IMK
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Study

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# The IMK's Model of the German Economy

## A Structural Macro-Econometric Model

Estimated by Camille Logeay, Katja Rietzler, Sabine Stephan and Rudolf Zwiener

Documentation by Katja Rietzler

**Abstract**

This IMK Study is a documentation of the IMK's macro-econometric model of the German economy. Currently the model includes 48 behavioural equations, which are usually specified as error-correction equations, and 61 definitions. The model is based on seasonally unadjusted quarterly national accounts data complemented by additional statistics and calculations of the IMK. Special features of the model include a more detailed representation of the German exports by destination (euro area, UK, USA, rest of the world) as well as a Keynesian employment function. The model is used both for economic policy simulations and forecasts.

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# 1. Introduction

The IMK's macro model is a structural econometric model of the German economy. It has been used for forecasts and policy simulations at the IMK for several years. During this time the models has often been modified[1]. Like most macro models it is still work in progress and is likely to be modified further in the future. Thus this documentation provides an insight into the general model philosophy as well as the current state of affairs.

Whenever possible the equations of the model are specified as error-correction equations (Engle and Granger, 1987, Banerjee et al. 1998). Critical values for the coefficients of the error-correction terms are taken from Banerjee et al. (1998) as quoted by Hassler (2004).

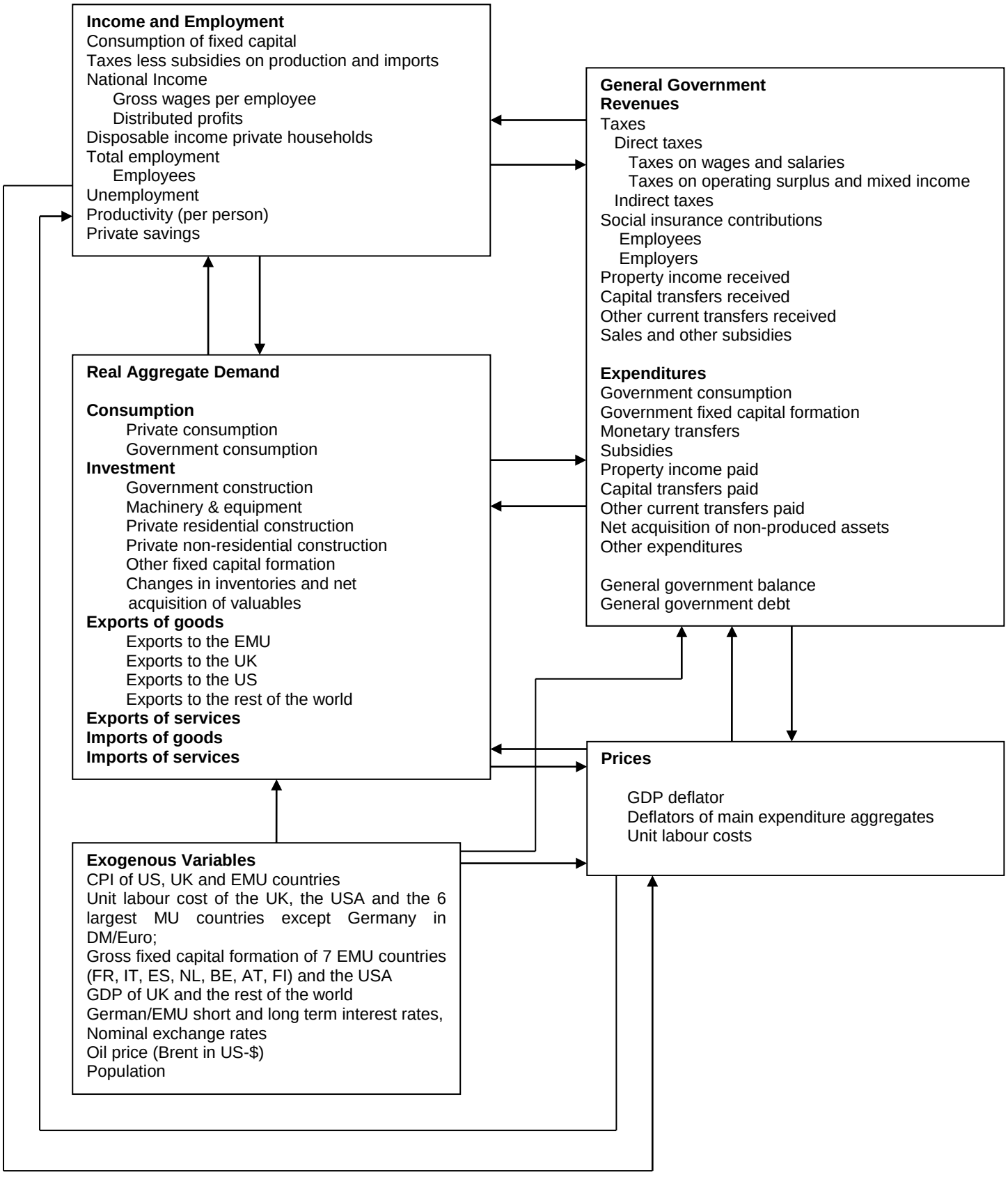
Economic theory plays a role especially for the long-run relationships. Generally the specifications of the model are guided by Keynesian theory. Besides the existence of nominal rigidities and market spillovers this also means that economic policy has long-term effects on the real economy and that unemployment may exist in the long run. Further, the employment function estimates the long-run relationship between productivity and the capital stock, whereas the real wage is of minor importance for employment.

Further, the properties of the time series play a central role. The IMK's macro model is estimated on the basis of seasonally unadjusted quarterly data. Generally, no restrictions are imposed with regard to homogeneity and no calibration is applied. There are only a few restrictions of coefficients.

The model uses highly aggregated national accounts data for the real aggregate demand, income and employment, the government sector and prices and exchange rates. There are 48 behavioural equations and 61 definitions. Unlike in most other macro models real exports of goods are regionally disaggregated for four regions (EMU, UK, US and the rest of the world). Interest rates, nominal exchange rates, population growth, foreign prices and foreign demand remain exogenous. Figure 1 on the next page provides an overview of the general structure of the IMK's macro model.

[1] The basic structure oft he model is similar to that of a model built largely by the same authors at the DIW Berlin (Duong et al, 2005). However, numerous important equations, such as the employment equations have been changed completely.

**Figure 1: Structure of the IMK Model**




Source: IMK.

# 2. Model Data

## 2.1. Data Sources

The majority of time series used in the model are from the German national accounts provided by Destatis, the German statistical office. They are quarterly, seasonally unadjusted series. Data of other European economies are largely obtained from Eurostat. For countries outside the EU the OECD is the main data source. Table 99 in the Appendix provides a list of variables including the variable abbreviations, their explanations and sources. A substantial number of variables have been calculated by the IMK. This applies to the capital stock, real interest rates or the regional breakdown of exports (Stephan, 2002).

Revenues and expenditures of the general government are only partly available on a quarterly basis. Some series including total revenues and expenditures as well as interest payments of the government, property transfers have been temporarily disaggregated from half-yearly data with the help of Eurostat's software package ECOTRIM (Chow and Lin 1971, Barcellan, 1994). Indicator series were applied in the temporal disaggregation whenever possible.

Due to German reunification data for the period since 1991 cover the whole of Germany, whereas all data for earlier periods refer to West Germany. Thus, for the estimation of equations for the whole sample beginning in 1980 extensive use of dummy variables (step dummies in particular) has been made. In this documentation labels of step dummies begin with an S e.g. S91Q1. This step dummy is equal to zero from 1980 until the fourth quarter of 1990 and 1 from the first quarter of 1991 onwards. An I indicates an impulse dummy. It equals 1 in the respective quarter and zero otherwise, e.g. I91Q1. I92_94_99 is an exception to the rule. It equals 1 in the fourth quarter of 1992, in the first quarter of 1994 and in the first quarter of 1999 and zero otherwise. Variables z1, z2 and z3 are centred seasonal dummies.

## 2.2. Unit Root Tests

Most macroeconomic time series are integrated of order 1 or I(1). This is why many of the behavioural equations in the model are error-correction equations. To obtain an idea which variables can be combined in an error-correction equation, we have to know the stochastic properties of the series. For this purpose we run unit root tests before estimating. The augmented Dickey-Fuller (Dickey and Fuller, 1979) test is the norm. However, due to the German reunification, numerous time series show a clear structural break in 1991. For this reason the Perron test (Perron 1989, Perron and Vogelsang 1993) is applied in these cases.

The results of the unit root tests given in Table 1and in Table 2 serve as a guideline. However, there are cases, when cointegration tests indicate that series, which - according to the unit root tests - have different stochastic properties, are cointegrated. In these cases theoretical considerations are also taken into account and the results of the estimation equation are given priority. Contradictions between the unit root tests and the estimated equations may also be due to different sample sizes. The unit root tests are performed in advance for the whole sample length. Thus, if a reduced sample is used in the estimation equation it may not be surprising that stochastic properties differ.

Most time series are I(1), stationary with respect to a linear trend (TS) or I(0). Series integrated of order 2 remain exceptions (some prices series or nominal series).

**Table 1: Results of the Augmented Dickey-Fuller Tests**

| Variable | From | Deter-ministics | Lags | Test statistics | Result |
|---|---|---|---|---|---|
| LOG(CPI_DE) | 1981Q2 | c, t, s | 1,4 | -2.27 (-3.45) | I(1) |
| ΔLOG(CPI_DE) | 1981Q2 | c, s | 1,2,3 | -3.17 (-2.88) | |
| LOG(CPI_EWU) | 1980Q4 | c,t,s | 2 | -6.37 (-3.45) | TS |
| ΔLOG(CPI_EWU) | 1981Q1 | c,s | 1,2 | -2.98 (-2.88) | |
| LOG(CPI_Uk) | 1981Q2 | c, s | 1,4 | -2.20 (-2.88) | I(1) |
| ΔLOG(CPI_UK) | 1981Q2 | s | 1-3 | -2.69 (-1.94) | |
| LOG(CPI_US) | 1981Q1 | c,t,s | 1-3 | -2.37 (-3.45) | I(1) |
| ΔLOG(CPI_US) | 1981Q1 | c,s | 2,4 | -6.34 (-2.88) | |
| DE_BGOV | 1991Q3 | c, s | 1 | -4.41 (-2.90) | I(0) |
| ΔDE_BGOV | 1991Q4 | s | 1 | -9.94 (-1.94) | |
| LOG(DE_CAPA) | 1980Q2 | c | 0 | -4.27 (-2.88) | I(0) |
| ΔLOG(DE_CAPA) | 1980Q3 | none | 0 | -12.94 (-1.94) | |
| LOG(DE_DBTGOV) | 1991Q4 | c,s | 2 | -1.94 (-2.90) | I(1) |
| ΔLOG(DE_DBTGOV) | 1991Q4 | s | 1 | -2.96 (-1.94) | |
| LOG(DE_EXPGOV) | 1991Q3 | c, t, s | 1 | -4.37 (-3.47) | TS |
| ΔLOG(DE_EXPGOV) | 1991Q4 | c, s | 1 | -10.05 (-2.90) | |
| LOG(DE_EXPOTH) | 1991Q4 | c,t,s | 1,2 | -2.87 (-3.47) | I(1) |
| ΔLOG(DE_EXPOTH) | 1992q2 | c,s | 1-3 | -8.14 (-2.90) | |
| LOG(DE_GYPROP) | 1981Q2 | c, s | 1,3,4 | -2.00 (-2.88) | I(1) |
| ΔLOG(DE_GYPROP) | 1981Q2 | s | 1-3 | -4.16 (-1.94) | |
| LOG(DE_ID00) | 1981Q2 | c, s | 1,4 | -1.49 (-2.88) | I(1) |
| ΔLOG(DE_ID00) | 1981Q2 | s | 2,3 | -16.47 (-1.94) | |
| LOG(DE_IGOV) | 1992Q2 | c, s | 1,2,4 | -1.91 (-2.90) | I(1) |
| ΔLOG(DE_IGOV) | 1992Q2 | s | 1,3 | -11.54 (-1.94) | |
| LOG(DE_IMEQ00) | 1981Q2 | c, t, s | 2,4 | -4.31 (-3.45) | TS |
| ΔLOG(DE_IMEQ00) | 1981Q3 | c, s | 1,4 | -5.91 (-2.89) | |
| LOG(DE_INTPAGOV) | 1991Q2 | c, s | none | -5.61 (-2.90) | I(0) |
| ΔLOG(DE_INTPAGOV) | 1991Q3 | s | none | -8.35 (-1.94) | |

| Variable | From | Deter-ministics | Lags | Test statistics | Result |
|---|---|---|---|---|---|
| DE_INV | 1981Q2 | c, s | 3,4 | -8.08 (-2.88) | I(0) |
| ΔDE_INV | 1981Q1 | s | 1,2 | -17.07 (-1.94) | |
| DE_INV00 | 1981Q2 | c, s | 1-4 | -3.24 (-2.88) | I(0) |
| ΔDE_INV00 | 1981Q1 | s | 1,2 | -18.03 (-1.94) | |
| LOG(DE_IOTH00) | 1981Q2 | c, t, s | 4 | -2.70 (-3.45) | I(1) |
| ΔLOG(DE_IOTH00) | 1981Q2 | c, s | 1-3 | -3.69 (-2.88) | |
| LOG(DE_M) | 1980Q4 | c, t, s | 2 | -3.55 (-3.45) | TS |
| ΔLOG(DE_M) | 1981Q3 | c,s | 2,3,4 | -10.18 (-2.89) | |
| LOG(DE_M00) | 1981Q2 | c,t,s | 2,4 | -4.20 (-3.45) | TS |
| ΔLOG(DE_M00) | 1981Q3 | c,s | 4 | -13.20 (-2.89) | |
| LOG(DE_MASSENEINK00) | 1992Q2 | c,s | 4 | -1.83 (-2.90) | I(1) |
| Δ LOG(DE_MASSENEINK00) | 1992Q2 | s | 2,3 | -9.40 (-1.94) | |
| LOG(DE_MASSENEINK) | 1992Q2 | c,t,s | 4 | -3.46 (-3.47) | I(1)/I(2) |
| ΔLOG(DE_MASSENEINK) | 1992Q2 | c, s | 1-3 | -2.89 (-2.90) | |
| LOG(DE_MG00) | 1980Q4 | c,t,s | 2 | -3.80 (-3.45) | TS |
| ΔLOG(DE_MG00) | 1980Q3 | c,s | none | -12.61 (-2.88) | |
| LOG(DE_MS00) | 1981Q2 | c,t,s | 1-4 | -1.75 (-3.45) | I(1) |
| ΔLOG(DE_MS00) | 1981Q2 | c,s | 2,3 | -21.22 (-2.88) | |
| DE_NETPRGOV | 1991Q2 | c | none | -9.13 (-2.90) | I(0) |
| ΔDE_NETPRGOV | 1992Q1 | none | 1,2 | -8.78 (1.94) | |
| LOG(DE_NEV_UK) | 1980Q3 | c | 1 | -1.76 (-2.88) | I(1) |
| ΔLOG(DE_NEV_UK) | 1980Q3 | none | none | -8.28 (-1.94) | |
| LOG(DE_NEV_US) | 1980Q3 | c | 1 | -1.71 (-2.88) | I(1) |
| ΔLOG(DE_NEV_US) | 1980Q3 | none | none | -8.18 (-1.94) | |
| LOG(DE_PCP00) | 1981Q2 | c,t | 4 | -4.47 (-3.45) | TS |
| ΔLOG(DE_PCP00) | 1981Q2 | c | 3 | -19.89 (-2.88) | |
| LOG(DE_PGCF00) | 1981Q2 | c, s | 1,3,4 | -1.68 (-2.88) | I(1) |
| ΔLOG(DE_PGCF00) | 1981Q2 | s | 1-3 | -4.49 (-1.94) | |
| LOG(DE_PICONGOV00) | 1982Q2 | c,t | 1,2,4,6,8 | -2.93 (-3.45) | I(2) |
| ΔLOG(DE_PICONGOV00) | 1982Q3 | c | 1-3,5,8 | -2.47 (-2.89) | |
| LOG(DE_PID00) | 1982Q2 | c,t | 1,4,8 | -2.73 (-3.45) | I(2) |
| ΔLOG(DE_PID00) | 1982Q3 | c | 1-3,8 | -2.25 (-2.89) | |
| LOG_DE_PIFC00) | 1981Q2 | c | 4 | -2.42 (-2.88) | I(2) |
| ΔLOG_DE_PIFC00) | 1981Q2 | none | 1-3 | -1.86 (-1.94) | |
| LOG(DE_PIFC_ID) | 1981Q2 | c | 4 | -2.74 (-2.88) | I(1) |
| ΔLOG(DE_PIFC_ID) | 1981Q2 | none | 1-3 | -2.40 (-1.94) | |
| LOG(DE_PINRB00) | 1981Q2 | c,t | 4 | -1.61 (-3.45) | I(1) |
| ΔLOG(DE_PINRB00) | 1981Q2 | c | 3 | -24,04 (-2.88) | |
| LOG(DE_PM00) | 1981Q3 | c | 1,4,5 | -2.52 (-2.89) | I(1) |
| ΔLOG(DE_PM00) | 1981Q3 | none | 4 | -8.80 (-1.94) | |
| LOG(DE_PMG00) | 1980Q3 | c | 1 | -2.79 (-2.88) | I(1) |
| ΔLOG(DE_PMG00) | 1980Q3 | none | none | -7.44 (-1.94) | |
| LOG(DE_PMGREL) | 1980Q3 | c, s | 1 | -1.30 (-2.88) | I(1) |
| ΔLOG(DE_PMGREL) | 1980Q3 | s | none | -7.09 (-1.94) | |
| LOG(DE_PMREL) | 1981Q3 | c, s | 1,4,5 | -1.90 (-2.89) | I(1) |
| ΔLOG(DE_PMREL) | 1981Q3 | s | 4 | -8.55 (-1.94) | |

| Variable | From | Deter-ministics | Lags | Test statistics | Result |
|---|---|---|---|---|---|
| LOG(DE_PMS00) | 1981Q2 | c,t,s | 4 | -2.85 (-3.45) | I(1) |
| ΔLOG(DE_PMS00) | 1981Q3 | c,s | 2,3,4 | -10.95 (-2.89) | |
| LOG(DE_PROTRGOV) | 1991Q2 | c,s | none | -7.90 (-2.90) | I(0) |
| ΔLOG(DE_PROTRGOV) | 1992Q2 | s | 1-3 | -7.51 (-1.94) | |
| LOG(DE_PX00) | 1981Q3 | c,t,s | 1,4,5 | -4.03 (-3.45) | TS |
| ΔLOG(DE_PX00) | 1981Q3 | c, s | 4 | -8.37 (-2.89) | |
| LOG(DE_PXG00) | 1981Q3 | c,t,s | 1,2,5 | -3.87 (-3.45) | TS |
| ΔLOG(DE_PXG00) | 1981Q3 | c,s | 1,4 | -5.98 (-2.89) | |
| LOG(DE_PXS00) | 1980Q4 | c,s | 2 | -3.85 (-2.88) | I(0) |
| ΔLOG(DE_PXS00) | 1981Q2 | s | 2,3 | -11.51 (-1.94) | |
| LOG(DE_RECPROTR) | 1992Q2 | c,s | 1-4 | -2.72 (-2.90) | I(1) |
| ΔLOG(DE_RECPROTR) | 1992Q2 | s | 1-3 | -8.13 (-1.94) | |
| LOG(DE_REEV_24_PTOTDEM) | 1980Q4 | c,s | 1,2 | -2.18 (-2.88) | I(1) |
| ΔLOG(DE_REEV_24_PTOTDEM) | 1980Q4 | s | 1 | -5.30 (-1.94) | |
| LOG(DE_REEV_56_CPI) | 1981Q1 | c,s | 1,3 | -2.40 (-2.88) | I(1) |
| ΔLOG(DE_REEV_56_CPI) | 1981Q3 | s | 4 | -8.98 (-1.94) | |
| LOG(DE_REVGOV) | 1992Q2 | c,t,s | 3,4 | -3.03 (-3.47) | I(1) |
| ΔLOG(DE_REVGOV) | 1992Q2 | c,s | 1,2,3 | -3.92 (-2.90) | |
| LOG(DE_REVYTRF) | 1991Q4 | c,s | 2 | -4.10 (-2.90) | I(0) |
| ΔLOG(DE_REVYTRF) | 1991Q4 | s | 1 | -8.71 (-1.94) | |
| DE_RL10Y | 1981Q1 | c,t | 1-3 | -3.39 (-3.45) | I(1) |
| ΔDE_RL10Y | 1981Q2 | c | 1,3 | -8.65 (-2.88) | |
| DE_RL10Y00 | 1981Q2 | c, t | none | -5.01 (-3.45) | TS |
| ΔDE_RL10Y00 | 1981Q3 | c | none | -10.67 (-2.89) | |
| DE_RS3M | 1981Q2 | c,t | 1,4 | -4.39 (-3.45) | TS |
| ΔDE_RS3M | 1981Q1 | c | 2 | -5.02 (-2.88) | |
| DE_RS3M00 | 1981Q3 | c,t | 1 | -5.56 (-3.45) | TS |
| ΔDE_RS3M00 | 1981Q3 | c | none | -10.13 (-2.88) | |
| LOG(DE_SALESSUB) | 1992Q2 | c,s | 1,3,4 | 1.15 (-2.90) | I(1) |
| ΔLOG(DE_SALESSUB) | 1992Q2 | s | 1-3 | -3.39 (-1.94) | |
| DE_SAV_RATIO | 1981Q2 | c,s | 2-4 | -5.69 (-2.88) | I(0) |
| ΔDE_SAV_RATIO | 1981Q2 | s | 2,3 | -20.91 (-1.94) | |
| LOG(DE_SUBGOV) | 1992Q2 | c,s | 1-4 | -0.74 (-2.90) | I(1) |
| ΔLOG(DE_SUBGOV) | 1992Q2 | s | 1,3 | -15.71 (-1.94) | |
| LOG(DE_T) | 1992Q2 | c,t,s | 4 | -4.23 (-3.47) | TS |
| ΔLOG(DE_T) | 1992Q4 | c,s | 4,5 | -10.01 (-2.90) | |
| LOG(DE_TDIR) | 1992Q3 | c,t | 1,3,4,5 | -4.65 (-3.47) | TS |
| ΔLOG(DE_TDIR) | 1992Q4 | c | 3,4,5 | -6.67 (-2.90) | |
| LOG(DE_TDIREE) | 1992Q3 | c,s | 1-5 | -1.94 (-2.90) | I(1) |
| ΔLOG(DE_TDIREE) | 1993Q1 | s | 2-4 | -7.10 (-1.95) | |
| LOG(DE_TDIREM1) | 1992Q4 | c,t,s | 1-2,4-6 | -3.10 (-3.47) | I(1) |
| ΔLOG(DE_TDIREM1) | 1992Q3 | c,s | 1,4 | -6.57 (-2.90) | |
| LOG(DE_TIND) | 1991Q3 | c,t,s | 1 | -3.67 (-3.47) | TS |
| ΔLOG(DE_TIND) | 1991Q3 | c,s | none | -13.50 (-2.90) | |
| LOG(DE_TIND_TARIFFSA_SA) | 1991Q2 | c,t | 1 | -3.33 (-3.47) | I(1) |
| ΔLOG(DE_TIND_TARIFFSA_SA) | 1991Q3 | c | none | -13.78 (-2.90) | |

