Agricultural productivity paths in Central and Eastern Europe and the Former Soviet Union: The role of reforms, initial conditions and induced technological change

Jo Swinnen, Kristine Van Herck & Liesbet Vranken

LICOS Centre for Institutions and Economic Performance
University of Leuven

Centre for Corporate Sustainability, HUBrussel

Introduction

- Measuring agric productivity changes and identifying causes is difficult
  - Survey-data – 1 year, no panel
  - Time series only aggregate data
  - Cross-country comparisons use different samples

- We use three sets of productivity indicators to get comprehensive picture

Productivity indicators

- Partial productivity 1 : LABOR productivity
- Partial productivity 2 : YIELDS (land & animal productivity)
- Total factor productivity (TFP):
  - Evolution of output-input ratio

Resource endowments, reforms and technical change in transition countries

- Resource endowments play important role in agricultural productivity growth
- Induced innovations in technology biased towards saving the limiting factor
- Labor abundant & land scarce → technology innovations to use land more efficiently
  - → biological innovations
- Land abundant & labor scarce → technology innovations to use labor more efficiently
  - → mechanical innovations
  - → adjustment in land labor ratio

Resource endowments, reforms and technical change in transition countries

- Major differences in resource endowments and nature of technology in transition countries

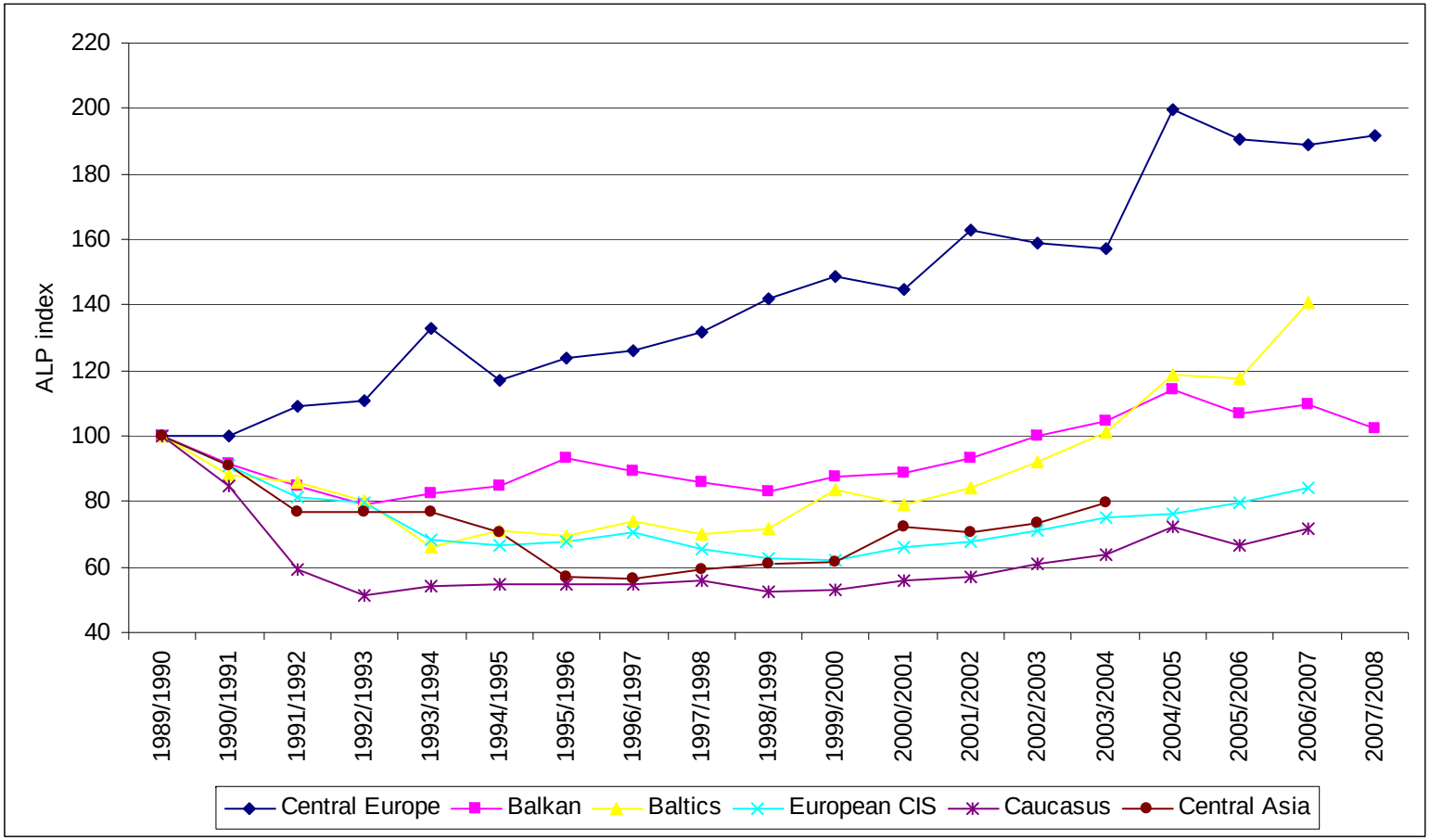
Resource endowments, reforms and technical change in transition countries

		Share of agr. in empl (%)	Labor/land ratio	Agr. land in ind. farms
Central Asia	Mongolia	32.7	0.002	0
	Kazakhstan	22.6	0.008	0
	Kyrgyzstan	32.6	0.054	4
	Tajikistan	43.0	0.185	4
	Turkmenista	41.8	0.015	2
	Uzbekistan	39.2	0.109	5
Caucasus	Armenia	17.4	0.218	7
	Azerbaijan	30.7	0.203	2
	Georgia	25.2	0.217	12
European CIS	Belarus	19.1	0.105	7
	Moldova	32.5	0.269	7
	Russia	12.9	0.044	2
	Ukraine	19.5	0.118	6
Baltics	Estonia	12.0	0.072	4
	Latvia	15.5	0.085	4
	Lithuania	18.6	0.098	9
Central Europe	Czech	9.9	0.122	1
	Hungary	17.9	0.131	13
	Poland	26.4	0.258	76
	Slovakia	12.2	0.139	2
Balkans	Albania	49.4	0.627	3
	Bulgaria	18.1	0.132	14
	Romania	28.2	0.204	14
	Slovenia	11.8	0.116	83

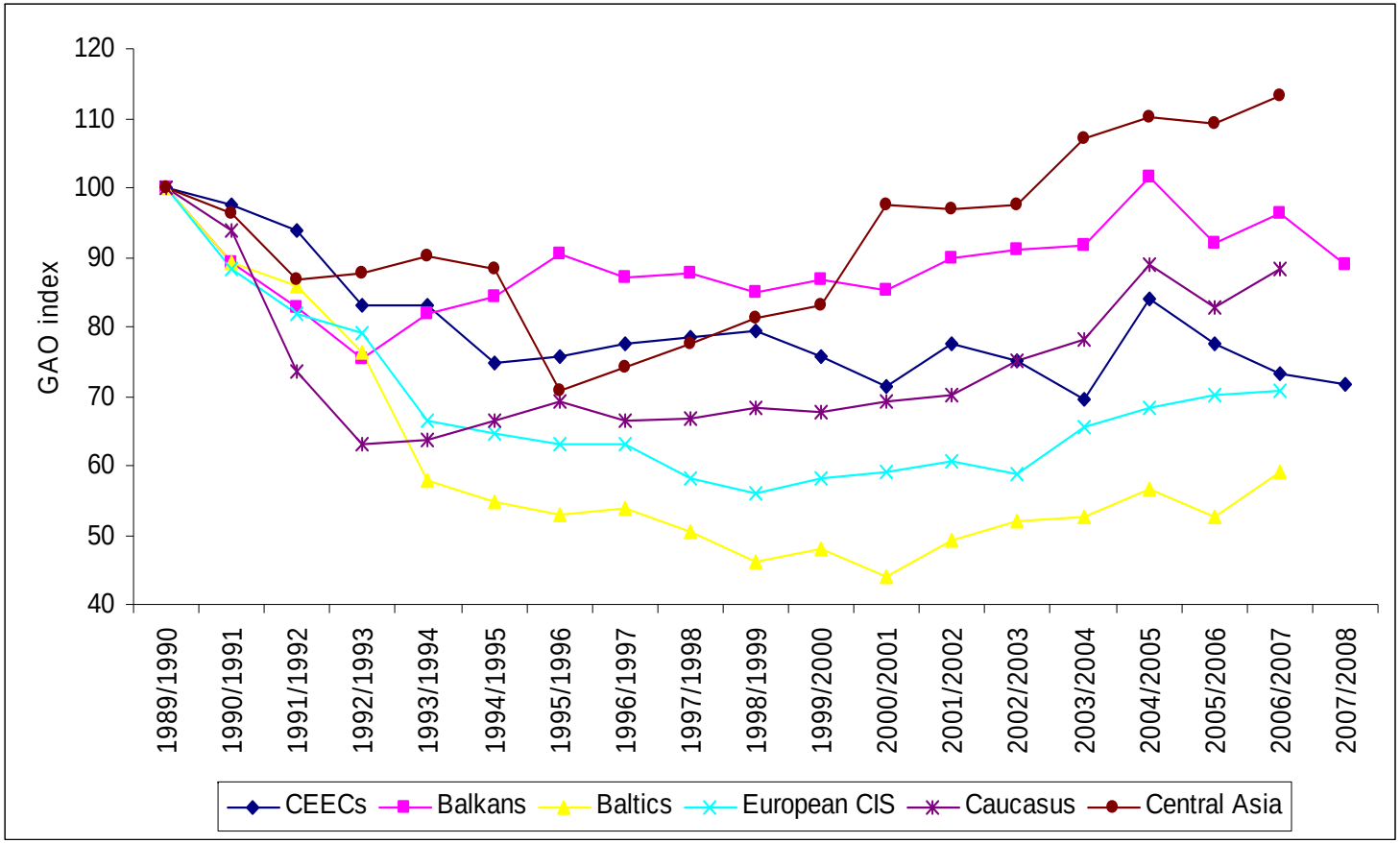
Resource endowments, reforms and technical change in transition countries

