Factor Productivity & Factor Market Imperfections in EU Agriculture

Martin Petrick

Selected Paper prepared for presentation at the International Agricultural Trade Research Consortium's (IATRC's) 2013 Symposium: Productivity and Its Impacts on Global Trade, June 2-4, 2013, Seville, Spain

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Evidence from micro-data

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Research assistance by Mathias Kloss is acknowledged

Kaffee Pommes Apfelsaft

Lebensmittel bis zu 43 % teurer!

Donnerstag, 12. Mai 2011 110/19 0,50 €

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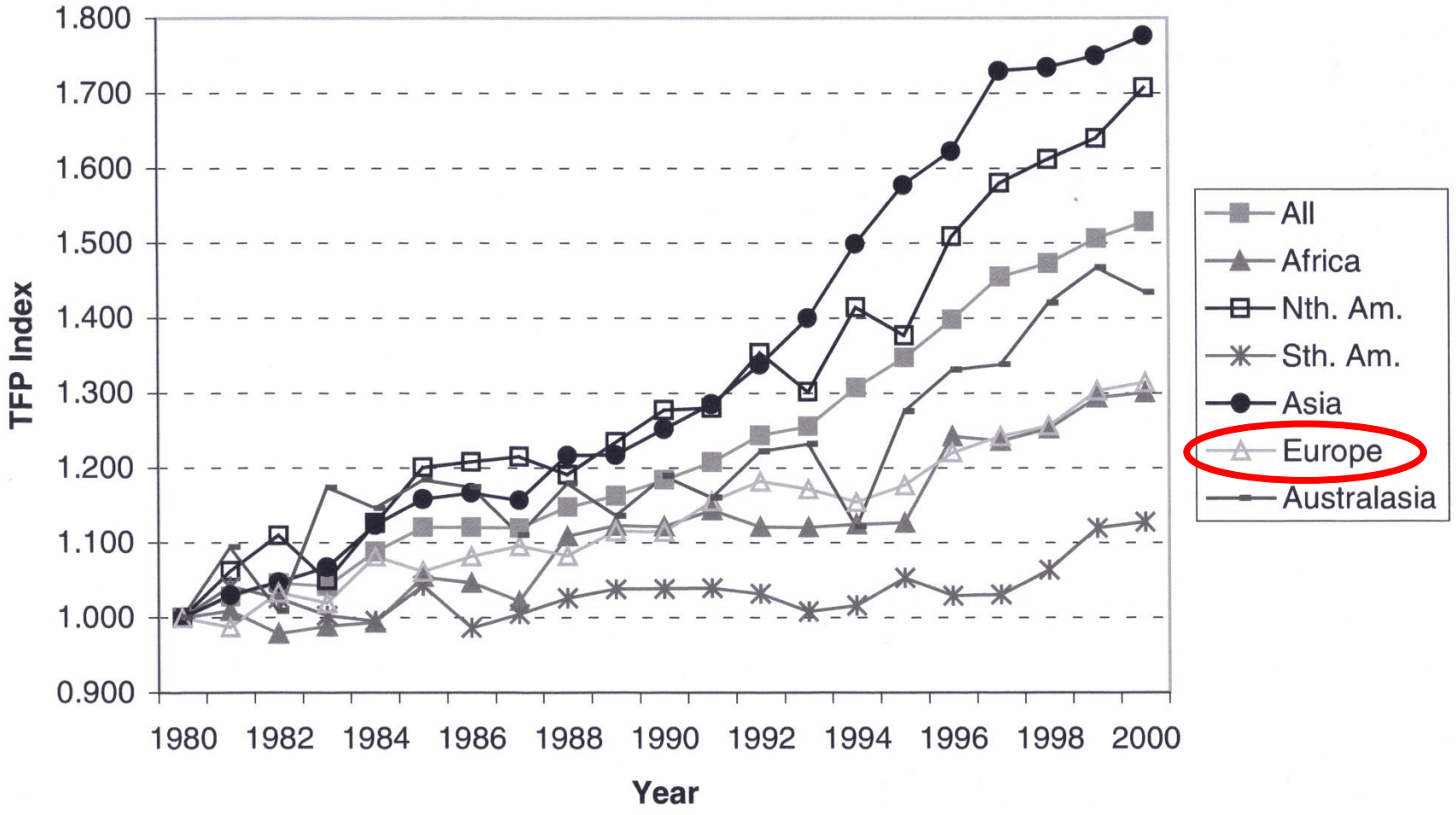
Von CHRISTIN MARTENS

Die Preise für Lebensmittel in Deutschland sind drastisch gestiegen! Nach einer aktuellen Studie um bis zu 43%! Am teuersten wurden tiefgekühlte Pommes frites. Auch der Preis für Apfelsaft stieg dramatisch (siehe große Tabelle)! Warum alles teurer wurde, ob die Preise weiter steigen – S. 11.

Produkt (Menge)	aktueller Preis*	Preis Mai 2010	Differenz in %
GETRÄNKE			
Apfelsaft (1 l)	0,65 Euro	0,49 Euro	+ 33%
Kaffee Unser Bester (500 g)	3,99 Euro	2,99 Euro	+ 33%
Cola (1,5 l)	0,35 Euro	0,29 Euro	+ 21%
Orangen-Limonade (1,5 l)	0,35 Euro	0,29 Euro	+ 21%
Zitronen-Limonade (1,5 l)	0,35 Euro	0,29 Euro	+ 21%

Produkt (Menge)	aktueller Preis*	Preis Mai 2010	Differenz in %
KÖRPERPFLEGE			
Tissue Toilettenpapier 3-lagig (2000 Blatt)	2,65 Euro	2,65 Euro	–
Wattestäbchen (300 St.)	0,59 Euro	0,59 Euro	–
Pflegebad Soft Cream (1000 ml)	1,79 Euro	1,85 Euro	– 3%
Premium Zahnbürsten weich (2 St.)	1,89 Euro	1,99 Euro	– 5%

Stagnating ag. productivity growth in Europe



Source: Coelli & Rao 2005, p. 127.

My contribution today:

- A factor market perspective on productivity & structural change
  - Which factors are the bottlenecks for productivity growth?
  - What does microdata tell us about the efficiency of factor markets in the EU?
- Some theoretical structuring
- A brief intro to recent innovations in production function estimation
- New estimates of production elasticities for EU8 countries
- Evidence on shadow prices & factor market efficiency
- Conclusions

Factor allocation under a generalised input constraint

Farmers' behaviour is assumed to follow

$$\underset{x}{Max}\,\pi = f(x) - px$$

subject to $X - x \geq 0$

with π profits, x input, f a concave production function, p the input price observed in the market, X a generalised input constraint.

Optimal input use under the binding constraint is

$$\partial f / \partial x = p^* > p$$

with p^* the **shadow price** of the production factor.

Empirical strategy

- **Key idea**: Use an estimate of the shadow price to study drivers and impacts of factor use
- The empirical relation $p^* > p$ is a measure of on-farm input productivity & potential supply rationing
- $p^* < p$ is evidence of a release constraint (over-utilisation)
- **Required**: a consistent estimate of f, reliable data on x, p...

