Assessing the Impact of CAP Direct Payments in EU Member States: An Analysis of Efficiency and Effectiveness in Croatia and Greece

Agriculture and Food Global Practice, The World Bank

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Outline

1. Scope
2. Methodological and conceptual underpinnings
3. Application
4. Main findings
5. Potential (policy options)

1. Scope: Evidence-based strategic planning

Diagnosis of the efficiency and effectiveness of public expenditure in agriculture in Croatia and Greece.

Efficiency and Productivity analysis combined with other analyses such as:

- Background analysis on agri-food sector economic performance.
- Analysis of economy-wide impacts of agricultural and rural development support.
- Structural analysis: comparative static analysis of agri-food economic linkages (Foster and Valdes, 2015).
- Equity analysis: regional distribution of CAP funds vis-à-vis regional poverty and income per capita.

Ultimate Goal: Utilize diagnostic analysis to propose an evidence-based national agriculture strategy for Croatia and Greece.

2. Methodological & conceptual underpinnings

Main method: Efficiency and Productivity Analysis:

- Diagnosing the current situation
- Exploring the dynamics
- Identifying positive and negative influential factors
- Disclosing potential opportunities and threats
- Instigating the discussion about policy directions

2. Methodological & conceptual underpinnings

We need some clarifications…

2. Methodological & conceptual underpinnings

Key Concept of Efficiency Analysis: **Productive Performance**

- The microeconomic context: Production Theory
- Production frontier: the mechanism which transforms production inputs into outputs
- Production frontier:
  - Analysis is grounded on **benchmarking**
  - All measures in **distance functions** contexts
- This analysis adopted the efficiency direction or productive performance (PP) evaluation
- PP is defined as the **quantity of output produced per input unit**:

$$PP = \frac{\text{Outputs}}{\text{Inputs}}$$

2. Methodological & conceptual underpinnings

(i) **Facets of Efficiency**: Technical, Scale and Allocative

(ii) **Technical Efficiency (TE)**: How much more can a DMU produce with a given level of inputs? **Or**: How much input reduction is possible to produce a given level of observed output? ($0<TE\leq1$)

(iii) **Scale efficiency (SE)**: Reflects the level of exploitation of scale economies. The Most Productive Scale Size (MPSS) is the scale which coincides with CRS ($0<SE\leq1$)

(iv) **Allocative Efficiency**: The inputs are employed (optimally) according to their relative prices and the available technology (*prices of inputs and outputs as well as strict assumptions about the competitive structure are needed*)

(v) **Benchmarking**: DMUs are ranked according to their productive performance. Those with Efficiency equal to 1 define the frontier. Those which lie away from the frontier are assigned with efficiency scores smaller than 1 and exhibit inefficiency losses.

2. Methodological & conceptual underpinnings

- **Productivity**: The analysis becomes dynamic
- **What to avoid**: Partial productivity measures – output per person employed; output per hour worked; output per hectare etc.
- Employ **Total Factor Productivity (TFP)** measures – Productivity measure which involves all production factors
- Productivity: The time evolution of productive efficiency captured by Malmquist TFP growth index (M) as:

Δ denotes change and TC stands of Technical Change or Innovation (movement of the frontier)

$$M=(\Delta TE)*(\Delta SE)*(TC)$$

2. Methodological & conceptual underpinnings

Disclosures….

- **Technical efficiency** captures managerial competencies, effectiveness of organizational routines and adjustment to business environment and regulatory framework. **Organizational and marketing innovation** matters
- **Scale efficiency** reflects the influence of technology compatibility and lumpiness, market size, scale decisions, and irreversibility of investments. **Process innovation is crucial**
- **Technical Change** captures the ability of the farms to introduce new technologies – innovations which become available and push the frontier "outwards". **General Purpose Technologies and disruptive innovations** are of primary importance
- **Data is crucial**: Observed input and output data for a large sample of firms from a given industry (cross-sectional data); Panel data on a cross-section of firms over time. Very Important is the Completeness of each FADN database.

2. Methodological & conceptual underpinnings

Methods: Take your pick….

