OECD-FLA Network Project ‚Drivers of Farm Performance'

Progress Report 10-19





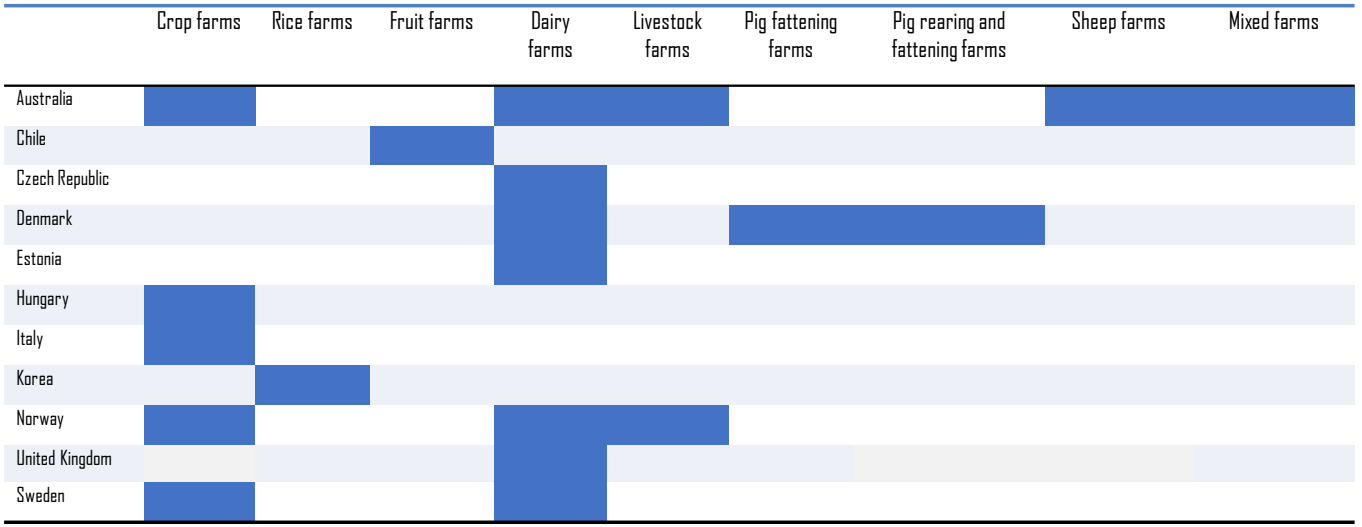

Professor Johannes Sauer | TU Munich, Germany

OECD
BETTER POLICIES FOR BETTER LIVES

1 intro

- OECD FLA network project running from Sep 17 – Dec 19 (phase I)
- project aims
  - analyse correlations between farm characteristics and farm performances
  - more accurately predict farm responses to policy measures
- cross-country perspective and focus on different sectors/systems/types

Table I. Farm case studies included in the report



Note: Darker blue indicates the farm case studies (farm types and countries) included in the report.

performance measurement at farm level

- econometric production function based farm (absolute) productivity measure (i.e. output level)

in reality: different production technologies or systems with varying technical change patterns

over time: evolvement of new technologies or systems (continuum or discrete shock)

farm categorization often depends on research experience and/or policy/management interest

structural, process related and behavioural factors for performance

- production structure: e.g. labor, farm size
- access to resources and technologies: natural, infrastructure, extension etc.
- agro-ecological conditions and climate dynamics: soil, precipitation, biodiversity
- location: market access, policy framework, network effects
- unforeseen events: pests, diseases, natural disasters
- individual abilities: experience, education, age, peer-group interaction





.. applied method(s)

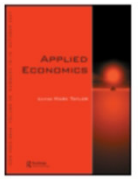
index based simultaneous estimation of technology and farm clusters

. multi-dimensional indeces based on standardized deviations

. well-defined 2nd order functional form

. latent-class estimation

. panel features



Applied Economics

ISSN: 0003-6846 (Print) 1466-4283 (Online) Journal homepage: http://www.tandfonline.com/loi/raec20

The empirical identification of heterogeneous technologies and technical change

Johannes Sauer & Catherine J. Morrison Paul

To cite this article: Johannes Sauer & Catherine J. Morrison Paul (2013) The empirical identification of heterogeneous technologies and technical change, Applied Economics, 45:11, 1461-1479, DOI: 10.1080/00036846.2011.617704

2 analysis

Indexes / Components	Index 1 Structure	Index 2 Sustainability	Index 3 Innovation/ Com/Coop	Index 4 Intensity	Index 5 Diversity	Index 6 Individual/ HumCap	Index 7 Location	Index 8 Household	Index 9 Financial
Agricultural area	x								
Age of operator						x			
Agritourism income			x						
Altitude							x		
Biofuel income			x						
Capital per cow				x					
Capital per labour				x					
Chemicals usage		X							
Education						x			
Environmental subsidies		X							
Equity/Debt ratio									x
Experience						x			
Family labour share	x								
Female/Male labour share								x	
Forestry production					x				
Gender						x			
Herd size	x								
Herfindahl index[1]					x				
Investment subsidies			x						
Labour per cow				x					
Land irrigated share			x						
Land rented share			x						
Less-favoured-area							x		
Material per land				x					
Natura2000							x		
Net investment ratio			x						
Off-farm income								x	
Organic production		x							
Ownership	x								
Production diversity					x				
Stocking density		x							
Total subsidies									x
Total assets									x

Table 2. Indexes for farm classification

Components for multi-dimensional indices as elements of class identification vector q, see equation [3]
Note: Final choice of indices' components depends on production type and data availability per country case.
1. The Herfindahl Index measures the degree of specialisation based on the sum pf squared output shares.

indices Australia dairy/crops/beef/sheep/mixed ..

index 01 – structure	[family/hired labor, herd size, farms size land, ownership]
index 02 – sustainability	[chemicals per ha, stocking density, fuel per ha]
index 03 - innovation/commercialisation	[net investment, share land rented, contracts, gen vet exp per lu, insur exp per lu]
index 04 – technology	[capital/labor, capital/cow, fodder per cow, labor per cow, lab per ha, mat/interm per ha, depr/capital per ha, seed per ha, herdtest]
index 05 - diversity	[Herfindahl index, production diversity]
index 06 - individual	[age, gender, education]
index 07 - location/environmental conditions	[various production zones]
index 08 - household	[off-farm income, spouse age/education/gender]
index 09 - financial	[subsidies, debt/equity, total assets]

indices SE dairy/crops ..

index 01 – structure	[family/hired labor, herd size, farms size land, ownership]
index 02 – sustainability	[chemicals per ha, stocking density, prob organic, agri-env payments, fuel per ha]
index 03 - innovation/commercialisation	[net investment, share land rented, biofuel/misc inc]
index 04 – technology	[capital/labor, capital/cow, fodder per cow, labor per cow, mat per cow, lab per ha, mat/interm per ha, depr/capital per ha, seed per ha]
index 05 - diversity	[Herfindahl index, production diversity]
index 06 - individual	[age]
index 07 - location/environmental conditions	[various subregions, altitude, lfa, rural-urban class]
index 08 - household	[off-farm income]
index 09 - financial	[subsidies, total assets]

indices UK dairy/crops ..

index 01 – structure	[family/hired labor, herd size, farms size land, ownership]
index 02 – sustainability	[chemicals per ha, stocking density, prob organic, agri-env payments, fuel per ha]
index 03 - innovation/commercialisation	[net investment, share land rented, contracts, biofuel/misc inc, insur cost, prof fees]
index 04 – technology	[capital/labor, capital/cow, fodder per cow, labor per cow, mat per cow, lab per ha, mat/interm per ha, depr/capital per ha, seed per ha]
index 05 - diversity	[Herfindahl index, production diversity]
index 06 - individual	[age, gender, education]
index 07 - location/environmental conditions	[various gor zones, altitude, lfa, rural-urban class]
index 08 - household	[off-farm income, working time spouse]
index 09 - financial	[subsidies, debt/equity, total assets]

.. estimation of technologies and classes

$$lny_{it|c} = \alpha_0 + \sum_{k=1}^{n} \beta_{k,c} lnx_{kit} + \frac{1}{2} \sum_{k=1}^{n} \beta_{kk,c} lnx_{kit} lnx_{kit} + \sum_{k=1}^{n-1} \sum_{l=k+1}^{n} \gamma_{kl,c} lnx_{kit} lnx_{lit}$$
$$+ \delta_{T,c} t_{it} + \delta_{TT,c} t_{it} t_{it} + \sum_{k=1}^{n} \delta_{kT,c} lnx_{kit} t_{it} + \varepsilon_{it|c}$$

$$P_{ic} = exp(\theta_c q_i) \Big/ \left[\sum_{c} exp(\theta_c q_i) \right]$$

i - farm

t - year

c - group/cluster

q - drivers/characteristics/indices =

[i01, i02, i03, i04, i05, i06, i07, i08, i09]

3 empirical cases

	Farm type	Period	Number of observations	Number of farms	Average number of years in the panel	Source
Chile	Fruit farms	2015	448	448	1	Chilean Office of Agricultural Studies and Policies (ODEPA), Santiago de Chile
Czech Republic	Dairy farms	2005-15	1 011	156	8	Institute of Agricultural Economics and Information, Prague
Denmark	Dairy farms	2006-16	17 121		8.5	Food and Resource Economic Institute at the University of Copenhagen, CPH
	Pig farms I	2006-16	4 934		5.1	
	Pig farms II	2006-16	9 524		5.1	
Estonia	Dairy farms	2000-15	2 935	1 056	10	Ministry of Rural Affairs, Talinn
Hungary	Crop farms	2001-14	14 128	2 937	9	Ministry of Agriculture and Research Institute of Agricultural Economics, Budapest
Italy	Crop farms	2008-15	20 847	7 239	2.9	CREA at the Ministry of Agriculture, Rome
Korea	Rice farms	2003-15	16 565	1 800	9	Korean Rural Economic Institute
Norway	Crop farms	2005-16	1 613	285	8.3	Norwegian Institute of Bioeconomy Research (NIBIO), Oslo
	Dairy farms	2005-16	5 549	948	7.5	
	Livestock farms	2005-16	1 655	293	7.9	
Australia	Dairy/Cropping/Sheep/Beef/ Mixed C-L/Mixed S-B	1989-18	4000 -10000	up to 2367	up to 4.7	ABARES, Canberra
UK	Dairy/Crops/Sheep/Pigs	1995-17	11000	2055	4.5	DEFRA, London
Sweden	Dairy/Crops	1997-17	7729/3940	2500/1000	3.7/3.1	Jordbruksverket, Stockholm