Carter & Wiebe AJAE 1990

Identifying factor productivity

A general production function:

$$y_{it} = f(A_{it}, L_{it}, K_{it}, M_{it}) + \omega_{it} + \varepsilon_{it}$$

with

y	Output
A	Land
L	Labour
K	Capital (fixed)
M	Materials (Working capital)
ω	Farm- & time-specific factor(s) known to farmer, unobserved by analyst
ε	Independent & identically distributed noise
i, t	Farm & time indices

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No identification of f possible if ω is not taken into account!

3 approaches to solve the identification problem

1. **Ordinary Least Squares**: ignore it.
   Bias: elasticities of flexible inputs too high (capture ω)
2. **"Within" (fixed effects)**: assume ω is constant over time.
   Bias: elasticities too low as signal-to-noise is reduced
3. **Control function**: assume ω evolves along with observed firm characteristics (Olley/Pakes 1996, Econometrica)
   Bias: hopefully small

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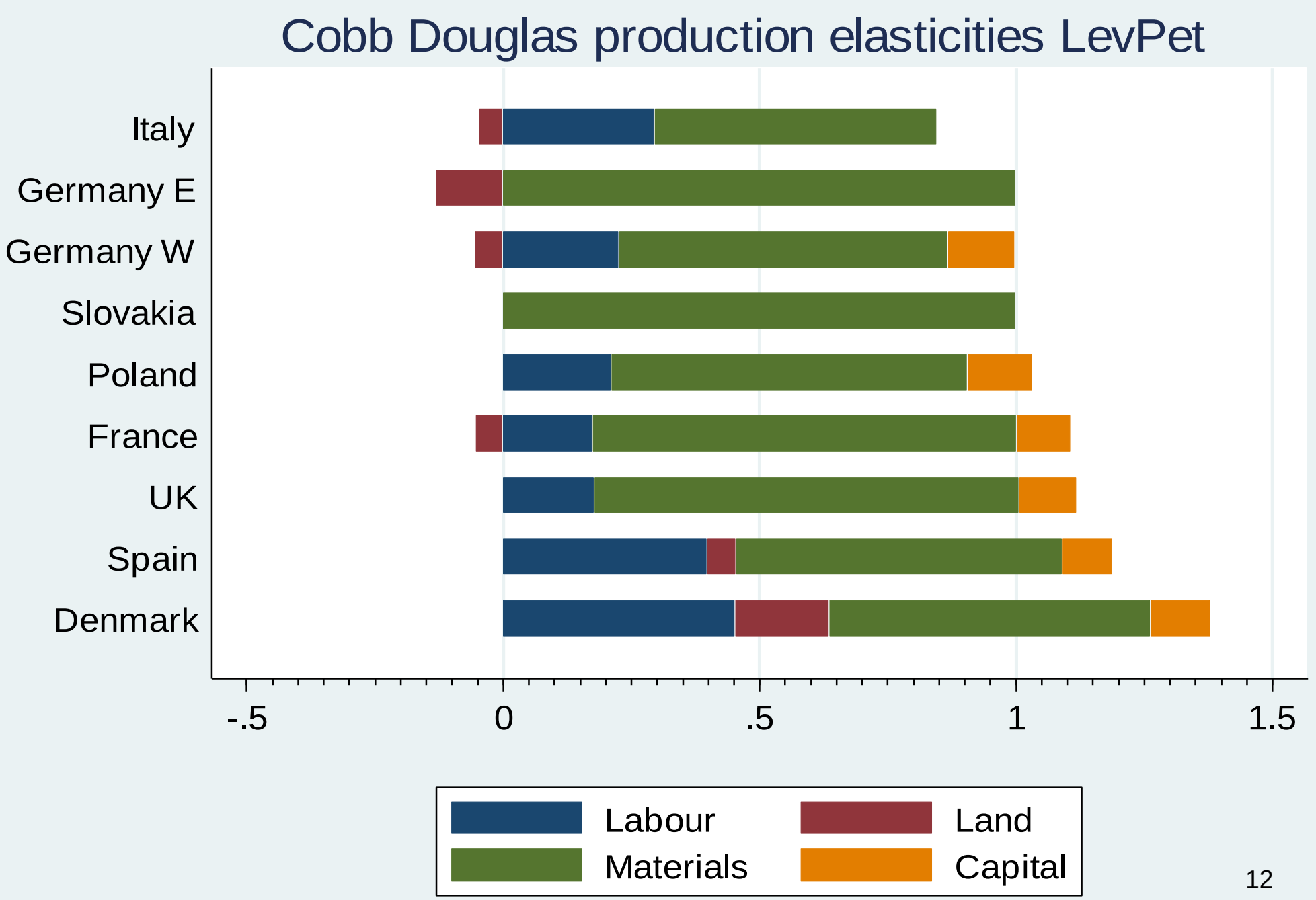
Levinsohn/Petrin 2003: materials a good control candidate for ω

a) Estimate "clean" A & L by controlling ω with M & K
b) Recover M & K from additional timing assumptions

Data & specifications

- FADN individual farm-level panel data made available by EC
- Field crop farms (TF1) in Denmark, France, Germany East, Germany West, Italy, Poland, Slovakia, Spain, United Kingdom
- T=7 (2002-2008) (only 2006-2008 for PL & SK)
- Cobb Douglas functional form (Translog examined as well)
- Annual fixed effects included via year dummies
- Estimation with Stata12 & LevPet estimator provided by Petrin et al. (2004)


