Climate Change, Agriculture and Trade Liberalization: A Dynamic CGE Analysis for Turkey

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Plan

- Motivation & Aim
- Model Structure: Climate, Crop, CGE
- Scenarios
  - Climate Change
  - Trade Liberalization
- Results
  - Welfare
  - Prices
  - Trade
  - Production
- Conlusion

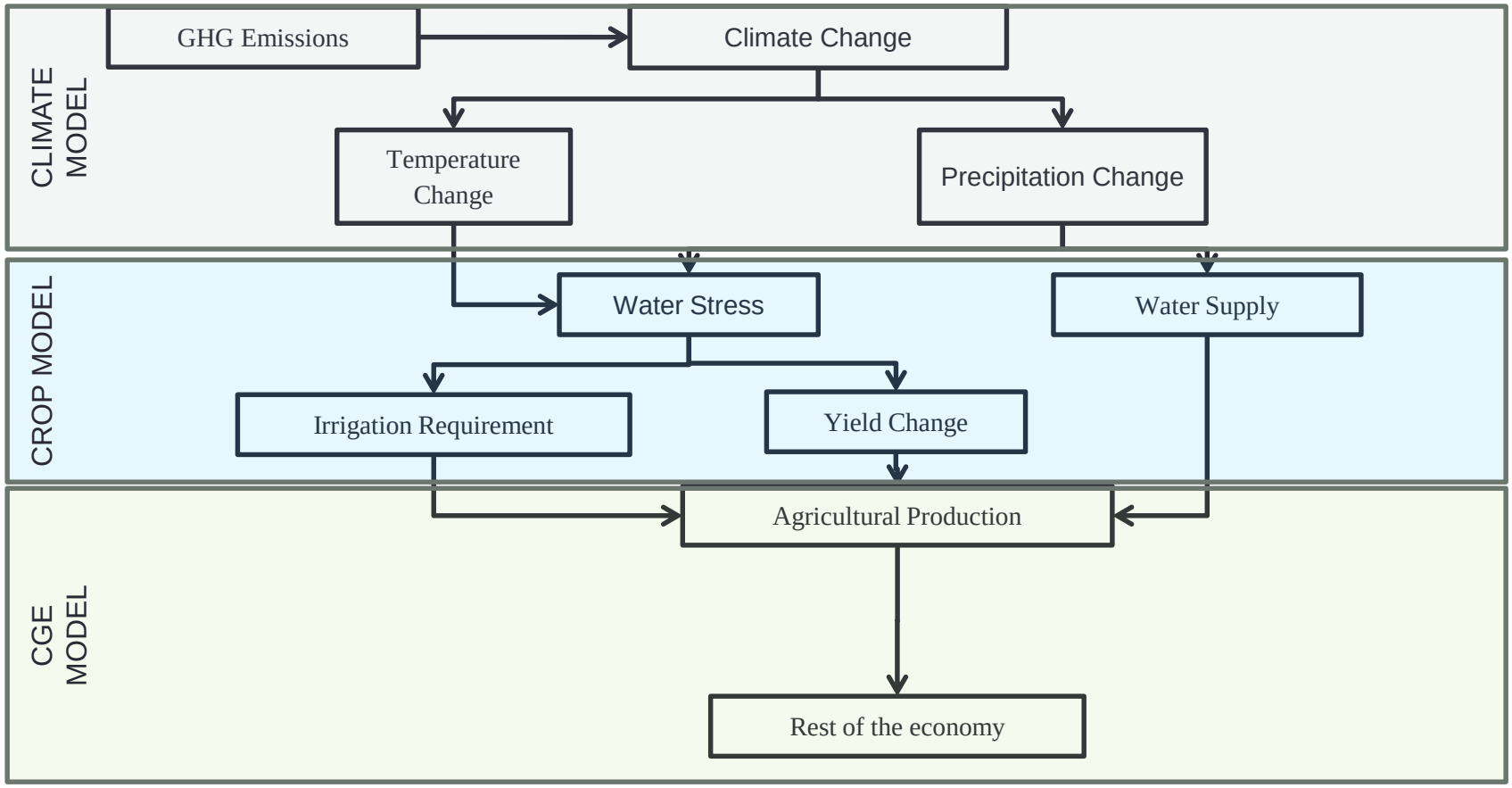
Motivation

- Climate change is expected to have a significant impact through
  - Increasing mean temperature
  - Decreasing precipitation
  - Prolonged Growing-degree days
    - hotter and drier summers
    - milder and drier winters
- Increasing frequency of hydrological extremes:
  - more drought years: Higher variations
  - Less ice and frost days
- Impacts on crops: Yields ↓ , irrigation requirements ↑

Aim

- Can trade policy be used to alleviate the effects of climate change?
- To what extent?
- For which activities?
- Winners? Losers?
- What is the mechanism?

Modeling Approach



Dalfes et al., 2008

Dudu and Cakmak, 2012

Climate Model

- Precipitation and mean temperature data for 81 NUTS3 Regions for the period 2001-2099 is obtained from “Climate Change Scenarios for Turkey” project (gaia.itu.edu.tr)
- Missing data are completed from different sources

Crop Hydrology Model

- Following Allen et al. (1998) [CropWAT]
- Min/max temperature spread, climatic constants, crop constants and coefficients, soil constants, sunlight data follows from Allen et al. (1998)
- First calculate the monthly reference evapotranspiration (ET_0) for each year and city
- Then actual ET is calculated
- Yield and irrigation water requirement is calculated from crop water stress determined by the difference between ET and ET_0
- Results are aggregated according to the CGE sectors