- But impact resource endowments on productivity growth complex because
  - Pre-reform distortions in factor and output prices → removal affects factor adjustments
  - Factor adjustments are conditional on progress in reform process
    - Affected also access to credit for investment in machinery and working capital
  - Government policies and level of development affect opportunity cost of labor and hence factor adjustments
  - Endogenous adjustments of farm restructuring

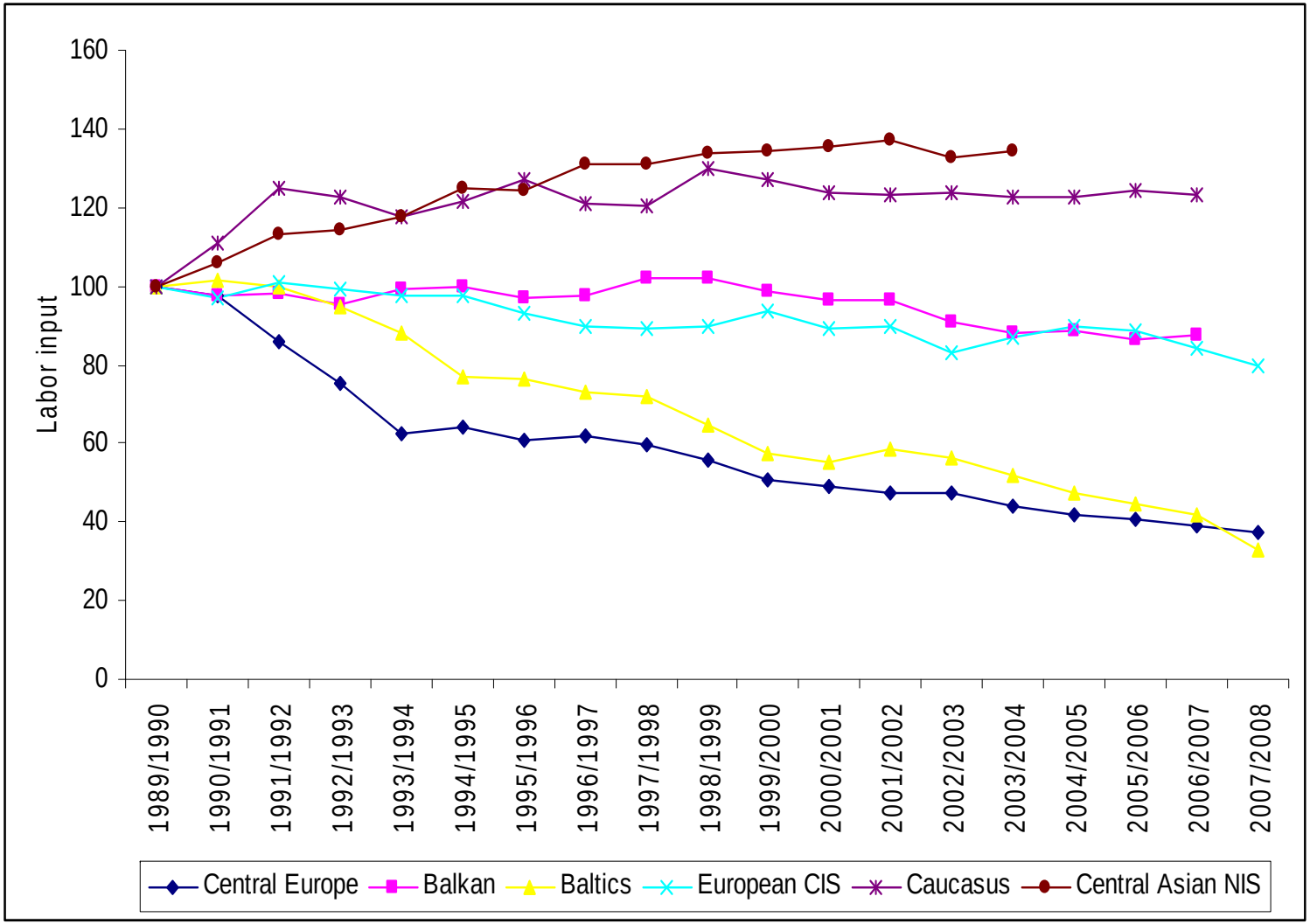
Changes in Agricultural Labor Productivity (output per farm worker – ALP)



