.1 Aggregate Demand

$CP_t = CP95_t * (PC_t/100)$

$XG95_t = XG95EWU_t + XG95REU_t + XG95US_t + XG95ROW_t$

$X95_t = XG95_t + XS95_t$

$ICON95_t = ICON95PR_t + ICON95PU_t$

$IFC95_t = ICON95_t + IMEQ95_t$

$GDP95_t = CP95_t + CGOV95_t + IFC95_t + IS95_t + X95_t - M95_t$

$CGOV_t = CGOV95_t * (PCGOV_t/100)$

$IFC_t = IFC95_t * (PIFC_t/100)$

$IS_t = GDP_t - CP_t - CGOV_t - IFC_t - X_t + M_t$

$X_t = X95_t * (PX_t/100)$

$M_t = M95_t * (PM_t/100)$

$XM_t = X_t - M_t$

$XM95_t = X95_t - M95_t$

$XM\_RATIO_t = XM_t/GDP_t * 100$

$GDP_t = GDP95_t * (PGDP_t/100)$

B.5.2 Income and Employment

$ET_t = EE_t + ES_t$

$EP_t = ET_t + U_t$

$UR_t = U_t/EP_t * 100$

$UR1_t = U_t/EP_t$

$COE_t = WEE_t * EE_t/1000$

$YD_t = COE_t + OSMIN_t + TRR_t - SC_t - TD_t$

$YD95_t = YD_t/(PC_t/100)$

B.5.3 Prices and Wages

$$PGDPPM_t = PGDP_t/PM_t * 100$$
$$WEE_t = RWEE_t * PC_t/100$$
$$INFL_t = PGDP_t/PGDP_{t-4} * 100 - 100$$

B.5.4 Real Effective Exchange Rates

$$RAW_t = RESTROW_t * CPI_t$$
$$NAWUS_t = 100/USD_t * 124.599224$$
$$RAWUS_t = NAWUS_t * CPI_t/US\_CPI_t$$
$$PVAT_t = CPI_t/AT\_CPI_t * 100$$
$$PVBE_t = CPI_t/BE\_CPI_t * 100$$
$$PVDE_t = CPI_t/DE\_CPI_t * 100$$
$$PVDK_t = CPI_t/DK\_CPI_t * 100$$
$$PVFI_t = CPI_t/FI\_CPI_t * 100$$
$$PVFR_t = CPI_t/FR\_CPI_t * 100$$
$$PVGR_t = CPI_t/GR\_CPI_t * 100$$
$$PVIE_t = CPI_t/IE\_CPI_t * 100$$
$$PVIT_t = CPI_t/IT\_CPI_t * 100$$
$$PVNL_t = CPI_t/NL\_CPI_t * 100$$
$$PVPT_t = CPI_t/PT\_CPI_t * 100$$
$$PVSE_t = CPI_t/SE\_CPI_t * 100$$
$$PVUK_t = CPI_t/UK\_CPI_t * 100$$
$$RAWAT_t = ERAT_t * PVAT_t/100$$
$$RAWBE_t = ERBE_t * PVBE_t/100$$
$$RAWDE_t = ERDE_t * PVDE_t/100$$
$$RAWDK_t = ERDK_t * PVDk_t/100$$
$$RAWFI_t = ERFI_t * PVFI_t/100$$
$$RAWFR_t = ERFR_t * PVFR_t/100$$
$$RAWGR_t = ERGR_t * PVGR_t/100$$

$$RAWIE_t = ERIE_t * PVIE_t/100$$
$$RAWIT_t = ERIT_t * PVIT_t/100$$
$$RAWNL_t = ERNL_t * PVNL_t/100$$
$$RAWPT_t = ERPT_t * PVPT_t/100$$
$$RAWSE_t = ERSE_t * PVSE_t/100$$
$$RAWUK_t = ERUK_t * PVUK_t/100$$

$$RAWEWU_t = RAWDE_t^{DE\_WTX/100} * RAWFR_t^{FR\_WTX/100} * RAWIT_t^{IT\_WTX/100} * RAWNL_t^{NL\_WTX/100} * RAWBE_t^{BE\_WTX/100} * RAWAT_t^{AT\_WTX/100} * RAWFI_t^{FI\_WTX/100} * RAWGR^{GR\_WTX/100} * RAWPT_t^{DE\_WTX/100} * RAWIE_t^{IE\_WTX/100}$$

