The New Quarterly Model of the Greek Economy: The Components of Aggregate Demand

Albani, M., Z. Bragoudakis, G. Pavlou and D. Sideris
Bank of Greece

31/03/2012

New Quarterly Model

BANK OF GREECE
EUROSYSTEM

- Existed models

  Greek Annual Econometric Model (Garganas, 1992)

  Greek Quarterly Multi-Country Model (Sideris and Zonzilos, 2005)

- Motivation for the new model:

  the previous models would not work properly after 2009 as the economy entered a period of crisis and structural change.

- The purpose of the new quarterly model is to:

a. Describe the functioning of the Greek economy since the early '90s.
b. Provide reliable forecasts of future developments of the Greek economy.
c. Be used in the Eurosystem of Central Banks Broad Macroeconomic Projection Exercise (BMPE).
d. Conduct policy scenarios on the Greek economy.

New Quarterly Model

BANK OF GREECE
EUROSYSTEM

- The period under study comprises significant changes in economic performance (sluggish economic growth and high inflation until the mid 90s, high economic growth and low inflation until the late 00s, the world financial crisis in 2008 and the current prolonged domestic economic crisis), different fiscal and monetary regimes.

- Challenge: The construction of a constant parameter model
- The model is continuously simulated and tested (should rather be viewed as work in progress)

Methodology

BANK OF GREECE
EUROSYSTEM

- The model is backward-looking.
- Expectations are treated implicitly by the inclusion of lagged variables.
- 36 behavioural equations, 82 identities.
- Most of the behavioural equations are estimated using the two-step Engle Granger procedure.

Data – Data Sources

BANK OF GREECE
EUROSYSTEM

- **Data**

  118 endogenous variables, 60 exogenous variables

  Frequency: Quarterly

  Estimation period: 1990q1-2010q4

- **Data sources**

  Macroeconomic data: Hellenic Statistical Authority (El.Stat.)

  Labour force data: Hellenic Statistical Authority (El.Stat.)

  Fiscal data: Hellenic Statistical Authority (El.Stat.)

  Prices: Hellenic Statistical Authority (El.Stat.)

  Balance of Payments: Bank of Greece (BoG)

  Financial data: Bank of Greece (BoG)

  External assumptions: European Central Bank (ECB)

  Qualitative data: European Commission

Blocks of the Model

BANK OF GREECE
EUROSYSTEM

- Supply side
- Demand side
- Prices and wages
- External sector
- Government sector

The supply side: the production function

BANK OF GREECE
EUROSYSTEM

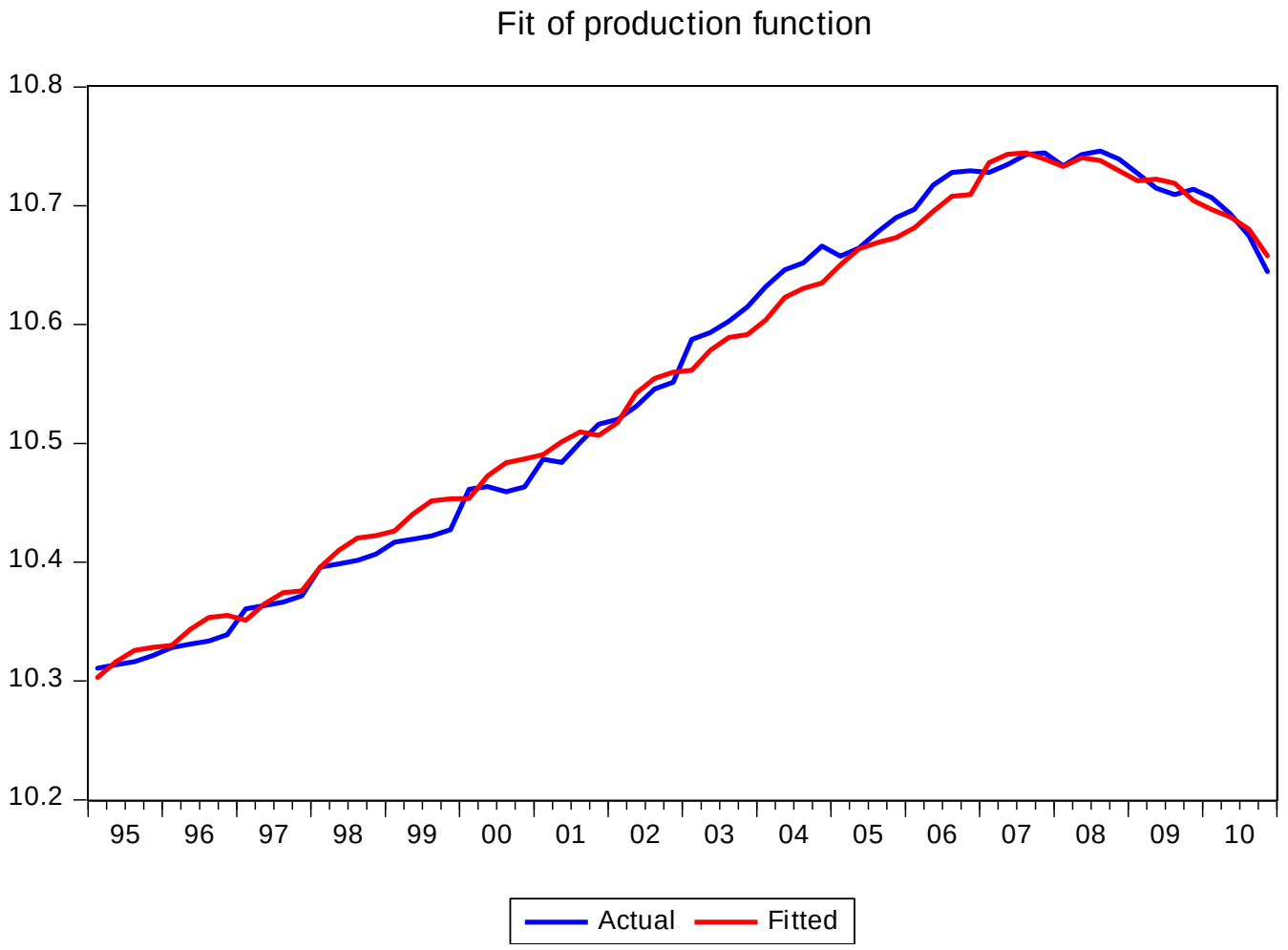
$$log(yfr) = -0.15 + log(alpha) + beta*log(ksr) + (1-beta)*log(lnn) + gamma* time + dummies$$
$$(-69.8)$$

- where:

yfr: real GDP at factor cost
ksr: total capital stock
lnn: total employment
alpha: labour productivity (2.36)
beta: share of capital in production (0.35)
gamma: technological progress growth rate (1.36)
time: time trend

Production function

BANK OF GREECE
EUROSYSTEM



Production function

BANK OF GREECE
EUROSYSTEM

- Output price equation:

$$log(yfd) = log(\eta) - log(1\text{-}beta) - log(alpha)/(1\text{-}beta) + log(wun) + beta/(1\text{-}beta)*log(yfr/ksr) - gamma*time$$

- where:

  yfd: GDP at factor cost deflator

  η: mark-up over marginal cost

  wun: compensation per employee

Production function

BANK OF GREECE
EUROSYSTEM

- Labour demand equation:

$$log(lnn) = - log(alpha) + log(yfr) – beta*log(ksr/lnn) – gamma*time$$

- Capital stock equation:

$$log(ksr) = -log(alpha) + (1-beta)*log(beta/(1-beta)) + (1-beta)*log(wun) – (1-beta)*log(cc0) + log(yfr) – gamma*time$$

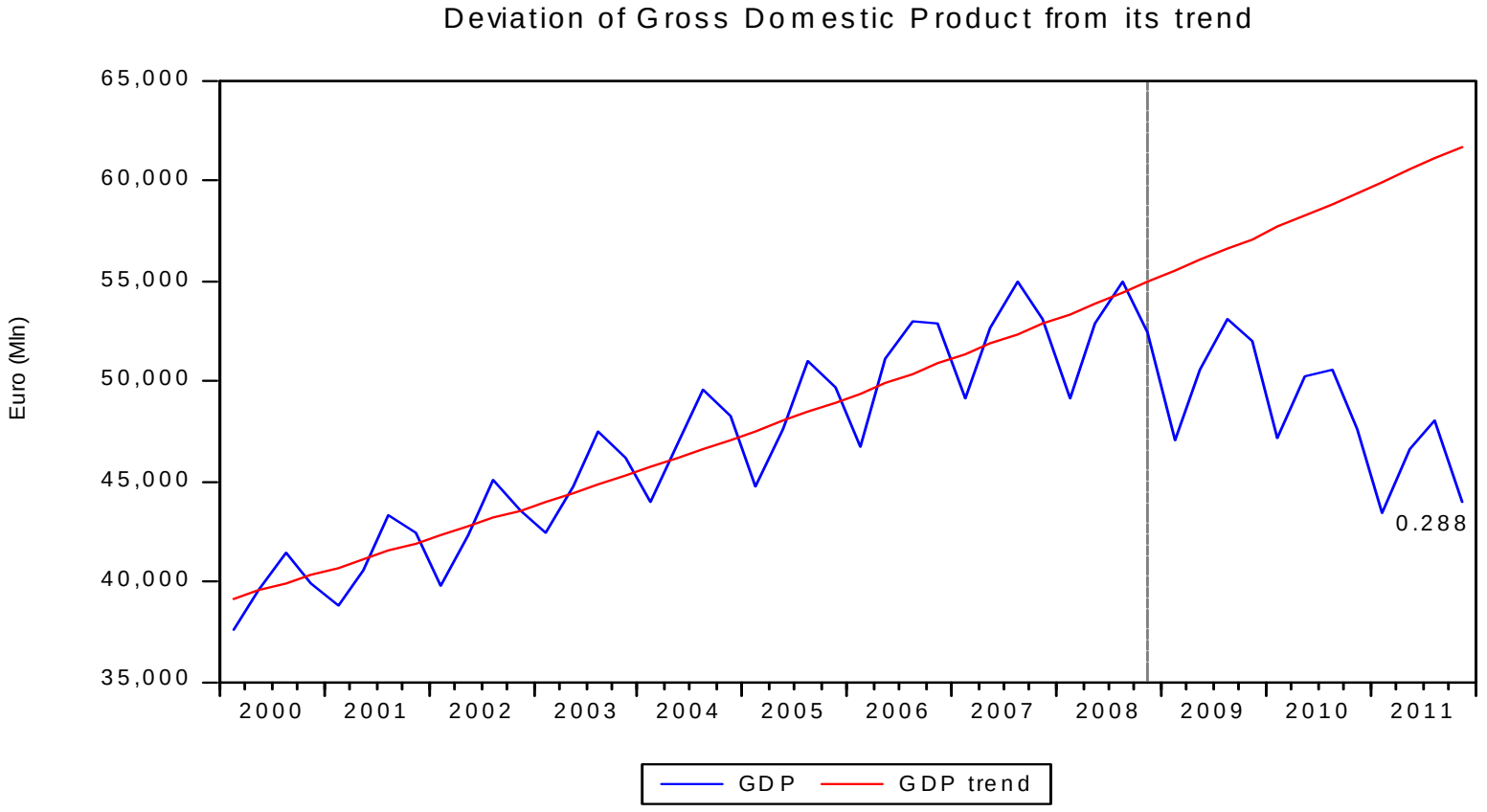
- where:

  cc0: nominal user cost of capital

The demand side

BANK OF GREECE
EUROSYSTEM

- The growth pattern has deteriorated since 2008(3)
- The cumulative real GDP decline over 2008-2011 is -13.7%