CGE Model

- **Walrasian** CGE model
- **19 activities** producing 19 commodities:
  - Wheat
  - Rice
  - Oil seeds
  - Diary
  - Oth. agr. activities
  - Other manuf.
  - Maize
  - Other cereals
  - Sugar beet
  - Meat
  - Food production
  - Private serv.
  - Oth. field crops
  - Fruits
  - Vegetables
  - Oth. livestock
  - Textiles
  - Public serv.
- Factors:
  - Nest 1: Labor, Capital, Rainfed land, Land-water comp.or industrial water
  - Nest 2: Irrigated land, Irrigation water composite

CGE Model

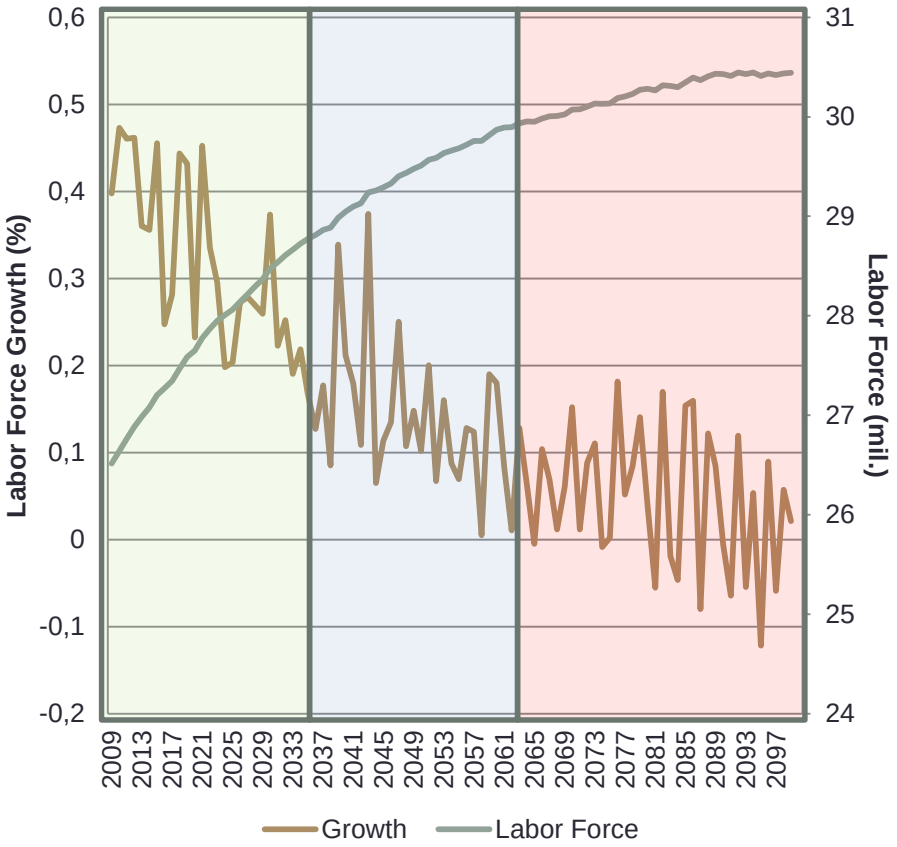
- **I/O** table is edited with **a priori information**
- **Subsidies** are updated acc. to from **OECD** data
- **ROW** account is **disaggregated** to five trading partners
  - EU - Other Europe
  - MENA - Rest of the World
  - North America
- **Tariffs** are updated according to **GTAP** data
- **One type** of HH with **endogenous labor** supply
- Households **consume only** food, dairy, meat, rice, vegetables and fruits and non-agricultural commodities
- Balanced closure

Dynamics

- **Recursive update** of sectoral capital stock, population and TFP
- **Capital** is accumulation: investment – depreciation
- Accumulated capital is **distributed** according to the return on capital in the **sectors**
- Population growth: **constant**; affects subsistence consumption and labor force
- TFP growth: **exogenous**; increase in shift parameter of CES

Scenarios

- Baseline
  - 2008 – 2099
  - 0.9% population growth
  - Labor force grows slowly, by responding to changes in real wage
- 3 Periods
  - 2008-2035
  - 2036-2060
  - 2060-2099