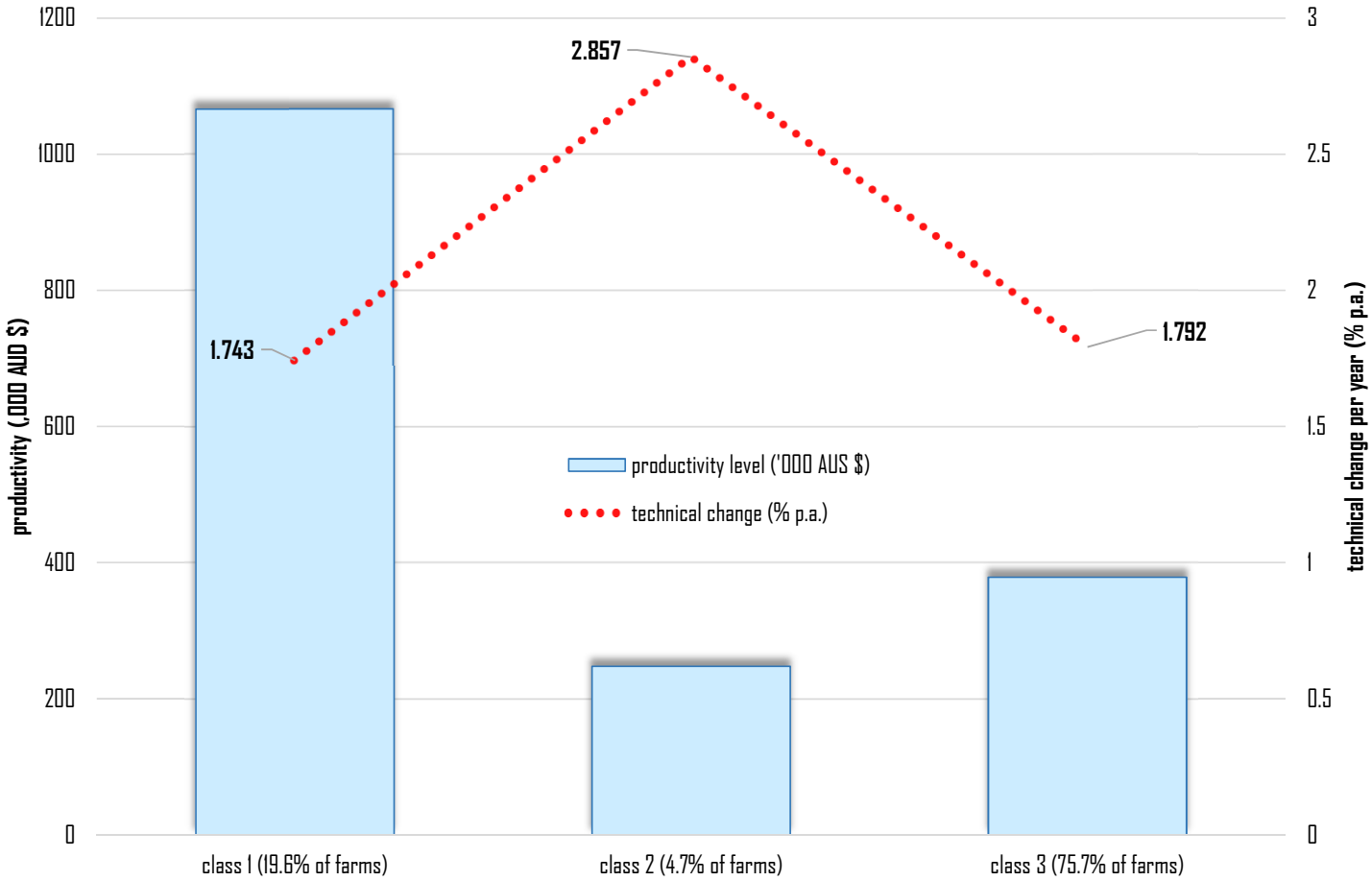
Table 3. Overview of data used in the report

Note: Pig farms I: rearing and fattening; Pig farms II: Specialised fattening.

overview - Australia

- dairy farms (1989-2018, 9161 obs, 3 classes, uneven distribution, significant performance differences)
- crop farms (1989-2018, 8921 obs, 2 classes, significant performance differences)
- sheep meat farms (1989-2018, 4011 obs, 3 classes, uneven distr, modest performance differences)
- sheep wool farms (1989-2018, 5186 obs, 3 classes, uneven distr, significant performance differences)
- beef farms (1989-2018, 9092 obs, 3 classes, uneven distr, highly significant performance differences)
- sheep|beef farms (1989-2018, 4787 obs, 3 classes, uneven distr, highly significant performance diff)
- mixed farms (1989-2018, 9715 obs, 3 classes, uneven distr, significant performance differences)