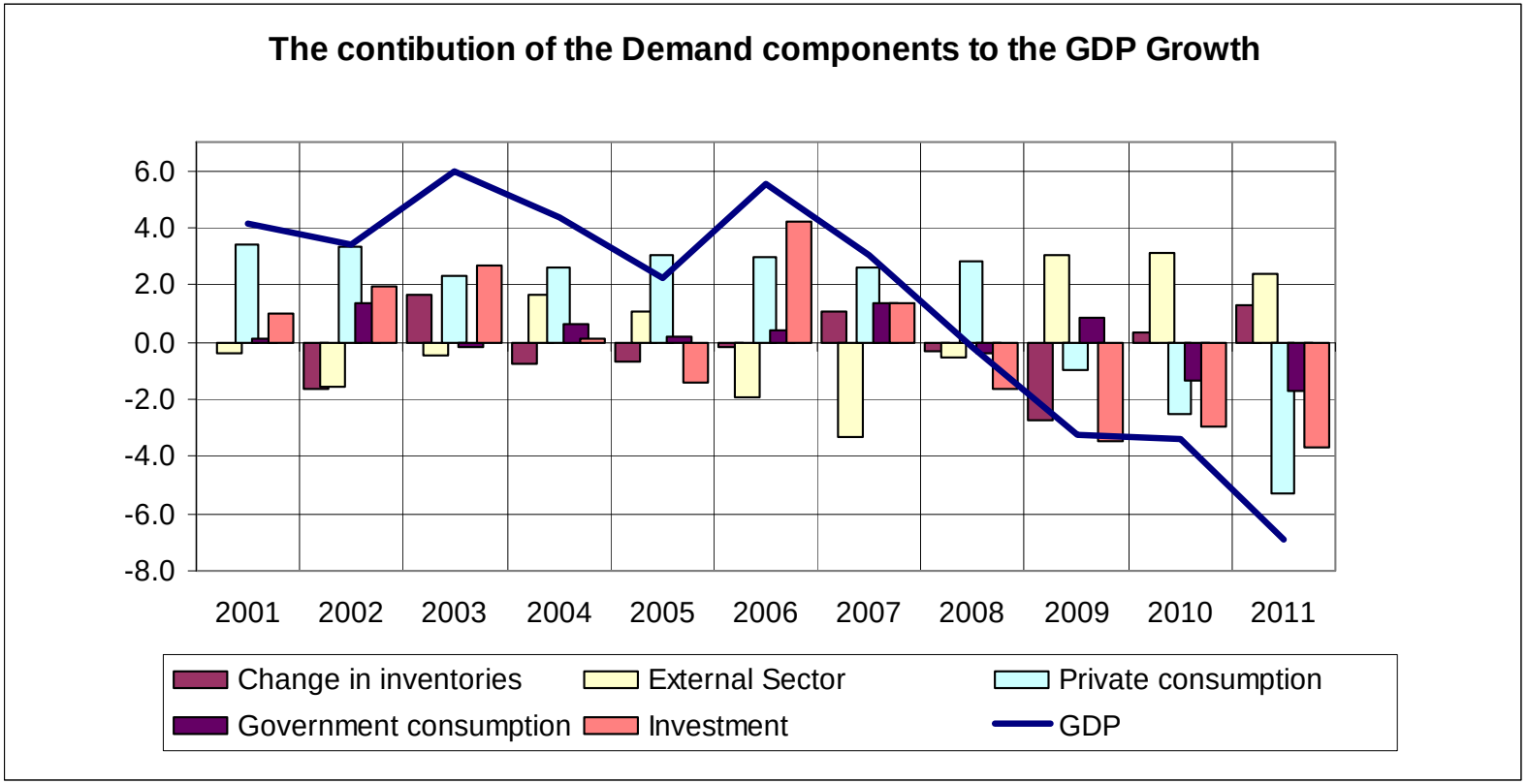


0.288= % deviation of the GDP trend from the actual value for 2011Q4

The demand side: the components of demand

BANK OF GREECE
EUROSYSTEM

- The economy changes: (Negative effect from domestic demand, positive from external sector from 2009 and on)
- Structural reforms

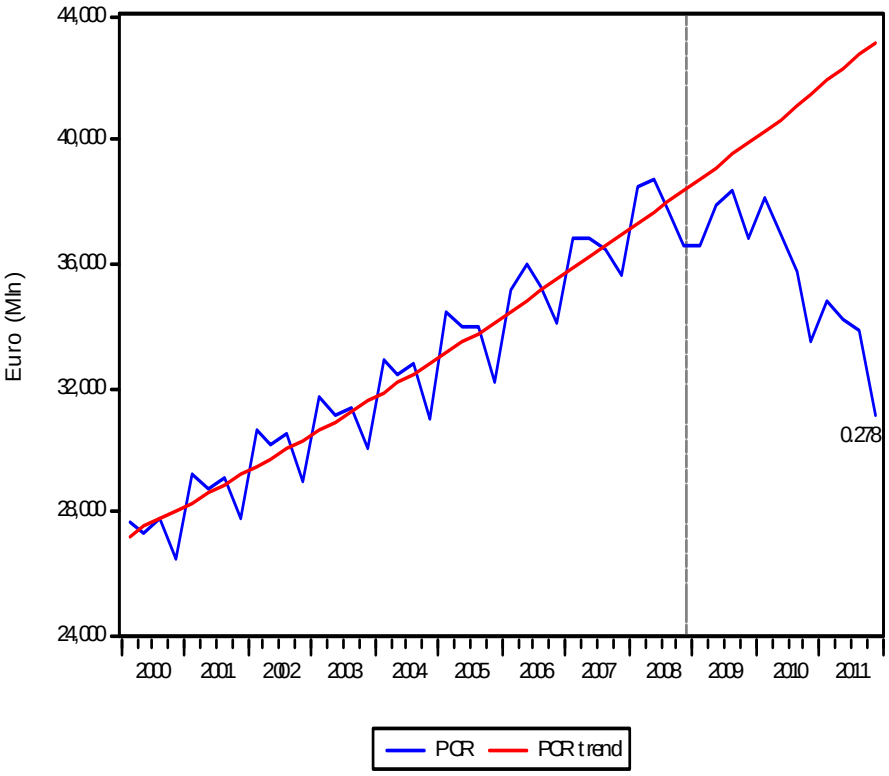


The demand side: the components of demand

BANK OF GREECE
EUROSYSTEM

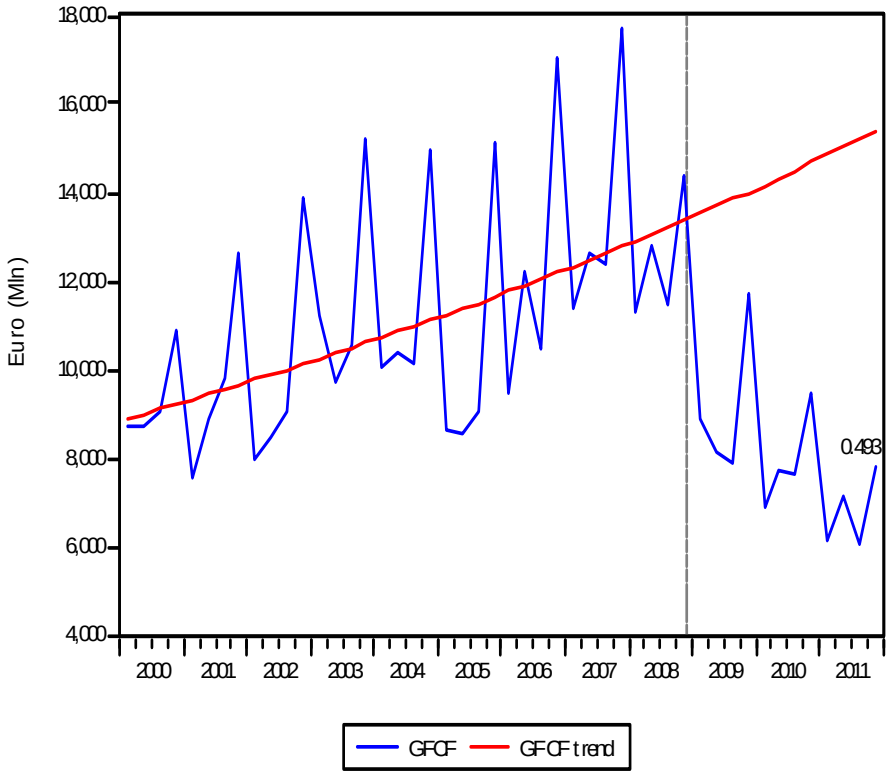
- The patterns of all demand components have changed since 2008(3).
- All demand equations have to be re-estimated.

Deviation of Private Consumption from its trend



0.278= % deviation of the PCR trend from the actual value for 2011Q4

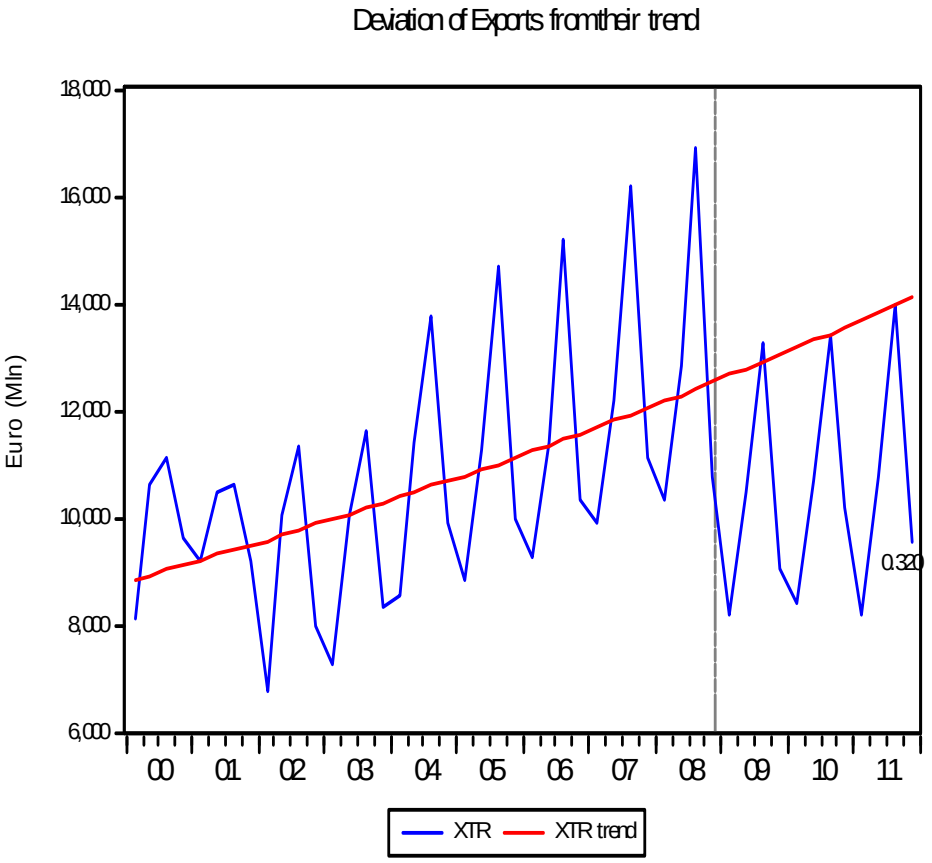
Deviation of Gross Fixed Capital Formation from its trend