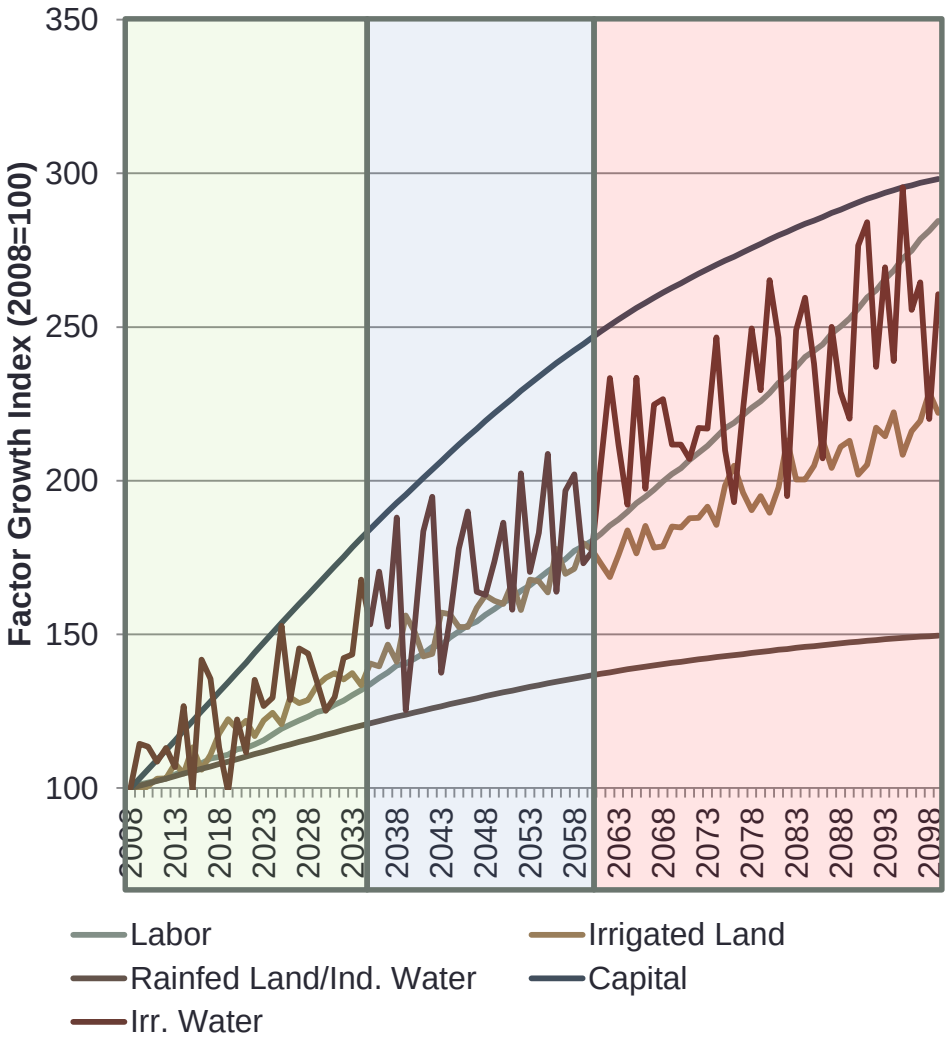


Baseline

- TFP Growth: 0.8% in agriculture, 1.06% in industry, 0.4% in services
- Capital/output ratio: 4.2
- Depreciation rate: 3%.
- Natural resource growth: 25% of capital growth

Baseline

- Factor growth paths:
  - Irr. water and land deviates significantly
  - Complementarity is important
  - Higher deviation in the second and last period



Climate Change Scenario

- Average yield and irrigation water requirement shocks at national level for crop production activities

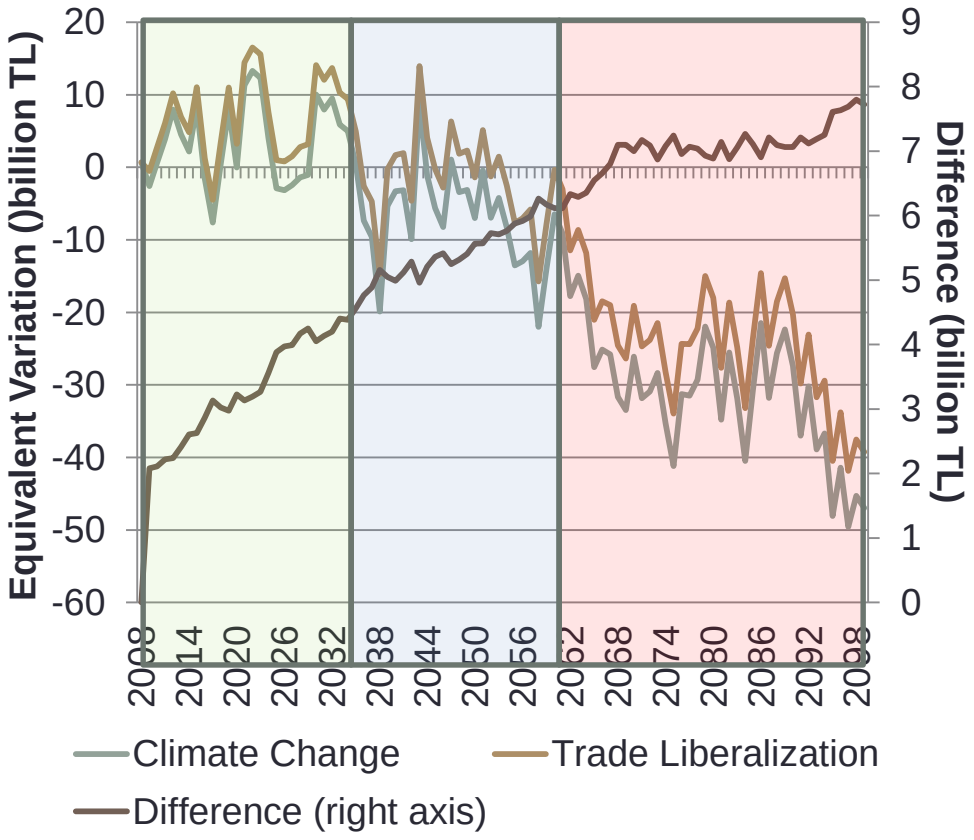
	Irr. Wat. Req.			Yield		
	P1	**P2**	**P3**	**P1**	**P2**	**P3**
Wheat	-3.30	-3.92	1.06	-2.15	-7.13	-17.55
Maize	-3.30	-1.52	-5.02	2.45	-9.88	**-29.73**
Oilseeds	**-5.46**	**-6.62**	**-10.27**	-1.94	**-15.44**	**-27.28**
Oth. Cereals	**-6.92**	-3.01	1.33	0.82	-0.14	-2.32
Fruit	-1.76	2.98	**12.54**	0.62	-1.32	-3.84
Vegetable	-4.44	1.09	**10.41**	5.35	-0.77	-7.33
Oth. Fld. Crp.	**-7.10**	-3.61	0.73	-0.25	-2.83	-10.02

Trade Liberalization

- Unilateral tariff elimination of Turkey on imports from EU
  - EU is the most important trade partner of Turkey (25% to 50% share in agri-food imports)
- Results are presented as deviation from the CC scenario