Cobb Douglas production elasticities LevPet
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Labour
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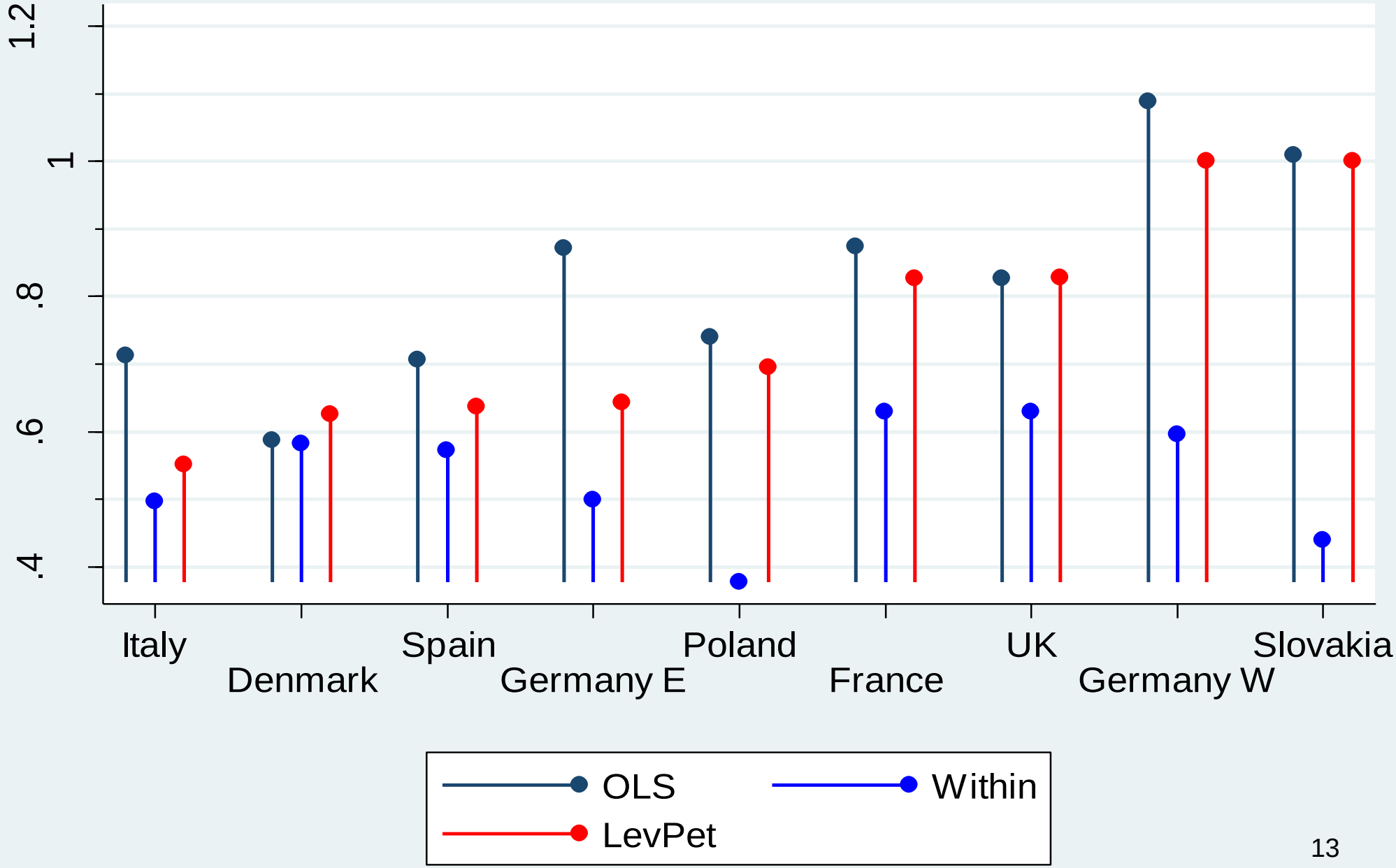
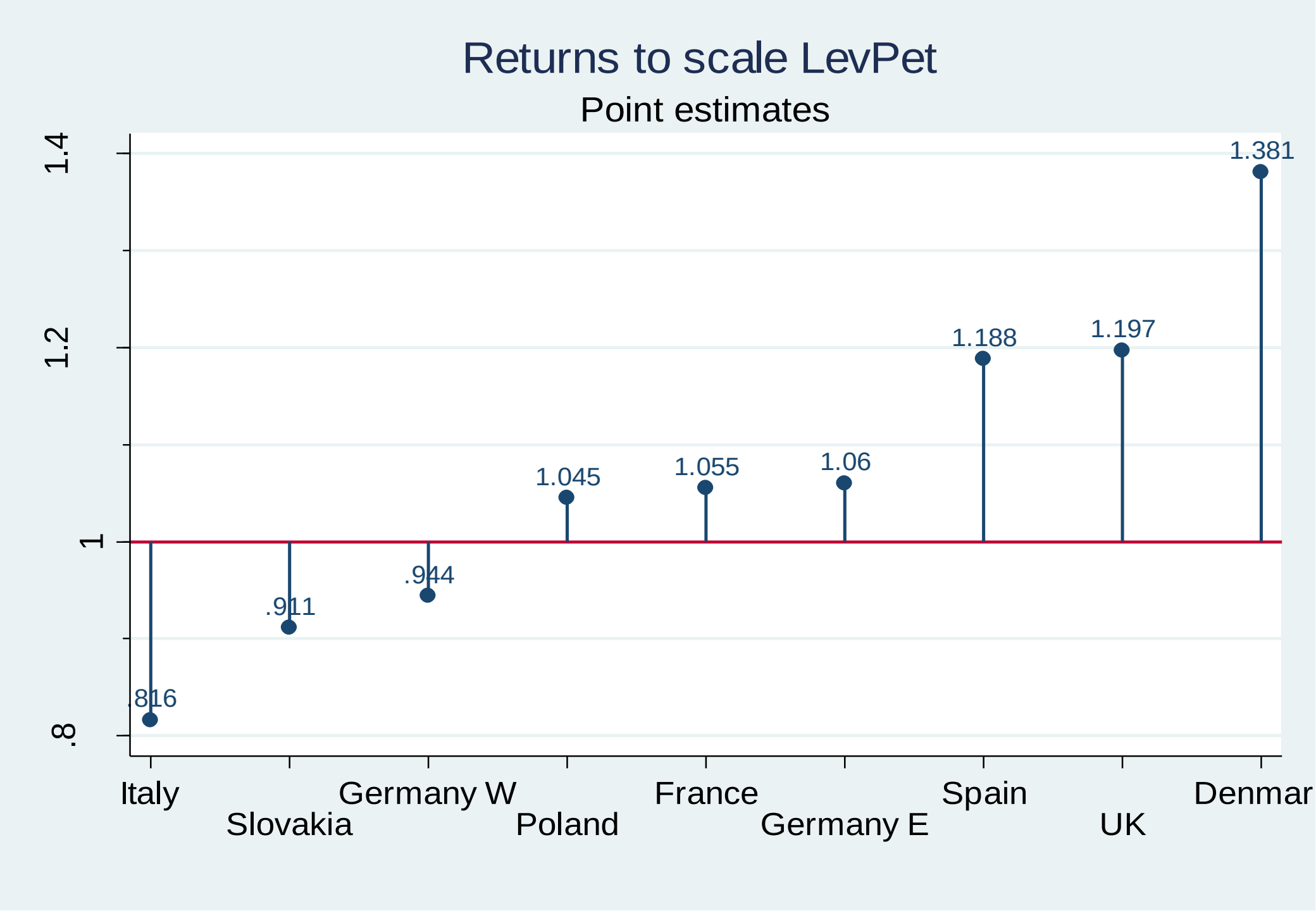
Capital