| Variable | From | Deter-ministics | Lags | Test statistics | Result |
|---|---|---|---|---|---|
| LOG(DE_TINDSUB) | 1992Q2 | c,t,s | 4 | -5.12 (-3.47) | TS |
| ΔLOG(DE_TINDSUB) | 1992Q2 | c,s | 1,3 | -9.95 (-2.90) | |
| LOG(DE_TRFGOV) | 1992Q2 | c,s | 4 | -3.21 (-2.90) | I(0) |
| ΔLOG(DE_TRFGOV) | 1992Q2 | s | 1-3 | -2.92 (-1.94) | |
| LOG(DE_TRFGOV_PH) | 1992Q2 | c,s | 4 | -2.76 (-2.90) | I(1) |
| ΔLOG(DE_TRFGOV_PH) | 1992Q2 | s | 1-3 | -2.92 (-1.94) | |
| LOG(DE_TRSONGOV) | 1992Q1 | c,t,s | 1-3 | -3.15 (-3.47) | I(1) |
| ΔLOG(DE_TRSONGOV) | 1992Q1 | c,s | 1,2 | -9.62 (-2.90) | |
| LOG(DE_TSS) | 1992Q2 | c,s | 1-4 | -3.07 (-2.90) | I(0) |
| ΔLOG(DE_TSS) | 1992Q3 | s | 1-4 | -2.16 (-1.95) | |
| LOG(DE_TSSEE_TARIFFSA_SA) | 1991Q2 | c,t | none | -3.02 (-3.47) | I(1) |
| ΔLOG(DE_TSSEE_TARIFFSA_SA) | 1991Q3 | c | none | -10.61(-2.90) | |
| LOG(DE_TSSEM) | 1992Q2 | c,s | 2,4 | -3.46 (-2.90) | I(0) |
| ΔLOG(DE_TSSEM) | 1992Q3 | s | 1-4 | -2.10 (-1.95) | |
| LOG(DE_TSSEM_TARIFFSA_SA) | 1992Q2 | c | 1,4 | -1.76 (-2.90) | I(1) |
| ΔLOG(DE_TSSEM_TARIFFSA_SA) | 1992Q2 | none | 1-3 | -2.37 (-1.94) | |
| LOG(DE_TSSEM1_TARIFFSA_SA) | 1982Q2 | c | 1,4 | -1.72 (-2.89) | I(1) |
| ΔLOG(DE_TSSEM1_TARIFFSA_SA) | 1981Q3 | none | none | -13.83 (-1.94) | |
| LOG(DE_ULC00) | 1981Q2 | c,t,s | 3,4 | -4.08 (-3.45) | TS |
| ΔLOG(DE_ULC00) | 1981Q2 | c,s | 2,3 | -17.79 (-2.88) | |
| DE_UR | 1981Q3 | c,s | 1,4,5 | -2.82 (-2.89) | I(1) |
| ΔDE_UR | 1981Q3 | s | 4 | -5.98 (-1.94) | |
| DE_WAGESHARE | 1981Q2 | c,t,s | 1,3,4 | -3.54 (-3.45) | TS |
| ΔDE_WAGESHARE | 1981Q2 | c,s | 2,3 | -17.54 (-2.88) | |
| LOG(DE_WDYENT) | 1992Q2 | c,t,s | 4 | -4.62 (-3.47) | TS |
| ΔLOG(DE_WDYENT) | 1992Q2 | c,s | 2,3 | -13.71 (-2.90) | |
| LOG(DE_X) | 1980Q2 | c,t,s | none | -2.51 (-3.45) | I(1) |
| ΔLOG(DE_X) | 1980Q3 | c,s | none | -10.33 (-2.88) | |
| LOG(DE_X00) | 1980Q2 | c,t,s | none | -2.45 (-3.45) | I(1) |
| ΔLOG(DE_X00) | 1980Q3 | c,s | none | -11.04 (-2.88) | |
| LOG(DE_XG00) | 1981Q3 | c,s | 5 | -0.19 (-2.89) | I(1) |
| ΔLOG(DE_XG00) | 1981Q3 | s | 4 | -6.79 (-1.94) | |
| LOG(DE_XG00_EWU) | 1980Q2 | c,t,s | none | -2.28 (-3.45) | I(1) |
| Δ LOG(DE_XG00_EWU) | 1981Q3 | c,s | 4 | -10.20 (-2.89) | |
| LOG(DE_XG00_ROW) | 1980Q2 | c,t,s | none | -2.18 (-3.45) | I(1) |
| ΔLOG(DE_XG00_ROW) | 1981Q3 | c,s | 4 | -11.69 (-2.89) | |
| LOG(DE_XG00_UK) | 1981Q2 | c,t | 1,4 | -2.77 (-3.45) | I(1) |
| ΔLOG(DE_XG00_UK) | 1981Q3 | c | 4 | -14.53 (-2.89) | |
| LOG(DE_XG00_US) | 1980Q4 | c,s | 2 | -1.81 (-2.88) | I(1) |
| ΔLOG(DE_XG00_US) | 1980Q4 | s | 1 | -6.76 (-1.94) | |
| LOG(DE_XS00) | 1980Q3 | c,t,s | none | -3.05 (-3.45) | I(1) |
| ΔLOG(DE_XS00) | 1980Q4 | c,s | 1 | -10.69 (-2.88) | |
| LOG(DE_YPROGOV) | 1992Q2 | c | 1-4 | -0.98 (-2.90) | I(1) |
| ΔLOG(DE_YPROGOV) | 1992Q3 | none | 1,3,4 | -15.55 (-1.95) | |
| LOG(EWU_ODE_IFC00) | 1981Q2 | c,t,s | 1,3,4 | -3.20 (-3.45) | I(1) |
| ΔLOG(EWU_ODE_IFC00) | 1981Q3 | c,s | 1-4 | -2.94 (-2.89) | |

| Variable | From | Deter-ministics | Lags | Test statistics | Result |
|---|---|---|---|---|---|
| LOG(DE_EWU6_ULC) | 1982Q2 | c,s | 3,4 | -1.43 (-2.89) | I(1) |
| ΔLOG(DE_EWU6_ULC) | 1982Q2 | s | 1-3 | -2.98 (-1.94) | |
| LOG(OIL$) | 1981Q2 | c | 1-4 | -0.23 (-2.88) | I(1) |
| ΔLOG(OIL$) | 1981Q2 | none | 1,3 | -9.96 (-1.94) | |
| LOG(DE_ROW_GDP00) | 1981Q3 | c,t | 2,5 | -1.81 (-3.45) | I(1) |
| ΔLOG(DE_ROW_GDP00) | 1981Q3 | c | 1,4 | -6.06 (-2.89) | |
| LOG(UK_GDP05_SB) | 1980Q3 | c | 1 | -1.46 (-2.88) | I(1) |
| ΔLOG(UK_GDP05_SB) | 1980Q4 | none | 1 | -3.27 (-1.94) | |
| LOG(UK_ULC) | 1981Q2 | c, s | 1-4 | -1.18 (-2.88) | I(1) |
| ΔLOG(UK_ULC) | 1981Q3 | s | 1-4 | -2.46 (-1.94) | |
| LOG(US_IFC00) | 1980Q3 | c | 1 | -1.93 (-2.88) | I(1) |
| ΔLOG(US_IFC00) | 1980Q3 | none | none | -6.32 (-1.94) | |
| LOG(US_ULC) | 1980Q4 | c,t,s | 2 | -2.89 (-3.45) | I(1) |
| ΔLOG(US_ULC) | 1980Q4 | c,s | 1 | -5.92 (-2.88) | |

**Table 2: Results of the Perron Tests**

| Variable | Model | Test statistics | Result |
|---|---|---|---|
| LOG(DE_CAPITAL00) | Model C, λ=0.3 | -2.03 (-4.17) | I(1) |
| LOG(DE_CFC) | Model C, λ=0.3 | -3.56 (-4.17) | I(1) |
| LOG(DE_CGOV) | Model C, λ=0.3 | -3.47 (-4.17) | I(1) |
| LOG(DE_CGOV00) | Model A, λ=0.3 | -5.11 (-3.76) | TS |
| LOG(DE_COE) | Model C, λ=0.3 | -5.25 (-4.17) | TS |
| LOG(DE_COEE) | Model C, λ=0.3 | -5.25 (-4.17) | TS |
| LOG(DE_COEE00) | Model C, λ=0.3 | -2.24 (-4.17) | I(1) |
| LOG(DE_CP) | Model C, λ=0.3 | -2.55 (-4.17) | I(1) |
| LOG(DE_CP00) | Model C, λ=0.3 | -2.92 (-4.17) | I(1) |
| LOG(DE_DISPY) | Model C, λ=0.3 | -5.40 (-4.17) | TS |
| LOG(DE_DISPY00) | Model C, λ=0.3 | -3.76 (-4.17) | I(1) |
| LOG(DE_EE) | Model C, λ=0.3 | -3.51 (-4.17) | I(1) |
| LOG(DE_END00) | Model C, λ=0.3 | -3.80 (-4.17) | I(1) |
| LOG(DE_ET) | Model A, λ=0.3 | -3.36 (-3.76) | I(1) |
| LOG(DE_GCF00) | Model C, λ=0.3 | -3.87 (-4.17) | I(1) |
| LOG(DE_GDP) | Model C, λ=0.3 | -4.07 (-4.17) | I(1) |
| LOG(DE_GDP00) | Model C, λ=0.3 | -4.22 (-4.17) | TS |
| LOG(DE_GWAGE) | Model C, λ=0.3 | -5.32 (-4.17) | TS |
| LOG(DE_GWAGEE) | Model C, λ=0.3 | -5.15 (-4.17) | TS |
| LOG(DE_GWAGEE00) | Model C, λ=0.3 | -3.36 (-4.17) | I(1) |
| LOG(DE_ICONGOV00) | Model A, λ=0.3 | -2.02 (-3.76) | I(1) |
| LOG(DE_IEND00) | Model C, λ=0.3 | -3.75 (-4.17) | I(1) |
| LOG(DE_IFC) | Model C, λ=0.3 | -3.45 (-4.17) | I(1) |
| LOG(DE_IFC00) | Model C, λ=0.3 | -3.89 (-4.17) | I(1) |
| LOG(DE_INRB00) | Model C, λ=0.3 | -2.33 (-4.17) | I(1) |
| LOG(DE_NEV_EWU) | Model B, λ=0.6 | -4.46 (-3.94) | TS |
| LOG(DE_NWAGE) | Model C, λ=0.3 | -4.48 (-4.17) | TS |
| LOG(DE_PCGOV00) | Model C, λ=0.3 | -3.75 (-4.17) | I(1) |
| LOG(DE_PGDP00) | Model C, λ=0.3 | -3.62 (-4.17) | I(1) |
| LOG(DE_PIMEQ00) | Model C, λ=0.3 | -3.48 (-4.17) | I(1) |

| Variable | Model | Test statistics | Result |
|---|---|---|---|
| LOG(DE_PIOTH00) | Model C, λ=0.3 | -2.52 (-4.17) | I(1) |
| LOG(DE_POPUL) | Model A, λ=0.3 | -3.20 (-3.76) | I(1) |
| LOG(DE_PRODEE) | Model C, λ=0.3 | -3.52 (-4.17) | I(1) |
| LOG(DE_PTOTDEM) | Model C, λ=0.3 | -3.08 (-4.17) | I(1) |
| LOG(DE_TSSEE) | Model C, λ=0.3 | -2.00 (-4.17) | I(1) |
| LOG(DE_TSSEM1) | Model C, λ=0.3 | -2.96 (-4.17) | I(1) |
| LOG(DE_U) | Model A, λ=0.3 | -4.27 (-3.76) | I(0) |
| LOG(DE_ULC) | Model C, λ=0.3 | -3.63 (-4.17) | I(1) |
| DE_XM | Model A, λ=0.3 | -4.02 (-3.76) | TS |
| DE_XM00 | Model C, λ=0.3 | -3.65 (-4.17) | I(1) |

# 3. Model Equations

## 3.1. Behavioural Equations

### 3.1.1. Real Aggregate Demand

#### *Private final consumption expenditure*

In the long term private final consumption expenditures is explained by disposable income and the nominal short term interest rate. The wage share has some explanatory power in the short term serving as a proxy for the influence of income distribution on consumption and saving.

The t-value of the coefficient of the error correction term of -5.597 is highly significant (5 percent critical value: -3.69). The diagnostic tests indicate that the residuals are uncorrelated and homoskedastic.

**Table 3: Estimation equation of ΔLOG(DE_CP00)**

| **Dependent Variable: ΔLOG(DE_CP00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1982Q2 2011Q4**<br>**Included observations: 119 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_CP00(-1))** | **-0.485** | **0.087** | **-5.597** | **0.000** |
| **LOG(DE_DISPY00(-1))** | **0.473** | **0.086** | **5.515** | **0.000** |
| **DE_RS3M(-1)** | **-0.002** | **0.001** | **-3.326** | **0.001** |
| C | 0.031 | 0.025 | 1.207 | 0.230 |
| Z1 | -0.072 | 0.010 | -7.374 | 0.000 |
| Z2 | 0.005 | 0.007 | 0.646 | 0.520 |
| Z3 | -0.009 | 0.005 | -1.867 | 0.065 |
| Δ(DE_WAGESHARE(-1)) | 0.210 | 0.086 | 2.433 | 0.017 |
| ΔLOG(DE_CP00(-1))+ΔLOG(DE_CP00(-2)) | -0.091 | 0.025 | -3.587 | 0.001 |
| ΔLOG(DE_CP00(-4)) | 0.186 | 0.034 | 5.424 | 0.000 |
| ΔLOG(DE_DISPY00(-3)) | -0.104 | 0.027 | -3.884 | 0.000 |
| ΔLOG(DE_DISPY00(-5)) | -0.099 | 0.032 | -3.093 | 0.003 |
| ΔLOG(DE_DISPY00(-8)) | 0.346 | 0.038 | 9.098 | 0.000 |
| Δ(DE_RS3M(-1)) | 0.006 | 0.002 | 3.041 | 0.003 |
| I91Q1 | 0.244 | 0.010 | 23.601 | 0.000 |
| I93Q1 | -0.095 | 0.013 | -7.574 | 0.000 |
| I01Q1 | 0.026 | 0.010 | 2.592 | 0.011 |

**Table 4: Diagnostics of estimation equation of ΔLOG(DE_CP00)**

| **Adjusted R2** | **0.96** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.97 |
| Serial correlation LM test (lag 1) | 0.11 |
| Serial correlation LM test (lag 4) | 0.51 |
| Serial correlation LM test (lag 8) | 0.36 |
| ARCH LM test (lag 1) | 0.36 |
| ARCH LM test (lag 4) | 0.17 |
| White's heteroskedasticity test | 0.12 |
| RESET test (h=2) | 0.01 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 3 |

### *Government consumption expenditure*

The long-term evolution of government consumption is explained by past real GDP excluding government consumption. Due to structural breaks two step dummies are included in the error correction term. With a t-value of -3.105 the coefficient of the error-correction term is not significant (5 percent critical value: -3.91)

**Table 5: Estimation equation of ΔLOG(DE_CGOV00)**

| **Dependent Variable: ΔLOG(DE_CGOV00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1982Q2 2011Q4**<br>**Included observations: 119 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_CGOV00(-1))** | **-0.109** | **0.035** | **-3.105** | **0.003** |
| **LOG(DE_GDP00(-8)-DE_CGOV00(-8))** | **0.046** | **0.022** | **2.108** | **0.037** |
| **S91Q1** | **0.026** | **0.008** | **3.410** | **0.001** |
| **S09Q1** | **0.008** | **0.004** | **2.120** | **0.036** |
| C | 0.197 | 0.065 | 3.060 | 0.003 |
| Z1 | -0.037 | 0.006 | -6.003 | 0.000 |
| Z2 | -0.024 | 0.004 | -5.813 | 0.000 |
| Z3 | -0.018 | 0.004 | -4.261 | 0.000 |
| ΔLOG(DE_GDP00(-2)) | 0.103 | 0.035 | 2.907 | 0.005 |
| ΔLOG(DE_CGOV00(-4)) | 0.598 | 0.067 | 8.908 | 0.000 |
| ΔLOG(DE_CGOV00(-8)) | -0.154 | 0.044 | -3.514 | 0.001 |
| I89Q1 | -0.034 | 0.009 | -3.621 | 0.001 |
| I90Q1 | 0.042 | 0.009 | 4.452 | 0.000 |
| I91Q1 | 0.124 | 0.012 | 10.591 | 0.000 |
| I92Q1 | -0.102 | 0.014 | -7.083 | 0.000 |
| I95Q1 | -0.050 | 0.009 | -5.442 | 0.000 |

The diagnostic tests show that the residuals are well-behaved and the estimation is stable over the sample.

**Table 6: Diagnostics of estimation equation of ΔLOG(DE_CGOV00)**

| **Adjusted R2** | **0.94** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.51 |
| Serial correlation LM test (lag 1) | 0.34 |
| Serial correlation LM test (lag 4) | 0.52 |
| Serial correlation LM test (lag 8) | 0.13 |
| ARCH LM test (lag 1) | 0.94 |
| ARCH LM test (lag 4) | 0.76 |
| White's heteroskedasticity test | 0.29 |
| RESET test (h=2) | 0.11 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Gross fixed capital formation: machinery and equipment*

**Table 7: Estimation equation of ΔLOG(DE_IMEQ00)**

| **Dependent Variable: ΔLOG(DE_IMEQ00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1982Q3 2011Q4**<br>**Included observations: 118 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_IMEQ00(-1))** | **-0.107** | **0.031** | **-3.422** | **0.001** |
| **LOG(DE_GDP00(-1)+DE_M00(-1))** | **0.056** | **0.030** | **1.873** | **0.064** |
| **DE_RL10Y(-1)** | **-0.010** | **0.002** | **-4.651** | **0.000** |
| C | 0.079 | 0.114 | 0.690 | 0.492 |
| Z1 | -0.387 | 0.033 | -11.555 | 0.000 |
| Z2 | -0.052 | 0.033 | -1.608 | 0.111 |
| Z3 | -0.108 | 0.039 | -2.770 | 0.007 |
| Z1*S91Q1 | 0.124 | 0.014 | 8.795 | 0.000 |
| Z2*S91Q1 | 0.060 | 0.013 | 4.699 | 0.000 |
| Z3*S91Q1 | 0.085 | 0.015 | 5.659 | 0.000 |
| ΔLOG(DE_CAPA) | 1.026 | 0.168 | 6.127 | 0.000 |
| ΔLOG(DE_ULC00(-3))<br>+ΔLOG(DE_ULC00(-6)) | -0.245 | 0.123 | -1.986 | 0.050 |
| ΔLOG(DE_IMEQ00(-2)) | 0.288 | 0.053 | 5.399 | 0.000 |
| ΔLOG(DE_IMEQ00(-3)) | -0.102 | 0.062 | -1.656 | 0.101 |
| ΔLOG(DE_GDP00(-3)+ DE_M00(-3))<br>+ΔLOG(DE_GDP00(-5)+DE_M00(-5)) | 0.155 | 0.094 | 1.649 | 0.103 |
| Δ(DE_RL10Y(-1)) +Δ(DE_RL10Y(-5))<br>+Δ(DE_RL10Y(-4)) +Δ(DE_RL10Y(-9)) | 0.016 | 0.004 | 3.553 | 0.001 |
| I83Q1 | 0.036 | 0.021 | 1.705 | 0.092 |
| I83Q2 | 0.045 | 0.021 | 2.099 | 0.039 |
| I84Q2 | -0.062 | 0.022 | -2.857 | 0.005 |
| I84Q3 | 0.122 | 0.022 | 5.545 | 0.000 |
| I91Q1 | 0.113 | 0.023 | 4.827 | 0.000 |
| I01Q2 | -0.046 | 0.021 | -2.233 | 0.028 |
| I07Q4 | 0.057 | 0.021 | 2.764 | 0.007 |
| I09Q1 | -0.149 | 0.022 | -6.836 | 0.000 |

In the long run investment into machinery and equipment is determined by total demand and the long-term nominal interest rate. The coefficient of the error-correction term is significant at the 10 percent level (10 percent critical value: -3.39, 5 percent critical value: -3.69).

The estimated equation passes all diagnostic tests.

**Table 8: Diagnostics of estimation equation of ΔLOG(DE_IMEQ00)**

| **Adjusted R2** | **0.99** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.84 |
| Serial correlation LM test (lag 1) | 0.85 |
| Serial correlation LM test (lag 4) | 0.47 |
| Serial correlation LM test (lag 8) | 0.47 |
| ARCH LM test (lag 1) | 0.21 |
| ARCH LM test (lag 4) | 0.46 |
| White's heteroskedasticity test | 0.75 |
| RESET test (h=2) | 0.95 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Gross fixed capital formation: private residential construction*

In the long term private residential construction is explained by the population, the real long-term interest rate and a step dummy. With a t-value of -7.298 the coefficient of the error-correction term is highly significant (5 percent critical value: -3.91).

**Table 9: Estimation equation of ΔLOG(DE_ID00)**

| **Dependent Variable: ΔLOG(DE_ID00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q4 2011Q4**<br>**Included observations: 121 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_ID00(-1))** | **-0.315** | **0.043** | **-7.298** | **0.000** |
| **LOG(DE_POPUL(-1))** | **0.463** | **0.077** | **6.015** | **0.000** |
| **DE_RL10Y00(-3)** | **-0.005** | **0.001** | **-3.409** | **0.001** |
| **S02Q1** | **-0.058** | **0.010** | **-5.644** | **0.000** |
| C | -4.098 | 0.725 | -5.653 | 0.000 |
| Z1 | -0.062 | 0.009 | -6.591 | 0.000 |
| Z2 | 0.148 | 0.021 | 6.970 | 0.000 |
| Z3 | 0.080 | 0.010 | 8.329 | 0.000 |
| ΔLOG(DE_ID00(-4)) | 0.294 | 0.059 | 4.952 | 0.000 |
| ΔLOG(DE_PID00(-1)) | -1.477 | 0.363 | -4.070 | 0.000 |
| I85Q1 | -0.181 | 0.028 | -6.496 | 0.000 |
| I86Q1 | -0.123 | 0.030 | -4.145 | 0.000 |
| I87Q1 | -0.162 | 0.029 | -5.578 | 0.000 |
| I91Q1 | 0.125 | 0.029 | 4.366 | 0.000 |
| I05Q1 | -0.096 | 0.028 | -3.458 | 0.001 |

**Table 10: Diagnostics of estimation equation of ΔLOG(DE_ID00)**

| **Adjusted R2** | **0.97** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.19 |
| Serial correlation LM test (lag 1) | 0.61 |
| Serial correlation LM test (lag 4) | 0.63 |
| Serial correlation LM test (lag 8) | 0.52 |
| ARCH LM test (lag 1) | 0.81 |
| ARCH LM test (lag 4) | 0.10 |
| White's heteroskedasticity test | 0.05 |
| RESET test (h=2) | 0.35 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

The estimation equation passes most diagnostic tests. There is some indication of heteroskedasticity.

### *Gross fixed capital formation: private non-residential construction*

There is a highly significant long-term relationship between private non-residential construction and domestic final demand, although some structural changes in this relationship have to be modelled with dummy variables. With a t-statistic of -6.038 the coefficient of the error-correction term is highly significant (5 percent critical value: -3.91).

**Table 11: Estimation equation of ΔLOG(DE_INRB00)**

| Dependent Variable: ΔLOG(DE_INRB00)<br>Method: Least Squares<br>Sample (adjusted): 1981Q2 2011Q4<br>Included observations: 123 after adjustments | | | | |
|---|---|---|---|---|
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| **LOG(DE_INRB00(-1))** | **-0.419** | **0.069** | **-6.038** | **0.000** |
| **LOG(DE_IEND00(-1))** | **0.471** | **0.084** | **5.608** | **0.000** |
| **S02Q1*LOG(@TREND)** | **-0.012** | **0.003** | **-3.618** | **0.001** |
| **1-S98Q1** | **0.097** | **0.018** | **5.262** | **0.000** |
| C | -1.748 | 0.335 | -5.218 | 0.000 |
| Z1 | -0.087 | 0.020 | -4.336 | 0.000 |
| Z2 | 0.146 | 0.030 | 4.960 | 0.000 |
| Z3 | 0.061 | 0.016 | 3.682 | 0.000 |
| I91Q1 | 0.174 | 0.036 | 4.857 | 0.000 |
| Z1*S91Q1 | 0.052 | 0.022 | 2.401 | 0.018 |
| Z2*S91Q1 | -0.028 | 0.021 | -1.331 | 0.186 |
| Z3*S91Q1 | 0.011 | 0.019 | 0.604 | 0.547 |
| ΔLOG(DE_INRB00(-4)) | 0.296 | 0.065 | 4.565 | 0.000 |
| I85Q1 | -0.152 | 0.037 | -4.097 | 0.000 |
| I87Q1 | -0.134 | 0.037 | -3.608 | 0.001 |
| I96Q1 | -0.128 | 0.036 | -3.541 | 0.001 |
| I05Q1 | -0.110 | 0.036 | -3.063 | 0.003 |

Except for some heteroskedasticity the residuals are well-behaved and the estimation is stable over the sample period.

**Table 12: Diagnostics of estimation equation of ΔLOG(DE_INRB00)**

| **Adjusted R2** | **0.94** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.49 |
| Serial correlation LM test (lag 1) | 0.66 |
| Serial correlation LM test (lag 4) | 0.46 |
| Serial correlation LM test (lag 8) | 0.52 |
| ARCH LM test (lag 1) | 0.99 |
| ARCH LM test (lag 4) | 0.34 |
| White's heteroskedasticity test | 0.02 |
| RESET test (h=2) | 0.06 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Other gross fixed capital formation*

The long-term evolution of other gross fixed capital formation is explained by real exports and a linear trend starting in 1970. With a t-statistic of -4.225 the coefficient of the error-correction term is highly significant (5 percent critical value: -3.69).