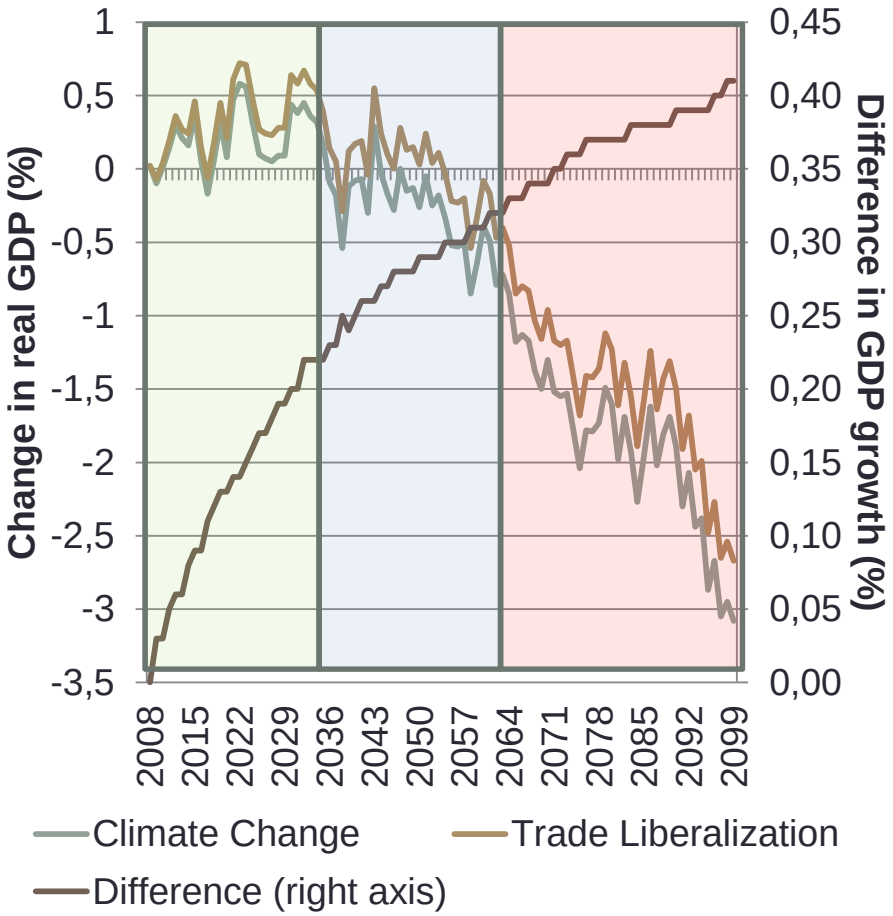
Change in EV

- EV starts to **decline** in **P2**, falls **significantly** in the **P3** period
- **Difference** between CC and TL are **small**
- However, TL effects **increase as CC worsens**



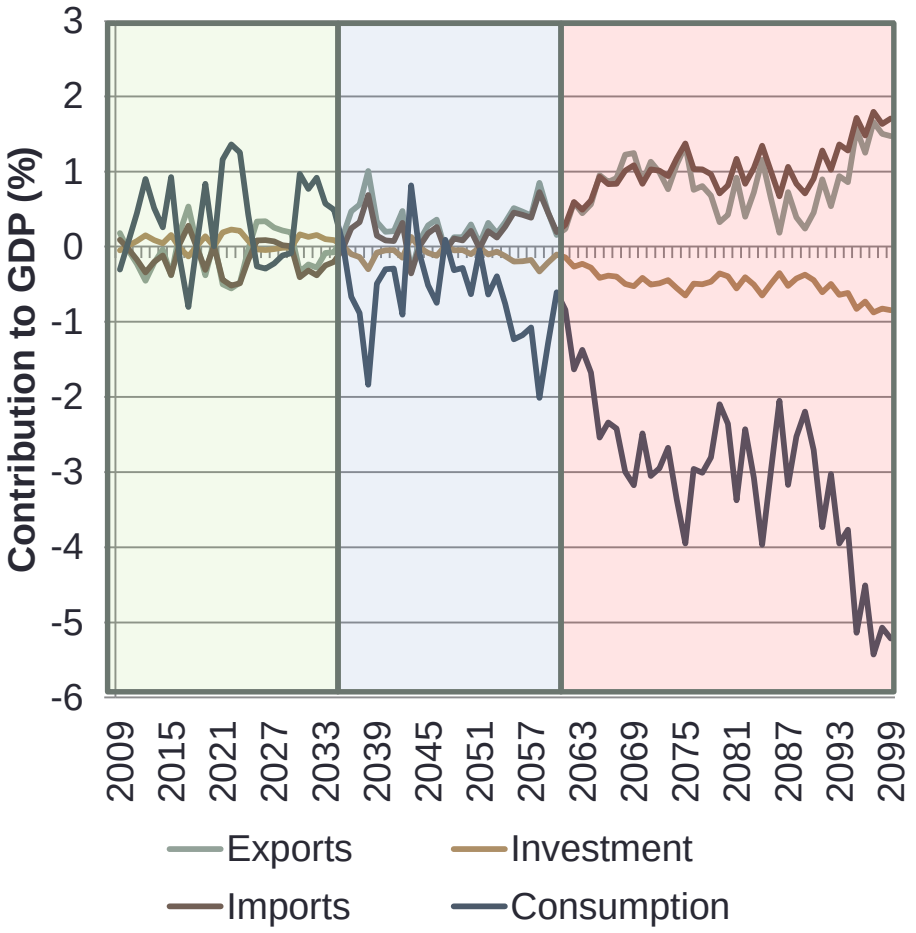
Change in GDP

- Effect on GDP is relatively **small** in the **first two** periods
- Mostly **+** in **P1**, mostly **–** in **P3**
- Deterioration become **significant** in the **last period** (-1 to -3)
- Other macro indicators follow the same path
- Difference between TL & CC is **small** but **increases over time**.