Elasticity of materials: Comparison of estimators

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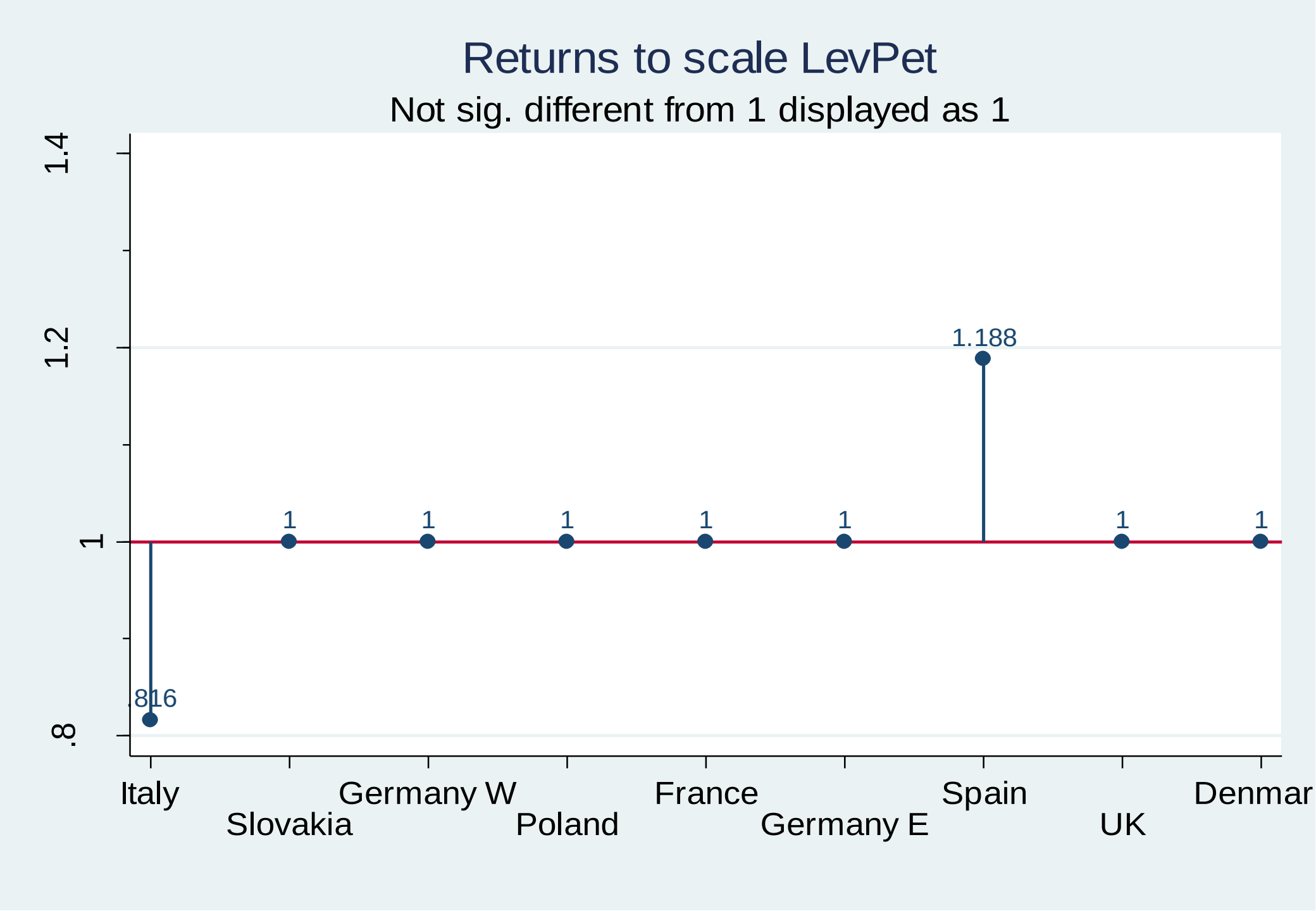
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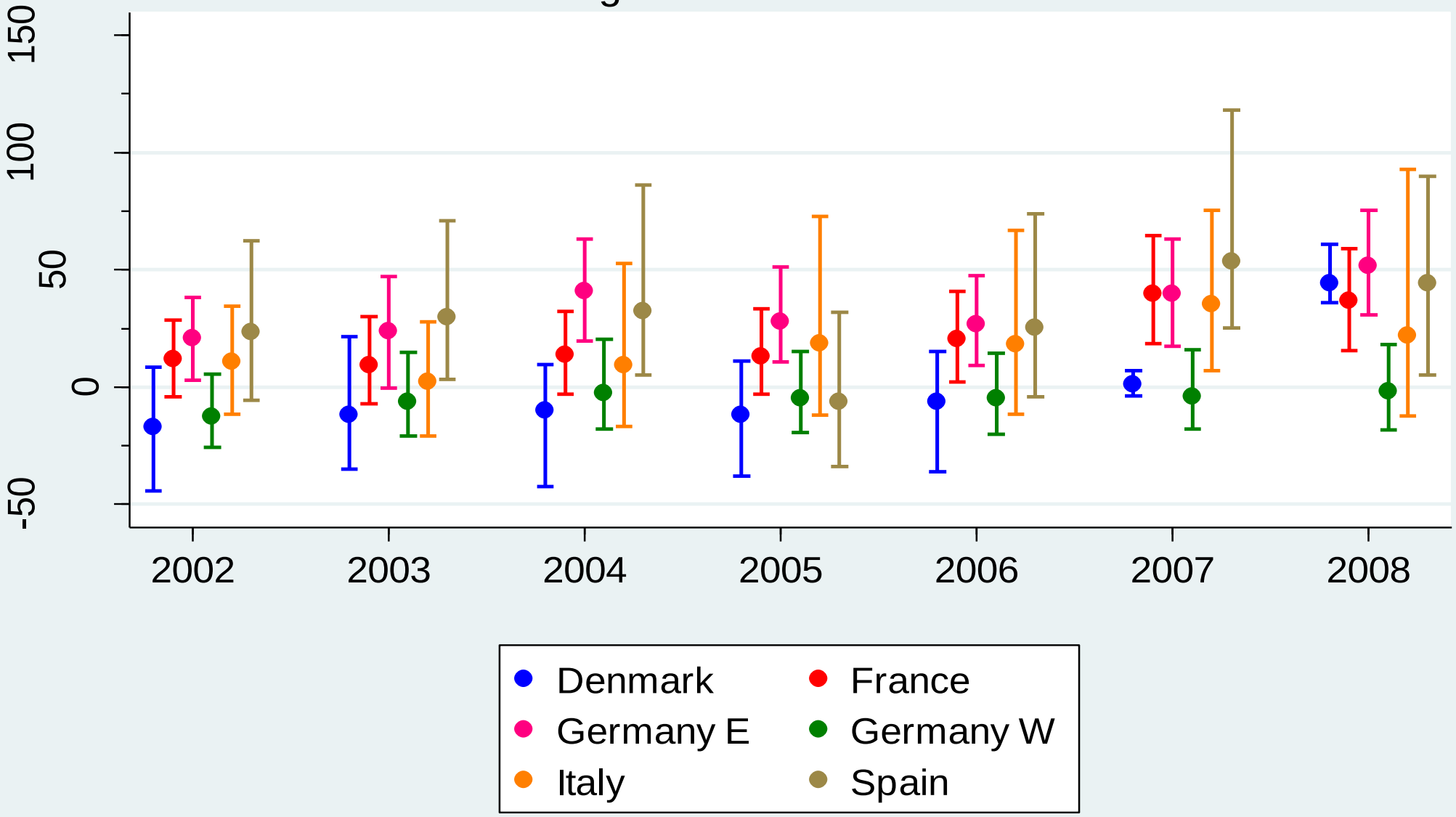
Field crop farms