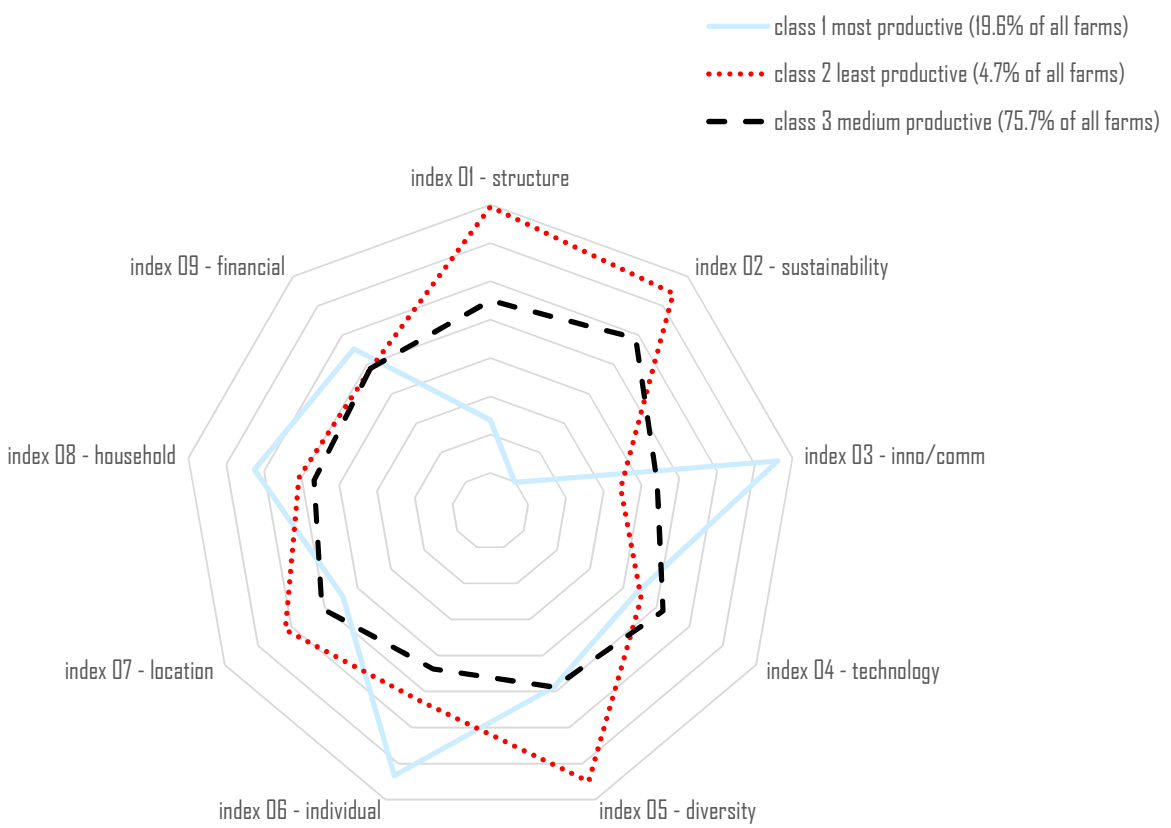
4 results - Australia - dairy



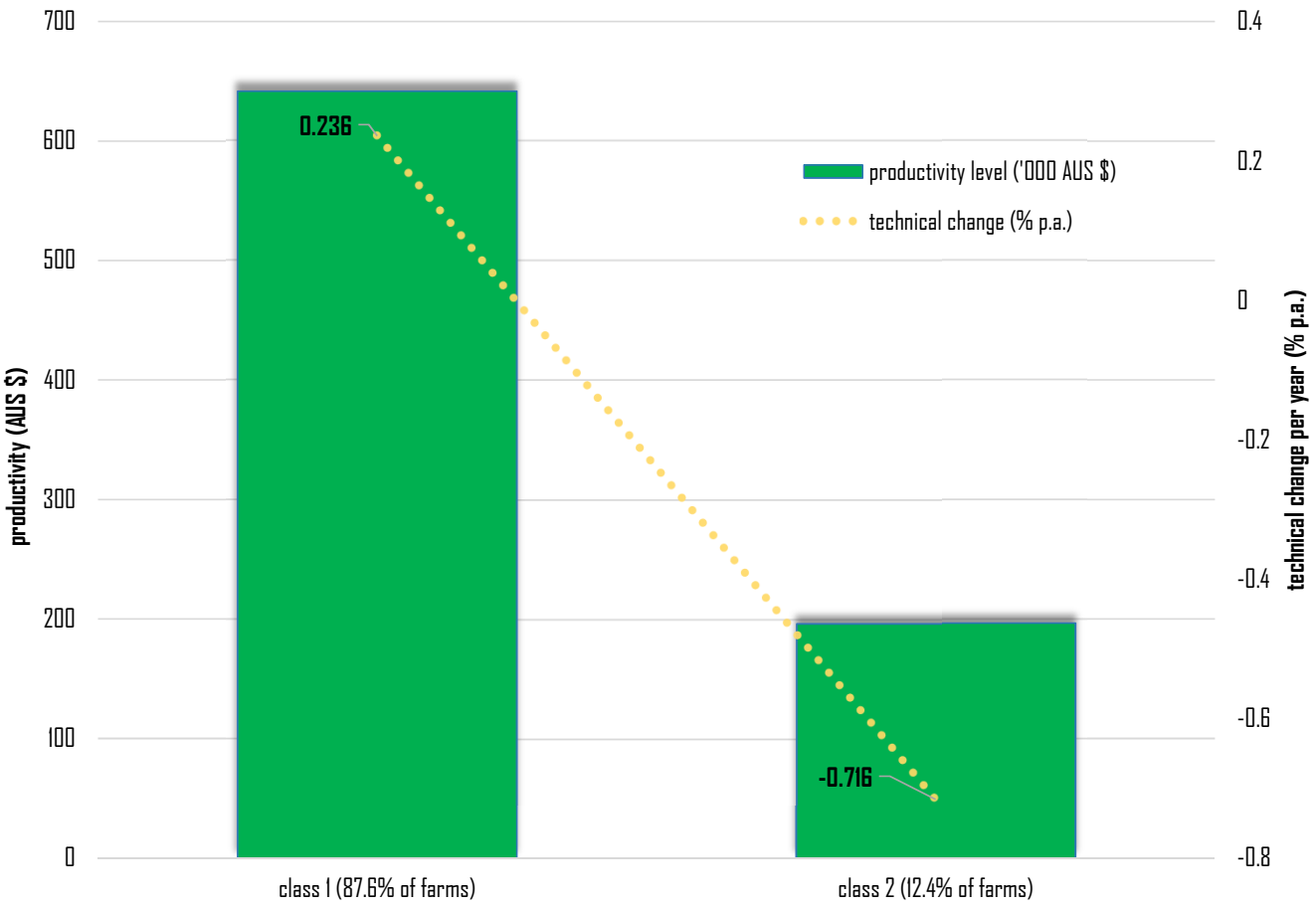


4 results - Australia - dairy

Descriptives (at class mean)	class 1 (19.6% of farms)	class 2 (4.7% of farms)	class 3 (75.7% of farms)
index 01 - structure	-0.5245	0.5891	0.1000
index 02 - sustainability	-0.8024	0.4844	0.1785
index 03 - inno/comm	0.5217	-0.3108	-0.1163
index 04 - technology	-0.1307	-0.0925	0.0396
index 05 - diversity	-0.0264	0.4995	-0.0238
index 06 - individual	0.4667	0.0567	-0.1246
index 07 - location	-0.1099	0.2352	0.0141
index 08 - household	0.2501	0.0144	-0.0658
index 09 - financial	1.0631	-0.2759	-0.2590



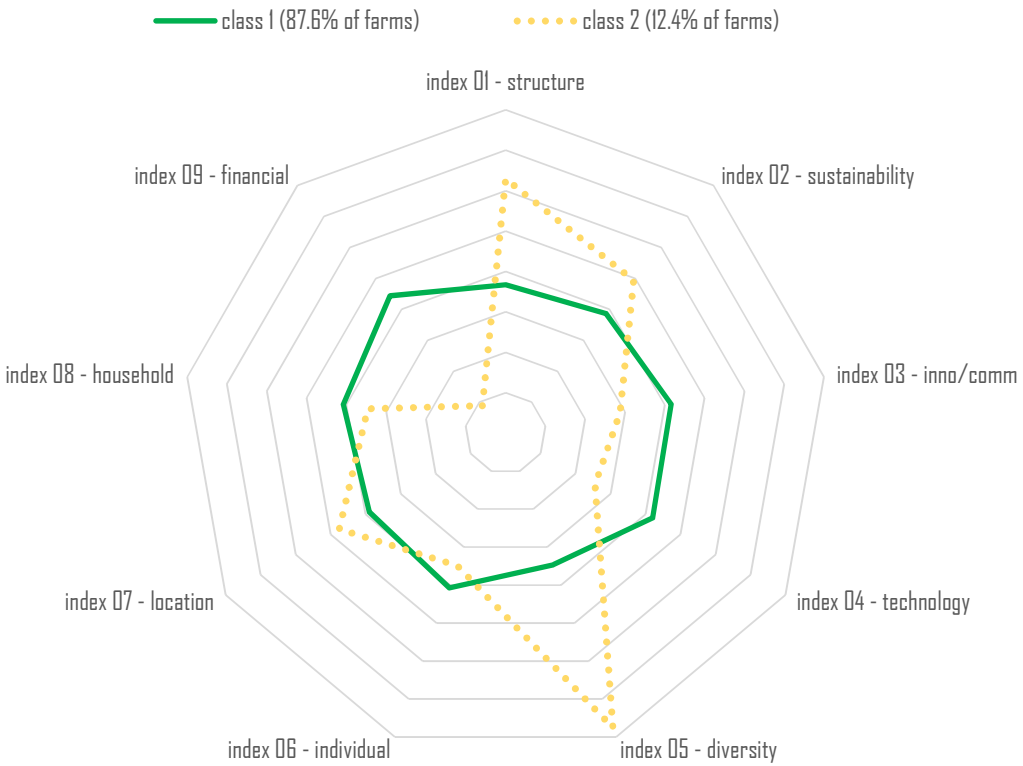
4 results - Australia - cropping



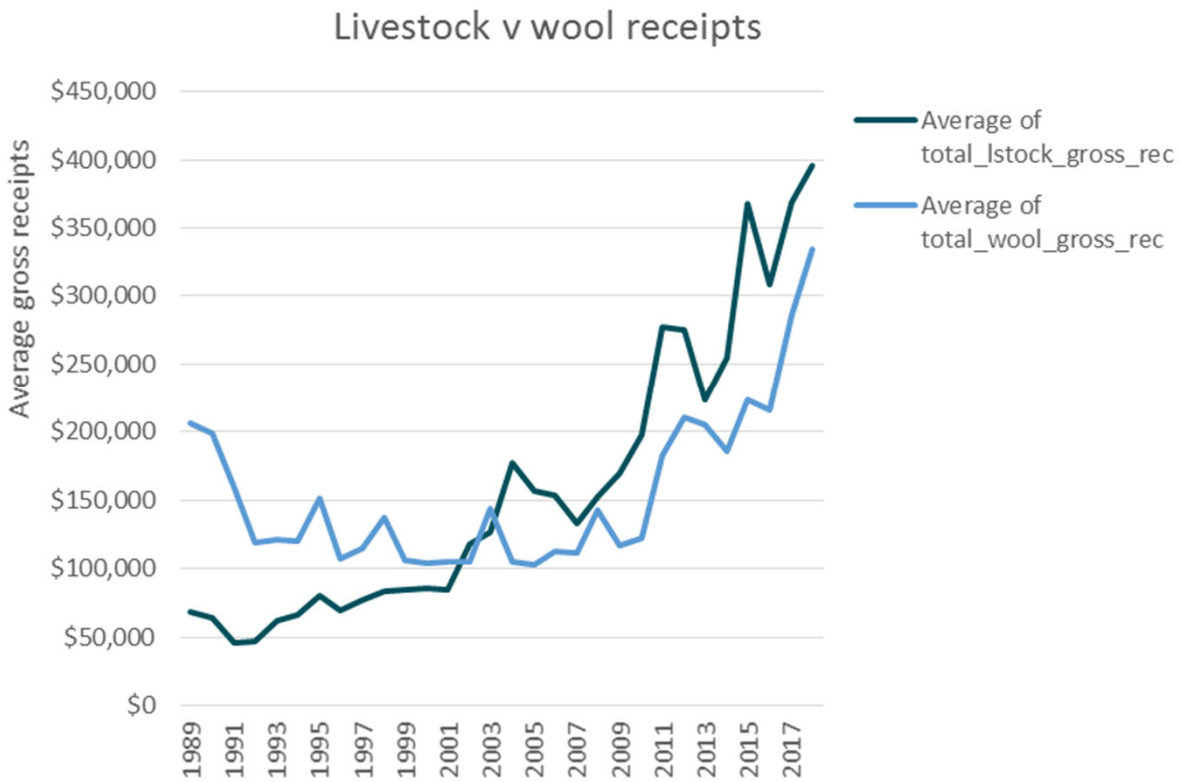


4 results - Australia - cropping

Descriptives	more productive class 1 (87.6% of farms)	less productive class 2 (12.4% of farms)
(at class mean)		
index 01 - structure	-0.0162	0.1147
index 02 - sustainability	-0.0660	0.4660
index 03 - inno/comm	0.0797	-0.5628
index 04 - technology	0.0102	-0.0721
index 05 - diversity	-0.2664	1.8805
index 06 - individual	0.0363	-0.2560
index 07 - location	-0.0532	0.3753
index 08 - household	0.0382	-0.2696
index 09 - financial	0.0220	-0.1554