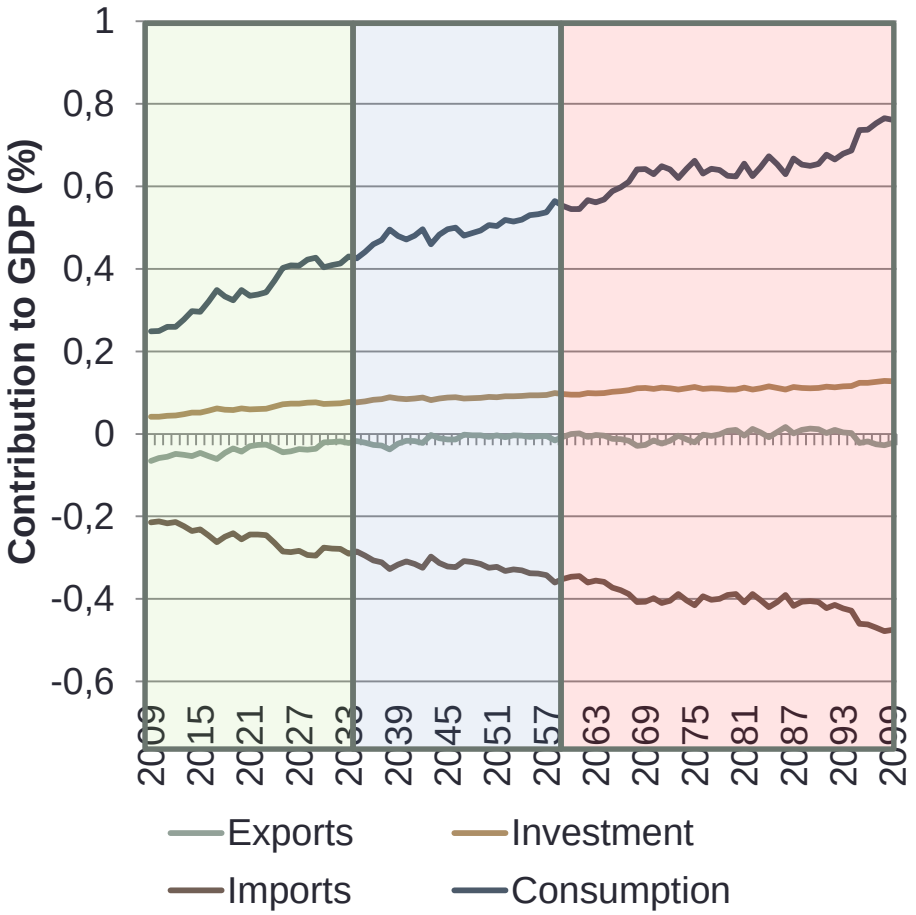
Decomposition of GDP Change

- **Main driver** of change in GDP is **consumption**
- Exports increase, imports decline
- Capital accumulation slows down
- Effects are **more amplified** in **P3**



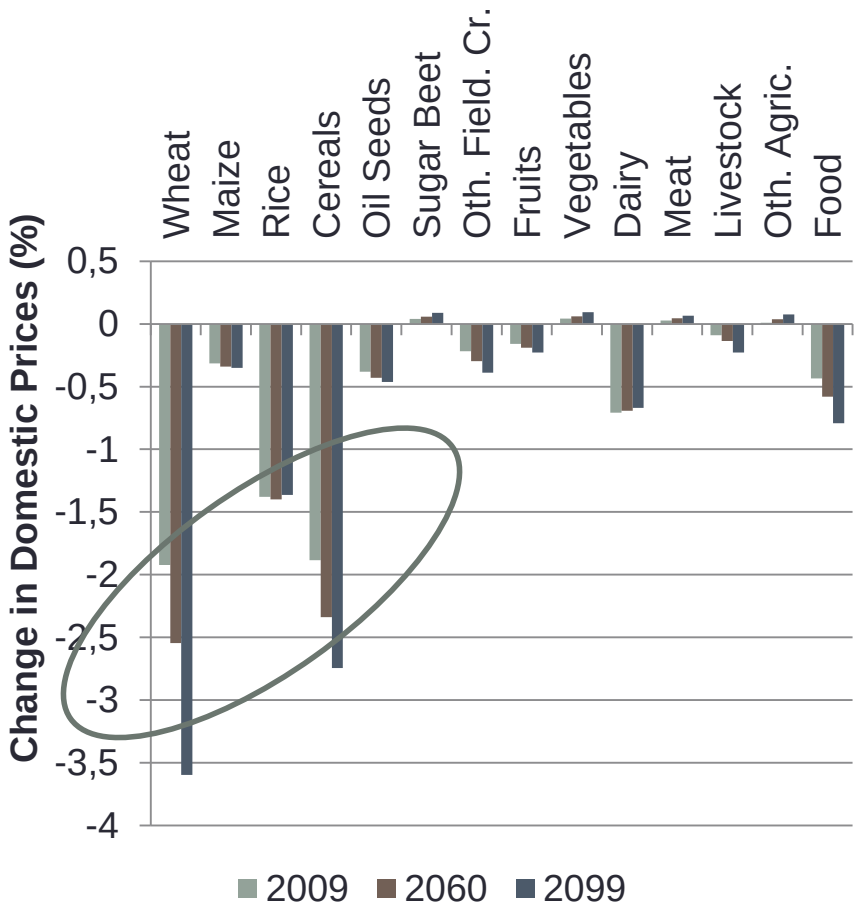
Decomposition of GDP (w.r.t CC scenario)

- The difference is small, but contribution of
  - **consumption increases**
  - **Imports decline** (~ imports increase)
  - **Exports** remains **same**
  - **Investment** (~capital accum.) **increases**