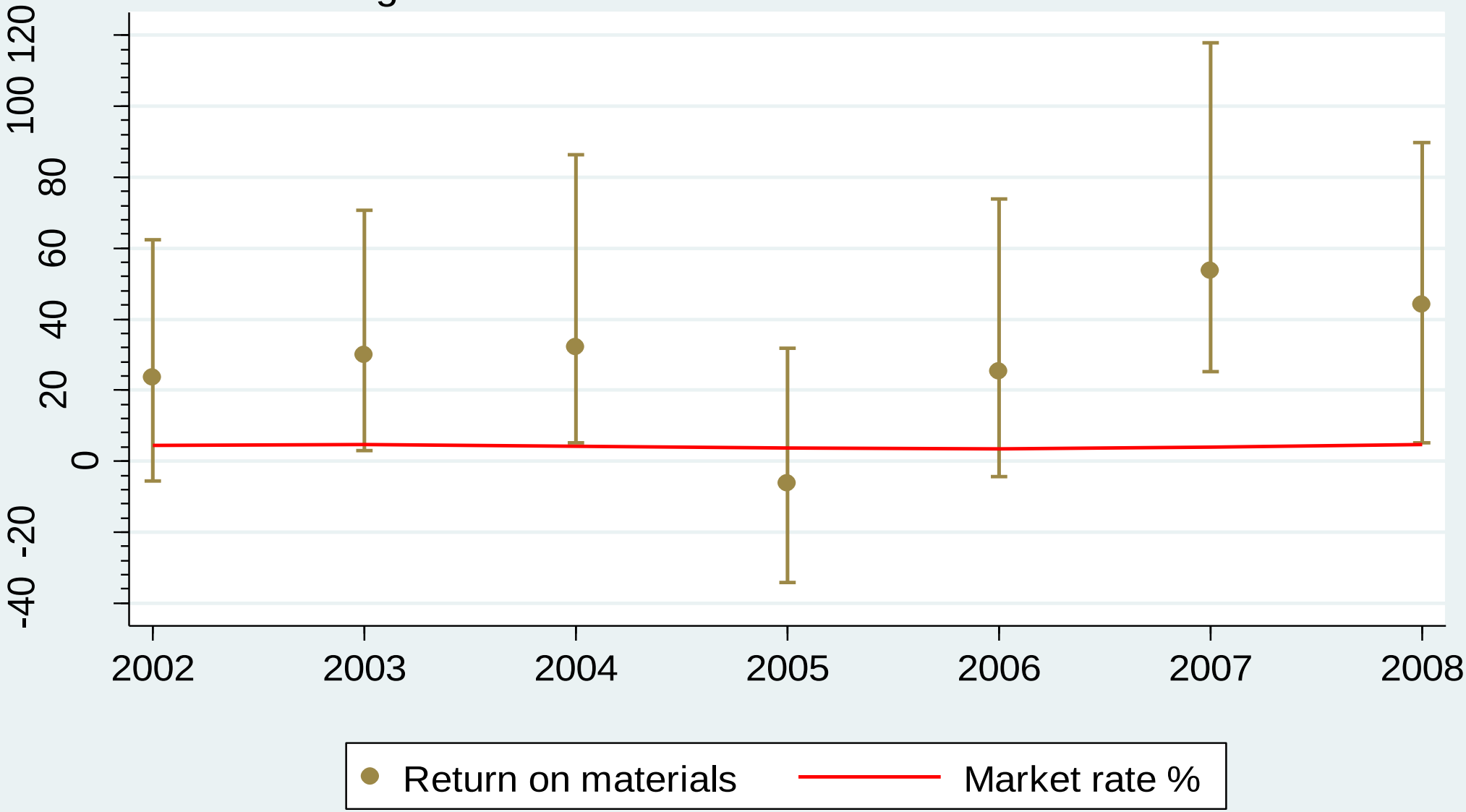
Marginal return on materials



Dots denote median; bars 3./1. quartiles.

Spanish field crop farms

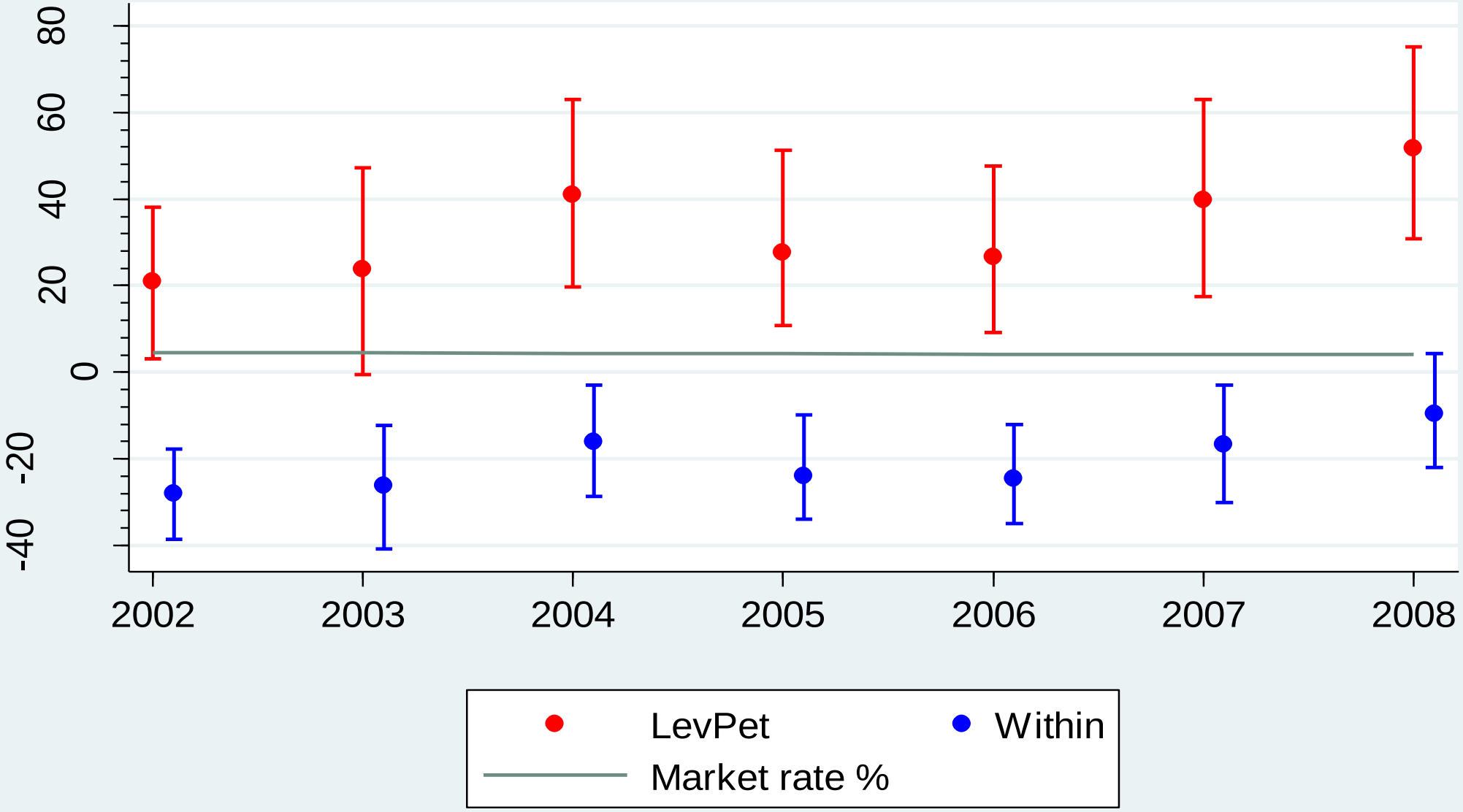
Marginal return on materials vs. market interest rate



Dots denote median; bars 3./1. quartiles.