- **Index numbers (IN):** Price and quantity index numbers used in aggregation (eg. Tornqvist, Fisher)
- **Data envelopment analysis (DEA):** Non-parametric, linear programming
- **Stochastic frontier analysis (SFA):** Parametric, econometric
- **DEA advantages:**
  - No need to specify functional form or distributional forms for errors
  - Accommodates multiple outputs
  - In the bootstrapping version, data noise is taken care of
- **SFA advantages:**
  - Accounts for data noise directly
  - Can conduct hypothesis tests

2. Methodological & conceptual underpinnings

In DEA:

- Each DMU is compared against all its peers
- At least one DMU defines the frontier
- Usually, multiple DMUs define the frontier in different production scales

Second Stage investigation of Efficiency and Productivity **drivers** using:

- Truncated regression
- Tobit
- Tobit with endogenous regressors
- Pooled Cross section, Fixed Effects or Random Effects panel regression for the TFP case
- Time varying vs time invariant characteristics

2. Methodological & conceptual underpinnings

$$Eff_t^i = f\left(X_t^1, \dots, X_t^k\right) + u_t^i$$

Drivers:

- Overall Productive Performance
- Do subsidies matter?
- The role of economic size
- Knowledge Conditions - Innovation
- Experience or Youth?
- Type of DMUs (farms)
- What about regional differentials?
- Growth patterns of efficiency
- Product mix

3. Application

Croatia:

- **Efficiency analysis:** 2016 FADN sample of 1328 farms - 1298 for analysis; Two-stage bootstrapped DEA approach. Single benchmark.
- A Technical Efficiency (TE) score of (e.g.) 0.30 shows that the average farm in the sample can produce the same output using 70 percent less inputs or can increase output by 70 percent, using the same amount of inputs
- A Scale Efficiency (SE) score indicates whether a farm operates at the most productive scale size (score=1) or not. A score over or under than 1 shows that the farm is over/under dimensioned, and there are losses in production because the farm does not operate at its optimal size
- **Productivity analysis:** FADN - 995 farms for 2014, 2015 and 2016; the Malmquist TFP index which measures the TFP change between two years as the product of three components (TC; TEC; SEC) is employed.
- A TFP (TC, TEC, SEC) score of 1.10 shows that between 2014 and 2016, TFP (TC, TEC, SEC) has an average annual increase by 10%; a score of 0.95 shows that TFP has decreased by 5%

3. Application

Greece:

- **Efficiency analysis:** 2018 FADN sample of 3638 farms - 3112 for analysis; Two-stage bootstrapped DEA approach.
- Two distinct farm-type specifications (arable; permanent; livestock; mixed / farms not granted environmental subsidies; crop farms receiving environmental subsidies; livestock farms receiving environmental subsidies) are utilized reflecting different output-specialization and production sustainability orientations, to capture technology heterogeneity.
- Metafrontier analysis, extended to accommodate DEA models, is used, allowing for the possibility of technological differences across farms, attributed to different group-specific production frontiers.
- Consequently, two efficiency measures (TE and meta-technical efficiency – MTE – which accounts for the distance of each farm from the metafrontier, and technology gaps – TG - reflecting distances of group-specific frontiers to the metafrontier) are estimated.
- **Productivity analysis:** FADN - 1545 farms for 2014, 2015, 2016, 2017 and 2018.

3. Application

In both cases:

- Two outputs: (i) total output of crops and crop products (SE135) and (ii) total output of livestock and livestock products (SE206).
- Five production factors: (i) labor input (SE011), (ii) total Utilized Agricultural Area (UAA) (SE025), (iii) total specific costs (SE281), (iv) total farming overheads (SE336) and (v) total assets (SE436 Inputs: Capital, Labor, Land, Total Specific Costs (intermediates), Overheads
- Other structural characteristics such as age; training; output orientation (TF); economic size; regional location, etc.