**Table 13: Estimation equation of ΔLOG(DE_IOTH00)**

| **Dependent Variable: ΔLOG(DE_IOTH00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1982Q2 2011Q4**<br>**Included observations: 119 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_IOTH00(-1))** | **-0.151** | **0.036** | **-4.225** | **0.000** |
| **LOG(DE_X00(-1))** | **0.034** | **0.014** | **2.363** | **0.020** |
| **LOG(@TREND(1970:1))** | **0.208** | **0.051** | **4.115** | **0.000** |
| C | -0.935 | 0.226 | -4.133 | 0.000 |
| Z1 | -0.058 | 0.011 | -5.145 | 0.000 |
| Z2 | -0.025 | 0.005 | -4.634 | 0.000 |
| Z3 | -0.034 | 0.007 | -4.597 | 0.000 |
| ΔLOG(DE_IOTH00(-4)) | 0.576 | 0.080 | 7.197 | 0.000 |
| ΔLOG(DE_IOTH00(-8)) | 0.172 | 0.081 | 2.118 | 0.037 |
| ΔLOG(DE_X00(-3)) | 0.103 | 0.044 | 2.378 | 0.019 |
| ΔLOG(DE_X00(-4)) | -0.114 | 0.045 | -2.546 | 0.012 |
| I86Q4 | -0.066 | 0.018 | -3.726 | 0.000 |

The specification passes all diagnostic tests at the 5 percent level.

**Table 14: Diagnostics of estimation equation of ΔLOG(DE_IOTH00)**

| **Adjusted R2** | **0.93** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.11 |
| Serial correlation LM test (lag 1) | 0.56 |
| Serial correlation LM test (lag 4) | 0.78 |
| Serial correlation LM test (lag 8) | 0.89 |
| ARCH LM test (lag 1) | 0.09 |
| ARCH LM test (lag 4) | 0.17 |
| White's heteroskedasticity test | 0.15 |
| RESET test (h=2) | 0.24 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Changes in inventories and net acquisition of valuables*

No error-correction equation is estimated, because the variable is stationary. It is explained by its own lagged observations and some deterministics, making it in fact an exogenous variable.

**Table 15: Estimation equation of DE_INV00**

| **Dependent Variable: DE_INV00**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q2 2011Q4**<br>**Included observations: 123 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 0.938 | 0.434 | 2.161 | 0.033 |
| Z1*@TREND | 0.041 | 0.024 | 1.693 | 0.093 |
| Z2*@TREND | 0.029 | 0.013 | 2.219 | 0.029 |
| Z3*@TREND | -0.001 | 0.023 | -0.038 | 0.970 |
| DE_INV00(-1) | 0.153 | 0.079 | 1.921 | 0.057 |
| DE_INV00(-3) | -0.213 | 0.056 | -3.781 | 0.000 |
| DE_INV00(-4) | 0.642 | 0.059 | 10.882 | 0.000 |
| DE_INV00(-5) | -0.251 | 0.075 | -3.342 | 0.001 |
| I91Q1 | 12.753 | 2.592 | 4.920 | 0.000 |
| I91Q2 | 6.732 | 2.759 | 2.440 | 0.016 |
| I91Q3 | 9.136 | 2.688 | 3.399 | 0.001 |
| I06Q4 | -10.899 | 2.683 | -4.063 | 0.000 |
| I09Q2 | -8.880 | 2.657 | -3.343 | 0.001 |
| S91Q1 | 1.449 | 0.558 | 2.598 | 0.011 |

The diagnostic tests indicate autoregressive conditional heteroskedasticity as well as limited stability over the sample period.

**Table 16: Diagnostics of estimation equation of DE_INV00**

| **Adjusted R2** | **0.93** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.65 |
| Serial correlation LM test (lag 1) | 0.87 |
| Serial correlation LM test (lag 4) | 0.84 |
| Serial correlation LM test (lag 8) | 0.59 |
| ARCH LM test (lag 1) | 0.68 |
| ARCH LM test (lag 4) | 0.00 |
| White's heteroskedasticity test | 0.45 |
| RESET test (h=2) | 0.92 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 24 |

### *Exports of goods to the euro area*

In the long run real exports of goods to the euro area are explained by gross fixed capital formation in other euro area countries, the real exchange rate based on unit labour costs and a trend representing increasing economic integration. With a t-statistic of -8.174 the coefficient of the error-correction term is highly significant (5 percent critical value: -3.91)

**Table 17: Estimation equation of ΔLOG(DE_XG00_EWU)**

| **Dependent Variable: ΔLOG(DE_XG00_EWU)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q2 2011Q4**<br>**Included observations: 123 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_XG00_EWU(-1))** | **-0.789** | **0.096** | **-8.174** | **0.000** |
| **LOG(EWU_ODE_IFC00(-1))** | **0.551** | **0.084** | **6.563** | **0.000** |
| **LOG(DE_NEV_EWU(-1)*DE_ULC(-1)*100/EWU6_ULC(-1))** | **-0.539** | **0.071** | **-7.577** | **0.000** |
| **@TREND** | **0.004** | **0.001** | **8.111** | **0.000** |
| C | 2.881 | 0.394 | 7.314 | 0.000 |
| Z1 | 0.022 | 0.054 | 0.402 | 0.689 |
| Z2 | -0.062 | 0.016 | -3.939 | 0.000 |
| Z3 | -0.029 | 0.050 | -0.580 | 0.563 |
| ΔLOG(DE_XG00_EWU(-1)) | 0.154 | 0.089 | 1.732 | 0.086 |
| ΔLOG(DE_XG00_EWU(-2)) | 0.102 | 0.082 | 1.247 | 0.215 |
| ΔLOG(DE_XG00_EWU(-4)) | 0.189 | 0.079 | 2.399 | 0.018 |
| ΔLOG(EWU_ODE_IFC00) | 0.823 | 0.124 | 6.652 | 0.000 |
| ΔLOG(EWU_ODE_IFC00(-1)) | 0.389 | 0.146 | 2.668 | 0.009 |
| ΔLOG(EWU_ODE_IFC00(-2)) | 0.603 | 0.139 | 4.351 | 0.000 |
| ΔLOG(EWU_ODE_IFC00(-3)) | 0.324 | 0.137 | 2.356 | 0.020 |
| ΔLOG(DE_NEV_EWU*DE_ULC*100/EWU6_ULC) | -0.427 | 0.134 | -3.176 | 0.002 |

The specification passes all diagnostic tests. The residuals are well-behaved and the estimated equation is stable over the sample period.

**Table 18: Diagnostics of estimation equation of ΔLOG(DE_XG00_EWU)**

| **Adjusted R2** | **0.85** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.17 |
| Serial correlation LM test (lag 1) | 0.05 |
| Serial correlation LM test (lag 4) | 0.29 |
| Serial correlation LM test (lag 8) | 0.55 |
| ARCH LM test (lag 1) | 0.55 |
| ARCH LM test (lag 4) | 0.76 |
| White's heteroskedasticity test | 0.99 |
| RESET test (h=2) | 0.31 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Exports of goods to the United Kingdom*

German exports to the UK are explained by UK GDP and the real exchange rate based on unit labour costs. With a t-statistic of -5.922 the coefficient of the error-correction term is highly significant (5 percent critical value: -3.69).

In the estimation of the short run dynamics some insignificant variables were not eliminated, because this would have led to autocorrelation in the residuals.

**Table 19: Estimation equation of ΔLOG(DE_XG00_UK)**

| **Dependent Variable: ΔLOG(DE_XG00_UK)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q2 2011Q4**<br>**Included observations: 123 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_XG00_UK(-1))** | **-0.399** | **0.067** | **-5.922** | **0.000** |
| **LOG(UK_GDP05_SB(-1))** | **0.656** | **0.119** | **5.505** | **0.000** |
| **LOG(DE_NEV_UK(-1)*DE_ULC(-1)*100/UK_ULC(-1))** | **-0.115** | **0.033** | **-3.515** | **0.001** |
| C | -1.440 | 0.350 | -4.112 | 0.000 |
| ΔLOG(UK_GDP05_SB) | 2.463 | 0.668 | 3.684 | 0.000 |
| ΔLOG(UK_GDP05_SB(-1)) | 1.286 | 0.731 | 1.760 | 0.081 |
| ΔLOG(UK_GDP05_SB(-3)) | 1.504 | 0.680 | 2.212 | 0.029 |
| ΔLOG(DE_XG00_UK(-1)) | -0.328 | 0.088 | -3.731 | 0.000 |
| ΔLOG(DE_XG00_UK(-3)) | -0.136 | 0.084 | -1.610 | 0.110 |
| ΔLOG(DE_XG00_UK(-2)) | -0.093 | 0.087 | -1.066 | 0.289 |
| ΔLOG(DE_XG00_UK(-4)) | 0.122 | 0.079 | 1.550 | 0.124 |
| ΔLOG(DE_NEV_UK*DE_ULC*100/UK_ULC) | -0.183 | 0.045 | -4.048 | 0.000 |
| ΔLOG(DE_NEV_UK(-1)*DE_ULC(-1)*100/UK_ULC(-1)) | -0.071 | 0.048 | -1.481 | 0.142 |
| ΔLOG(DE_NEV_UK(-2)*DE_ULC(-2)*100/UK_ULC(-2)) | -0.097 | 0.046 | -2.132 | 0.035 |
| ΔLOG(DE_NEV_UK(-3)*DE_ULC(-3)*100/UK_ULC(-3)) | -0.126 | 0.045 | -2.802 | 0.006 |

The residuals are well-behaved and the estimation equation is stable over the sample period.

**Table 20: Estimation equation of ΔLOG(DE_XG00_UK)**

| **Adjusted R2** | **0.49** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.45 |
| Serial correlation LM test (lag 1) | 0.26 |
| Serial correlation LM test (lag 4) | 0.09 |
| Serial correlation LM test (lag 8) | 0.34 |
| ARCH LM test (lag 1) | 0.61 |
| ARCH LM test (lag 4) | 0.78 |
| White's heteroskedasticity test | 0.17 |
| RESET test (h=2) | 0.31 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Exports of goods to the United States of America*

German exports of goods to the USA are determined in the long run by US gross fixed capital formation, the real exchange rate based on unit labour costs and a trend. With a t-statistic of -5.691 error-correction coefficient is highly significant (5 percent critical value: -3.91)

**Table 21: Estimation equation of ΔLOG(DE_XG00_US)**

| **Dependent Variable: ΔLOG(DE_XG00_US)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q3 2011Q4**<br>**Included observations: 122 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_XG00_US(-1))** | **-0.322** | **0.057** | **-5.691** | **0.000** |
| **LOG(US_IFC00(-1))** | **0.235** | **0.081** | **2.919** | **0.004** |
| **LOG(DE_NEV_US(-1) *DE_ULC(-1) *100/US_ULC(-1))** | **-0.337** | **0.046** | **-7.391** | **0.000** |
| **@TREND** | **0.002** | **0.000** | **4.945** | **0.000** |
| C | 0.850 | 0.241 | 3.526 | 0.001 |
| Z1 | -0.078 | 0.029 | -2.642 | 0.010 |
| Z2 | -0.096 | 0.019 | -5.059 | 0.000 |
| Z3 | -0.063 | 0.019 | -3.277 | 0.001 |
| ΔLOG(DE_XG00_US(-1)) | -0.277 | 0.070 | -3.937 | 0.000 |
| ΔLOG(DE_XG00_US(-2)) | -0.181 | 0.081 | -2.243 | 0.027 |
| ΔLOG(DE_XG00_US(-3)) | -0.244 | 0.070 | -3.491 | 0.001 |
| ΔLOG(DE_XG00_US(-5)) | -0.184 | 0.064 | -2.891 | 0.005 |
| ΔLOG(US_IFC00) | 1.241 | 0.269 | 4.616 | 0.000 |
| ΔLOG(US_IFC00(-2)) | 1.426 | 0.344 | 4.148 | 0.000 |
| ΔLOG(US_IFC00(-4)) | 0.635 | 0.296 | 2.147 | 0.034 |
| ΔLOG(DE_NEV_US *DE_ULC*100/US_ULC) | -0.264 | 0.089 | -2.949 | 0.004 |
| I84Q2 | -0.190 | 0.050 | -3.807 | 0.000 |

The specification passes all diagnostic tests.

**Table 22: Diagnostics of estimation equation of ΔLOG(DE_XG00_US)**

| **Adjusted R2** | **0.70** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.84 |
| Serial correlation LM test (lag 1) | 0.16 |
| Serial correlation LM test (lag 4) | 0.17 |
| Serial correlation LM test (lag 8) | 0.27 |
| ARCH LM test (lag 1) | 0.66 |
| ARCH LM test (lag 4) | 0.28 |
| White's heteroskedasticity test | 0.63 |
| RESET test (h=2) | 0.84 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Exports of goods to the rest of the world*

The long-term evolution of exports to the rest of the world is explained by real GDP in the rest of the world and the real effective exchange rate in terms of the CPI vis-à-vis 56 countries. With a t-statistic of -5.064 the error-correction coefficient is highly significant (5 percent critical value: -3.69). Short-run dynamics of exports of goods to the rest of the world are determined by foreign demand.

**Table 23: Estimation equation of ΔLOG(DE_XG00_ROW)**

| **Dependent Variable: ΔLOG(DE_XG00_ROW)**<br>**Method: Least Squares**<br>**Sample: 1988Q1 2011Q4**<br>**Included observations: 96** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_XG00_ROW(-1))** | **-0.430** | **0.085** | **-5.064** | **0.000** |
| **LOG(ROW_GDP00(-1))** | **0.914** | **0.185** | **4.944** | **0.000** |
| **LOG(DE_REEV_56_CPI(-1))** | **-0.395** | **0.124** | **-3.180** | **0.002** |
| C | -0.719 | 0.610 | -1.179 | 0.242 |
| Z1 | -0.099 | 0.014 | -7.183 | 0.000 |
| Z2 | -0.027 | 0.013 | -1.991 | 0.050 |
| Z3 | -0.018 | 0.013 | -1.409 | 0.163 |
| ΔLOG(ROW_GDP00) | 1.291 | 0.747 | 1.730 | 0.087 |
| ΔLOG(ROW_GDP00(-1)) | 2.446 | 0.701 | 3.487 | 0.001 |
| ΔLOG(ROW_GDP00(-5)) | 1.604 | 0.719 | 2.231 | 0.028 |
| I90Q4 | 0.186 | 0.048 | 3.849 | 0.000 |
| I91Q1 | -0.117 | 0.053 | -2.222 | 0.029 |

The residuals pass all diagnostic tests and the specification is stable over the sample period.

**Table 24: Diagnostics of estimation equation of ΔLOG(DE_XG00_ROW)**

| **Adjusted R2** | **0.67** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.23 |
| Serial correlation LM test (lag 1) | 0.73 |
| Serial correlation LM test (lag 4) | 0.29 |
| Serial correlation LM test (lag 8) | 0.53 |
| ARCH LM test (lag 1) | 0.72 |
| ARCH LM test (lag 4) | 0.70 |
| White's heteroskedasticity test | 0.43 |
| RESET test (h=2) | 0.49 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Exports of services*

Exports of services include a large number of services which are somehow connected to exports of goods such as transport or insurance. Therefore it is not surprising that long-term service exports are linked to goods exports. The t-statistic of -4.495 indicates that the error-correction coefficient is highly significant (5 percent critical value: -3.41). The real effective exchange rate vis-à-vis 24 countries (based on the total demand deflator) plays an important role for the short-term dynamics.

**Table 25: Estimation equation of ΔLOG(DE_XS00)**

| **Dependent Variable: ΔLOG(DE_XS00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q4 2011Q4**<br>**Included observations: 121 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_XS00(-1))** | **-0.234** | **0.052** | **-4.495** | **0.000** |
| **LOG(DE_XG00(-1))** | **0.233** | **0.050** | **4.636** | **0.000** |
| C | -0.397 | 0.090 | -4.431 | 0.000 |
| Z1 | -0.155 | 0.016 | -9.767 | 0.000 |
| Z2 | -0.048 | 0.014 | -3.378 | 0.001 |
| Z3 | -0.023 | 0.015 | -1.542 | 0.126 |
| ΔLOG(DE_XS00(-1)) | -0.248 | 0.051 | -4.839 | 0.000 |
| ΔLOG(DE_XG00(-4)) | -0.206 | 0.112 | -1.836 | 0.069 |
| ΔLOG(DE_REEV_24_PTOTDEM) | -0.714 | 0.322 | -2.216 | 0.029 |
| ΔLOG(DE_REEV_24_PTOTDEM(-1)) | -1.096 | 0.313 | -3.501 | 0.001 |
| ΔLOG(DE_REEV_24_PTOTDEM(-3)) | 0.681 | 0.315 | 2.159 | 0.033 |
| ΔLOG(DE_REEV_24_PTOTDEM(-6)) | -0.527 | 0.279 | -1.890 | 0.062 |
| I90Q1 | 0.181 | 0.043 | 4.259 | 0.000 |
| I90Q3 | 0.380 | 0.043 | 8.834 | 0.000 |
| I90Q4 | 0.234 | 0.049 | 4.774 | 0.000 |
| I91Q1 | -0.450 | 0.048 | -9.421 | 0.000 |
| I99Q1 | -0.199 | 0.043 | -4.595 | 0.000 |
| I01Q4 | 0.177 | 0.043 | 4.114 | 0.000 |

The diagnostics reveal some serial correlation, which could not be eliminated despite the inclusion of lagged dependent variables.

**Table 26: Diagnostics of estimation equation of ΔLOG(DE_XS00)**

| **Adjusted R2** | **0.88** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.64 |
| Serial correlation LM test (lag 1) | 0.09 |
| Serial correlation LM test (lag 4) | 0.02 |
| Serial correlation LM test (lag 8) | 0.15 |
| ARCH LM test (lag 1) | 0.33 |
| ARCH LM test (lag 4) | 0.18 |
| White's heteroskedasticity test | 0.30 |
| RESET test (h=2) | 0.13 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Imports of goods*

**Table 27: Estimation equation of ΔLOG(DE_MG00)**

| **Dependent Variable: ΔLOG(DE_MG00)** | | | | |
|---|---|---|---|---|
| **Method: Least Squares** | | | | |
| **Sample (adjusted): 1981Q3 2011Q4** | | | | |
| **Included observations: 122 after adjustments** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_MG00(-1))** | **-0.468** | **0.075** | **-6.224** | **0.000** |
| **LOG(DE_PMGREL(-1))** | **-0.206** | **0.037** | **-5.618** | **0.000** |
| **LOG(DE_XG00(-1))** | **0.277** | **0.043** | **6.407** | **0.000** |
| **LOG(DE_IMEQ00(-1))** | **0.126** | **0.037** | **3.396** | **0.001** |
| **(S91Q1)*@TREND** | **0.001** | **0.000** | **4.504** | **0.000** |
| C | 1.283 | 0.219 | 5.863 | 0.000 |
| Z1 | -0.043 | 0.025 | -1.720 | 0.088 |
| Z2 | -0.029 | 0.015 | -1.955 | 0.053 |
| Z3 | -0.071 | 0.023 | -3.080 | 0.003 |
| ΔLOG(DE_XG00) | 0.410 | 0.059 | 6.968 | 0.000 |
| ΔLOG(DE_XG00(-3)) | -0.140 | 0.058 | -2.400 | 0.018 |
| ΔLOG(DE_XG00(-5)) | -0.104 | 0.055 | -1.894 | 0.061 |
| ΔLOG(DE_CP00(-1)) | 0.265 | 0.067 | 3.984 | 0.000 |
| ΔLOG(DE_IMEQ00) | 0.182 | 0.054 | 3.379 | 0.001 |
| ΔLOG(DE_IMEQ00(-3)) | 0.185 | 0.055 | 3.341 | 0.001 |
| ΔLOG(DE_MG00(-2)) | 0.111 | 0.059 | 1.869 | 0.064 |
| I93Q1 | -0.084 | 0.022 | -3.810 | 0.000 |
| I05Q1 | -0.066 | 0.021 | -3.147 | 0.002 |

In the long run imports of goods depend on the prices of imported goods relative to the domestic price level, exports of goods and investment into machinery and equipment. They rise with increasing economic integration, which is represented by a trend beginning in 1991 in this equation. The error-

correction coefficient is highly significant with a t-statistic of -6.224 (5 percent critical value: -4.12). In the short run changes of private consumption also play a role.

The residuals are well-behaved and the specification is stable over the forecast period.

**Table 28: Diagnostics of estimation equation of ΔLOG(DE_MG00)**

| **Adjusted R2** | **0.83** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.29 |
| Serial correlation LM test (lag 1) | 0.76 |
| Serial correlation LM test (lag 4) | 0.17 |
| Serial correlation LM test (lag 8) | 0.17 |
| ARCH LM test (lag 1) | 0.31 |
| ARCH LM test (lag 4) | 0.29 |
| White's heteroskedasticity test | 0.27 |
| RESET test (h=2) | 0.73 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Imports of services*

In the long run real imports of services, which include expenditures of German tourists abroad, are explained by real disposable income. The t-statistic of the error-correction coefficient is not very significant (5 percent critical value: -3.41, 10 percent critical value: -3.13).

**Table 29: Estimation equation of ΔLOG(DE_MS00)**

| **Dependent Variable: ΔLOG(DE_MS00)** | | | | |
|---|---|---|---|---|
| **Method: Least Squares** | | | | |
| **Sample (adjusted): 1981Q2 2011Q4** | | | | |
| **Included observations: 123 after adjustments** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_MS00(-1))** | **-0.054** | **0.018** | **-3.094** | **0.003** |
| **LOG(DE_DISPY00(-1))** | **0.095** | **0.030** | **3.185** | **0.002** |
| C | -0.345 | 0.117 | -2.946 | 0.004 |
| Z1 | -0.005 | 0.024 | -0.197 | 0.844 |
| Z2 | 0.052 | 0.031 | 1.692 | 0.093 |
| Z3 | 0.115 | 0.025 | 4.528 | 0.000 |
| ΔLOG(DE_MS00(-1)) | -0.336 | 0.083 | -4.063 | 0.000 |
| ΔLOG(DE_MS00(-2)) | -0.252 | 0.084 | -3.002 | 0.003 |
| ΔLOG(DE_MS00(-3)) | -0.248 | 0.085 | -2.908 | 0.004 |
| ΔLOG(DE_MS00(-4)) | 0.292 | 0.085 | 3.445 | 0.001 |
| ΔLOG(DE_DISPY00(-3)) | 0.199 | 0.093 | 2.140 | 0.035 |
| ΔLOG(DE_DISPY00(-4)) | -0.276 | 0.094 | -2.947 | 0.004 |

There is some higher order autocorrelation in the residuals as well as some autoregressive conditional heteroskedasticity. Thus, the specification is not optimal.

**Table 30: Diagnostics of estimation equation of ΔLOG(DE_MS00)**

| **Adjusted R2** | **0.96** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.43 |
| Serial correlation LM test (lag 1) | 0.80 |
| Serial correlation LM test (lag 4) | 0.08 |
| Serial correlation LM test (lag 8) | 0.07 |
| ARCH LM test (lag 1) | 0.76 |
| ARCH LM test (lag 4) | 0.05 |
| White's heteroskedasticity test | 0.60 |
| RESET test (h=2) | 0.02 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 4 |

### 3.1.2. Prices and Exchange Rates

#### *Private consumption deflator*

In the long term the private consumption deflator is explained by unit labour costs, the price level (CPI) in the euro area and the oil price in euro terms. The error-correction coefficient is highly significant with a t-statistic of -7.250 (5 percent critical value: -3.91).