$$RAWREU_t = RAWDK_t^{DK\_WTX/100} * RAWSE_t^{SE\_WTX/100} * RAWUK_t^{UK\_WTX/100}$$

$$PVEWU_t = PVDE_t^{DE\_WTX/100} * PVFR_t^{FR\_WTX/100} * PVIT_t^{IT\_WTX/100} * PVNL_t^{NL\_WTX/100} * PVBE_t^{BE\_WTX/100} * PVAT_t^{AT\_WTX/100} * PVFI_t^{FI\_WTX/100} * PVGR^{GR\_WTX/100} * PVPT_t^{DE\_WTX/100} * PVIE_t^{IE\_WTX/100}$$

$$CPIEWU_t = 1/PVEWU_t * CPI_t * 100$$

B.5.5 Other Definitions

$$PRODET_t = GDP95_t/ET_t * 1000$$
$$ULC_t = WEE_t/PRODET_t$$
$$SPREAD_t = NL_t - NS_t$$

B.6 Documentation of Johansen Tests for the Consumption Function

Before a reliable and sensible cointegration relationship is confirmed, an number of Johansen cointegration tests is carried out for alternative periods and variables. Starting from a bivariate system with consumption and disposable income additional variables are included step-by-step until a cointegrating relationship is found.

The software package used is PC-GIVE 10.2, in which the trace statistic is adjusted for small samples. Critical values are taken from Pesaran et al. (2000), who allow for exogenous I(1) variables in the test.

The lag length is determined according to the Akaike information criterion. As quarterly data are analysed the maximum lag length is set to 5 in levels. Thus, in all cases, the maximum lag length of four (in differences) is chosen.

The following tables provide the estimated long-term coefficients, the lag length and the trace statistic. Cointegration at a 5% confidence level is indicated by an asterisk. In analogy to the main part of this paper variable names in lower case letters mean logarithms. The tables show that a cointegrating relationship exists only in a few cases. In addition, the estimated relationships are very unstable. In several cases coefficients even change their signs or adopt extreme values as in Table B.30[6].

None of the consumption hypotheses (except for the random walk hypothesis, which cannot be modelled with an error correction approach) leaves out disposable income. This is why the first cointegration test examines whether we can postulate the absolute income hypothesis. However, disposable income alone cannot explain consumption behaviour in the long run. We find no cointegrating relationship (cf. Table B.28). Therefore additional variables are subsequently tried out. Due to the theoretical foundations household disposable income is included in each group of variables. When a deterministic trend or a step dummy equal to 0 from 1980 until 1992Q4 and equal to 1 afterwards (SD9301) is added the null hypothesis of no cointegrating relationship still cannot be rejected.

For the addition of wealth variables the results are not any better. The total of the

[6] Lütkepohl and Brüggemann (Brüggemann and Lütkepohl 2004) show that for small samples this is a typical feature of the maximum likelihood estimator applied in the Johansen test. They offer an alternative approach based on generalised least squares (GLS).

real private capital stock, government debt and net foreign assets is the wealth variable used by the European Central Bank in the euro area wide model (Fagan, Henry, and Mestre 2001). In the Spanish module of the ESCB-Multi-Country Model the Bank of Spain (Estrada and Willman 2002) uses a slightly modified wealth variable: the ratio of real wealth as defined above over disposable income (RATIO). For neither set of variables the null hypothesis of no cointegrating relationship can be rejected (cf. Tables B.31 and B.32). For the period from 1983-2002 the trace statistic allows to reject the null hypothesis of no cointegration for consumption, disposable income and real wealth, but the estimated coefficients are contrary to any logic: the long-term effect of wealth on consumption is negative and the propensity to consume is higher than 1 (cf. Table B.31). Such findings are regarded as spurious. They cannot serve as a basis for a sound consumption function.

The unemployment rate is found to be cointegrated with consumption and disposable income in two periods (cf. Table B.33). However, using a general to specific approach with four lags (including additional variables such as interest rates) no error correction equation with a significant adjustment coefficient can be estimated.