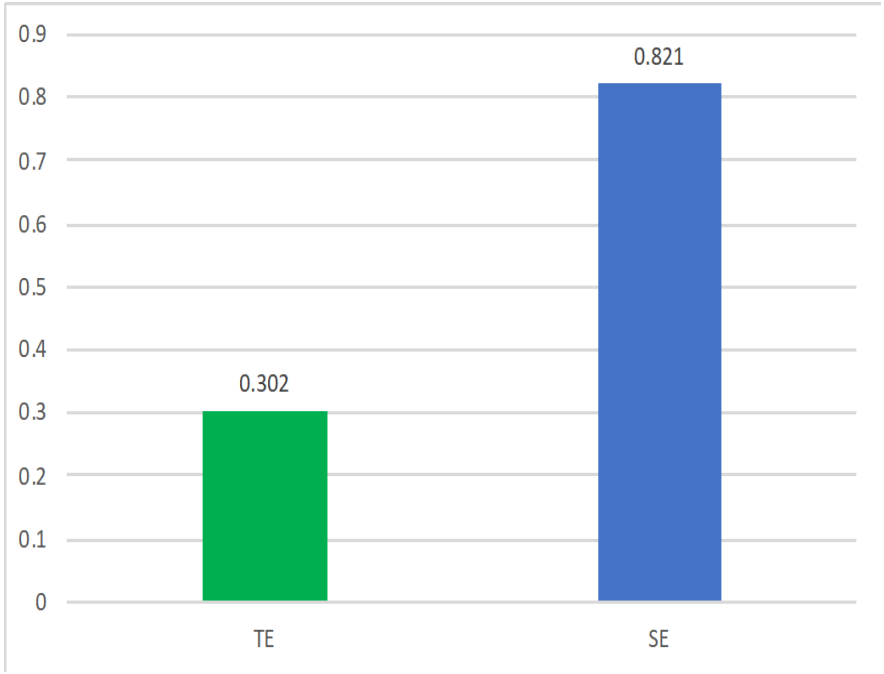
Croatia:

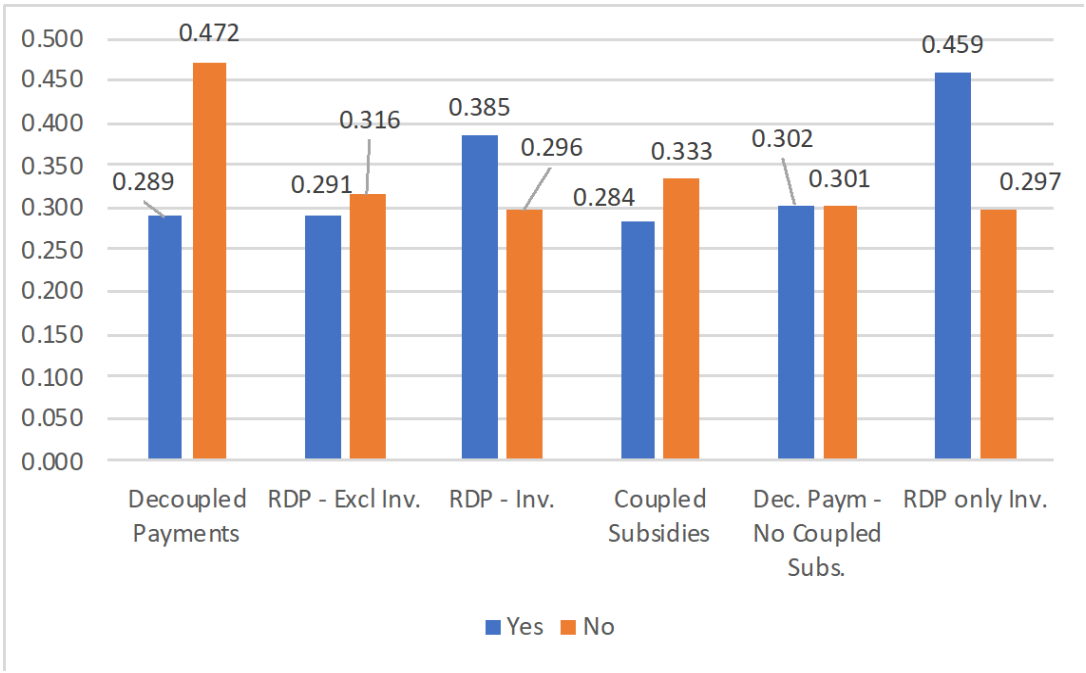
- Coupled subsidies; Decoupled payments; Decoupled payments with no coupled subsidies; Rural development support - excluding investment; Rural development support on investments; Rural development support on investments only.

Greece:

- Coupled subsidies on crops ; Coupled subsidies on livestock; Environmental subsidies; Less Favored Area (LFA) subsidies; Decoupled payments with no coupled subsidies.