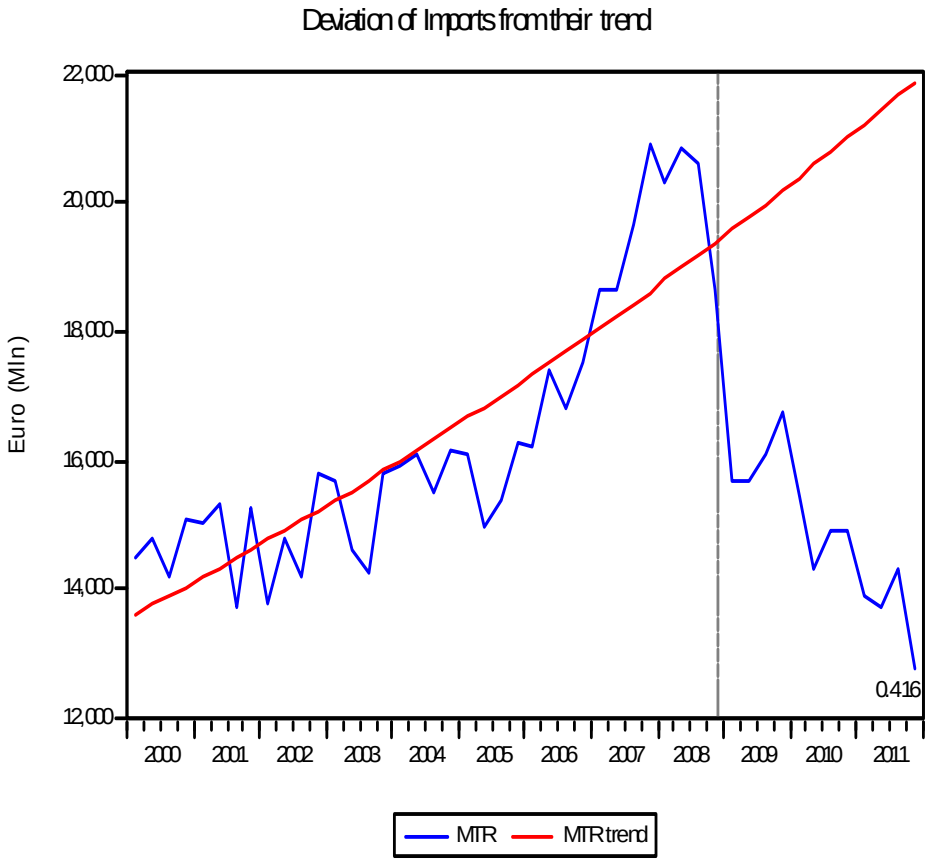
0.493= % deviation of the GFCF trend from the actual value for 2011Q4

The demand side: the components of demand

BANK OF GREECE
EUROSYSTEM



0.32= %deviation of the XTR trend from the actual value for 2011Q4



0.416= %deviation of the MTR trend from the actual value for 2011Q4

The consumption equation

BANK OF GREECE
EUROSYSTEM

- The long-run equilibrium relationship, the initial specification

$$log(pcr) = -0.66 + 0.77*log(pyr) + (1-0.77)*log(fwr) + dummies$$
$$(-12.01)\ \ (31.22)$$

ADF: -3.1, MacKinnon critical value at 5%: -2.9

- where:

pcr: real private consumption

pyr: real disposable income

fwr: real household financial wealth

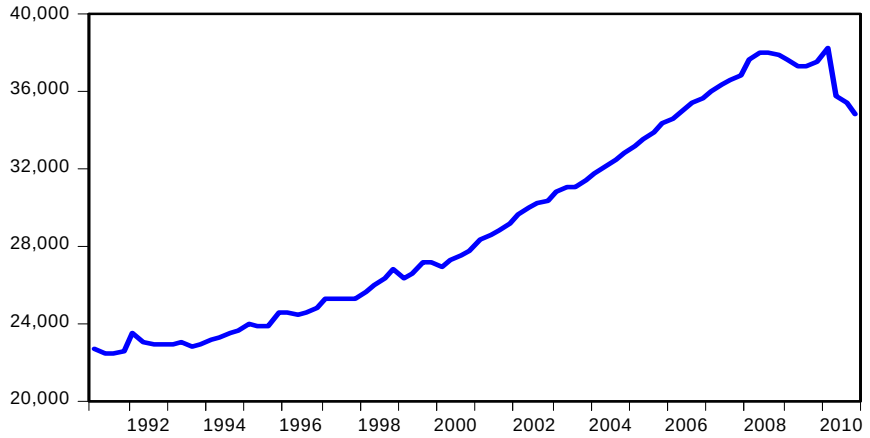
- Statistically robust for the period 1990(1)-2008(3), its statistical properties worsened when estimated for the whole sample.

The consumption equation

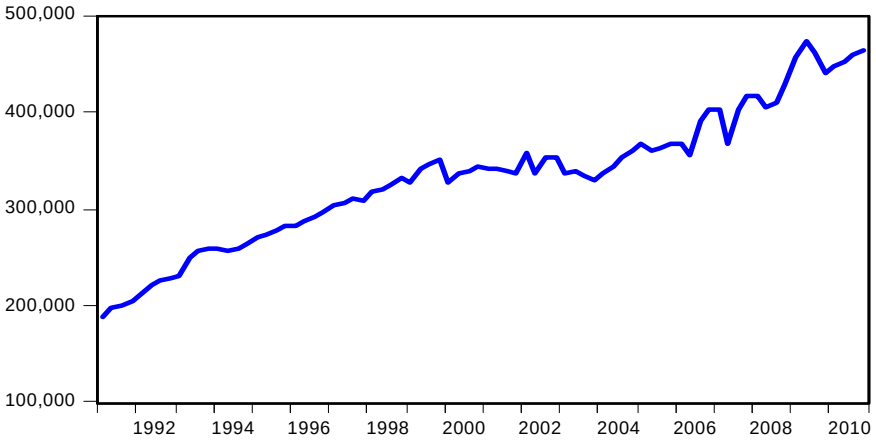
BANK OF GREECE
EUROSYSTEM

- The variables

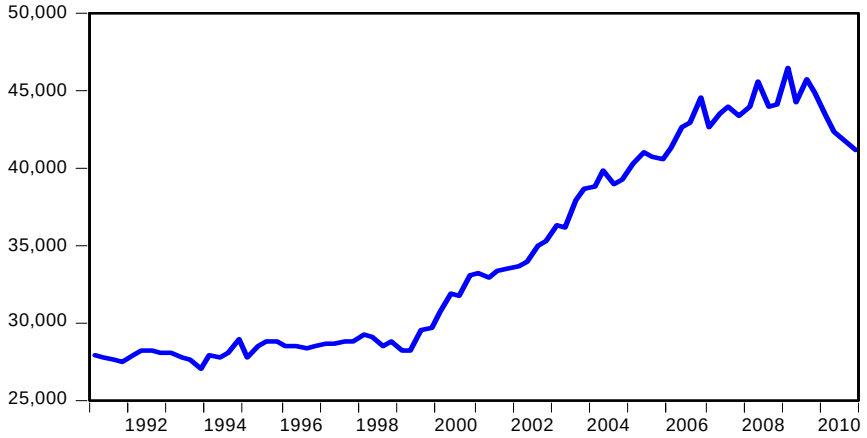
real private consumption



real household financial wealth



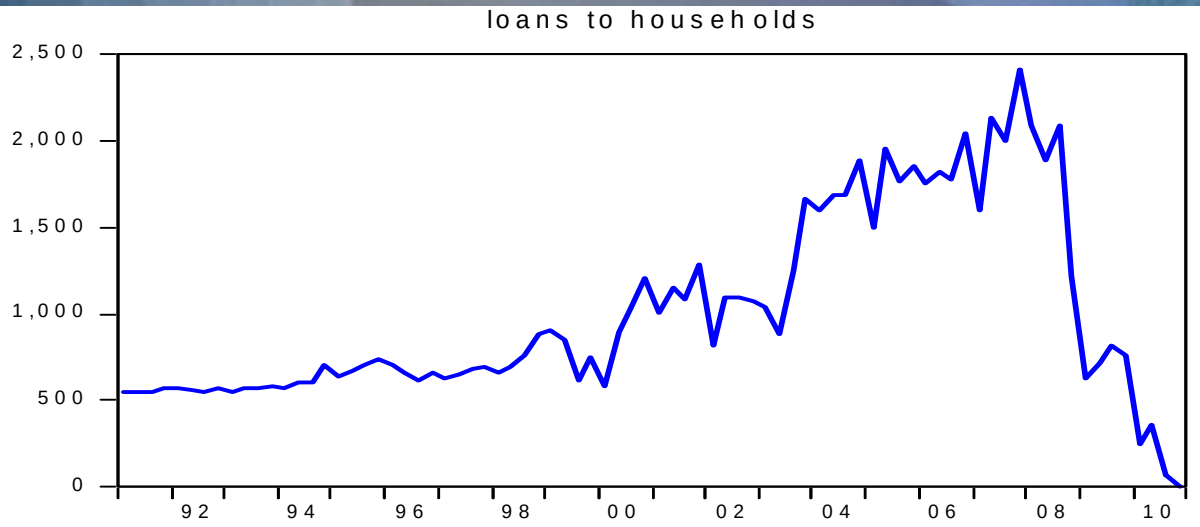
real disposable income

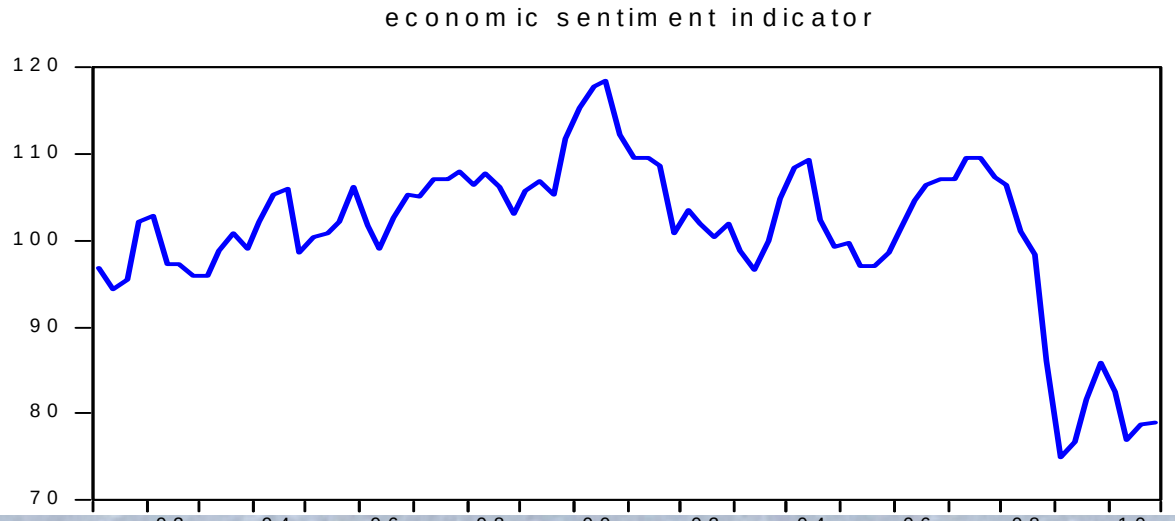


The consumption equation

BANK OF GREECE
EUROSYSTEM

- Need to include new explanatory variables





The consumption equation

BANK OF GREECE
EUROSYSTEM

- The final long-run equilibrium relationship, with better fit.