**Table 31: Estimation equation of ΔLOG(DE_PCP00)**

| **Dependent Variable: ΔLOG(DE_PCP00)**<br>**Method: Least Squares**<br>**Sample: 1982Q1 2011Q4**<br>**Included observations: 120** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PCP00(-1))** | **-0.159** | **0.022** | **-7.250** | **0.000** |
| **LOG(DE_ULC(-1))** | **0.040** | **0.011** | **3.605** | **0.001** |
| **LOG(CPI_EWU(-1))** | **0.079** | **0.011** | **7.201** | **0.000** |
| **LOG(OIL$(-1)/DE_NEV_US(-1)/100)** | **0.003** | **0.001** | **2.295** | **0.024** |
| C | 0.406 | 0.074 | 5.514 | 0.000 |
| Z1 | -0.024 | 0.005 | -5.234 | 0.000 |
| Z2 | -0.010 | 0.002 | -4.795 | 0.000 |
| Z3 | -0.009 | 0.002 | -4.146 | 0.000 |
| ΔLOG(DE_PCP00(-4)) | 0.131 | 0.025 | 5.173 | 0.000 |
| ΔLOG(DE_PM00) | 0.086 | 0.020 | 4.345 | 0.000 |
| ΔLOG(DE_PM00(-1)) | -0.107 | 0.018 | -5.952 | 0.000 |
| ΔLOG(DE_ULC(-4)) | -0.064 | 0.018 | -3.643 | 0.000 |
| ΔLOG(CPI_EWU) | 0.535 | 0.084 | 6.338 | 0.000 |
| ΔLOG(CPI_EWU(-1)) | 0.423 | 0.089 | 4.744 | 0.000 |
| I91Q1 | -0.050 | 0.003 | -15.935 | 0.000 |

The specification passes all diagnostic tests.

**Table 32: Diagnostics of Estimation equation of ΔLOG(DE_PCP00)**

| **Adjusted R2** | **0.86** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.25 |
| Serial correlation LM test (lag 1) | 0.95 |
| Serial correlation LM test (lag 4) | 0.42 |
| Serial correlation LM test (lag 8) | 0.60 |
| ARCH LM test (lag 1) | 0.62 |
| ARCH LM test (lag 4) | 0.34 |
| White's heteroskedasticity test | 0.13 |
| RESET test (h=2) | 0.25 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Government consumption deflator*

The government consumption deflator is determined by the wage level and the GDP deflator in the long run. A step dummy is included in the error-correction term to account for German reunification. With a t-statistic of -7.798 the error-correction coefficient is highly significant (5 percent critical value: -3.91).

**Table 33: Estimation equation of ΔLOG(DE_PCGOV00)**

| **Dependent Variable: ΔLOG(DE_PCGOV00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1982Q2 2011Q4**<br>**Included observations: 119 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PCGOV00(-1))** | **-0.610** | **0.078** | **-7.798** | **0.000** |
| **LOG(DE_GWAGE(-1))** | **0.192** | **0.029** | **6.574** | **0.000** |
| **LOG(DE_PGDP00(-1))** | **0.273** | **0.069** | **3.943** | **0.000** |
| **S91Q1** | **-0.040** | **0.006** | **-6.214** | **0.000** |
| C | 0.548 | 0.112 | 4.908 | 0.000 |
| Z1 | -0.041 | 0.010 | -4.086 | 0.000 |
| Z2 | -0.017 | 0.006 | -2.752 | 0.007 |
| Z3 | -0.007 | 0.009 | -0.842 | 0.402 |
| Z1*(1-S91Q1) | -0.017 | 0.006 | -2.726 | 0.008 |
| Z2*(1-S91Q1) | -0.013 | 0.005 | -2.528 | 0.013 |
| Z3*(1-S91Q1) | -0.005 | 0.006 | -0.852 | 0.396 |
| ΔLOG(DE_PCGOV00(-3)) | -0.131 | 0.050 | -2.607 | 0.011 |
| ΔLOG(DE_PCGOV00(-4)) | 0.387 | 0.078 | 4.969 | 0.000 |
| ΔLOG(DE_PCGOV00(-8)) | 0.157 | 0.066 | 2.395 | 0.018 |
| I91Q2 | 0.038 | 0.009 | 4.013 | 0.000 |
| I92Q2 | -0.020 | 0.009 | -2.168 | 0.033 |
| I92Q3 | 0.031 | 0.009 | 3.616 | 0.001 |

The specification passes all diagnostic tests.

**Table 34: Diagnostics of Estimation equation of ΔLOG(DE_PCGOV00)**

| **Adjusted R2** | **0.99** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.93 |
| Serial correlation LM test (lag 1) | 0.69 |
| Serial correlation LM test (lag 4) | 0.49 |
| Serial correlation LM test (lag 8) | 0.10 |
| ARCH LM test (lag 1) | 0.18 |
| ARCH LM test (lag 4) | 0.21 |
| White's heteroskedasticity test | 0.51 |
| RESET test (h=2) | 0.17 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Deflator of investment into machinery and equipment*

As no cointegrating relationship was found which could explain the long-term evolution of the deflator of investment into machinery and equipment, the variable was estimated in levels with its own lagged observations as well as coincident and lagged observations of unit labour costs and the import deflator.

**Table 35: Estimation equation of LOG(DE_PIMEQ00)**

| **Dependent Variable: LOG(DE_PIMEQ00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q3 2011Q4**<br>**Included observations: 122 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | -0.094 | 0.060 | -1.569 | 0.120 |
| Z1 | 0.015 | 0.003 | 4.802 | 0.000 |
| Z2 | 0.031 | 0.005 | 6.808 | 0.000 |
| Z3 | -0.002 | 0.003 | -0.729 | 0.468 |
| (1-S91Q1)*Z1 | -0.017 | 0.003 | -5.240 | 0.000 |
| (1-S91Q1)*Z2 | -0.022 | 0.004 | -5.813 | 0.000 |
| (1-S91Q1)*Z3 | 0.012 | 0.004 | 3.242 | 0.002 |
| Z1*S05Q1 | 0.020 | 0.003 | 6.737 | 0.000 |
| Z2*S05Q1 | 0.009 | 0.003 | 3.050 | 0.003 |
| Z3*S05Q1 | 0.010 | 0.003 | 3.476 | 0.001 |
| LOG(DE_PIMEQ00(-1)) | 0.647 | 0.081 | 7.970 | 0.000 |
| LOG(DE_PIMEQ00(-2)) | 0.348 | 0.081 | 4.289 | 0.000 |
| LOG(DE_ULC) | 0.035 | 0.016 | 2.275 | 0.025 |
| LOG(DE_ULC(-6)) | -0.075 | 0.013 | -5.610 | 0.000 |
| LOG(DE_PMG00) | 0.121 | 0.024 | 5.139 | 0.000 |
| LOG(DE_PMG00(-1)) | -0.102 | 0.023 | -4.474 | 0.000 |
| I91Q1 | 0.113 | 0.004 | 25.710 | 0.000 |
| I91Q2 | 0.037 | 0.010 | 3.734 | 0.000 |
| I00Q2 | 0.014 | 0.004 | 3.255 | 0.002 |

Apart from some heteroskedasticity the residuals are well-behaved and the specification can be assumed to be stable over the sample period.

**Table 36: Diagnostics of estimation equation of LOG(DE_PIMEQ00)**

| **Adjusted R2** | **0.998** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.64 |
| Serial correlation LM test (lag 1) | 0.78 |
| Serial correlation LM test (lag 4) | 0.44 |
| Serial correlation LM test (lag 8) | 0.47 |
| ARCH LM test (lag 1) | 0.89 |
| ARCH LM test (lag 4) | 0.03 |
| White's heteroskedasticity test | 0.01 |
| RESET test (h=2) | 0.58 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Deflator of private residential construction investment*

A long-run relationship has been established between the deflator of private residential construction and the deflator of private non-residential construction. However, the t-statistic of the error-correction coefficient is significant only at the 10 percent level (-3.13; 5 percent critical value: -3.41).

**Table 37: Estimation equation of ΔLOG(DE_PID00)**

| **Dependent Variable: ΔLOG(DE_PID00)**<br>**Method: Least Squares**<br>**Sample: 1982Q1 2011Q4**<br>**Included observations: 120** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PID00(-1))** | **-0.143** | **0.045** | **-3.165** | **0.002** |
| **LOG(DE_PINRB00(-1))** | **0.153** | **0.050** | **3.045** | **0.003** |
| C | -0.046 | 0.026 | -1.798 | 0.075 |
| Z1 | -0.010 | 0.002 | -3.979 | 0.000 |
| Z2 | 0.013 | 0.002 | 6.171 | 0.000 |
| Z3 | -0.004 | 0.002 | -1.539 | 0.127 |
| Z1*S91Q1 | 0.014 | 0.003 | 5.126 | 0.000 |
| Z2*S91Q1 | -0.011 | 0.002 | -4.444 | 0.000 |
| Z3*S91Q1 | 0.005 | 0.003 | 1.784 | 0.077 |
| ΔLOG(DE_PID00(-2)) | 0.119 | 0.069 | 1.729 | 0.087 |
| ΔLOG(DE_PINRB00(-1)) | 0.268 | 0.065 | 4.100 | 0.000 |
| ΔLOG(DE_PINRB00(-7)) | 0.087 | 0.025 | 3.458 | 0.001 |
| I90Q1 | 0.017 | 0.004 | 4.163 | 0.000 |
| I91Q2 | 0.021 | 0.004 | 5.442 | 0.000 |
| I07Q1 | 0.028 | 0.004 | 7.036 | 0.000 |

The specification does not pass all diagnostic tests. There is heteroskedasticity in the residuals and the CUSUM of squares test points to instability.

**Table 38: Diagnostics of Estimation equation of ΔLOG(DE_PID00)**

| **Adjusted R2** | **0.73** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.54 |
| Serial correlation LM test (lag 1) | 0.06 |
| Serial correlation LM test (lag 4) | 0.15 |
| Serial correlation LM test (lag 8) | 0.20 |
| ARCH LM test (lag 1) | 0.03 |
| ARCH LM test (lag 4) | 0.02 |
| White's heteroskedasticity test | 0.05 |
| RESET test (h=2) | 0.53 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 24 |

### *Deflator of private non-residential construction investment*

The deflator of private non-residential construction investment is explained by capacity utilisation and a trend. Two step dummies are included. It has proved rather difficult to estimate the investment deflators using variables of the model. Strictly speaking the variables used here (which are of different order of integration) should not be used in one error-correction term, but the equation proved the best of a number of alternatives.

**Table 39: Estimation equation of ΔLOG(DE_PINRB00)**

| **Dependent Variable: ΔLOG(DE_PINRB00)**<br>**Method: Least Squares**<br>**Sample: 1982Q1 2011Q4**<br>**Included observations: 120** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PINRB00(-1))** | **-0.053** | **0.013** | **-4.154** | **0.000** |
| **LOG(DE_CAPA(-1))** | **0.049** | **0.012** | **4.186** | **0.000** |
| **@TREND*(S91Q1-1)** | **0.000** | **0.000** | **-2.667** | **0.009** |
| **S91Q1** | **0.020** | **0.005** | **3.737** | **0.000** |
| **S05Q1** | **0.008** | **0.002** | **3.914** | **0.000** |
| Z1*S91Q1 | 0.024 | 0.003 | 7.685 | 0.000 |
| Z2*S91Q1 | -0.010 | 0.003 | -3.984 | 0.000 |
| Z3*S91Q1 | 0.011 | 0.003 | 3.266 | 0.002 |
| ΔLOG(DE_PINRB00(-1)) | 0.365 | 0.077 | 4.758 | 0.000 |
| ΔLOG(DE_ULC(-1)) | -0.115 | 0.012 | -9.616 | 0.000 |
| ΔLOG(DE_ULC(-3)) | -0.026 | 0.011 | -2.438 | 0.017 |
| ΔLOG(DE_CAPA(-2)) | 0.077 | 0.038 | 2.032 | 0.045 |
| I90Q1 | 0.018 | 0.005 | 3.318 | 0.001 |
| I91Q1 | -0.014 | 0.006 | -2.543 | 0.012 |

The residuals pass the diagnostic tests with the exception of White's heteroskedasticity test and the CUSUM of squares test.

**Table 40: Diagnostics of estimation equation of ΔLOG(DE_PINRB00)**

| **Adjusted R2** | **0.58** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.19 |
| Serial correlation LM test (lag 1) | 0.60 |
| Serial correlation LM test (lag 4) | 0.15 |
| Serial correlation LM test (lag 8) | 0.39 |
| ARCH LM test (lag 1) | 0.11 |
| ARCH LM test (lag 4) | 0.52 |
| White's heteroskedasticity test | 0.00 |
| RESET test (h=2) | 0.76 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 52 |

### *Deflator of government construction investment*

No cointegrating relationship could be found to explain the government construction deflator. It is therefore estimated in levels being explained by its past observations as well as the coincident and lagged observations of the deflator of private non-residential construction.

**Table 41: Estimation equation of LOG(DE_PICONGOV00)**

| **Dependent Variable: LOG(DE_PICONGOV00)** | | | | |
|---|---|---|---|---|
| **Method: Least Squares** | | | | |
| **Sample (adjusted): 1981Q2 2011Q4** | | | | |
| **Included observations: 123 after adjustments** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | -0.010 | 0.009 | -1.035 | 0.303 |
| LOG(DE_PICONGOV00(-1)) | 0.816 | 0.043 | 19.194 | 0.000 |
| LOG(DE_PICONGOV00(-4)) | 0.179 | 0.053 | 3.342 | 0.001 |
| LOG(DE_PICONGOV00(-5)) | -0.192 | 0.049 | -3.872 | 0.000 |
| LOG(DE_PINRB00) | 0.823 | 0.053 | 15.649 | 0.000 |
| LOG(DE_PINRB00(-1)) | -0.637 | 0.066 | -9.658 | 0.000 |
| LOG(DE_PINRB00(-3)) | 0.071 | 0.024 | 2.982 | 0.004 |
| LOG(DE_PINRB00(-5)) | -0.057 | 0.019 | -3.012 | 0.003 |

The specification passes all diagnostic tests at the 5 percent level.

**Table 42: Diagnostics of estimation equation of LOG(DE_PICONGOV00)**

| **Adjusted R2** | **0.9996** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.85 |
| Serial correlation LM test (lag 1) | 0.09 |
| Serial correlation LM test (lag 4) | 0.36 |
| Serial correlation LM test (lag 8) | 0.61 |
| ARCH LM test (lag 1) | 0.85 |
| ARCH LM test (lag 4) | 0.39 |
| White's heteroskedasticity test | 0.13 |
| RESET test (h=2) | 0.09 |
| **Number of observations outside error bands** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Deflator of other gross fixed capital formation*

Despite an insignificant error-correction coefficient the deflator of other gross fixed capital formation has been estimated in an error-correction equation including the deflator of investment in machinery and equipment and a broken trend. The equation shows a satisfactory in-sample forecast performance and is the best option among several alternatives.

**Table 43: Estimation equation of ΔLOG(DE_PIOTH00)**

| **Dependent Variable: ΔLOG(DE_PIOTH00)**<br>**Method: Least Squares**<br>**Sample: 1982Q2 2011Q4**<br>**Included observations: 119** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PIOTH00(-1))** | **-0.113** | **0.039** | **-2.872** | **0.005** |
| **LOG(DE_PIMEQ00(-1))** | **0.101** | **0.030** | **3.400** | **0.001** |
| **@TREND** | **0.000** | **0.000** | **-2.986** | **0.004** |
| **(1-S94Q1)*@TREND** | **0.000** | **0.000** | **-2.248** | **0.027** |
| C | 0.093 | 0.077 | 1.208 | 0.230 |
| Z1 | 0.002 | 0.003 | 0.624 | 0.534 |
| Z2 | -0.011 | 0.002 | -4.424 | 0.000 |
| Z3 | 0.000 | 0.002 | -0.139 | 0.890 |
| ΔLOG(DE_PIOTH00(-4)) | 0.142 | 0.061 | 2.302 | 0.023 |
| ΔLOG(DE_PM00(-4)) | 0.118 | 0.047 | 2.531 | 0.013 |
| ΔLOG(DE_PIMEQ00) | 0.645 | 0.062 | 10.338 | 0.000 |
| I82Q4 | -0.039 | 0.009 | -4.217 | 0.000 |
| I83Q1 | 0.049 | 0.009 | 5.155 | 0.000 |

The specification does not pass all diagnostic tests. There is some higher order autocorrelation as well as heteroskedasticity in the residuals.

**Table 44: Diagnostics of estimation equation of ΔLOG(DE_PIOTH00)**

| **Adjusted R2** | **0.68** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.30 |
| Serial correlation LM test (lag 1) | 0.20 |
| Serial correlation LM test (lag 4) | 0.00 |
| Serial correlation LM test (lag 8) | 0.00 |
| ARCH LM test (lag 1) | 0.30 |
| ARCH LM test (lag 4) | 0.01 |
| White's heteroskedasticity test | 0.08 |
| RESET test (h=2) | 0.44 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Deflator of exports of goods*

In the long run the deflator of exports of goods is explained by import prices, German unit labour costs and unit labour costs in the major EMU countries (excluding Germany) in euro (proxy for production costs of foreign competitors). The assumption that German exporters do not only take their own costs into account, but also those of their competitors is known as pricing to market. With a t-statistic of -4.21 the error-correction coefficient is significant (5 percent critical value: -3.91).

**Table 45: Estimation equation of ΔLOG(DE_PXG00)**

| **Dependent Variable: ΔLOG(DE_PXG00)**<br>**Method: Least Squares**<br>**Sample: 1988Q1 2011Q4**<br>**Included observations: 96** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PXG00(-1))** | **-0.195** | **0.046** | **-4.214** | **0.000** |
| **LOG(DE_ULC(-1))** | **0.035** | **0.014** | **2.608** | **0.011** |
| **LOG(EWU6_ULC(-1)/ DE_NEV_EWU(-1))** | **0.012** | **0.004** | **3.068** | **0.003** |
| **LOG(DE_PMG00(-1))** | **0.084** | **0.022** | **3.797** | **0.000** |
| C | 0.544 | 0.145 | 3.740 | 0.000 |
| Z1 | -0.001 | 0.003 | -0.491 | 0.625 |
| Z2 | 0.007 | 0.001 | 5.666 | 0.000 |
| Z3 | 0.003 | 0.003 | 1.037 | 0.303 |
| ΔLOG(DE_PXG00(-2)) | -0.103 | 0.060 | -1.715 | 0.090 |
| ΔLOG(DE_PMG00) | 0.273 | 0.020 | 13.629 | 0.000 |
| ΔLOG(DE_PMG00(-1)) | 0.050 | 0.021 | 2.345 | 0.022 |
| ΔLOG(DE_PMG00(-2)) | 0.064 | 0.028 | 2.277 | 0.026 |
| ΔLOG(EWU6_ULC(-2)/ DE_NEV_EWU(-2)) | -0.061 | 0.020 | -3.000 | 0.004 |
| ΔLOG(EWU6_ULC(-3)/ DE_NEV_EWU(-3)) | -0.075 | 0.020 | -3.681 | 0.000 |
| Δ(S91Q1) | -0.020 | 0.003 | -6.629 | 0.000 |
| Δ(S91Q2) | 0.021 | 0.003 | 6.781 | 0.000 |
| I95Q1 | 0.006 | 0.003 | 2.174 | 0.033 |

The specification passes all diagnostic tests at the 5 percent level.

**Table 46: Diagnostics of estimation equation of ΔLOG(DE_PXG00)**

| **Adjusted R2** | **0.88** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.79 |
| Serial correlation LM test (lag 1) | 0.62 |
| Serial correlation LM test (lag 4) | 0.55 |
| Serial correlation LM test (lag 8) | 0.26 |
| ARCH LM test (lag 1) | 0.20 |
| ARCH LM test (lag 4) | 0.23 |
| White's heteroskedasticity test | 0.09 |
| RESET test (h=2) | 0.24 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Deflator of exports of services*

In the long term the deflator of exports of services is determined by unit labour costs. With a t-statistic of -3.401 the error-correction coefficient is significant at the 5 percent level (-3.19).

**Table 47: Estimation equation of ΔLOG(DE_PXS00)**

| **Dependent Variable: ΔLOG(DE_PXS00)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q4 2011Q4**<br>**Included observations: 121 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PXS00(-1))** | **-0.110** | **0.032** | **-3.401** | **0.001** |
| **LOG(DE_ULC(-1))** | **0.088** | **0.035** | **2.492** | **0.014** |
| C | 0.564 | 0.170 | 3.311 | 0.001 |
| Z1 | -0.069 | 0.018 | -3.804 | 0.000 |
| Z2 | -0.018 | 0.007 | -2.555 | 0.012 |
| Z3 | -0.025 | 0.008 | -3.074 | 0.003 |
| ΔLOG(DE_PXS00(-2)) | -0.163 | 0.079 | -2.066 | 0.041 |
| ΔLOG(DE_PXS00(-4)) | 0.208 | 0.082 | 2.528 | 0.013 |
| ΔLOG(DE_PXS00(-6)) | -0.218 | 0.078 | -2.791 | 0.006 |
| ΔLOG(DE_ULC(-4)) | -0.202 | 0.069 | -2.941 | 0.004 |
| I90Q3 | 0.028 | 0.012 | 2.247 | 0.027 |
| I02Q3 | 0.042 | 0.013 | 3.244 | 0.002 |
| I03Q1 | -0.073 | 0.013 | -5.539 | 0.000 |

The residuals are not normally distributed, which is due to two outliers in the first two quarters of 2009. These are due to the financial and economic crisis and are deliberately kept.

**Table 48: Diagnostics of estimation equation of ΔLOG(DE_PXS00)**

| **Adjusted R2** | **0.57** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.00 |
| Serial correlation LM test (lag 1) | 0.49 |
| Serial correlation LM test (lag 4) | 0.38 |
| Serial correlation LM test (lag 8) | 0.19 |
| ARCH LM test (lag 1) | 0.00 |
| ARCH LM test (lag 4) | 0.00 |
| White's heteroskedasticity test | 0.24 |
| RESET test (h=2) | 0.25 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Deflator of imports of goods*

An error-correction equation has been estimated for the deflator of imports of goods. In the long run the latter is explained by the foreign price level in euro terms, the oil price in euro terms and a trend. With a t-statistic of -3.309 the error-correction coefficient is not significant (5 percent critical value: -3.91).

**Table 49: Estimation equation of ΔLOG(DE_PMG00)**

| **Dependent Variable: ΔLOG(DE_PMG00)**<br>**Method: Least Squares**<br>**Sample: 1982Q1 2011Q4**<br>**Included observations: 120** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_PMG00(-1))** | **-0.146** | **0.044** | **-3.309** | **0.001** |
| **LOG(DE_PTOTDEM(-1)/ DE_REEV_24_PTOTDEM(-1))** | **0.050** | **0.030** | **1.700** | **0.092** |
| **LOG(OIL$(-1)/DE_NEV_US(-1))** | **0.015** | **0.004** | **3.598** | **0.001** |
| **@TREND** | **0.000** | **0.000** | **-2.651** | **0.009** |
| C | 0.722 | 0.219 | 3.302 | 0.001 |
| Z1 | 0.018 | 0.003 | 6.156 | 0.000 |
| Z2 | 0.010 | 0.003 | 3.920 | 0.000 |
| Z3 | 0.001 | 0.003 | 0.549 | 0.584 |
| ΔLOG(DE_PMG00(-3)) | 0.133 | 0.048 | 2.793 | 0.006 |
| ΔLOG(DE_PTOTDEM/ DE_REEV_24_PTOTDEM) | 0.568 | 0.065 | 8.692 | 0.000 |
| ΔLOG(DE_PTOTDEM(-2)/ DE_REEV_24_PTOTDEM(-2)) | 0.120 | 0.062 | 1.930 | 0.056 |
| ΔLOG(OIL$/DE_NEV_US) | 0.035 | 0.006 | 5.490 | 0.000 |
| ΔLOG(OIL$(-1)/DE_NEV_US(-1)) | 0.044 | 0.006 | 6.959 | 0.000 |
| ΔLOG(OIL$(-2)/DE_NEV_US(-2)) | -0.010 | 0.006 | -1.549 | 0.125 |
| ΔLOG(OIL$(-6)/DE_NEV_US(-6)) | -0.010 | 0.006 | -1.651 | 0.102 |
| I95Q1 | 0.037 | 0.009 | 4.070 | 0.000 |

Except for White's heteroskedasticity test the specification passes all diagnostic tests at the 5 percent level.

**Table 50: Diagnostics of estimation equation of ΔLOG(DE_PMG00)**

| **Adjusted R2** | **0.79** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.20 |
| Serial correlation LM test (lag 1) | 0.70 |
| Serial correlation LM test (lag 4) | 0.30 |
| Serial correlation LM test (lag 8) | 0.13 |
| ARCH LM test (lag 1) | 0.67 |
| ARCH LM test (lag 4) | 0.45 |
| White's heteroskedasticity test | 0.01 |
| RESET test (h=2) | 0.08 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Deflator of imports of services*

No cointegrating relationship could be established for the deflator of imports of services. It has thus been estimated using its own lagged observations as well as lagged observations of the foreign price level in euro terms. The effects of German unification are accounted for with a step dummy.