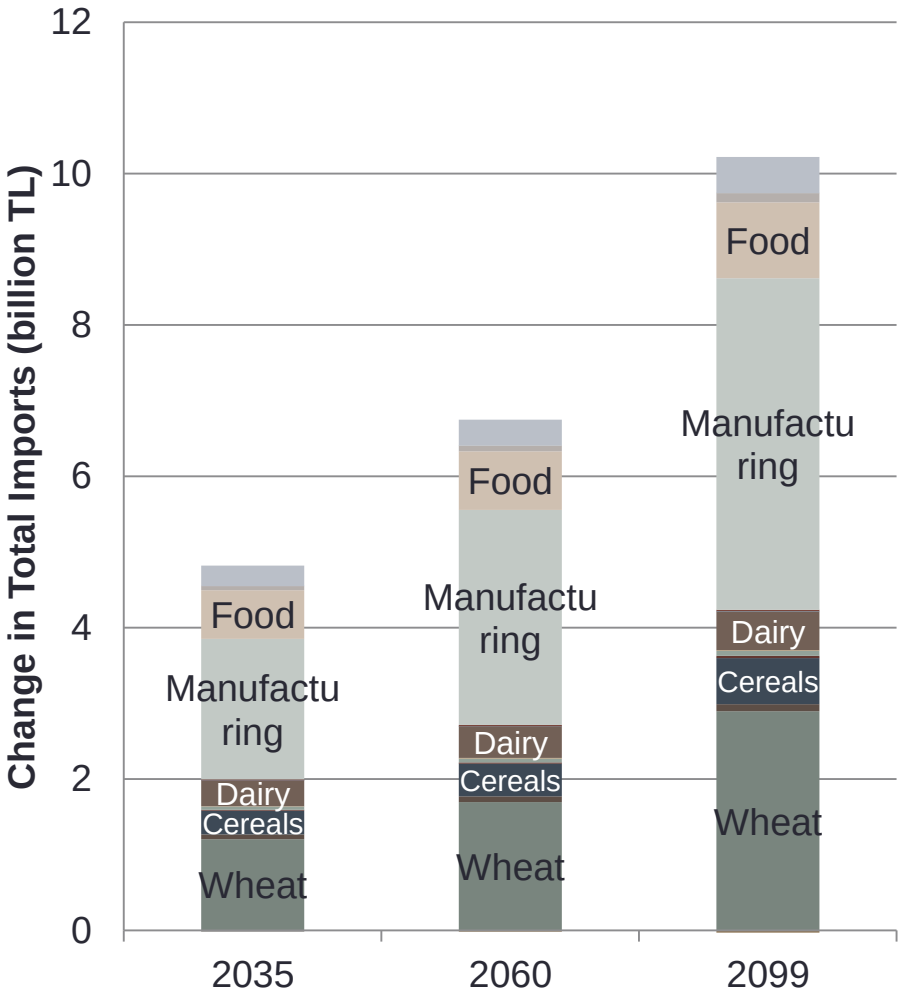
Domestic price (w.r.t CC scen.)

- Domestic **prices decline** in all sectors **except**:
  - Sugarbeet
  - Vegetables: low protection
  - Meat: low trade volume
  - Oth. Agriculture: low protection
- Change in maize, oilseeds, field crops, fruits and livestock is **low**
- Changes **get higher** as CC effects increase



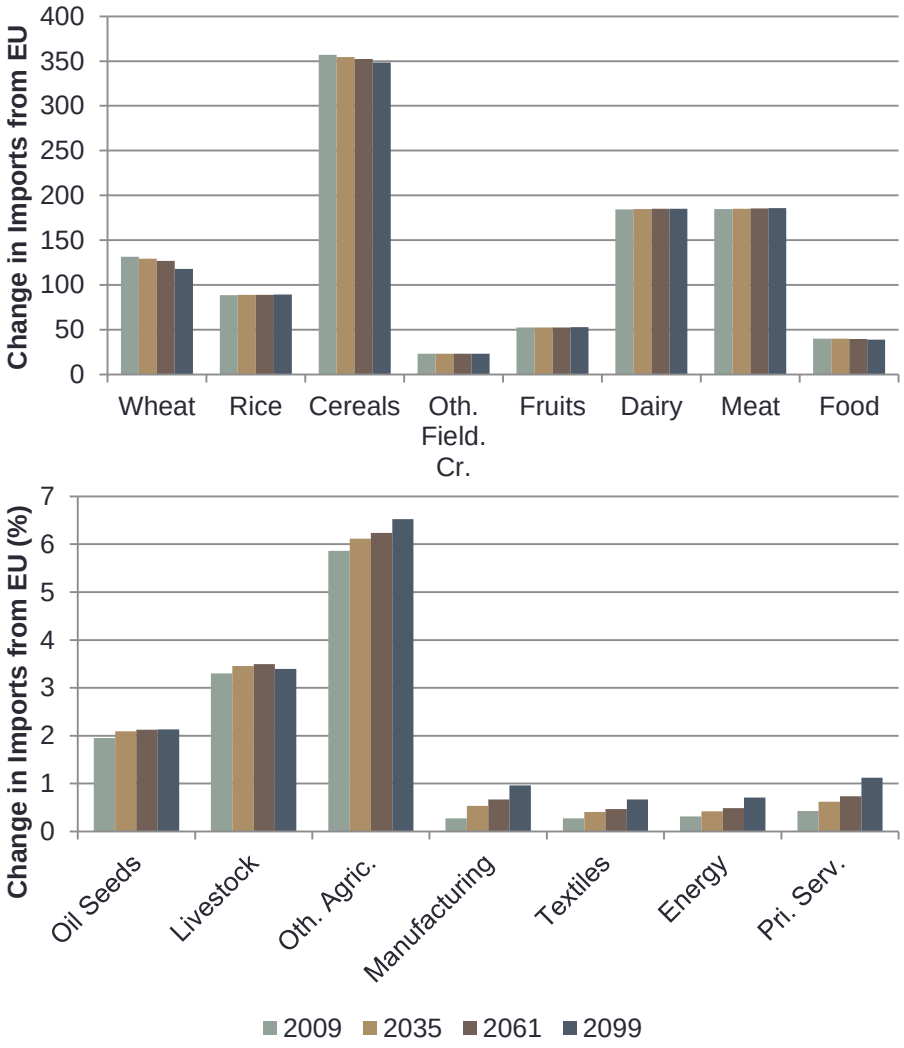
Imports

- Wheat, dairy, cereals and food imports increase
- Manufacturing imports increase significantly. It is the main driver
- Agricultural imports increase more as CC worsen