4. Main findings - Croatia





Efficiency analysis:

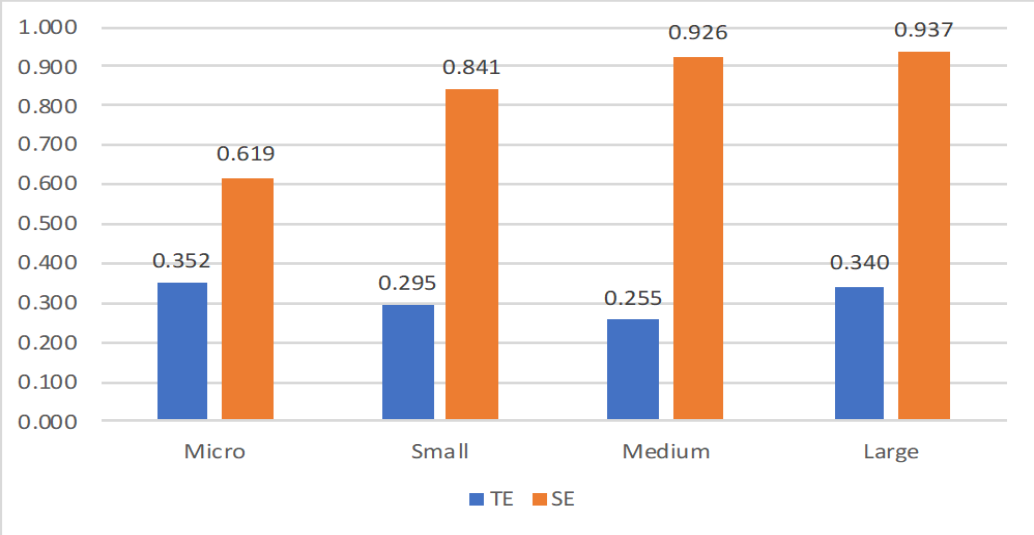
a) Low overall TE score: 29% of farms under 0.2; nearly 10% over 0.6 (polarization); very high overall SE score: 78% of farms over 0.7; 67% over 0.8; 9% under 0.5

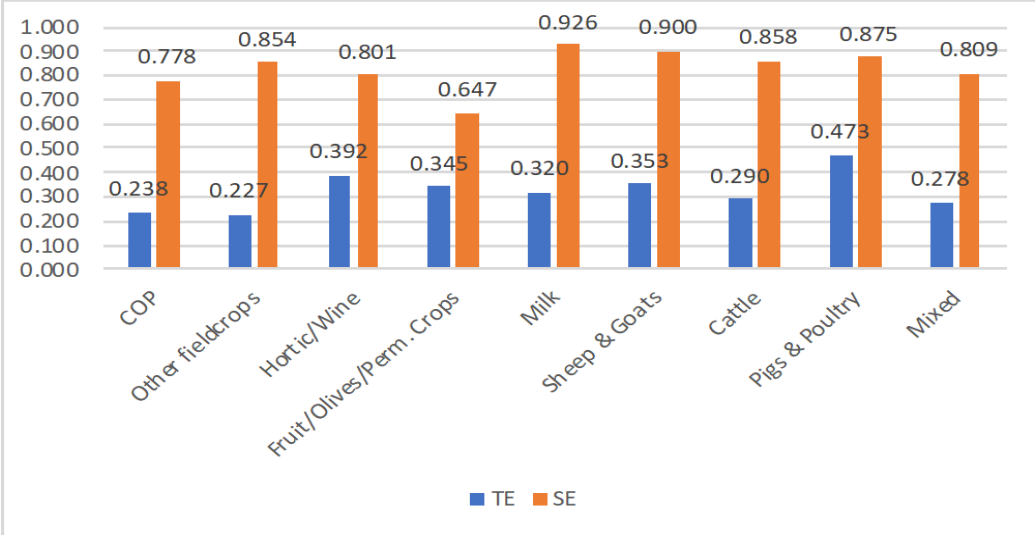
b) Croatian farms suffer losses due to technical inefficiency but (on average) operate exceptionally well with respects to returns to scale

c) TE losses for farms receiving coupled subsidies, decoupled payments and RDP no-investment support

d) Farms receiving RDP support only on investments and RDP investment support (+ other RDP support) are doing much better