**Table 51: Estimation equation of ΔLOG(DE_PMS000)**

| **Dependent Variable: ΔLOG(DE_PMS000)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q4 2011Q4**<br>**Included observations: 121 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 0.010 | 0.002 | 4.203 | 0.000 |
| ΔLOG(DE_PMS00(-1)) | -0.129 | 0.092 | -1.403 | 0.163 |
| ΔLOG(DE_PMS00(-2)) | -0.285 | 0.095 | -2.988 | 0.004 |
| ΔLOG(DE_PMS00(-3)) | -0.340 | 0.086 | -3.944 | 0.000 |
| ΔLOG(DE_PMS00(-4)) | 0.378 | 0.076 | 4.958 | 0.000 |
| ΔLOG(DE_PMS00(-5)) | -0.216 | 0.082 | -2.624 | 0.010 |
| ΔLOG(DE_PMS00(-6)) | -0.136 | 0.083 | -1.629 | 0.106 |
| ΔLOG(DE_PTOTDEM(-2)/ DE_REEV_24_PTOTDEM(-2)) | 0.119 | 0.059 | 2.027 | 0.045 |
| ΔLOG(DE_PTOTDEM(-3)/ DE_REEV_24_PTOTDEM(-3)) | 0.149 | 0.059 | 2.534 | 0.013 |
| S91Q1 | -0.008 | 0.002 | -3.149 | 0.002 |

The specification passes all tests except for White's heteroskedasticity test and the ARCH LM test for lag 4.

**Table 52: Diagnostics of estimation equation of ΔLOG(DE_PMS000)**

| **Adjusted R2** | **0.55** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.81 |
| Serial correlation LM test (lag 1) | 0.85 |
| Serial correlation LM test (lag 4) | 0.91 |
| Serial correlation LM test (lag 8) | 0.97 |
| ARCH LM test (lag 1) | 0.51 |
| ARCH LM test (lag 4) | 0.01 |
| White's heteroskedasticity test | 0.04 |
| RESET test (h=2) | 0.74 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Consumer price index*

The consumer price index covers a similar range of products and services as the private consumption deflator. Whereas the private consumption deflator is a Paasche index, the CPI is a Laspeyres index. This difference can be modelled by adding a trend. The private consumption deflator has a level shift, which is absent in the CPI. Thus a step dummy has to be included in the cointegration relationship. The t-statistic of the error-correction coefficient is highly significant (5 % critical value: -3.91).

**Table 53: Estimation equation of LOG(CPI_DE)**

| **Dependent Variable: LOG(CPI_DE)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q2 2011Q4**<br>**Included observations: 123 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| LOG(CPI_DE(-1)) | -0.138 | 0.033 | -4.123 | 0.000 |
| LOG(DE_PCP00(-1)) | 0.103 | 0.043 | 2.407 | 0.018 |
| S91Q1 | 0.008 | 0.002 | 4.135 | 0.000 |
| @TREND | 0.000 | 0.000 | 2.858 | 0.005 |
| C | 0.134 | 0.095 | 1.411 | 0.161 |
| Z1 | 0.004 | 0.001 | 4.388 | 0.000 |
| Z2 | 0.002 | 0.001 | 3.037 | 0.003 |
| Z3 | 0.000 | 0.001 | -0.142 | 0.888 |
| ΔLOG(CPI_DE(-2)) | 0.272 | 0.068 | 3.973 | 0.000 |
| ΔLOG(CPI_DE(-4)) | 0.255 | 0.067 | 3.805 | 0.000 |
| ΔLOG(DE_PCP00(-3)) | -0.126 | 0.038 | -3.338 | 0.001 |
| ΔLOG(OIL$) | 0.011 | 0.002 | 6.795 | 0.000 |
| I91Q3 | 0.011 | 0.003 | 3.547 | 0.001 |
| I93Q1 | 0.016 | 0.003 | 5.818 | 0.000 |

The residuals of the estimation are generally well-behaved. However, the null hypothesis of no autoregressive conditional heteroskedasticity can be rejected at the 10% level (in fact: 8%). The specification is stable over the sample period.

**Table 54: Diagnostics of estimation equation of LOG(CPI_DE)**

| **Adjusted R2** | |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.71 |
| Serial correlation LM test (lag 1) | 0.47 |
| Serial correlation LM test (lag 4) | 0.65 |
| Serial correlation LM test (lag 8) | 0.16 |
| ARCH LM test (lag 1) | 0.08 |
| ARCH LM test (lag 4) | 0.33 |
| White's heteroskedasticity test | 0.98 |
| RESET test (h=2) | 0.70 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### 3.1.3. Income and Employment

#### *Consumption of fixed capital*

There is a stable long-run relationship between consumption of fixed capital and the nominal capital stock calculated as the product of the real capital stock and the deflator of private non-residential capital formation. There are numerous outliers and the seasonal patterns change repeatedly.

**Table 55: Estimation equation of LOG(DE_CFC)**

| **Dependent variable: DLOG(DE_CFC)**<br>**Method: Least squares**<br>**Sample: 1983Q1 2011Q4**<br>**Included observations: 116** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_CFC(-1))**<br>**-LOG(DE_CAPITAL00(-1)*DE_PIFC_ID(-1)/100)** | **-0.012** | **0.002** | **-5.776** | **0.000** |
| Z1 | 0.004 | 0.004 | 1.095 | 0.276 |
| Z2 | 0.017 | 0.003 | 5.623 | 0.000 |
| Z3 | -0.014 | 0.004 | -3.664 | 0.000 |
| I91Q1 | 0.084 | 0.003 | 27.328 | 0.000 |
| (1-S91Q1)*Z1 | -0.023 | 0.003 | -7.845 | 0.000 |
| (1-S91Q1)*Z2 | 0.002 | 0.002 | 0.964 | 0.337 |
| (1-S91Q1)*Z3 | 0.008 | 0.003 | 2.802 | 0.006 |
| ΔLOG(DE_CFC(-2)) | 0.081 | 0.031 | 2.569 | 0.012 |
| ΔLOG(DE_CFC(-6)) | 0.072 | 0.032 | 2.298 | 0.024 |
| ΔLOG(DE_IFC(-1)) | 0.033 | 0.008 | 4.007 | 0.000 |
| ΔLOG(DE_IFC(-3)) | 0.035 | 0.008 | 4.186 | 0.000 |
| ΔLOG(DE_IFC(-4)) | 0.018 | 0.009 | 2.059 | 0.042 |
| ΔLOG(DE_IFC(-5)) | 0.041 | 0.009 | 4.735 | 0.000 |
| ΔLOG(DE_IFC(-6)) | 0.032 | 0.009 | 3.626 | 0.001 |
| S07Q1*Z1 | 0.014 | 0.002 | 6.452 | 0.000 |
| S07Q1*Z2 | 0.005 | 0.002 | 2.368 | 0.020 |
| S07Q1*Z3 | 0.006 | 0.002 | 2.665 | 0.009 |
| I07Q1 | 0.013 | 0.003 | 4.015 | 0.000 |
| I90Q1 | 0.020 | 0.003 | 6.266 | 0.000 |
| I89Q1 | 0.014 | 0.003 | 4.655 | 0.000 |

The residuals can be assumed to be uncorrelated and homoskedastic. The specification is stable over the estimation period.

**Table 56: Diagnostics of estimation equation of LOG(DE_CFC)**

| **Adjusted R2** | **0.95** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.47 |
| Serial correlation LM test (lag 1) | 0.60 |
| Serial correlation LM test (lag 4) | 0.20 |
| Serial correlation LM test (lag 8) | 0.54 |
| ARCH LM test (lag 1) | 0.34 |
| ARCH LM test (lag 4) | 0.65 |
| White's heteroskedasticity test | 0.84 |
| RESET test (h=2) | 0.00 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Taxes less subsidies on production and income*

To a large extent taxes less subsidies on production and income consist of VAT. This is why a cointegrating relationship is established between this variable and the product of the average indirect tax rate and nominal private consumption as well as a trend. With a t-statistic of -5.081 the error-correction coefficient is highly significant (5 percent critical value: -3.69).

**Table 57: Estimation equation of ΔLOG(DE_TINDSUB)**

| **Dependent Variable: ΔLOG(DE_TINDSUB)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1993Q1 2011Q4**<br>**Included observations: 76 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_TINDSUB(-1))** | **-0.552** | **0.109** | **-5.081** | **0.000** |
| **LOG(DE_TIND_TARIFFSA_SA(-1) *DE_CP(-1))** | **0.556** | **0.134** | **4.148** | **0.000** |
| **@TREND** | **0.001** | **0.001** | **1.883** | **0.064** |
| C | -2.748 | 0.816 | -3.367 | 0.001 |
| Z1 | 0.013 | 0.025 | 0.529 | 0.599 |
| Z2 | 0.061 | 0.016 | 3.859 | 0.000 |
| Z3 | 0.042 | 0.018 | 2.317 | 0.024 |
| S96Q4*Z1 | -0.023 | 0.017 | -1.353 | 0.181 |
| S96Q4*Z2 | 0.009 | 0.016 | 0.604 | 0.548 |
| S96Q4*Z3 | -0.012 | 0.017 | -0.718 | 0.476 |
| ΔLOG(DE_TIND_TARIFFSA_SA) | 1.163 | 0.088 | 13.209 | 0.000 |
| ΔLOG(DE_TINDSUB(-4)) | 0.294 | 0.081 | 3.637 | 0.001 |
| ΔLOG(DE_TIND_TARIFFSA_SA(-4) *DE_CP(-4)) | -0.310 | 0.106 | -2.938 | 0.005 |
| ΔLOG(DE_TIND_TARIFFSA_SA(-7) *DE_CP(-7)) | -0.128 | 0.074 | -1.738 | 0.087 |

There is some indication of heteroskedasticity and the specification is not completely stable over the sample period.

**Table 58: Diagnostics of estimation equation of ΔLOG(DE_TINDSUB)**

| **Adjusted R2** | **0.86** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.81 |
| Serial correlation LM test (lag 1) | 0.67 |
| Serial correlation LM test (lag 4) | 0.57 |
| Serial correlation LM test (lag 8) | 0.70 |
| ARCH LM test (lag 1) | 0.38 |
| ARCH LM test (lag 4) | 0.09 |
| White's heteroskedasticity test | 0.03 |
| RESET test (h=2) | 0.46 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 8 |

### *Gross wage per employee*

The main explaining variables are the GDP deflator (with a restricted coefficient), productivity and the unemployment rate. As there are several structural breaks, which are partly due to German reunification, some of the variables have been multiplied with step dummies. With a t-statistic of -3.557 the error-correction coefficient is not significant. Nevertheless, the equation is being used as the coefficients and elasticities seem sensible and there is no superior alternative.

**Table 59: Estimation equation of ΔLOG(DE_GWAGEE)**

| **Dependent Variable: ΔLOG(DE_GWAGEE)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q4 2011Q4**<br>**Included observations: 121 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_GWAGEE(-1))-LOG(DE_PGDP00(-1))** | **-0.210** | **0.059** | **-3.557** | **0.001** |
| **LOG(DE_PRODEE(-1))** | **0.137** | **0.046** | **2.960** | **0.004** |
| **DE_UR(-1)/100** | **-0.398** | **0.092** | **-4.311** | **0.000** |
| **S91Q1** | **0.723** | **0.305** | **2.369** | **0.020** |
| **LOG(DE_PRODEE(-1))*S91Q1** | **-0.074** | **0.032** | **-2.327** | **0.022** |
| **(DE_UR(-1)/100)*S94Q1** | **-0.205** | **0.040** | **-5.117** | **0.000** |
| C | -0.379 | 0.279 | -1.358 | 0.178 |
| Z1 | -0.198 | 0.013 | -15.314 | 0.000 |
| Z2 | -0.003 | 0.012 | -0.270 | 0.788 |
| Z3 | -0.154 | 0.018 | -8.505 | 0.000 |
| ΔLOG(DE_GWAGEE(-2)) | -0.498 | 0.060 | -8.300 | 0.000 |
| ΔLOG(DE_GWAGEE(-3)) | -0.317 | 0.056 | -5.664 | 0.000 |
| ΔLOG(DE_GWAGEE(-6)) | -0.171 | 0.034 | -4.977 | 0.000 |
| ΔLOG(DE_PGDP00(-1)) | -0.782 | 0.146 | -5.370 | 0.000 |
| ΔLOG(DE_PRODEE(-1)) | -0.246 | 0.044 | -5.656 | 0.000 |
| ΔLOG(DE_PRODEE(-3)) | -0.143 | 0.045 | -3.214 | 0.002 |
| ΔLOG(DE_PRODEE(-5)) | -0.098 | 0.029 | -3.353 | 0.001 |
| Δ(DE_UR(-2)/100) | 0.622 | 0.277 | 2.242 | 0.027 |
| I91Q1 | -0.179 | 0.007 | -23.910 | 0.000 |
| I91Q1(-1) | -0.073 | 0.012 | -6.070 | 0.000 |
| I91Q1(-2) | -0.070 | 0.013 | -5.258 | 0.000 |
| I91Q1(-3) | -0.061 | 0.013 | -4.782 | 0.000 |
| I84Q1 | 0.027 | 0.007 | 3.824 | 0.000 |
| I84Q2 | -0.042 | 0.007 | -6.160 | 0.000 |
| DUMMY_KA | 0.000 | 0.000 | -5.388 | 0.000 |

The RESET test points to some type of specification error, but otherwise the specification passes the diagnostic tests.

**Table 60: Diagnostics of estimation equation of ΔLOG(DE_GWAGEE)**

| **Adjusted R2** | |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.83 |
| Serial correlation LM test (lag 1) | 0.46 |
| Serial correlation LM test (lag 4) | 0.14 |
| Serial correlation LM test (lag 8) | 0.27 |
| ARCH LM test (lag 1) | 0.75 |
| ARCH LM test (lag 4) | 0.24 |
| White's heteroskedasticity test | 0.09 |
| RESET test (h=2) | 0.00 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Employees*

In the long-run the number of employees is explained by the impact of the capital stock (adjusted for technical progress using a modified trend) on productivity. A step dummy is included to account for the level shift due to German reunification. With a t-statistic of -5.954 the error-correction coefficient is highly significant (5 percent critical value: -3.69).

**Table 61: Estimation equation of ΔLOG(DE_EE)**

| **Dependent Variable: ΔLOG(DE_EE)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q2 2011Q4**<br>**Included observations: 123 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_EE(-1))-LOG(DE_GDP00(-1))** | **-0.099** | **0.017** | **-5.954** | **0.000** |
| **LOG(DE_CAPITAL00(-1) +50*(100+(T80)))** | **-0.065** | **0.011** | **-5.738** | **0.000** |
| **S91Q1** | **0.015** | **0.003** | **4.970** | **0.000** |
| C | 1.026 | 0.172 | 5.962 | 0.000 |
| Z1 | -0.009 | 0.003 | -2.930 | 0.004 |
| Z2 | 0.007 | 0.002 | 4.286 | 0.000 |
| Z3 | 0.004 | 0.002 | 2.885 | 0.005 |
| S91Q1*Z1 | -0.001 | 0.002 | -0.556 | 0.579 |
| S91Q1*Z2 | -0.004 | 0.002 | -2.779 | 0.007 |
| S91Q1*Z3 | -0.004 | 0.002 | -2.007 | 0.047 |
| ΔLOG(DE_EE(-1)) +ΔLOG(DE_EE(-2)) | 0.086 | 0.046 | 1.896 | 0.061 |
| ΔLOG(DE_EE(-4)) | 0.410 | 0.071 | 5.796 | 0.000 |
| ΔLOG(DE_GDP00) | 0.074 | 0.021 | 3.471 | 0.001 |
| ΔLOG(DE_CAPITAL00(-1)) | -0.255 | 0.106 | -2.402 | 0.018 |
| ΔLOG(DE_CAPITAL00(-2)) | -0.236 | 0.101 | -2.344 | 0.021 |
| I90Q1 | 0.013 | 0.003 | 4.254 | 0.000 |
| I91Q1 | 0.289 | 0.006 | 50.816 | 0.000 |
| I91Q1(-4) | -0.130 | 0.023 | -5.559 | 0.000 |
| DUMMY_KA(-4) | 0.000 | 0.000 | 3.079 | 0.003 |

The specification passes all diagnostic tests at the 5 percent level.

**Table 62: Diagnostics of Estimation equation of ΔLOG(DE_EE)**

| **Adjusted R2** | **0.99** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.88 |
| Serial correlation LM test (lag 1) | 0.16 |
| Serial correlation LM test (lag 4) | 0.19 |
| Serial correlation LM test (lag 8) | 0.48 |
| ARCH LM test (lag 1) | 0.51 |
| ARCH LM test (lag 4) | 0.26 |
| White's heteroskedasticity test | 0.08 |
| RESET test (h=2) | 0.77 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Total employment*

As total employment is mostly made up of employees the same variables are used for the estimation of the long-term relationship in the estimation equation of total employment. Again the error-correction coefficient is highly significant: -6.139 (5 percent critical value: -3.69).

**Table 63: Estimation equation of ΔLOG(DE_ET)**

| **Dependent Variable: ΔLOG(DE_ET)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q2 2011Q4**<br>**Included observations: 123 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_ET(-1))-LOG(DE_GDP00(-1))** | **-0.089** | **0.014** | **-6.139** | **0.000** |
| **LOG(DE_CAPITAL00(-1)+50*(100+(T80)))** | **-0.055** | **0.009** | **-5.867** | **0.000** |
| **S91Q1** | **0.011** | **0.002** | **4.865** | **0.000** |
| C | 0.902 | 0.147 | 6.151 | 0.000 |
| Z1 | -0.010 | 0.003 | -3.328 | 0.001 |
| Z2 | 0.007 | 0.001 | 4.764 | 0.000 |
| Z3 | 0.004 | 0.001 | 3.217 | 0.002 |
| S91Q1*Z1 | 0.000 | 0.002 | -0.226 | 0.821 |
| S91Q1*Z2 | -0.003 | 0.001 | -2.501 | 0.014 |
| S91Q1*Z3 | -0.003 | 0.002 | -1.975 | 0.051 |
| ΔLOG(DE_ET(-1))+ΔLOG(DE_ET(-2)) | 0.099 | 0.044 | 2.222 | 0.029 |
| ΔLOG(DE_ET(-4)) | 0.371 | 0.071 | 5.190 | 0.000 |
| ΔLOG(DE_GDP00) | 0.062 | 0.019 | 3.269 | 0.002 |
| ΔLOG(DE_CAPITAL00(-1)) | -0.269 | 0.098 | -2.749 | 0.007 |
| ΔLOG(DE_CAPITAL00(-2)) | -0.253 | 0.093 | -2.729 | 0.008 |
| I90Q1 | 0.011 | 0.003 | 4.087 | 0.000 |
| I91Q1 | 0.278 | 0.005 | 57.105 | 0.000 |
| I91Q1(-4) | -0.112 | 0.022 | -4.999 | 0.000 |
| DUMMY_KA(-4) | 0.000 | 0.000 | 3.151 | 0.002 |

The specification passes all diagnostic tests.

**Table 64: Diagnostics of estimation equation of ΔLOG(DE_ET)**

| **Adjusted R2** | **0.99** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.69 |
| Serial correlation LM test (lag 1) | 0.32 |
| Serial correlation LM test (lag 4) | 0.31 |
| Serial correlation LM test (lag 8) | 0.63 |
| ARCH LM test (lag 1) | 0.44 |
| ARCH LM test (lag 4) | 0.53 |
| White's heteroskedasticity test | 0.28 |
| RESET test (h=2) | 0.77 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Unemployment*

There is an inverse long-term relationship between employment and unemployment. Some structural changes are accounted for by step dummies. With a t-statistic of -6.717 the error-correction coefficient is highly significant (5 percent critical value: -3.74).

**Table 65: Estimation equation of Δ(DE_U)**

| **Dependent Variable: Δ(DE_U)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q2 2011Q4**<br>**Included observations: 123 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **DE_U(-1)** | **-0.088** | **0.013** | **-6.717** | **0.000** |
| **DE_EE(-1)** | **-0.027** | **0.006** | **-4.230** | **0.000** |
| **S91Q1** | **452.583** | **68.480** | **6.609** | **0.000** |
| **S06Q1** | **-58.329** | **20.802** | **-2.804** | **0.006** |
| C | 832.453 | 149.439 | 5.571 | 0.000 |
| Z1 | 146.905 | 48.855 | 3.007 | 0.003 |
| Z2 | -408.881 | 40.875 | -10.003 | 0.000 |
| Z3 | -10.883 | 35.002 | -0.311 | 0.757 |
| Z1*S91Q1 | 324.004 | 49.216 | 6.583 | 0.000 |
| Z2*S91Q1 | 82.828 | 38.917 | 2.128 | 0.036 |
| Z3*S91Q1 | 140.700 | 42.365 | 3.321 | 0.001 |
| Δ(DE_U(-1)) | 0.413 | 0.070 | 5.874 | 0.000 |
| Δ(DE_EE(-1)) | -0.018 | 0.007 | -2.458 | 0.016 |
| ΔLOG(DE_GDP00(-4)) | -1157.427 | 363.500 | -3.184 | 0.002 |
| I05Q1 | 555.800 | 69.305 | 8.020 | 0.000 |
| I05Q2 | -213.482 | 80.722 | -2.645 | 0.009 |

The CUSUM of squares test indicates some instability. Otherwise the specification passes all diagnostic tests at the 5 percent level.

**Table 66: Diagnostics of estimation equation of Δ(DE_U)**

| **Adjusted R2** | **0.94** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.24 |
| Serial correlation LM test (lag 1) | 0.17 |
| Serial correlation LM test (lag 4) | 0.18 |
| Serial correlation LM test (lag 8) | 0.26 |
| ARCH LM test (lag 1) | 0.18 |
| ARCH LM test (lag 4) | 0.75 |
| White's heteroskedasticity test | 0.09 |
| RESET test (h=2) | 0.87 |
| **Stability tests** | **Number of observations outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 5 |

### *Distributed profits*

In the long term distributed profits are explained by operating surplus and mixed income less direct taxes on operating surplus and mixed income and a trend beginning in 1970. Although the error-correction coefficient is not significant this specification is adhered to because it makes economic sense and there is no viable alternative.

**Table 67: Estimation equation of ΔLOG(DE_WDYENT)**

| **Dependent Variable: ΔLOG(DE_WDYENT)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1992Q2 2011Q4**<br>**Included observations: 79 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_WDYENT(-1))** | **-0.302** | **0.104** | **-2.917** | **0.005** |
| **LOG(DE_GYPROP(-1)-DE_TDIREM1(-1))** | **0.139** | **0.066** | **2.129** | **0.037** |
| **@TREND(1970:1)** | **0.001** | **0.001** | **2.061** | **0.043** |
| C | 0.541 | 0.307 | 1.761 | 0.083 |
| Z1 | 0.005 | 0.042 | 0.121 | 0.904 |
| Z2 | 0.066 | 0.030 | 2.228 | 0.029 |
| Z3 | -0.017 | 0.036 | -0.484 | 0.630 |
| ΔLOG(DE_GYPROP-DE_TDIREM1) | 0.380 | 0.068 | 5.569 | 0.000 |
| ΔLOG(DE_GYPROP(-2)-DE_TDIREM1(-2))<br>+ΔLOG(DE_GYPROP(-3)-DE_TDIREM1(-3)) | 0.112 | 0.054 | 2.096 | 0.040 |
| ΔLOG(DE_WDYENT(-1)) | -0.149 | 0.093 | -1.608 | 0.113 |
| ΔLOG(DE_WDYENT(-2)) | -0.212 | 0.087 | -2.448 | 0.017 |
| ΔLOG(DE_WDYENT(-4)-DE_RES_WDYENT(-4)) | 0.382 | 0.075 | 5.085 | 0.000 |

The residuals are well-behaved. There may be some heteroskedasticity in the residuals. The specification is stable over the sample period.

**Table 68: Diagnostics of estimation equation of ΔLOG(DE_WDYENT)**

| **Adjusted R2** | **0.94** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.65 |
| Serial correlation LM test (lag 1) | 0.37 |
| Serial correlation LM test (lag 4) | 0.38 |
| Serial correlation LM test (lag 8) | 0.62 |
| ARCH LM test (lag 1) | 0.40 |
| ARCH LM test (lag 4) | 0.53 |
| White's heteroskedasticity test | 0.06 |
| RESET test (h=2) | 0.17 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *Monetary transfers received by households*

An error-correction equation has been estimated for monetary transfers received by households. Their long-term behaviour is explained by wages and salaries, a step dummy and a trend. With a t-statistic of -4.851 the error-correction coefficient is highly significant (5 percent critical value: -3.91).