A number of Johansen cointegration tests are carried out with long- and short-term interest rates as well as their lagged values (cf. Tables B.34-B.45. The real short-term interest rate (RS) is calculated as follows

$RS = (((1 + NS/100)/((CPI/CPI_{t-1})^4)) - 1) * 100$

NS stands for the nominal short-term interest rate. In this case the 3-month interbank offered rate is used. From 1999 onwards the national series is replaced by the 3-month euribor. Data for interest rates and consumer prices have been taken from the OECD's Main Economic Indicators. However, no sensible results are found apart from the consumption function described in the main part of this paper.

Sample	cp95	yd95	Lags (AIC)	Trace stat.
1982-2002	1.00	-1.04	1-4	8.51
1983-2002	1.00	-1.03	1-4	7.50
1984-2002	1.00	-1.04	1-4	8.27
1985-2002	1.00	-1.10	1-4	11.21
1986-2002	1.00	-1.11	1-4	11.13
1982-2001	1.00	-1.02	1-4	9.52
1982-2000	1.00	-1.01	1-4	9.06
1982-1999	1.00	-0.98	1-4	13.12
1982-1998	1.00	-0.97	1-4	15.60
1982-1997	1.00	-0.96	1-4	14.12
1982-1996	1.00	-0.97	1-4	12.83

Table B.28: Johansen tests: consumption (cp95) and household disposable income (yd95)

Sample	cp95	yd95	SD9301	Lags (AIC)	Trace stat.
1982-2002	1.00	-1.16	0.04	1-4	13.26
1983-2002	1.00	-1.17	0.04	1-4	11.86
1984-2002	1.00	-1.30	0.07	1-4	13.38
1985-2002	1.00	-1.40	0.08	1-4	16.73
1986-2002	1.00	-1.39	0.07	1-4	18.09
1982-2001	1.00	-1.13	0.04	1-4	14.32
1982-2000	1.00	-1.13	0.04	1-4	13.14
1982-1999	1.00	-1.04	0.02	1-4	18.80
1982-1998	1.00	-1.01	0.02	1-4	22.90
1982-1997	1.00	-1.01	0.02	1-4	22.61
1982-1996	1.00	-1.008	0.02	1-4	21.09

Table B.29: Johansen tests: consumption, household disposable income and step dummy (1993Q1)

Sample	cp95	yd95	trend	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.55	-0.003	1-4	16.65
1983-2002	1.00	-0.41	-0.004	1-4	15.84
1984-2002	1.00	-0.39	-0.004	1-4	15.30
1985-2002	1.00	1.18	-0.013	1-4	17.51
1986-2002	1.00	-186.35	1.06	1-4	18.29
1982-2001	1.00	-0.66	-0.002	1-4	17.25
1982-2000	1.00	-0.71	-0.002	1-4	16.14
1982-1999	1.00	-0.98	-0.0000	1-4	20.99
1982-1998	1.00	-0.99	0.0002	1-4	23.01
1982-1997	1.00	-1.002	0.0003	1-4	21.53
1982-1996	1.00	-0.99	0.0002	1-4	18.48

Table B.30: Johansen tests: consumption, household disposable income and trend

Sample	cp95	yd95	Real wealth	Lags (AIC)	Trace stat.
1982-2002	1.00	-1.60	0.29	1-4	22.32
1983-2002	1.00	-1.46	0.37	1-4	33.54*
1984-2002	1.00	-1.26	0.35	1-4	28.25
1985-2002	1.00	-0.70	1.14	1-4	30.78
1986-2002	1.00	-1.99	-1.29	1-4	30.63
1982-2001	1.00	-1.45	0.22	1-4	21.73
1982-2000	1.00	-1.34	0.164	1-4	20.36
1982-1999	1.00	-1.07	0.04	1-4	22.94
1982-1998	1.00	-0.98	-0.001	1-4	26.95
1982-1997	1.00	-0.96	-0.003	1-4	24.83
1982-1996	1.00	-0.96	-0.0006	1-4	19.91

Table B.31: Johansen tests: consumption, household disposable income and real wealth (capital stock+gov. debt+net foreign assets)