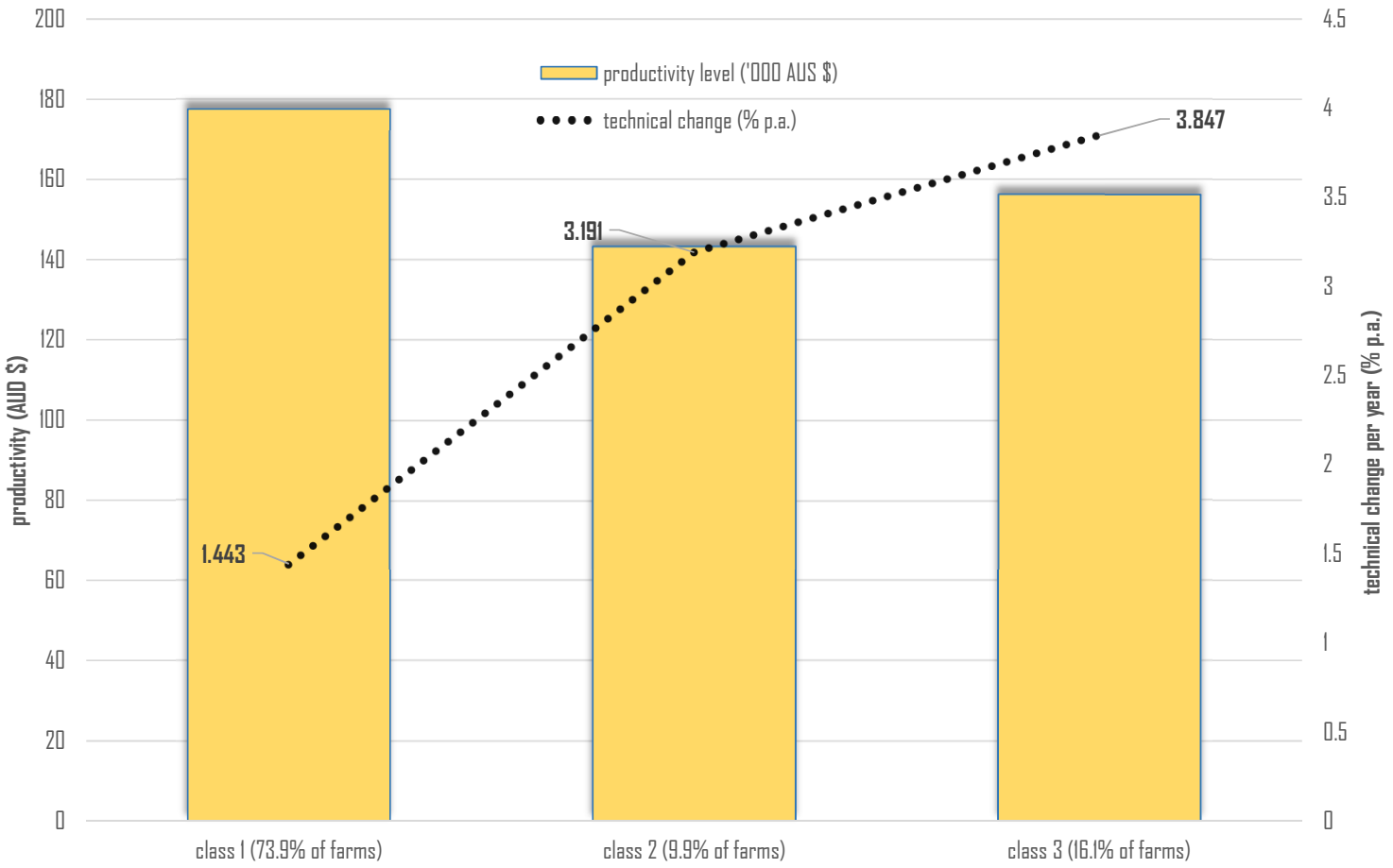
4 results - Australia - sheep



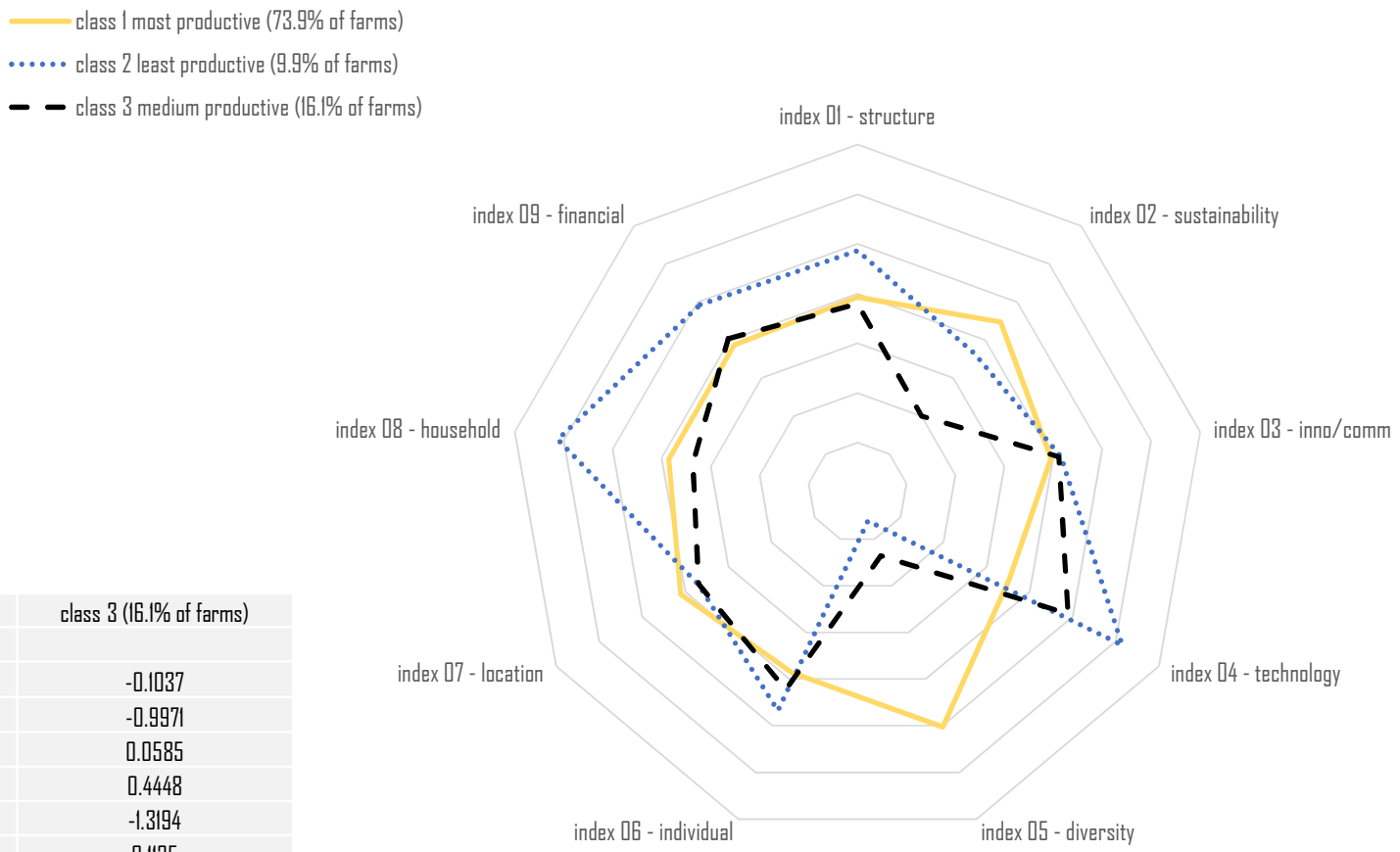




4 results - Australia - sheep meat



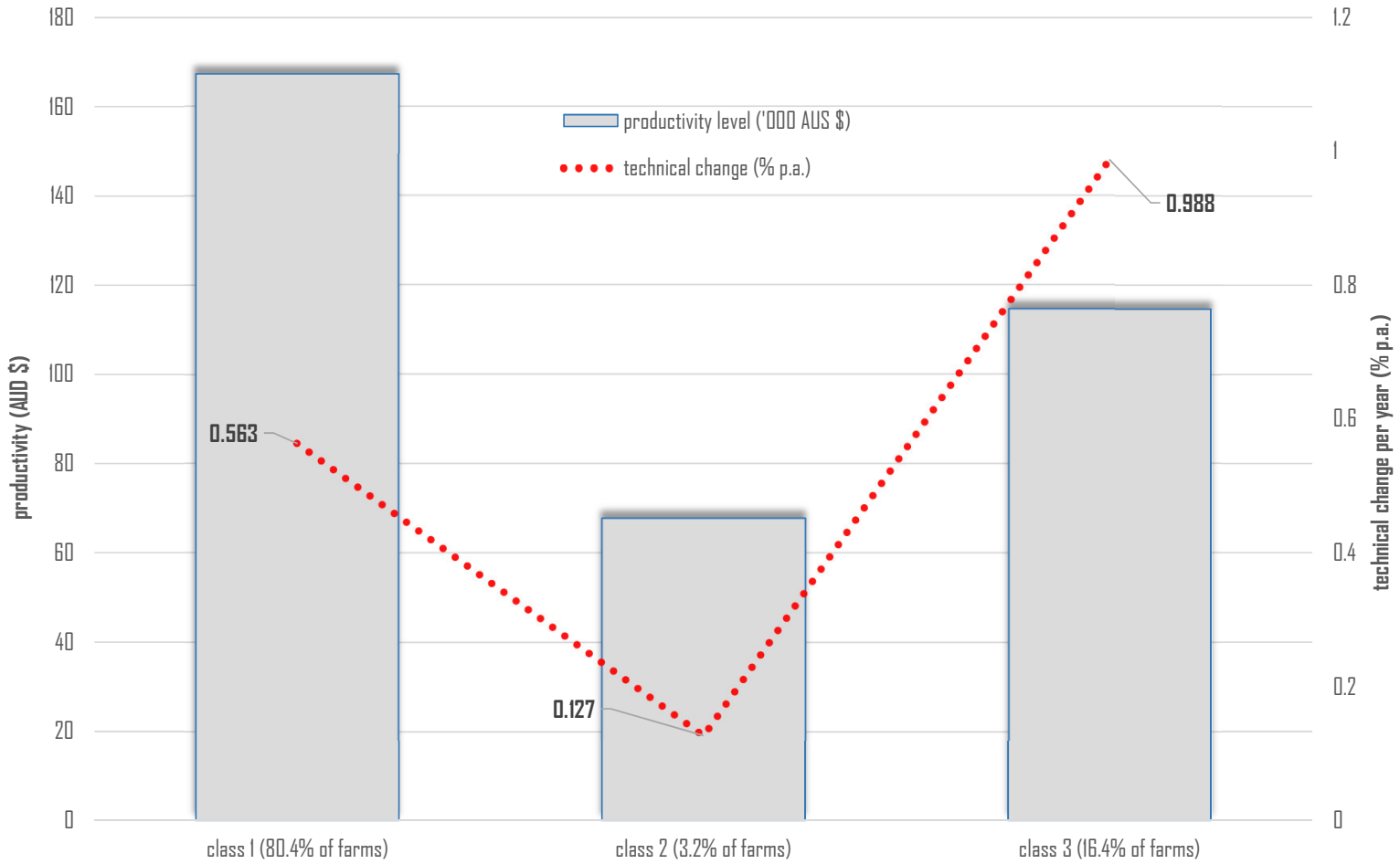
4 results - Australia - sheep meat



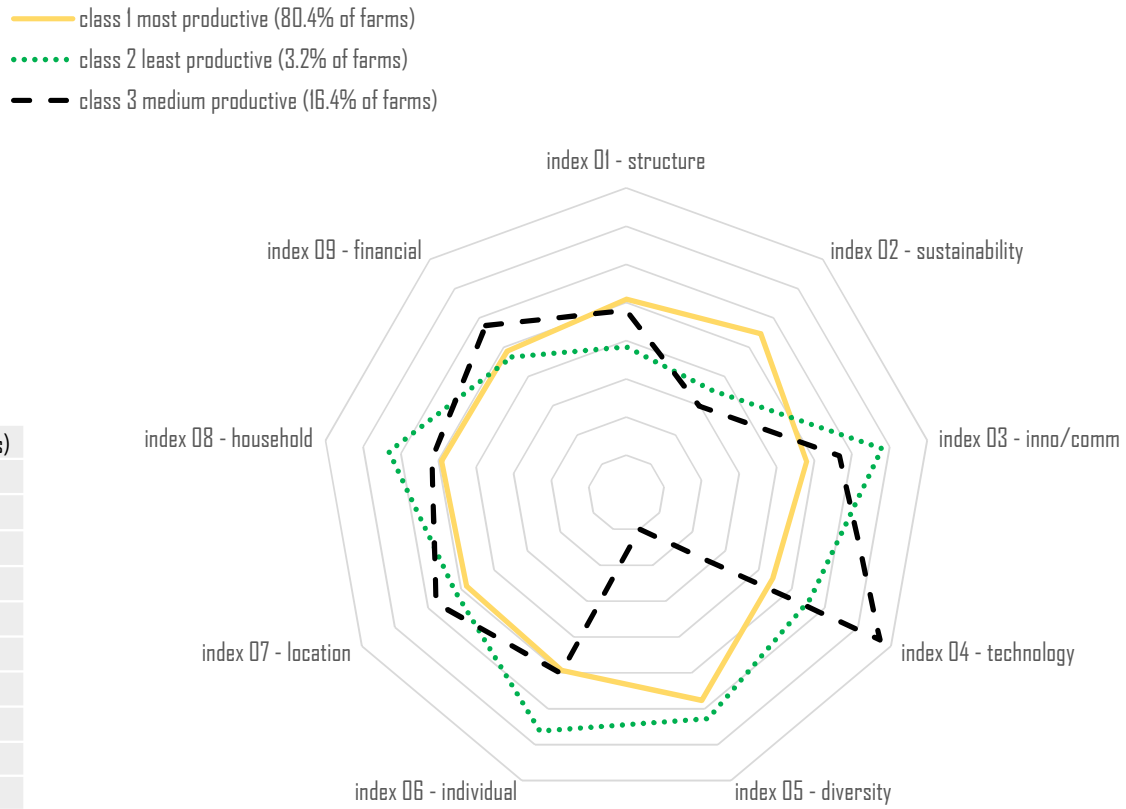
Descriptives (at class mean)	class 1 (73.9% of farms)	class 2 (9.9% of farms)	class 3 (16.1% of farms)
index 01 - structure	-0.0352	0.4319	-0.1037
index 02 - sustainability	0.2402	-0.1730	-0.9971
index 03 - inno/comm	-0.0229	0.0758	0.0585
index 04 - technology	-0.2404	1.0735	0.4448
index 05 - diversity	0.5135	-1.6918	-1.3194
index 06 - individual	-0.0699	0.3379	0.1135
index 07 - location	0.0534	-0.1501	-0.1531
index 08 - household	-0.0726	1.0616	-0.3187
index 09 - financial	-0.0667	0.4644	0.0212

4 results - Australia - sheep wool