**Table 69: Estimation equation of ΔLOG(DE_TRFGOV_PH)**

| **Dependent Variable: ΔLOG(DE_TRFGOV_PH)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1992Q2 2011Q4**<br>**Included observations: 79 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_TRFGOV_PH(-1))** | **-0.266** | **0.055** | **-4.851** | **0.000** |
| **LOG(DE_GWAGEE(-1))** | **0.248** | **0.090** | **2.754** | **0.008** |
| **LOG(@TREND)** | **0.068** | **0.032** | **2.164** | **0.034** |
| **S06Q2** | **-0.017** | **0.006** | **-3.084** | **0.003** |
| C | -1.249 | 0.652 | -1.914 | 0.060 |
| Z1 | -0.015 | 0.011 | -1.369 | 0.176 |
| Z2 | 0.011 | 0.011 | 0.986 | 0.328 |
| Z3 | -0.037 | 0.019 | -1.939 | 0.057 |
| ΔLOG(DE_TRFGOV_PH(-4)) | 0.167 | 0.089 | 1.877 | 0.065 |
| ΔLOG(DE_GWAGEE(-2)) | -0.200 | 0.102 | -1.953 | 0.055 |
| I09Q1-I08Q4 | 0.025 | 0.007 | 3.342 | 0.001 |
| I09Q2 | 0.033 | 0.011 | 3.058 | 0.003 |

The residuals are generally well-behaved and the specification is stable. However, the RESET test indicates some form of misspecification.

**Table 70: Diagnostics of estimation equation of ΔLOG(DE_TRFGOV_PH)**

| **Adjusted R2** | **0.77** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.84 |
| Serial correlation LM test (lag 1) | 0.66 |
| Serial correlation LM test (lag 4) | 0.35 |
| Serial correlation LM test (lag 8) | 0.52 |
| ARCH LM test (lag 1) | 0.48 |
| ARCH LM test (lag 4) | 0.39 |
| White's heteroskedasticity test | 0.24 |
| RESET test (h=2) | 0.00 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### 3.1.4. General Government

#### *3.1.4.1. Expenditures*

Unlike the other government expenditure aggregates nominal government expenditure is not estimated directly. Instead it is calculated as the product of real government consumption and the government consumption deflator divided by 100. Definitions are presented in section 3.2.5. All other government expenditures are estimated. The equations are presented below.

##### Monetary transfers

Like monetary transfers received by households monetary transfers paid by the government move in line with wages and salaries in the long run. The error-correction coefficient is significant exhibiting a t-statistic of -3.569 (5 percent critical value: -3.41). Unemployment plays a role only for the short-term dynamics.

**Table 71: Estimation equation of ΔLOG(DE_TRFGOV)**

| **Dependent Variable: ΔLOG(DE_TRFGOV)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1991Q4 2011Q4**<br>**Included observations: 81 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_TRFGOV(-1))** | **-0.093** | **0.026** | **-3.569** | **0.001** |
| **LOG(DE_GWAGEE(-5))** | **0.088** | **0.044** | **2.006** | **0.049** |
| C | -0.343 | 0.280 | -1.225 | 0.225 |
| Z1 | -0.067 | 0.016 | -4.037 | 0.000 |
| Z2 | 0.035 | 0.018 | 1.951 | 0.055 |
| Z3 | -0.043 | 0.014 | -3.002 | 0.004 |
| ΔLOG(DE_U) | 0.176 | 0.044 | 4.012 | 0.000 |
| ΔLOG(DE_TRFGOV(-1))+ΔLOG(DE_TRFGOV(-2)) | -0.171 | 0.064 | -2.673 | 0.009 |
| ΔLOG(DE_GWAGEE(-1)) | 0.388 | 0.095 | 4.096 | 0.000 |
| ΔLOG(DE_GWAGEE(-3)) | 0.210 | 0.049 | 4.316 | 0.000 |
| I09Q2 | 0.031 | 0.011 | 2.886 | 0.005 |

The specification passes all diagnostic tests. The residuals are well-behaved and the estimation equation is stable over the sample period.

**Table 72: Diagnostics of estimation equation of ΔLOG(DE_TRFGOV)**

| **Adjusted R2** | **0.86** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.79 |
| Serial correlation LM test (lag 1) | 0.81 |
| Serial correlation LM test (lag 4) | 0.78 |
| Serial correlation LM test (lag 8) | 0.65 |
| ARCH LM test (lag 1) | 0.91 |
| ARCH LM test (lag 4) | 0.77 |
| White's heteroskedasticity test | 0.66 |
| RESET test (h=2) | 0.10 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### Property income paid

Property income paid comprises the government's interest payments on debt. A cointegrating relationship has been established between property income paid and the product of government debt and the long-term interest rate divided by 100. With a t-statistic of -6.200 the error-correction coefficient is highly significant (5 percent critical value: -3.19).

**Table 73: Estimation equation of ΔLOG(DE_INTPAGOV)**

| **Dependent Variable: ΔLOG(DE_INTPAGOV)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1991Q3 2011Q4**<br>**Included observations: 82 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_INTPAGOV(-1))** | **-0.194** | **0.031** | **-6.200** | **0.000** |
| **LOG(DE_DBTGOV(-1)*DE_RL10Y(-1)/100)** | **0.058** | **0.026** | **2.191** | **0.032** |
| C | 0.305 | 0.099 | 3.082 | 0.003 |
| Z1 | -0.014 | 0.008 | -1.797 | 0.076 |
| Z2 | 0.006 | 0.008 | 0.827 | 0.411 |
| Z3 | -0.009 | 0.008 | -1.145 | 0.256 |
| ΔLOG(DE_INTPAGOV(-1)) | -0.170 | 0.094 | -1.817 | 0.073 |
| I11Q1 | 0.092 | 0.025 | 3.662 | 0.001 |

Except for White's heteroskedasticity test the specification passes all diagnostic tests.

**Table 74: Diagnostics of estimation equation of ΔLOG(DE_INTPAGOV)**

| **Adjusted R2** | **0.40** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.39 |
| Serial correlation LM test (lag 1) | 0.27 |
| Serial correlation LM test (lag 4) | 0.55 |
| Serial correlation LM test (lag 8) | 0.73 |
| ARCH LM test (lag 1) | 0.90 |
| ARCH LM test (lag 4) | 0.27 |
| White's heteroskedasticity test | 0.00 |
| RESET test (h=2) | 0.64 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### Other current transfers paid

Other current transfers are explained only by a trend and the lagged dependent variable. There are some outliers. It proved impossible to explain this variable using only other variables of the model. Thus, essentially the variable remains exogenous.

**Table 75: Estimation equation of LOG(DE_TRSONGOV)**

| **Dependent Variable: LOG(DE_TRSONGOV)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1992Q1 2011Q4**<br>**Included observations: 80 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 0.965 | 0.122 | 7.919 | 0.000 |
| Z1 | 0.064 | 0.027 | 2.406 | 0.019 |
| Z2 | -0.028 | 0.028 | -0.981 | 0.330 |
| Z3 | 0.039 | 0.027 | 1.481 | 0.143 |
| @TREND | 0.007 | 0.001 | 8.966 | 0.000 |
| LOG(DE_TRSONGOV(-4)) | 0.286 | 0.080 | 3.564 | 0.001 |
| I93Q4 | 0.322 | 0.084 | 3.827 | 0.000 |
| I00Q4 | 0.284 | 0.083 | 3.413 | 0.001 |
| I09Q4 | 0.275 | 0.084 | 3.275 | 0.002 |

Except for the RESET test the specification passes all diagnostic tests.

**Table 76: Diagnostics of estimation equation of LOG(DE_TRSONGOV)**

| **Adjusted R2** | **0.89** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.52 |
| Serial correlation LM test (lag 1) | 0.10 |
| Serial correlation LM test (lag 4) | 0.18 |
| Serial correlation LM test (lag 8) | 0.16 |
| ARCH LM test (lag 1) | 0.40 |
| ARCH LM test (lag 4) | 0.46 |
| White's heteroskedasticity test | 0.60 |
| RESET test (h=2) | 0.01 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### Capital transfers paid

This variable is I(0). Therefore no attempts were made to estimate an error-correction equation. In addition the variable seems totally uncorrelated with any other model variable. It is thus explained only by lagged observations and deterministics.

**Table 77: Estimation equation of LOG(DE_PROTRGOV)**

| **Dependent Variable: LOG(DE_PROTRGOV)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1991Q3 2011Q4**<br>**Included observations: 82 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 2.017 | 0.163 | 12.397 | 0.000 |
| Z1 | -0.163 | 0.075 | -2.179 | 0.033 |
| Z2 | -0.527 | 0.088 | -5.998 | 0.000 |
| Z3 | -0.496 | 0.081 | -6.095 | 0.000 |
| @TREND | 0.004 | 0.001 | 3.203 | 0.002 |
| LOG(DE_PROTRGOV(-2)) | -0.200 | 0.078 | -2.564 | 0.012 |
| I95Q1 | 2.671 | 0.237 | 11.283 | 0.000 |
| I95Q3 | 1.919 | 0.316 | 6.077 | 0.000 |
| I10Q3 | 1.734 | 0.239 | 7.259 | 0.000 |

Due to the limited availability of suitable variables it has proved impossible to estimate an equation that passes all diagnostic tests. Auto-correlation and heteroskedasticity could not be avoided.

**Table 78: Diagnostics of estimation equation of LOG(DE_PROTRGOV)**

| **Adjusted R2** | **0.81** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.43 |
| Serial correlation LM test (lag 1) | 0.70 |
| Serial correlation LM test (lag 4) | 0.00 |
| Serial correlation LM test (lag 8) | 0.00 |
| ARCH LM test (lag 1) | 0.14 |
| ARCH LM test (lag 4) | 0.00 |
| White's heteroskedasticity test | 0.00 |
| RESET test (h=2) | 0.55 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 7 |

### Net acquisition of non-produced assets

This variable is I(0). Therefore no attempts were made to estimate an error-correction equation. In addition the variable seems totally uncorrelated with any other model variable. It is thus explained only by lagged observations and deterministics.

**Table 79: Estimation equation of DE_NETPRGOV**

| **Dependent Variable: DE_NETPRGOV**<br>**Method: Least Squares**<br>**Sample (adjusted): 1991Q2 2011Q4**<br>**Included observations: 83 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | -0.364 | 0.009 | -41.627 | 0.000 |
| Z1 | 0.145 | 0.022 | 6.574 | 0.000 |
| Z2 | 0.149 | 0.022 | 6.749 | 0.000 |
| Z3 | 0.104 | 0.022 | 4.740 | 0.000 |
| (1-S95Q1)*@TREND | 0.001 | 0.000 | 3.461 | 0.001 |
| DE_NETPRGOV(-1) | -0.002 | 0.001 | -1.233 | 0.222 |
| I00Q3 | -50.773 | 0.072 | -709.156 | 0.000 |
| I10Q2 | -4.359 | 0.072 | -60.892 | 0.000 |

Except for the RESET test the estimation equation passes all specification tests. The residuals are uncorrelated and can be assumed to be homoskedastic. The specification is stable over the sample period.

**Table 80: Diagnostics of estimation equation of DE_NETPRGOV**

| **Adjusted R2** | **0.9999** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.12 |
| Serial correlation LM test (lag 1) | 0.12 |
| Serial correlation LM test (lag 4) | 0.17 |
| Serial correlation LM test (lag 8) | 0.52 |
| ARCH LM test (lag 1) | 0.96 |
| ARCH LM test (lag 4) | 0.22 |
| White's heteroskedasticity test | 0.28 |
| RESET test (h=2) | 0.03 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### Other expenditures

Other expenditures are also explained by past observations and deterministics.

**Table 81: Estimation equation of LOG(DE_EXPOTH)**

| **Dependent Variable: LOG(DE_EXPOTH)** | | | | |
|---|---|---|---|---|
| **Method: Least Squares** | | | | |
| **Sample (adjusted): 1993Q1 2011Q4** | | | | |
| **Included observations: 76 after adjustments** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 0.230 | 0.099 | 2.314 | 0.024 |
| Z1 | -0.319 | 0.049 | -6.554 | 0.000 |
| Z2 | -0.237 | 0.045 | -5.315 | 0.000 |
| Z3 | -0.070 | 0.045 | -1.551 | 0.126 |
| LOG(DE_EXPOTH(-1)) | 0.384 | 0.087 | 4.411 | 0.000 |
| LOG(DE_EXPOTH(-3)) | 0.111 | 0.050 | 2.196 | 0.032 |
| LOG(DE_EXPOTH(-4)) | 0.122 | 0.051 | 2.381 | 0.021 |
| LOG(DE_EXPOTH(-7)) | 0.104 | 0.050 | 2.079 | 0.042 |
| LOG(DE_EXPOTH(-8)) | 0.105 | 0.051 | 2.067 | 0.043 |
| I95Q1 | 0.623 | 0.087 | 7.153 | 0.000 |
| I95Q2 | -1.550 | 0.099 | -15.624 | 0.000 |
| I95Q3 | 0.418 | 0.143 | 2.932 | 0.005 |
| I00Q3 | -0.395 | 0.088 | -4.510 | 0.000 |
| I00Q4 | 0.478 | 0.093 | 5.147 | 0.000 |
| S05Q1 | 0.144 | 0.045 | 3.155 | 0.003 |
| I11Q1 | 0.198 | 0.093 | 2.127 | 0.038 |

There is some indication of higher order autocorrelation. The specification is stable and the residuals are homoskedastic.

**Table 82: Diagnostics of estimation equation of LOG(DE_EXPOTH)**

| **Adjusted R2** | **0.96** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.61 |
| Serial correlation LM test (lag 1) | 0.76 |
| Serial correlation LM test (lag 4) | 0.00 |
| Serial correlation LM test (lag 8) | 0.00 |
| ARCH LM test (lag 1) | 0.89 |
| ARCH LM test (lag 4) | 0.89 |
| White's heteroskedasticity test | 0.79 |
| RESET test (h=2) | 0.08 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### *3.1.4.2. Revenues*

Social contributions from employees and from employers are calculated from gross wages and salaries and the seasonally adjusted average contribution rates (for the documentation of the definition see section 3.2.5 below).

#### Indirect taxes

Most indirect taxes are closely connected to nominal private consumption. This is why a cointegrating relationship has been established between indirect taxes and nominal private consumption multiplied by the average seasonally adjusted indirect tax rate. With a t-statistic of -3.785 the error-correction coefficient is significant (5 percent critical value: -3.41).

**Table 83: Estimation equation of ΔLOG(DE_TIND)**

| **Dependent Variable: ΔLOG(DE_TIND)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1991Q3 2011Q4**<br>**Included observations: 82 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_TIND(-1))** | **-0.670** | **0.177** | **-3.785** | **0.000** |
| **LOG(DE_TIND_TARIFFSA_SA(-1) *DE_CP00(-1)*DE_PCP00(-1)/100)** | **0.652** | **0.178** | **3.667** | **0.001** |
| C | -2.919 | 0.823 | -3.547 | 0.001 |
| Z1 | -0.036 | 0.009 | -3.794 | 0.000 |
| Z2 | -0.031 | 0.011 | -2.725 | 0.008 |
| Z3 | -0.045 | 0.007 | -6.094 | 0.000 |
| S96Q4*Z1 | 0.006 | 0.010 | 0.575 | 0.567 |
| S96Q4*Z2 | 0.040 | 0.009 | 4.555 | 0.000 |
| S96Q4*Z3 | 0.043 | 0.008 | 5.134 | 0.000 |
| ΔLOG(DE_TIND_TARIFFSA_SA) | 1.005 | 0.056 | 17.822 | 0.000 |
| ΔLOG(DE_TIND(-1)) | -0.445 | 0.096 | -4.638 | 0.000 |
| ΔLOG(DE_TIND_TARIFFSA_SA(-1)) | 0.469 | 0.108 | 4.353 | 0.000 |
| I08Q4 | -0.026 | 0.012 | -2.109 | 0.039 |

The residuals show some higher-order autocorrelation as well as heteroskedasticity. Further the specification is not completely stable over the sample.

**Table 84: Diagnostics of estimation equation of ΔLOG(DE_TIND)**

| **Adjusted R2** | **0.89** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.76 |
| Serial correlation LM test (lag 1) | 0.45 |
| Serial correlation LM test (lag 4) | 0.03 |
| Serial correlation LM test (lag 8) | 0.06 |
| ARCH LM test (lag 1) | 0.93 |
| ARCH LM test (lag 4) | 0.15 |
| White's heteroskedasticity test | 0.05 |
| RESET test (h=2) | 0.38 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 7 |

### Direct taxes on wages and salaries

The long-term evolution of direct taxes on wages and salaries is explained by gross wages and salaries per employee, the number of employees and a step dummy accounting for tax reform at the turn of the millennium.

**Table 85: Estimation equation of ΔLOG(DE_TDIREE)**

| **Dependent Variable: ΔLOG(DE_TDIREE)**<br>**Method: Least Squares**<br>**Sample: 1982Q2 2011Q4**<br>**Included observations: 119** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_TDIREE(-1))** | **-0.273** | **0.056** | **-4.889** | **0.000** |
| **LOG(DE_GWAGEE(-1))** | **0.353** | **0.077** | **4.589** | **0.000** |
| **LOG(DE_EE(-1))** | **0.221** | **0.064** | **3.462** | **0.001** |
| **S00Q1** | **-0.029** | **0.008** | **-3.458** | **0.001** |
| C | -4.392 | 0.973 | -4.516 | 0.000 |
| Z1 | -0.083 | 0.043 | -1.906 | 0.060 |
| Z2 | -0.087 | 0.039 | -2.231 | 0.028 |
| Z3 | -0.130 | 0.044 | -2.928 | 0.004 |
| ΔLOG(DE_TDIREE(-1)) | 0.213 | 0.085 | 2.515 | 0.013 |
| ΔLOG(DE_TDIREE(-3)) | -0.182 | 0.059 | -3.069 | 0.003 |
| ΔLOG(DE_TDIREE(-4)) | 0.625 | 0.057 | 11.013 | 0.000 |
| ΔLOG(DE_EE(-1)) | -0.301 | 0.157 | -1.916 | 0.058 |
| ΔLOG(DE_GWAGEE(-1)) | -0.915 | 0.249 | -3.672 | 0.000 |
| ΔLOG(DE_GWAGEE(-2)) | -0.517 | 0.122 | -4.229 | 0.000 |
| I90Q1 | -0.116 | 0.026 | -4.563 | 0.000 |

Except for White’s heteroskedasticity test the specification passes all diagnostic tests.

**Table 86: Diagnostics of estimation equation of ΔLOG(DE_TDIREE)**

| **Adjusted R2** | **0.99** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.53 |
| Serial correlation LM test (lag 1) | 0.29 |
| Serial correlation LM test (lag 4) | 0.82 |
| Serial correlation LM test (lag 8) | 0.93 |
| ARCH LM test (lag 1) | 0.52 |
| ARCH LM test (lag 4) | 0.47 |
| White's heteroskedasticity test | 0.01 |
| RESET test (h=2) | 0.38 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### Direct taxes on operating surplus and mixed income

In the long term direct taxes on operating surplus and mixed income depend on operating surplus and mixed income. With a t-statistic of -4.071 the error-correction coefficient is highly significant (5 percent critical value: -3.69).

**Table 87: Estimation equation of ΔLOG(DE_TDIREM1)**

| **Dependent Variable: ΔLOG(DE_TDIREM1)** | | | | |
|---|---|---|---|---|
| **Method: Least Squares** | | | | |
| **Sample (adjusted): 1992Q4 2011Q4** | | | | |
| **Included observations: 77 after adjustments** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_TDIREM1(-1))** | **-0.151** | **0.037** | **-4.071** | **0.000** |
| **LOG(DE_GYPROP(-1))** | **0.165** | **0.045** | **3.689** | **0.001** |
| C | -0.315 | 0.144 | -2.194 | 0.032 |
| Z1 | -0.040 | 0.042 | -0.944 | 0.349 |
| Z2 | -0.021 | 0.019 | -1.109 | 0.272 |
| Z3 | -0.118 | 0.057 | -2.092 | 0.041 |
| ΔLOG(DE_TDIREM1(-1)) | 0.694 | 0.094 | 7.353 | 0.000 |
| ΔLOG(DE_TDIREM1(-2)) | -0.344 | 0.093 | -3.686 | 0.001 |
| ΔLOG(DE_TDIREM1(-4)) | 0.790 | 0.093 | 8.507 | 0.000 |
| ΔLOG(DE_TDIREM1(-5)) | -0.446 | 0.110 | -4.051 | 0.000 |
| ΔLOG(DE_TDIREM1(-6)) | 0.340 | 0.109 | 3.132 | 0.003 |
| ΔLOG(DE_GYPROP(-7)) | -0.205 | 0.105 | -1.946 | 0.056 |
| Δ (DE_RS3M(-3)) | -0.043 | 0.013 | -3.283 | 0.002 |
| I95Q1 | -0.124 | 0.041 | -2.996 | 0.004 |

The residuals are well-behaved and the specification is stable over the sample. All diagnostic tests are passed.

**Table 88: Diagnostics of estimation equation of ΔLOG(DE_TDIREM1)**

| **Adjusted R2** | **0.88** |
|---|---|
| Residual tests | |
| Normality test (Jarque-Bera) | 0.16 |
| Serial correlation LM test (lag 1) | 0.81 |
| Serial correlation LM test (lag 4) | 0.99 |
| Serial correlation LM test (lag 8) | 0.29 |
| ARCH LM test (lag 1) | 0.97 |
| ARCH LM test (lag 4) | 0.91 |
| White's heteroskedasticity test | 0.91 |
| RESET test (h=2) | 0.41 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### Property income received

Property income receive is also estimated as an error-correction equation. There is a long-run relationship between property income received, the nominal short-term interest rate and a linear trend. The error-correction coefficient is highly significant exhibiting a t-statistic of -5.175 compared to the 5 percent critical value of -3.69.

**Table 89: Estimation equation of ΔLOG(DE_YPROGOV)**

| **Dependent Variable: ΔLOG(DE_YPROGOV)**<br>**Method: Least Squares**<br>**Sample (adjusted): 1991Q3 2011Q4**<br>**Included observations: 82 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| **LOG(DE_YPROGOV(-1))** | **-0.489** | **0.094** | **-5.175** | **0.000** |
| **@TREND** | **0.003** | **0.001** | **3.076** | **0.003** |
| **DE_RS3M(-1)** | **0.031** | **0.012** | **2.583** | **0.012** |
| C | 0.330 | 0.149 | 2.217 | 0.030 |
| Z1 | -0.043 | 0.093 | -0.461 | 0.646 |
| Z2 | 1.109 | 0.083 | 13.429 | 0.000 |
| Z3 | -0.065 | 0.139 | -0.468 | 0.642 |
| Z1*S05Q1 | 0.649 | 0.111 | 5.839 | 0.000 |
| Z2*S05Q1 | -0.982 | 0.108 | -9.069 | 0.000 |
| Z3*S05Q1 | -0.064 | 0.164 | -0.391 | 0.697 |
| ΔLOG(DE_YPROGOV(-1)) | -0.245 | 0.083 | -2.941 | 0.004 |
| I04Q2 | -1.013 | 0.149 | -6.817 | 0.000 |
| I05Q1 | -0.681 | 0.153 | -4.456 | 0.000 |

The CUSUM of squares test indicates some instability. Otherwise the specification passes all diagnostic tests.

**Table 90: Diagnostics of estimation equation of ΔLOG(DE_YPROGOV)**

| **Adjusted R2** | **0.95** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.21 |
| Serial correlation LM test (lag 1) | 0.35 |
| Serial correlation LM test (lag 4) | 0.23 |
| Serial correlation LM test (lag 8) | 0.11 |
| ARCH LM test (lag 1) | 0.87 |
| ARCH LM test (lag 4) | 0.23 |
| White's heteroskedasticity test | 0.80 |
| RESET test (h=2) | 0.13 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 11 |

### Other current transfers received

Other current transfers received cannot be explained by any other variable of the model. Rather the variable is estimated using lagged observations and deterministics. There are also numerous outliers. In fact, the variable remains exogenous.