$$log(pcr) = -0.96 + 0.79*log(pyr) + (1-0.79)*log(fwr) + 0.07*log(econsent) + dummies$$
$$(-6.21)\ \ (35.75) \qquad\qquad\qquad\qquad\qquad\qquad (2.26)$$

ADF: -3.9, MacKinnon critical value at 5%: -2.9

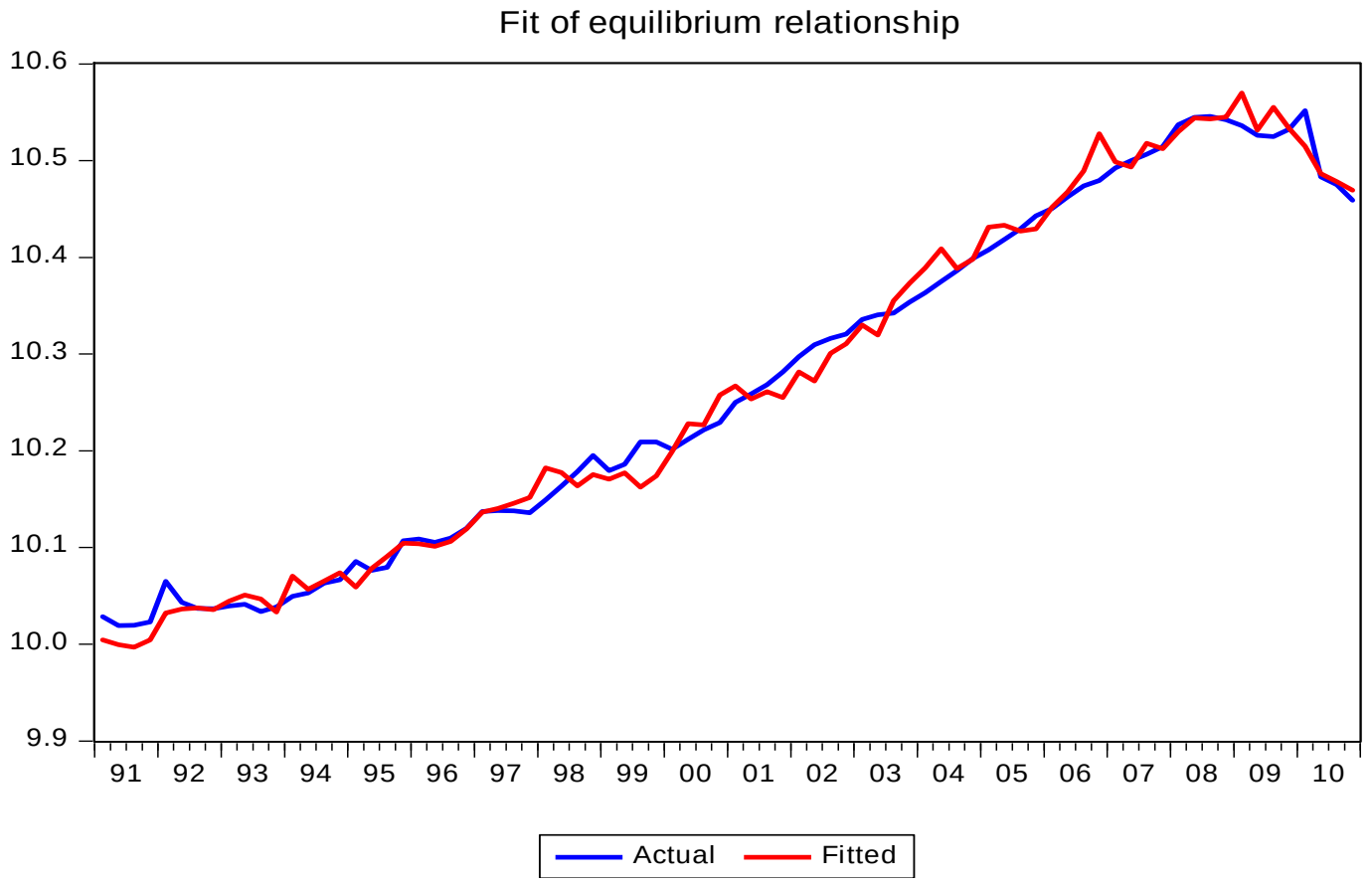
- where:

pcr: real private consumption
pyr: real disposable income
fwr: real household financial wealth
econsent: economic sentiment indicator

The consumption equation

BANK OF GREECE
EUROSYSTEM

- The long-run consumption relationship



The consumption equation

BANK OF GREECE
EUROSYSTEM

- The short-term dynamics

$$dlog(pcr) = 0.01 + 0.09*dlog(pyr) + 0.07*dlog(econsent) + 0.004*dlog(credit) - 0.14*ect(-1)$$
$$(4.37) \quad (4.57) \quad (1.96) \quad (1.69) \quad (-2.18)$$

R^2: 0.44, S.E.: 0.01, D.W.: 1.98

- where:

credit: loans to households

ect: error-correction term

The investment equation

BANK OF GREECE
EUROSYSTEM

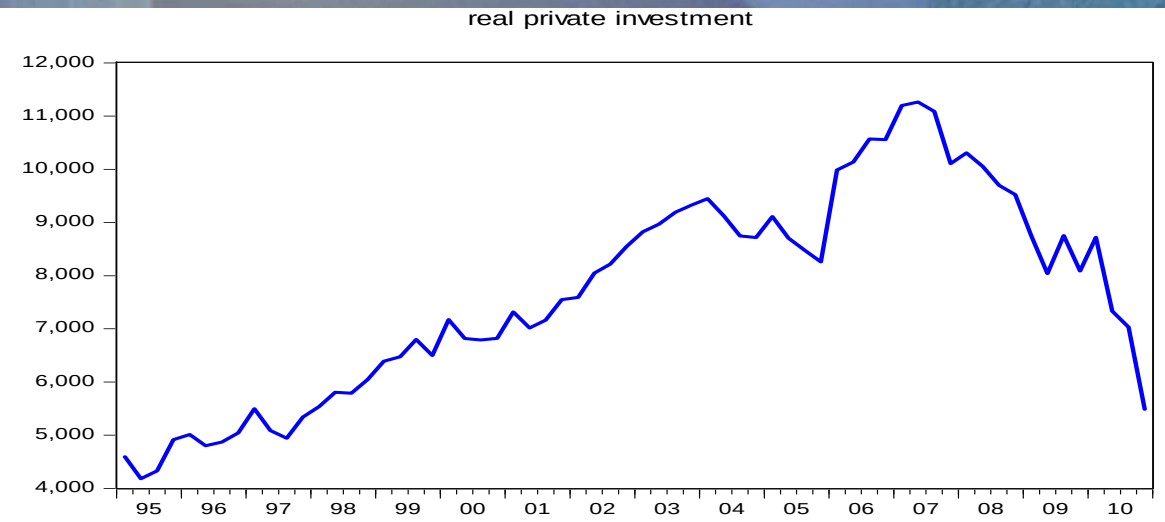
- The variables:

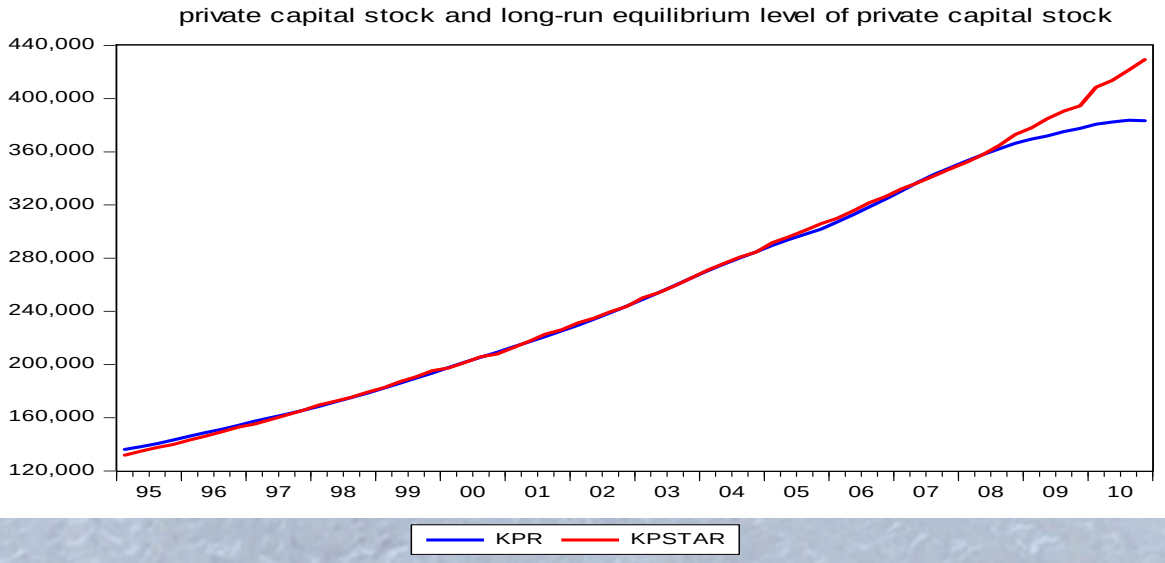
Investment

Long-run level of private capital stock (derived from the production function)

Capital stock

The capital stock starts to deviate from its equilibrium in 2008(3)





Investment equation

BANK OF GREECE
EUROSYSTEM

- Long-run equilibrium relationship, the initial specification

$$log(ipr) = 0.68 + 0.68*log(kpstar) - 0.01*lti + dummies$$
$$(0.8) \quad (10.5) \qquad\qquad (-3.8)$$