Sample	cp95	yd95	RATIO	Lags (AIC)	Trace stat.
1982-2002	1.00	-1.25	0.03	1-4	19.27
1983-2002	1.00	-1.18	0.04	1-4	26.18
1984-2002	1.00	-1.15	0.03	1-4	23.70
1985-2002	1.00	-4.01	-0.09	1-4	28.11
1986-2002	1.00	-1.83	-0.02	1-4	29.44
1982-2001	1.00	-1.21	0.03	1-4	19.45
1982-2000	1.00	-1.19	0.023	1-4	18.55
1982-1999	1.00	-1.02	0.004	1-4	21.77
1982-1998	1.00	-0.97	-0.0004	1-4	25.97
1982-1997	1.00	-0.96	-0.0005	1-4	26.38
1982-1996	1.00	-0.95	-0.0003	1-4	21.97

Table B.32: Johansen tests: consumption, household disposable income and real wealth/disposable income (RATIO)

Sample	cp95	yd95	UR	Lags (AIC)	Trace stat.
1982-2002	1.00	-1.01	0.003	1-4	23.59
1983-2002	1.00	-0.99	0.004	1-4	24.82
1984-2002	1.00	-0.93	0.004	1-4	28.44
1985-2002	1.00	-0.80	0.005	1-4	36.39*
1986-2002	1.00	-0.74	0.005	1-4	35.63*
1982-2001	1.00	-1.04	0.004	1-4	25.58
1982-2000	1.00	-1.05	0.005	1-4	22.15
1982-1999	1.00	-1.005	0.002	1-4	23.49
1982-1998	1.00	-0.98	-0.0003	1-4	28.03
1982-1997	1.00	-0.97	-0.0005	1-4	25.53
1982-1996	1.00	-0.98	0.0002	1-4	22.40

Table B.33: Johansen tests: consumption, household disposable income and the unemployment rate (UR)

Sample	cp95	yd95	NL	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.80	0.01	1-4	13.63
1983-2002	1.00	-0.77	0.01	1-4	12.48
1984-2002	1.00	-0.71	0.01	1-4	13.70
1985-2002	1.00	-0.84	0.01	1-4	17.25
1986-2002	1.00	-0.98	0.005	1-4	22.47
1982-2001	1.00	-0.85	0.007	1-4	14.79
1982-2000	1.00	-0.86	0.006	1-4	13.21
1982-1999	1.00	-0.95	0.002	1-4	17.18
1982-1998	1.00	-0.97	-0.0002	1-4	18.69
1982-1997	1.00	-0.98	-0.0008	1-4	18.44
1982-1996	1.00	-0.96	0.0005	1-4	17.34

Table B.34: Johansen tests: consumption, household disposable income and the long-term nominal interest rate (NL)

Sample	cp95	yd95	NL_{t-1}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.74	0.01	1-4	14.12
1983-2002	1.00	-0.76	0.01	1-4	12.28
1984-2002	1.00	-0.71	0.01	1-4	12.91
1985-2002	1.00	-0.91	0.007	1-4	16.92
1986-2002	1.00	-0.89	0.007	1-4	15.74
1982-2001	1.00	-0.84	0.008	1-4	14.77
1982-2000	1.00	-0.85	0.007	1-4	13.56
1982-1999	1.00	-0.97	0.0006	1-4	17.70
1982-1998	1.00	-0.99	-0.001	1-4	19.09
1982-1997	1.00	-1.02	-0.003	1-4	19.44
1982-1996	1.00	-0.99	-0.001	1-4	17.55

Table B.35: Johansen tests: consumption, household disposable income and the lagged (-1) long-term nominal interest rate

Sample	cp95	yd95	NL_{t-2}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.81	0.01	1-4	18.48
1983-2002	1.00	-0.79	0.01	1-4	17.27
1984-2002	1.00	-0.76	0.01	1-4	18.83
1985-2002	1.00	-0.71	0.01	1-4	23.36
1986-2002	1.00	-0.68	0.01	1-4	20.83
1982-2001	1.00	-0.85	0.007	1-4	19.09
1982-2000	1.00	-0.86	0.007	1-4	17.11
1982-1999	1.00	-0.93	0.003	1-4	20.24
1982-1998	1.00	-0.98	-0.0007	1-4	21.69
1982-1997	1.00	-1.02	-0.003	1-4	21.78
1982-1996	1.00	-0.96	0.0002	1-4	18.92