**Table 91: Estimation equation of DE_REVYTRF**

| **Dependent Variable: DE_REVYTRF**<br>**Method: Least Squares**<br>**Sample (adjusted): 1991Q2 2011Q4**<br>**Included observations: 83 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | 1.243 | 0.291 | 4.272 | 0.000 |
| Z1 | -0.600 | 0.094 | -6.374 | 0.000 |
| Z2 | -0.485 | 0.087 | -5.562 | 0.000 |
| Z3 | -0.275 | 0.088 | -3.131 | 0.003 |
| @TREND | 0.004 | 0.001 | 2.451 | 0.017 |
| DE_REVYTRF(-1) | 0.586 | 0.089 | 6.616 | 0.000 |
| I92Q3 | 0.661 | 0.286 | 2.315 | 0.024 |
| I04Q4 | 1.748 | 0.287 | 6.098 | 0.000 |
| I05Q1 | 2.010 | 0.340 | 5.909 | 0.000 |
| I05Q2 | -1.738 | 0.408 | -4.258 | 0.000 |
| I09Q1 | -0.468 | 0.287 | -1.633 | 0.107 |

The serial correlation LM test indicates higher-order autocorrelation and the specification is not completely stable over the sample.

**Table 92: Diagnostics of estimation equation of DE_REVYTRF**

| **Adjusted R2** | **0.81** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.44 |
| Serial correlation LM test (lag 1) | 0.72 |
| Serial correlation LM test (lag 4) | 0.02 |
| Serial correlation LM test (lag 8) | 0.04 |
| ARCH LM test (lag 1) | 0.74 |
| ARCH LM test (lag 4) | 0.67 |
| White's heteroskedasticity test | 0.78 |
| RESET test (h=2) | 0.99 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 4 |

### Capital transfers received

Being I(0) capital transfers received are estimated in log-levels. Explaining variables are limited to the lagged dependent variable and deterministics. The specification passes all diagnostic tests except for the RESET test.

**Table 93: Estimation equation of LOG(DE_RECPROTR)**

| **Dependent Variable: LOG(DE_RECPROTR)** | | | | |
|---|---|---|---|---|
| **Method: Least Squares** | | | | |
| **Sample (adjusted): 1992Q1 2011Q4** | | | | |
| **Included observations: 80 after adjustments** | | | | |
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | -1.301 | 0.298 | -4.371 | 0.000 |
| Z1 | -0.069 | 0.042 | -1.629 | 0.108 |
| Z2 | -0.176 | 0.046 | -3.853 | 0.000 |
| Z3 | -0.116 | 0.043 | -2.673 | 0.009 |
| LOG(@TREND) | 0.422 | 0.076 | 5.562 | 0.000 |
| I95Q1 | 0.939 | 0.136 | 6.897 | 0.000 |
| LOG(DE_RECPROTR(-4)) | 0.226 | 0.084 | 2.686 | 0.009 |

**Table 94: Diagnostics of estimation equation of LOG(DE_RECPROTR)**

| **Adjusted R2** | **0.70** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.40 |
| Serial correlation LM test (lag 1) | 0.67 |
| Serial correlation LM test (lag 4) | 0.98 |
| Serial correlation LM test (lag 8) | 0.66 |
| ARCH LM test (lag 1) | 0.66 |
| ARCH LM test (lag 4) | 0.29 |
| White's heteroskedasticity test | 0.28 |
| RESET test (h=2) | 0.00 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 0 |

### Sales and other subsidies

cannot be explained by any other variable of the model. Rather the variable is estimated using lagged observations and deterministics. Thus, in fact, the variable remains exogenous.

**Table 95: Estimation equation of DE_SALESSUB**

| **Dependent Variable: DE_SALESSUB**<br>**Method: Least Squares**<br>**Sample (adjusted): 1992Q2 2011Q4**<br>**Included observations: 79 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | -0.172 | 0.180 | -0.958 | 0.342 |
| Z1 | -1.096 | 0.330 | -3.319 | 0.001 |
| Z2 | -0.007 | 0.164 | -0.045 | 0.964 |
| Z3 | -0.086 | 0.313 | -0.274 | 0.785 |
| DE_SALESSUB(-1) | 0.899 | 0.066 | 13.631 | 0.000 |
| DE_SALESSUB(-3) | -0.155 | 0.081 | -1.909 | 0.060 |
| DE_SALESSUB(-4) | 0.790 | 0.090 | 8.821 | 0.000 |
| DE_SALESSUB(-5) | -0.512 | 0.083 | -6.192 | 0.000 |
| I04Q2 | -0.659 | 0.235 | -2.808 | 0.007 |
| I11Q1 | 0.699 | 0.242 | 2.889 | 0.005 |

The CUSUM of squares test points to some instability. Otherwise the specification passes all diagnostic tests.

**Table 96: Diagnostics of estimation equation of DE_SALESSUB**

| **Adjusted R2** | **0.99** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.99 |
| Serial correlation LM test (lag 1) | 0.86 |
| Serial correlation LM test (lag 4) | 0.53 |
| Serial correlation LM test (lag 8) | 0.39 |
| ARCH LM test (lag 1) | 0.99 |
| ARCH LM test (lag 4) | 0.63 |
| White's heteroskedasticity test | 0.45 |
| RESET test (h=2) | 0.66 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 2 |

### 3.1.5. Other variables

#### *Nominal changes in inventories and net acquisitions of valuables*

The variable is I(0). Therefore an error-correction equation is not appropriate. Changes in inventories and net acquisitions of valuables are explained by past observations, the coincident change of total demand and deterministics.

**Table 97: Estimation equation of DE_INV**

| **Dependent Variable: DE_INV**<br>**Method: Least Squares**<br>**Sample (adjusted): 1981Q1 2011Q4**<br>**Included observations: 124 after adjustments** | | | | |
|---|---|---|---|---|
| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
| C | -0.158 | 0.299 | -0.527 | 0.599 |
| Z1 | 14.892 | 2.089 | 7.129 | 0.000 |
| Z2 | 3.997 | 1.270 | 3.147 | 0.002 |
| Z3 | 10.404 | 1.612 | 6.454 | 0.000 |
| DE_INV(-1) | 0.281 | 0.073 | 3.845 | 0.000 |
| DE_INV(-4) | 0.511 | 0.071 | 7.158 | 0.000 |
| S91Q1*Z1 | 6.859 | 1.653 | 4.149 | 0.000 |
| S91Q1*Z2 | -2.182 | 1.511 | -1.444 | 0.152 |
| S91Q1*Z3 | 3.067 | 1.657 | 1.851 | 0.067 |
| Δ(DE_GDP+DE_M) | 0.066 | 0.025 | 2.641 | 0.010 |
| I06Q4 | -9.938 | 2.671 | -3.720 | 0.000 |
| I09Q2 | -11.760 | 2.712 | -4.336 | 0.000 |
| I09Q2(2) | 3.756 | 2.849 | 1.318 | 0.190 |

Except for White's heteroskedasticity test the specification passes all diagnostic tests at the 5 percent level. However, the probability of first order autocorrelation is close to 5 percent.

**Table 98: Diagnostics of estimation equation of DE_INV**

| **Adjusted R2** | **0.94** |
|---|---|
| **Residual tests** | |
| Normality test (Jarque-Bera) | 0.67 |
| Serial correlation LM test (lag 1) | 0.06 |
| Serial correlation LM test (lag 4) | 0.18 |
| Serial correlation LM test (lag 8) | 0.20 |
| ARCH LM test (lag 1) | 0.72 |
| ARCH LM test (lag 4) | 0.52 |
| White's heteroskedasticity test | 0.00 |
| RESET test (h=2) | 0.06 |
| **Stability tests** | **outside error bands** |
| CUSUM test | 0 |
| CUSUM of squares test | 65 |

## 3.2. Definitions

### 3.2.1. Real GDP

**de_gdp00** = (1 - s91q1agg) * (de_cp00 + de_cgov00 + de_gcf00 + de_x00 - de_m00) + @nan(s91q1agg * ((@movav(de_pcp00(-1) , 4) * s1 + @movav(de_pcp00(-2) , 4) * s2 + @movav(de_pcp00(-3) , 4) * s3 + @movav(de_pcp00(-4) , 4) * s4) / ( @movav(de_pgdp00(-1) , 4) * s1 + @movav(de_pgdp00(-2) , 4) * s2 + @movav(de_pgdp00(-3) , 4) * s3 + @movav(de_pgdp00(-4) , 4) * s4) * de_cp00 + (@movav(de_pcgov00(-1) , 4) * s1 + @movav(de_pcgov00(-2) , 4) * s2 + @movav(de_pcgov00(-3) , 4) * s3 + @movav(de_pcgov00(-4) , 4) * s4) / ( @movav(de_pgdp00(-1) , 4) * s1 + @movav(de_pgdp00(-2) , 4) * s2 + @movav(de_pgdp00(-3) , 4) * s3 + @movav(de_pgdp00(-4) , 4) * s4) * de_cgov00 + (@movav(de_pgcf00(-1) , 4) * s1 + @movav(de_pgcf00(-2) , 4) * s2 + @movav(de_pgcf00(-3) , 4) * s3 + @movav(de_pgcf00(-4) , 4) * s4) / (@movav(de_pgdp00(-1) , 4) * s1 + @movav(de_pgdp00(-2) , 4) * s2 + @movav(de_pgdp00(-3) , 4) * s3 + @movav(de_pgdp00(-4) , 4) * s4) * de_gcf00 + (@movav(de_px00(-1) , 4) * s1 + @movav(de_px00(-2) , 4) * s2 + @movav(de_px00(-3) , 4) * s3 + @movav(de_px00(-4) , 4) * s4) / (@movav(de_pgdp00(-1) , 4) * s1 + @movav(de_pgdp00(-2) , 4) * s2 + @movav(de_pgdp00(-3) , 4) * s3 + @movav(de_pgdp00(-4) , 4) * s4) * de_x00 - (@movav(de_pm00(-1) , 4) * s1 + @movav(de_pm00(-2) , 4) * s2 + @movav(de_pm00(-3) , 4) * s3 + @movav(de_pm00(-4) , 4) * s4) / (@movav(de_pgdp00(-1) , 4) * s1 + @movav(de_pgdp00(-2) , 4) * s2 + @movav(de_pgdp00(-3) , 4) * s3 + @movav(de_pgdp00(-4) , 4) * s4) * de_m00) , 0)

**de_ifc00** = (1 - s91q1agg) * (de_imeq00 + de_inrb00 + de_id00 + de_icongov00 + de_ioth00) + @nan(s91q1agg * ((@movav(de_pimeq00(-1) , 4) * s1 + @movav(de_pimeq00(-2) , 4) * s2 + @movav(de_pimeq00(-3) , 4) * s3 + @movav(de_pimeq00(-4) , 4) * s4) / ( @movav(de_pifc00(-1) , 4) * s1 + @movav(de_pifc00(-2) , 4) * s2 + @movav(de_pifc00(-3) , 4) * s3 + @movav(de_pifc00(-4) , 4) * s4) * de_imeq00 + (@movav(de_picongov00(-1) , 4) * s1 + @movav(de_picongov00(-2) , 4) * s2 + @movav(de_picongov00(-3) , 4) * s3 + @movav(de_picongov00(-4) , 4) * s4) / ( @movav(de_pifc00(-1) , 4) * s1 + @movav(de_pifc00(-2) , 4) * s2 + @movav(de_pifc00(-3) , 4) * s3 + @movav(de_pifc00(-4) , 4) * s4) * de_icongov00 + (@movav(de_pioth00(-1) , 4) * s1 + @movav(de_pioth00(-2) , 4) * s2 + @movav(de_pioth00(-3) , 4) * s3 + @movav(de_pioth00(-4) , 4) * s4) / (@movav(de_pifc00(-1) , 4) * s1 + @movav(de_pifc00(-2) , 4) * s2 + @movav(de_pifc00(-3) , 4) * s3 + @movav(de_pifc00(-4) , 4) * s4) * de_ioth00 + (@movav(de_pinrb00(-1) , 4) * s1 + @movav(de_pinrb00(-2) , 4) * s2 + @movav(de_pinrb00(-3) , 4) * s3 + @movav(de_pinrb00(-4) , 4) * s4) / (@movav(de_pifc00(-1) , 4) * s1 + @movav(de_pifc00(-2) , 4) * s2 + @movav(de_pifc00(-3) , 4) * s3 + @movav(de_pifc00(-4) , 4) * s4) * de_inrb00 + (@movav(de_pid00(-1) , 4) * s1 + @movav(de_pid00(-2) , 4) * s2 + @movav(de_pid00(-3) , 4) * s3 + @movav(de_pid00(-4) , 4) * s4) / (@movav(de_pifc00(-1) , 4) * s1 + @movav(de_pifc00(-2) , 4) * s2 + @movav(de_pifc00(-3) , 4) * s3 + @movav(de_pifc00(-4) , 4) * s4) * de_id00) , 0)

**de_x00** = (1 - s91q1agg) * (de_xg00 + de_xs00 ) + @nan(s91q1agg * ((@movav(de_pxg00(-1) , 4) * s1 + @movav(de_pxg00(-2) , 4) * s2 + @movav(de_pxg00(-3) , 4) * s3 + @movav(de_pxg00(-4) , 4) * s4) / ( @movav(de_px00(-1) , 4) * s1 + @movav(de_px00(-2) , 4) * s2 + @movav(de_px00(-3) , 4) * s3 + @movav(de_px00(-4) , 4) * s4) * de_xg00 + (@movav(de_pxs00(-1) , 4) * s1 + @movav(de_pxs00(-2) , 4) * s2 + @movav(de_pxs00(-3) , 4) * s3 + @movav(de_pxs00(-4) , 4) * s4) / ( @movav(de_px00(-1) , 4) * s1 + @movav(de_px00(-2) , 4) * s2 + @movav(de_px00(-3) , 4) * s3 + @movav(de_px00(-4) , 4) * s4) * de_xs00) , 0)

**de_m00** = (1 - s91q1agg) * (de_mg00 + de_ms00 ) + @nan(s91q1agg * ((@movav(de_pmg00(-1) , 4) * s1 + @movav(de_pmg00(-2) , 4) * s2 + @movav(de_pmg00(-3) , 4) * s3 + @movav(de_pmg00(-4) , 4) * s4) / ( @movav(de_pm00(-1) , 4) * s1 + @movav(de_pm00(-2) , 4) * s2 + @movav(de_pm00(-3) , 4) * s3 + @movav(de_pm00(-4) , 4) * s4) * de_mg00 + (@movav(de_pms00(-1) , 4) * s1 + @movav(de_pms00(-2) , 4) * s2 + @movav(de_pms00(-3) , 4) * s3 + @movav(de_pms00(-4) , 4) * s4) / ( @movav(de_pm00(-1) , 4) * s1 + @movav(de_pm00(-2) , 4) * s2 + @movav(de_pm00(-3) , 4) * s3 + @movav(de_pm00(-4) , 4) * s4) * de_ms00) , 0)

**de_xm00** = de_x00 - de_m00

**de_xg00** = de_xg00_ewu + de_xg00_us + de_xg00_uk + de_xg00_row

**de_gcf00** = de_ifc00 + de_inv00

**de_iend00** = de_gdp00 + de_m00 - de_x00

**de_end00** = de_gdp00 + de_m00

### 3.2.2. Nominal GDP

**de_gdp** = (de_pcp00 * de_cp00 / 100 + de_pcgov00 * de_cgov00 / 100 + de_pifc00 * de_ifc00 / 100 + de_inv + de_px00 * de_x00 / 100 - de_pm00 * de_m00 / 100)

**de_cp** = de_cp00 * de_pcp00 / 100

**de_cgov** = de_pcgov00 * de_cgov00 / 100

**de_ifc** = de_imeq00 * de_pimeq00 / 100 + de_id00 * de_pid00 / 100 + de_inrb00 * de_pinrb00 / 100 + de_icongov00 * de_picongov00 / 100 + de_ioth00 * de_pioth00 / 100

**de_x** = (de_xg00 * de_pxg00) / 100 + (de_xs00 * de_pxs00) / 100

**de_m** = (de_mg00 * de_pmg00) / 100 + (de_ms00 * de_pms00) / 100

**de_xm** = de_x - de_m

### 3.2.3. Prices

**de_pgdp00** = de_gdp / de_gdp00 * 100

**de_pifc00** = de_ifc / de_ifc00 * 100

**de_pifc_id** = (de_ifc - de_id00 * de_pid00 / 100) / (de_ifc00 - de_id00) * 100

**de_pgcf00** = (de_ifc + de_inv) / (de_ifc00 + de_inv00) * 100

**de_px00** = de_x / de_x00 * 100

**de_pm00** = de_m / de_m00 * 100

**de_pmgrel** = de_pmg00 / de_ptotdem * 100

**de_pmrel** = de_pm00 / de_ptotdem * 100

**de_ptotdem** = (de_gdp + de_m) / (de_gdp00 + de_m00) * 100

### 3.2.4. Wages and income

**de_wageshare** = de_coe / (de_coe + de_gyprop)

**de_coe** = de_gwage + de_tssem1

**de_coee** = de_coe / de_ee * 1000000

**de_coee00** = de_coee / de_pgdp00 * 100

**de_gwage** = (de_gwagee * de_ee) / 1000000

**de_gwagee00** = de_gwagee / de_pgdp00 * 100

**de_ulc** = (de_coe) / de_gdp00

**de_ulc00** = de_ulc / de_pgdp00 * 100

**de_dispy** = de_nwage + de_trfgov_ph + de_wdyent

**de_dispy00** = (de_dispy / de_pcp00) * 100

**de_y** = de_gdp - de_tindsub - de_cfc

**de_gyprop** = de_y - de_coe

**de_nwage** = de_gwage - de_tdiree - de_tssee

**de_masseneink** = de_nwage + de_trfgov_ph

**de_masseink00** = de_masseneink / de_pcp00 * 100

### 3.2.5. General government

**de_tdir** = de_tdiree + de_tdirem1

**de_t** = de_tdir + de_tind

**de_tssem1** = de_gwage * de_tssem1_tariffsa_sa / 100

**de_tssem** = de_gwage * de_tssem_tariffsa_sa / 100

**de_tssee** = de_gwage * de_tssee_tariffsa_sa / 100

**de_tss** = de_tssee + de_tssem

**de_revgov** = de_t + de_tss + de_yprogov + de_revytrf + de_recprotr + de_salessub

**de_expgov** = de_cgov + de_intpagov + de_trfgov + de_protrgov + de_igov + de_subgov + de_trsongov + de_netprgov + de_expoth

**de_bgov** = de_revgov - de_expgov

**deficit_gdp_ratio** = de_bgov / de_gdp * 100

**de_dbtgov** = de_dbtgov(-1) - de_bgov

**dbt_gdp_ratio** = de_dbtgov / (de_gdp + de_gdp(-1) + de_gdp(-2) + de_gdp(-3)) * 100

### 3.2.6. Other variables

**de_capital00** = de_capital00(-1) + de_imeq00 + de_inrb00 + de_icongov00 + de_ioth00 - de_cfc / de_pifc_id * 100 * .76 + i91q1 * 681

**de_ur** = (de_u ) / (de_et + de_u ) * 100

**de_prodee** = de_gdp00 / de_ee * 1000000

**de_capa** = (de_gdp00 / de_gdp00t) * 100

**de_rl10y00** = de_rl10y - (de_pcp00 / de_pcp00(-4) - 1) * 100

**de_rs3m00** = de_rs3m - (de_pcp00 / de_pcp00(-4) - 1) * 100

**de_sav_ratio** = 100 - de_cp / de_dispy * 100

**de_reev_24_ptotdem =** de_apeuro_24_ptotdem * de_ptotdem / 100

**de_reev_56_cpi =** de_apeuro_56_cpi * cpi_de / 100

# 4. Simulations

Four standard simulations have been carried out to illustrate the effects of alternative shocks to the German economy:

a) Increase of nominal government investment by € 1 billion per quarter. Real government construction investment (DE_ICONGOV00) is also increased by € 1 billion per quarter and deflated by the respective price index).

b) Increase of wages and salaries per employee by a constant amount corresponding to 1% at the start of the simulation period. Wages are kept exogenous in the simulation.

c) Increase of US real gross fixed capital formation by € 10 billion per quarter.

d) Increase of euro area (excluding Germany) real gross fixed capital formation by € 10 billion per quarter.

The simulation period begins in the first quarter of 2002 and ends in the fourth quarter of 2011. The figures below illustrate the deviations from the baseline for each scenario.

a) In the case of the government investment shock the multiplier reaches almost 2 at the peak, but subsequently declines to about 1.3 in the long run due to price and employment effects. The effect on the budget balance is negative during the whole simulation period as some expenditure items also increase with GDP, but there is a partial self-financing effect during several years (Figure 2).

b) A permanent wage increase of the given size temporarily increases real GDP and employment. However, the longer run effect is slightly negative due to the loss in price competitiveness resulting in lower exports. The price level increases permanently. The effect on the budget balance turns negative at the end of the simulation period (Figure 3).

c) Via increased exports the increase of US demand has a strong and permanent effect on real GDP and employment. Due to the negative effect of capital accumulation on the latter the permanent increase in employment is lower than the peak reached after about four years. There is a substantial positive effect on the budget balance (Figure 4).

d) An increase of euro area demand of a similar size has a much stronger effect on the German economy as exports to the euro area account for a much larger share of total exports. There is a considerable long-term increase in real GDP as well as employment. The budget balance improves substantially.