4. Main findings - Croatia





a) **TE: Micro farms perform better, followed by large ones; medium/small perform worse**

b) SE: Large farms have superior SE, micro farms suffer losses

c) TE: Pigs & poultry are the champions, followed by horticulture/wine and sheep & goats; other fieldcrops, COP and mixed farms perform worse

d) SE: Specialist milk, sheep & goats and pigs & poultry have superior SE; fruit/olives/permanent crops suffer losses

Drivers:

a) Age of farmers has negative effects on TE (-0.042)

b) Size: negative influence on TE (-0.366) when farms grow from small into medium; positive influence when they become large (0.017) - U-shaped relationship.

c) Coupled support has negative effects (-0.04); RD investments only have positive (0.102); no statistically-significant effects for decoupled payments.

4. Main findings - Croatia

- **Productivity analysis:**
  - Increase in TFP between 2014 and 2016 (4.5% yr) => driven by technical (+3.2%) and scale efficiency (+2.6%), not technical change (-1.1%);
  - Significant polarization: TFP improves for 50% of farms, skyrockets for 22% (+20%), declines for 40%; 42% of farms record improvements in TC, 58% show a regress; 55% of farms improve TEC; 65% improve SEC; farms regressing in both are not negligible
  - Medium farms seem to be catching up as their TFP grows at a higher rate than larger ones

  Drivers:

  - **Unrecorded factors such as human capital, social capital, institutions, public goods and infrastructure are those mostly affecting TFP growth**
  - **Farms employing capital more intensively exhibit higher TFP growth rates**
  - **Decoupled payments positively affect TC and TEC; same for younger farmers**
  - **Productivity paradox: in the short run, adoption of new technology might result into significant adjustment costs, mainly attributed to organizational and human factors**

4. Main findings - Greece

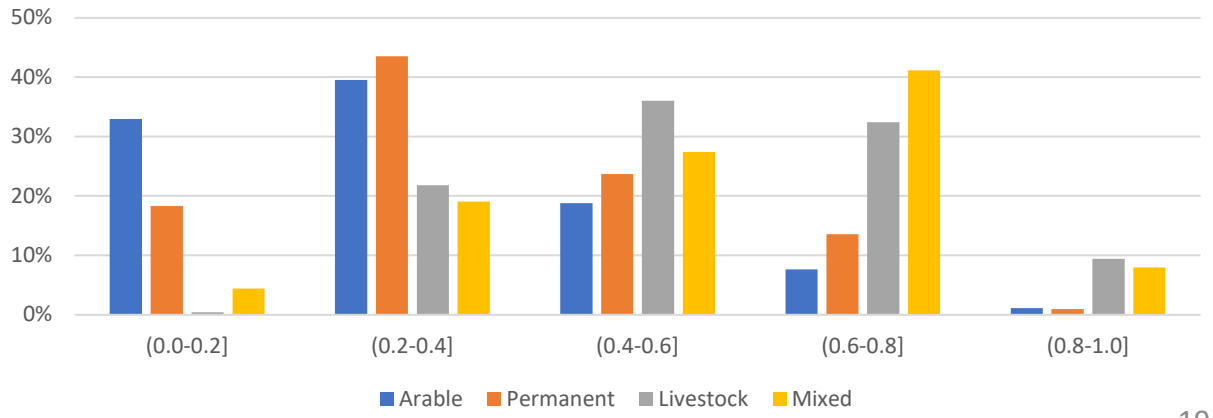
- **Efficiency analysis:**

Between Groups:

- In all groups technology gap is statistically different from zero (not-comparable between on a single frontier basis)
- **On average, farms of the arable cluster exhibit the higher performance with respect to technology gap; they could improve their productive performance by only 8.6% by using the best technology/practices in Greek agriculture.**
- **Permanent crops (13.4%), livestock (21.8%) and mixed farms (42.1%) groups seem to have significant potential for improvements exploiting the inter-groups flows of technology and business practice.**
- **Environmental farming does not seem costless in terms of productive performance**.
- Farms not receiving environmental subsidies could improve their productive performance by only 2.3% by using the best technology/practices in Greek agriculture
- There is a lot of room for improvement for crop farms receiving environmental subsidies (39.7%) and for livestock farms receiving environmental subsidies (30.8%)