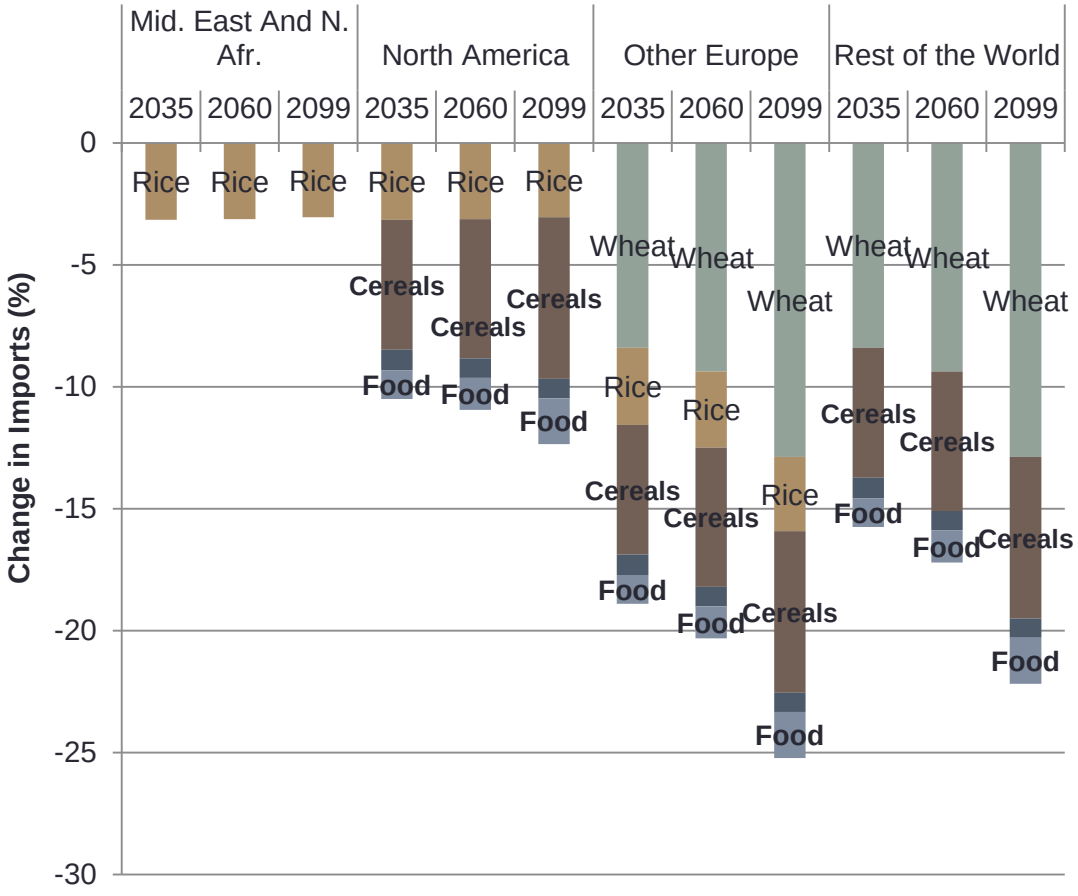
Imports from EU

- Increase in imports from EU is high:
  - Wheat, Oth. Cereals, Fruits, dairy, meat, food
  - Oil seeds, livestock, Other agri., and non agri. commodities
- proportional to the amount of protection
- Other cereals: low trade volume in base