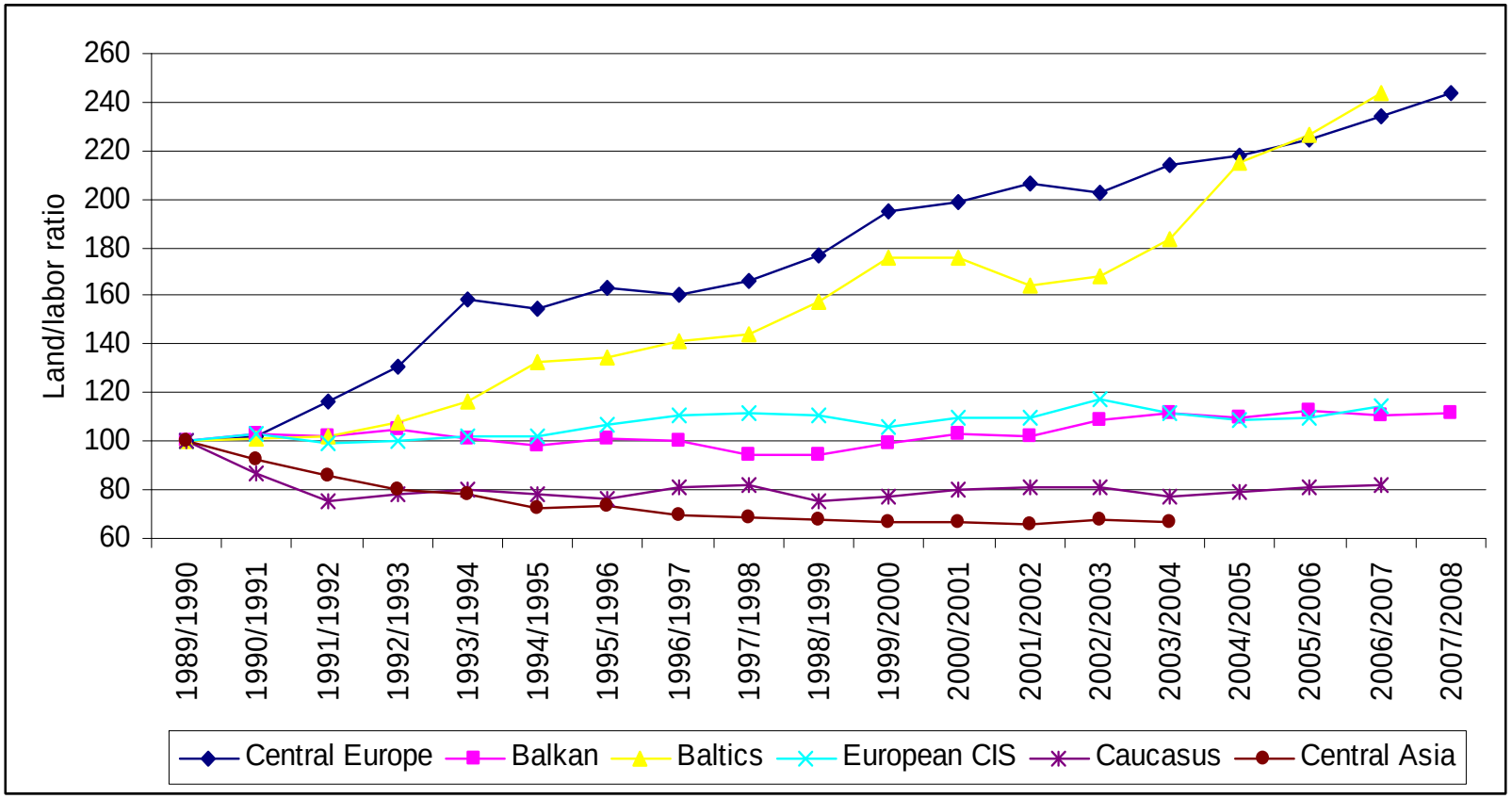
Changes in Agricultural Output



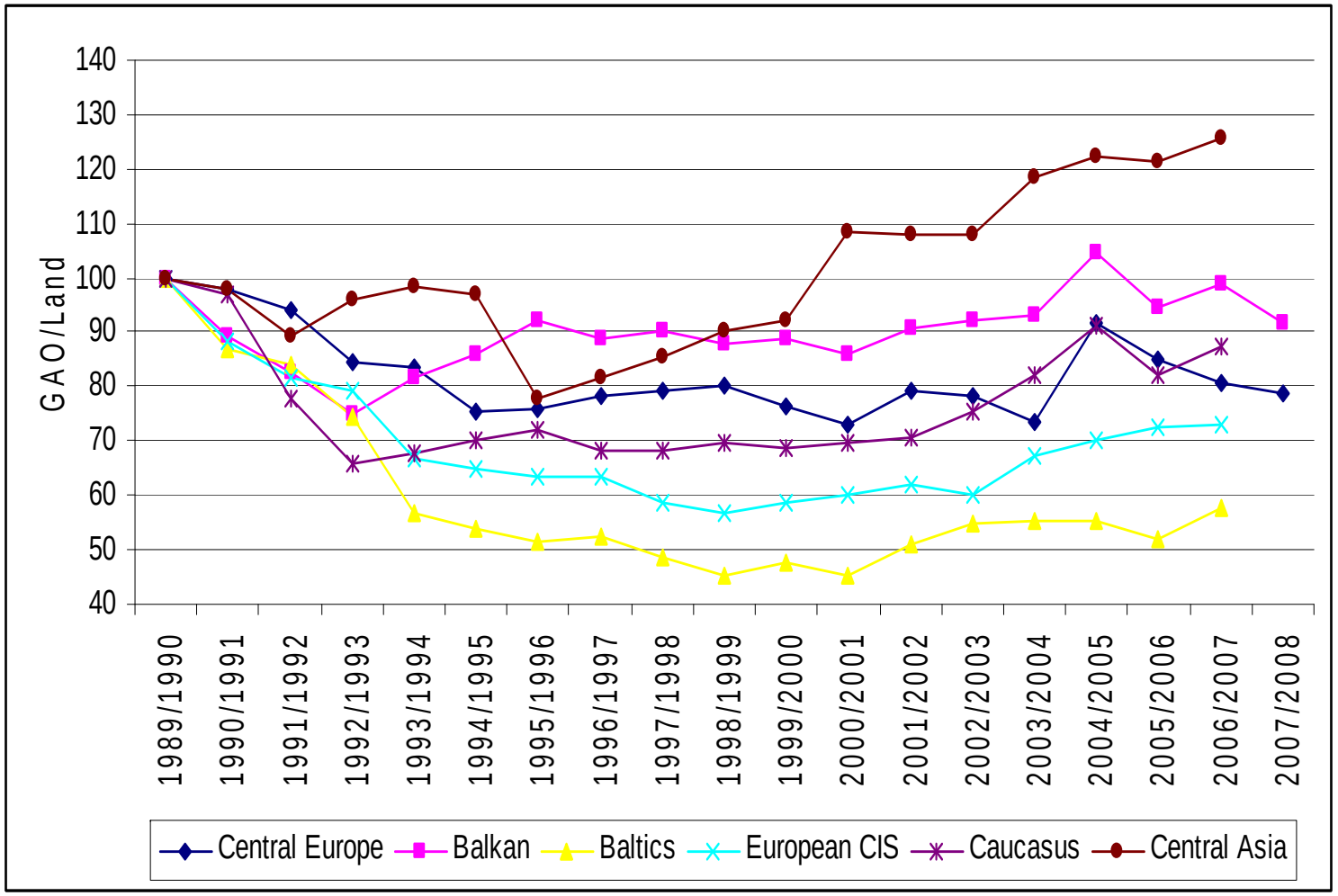
Changes in Labor Use



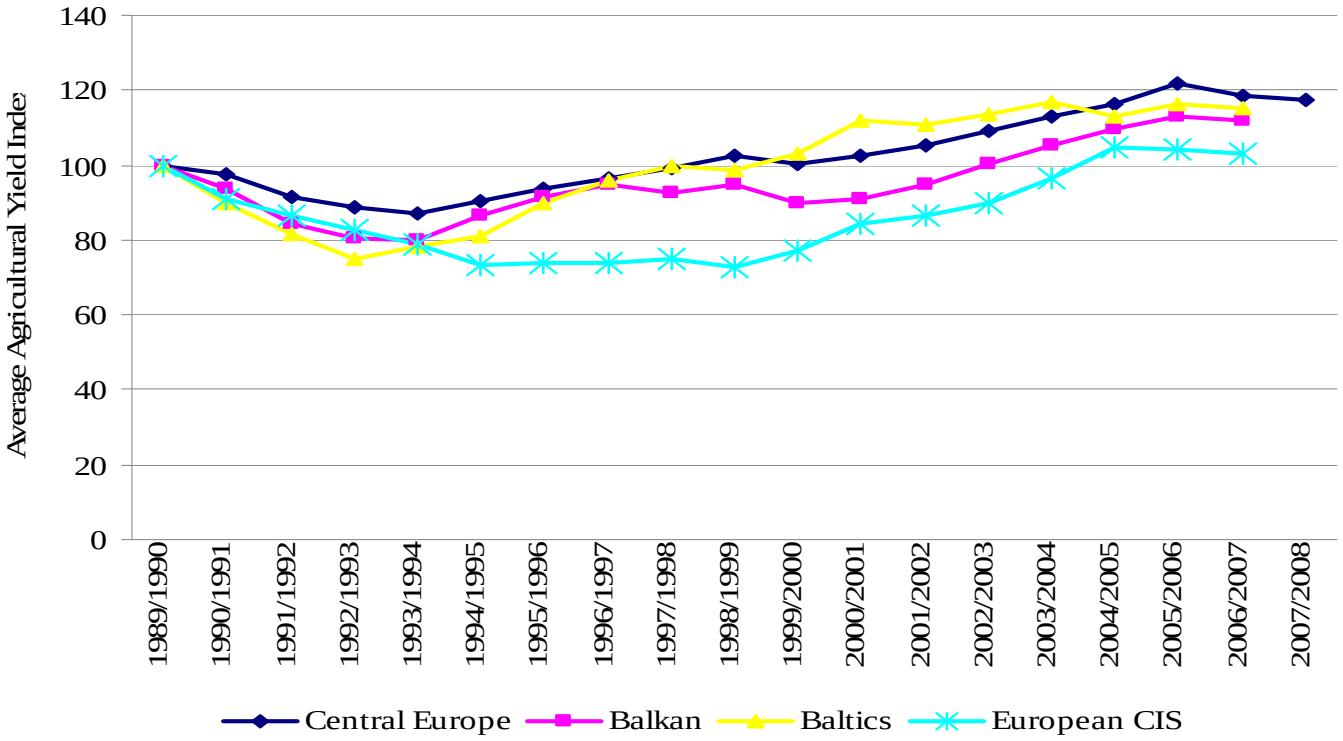
Change in Land/Labor ratio



Change in GAO/Land



Change in average agricultural yields (grains, sugar beet and milk)