ADF: -3.69 , MacKinnon critical value at 5%: -2.9

- where:

  ipr: real private investment

  kpstar: long-run equilibrium level of private capital stock

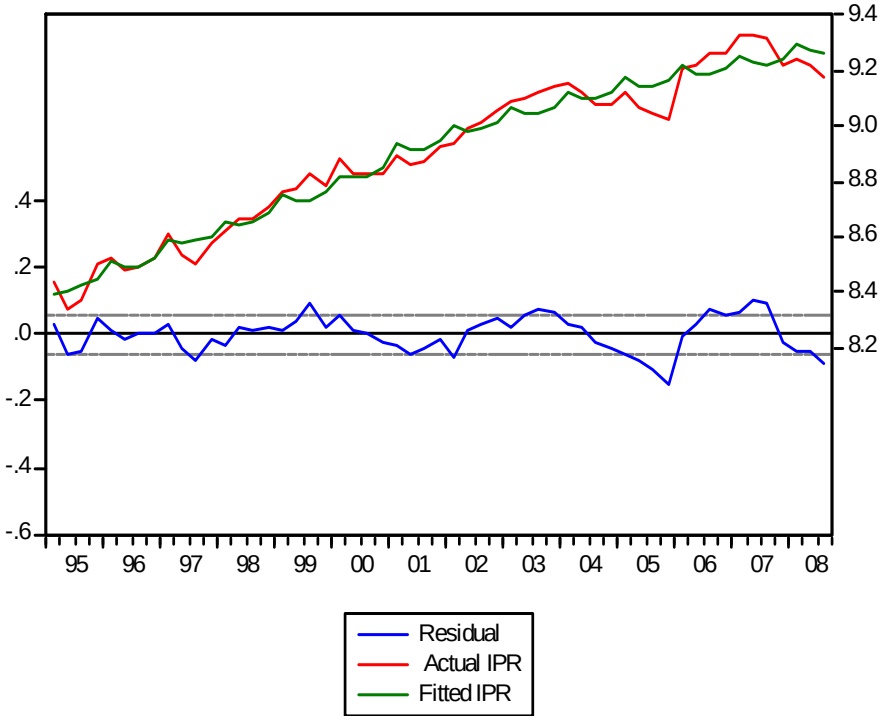
  lti: long-term real interest rate

Investment equation

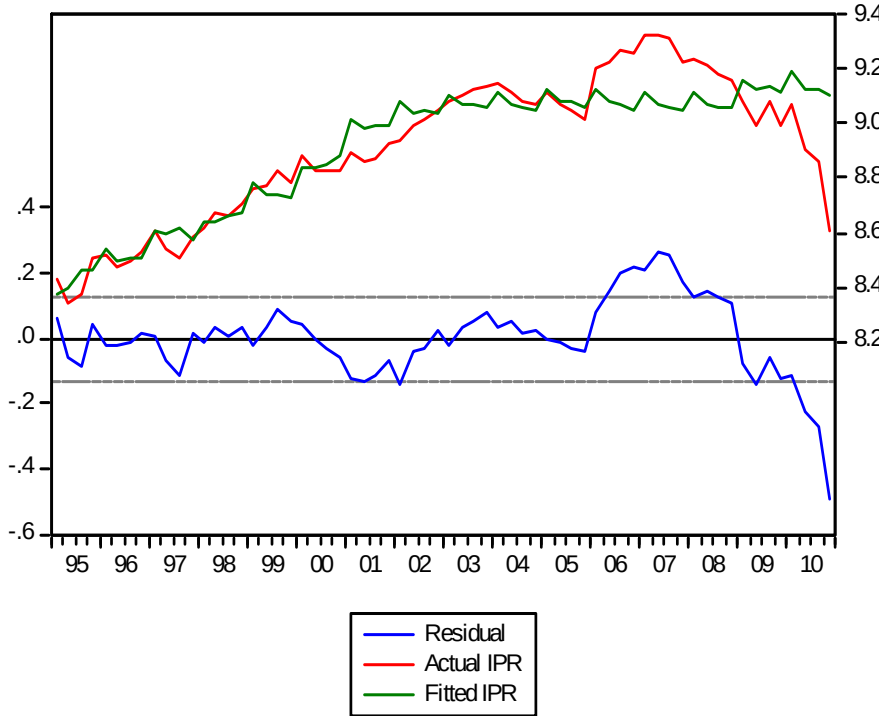
BANK OF GREECE
EUROSYSTEM

➢The initial long-run relationship breaks in 2008(3) and the ect does not turn out significant in the dynamic equation.

Long-run IPR, initial specification 1995-2008



Long-run IPR, initial specification, 1995-2010



Investment equation

BANK OF GREECE
EUROSYSTEM

- Long-run equilibrium relationship

$$log(ipr) = -1.27 + 0.66*log(kpstar) + 0.54*log(econsent) - 0.18*lti + dummies$$
$$(-1.21)\ (11.01) \qquad (3.92) \qquad (-4.54)$$

ADF: -3.69 , MacKinnon critical value at 5%: -2.9

- where:

ipr: real private investment

kpstar: long-run equilibrium level of private capital stock

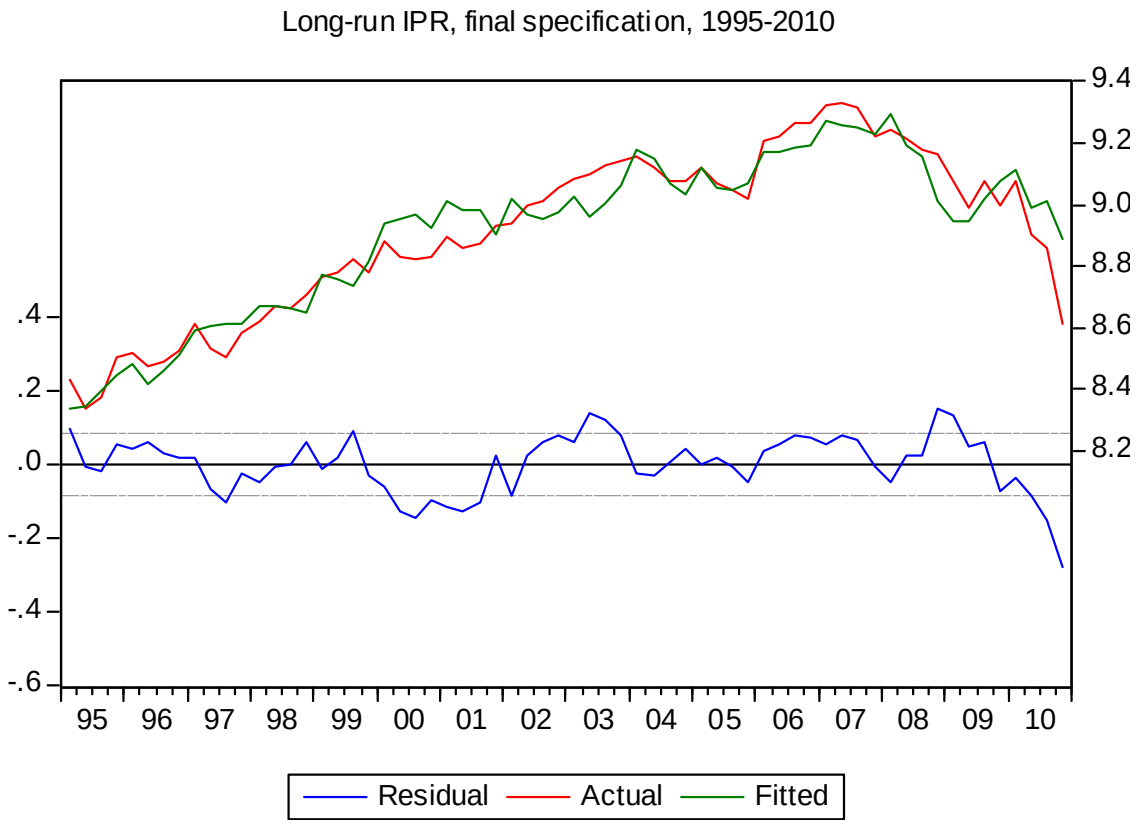
econsent: economic sentiment indicator

lti: long-term real interest rate

Investment equation

BANK OF GREECE
EUROSYSTEM

- The new long-run specification fits better and is significant in the dynamic equation.



Investment equation

BANK OF GREECE
EUROSYSTEM

- Short-term dynamics

$$dlog(ipr) = 0.01 - 0.95*(log(kpr(-1)) - log(kprstar(-1)) - 0.38*ect(-1) + 0.45*dlog(econsent)$$
$$(1.63)\ (-1.66) \qquad\qquad (-3.35) \qquad (2.61)$$
$$+ dummies$$

R^2: 0.45, S.E.: 0.04, D.W.: 1.8

- where:

  kpr: private capital stock

The trade block

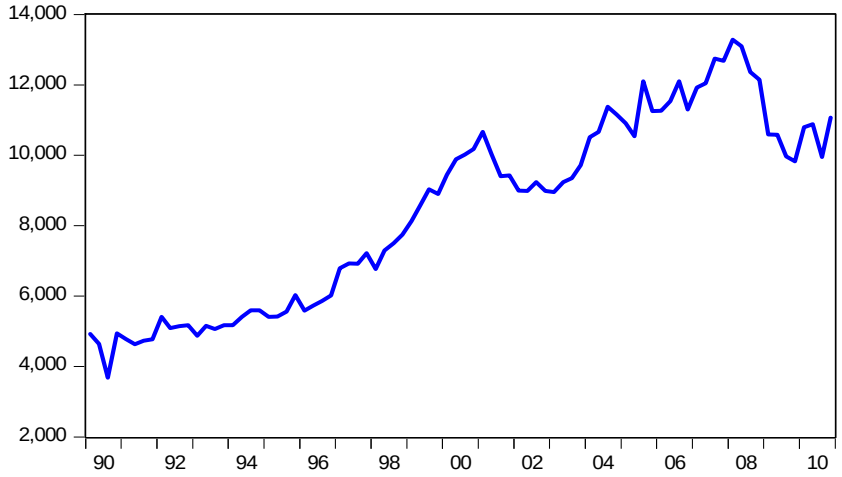
BANK OF GREECE
EUROSYSTEM

- Exports
- Imports
- Export deflator
- Import deflator

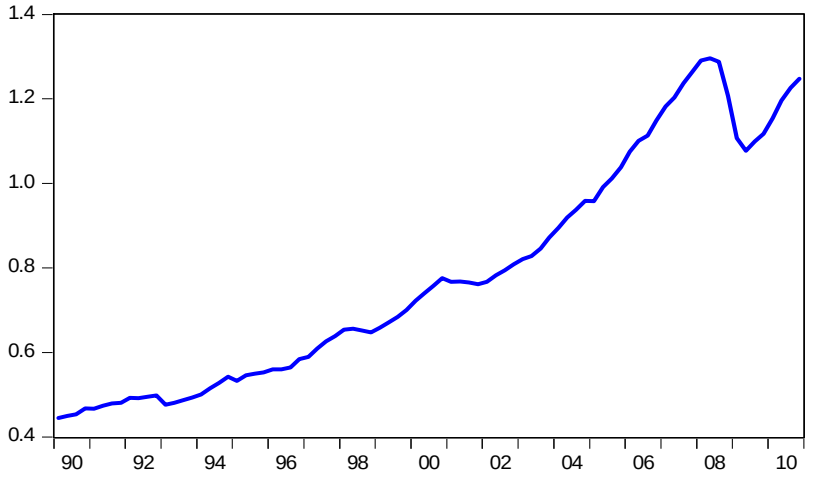
Exports equation

BANK OF GREECE
EUROSYSTEM

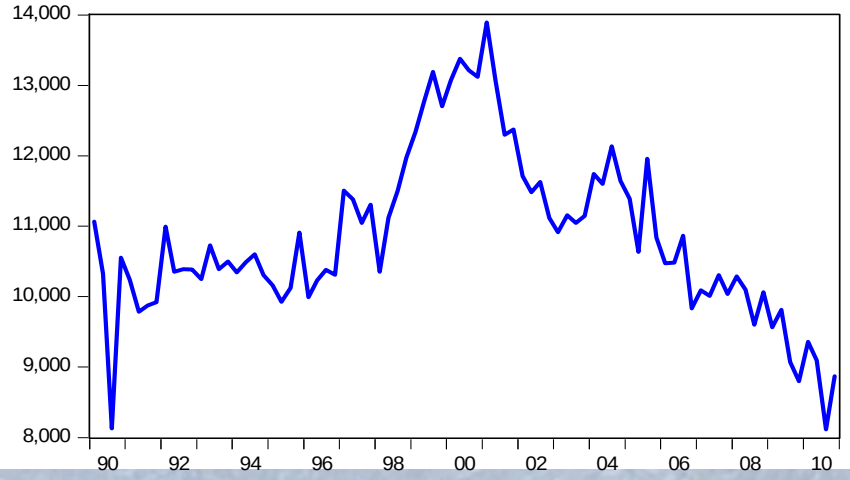
real exports



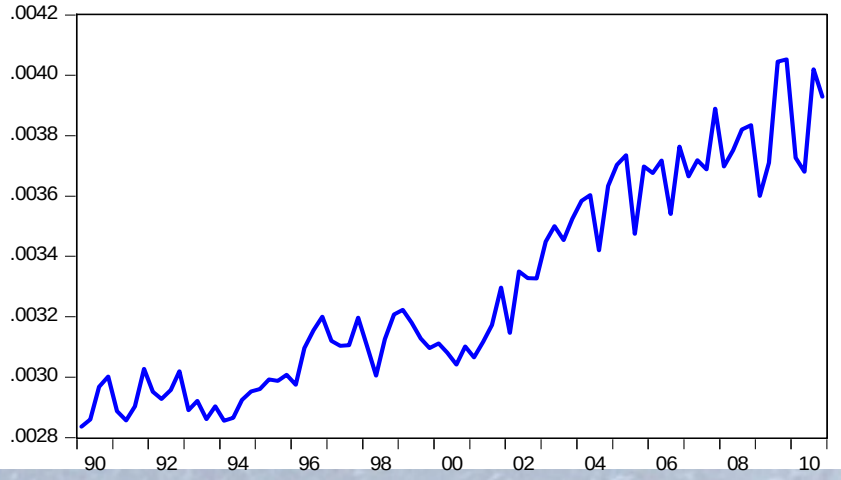
world demand indicator



real exports to world demand indicator ratio



export deflator to competitor's export price ratio



Exports equation

BANK OF GREECE
EUROSYSTEM

- Long-run equilibrium relationship

$$log(xtr/wdr) = 5.43 - 0.62*log(xtd/cxd) + dummies$$

$$(10.0) \quad (-7.19)$$

ADF: -3.83 , MacKinnon critical value at 5%: -2.9

- where:

  xtr: real exports

  wdr: world demand indicator

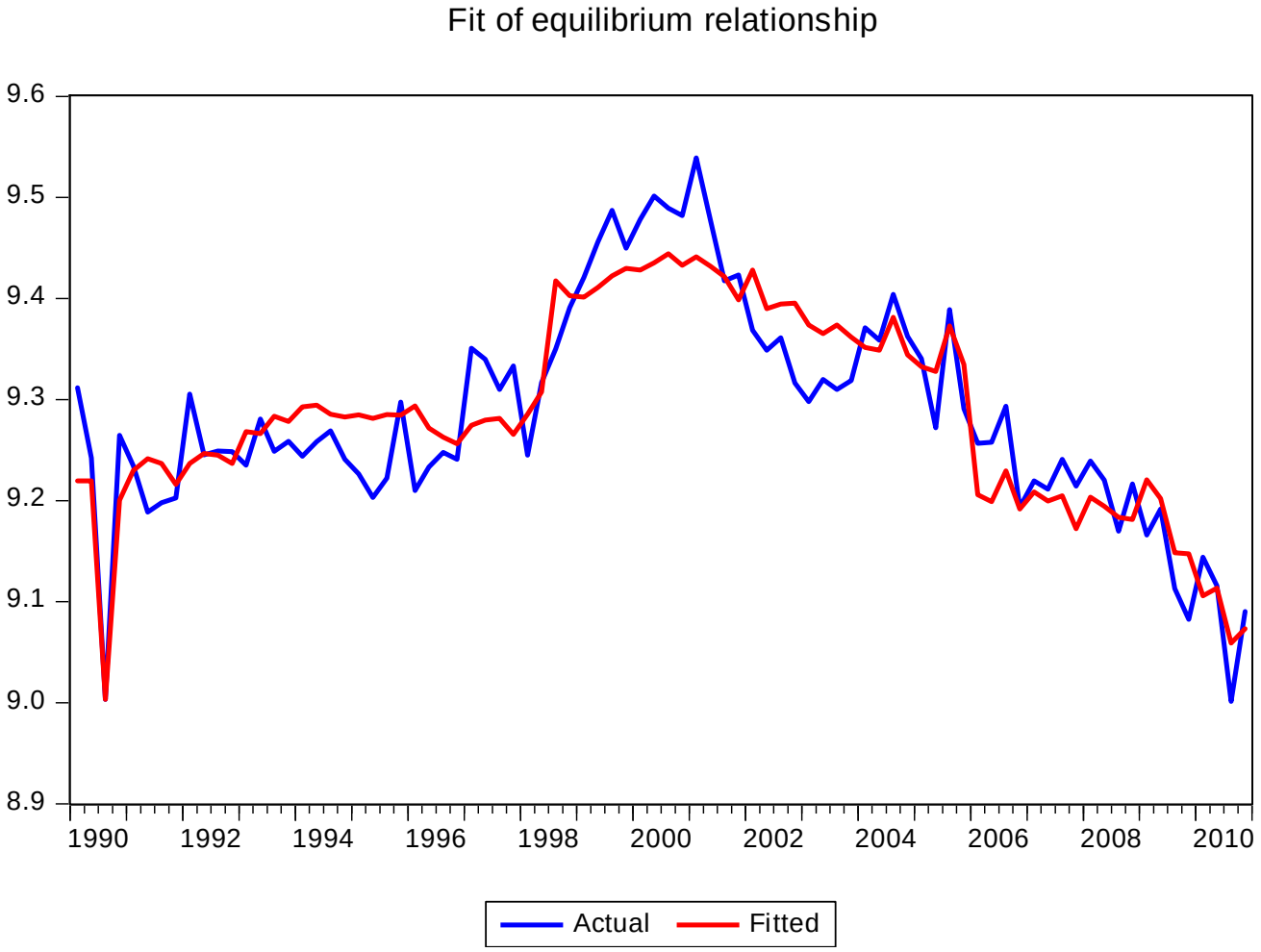
  xtd: export deflator

  cxd: competitors' export prices

- The relative price elasticity is relatively low

Exports equation

BANK OF GREECE
EUROSYSTEM



Exports equation

BANK OF GREECE
EUROSYSTEM

- Short-term dynamics

$$dlog(xtr) = \underset{(-0.77)}{-0.004} + \underset{(3.00)}{0.18}*dlog(xtr(-3)) + \underset{(5.16)}{0.98}*dlog(wdr) - \underset{(-5.34)}{0.65}*dlog(xtd/cxd) - \underset{(-5.58)}{0.48}*ect(-1)$$

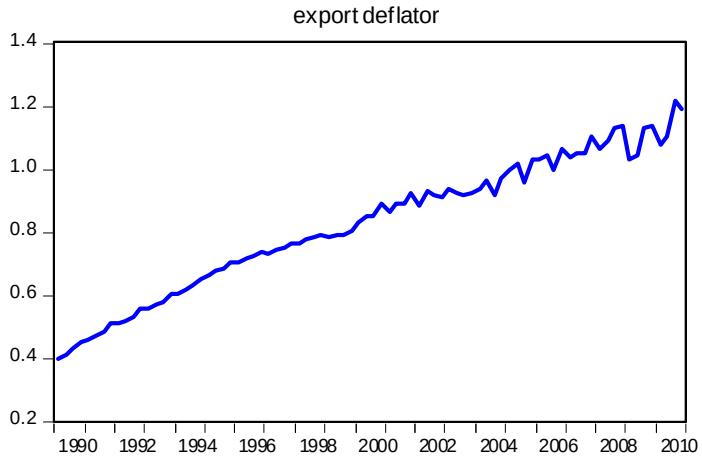
R^2: 0.59, S.E.: 0.03, D.W.: 2.20

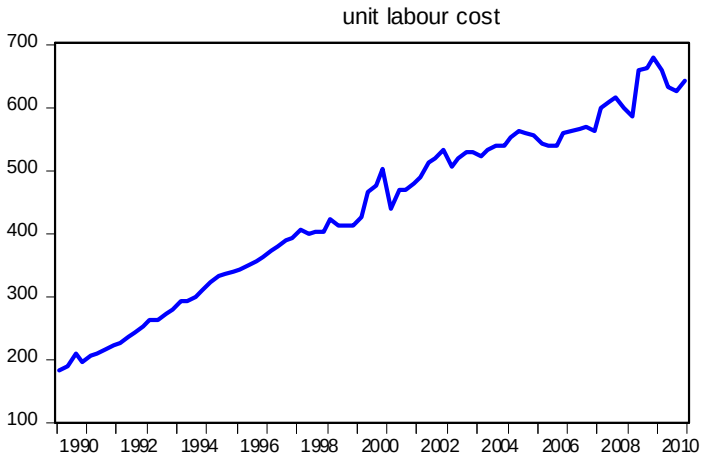
- where:

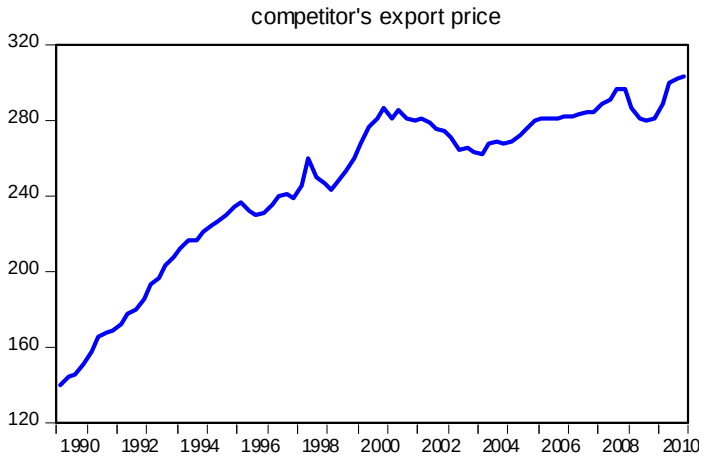
ect: error-correction term

The export deflator equation

BANK OF GREECE
EUROSYSTEM







Export deflator equation

BANK OF GREECE
EUROSYSTEM

- Long-run equilibrium relationship

$$log(xtd) = -5.91 + 0.72*log(cxd) + (1-0.72)*log(ula) + dummies$$
$$(-556.54) \quad (29.1)$$