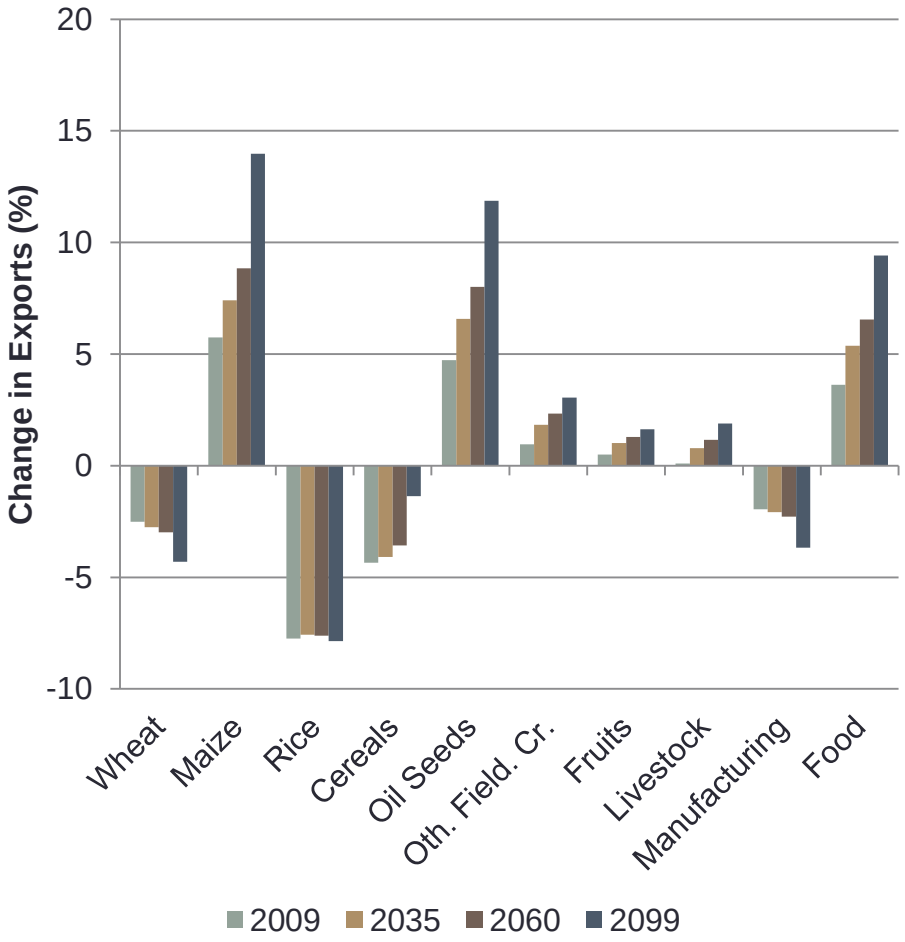
Imports from Other Regions

- imports from other trading regions decline
  - Rice, Cereals, Food, Wheat
- MENA trade is not affected much.
- Imports from Oth. Europe and ROW are down



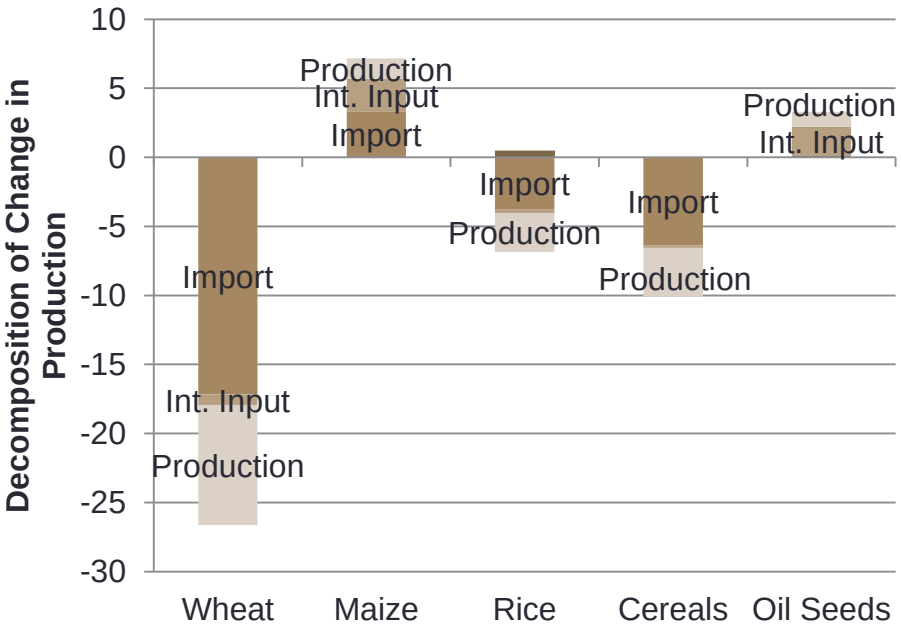
Exports

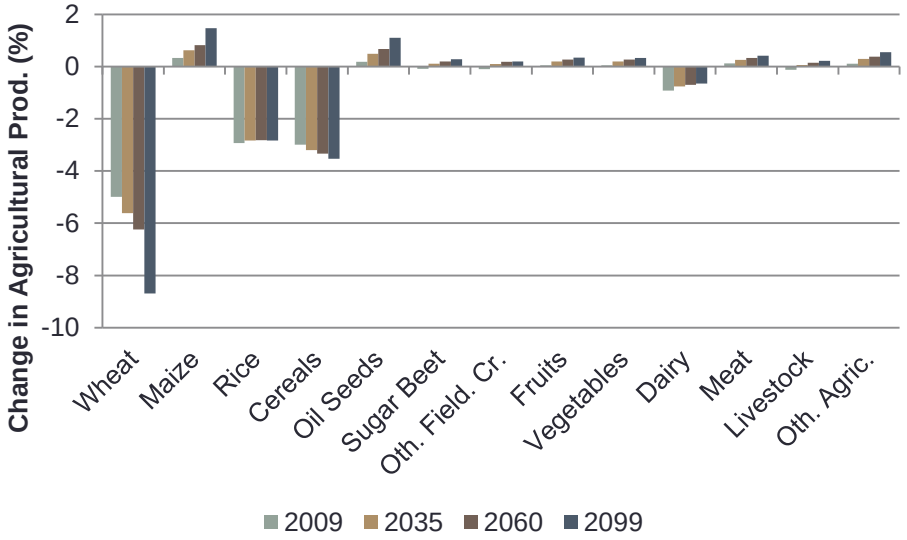
- Maize, oilseeds: significant increase (declining domestic prices)
- Wheat, rice, cereals (declining production)
  - Cost structure makes those sectors uncompetitive in factor markets compared to other agri. activities
- Manuf. exports decline (increasing domestic prices)



Production

- Wheat, rice, cereals & dairy production declines
- Maize and oilseed production increase





- Main driver is substitution of imports with domestic products, as import prices decline.

Conclusion

- Main drivers of the loss in GDP are significant decline in private consumption and up to 2 percent increase in total imports
- Tariff elimination alleviates the negative effects of climate change only marginally for Turkey
- Wheat, rice and cereals are most affected from TL as their yields decline under CC
- Maize, oilseeds, fruits and processed food benefit from trade liberalization
- Significant trade diversion effect