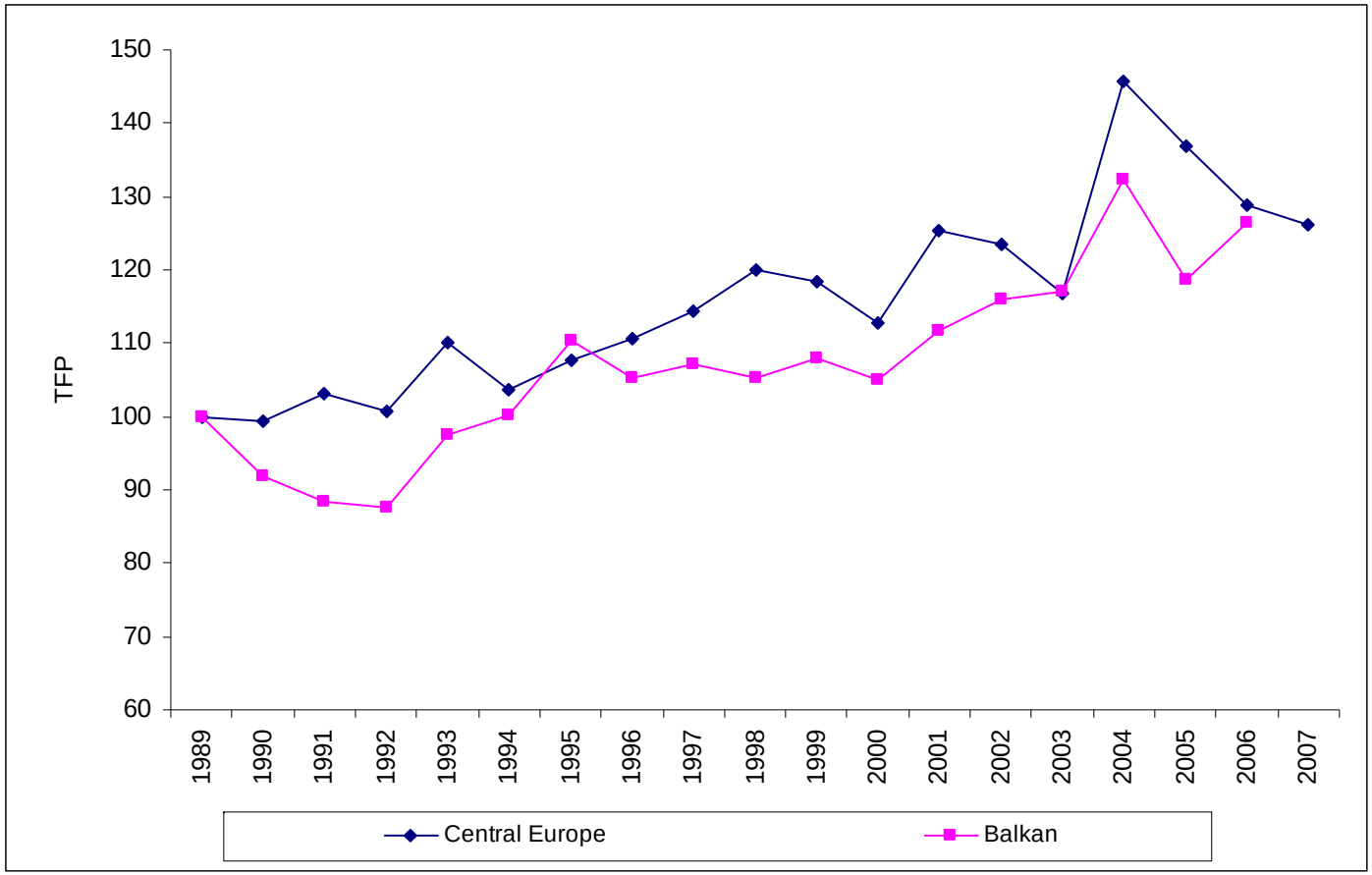


Agricultural yield index is calculated as the average yield index of grains, sugar beet and milk. Given the sensitivity of grain yields to the weather conditions, the figures show the moving average over three years. Balkans includes Albania, Bulgaria, Romania and excludes Slovenia

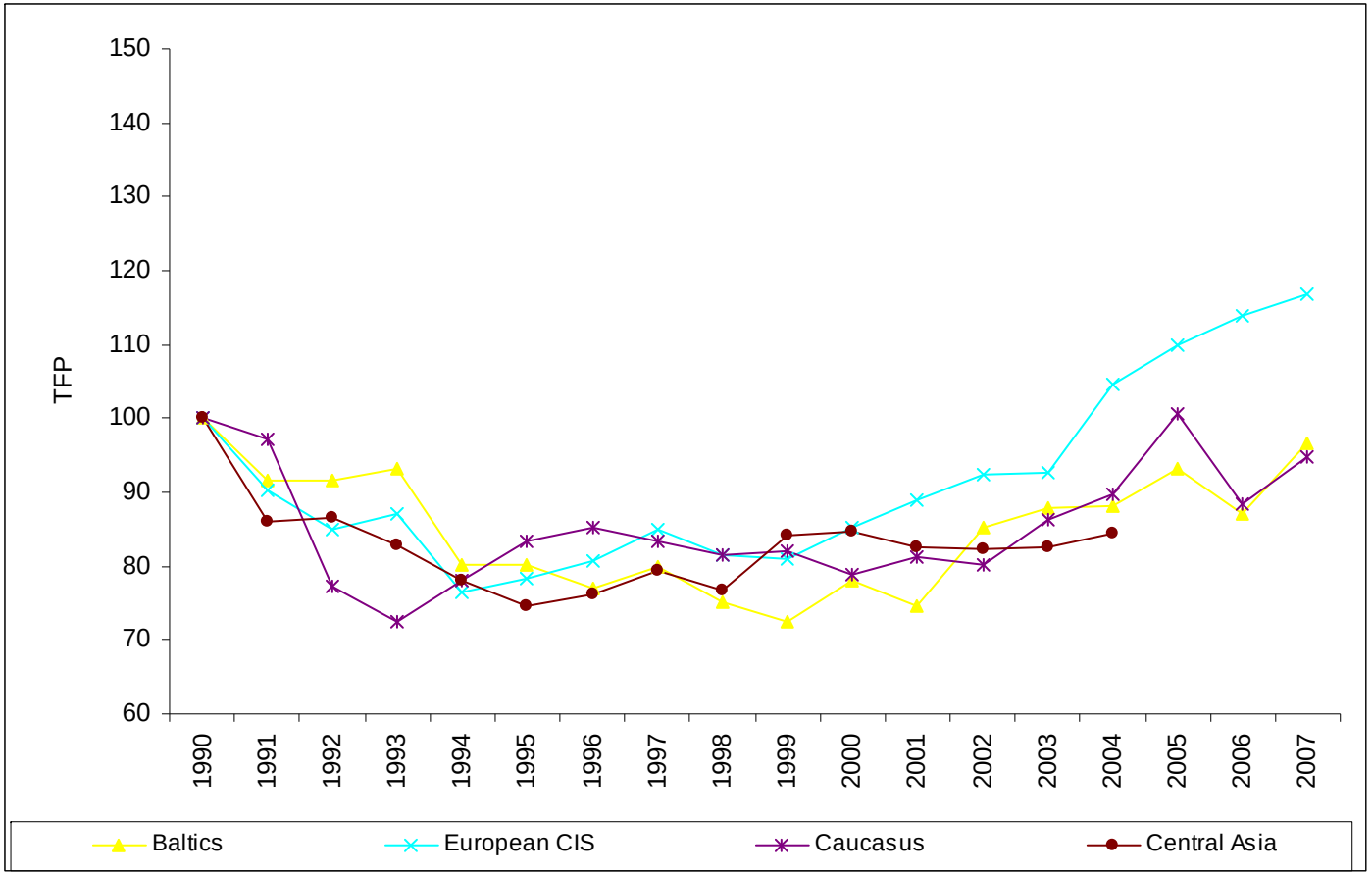
Methodology TFP

- Growth accounting approach
- Account for growth in output by measuring factor inputs and an unexplained residual, which is generally attributed to technological change
- TFP is measured as an output-input ratio where the estimated coefficients of the different production factors in a Cobb-Douglas production function are used as inputs weights
- As input weights, we used the coefficients of the production function estimated in Cungu & Swinnen (2003)