Table B.36: Johansen tests: consumption, household disposable income and the lagged (-2) long-term nominal interest rate

Sample	cp95	yd95	NL_{t-3}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.82	0.009	1-4	21.56
1983-2002	1.00	-0.78	0.01	1-4	20.96
1984-2002	1.00	-0.72	0.01	1-4	22.65
1985-2002	1.00	-0.69	0.01	1-4	26.99
1986-2002	1.00	-0.68	0.01	1-4	25.34
1982-2001	1.00	-0.88	0.006	1-4	22.49
1982-2000	1.00	-0.88	0.006	1-4	21.31
1982-1999	1.00	-0.97	0.0008	1-4	22.76
1982-1998	1.00	-1.02	-0.003	1-4	24.81
1982-1997	1.00	-1.05	-0.005	1-4	24.63
1982-1996	1.00	-1.05	-0.005	1-4	20.68

Table B.37: Johansen tests: consumption, household disposable income and the lagged (-3) long-term nominal interest rate

Sample	cp95	yd95	NS	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.79	0.008	1-4	16.86
1983-2002	1.00	-0.82	0.007	1-4	14.70
1984-2002	1.00	-0.80	0.008	1-4	14.19
1985-2002	1.00	-0.91	0.005	1-4	14.97
1986-2002	1.00	-1.63	-0.01	1-4	19.78
1982-2001	1.00	-0.84	0.006	1-4	17.53
1982-2000	1.00	-0.87	0.004	1-4	16.75
1982-1999	1.00	-0.95	0.0007	1-4	22.78
1982-1998	1.00	-0.97	-0.0006	1-4	25.85
1982-1997	1.00	-0.98	-0.001	1-4	25.66
1982-1996	1.00	-0.96	-0.0001	1-4	25.26

Table B.38: Johansen tests: consumption, household disposable income and the short-term nominal interest rate

Sample	cp95	yd95	NS_{t-1}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.79	0.008	1-4	15.70
1983-2002	1.00	-0.81	0.008	1-4	14.27
1984-2002	1.00	-0.83	0.007	1-4	14.34
1985-2002	1.00	-1.05	0.001	1-4	14.73
1986-2002	1.00	-1.41	-0.008	1-4	17.09
1982-2001	1.00	-0.87	0.005	1-4	16.44
1982-2000	1.00	-0.89	0.004	1-4	15.90
1982-1999	1.00	-0.97	0.0001	1-4	21.08
1982-1998	1.00	-0.99	-0.001	1-4	24.40
1982-1997	1.00	-1.00	-0.002	1-4	24.49
1982-1996	1.00	-0.99	-0.002	1-4	22.19

Table B.39: Johansen tests: consumption, household disposable income and the lagged (-1) short-term nominal interest rate

Sample	cp95	yd95	NS_{t-2}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.81	0.008	1-4	16.98
1983-2002	1.00	-0.82	0.007	1-4	15.37
1984-2002	1.00	-0.77	0.009	1-4	16.07
1985-2002	1.00	-0.64	0.01	1-4	18.15
1986-2002	1.00	-6.00	-0.12	1-4	17.59
1982-2001	1.00	-0.86	0.006	1-4	17.57
1982-2000	1.00	-0.87	0.004	1-4	16.93
1982-1999	1.00	-0.96	0.0006	1-4	22.18
1982-1998	1.00	-0.99	-0.001	1-4	25.24
1982-1997	1.00	-1.00	-0.002	1-4	25.44
1982-1996	1.00	-0.98	-0.001	1-4	23.70

Table B.40: Johansen tests: consumption, household disposable income and the lagged (-2) short-term nominal interest rate