Comparison of estimators

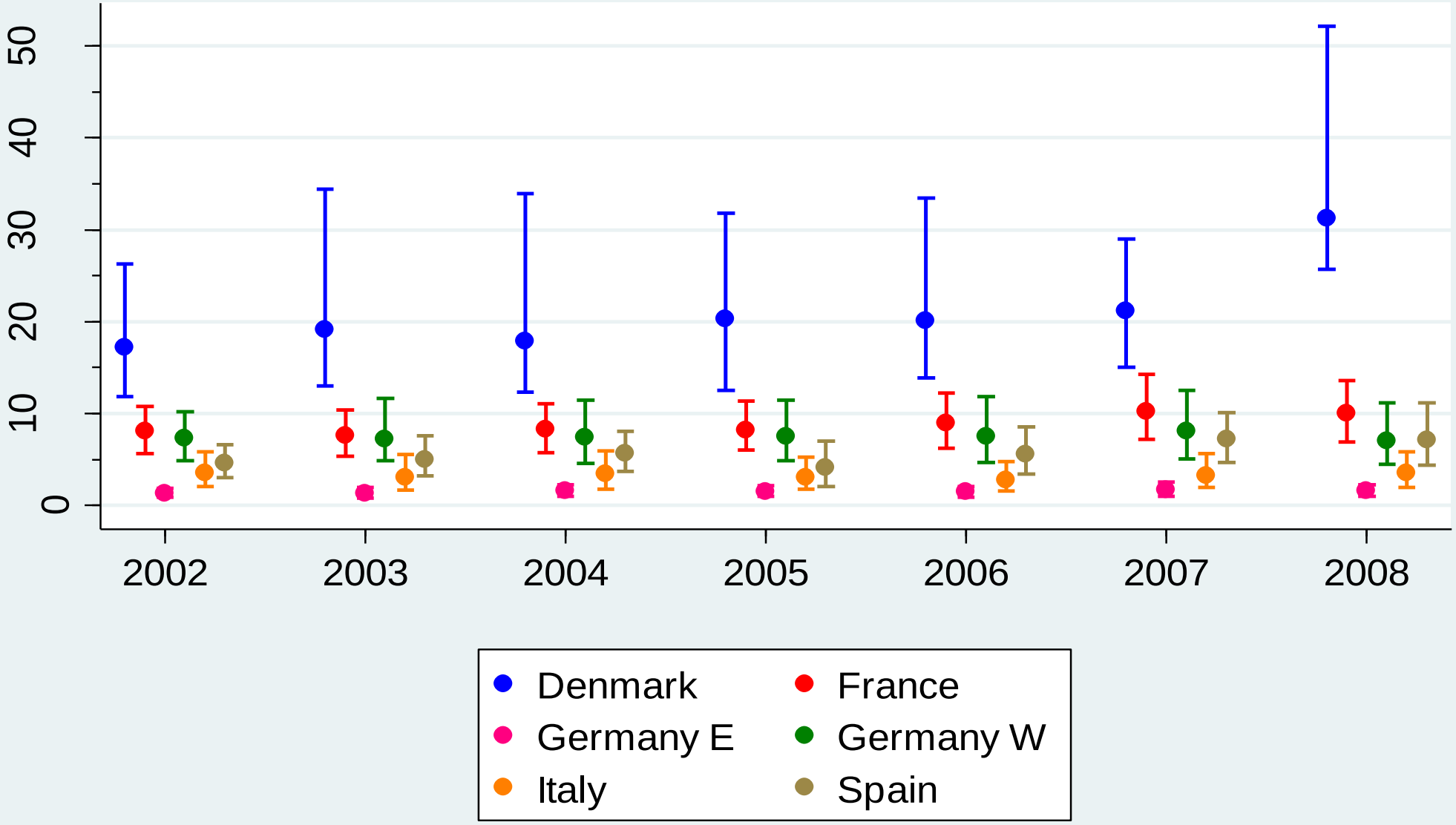
East German field crop farms: marginal return on materials



Dots denote median; bars 3./1. quartiles.

Field crop farms

Marginal return on labour



Dots denote median; bars 3./1. quartiles.

Conclusions

- In EU field crop farming, expansion of materials has the strongest effect on output (production elasticity of ~0.7)
- Shadow price analysis shows considerable heterogeneity across EU countries
  - Funding constraints (DEE, ES) vs. overutilisation (DEW, DK)?
  - Credit market imperfections – Financial crisis effects?
- Low labour remuneration (except in DK)
- Labour, land, fixed capital usually not scarce factors
- Constant returns to scale widely supported empirically
- Control function approach yields plausible results in FADN data analysis

Implications & outlook

- Challenge to widely used assumption of equilibrium factor markets
- Constraints on factor markets a possible explanation for stagnating productivity
- Estimated shadow prices a starting point for deeper analysis of its drivers & impacts
- Extension to other production systems (e.g., dairy)
- Need to collect complementary data on ag. credit markets in EU
- Access to FADN data is key for detailed analysis, update to recent years desirable

Thank you!

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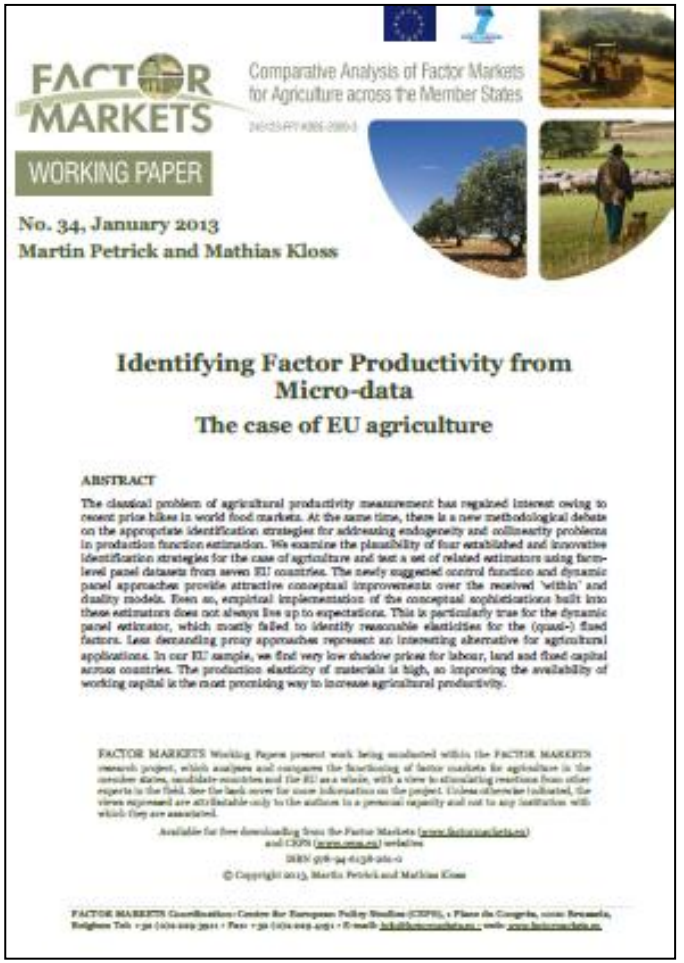
FACTOR MARKETS