Total factor productivity change



Total factor productivity change



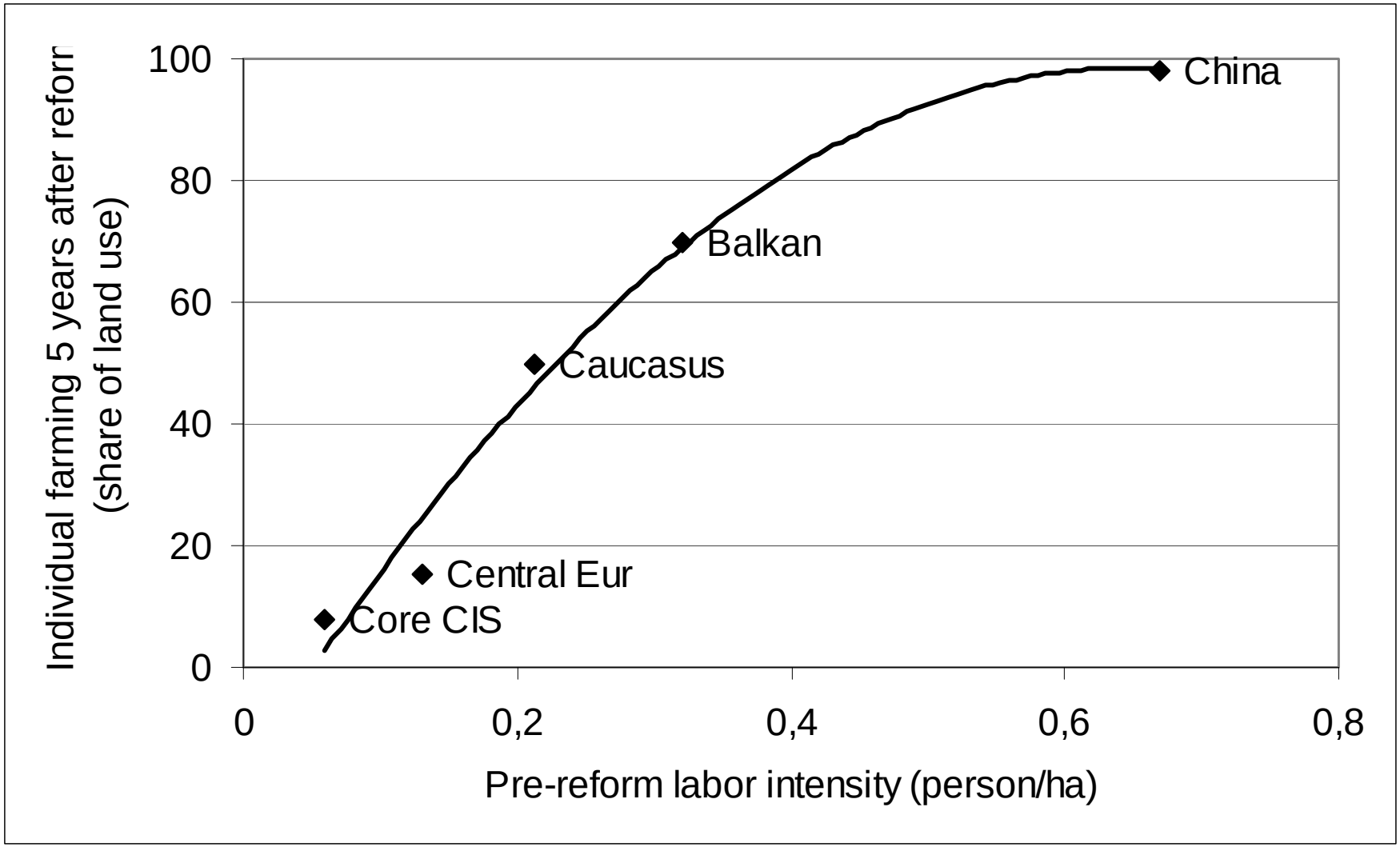
Total factor productivity change

Average annual change	1989-2006	1989-1992	1992-1995	1995-1998	1998-2001	2001-2004	2004-2006
Albania	3,2	-1,3	5,9	2,0	4,3	4,0	5,2
Bulgaria	-0,1	-1,2	3,6	-5,3	-1,0	5,0	-2,1
Romania	2,7	-4,1	11,6	-4,9	7,4	13,3	-11,5
Slovenia	0,3	-9,9	9,1	1,6	-2,2	5,3	-3,5
Balkan	**1,5**	**-4,1**	**7,5**	**-1,7**	**2,1**	**6,9**	**-3,0**
	1989-2007	1989-1992	1992-1995	1995-1998	1998-2001	2001-2004	2004-2007
Czech	1,4	1,3	2,4	3,5	-1,2	5,9	-3,3
Hungary	2,8	1,6	3,8	4,9	5,5	10,6	-9,6
Poland	0,6	-1,8	0,7	3,3	1,0	3,6	-3,3
Slovakia	1,0	0,0	2,4	4,5	1,8	7,1	-10,0
Central Europe	**1,4**	**0,3**	**2,3**	**4,1**	**1,8**	**6,8**	**-6,5**
	1990-2007	1990-1993	1993-1996	1996-1999	1999-2002	2002-2005	2005-2007
Estonia	-0,5	-8,6	-2,1	-1,1	5,2	1,2	4,0
Latvia	-1,1	-0,6	-11,1	-0,6	3,4	2,7	-0,3
Lithuania	1,0	2,4	-2,9	-2,8	4,1	4,2	1,3
Baltics	**-0,2**	**-2,3**	**-5,4**	**-1,5**	**4,2**	**2,7**	**1,7**
Belarus	1,8	-3,5	-3,1	-0,5	4,2	9,5	5,2
Russia	2,2	-3,4	-0,9	0,6	4,9	6,1	7,6
Ukraine	-1,0	-6,1	-2,2	0,1	2,3	1,9	-2,3
European CIS	**1,0**	**-4,3**	**-2,1**	**0,0**	**3,8**	**5,8**	**3,5**
Armenia	0,9	-8,1	3,0	-1,0	-1,3	9,3	4,8
Azerbaijan	-0,7	-10,3	0,7	-1,6	2,9	4,4	-0,5
Georgia	-1,1	-9,1	9,0	-0,4	-3,5	6,8	-13,3
Caucasus	**-0,3**	**-9,2**	**4,2**	**-1,0**	**-0,6**	**6,8**	**-3,0**
	1990-2004	1990-1993	1993-1996	1996-1999	1999-2002	2002-2004	
Kazakhstan	-2,7	-4,4	-7,2	6,2	-5,6	-2,7	
Kyrgyzstan	1,9	-4,3	5,7	2,9	1,3	4,9	
Tajikistan	-2,5	-8,4	-5,1	-1,0	2,3	1,1	
Central Asia	**-1,1**	**-5,7**	**-2,2**	**2,7**	**-0,7**	**1,1**	

Technology and the Nature of Productivity Gains

- gains in productivity have come both from property rights reforms and organizational restructuring,
- But: the relative importance of each component differs between countries reflecting technology.
- **In labor-intensive regions**: shift from large-scale collective farming to small-scale individual farming caused dramatic gains in productivity with relatively small losses in scale efficiency.
- In **capital and land intensive regions**, gains in labor productivity, if any, came primarily from large farms shedding labor with privatization of the farms.

Labor intensity and the shift to individual farming



Patterns of Restructuring

- In **labor intensive** nations

  e.g., Albania, Armenia, Georgia, Kyrgyzstan,...

  Gains from property rights came with shift to individual farming
- In **land intensive** nations

  e.g., Czech, Slovakia, Hungary, ...