ADF: -7.84 , MacKinnon critical value at 5%: -2.9

- where:

  xtd: export deflator

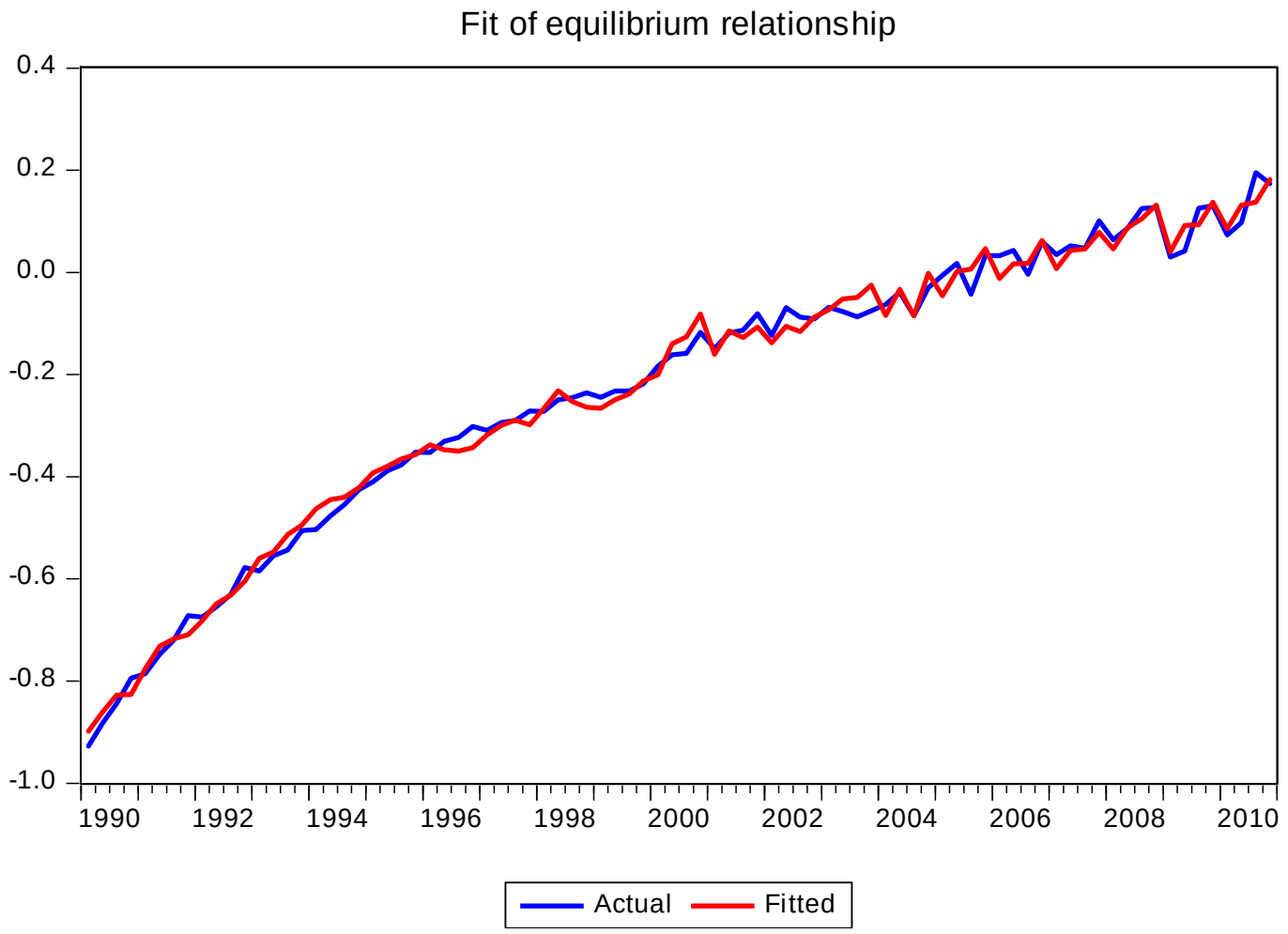
  cxd: competitors' prices on the export side

  ula: unit labour cost

- The effect of ula on export prices is rather low

Export deflator equation

BANK OF GREECE
EUROSYSTEM



Export deflator equation

BANK OF GREECE
EUROSYSTEM

- Short-term dynamics

$$dlog(xtd) = -0.0005 - 0.18*dlog(xtd(-2)) + 0.57*dlog(xtd(-4)) + 0.48*dlog(cxd)$$
$$(-0.2) \quad (-2.7) \qquad\qquad (7.42) \qquad\qquad (4.34)$$

$$+ 0.12*dlog(ula) - 0.39*ect(-1)$$
$$(5.02) \qquad\qquad (-4.3)$$

R^2: 0.76, S.E.: 0.02, D.W.: 2.18

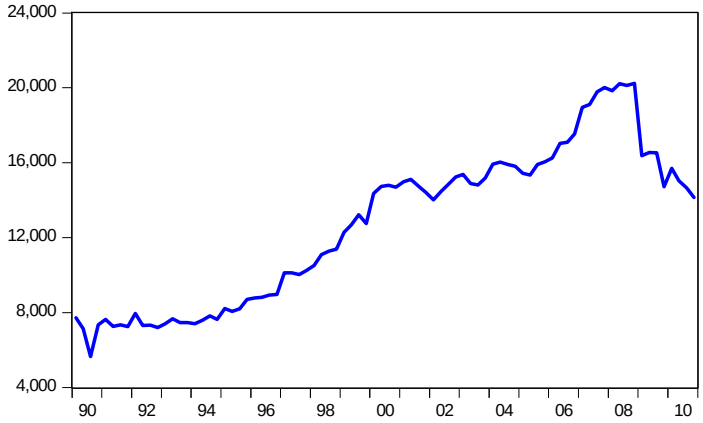
- where:

  ect: error-correction term

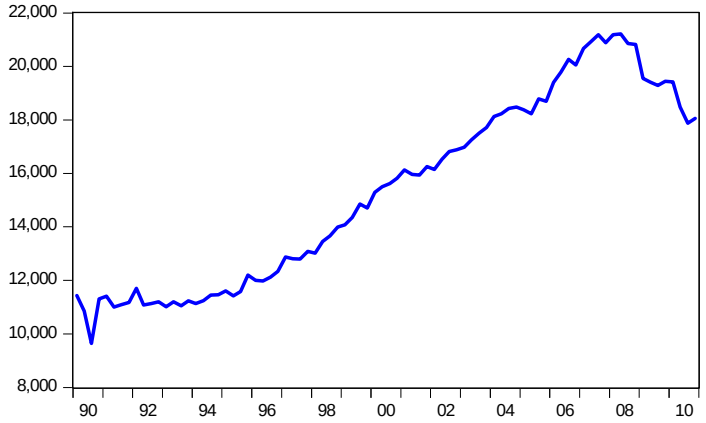
Imports equation

BANK OF GREECE
EUROSYSTEM

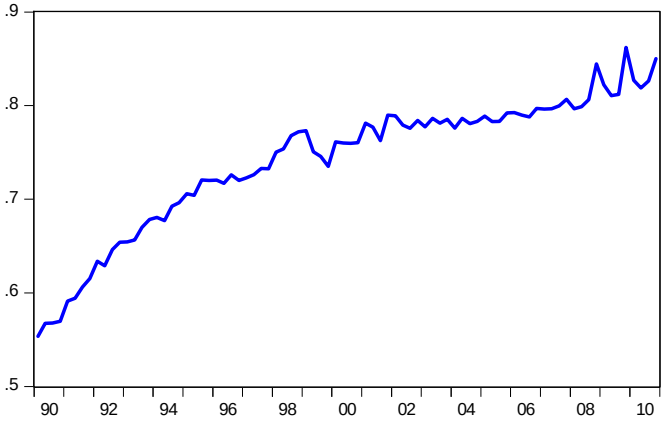
real imports



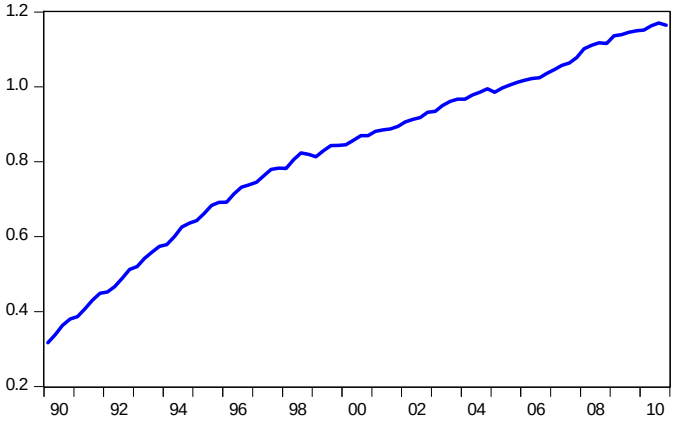
import demand indicator



import deflator net of oil



GDP deflator



Imports equation

BANK OF GREECE
EUROSYSTEM

- Long-run equilibrium relationship

$$log(mtr/wer) = -0.30 - 0.73*log(mtdno/yed) + dummies$$
$$(-41.84)\ (-20.63)$$

ADF: -4.96 , MacKinnon critical value at 5%: -2.9

- where:

mtr: real imports

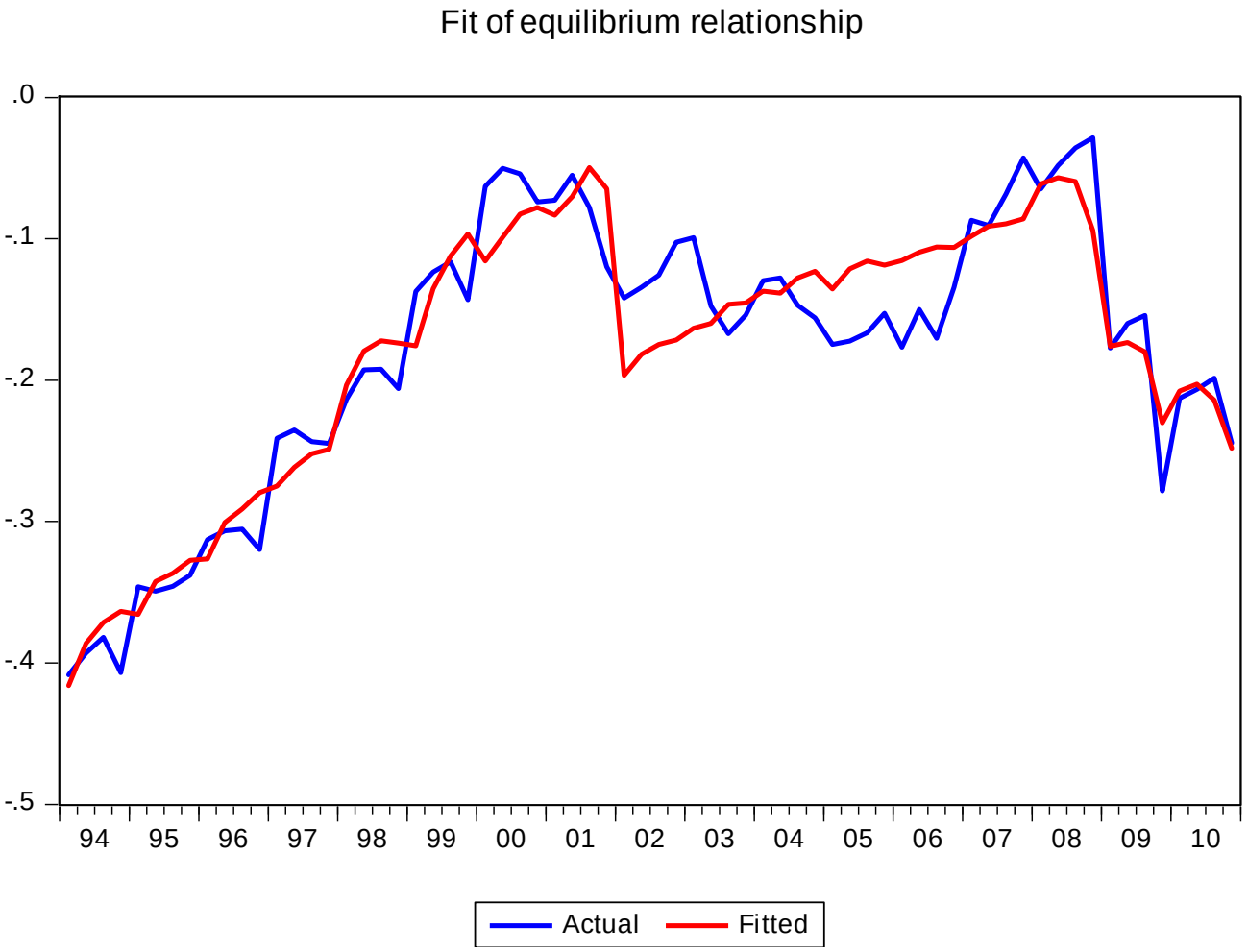
wer: import demand indicator

mtdno: import deflator net of oil

yed: GDP deflator

Imports equation

BANK OF GREECE
EUROSYSTEM



Imports equation

BANK OF GREECE
EUROSYSTEM

- Short-term dynamics

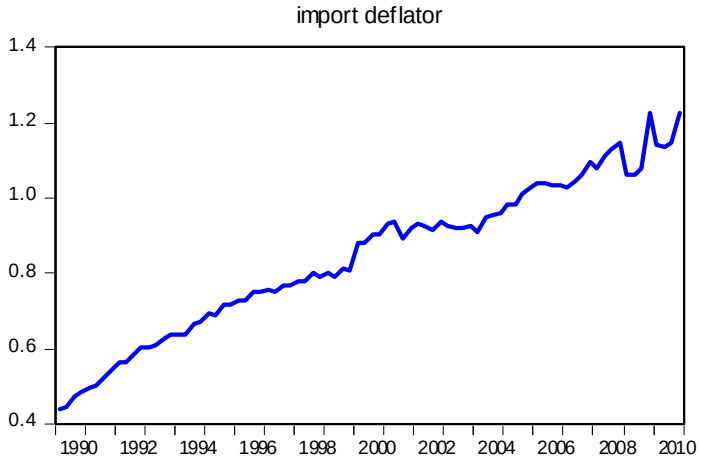
$$dlog(mtr) = 0.003 + 1.08*dlog(wer) - 0.30*dlog(mtdno(-3)/yed(-3)) - 0.23*ect(-1) + dummies$$
$$\qquad\quad (0.67) \quad (5.75) \qquad\qquad (-1.71) \qquad\qquad\qquad\qquad (-2.2)$$

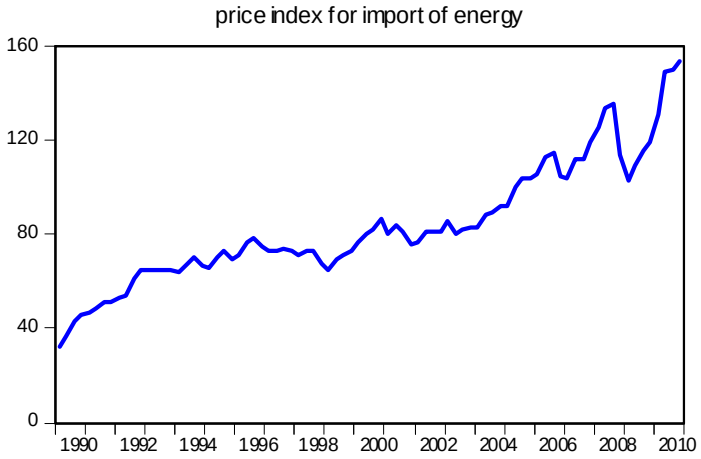
R^2: 0.70, S.E.: 0.03, D.W.: 1.95

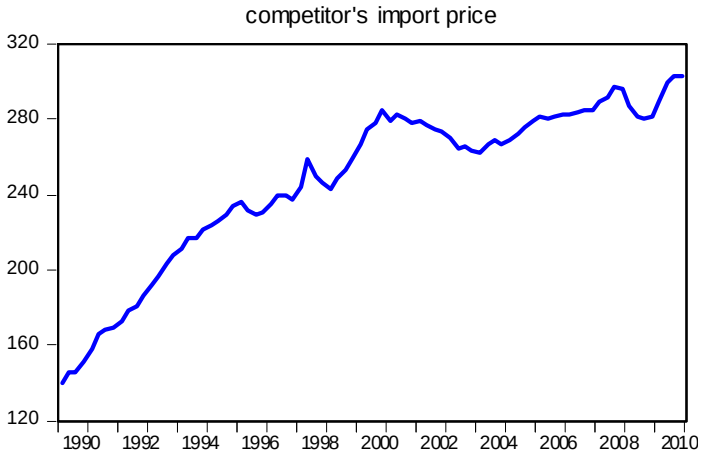
- where:
- *ect:* error-correction term

Import deflator equation

BANK OF GREECE
EUROSYSTEM







Import deflator equation

BANK OF GREECE
EUROSYSTEM

- Long-run equilibrium relationship

$$log(mtd) = -5.40 + 0.69*log(cmd) + (1-0.69)*log(pei) + dummies$$
$$(-178.2) \quad (27.3)$$

ADF: -5.82 , MacKinnon critical value at 5%: -2.9

- where:

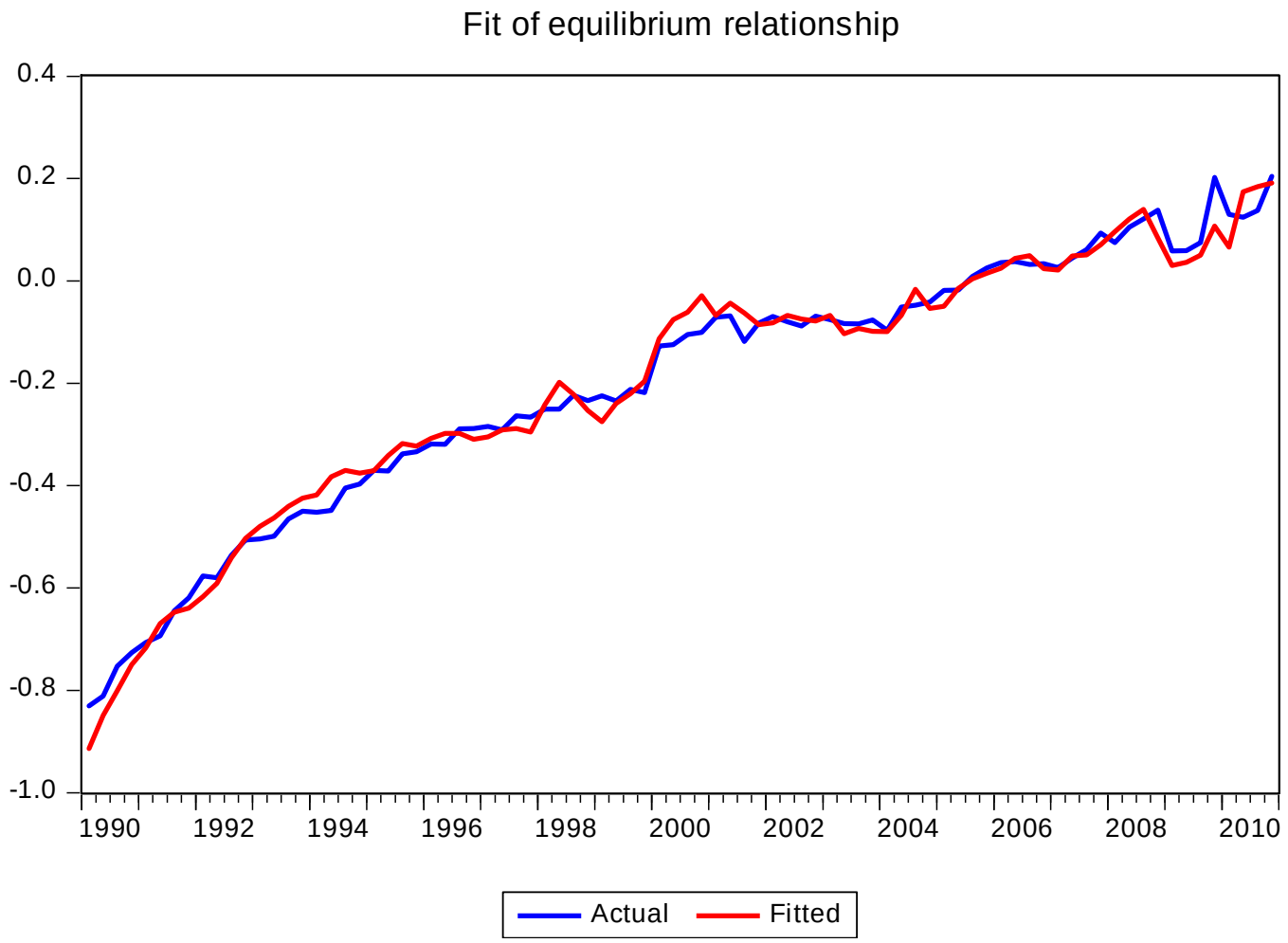
mtd: import deflator

cmd: competitors' prices on the import side

pei: price index for import of energy

Import deflator equation

BANK OF GREECE
EUROSYSTEM



Import deflator equation

BANK OF GREECE
EUROSYSTEM

- Short-term dynamics

$$dlog(mtd) = 0.01 - 0.24*dlog(mtd(-3)) + 0.24*dlog(cmd) + 0.11*dlog(pei) - 0.44*ect(-1) + dummies$$
$$(4.51)\ (-3.41) \qquad (2.15) \qquad (2.92) \qquad (-6.13)$$

R^2: 0.71, S.E.: 0.02, D.W.: 1.87

- where:

  ect: error-correction term

Thank you for your attention