Withing Groups:

Farms in the arable and permanent crops groups exhibit right skewed distribution of TE scores. In these two groups a small percentage of farms are detached from their counterparts and attain very high technical efficiency pushing down the efficiency scores of most farms within the cluster. This is a strong indication of a structural dichotomy within the arable and permanent crops groups

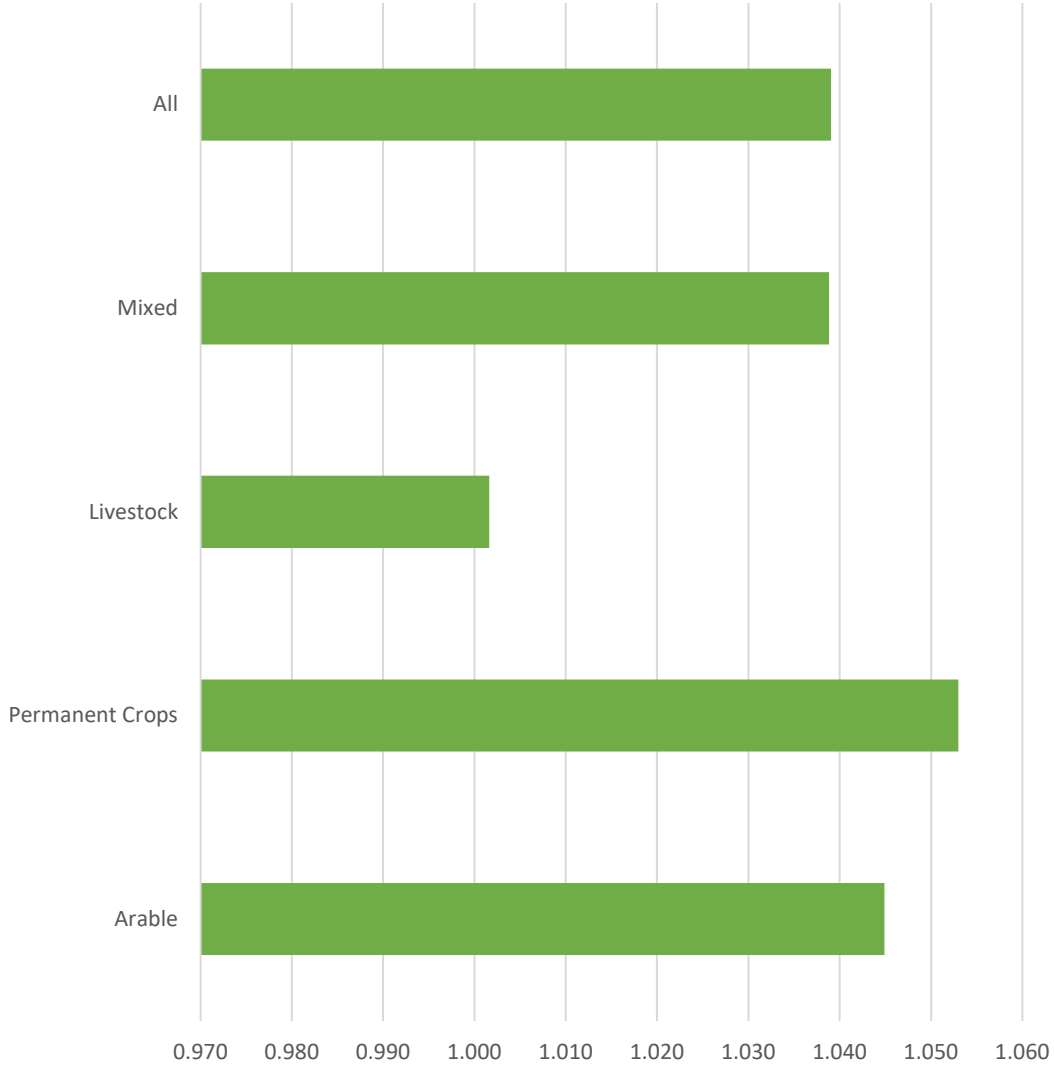


4. Main findings - Greece

- **Efficiency drivers (within groups):**
  - **Farm size exerts a U-shaped impact on TE. Micro and Large farms enjoy the highest benefits. On the contrary small and medium sized farms fall behind in terms of technical efficiency. The curse of the middle!**
  - **Upgrading skills and competencies through full training activities, proves to exert positive influence on TE**
  - **Farms which receive decoupled but not coupled payments attain higher TE compared to their counterparts; coupled support on crops exerts a negative influence on TE**
  - Location and output orientations do not seem to matter so much for TE
  - Environmental subsidies do not affect TE of farms in all groups. **However, when endogeneity of environmental subsidies is considered, a significant negative impact on TE of arable farms is found**