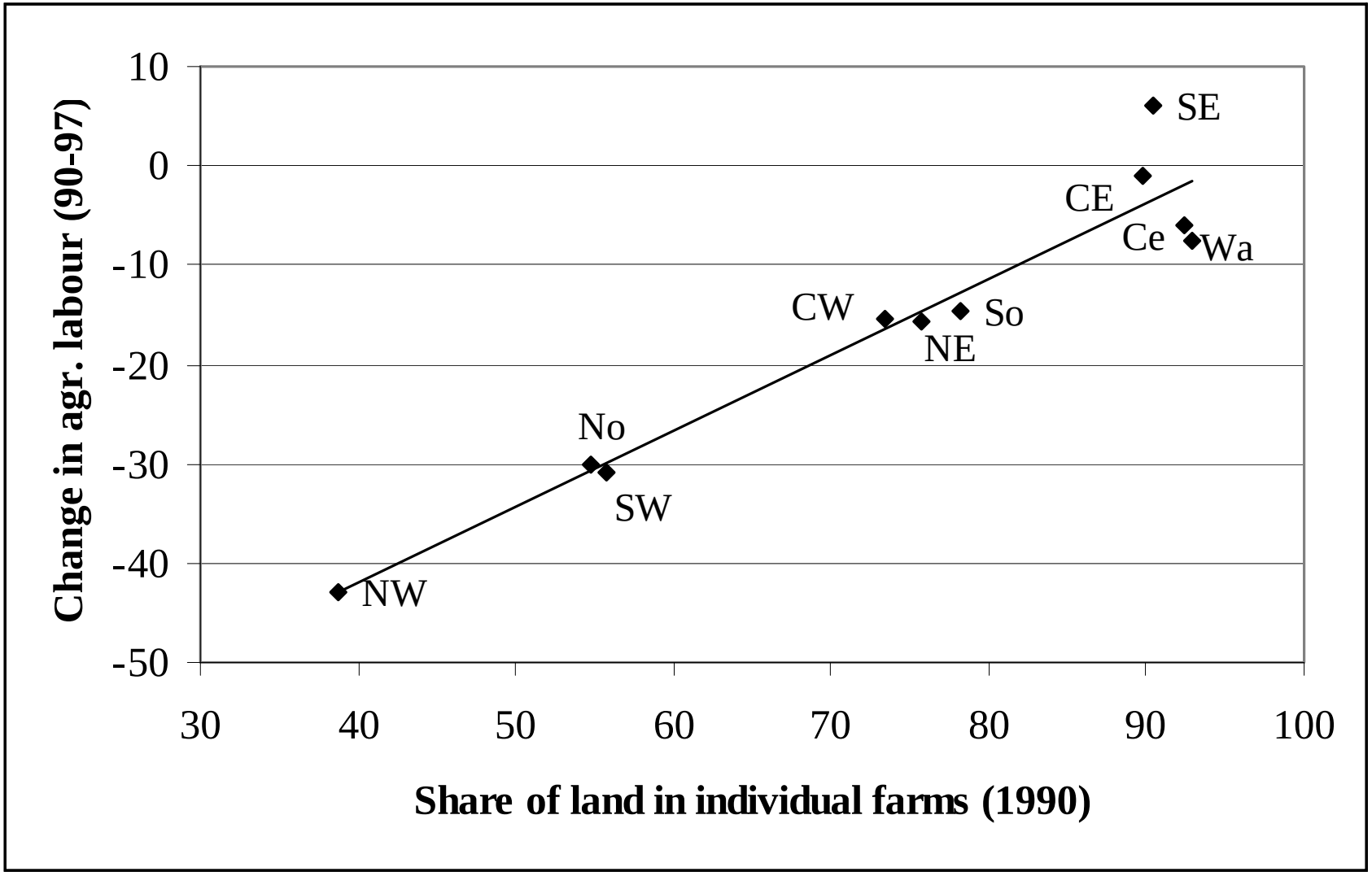
  Gains in productivity primarily from labor shedding on large private farms

Technology and the Nature of Productivity Gains

- **In labor-intensive regions**: shift to small-scale individual farming caused dramatic gains in efficiency
- In **capital and land intensive regions**, gains in productivity came from large farms shedding labour

=> **Labor adjustment is jointly endogenous with farm restructuring**

Initial farm structure and labor adjustment in Poland



Technology, Productivity & Policy

- **In labor-intensive regions**: shift to small-scale individual farming caused dramatic gains in efficiency

  => Conditional on land policy

Productivity gains only start after in-kind distribution of land

Immediately :

- Albania 1991
- Armenia 1992

After first trying the Russian (shares) approach :

- Georgia 1992
- Kyrgyz Rep 1995
- Azerbaijan 1996
- Moldova 1998
- ... ALL LABOR INTENSIVE AGRIC ECONOMIES

Technology, Productivity & Policy

- **In labor-intensive regions**: shift to small-scale individual farming caused dramatic gains in efficiency

  => Conditional on land policy

- In **capital and land intensive regions**, gains in productivity came from large farms shedding labor

  => Conditional on farm policy : hard vs soft budget constraints (CE vs Core CIS)

Conclusions

- Dramatic changes in productivity
- Generally: J (or U) effect
  - Some exceptions (pos, neg)
- Depth and length of initial decline differs
  - Most advanced reforms: milder decline and faster recovery.
  - Least advanced reformers: steeper decline and slower recovery

Conclusions

- Nature of the (initial) productivity gains differs
  - Most economic advanced Central European Countries
    - Initial resource endowment: labor extensive countries
    - Restitution of land: consolidation of land in large scale enterprises
    - Large outflow of labor ➔ strong increases in ALP drives productivity growth
    - Inflow of FDI and vertically coordinated supply chains

    e.g. Czech Republic, Hungary, Slovakia, Latvia, Estonia
    - But Latvia & Estonia: very strong decline in output → slow recovery of TFP

      - longer period under central planning: institutional environment less suited to serve individual farms

      - disruption of supply chain

Conclusions

- Nature of the (initial) productivity gains differs
  - Less economic advanced Central and East European Countries
    - Initial resource endowment: more labor intensive countries
    - Restitution of land: older persons enter farming to complement pensions
    - Initially limited outflow of labor: agriculture was social buffer
    - Large decline in output and productivity, but from beginning of the 2000s recovery due to shedding of labor and inflow of FDI

    e.g. Bulgaria, Poland, Romania, Lithuania

Conclusions

- Nature of the (initial) productivity gains differs
  - Low income countries in FSU
    - Initial resource endowment: labor intensive countries
    - Initially land shares distribution, physical plots later on
    - Initially large inflow of labor due to shift towards individual farming
    - Increase importance labor intensive secotrs
    - Large decline in output and labor productivity, but increase in yields

    e.g. Armenia, Azerbaijan, ...

Conclusions

- Nature of the (initial) productivity gains differs
  - Middle income countries in FSU
    - Initial resource endowment: land intensive countries
    - Slow implementation of reforms which still favor large scale farms (threshold reforms not yet)
    - Initially no outflow of labor
    - Large decline in output and productivity
    - Recently decline in agricultural employment and increasing investments due to macroeconomic improvements

    e.g. Russia, Ukraine, Kazakhstan, ...

Conclusions

- Drivers of productivity gains change over time. From land/farm reform to:
  - improved access to factor and output markets
  - improved options for employment outside agriculture,
  - improvements in social payments (unemployment, pensions, ...)