Sample	cp95	yd95	NS_{t-3}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.88	0.006	1-4	18.01
1983-2002	1.00	-0.85	0.007	1-4	17.15
1984-2002	1.00	-0.80	0.008	1-4	17.93
1985-2002	1.00	-0.84	0.007	1-4	19.16
1986-2002	1.00	-0.77	0.008	1-4	18.58
1982-2001	1.00	-0.90	0.004	1-4	18.39
1982-2000	1.00	-0.90	0.004	1-4	16.36
1982-1999	1.00	-0.96	0.0008	1-4	19.78
1982-1998	1.00	-0.99	-0.001	1-4	22.54
1982-1997	1.00	-1.00	0.002	1-4	22.19
1982-1996	1.00	-0.99	0.001	1-4	19.99

Table B.41: Johansen tests: consumption, household disposable income and the lagged (-3) short-term nominal interest rate

Sample	cp95	yd95	RS	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.93	0.007	1-4	23.74
1983-2002	1.00	-0.92	0.007	1-4	21.94
1984-2002	1.00	-0.91	0.008	1-4	18.29
1985-2002	1.00	-0.85	0.009	1-4	21.02
1986-2002	1.00	-0.71	0.01	1-4	22.38
1982-2001	1.00	-0.92	0.007	1-4	23.20
1982-2000	1.00	-0.93	0.004	1-4	22.91
1982-1999	1.00	-0.95	0.002	1-4	26.56
1982-1998	1.00	-0.96	-0.002	1-4	32.19*
1982-1997	1.00	-0.96	-0.004	1-4	35.91*
1982-1996	1.00	-0.95	-0.004	1-4	34.15*

Table B.42: Johansen tests: consumption, household disposable income and short-term real interest rate

Sample	cp95	yd95	RS_{t-1}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.96	0.006	1-4	18.38
1983-2002	1.00	-0.93	0.008	1-4	20.24
1984-2002	1.00	-0.93	0.008	1-4	15.45
1985-2002	1.00	-0.64	0.02	1-4	18.94
1986-2002	1.00	-0.83	0.01	1-4	16.40
1982-2001	1.00	-0.96	0.005	1-4	18.28
1982-2000	1.00	-0.95	0.003	1-4	17.57
1982-1999	1.00	-0.97	0.0004	1-4	21.51
1982-1998	1.00	-0.96	-0.002	1-4	28.23
1982-1997	1.00	-0.95	-0.003	1-4	31.22
1982-1996	1.00	-0.95	-0.003	1-4	33.56*

Table B.43: Johansen tests: consumption, household disposable income and the lagged (-1) short-term real interest rate

Sample	cp95	yd95	RS_{t-2}	Lags (AIC)	Trace stat.
1982-2002	1.00	-0.94	0.008	1-4	17.85
1983-2002	1.00	-0.89	0.01	1-4	22.46
1984-2002	1.00	-0.86	0.01	1-4	17.91
1985-2002	1.00	0.59	0.07	1-4	19.88
1986-2002	1.00	0.25	0.06	1-4	20.32
1982-2001	1.00	-0.94	0.007	1-4	18.06
1982-2000	1.00	-0.94	0.006	1-4	16.93
1982-1999	1.00	-0.98	-0.002	1-4	22.91
1982-1998	1.00	-0.96	-0.003	1-4	34.01*
1982-1997	1.00	-0.94	-0.003	1-4	37.59*
1982-1996	1.00	-0.94	-0.003	1-4	35.93*

Table B.44: Johansen tests: consumption, household disposable income and the lagged (-2) short-term real interest rate

Sample	cp95	yd95	RS_{t-3}	Lags (AIC)	Trace stat.
1983-2002	1.00	-0.93	0.01	1-4	20.03
1984-2002	1.00	-0.86	0.01	1-4	19.93
1985-2002	1.00	-3.97	-0.14	1-4	19.76
1986-2002	1.00	0.83	0.09	1-4	19.72
1982-2001	1.00	-0.94	0.009	1-4	20.12
1982-2000	1.00	-0.93	0.009	1-4	19.16
1982-1999	1.00	-0.99	-0.004	1-4	23.81
1982-1998	1.00	-0.96	-0.003	1-4	31.41
1982-1997	1.00	-0.95	-0.004	1-4	32.34*
1982-1996	1.00	-0.94	-0.003	1-4	29.46

Table B.45: Johansen tests: consumption, household disposable income and the lagged (-3) short-term real interest rate