**Figure 2: Simulation of an increase in government investment**

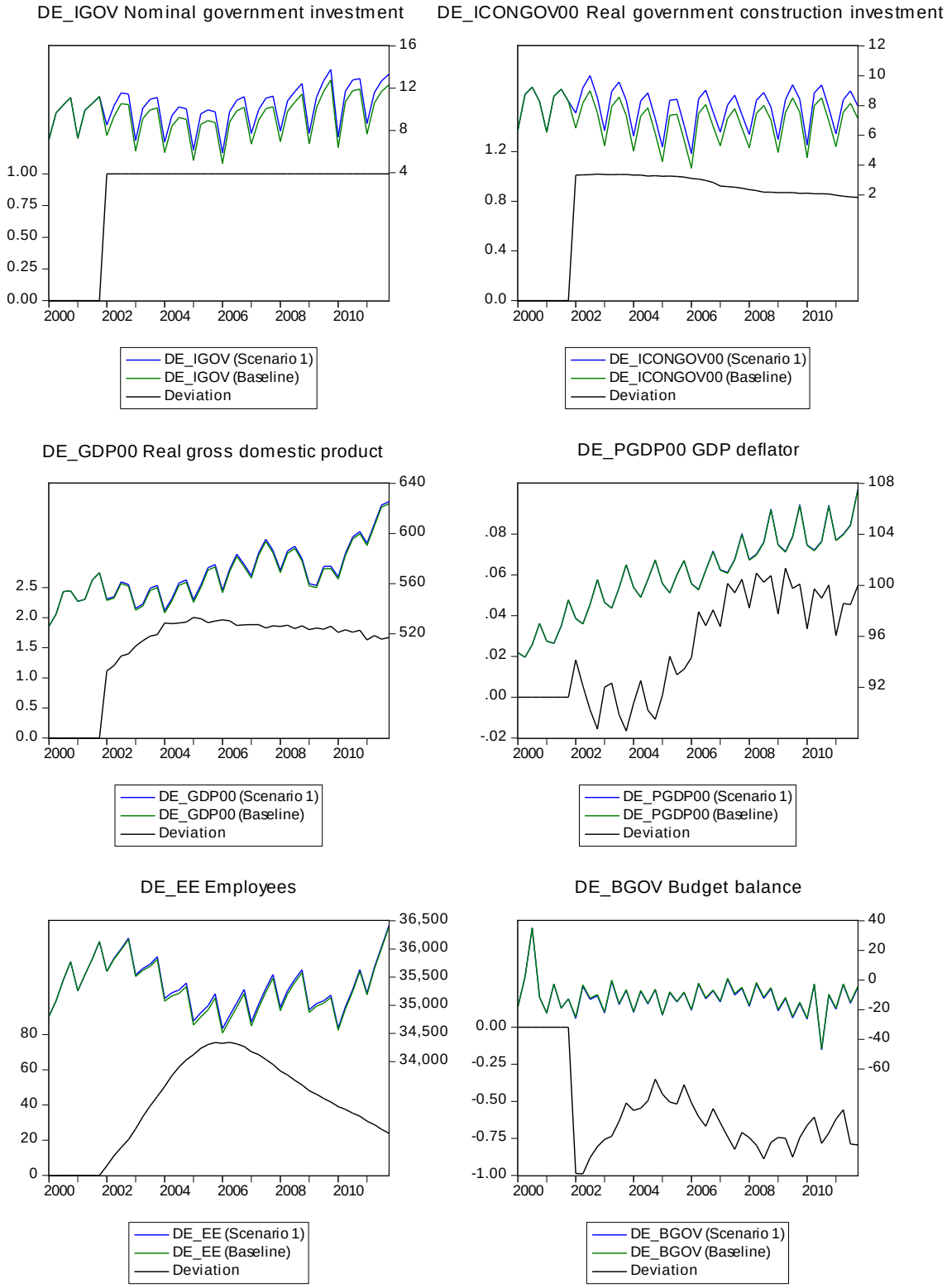


**Figure 3: Simulation of a wage increase**

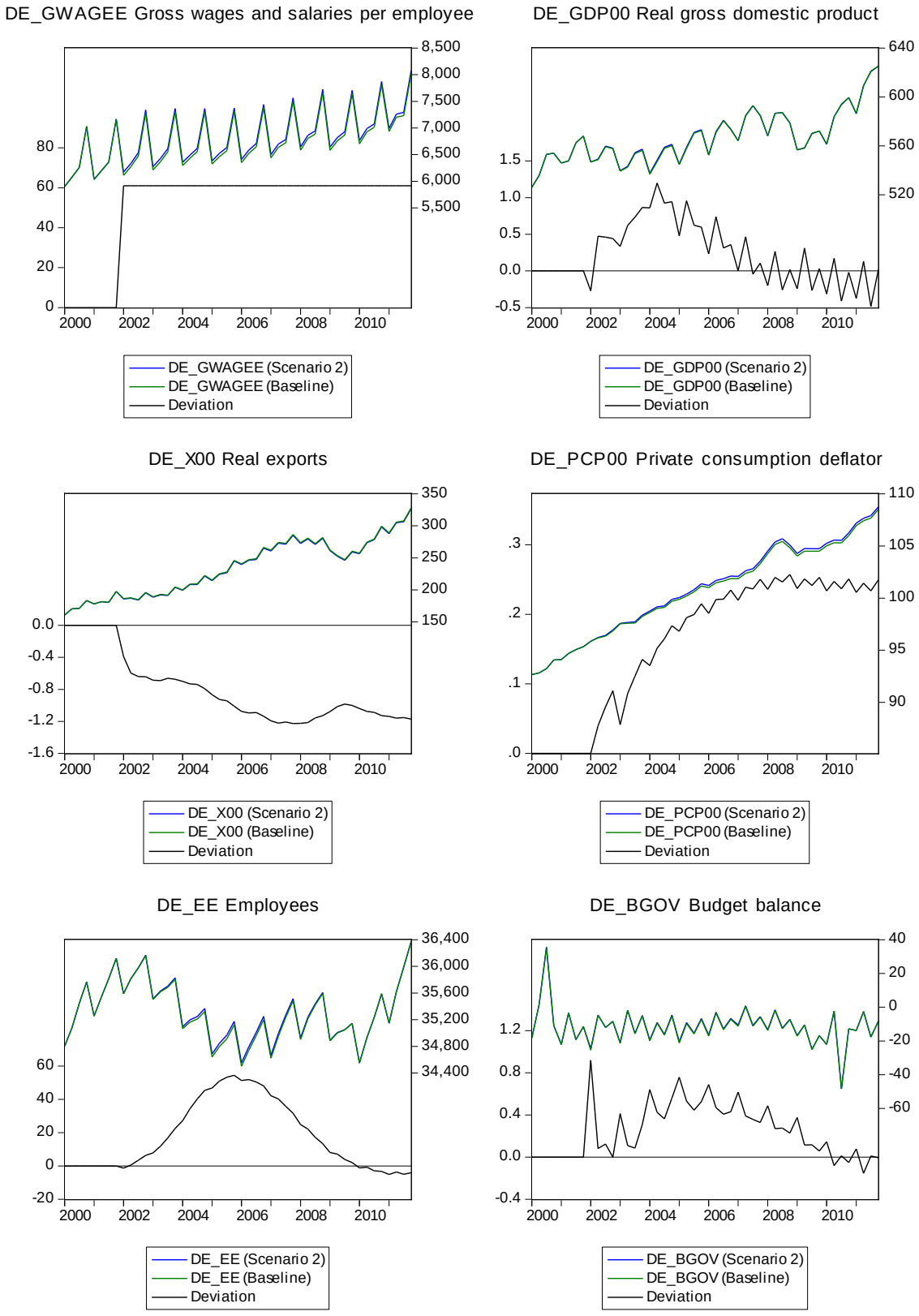


**Figure 4: Simulation of an increase of US gross fixed capital formation**

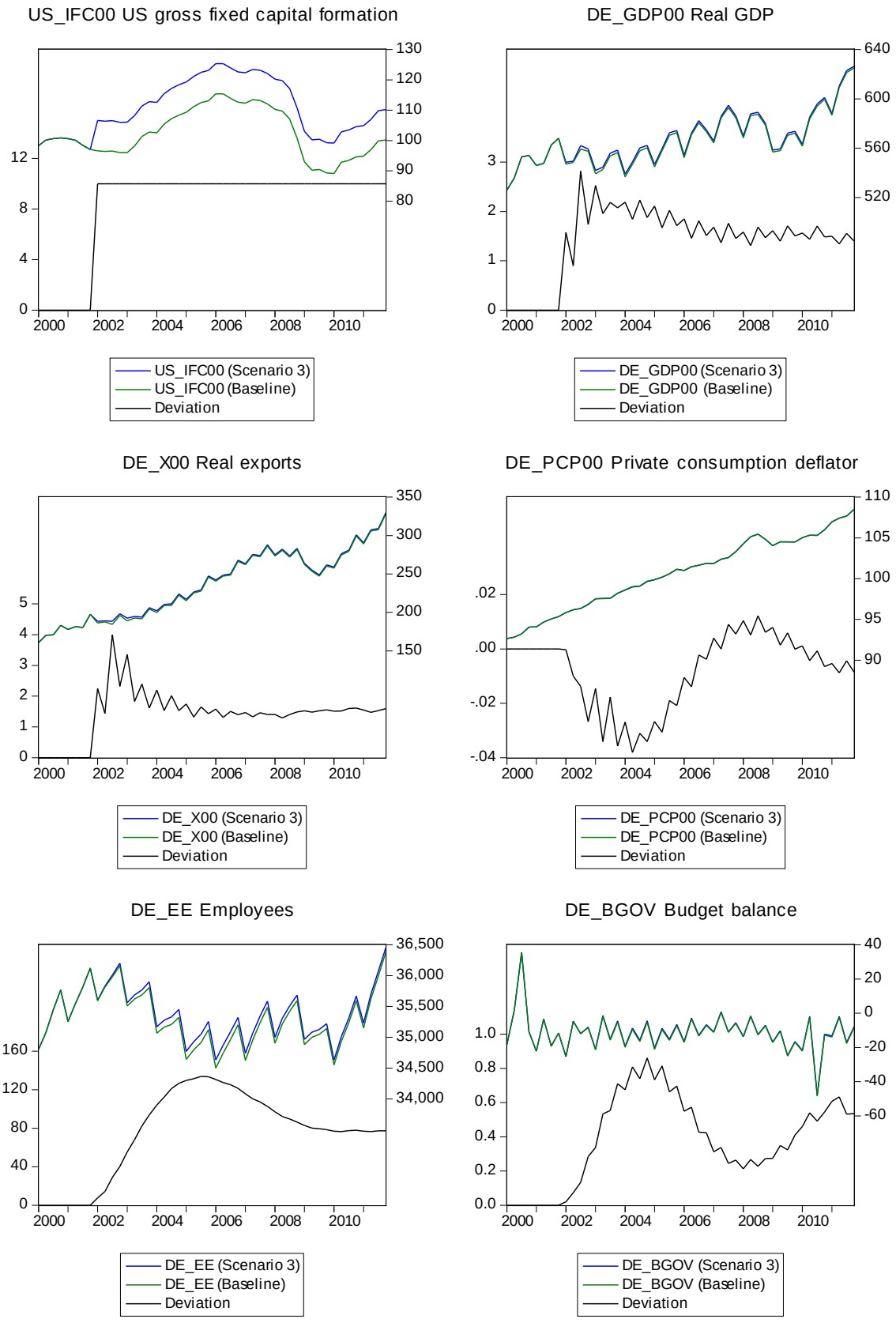
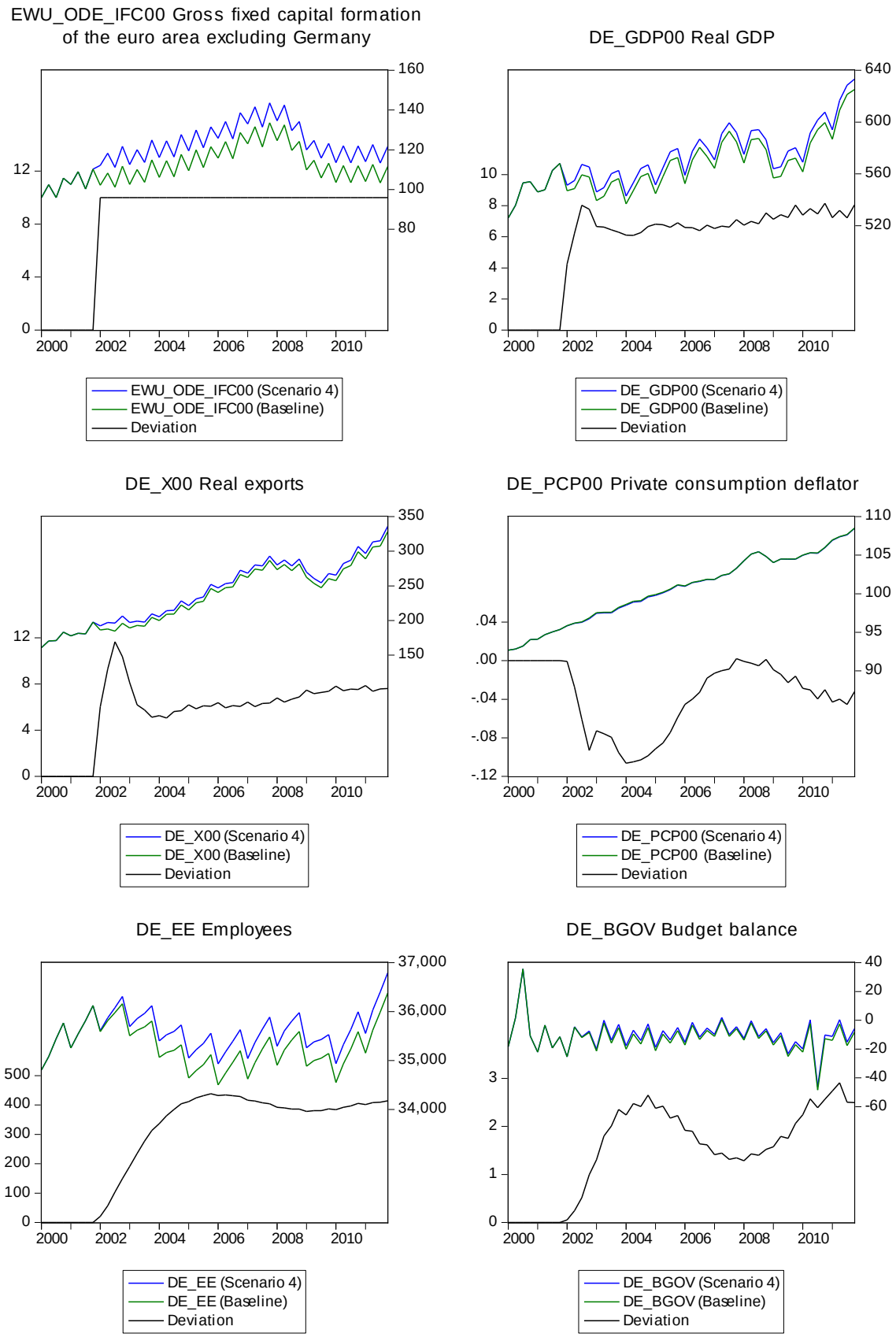


**Figure 5: Simulation of an increase of EMU gross fixed capital formation**



# 5. Conclusion

The IMK's macroeconometric model of the German economy has been used for the IMK's forecasts as well as policy simulations for several years now. During this time individual equations have been re-estimated frequently and will be re-estimated again whenever new data become available. Thus, the current specifications are not sacrosanct and this documentation is merely a snapshot of the state of the model in the summer of 2012. Despite frequent re-estimations the general structure and model philosophy have remained more or less the same over the years.

Generally, the model is highly aggregated and rather compact. It allows addressing a large number of macroeconomic issues, but has limitations. For specific interests additional equations and variables are therefore added temporarily. For example, the model was amended by a module for the pension system to analyse the effects of pension reform on macroeconomic stability (Meinhardt et al. 2009). This may be repeated in the case of other specific policy issues.

Next steps will concentrate on the role of income distribution for private consumption expenditure. With the availability of quarterly data for the government sector some more substantial revisions of the respective equations may also become necessary.

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# Appendix: Variables of the model

### Table 99: List of variables

| Abbreviation | Explanation | Source |
|---|---|---|
| CPI_DE | Consumer price index, Germany | OECD |
| CPI_EWU | Consumer price index, euro area | OECD |
| CPI_UK | Consumer price index, United Kingdom | OECD |
| CPI_US | Consumer price index, United States of America | OECD |
| DBT_GDP_RATIO | Debt to GDP ratio | IMK calculations |
| DE_APEURO_24_PTOTDEM | Foreign price level (total demand) of 24 countries in euro terms | IMK calculations |
| DE_APEURO_56_CPI | Foreign price level (cpi) of 56 countries in euro terms | IMK calculations |
| DE_BGOV | Government budget balance | Destatis, IMK |
| DE_CAPA | Capacity utilisation | IMK estimate |
| DE_CAPITAL00 | Capital stock, in real terms, reference year 2005 | IMK calculation |
| DE_CFC | Consumption of fixed capital | Destatis |
| DE_CGOV | Government consumption, nominal | Destatis |
| DE_CGOV00 | Government consumption, in real terms, reference year 2005 | Destatis |
| DE_COE | Compensation of employees | Destatis |
| DE_COEE | Compensation per employee | IMK calculation |
| DE_COEE00 | Compensation per employee, in real terms, reference year 2005 | IMK calculation |
| DE_CP | Private consumption, nominal | Destatis |
| DE_CP00 | Private consumption, in real terms, reference year 2005 | Destatis |
| DE_DBTGOV | Government gross debt | Destatis |
| DE_DISPY | Disposable income of households and NPISH, nominal | Destatis |
| DE_DISPY00 | Disposable income of households and NPISH, in real terms, reference year 2005 | Destatis |
| DE_EE | Employees | Destatis |
| DE_END00 | Total final demand, in real terms, reference year 2005 | IMK calculation |
| DE_ET | Employment | Destatis |
| DE_EXPGOV | Government expenditure | Destatis |
| DE_EXPOTH | Other government expenditures | Destatis, IMK calculation |
| DE_GCF00 | Gross capital formation, in real terms, reference year 2005 | Destatis |
| DE_GDP | Gross domestic product, nominal | Destatis |
| DE_GDP00 | Gross domestic product, in real terms, reference year 2005 | Destatis |
| DE_GDP00T | Trend of real GDP | IMK estimate |
| DE_GWAGE | Gross wages and salaries | Destatis |
| DE_GWAGEE | Gross wage per employee | IMK calculation |
| DE_GWAGEE00 | Real gross wage per employee, reference year 2005 | IMK calculation |
| DE_GYPROP | Operating surplus and mixed income | Destatis |
| DE_ICONGOV00 | Gross fixed capital formation of the government, in real terms, reference year 2005 | Destatis |

| Abbreviation | Explanation | Source |
|---|---|---|
| DE_ID00 | Gross fixed capital formation: residential construction of private sector, in real terms, reference year 2005 | Destatis |
| DE_IEND00 | Total final domestic demand (DE_END00 less exports), in real terms, reference year 2005 | IMK calculation |
| DE_IFC | Gross fixed capital formation, nominal | Destatis |
| DE_IFC00 | Gross fixed capital formation, in real terms, reference year 2005 | Destatis |
| DE_IGOV | Gross fixed capital formation: government | Destatis |
| DE_IMEQ00 | Gross fixed capital formation: machinery and equipment, in real terms, reference year 2005 | Destatis |
| DE_INRB00 | Gross fixed capital formation: non-residential construction of private sector, in real terms, reference year 2005 | Destatis |
| DE_INTPAGOV | Property income paid, government (i.e. interest payments) | Destatis |
| DE_INV | Changes in inventories and net acquisitions of valuables, nominal | Destatis |
| DE_INV00 | Changes in inventories and net acquisitions of valuables, in real terms, reference year 2005 | Destatis |
| DE_IOTH00 | Gross fixed capital formation: other products, in real terms, reference year 2005 | Destatis |
| DE_M | Imports of goods and services, nominal | Destatis |
| DE_M00 | Imports of goods and services, in real terms, reference year 2005 | Destatis |
| DE_MASSEINK00 | Mass income, in real terms, reference year 2005 | Destatis |
| DE_MASSENEINK | Mass income, nominal | Destatis |
| DE_MG00 | Imports of goods, in real terms, reference year 2005 | Destatis |
| DE_MS00 | Imports of services, in real terms, reference year 2005 | Destatis |
| DE_NETPRGOV | Government: net increase of valuables | |
| DE_NEV_EWU | Nominal effective exchange rate vis-à-vis euro area countries | IMK calculation |
| DE_NEV_UK | Nominal effective exchange rate vis-à-vis the United Kingdom | IMK calculation |
| DE_NEV_US | Nominal effective exchange rate vis-à-vis the United States of America | IMK calculation |
| DE_NWAGE | Net wages and salaries | Destatis |
| DE_PCGOV00 | Government consumption deflator; index: 2005=100 | Destatis |
| DE_PCP00 | Private consumption deflator; index: 2005=100 | Destatis |
| DE_PGCF00 | Deflator of gross capital formation; index: 2005=100 | Destatis |
| DE_PGDP00 | GDP deflator; index: 2005=100 | Destatis |
| DE_PICONGOV00 | Deflator of gross fixed capital formation: government construction; index: 2005=100 | Destatis |

| Abbreviation | Explanation | Source |
|---|---|---|
| DE_PID00 | Deflator of gross fixed capital formation: private residential construction; index: 2005=100 | Destatis |
| DE_PIFC00 | Deflator of gross fixed capital formation: total; index: 2005=100 | Destatis |
| DE_PIFC_ID | Deflator of gross fixed capital formation (excluding residential construction); index: 2005=100 | Destatis |
| DE_PIMEQ00 | Deflator of gross fixed capital formation: machinery and equipment; index: 2005=100 | Destatis |
| DE_PINRB00 | Deflator of gross fixed capital formation: private non-residential construction; index: 2005=100 | Destatis |
| DE_PIOTH00 | Deflator of gross fixed capital formation: other products; index: 2005=100 | Destatis |
| DE_PM00 | Deflator of imports of goods and services; index: 2005=100 | Destatis |
| DE_PMG00 | Deflator of imports of goods; index: 2005=100 | Destatis |
| DE_PMGREL | Price level of goods imports relative to domestic price level | IMK calculation |
| DE_PMREL | Price level of imports relative to domestic price level; index: 2005=100 | IMK calculation |
| DE_PMS00 | Deflator of imports of services; index: 2005=100 | Destatis |
| DE_POPUL | Population | Destatis |
| DE_PRODEE | Productivity per employee | IMK calculation |
| DE_PROTRGOV | Property transfers paid by the government | Destatis, IMK calculations |
| DE_PTOTDEM | Deflator of total demand | Destatis |
| DE_PX00 | Deflator of exports of goods and services; index: 2005=100 | Destatis |
| DE_PXG00 | Deflator of exports of goods; index: 2005=100 | Destatis |
| DE_PXS00 | Deflator of exports of services; index: 2005=100 | Destatis |
| DE_RECPROTR | Property transfers received by the government | Destatis, IMK calculations |
| DE_REEV_24_PTOTDEM | Real effective exchange rate vis-à-vis 24 industrialised countries (price index: deflator of total demand) | Deutsche Bundesbank |
| DE_REEV_56_CPI | Real effective exchange rate vis-à-vis 56 countries (price index: consumer price index) | Deutsche Bundesbank |
| DE_REVGOV | Government revenue | Destatis, IMK calculations |
| DE_REVYTRF | Other current transfers received by the government from the other sectors | Destatis, IMK calculations |
| DE_RL10Y | Nominal long term interest rate (10 years) | Deutsche Bundesbank |
| DE_RL10Y00 | Real long term interest rate (10 years) | Deutsche Bundesbank |
| DE_RS3M | Nominal short term interest rate (3 months, money market rate) | IMK calculation |
| DE_RS3M00 | Real short term interest rate (3 months, money market rate) | IMK calculation |
| DE_SALESSUB | Sales and other revenues of the | Destatis, IMK calculations |

| Abbreviation | Explanation | Source |
|---|---|---|
| | government | |
| DE_SAV_RATIO | Household savings ratio | Destatis |
| DE_SUBGOV | Government subsidies | Destatis, IMK calculations |
| DE_T | Taxes paid to the government | Destatis, IMK calculations |
| DE_TDIR | Direct taxes | Destatis, IMK calculations |
| DE_TDIREE | Taxes on income and wealth paid by employees | Destatis |
| DE_TDIREM1 | Taxes on income and wealth paid by employers and self-employed households | Destatis, IMK calculations |
| DE_TIND | Taxes on production and imports | Destatis |
| DE_TIND_TARIFFSA_SA | Seasonally adjusted indirect tax rate | IMK calculations |
| DE_TINDSUB | Taxes less subsidies on production and imports | Destatis |
| DE_TRFGOV | Monetary government transfers paid by the government | Destatis, IMK calculations |
| DE_TRFGOV_PH | Monetary government transfers received by households | Destatis |
| DE_TRSONGOV | Other current transfers paid by the government | Destatis, IMK calculations |
| DE_TSS | Social contributions paid to the government | Destatis, IMK calculations |
| DE_TSSEE | Social contributions paid by employees | Destatis |
| DE_TSSEE_TARIFFSA_SA | Employees' social security contribution rate (seasonally adjusted) | IMK calculations |
| DE_TSSEM | Social contributions paid by employers | Destatis, IMK calculations |
| DE_TSSEM1 | Employers' social contributions | Destatis, IMK calculations |
| DE_TSSEM1_TARIFFSA_SA | Employers' social contribution rate (seasonally adjusted, difference between compensation of employees and gross wages and salaries) | IMK calculations |
| DE_TSSEM_TARIFFSA_SA | Employers' social contribution rate (seasonally adjusted, government accounts) | IMK calculations |
| DE_U | Unemployed persons (thousands) | Destatis |
| DE_ULC | Unit labour cost | IMK calculation |
| DE_ULC00 | Real unit labour cost | IMK calculation |
| DE_UR | Unemployment rate | Destatis |
| DE_WAGESHARE | Wage share (as a fraction of 1) | IMK calculation |
| DE_WDYENT | Distributed profits | IMK calculation |
| DE_X | Exports of goods and services, nominal | Destatis |
| DE_X00 | Exports of goods and services, in real terms, reference year 2005 | Destatis |
| DE_XG00 | Exports of goods, in real terms, reference year 2005 | Destatis |
| DE_XG00_EWU | Exports of goods to the euro area, in real terms, reference year 2005 | Destatis |
| DE_XG00_ROW | Exports of goods to the rest of the world, in real terms, reference year 2005 | Destatis |
| DE_XG00_UK | Exports of goods to the UK, in real terms, reference year 2005 | Destatis |

| Abbreviation | Explanation | Source |
|---|---|---|
| DE_XG00_US | Exports of goods to the United States, in real terms, reference year 2005 | Destatis |
| DE_XM | Net exports, nominal | Destatis |
| DE_XM00 | Net exports, in real terms, reference year 2005 | IMK calculation |
| DE_XS00 | Exports of services, in real terms, reference year 2005 | Destatis |
| DE_Y | National income | Destatis |
| DE_YPROGOV | Property income reveived by the government | Destatis, IMK calculations |
| DEFICIT_GDP_RATIO | Budget balance in % of GDP | Destatis, IMK calculations |
| EWU6_ULC | Unit labour cost of 6 euro area countries | IMK calculation based on Eurostat data |
| EWU_ODE_IFC00 | Real gross fixed capital formation of EMU excluding Germany; index: 2000=100 | IMK calculation based on Eurostat data |
| OIL$ | Oil price in USD | IMF, EIA |
| ROW_GDP00 | Real GDP of the Rest of the world; index: 2000=100 | World Bank, IMK calculations |
| UK_GDP05_SB | UK GDP, in real terms; index: 2005=100 | Eurostat |
| UK_ULC | Unit labour cost UK | IMK calculation based on Eurostat data |
| US_IFC00 | Gross fixed capital formation of the United States, in real terms; index: 2000=100 | OECD |
| US_ULC | Unit labour cost, USA | OECD |

## List of Figures



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