Conclusions

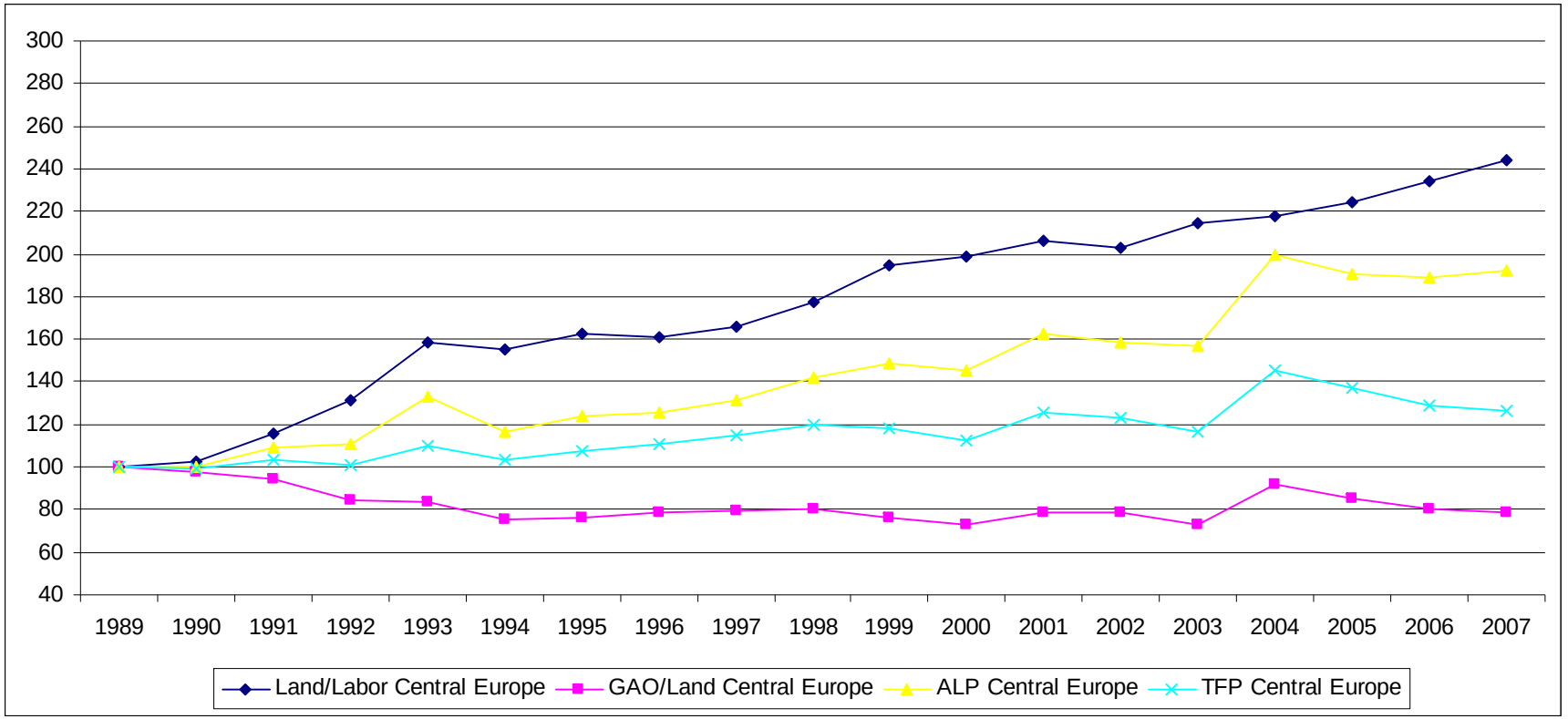
- Crucial role of reform policies

- Crucial role of initial conditions, incl:
  - technology/resource endowment
  - Institutional environment
- Interaction of initial conditions and policy choice (“endogeneity of policies”)

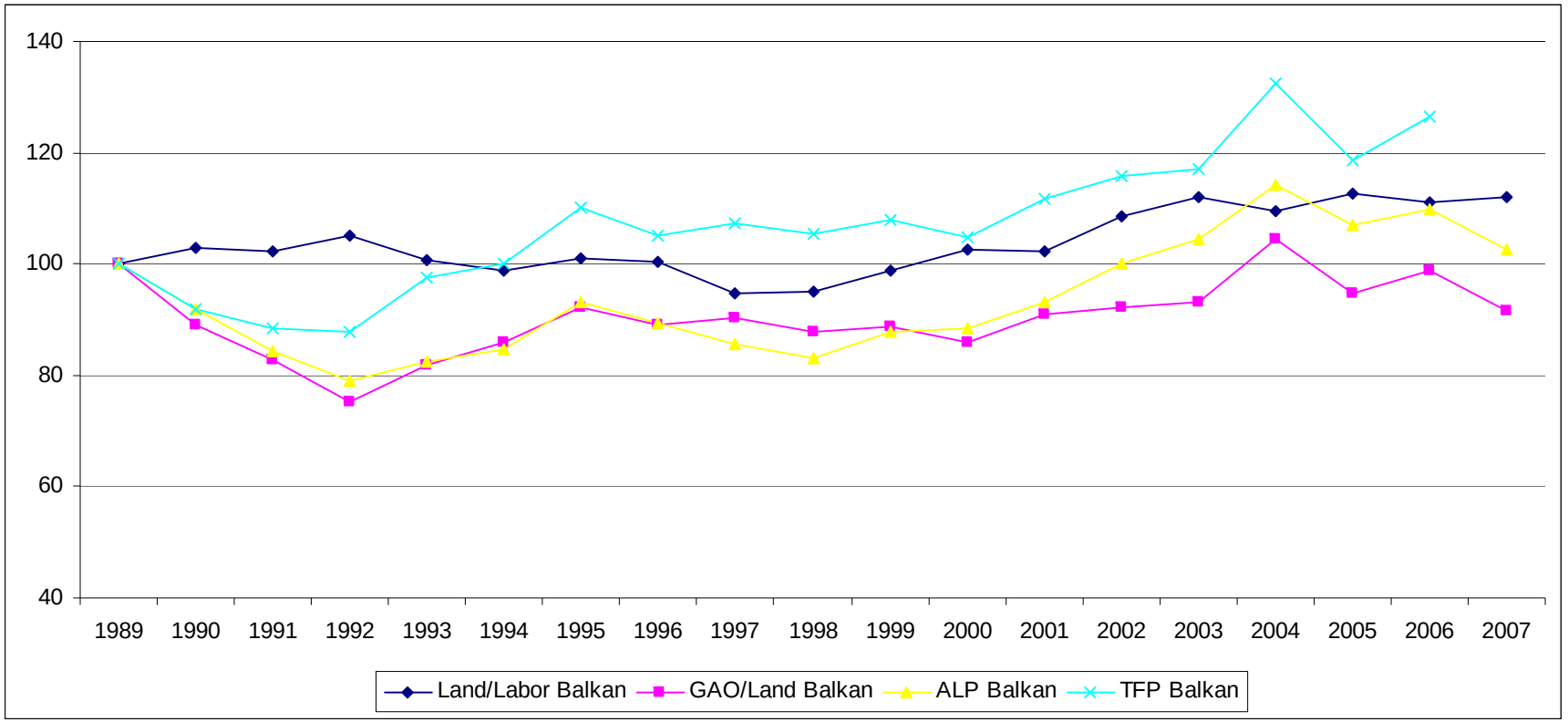
Appendix: Data TFP

- Output = net agricultural production index reported by FAO
- Land = arable + land under permanent crop cultivation, as reported by FAO
- Labor= number of people who are economically active in agriculture including those that are either engaged or seeking employment in agriculture, as reported by national statistics
- Livestock = number of cattle indicated as the number of live animal heads in a country at the time of enumeration, as reported by FAO
- Capital= physical number of tractors, as reported by FAO
- Fertilizer = quantity of pure nutrient fertilizer in metric tones consumed in agriculture, as reported by FAO