OECD-FLA Network Project ‚Drivers of Farm Performance' 9-19



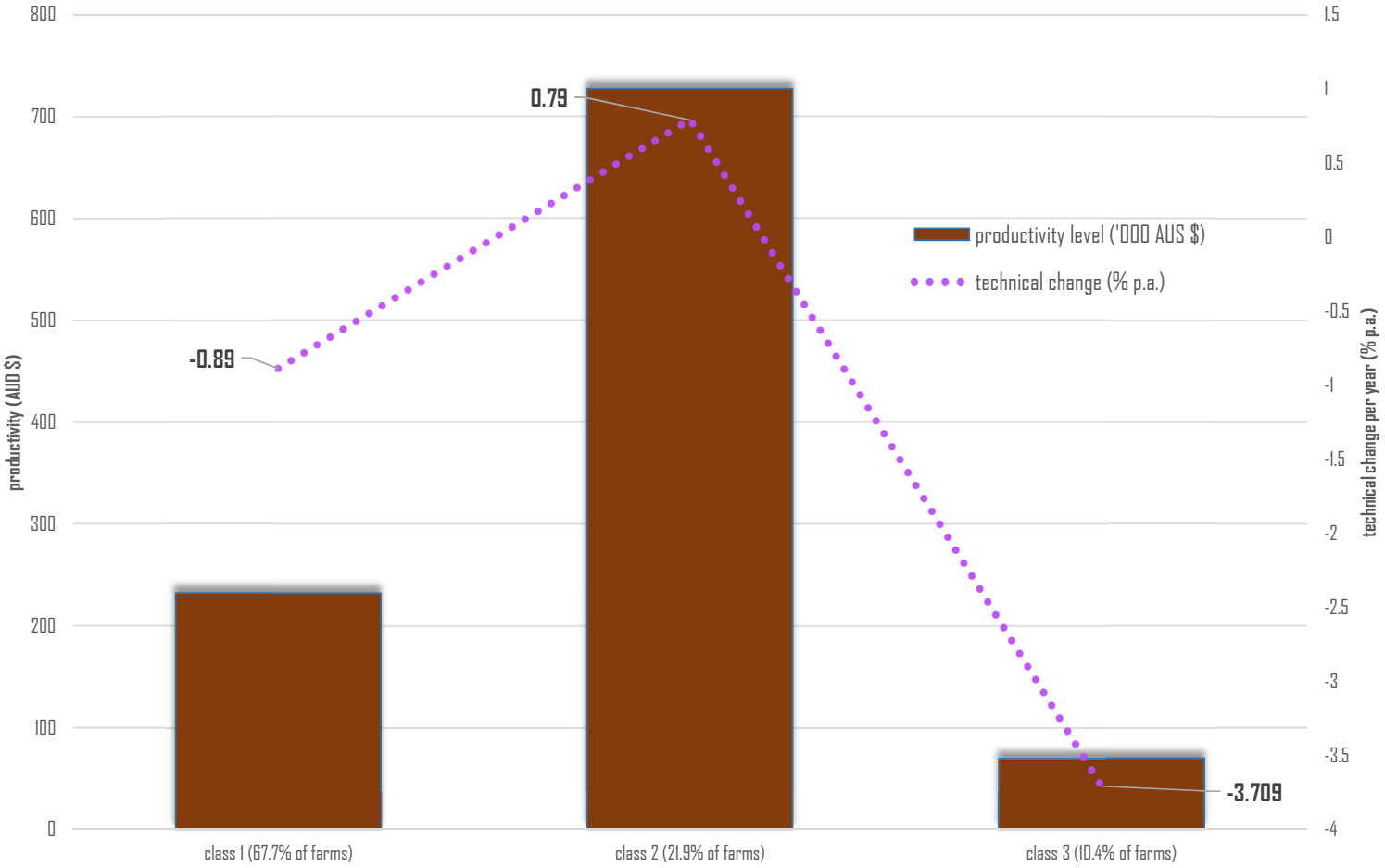
4 results - Australia - sheep wool



Descriptives (at class mean)	class 1 (80.4% of farms)	class 2 (3.2% of farms)	class 3 (16.4% of farms)
index 01 - structure	0.0437	-0.5804	-0.1008
index 02 - sustainability	0.2355	-0.7425	-1.0090
index 03 - inno/comm	-0.1034	0.8975	0.3313
index 04 - technology	-0.2835	0.2759	1.3352
index 05 - diversity	0.3835	0.6373	-2.0029
index 06 - individual	-0.0338	0.8113	0.0071
index 07 - location	-0.0801	0.0835	0.3760
index 08 - household	-0.0438	0.6584	0.0863
index 09 - financial	-0.0686	-0.1676	0.3688

4 results - Australia - beef

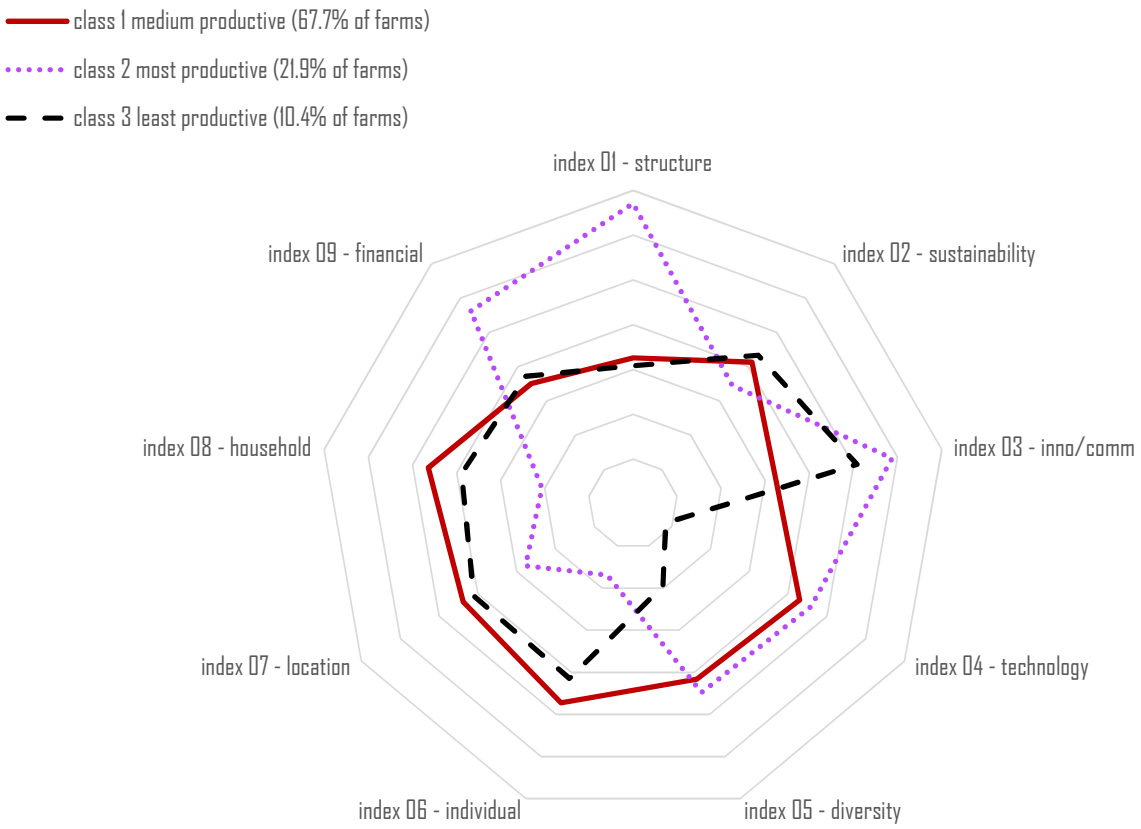
OECD-FLA Network Project ‚Drivers of Farm Performance' 9-19