COMPERATIVE ANALYSIS OF FACTOR MARKETS FOR AGRICULTURE ACROSS THE MEMBER STATES



FACTOR MARKETS

Comparative Analysis of Factor Markets for Agriculture across the Member States

WORKING PAPER

No. 34, January 2013

Martin Petrick and Mathias Kloss

Identifying Factor Productivity from Micro-data

The case of EU agriculture

ABSTRACT

The classical problem of agricultural productivity measurement has regained interest owing to recent price hikes in world food markets. At the same time, there is a new methodological debate on the appropriate identification strategies for addressing endogeneity and collinearity problems in production function estimation. We examine the plausibility of four established and innovative identification strategies for the case of agriculture and test a set of related estimators using farm-level panel datasets from seven EU countries. The newly suggested control function and dynamic panel approaches provide attractive conceptual improvements over the resolved 'within' and duality models. Even so, empirical implementation of the conceptual sophistications built into these estimators does not always live up to expectations. This is particularly true for the dynamic panel estimator, which mostly failed to identify reasonable elasticities for the (quasi-) fixed factors. Less demanding proxy approaches represent an interesting alternative for agricultural applications. In our EU sample, we find very low shadow prices for labour, land and fixed capital across countries. The production elasticity of materials is high, so improving the availability of working capital is the most promising way to increase agricultural productivity.

FACTOR MARKETS Working Papers present work being conducted within the FACTOR MARKETS research project, which analyses and compares the functioning of factor markets for agriculture in the member states, candidate countries and the EU as a whole, with a view to stimulating reactions from other experts in the field. See the back cover for more information on the project. Unless otherwise indicated, the views expressed are attributable only to the authors in a personal capacity and not to any institution with which they are associated.

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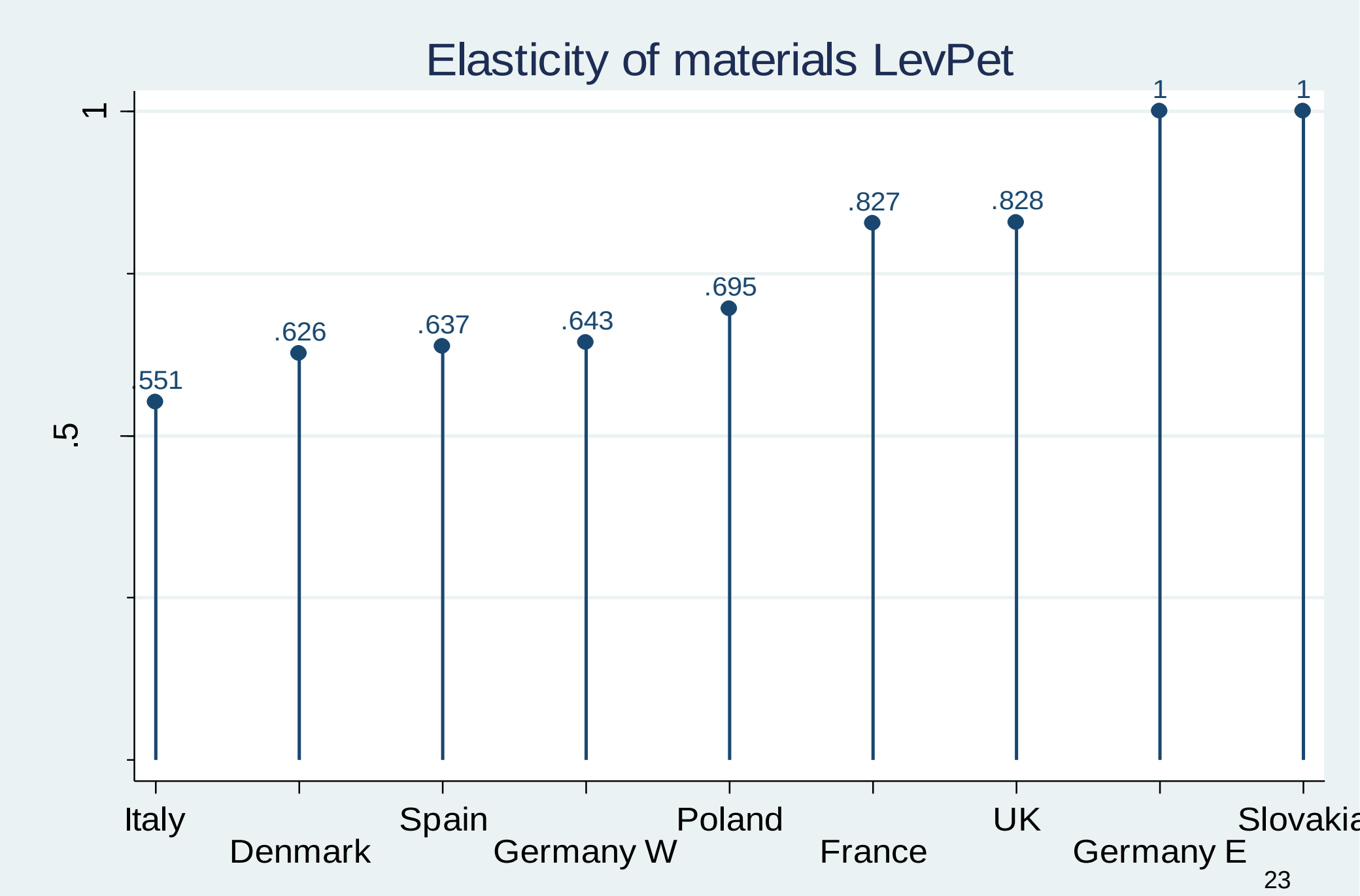
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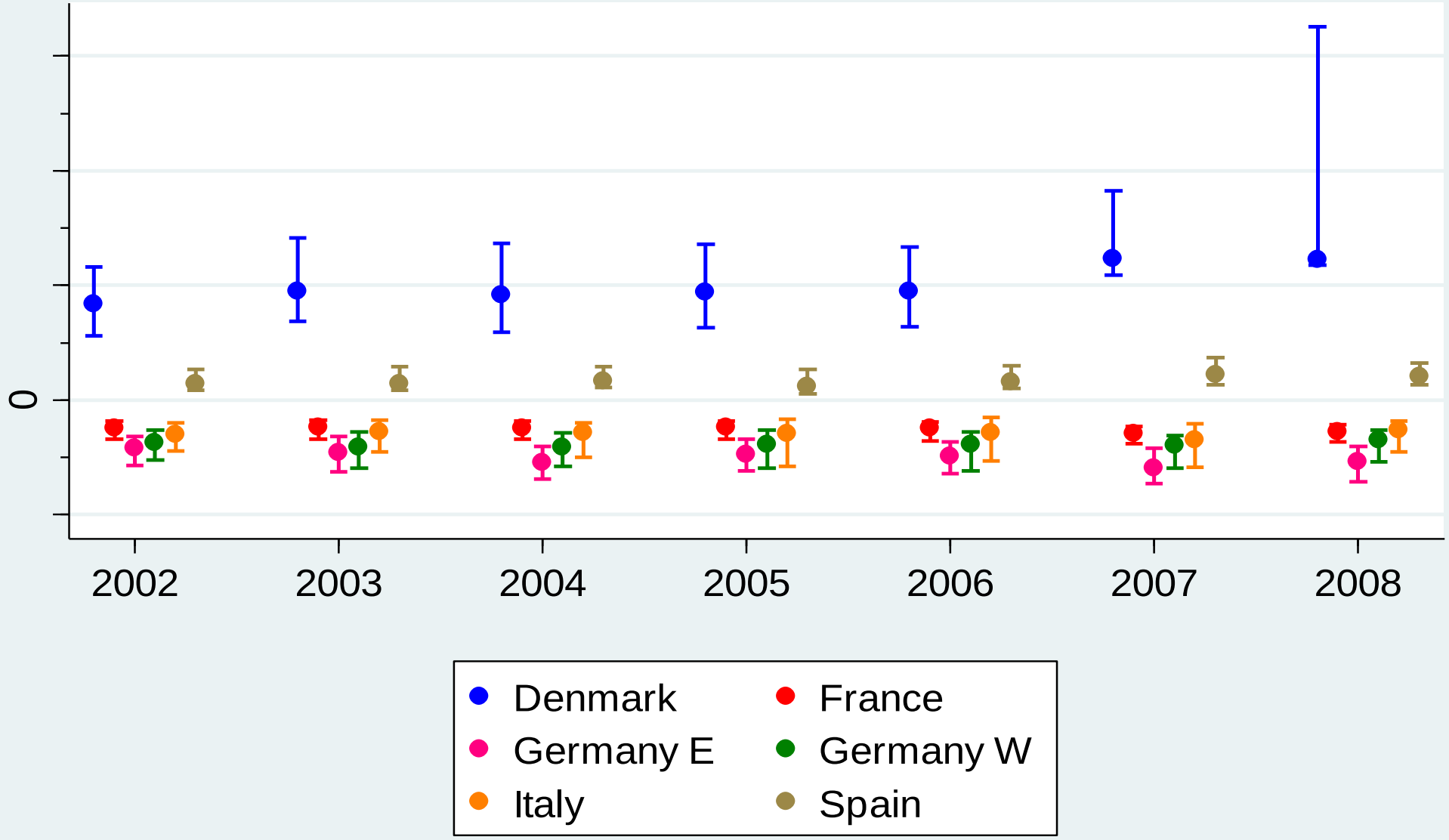
Field crop farms