  - **Farmers' age, in general, does not exert a significant influence on farms TE across all the groups**
  - **Capital/Labor and Capital/Land ratios seem to exert a strong positive influence on TE.**

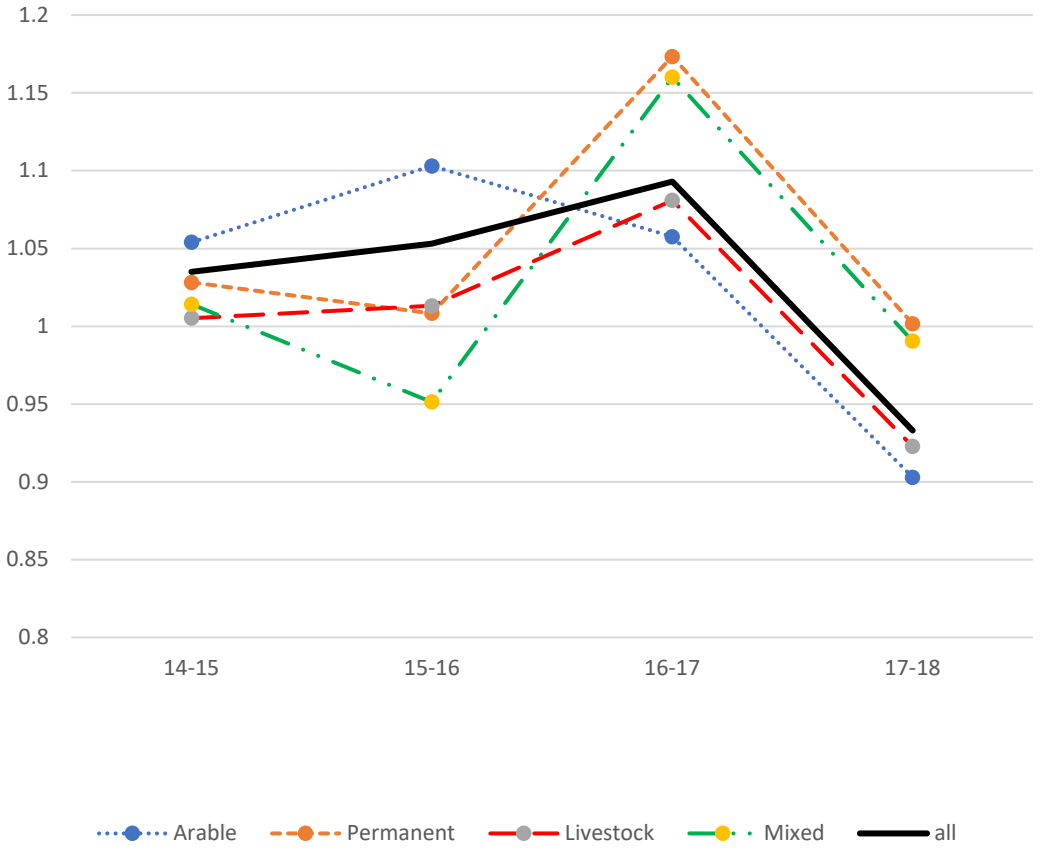
4. Main findings - Greece

- **Productivity analysis:**
  - **No significant changes of TFP and its components are identified. The system seems to be in a steady state equilibrium of a "second best" type**
  - The patterns of TFP growth components for each group are rather unique, making the policy suggestions difficult and rather non-horizontal
  - With regards to TFP and its components, there is not a single pattern. In some cases (permanent; livestock; mixed farms), convergence and catchup are identified, while in arable crop farms, the system is heading to divergence and polarization
  - **The TEC component is the locomotive of TFP growth. The good news is that this component mainly depicts improvements of managerial competencies and the adoption of better business models**
  - **The bad news is that Technical Change, capturing innovation activities, is not so strong**