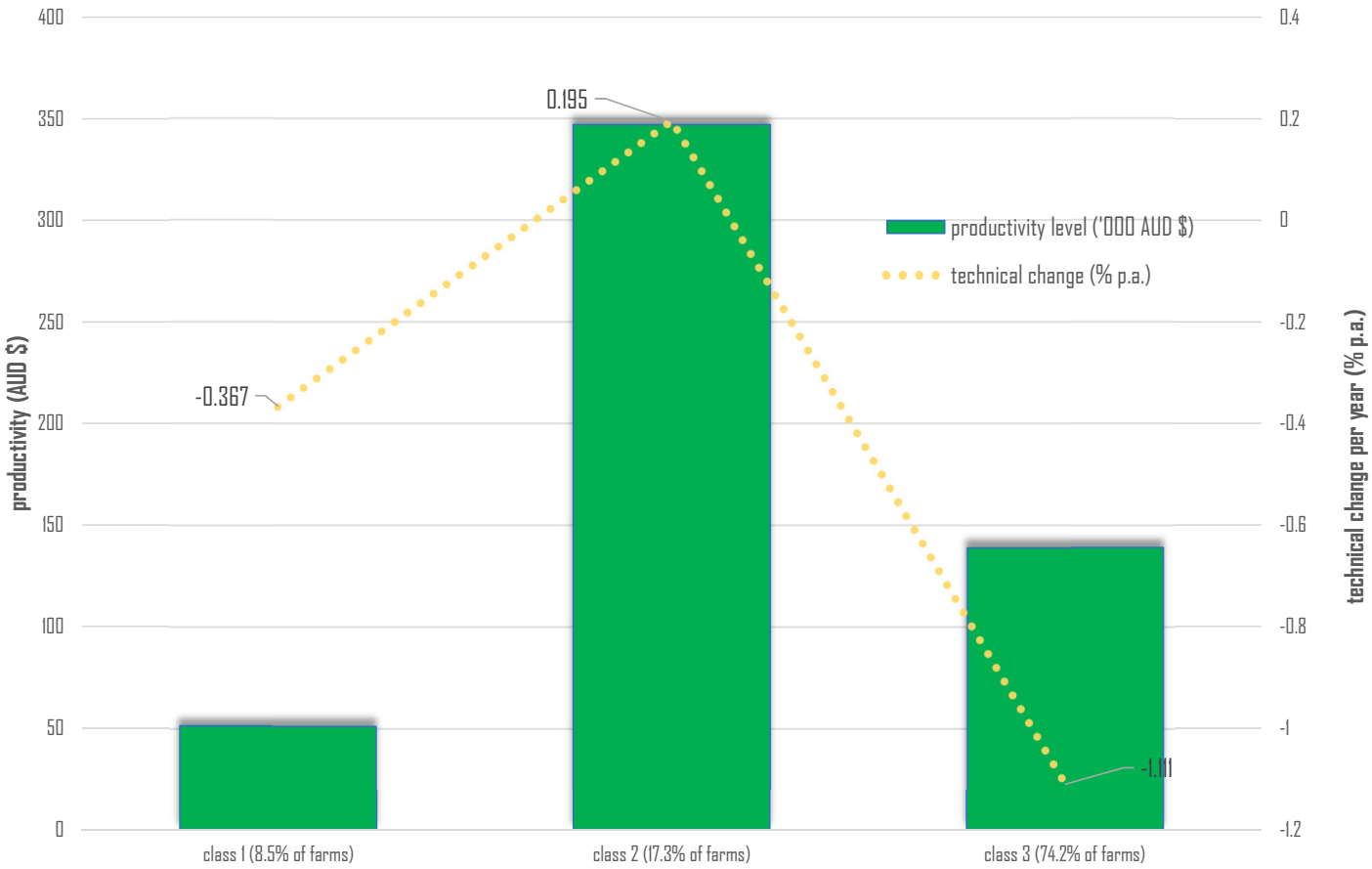
4 results - Australia - beef



Descriptives (at class mean)	class 1 (67.7% of farms)	class 2 (21.9% of farms)	class 3 (10.4% of farms)
index 01 - structure	-0.3679	1.3549	-0.4572
index 02 - sustainability	0.0637	-0.2764	0.1677
index 03 - inno/comm	-0.0385	0.0936	0.0538
index 04 - technology	0.0147	0.0292	-0.1580
index 05 - diversity	0.0793	0.2390	-1.0232
index 06 - individual	0.3620	-1.1545	0.0727
index 07 - location	0.1907	-0.6162	0.0548
index 08 - household	0.3215	-0.9680	-0.0571
index 09 - financial	-0.0242	0.0814	-0.0139