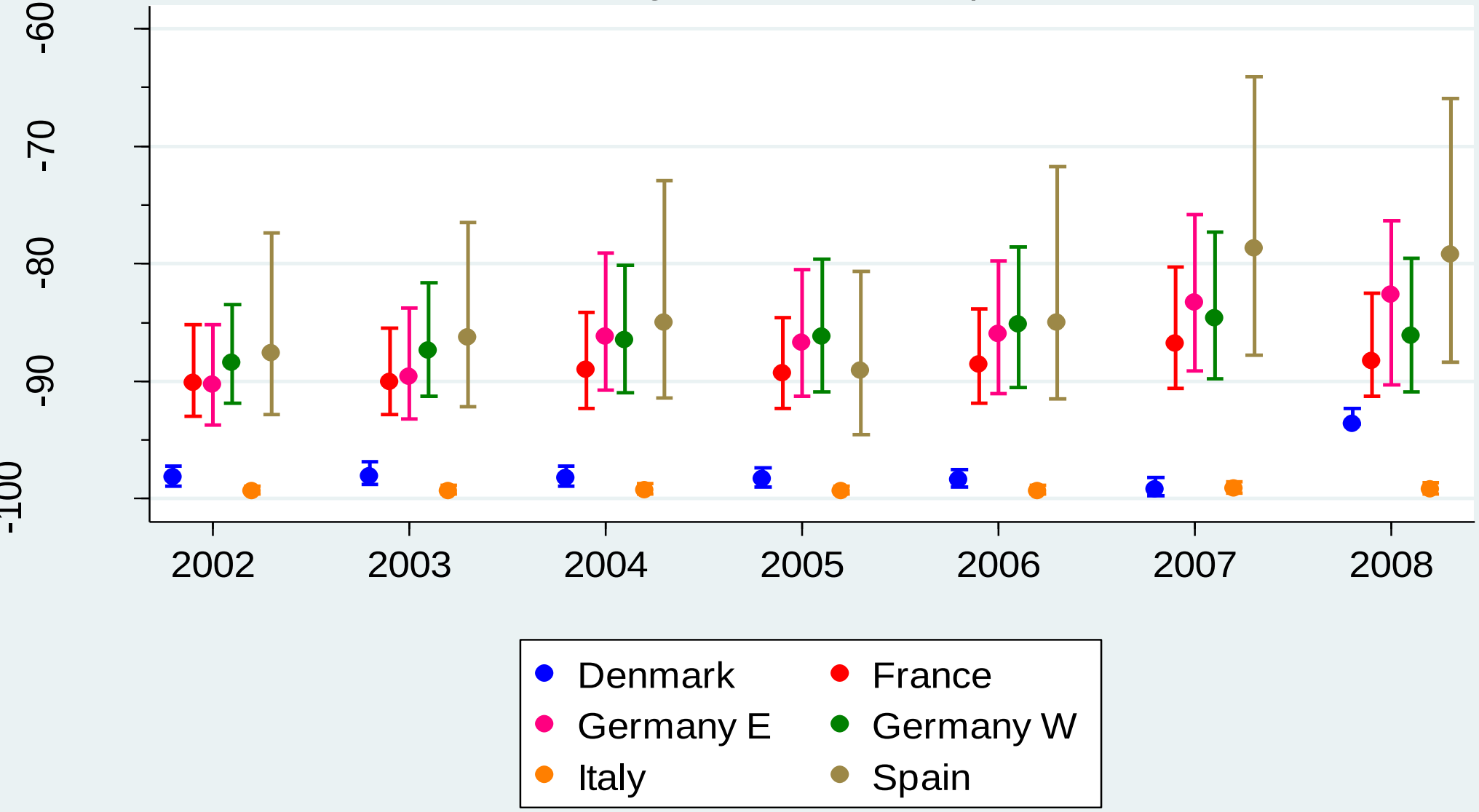
Marginal return on land



Dots denote median; bars 3./1. quartiles.

Field crop farms

Marginal return on capital



Dots denote median; bars 3./1. quartiles.

Examining the Translog form

- **OLS**: Highly implausible results at sample means
- **Within**: Interaction terms not sig. in the majority of cases
- **LevPet**: No straightforward implementation, as M & K are assumed to be additively separable