4. Main findings - Greece

- **Productivity drivers:**
  - Surprisingly enough, farm size is not a major determinant in most cases
  - **Subsidies' structure seems to be totally detached from productivity developments. The same holds for subsidies with sustainability orientation**
  - **Strong positive effects of both basic and full training**
  - **Negative effects of farm managers' age on arable crops; positive on mixed farms**
  - **Technological characteristics of farms (input ratios) seem to be of major importance. It seems that land use is rather problematic and that there is need for more, or better skilled, labor**
  - No real regional and product type differentials exist
  - In general, a lot of TFP and components variability is due to unobserved heterogeneity



5. Potential (policy options) - Croatia

- **Target direct (decoupled) payments:** They will only have the intended effect (income smoothing) and induce economic impacts if provided to poorer/smaller producers
- **Coupled support:** Reconsider the share of coupled subsidies in the support envelope and their sectoral distribution
- **Target interventions:** Combine targeted decoupled payments with targeted RD support which promotes farm investments and innovation

5. Potential (policy options) - Greece

- Policy needs to pursue improvements of product, organizational & marketing innovation.
- Consulting and technical support services seem to be of primary importance to improve the utilization and impact of technology. Need to prioritize innovation policies and induce technological advancements (especially in livestock and mixed farms).
- **Policy should facilitate an enabling environment which supports efficiency improvements in the process of scaling up.**
- **Policy should promote effective training programs.**
- **One size does not fit all and capital investments should be relevant to productive capacities and farm characteristics.**
- **Policy needs to reconsider types of subsidies granted to Greek farms and refrain from coupled support.**
- **It seems that environmental subsidies are used as pure income transfers (especially by low dynamism farms) => Improve advice provision so that farmers receiving such subsidies utilize their characteristics to improve productive performance. Promote the use of adequate technology and knowledge on how to utilize environmentally-friendly techniques. Improve knowledge generation & delivery. Design incentives that would engage high-performing farms in the adoption of environmentally-friendly practices.**

6. TE/TFP & PMEF: Marriage or Divorce?

- **SO1 Success Factor:** Agricultural income level in farms supported is increasing…
- **SO2 Success Factor**: Productivity in farms supported is increasing.
- **SO1 Impact Indicators:**
  - I.3 Reducing farm income variability: Evolution of agricultural income
  - I.4 Supporting viable farm income: Evolution of agricultural income level by type of farming (compared to the average in agriculture)
  - I.5 Contributing to territorial balance: Evolution of agricultural income in areas with natural constraints
- **SO2 Impact Indicator:**
  - I.6 Increasing farm productivity: Total factor productivity in agriculture
- SO3: No much hope as we need to know what is going on for other actors of the food chain.

Starting from the easy part: TFP estimates correspond to SO2 Success Factor and Impact Indicator; the same goes for its components (TEC, SEC, TC) especially those found to particularly influence TFP. Group analysis is very straightforward to perform.

6. TE/TFP & PMEF: Marriage or Divorce?

- **In the case of SO1:** The issue is the link between Income and TE.
- Economic efficiency refers to how much a farm can transform things like materials, labor and capital into services and products that produce the maximum possible revenue.
- It is a combination of TE and Allocative Efficiency: TE is concerned is concerned with achieving maximum outputs with the least amounts of inputs (**to do things right**). Allocative efficiency refers to how different resource inputs are combined to produce a mix of different outputs (**to do the right things**). The inputs are employed (optimally) according to their relative prices and the available technology (*prices of inputs and outputs as well as strict assumptions about the competitive structure of markets are needed*).
- Hence, farms must ensure that are Technically Efficient and then, be rational to attain allocative efficiency. The first is a farm-specific issue, while the second is mostly a systematic issue linked to market failures, lack of training, etc.
- Hence, assessing TE performance comes very close to assessing income evolution as if a farm is not technically "competent" it is almost impossible to be economically efficient.
- This is confirmed by the fact that most studies aiming to assess income evolution in agriculture have done so through assessing TE.

Thank you for your Attention!