4 results - Australia - sheep|beef

OECD-FLA Network Project ‚Drivers of Farm Performance' 9-19

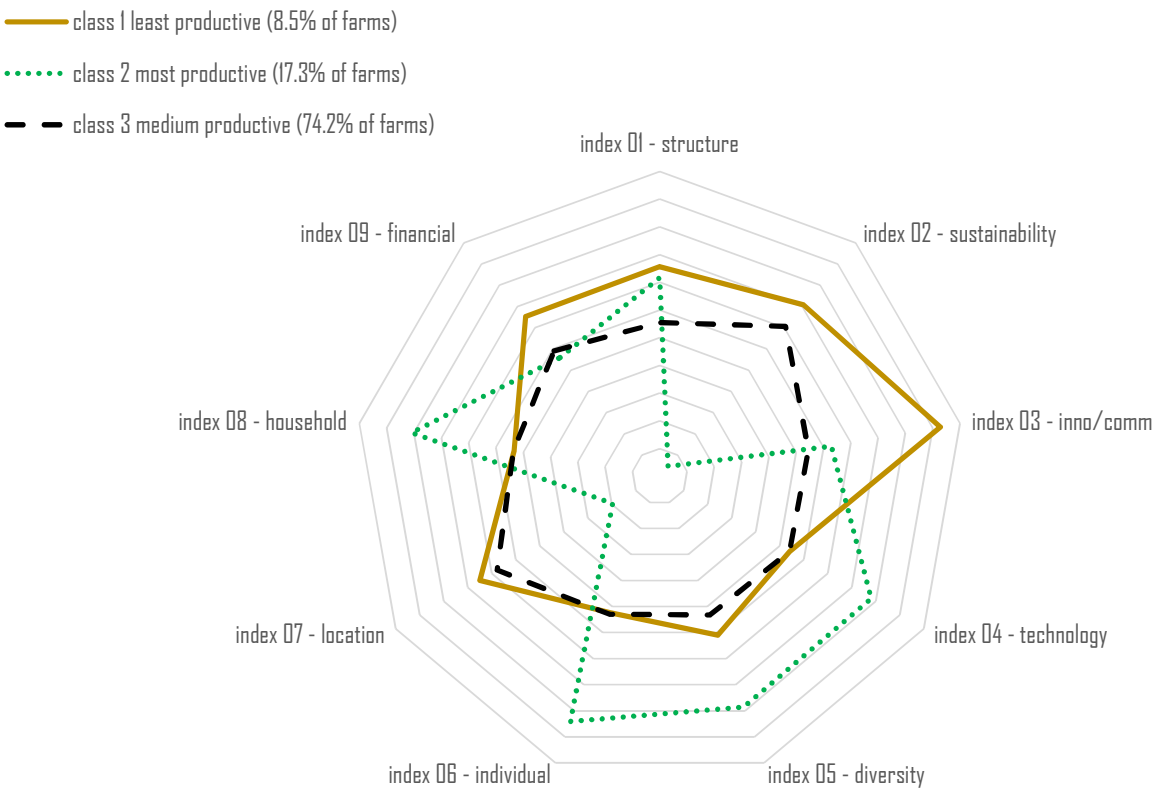




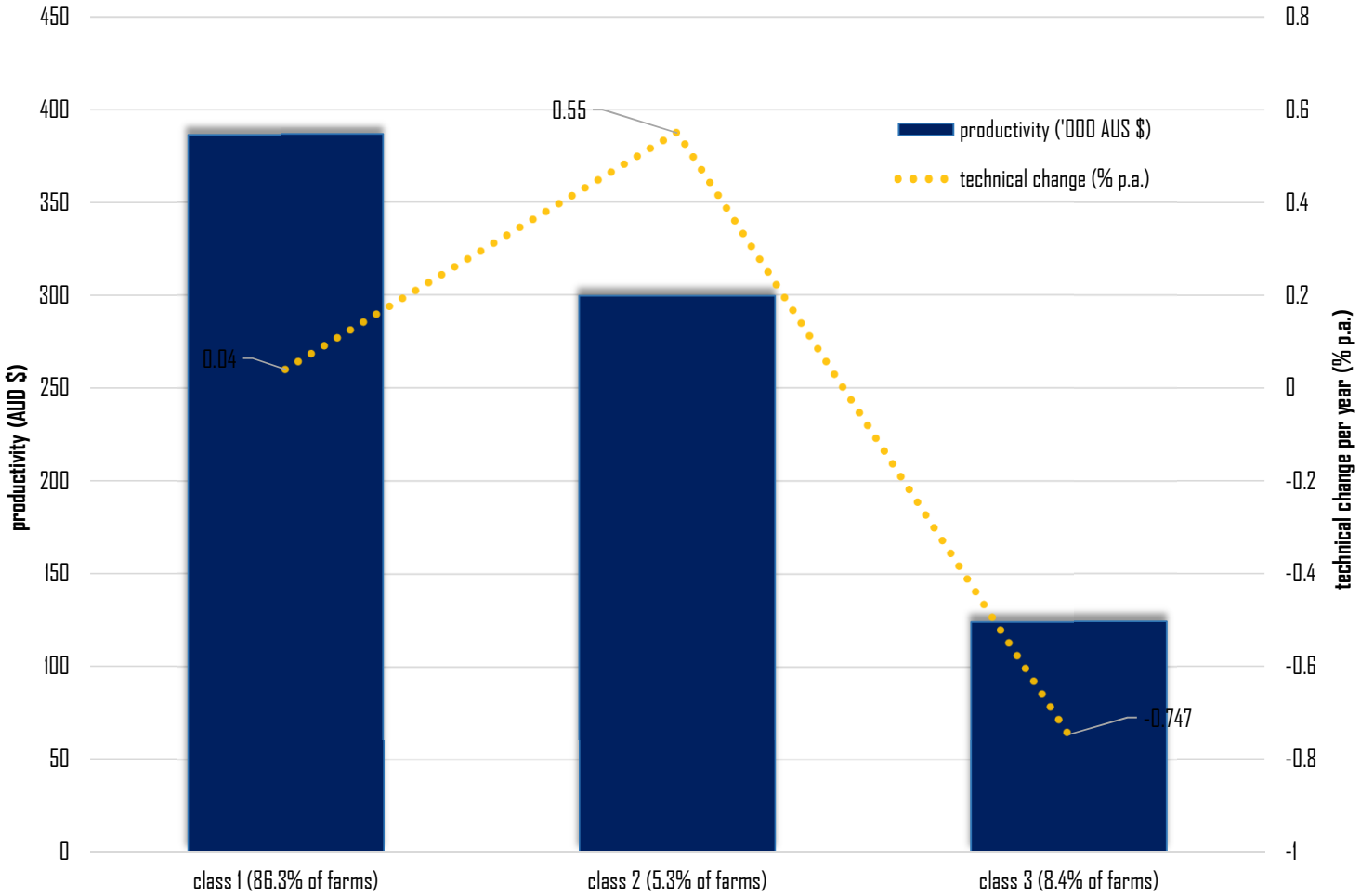


4 results - Australia - sheep|beef

Descriptives (at class mean)	class 1 (8.5% of farms)	class 2 (17.3% of farms)	class 3 (74.2% of farms)
index 01 - structure	0.3133	0.2333	-0.0903
index 02 - sustainability	0.4156	-1.1065	0.2111
index 03 - inno/comm	0.8566	0.0572	-0.1112
index 04 - technology	-0.1165	0.5623	-0.1181
index 05 - diversity	0.0020	0.0572	-0.0136
index 06 - individual	-0.1530	0.6820	-0.1419
index 07 - location	0.2986	-0.8074	0.1545
index 08 - household	-0.1328	0.6180	-0.1292
index 09 - financial	0.3054	-0.0812	-0.0159



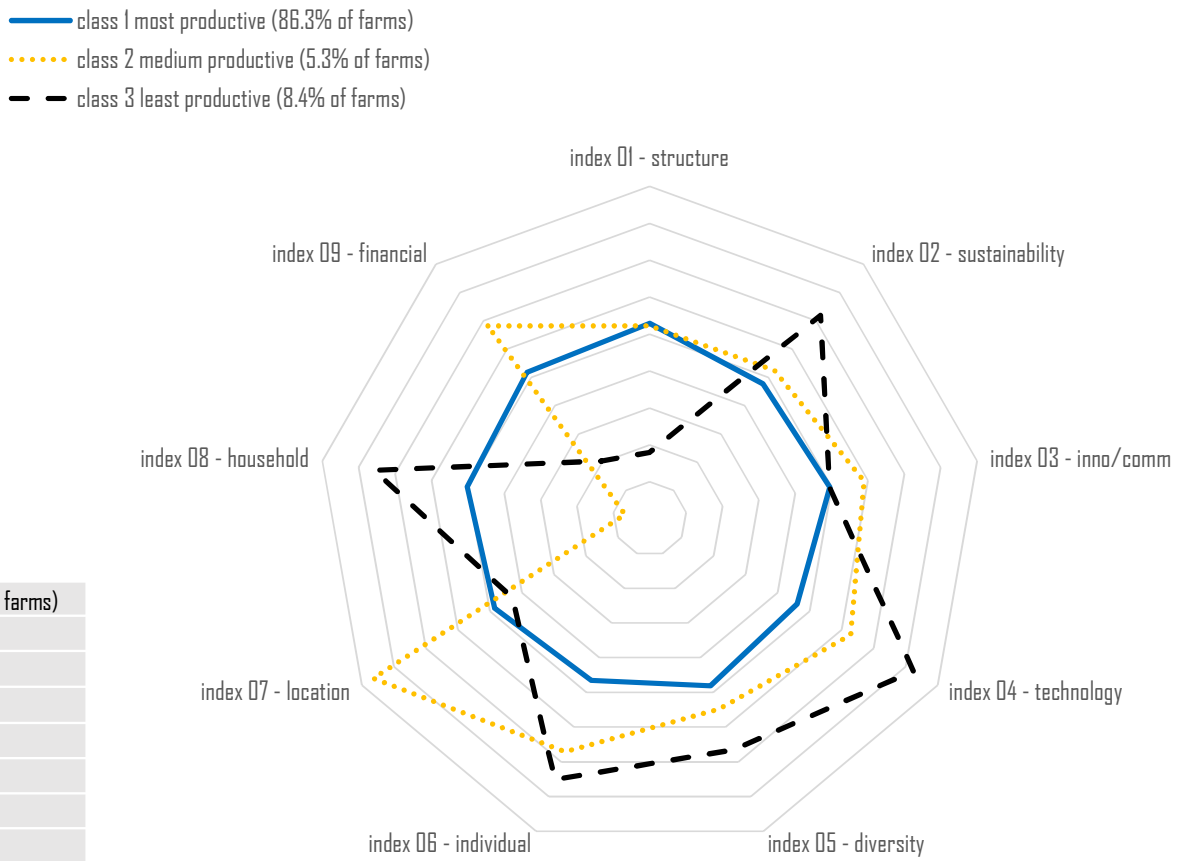
4 results - Australia - mixed







4 results - Australia - mixed



Descriptives (at class mean)	class 1 (86.3% of farms)	class 2 (5.3% of farms)	class 3 (8.4% of farms)
index 01 - structure	0.0296	0.0227	-0.3201
index 02 - sustainability	-0.0228	0.0248	0.2191
index 03 - inno/comm	-0.0496	0.8926	-0.0572
index 04 - technology	-0.0394	0.1284	0.3243
index 05 - diversity	-0.1901	0.4839	1.6521
index 06 - individual	-0.0349	0.1711	0.2514
index 07 - location	-0.0156	0.3642	-0.0717
index 08 - household	0.0017	-0.4317	0.2572
index 09 - financial	0.0175	0.1819	-0.2958

summary Australia

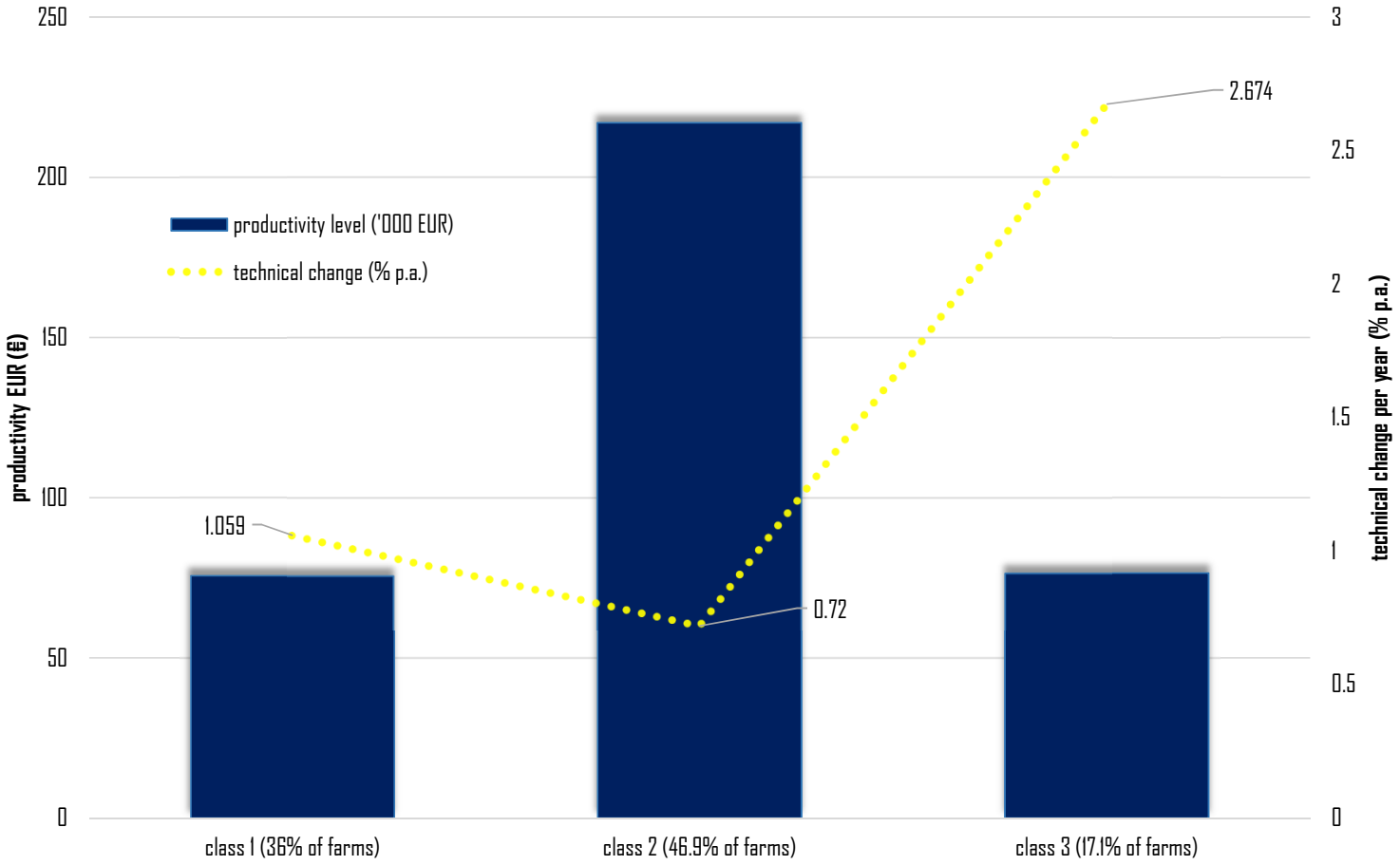
- **dairy** farms: most prod = most inno, least prod = most sust = smaller|more fam, no diff in techn & financial
- **crop** farms: more prod = less sust, more prod = more inno, more prod = larger | less fam | intensive
- **sheep meat** farms: more prod = more sust, less prod = smaller|more fam, no diff in inno
- **sheep wool** farms: more prod = more sust, more prod = smaller|more fam, more prod = less intens | inno
- **beef** farms: more prod = less sust, more prod = smaller|more fam, more prod = more inno
- **sheep|beef** farms: more prod = less sust, more prod = smaller|more fam, more prod = more intens
- **mixed** farms: more prod = less sust, more prod = smaller|more fam, more prod = less intens