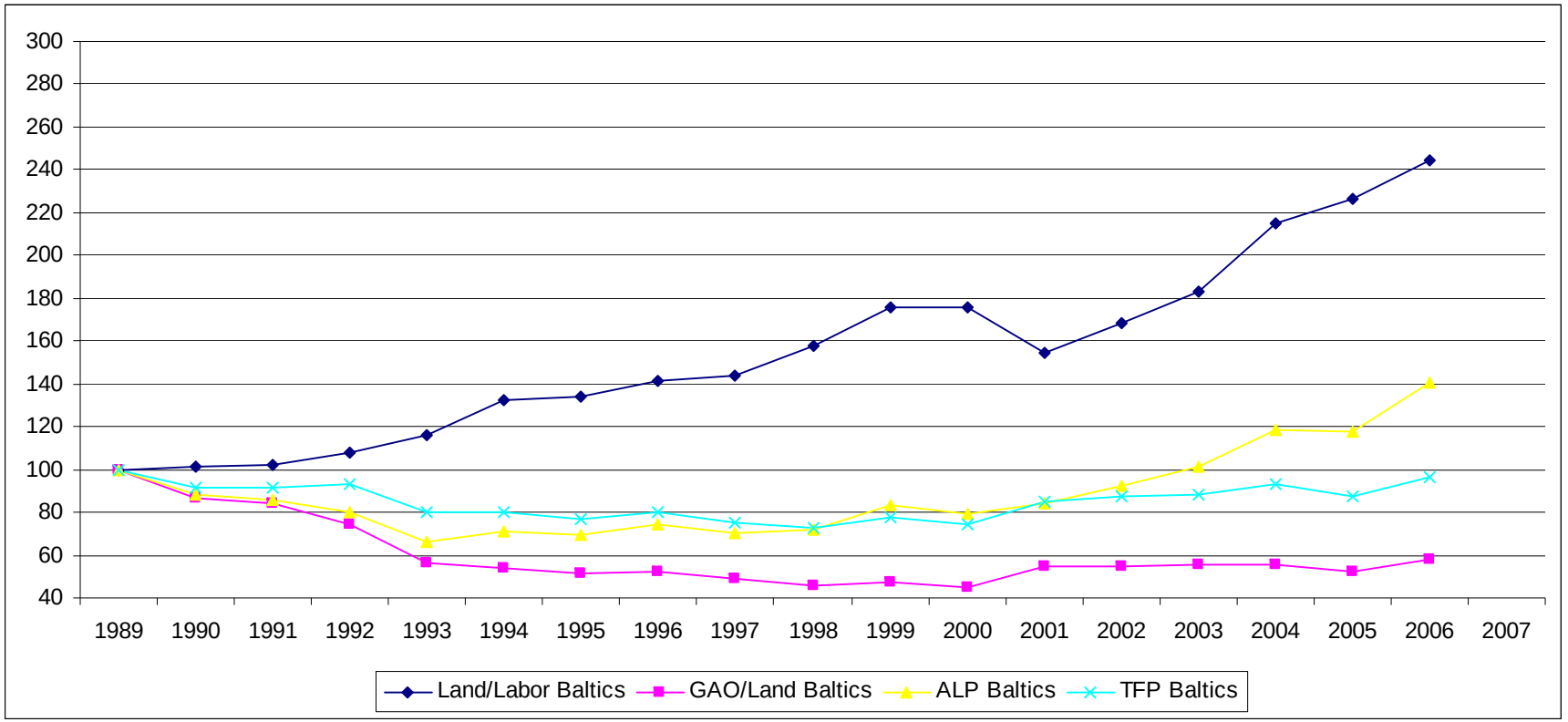
Figures ALP, GAO/Land, Land/Labor, TFP



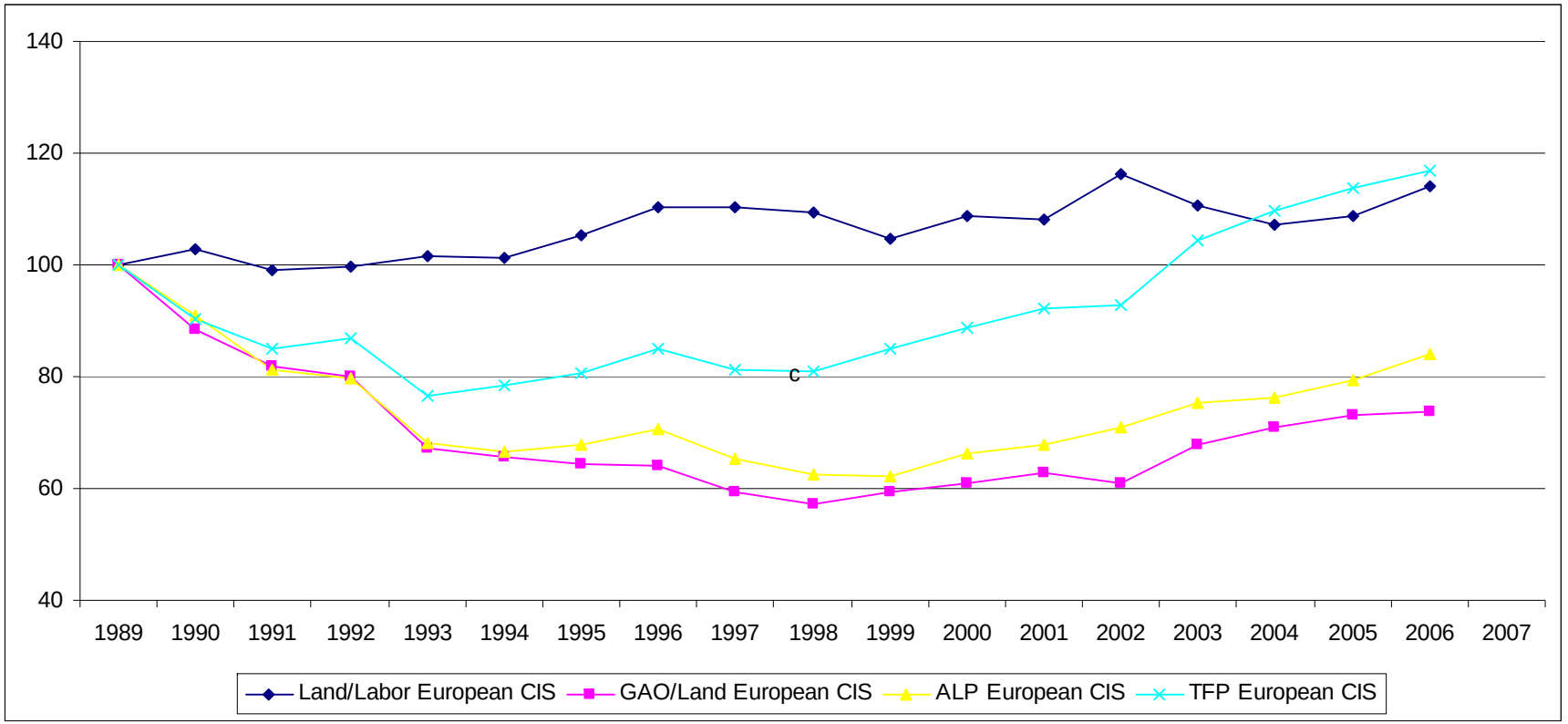
Figures ALP, GAO/Land, Land/Labor, TFP



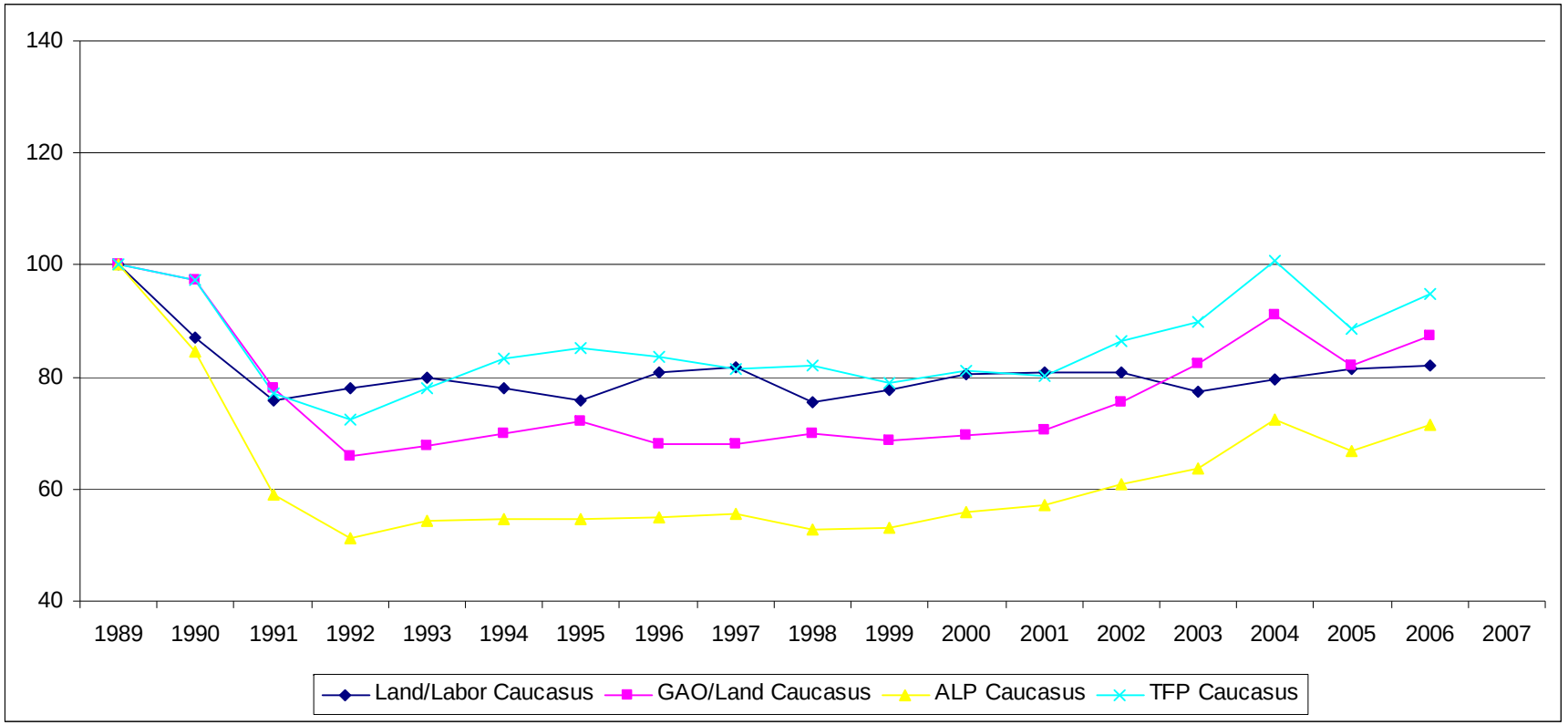
Figures ALP, GAO/Land, Land/Labor, TFP



Figures ALP, GAO/Land, Land/Labor, TFP



Figures ALP, GAO/Land, Land/Labor, TFP



Figures ALP, GAO/Land, Land/Labor, TFP