overview - SE

- dairy farms: (1997-2017, 7729 obs, 3 classes, uneven distribution, significant performance differences)
- crop farms: (1997-2017, 3939 obs, 3 classes, uneven distribution, significant performance differences)

5 results - SE - dairy

OECD-FLA Network Project ‚Drivers of Farm Performance' 9-19



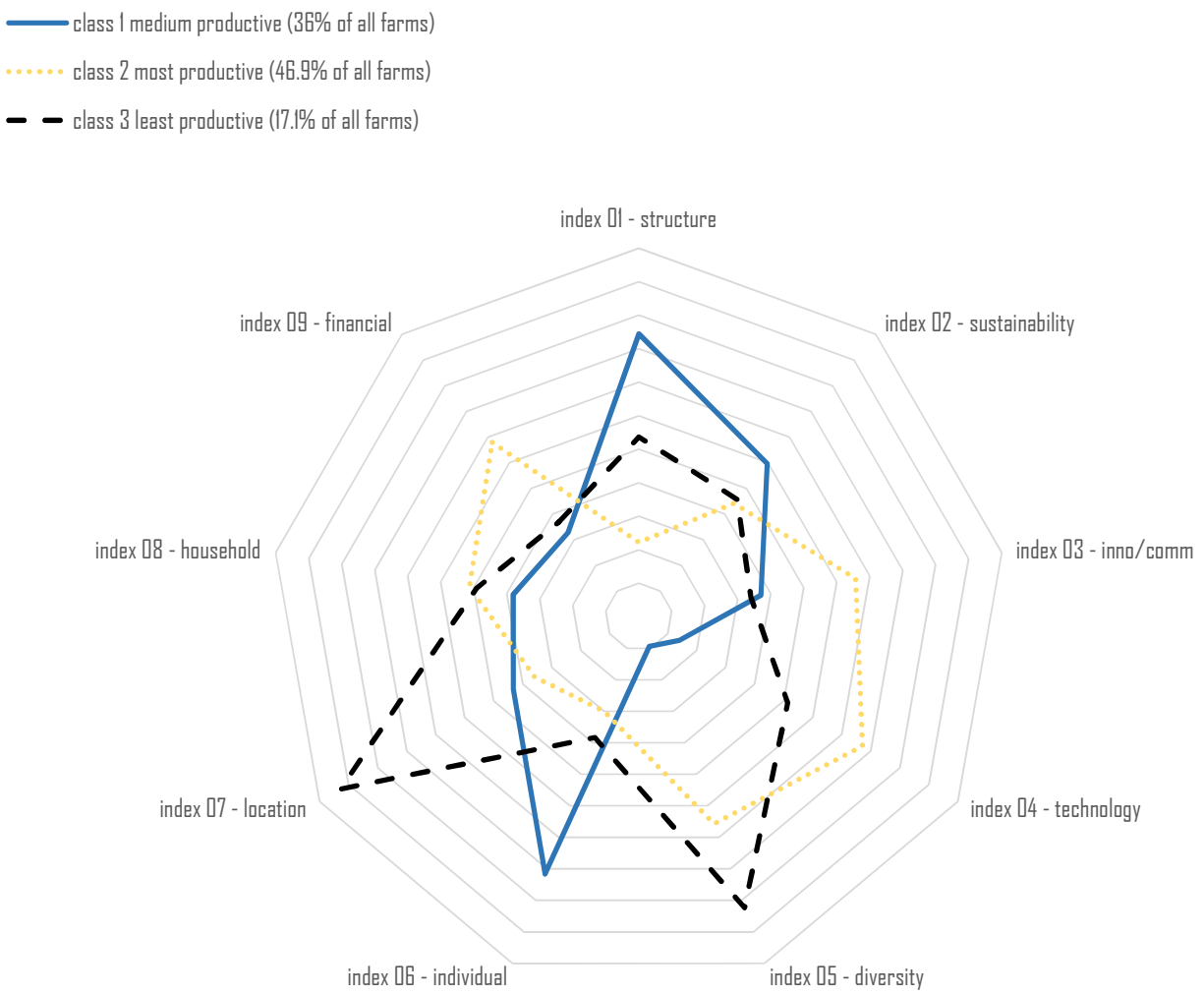




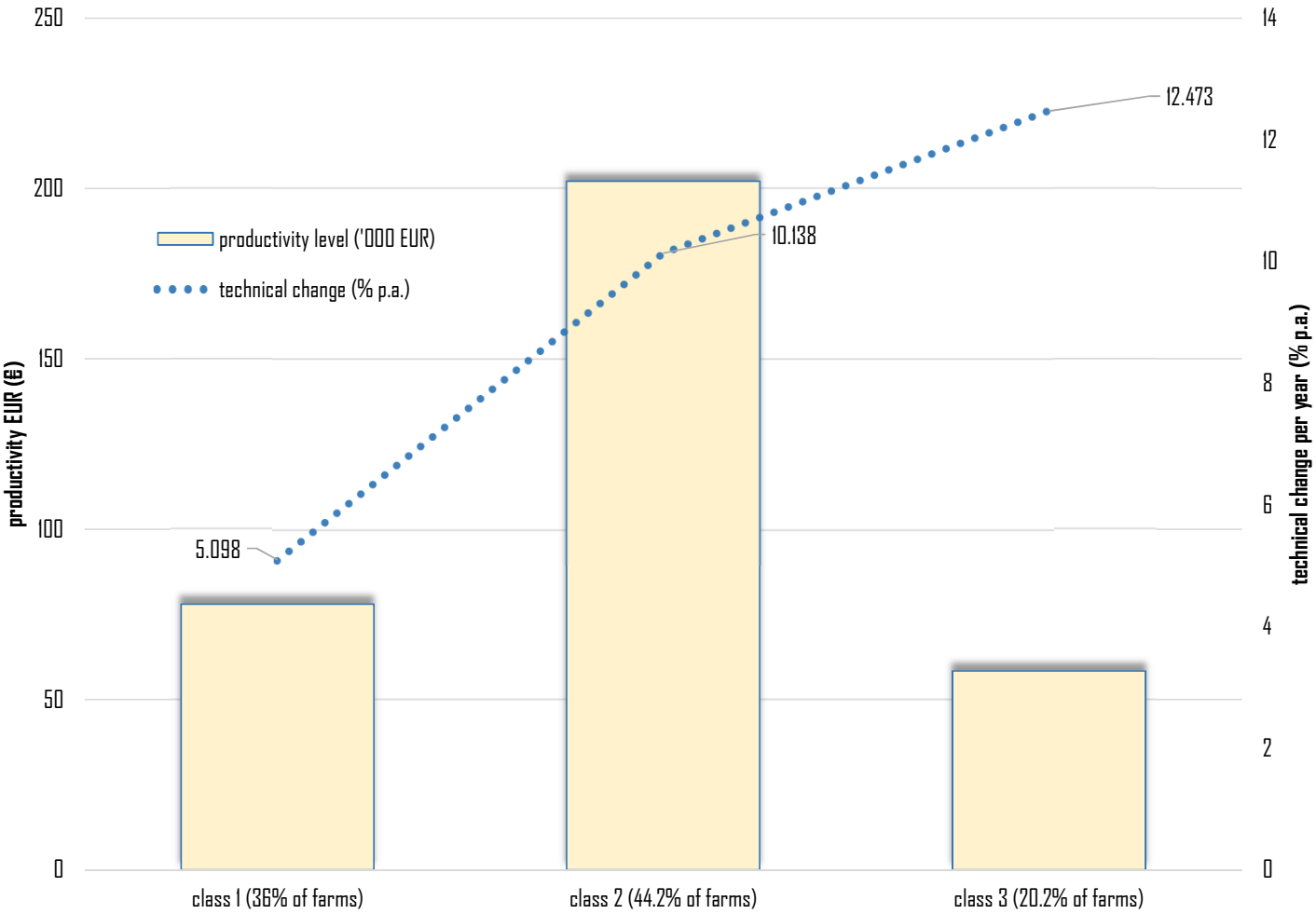
5 results - SE - dairy

OECD-FLA Network Project ‚Drivers of Farm Performance' 9-19

Descriptives	class 1 (36% of farms)	class 2 (46.9% of farms)	class 3 (17.1% of farms)
(at class mean)			
index 01 - structure	0.6886	-0.5555	0.0735
index 02 - sustainability	0.1928	-0.1166	-0.0856
index 03 - inno/comm	-0.2586	0.3157	-0.3199
index 04 - technology	-0.7195	0.5423	0.0272
index 05 - diversity	-0.8131	0.3138	0.8470
index 06 - individual	0.0633	-0.0400	-0.0234
index 07 - location	-0.1354	-0.2827	1.0553
index 08 - household	-0.2392	0.0260	-0.0178
index 09 - financial	-0.3440	0.3595	-0.2605



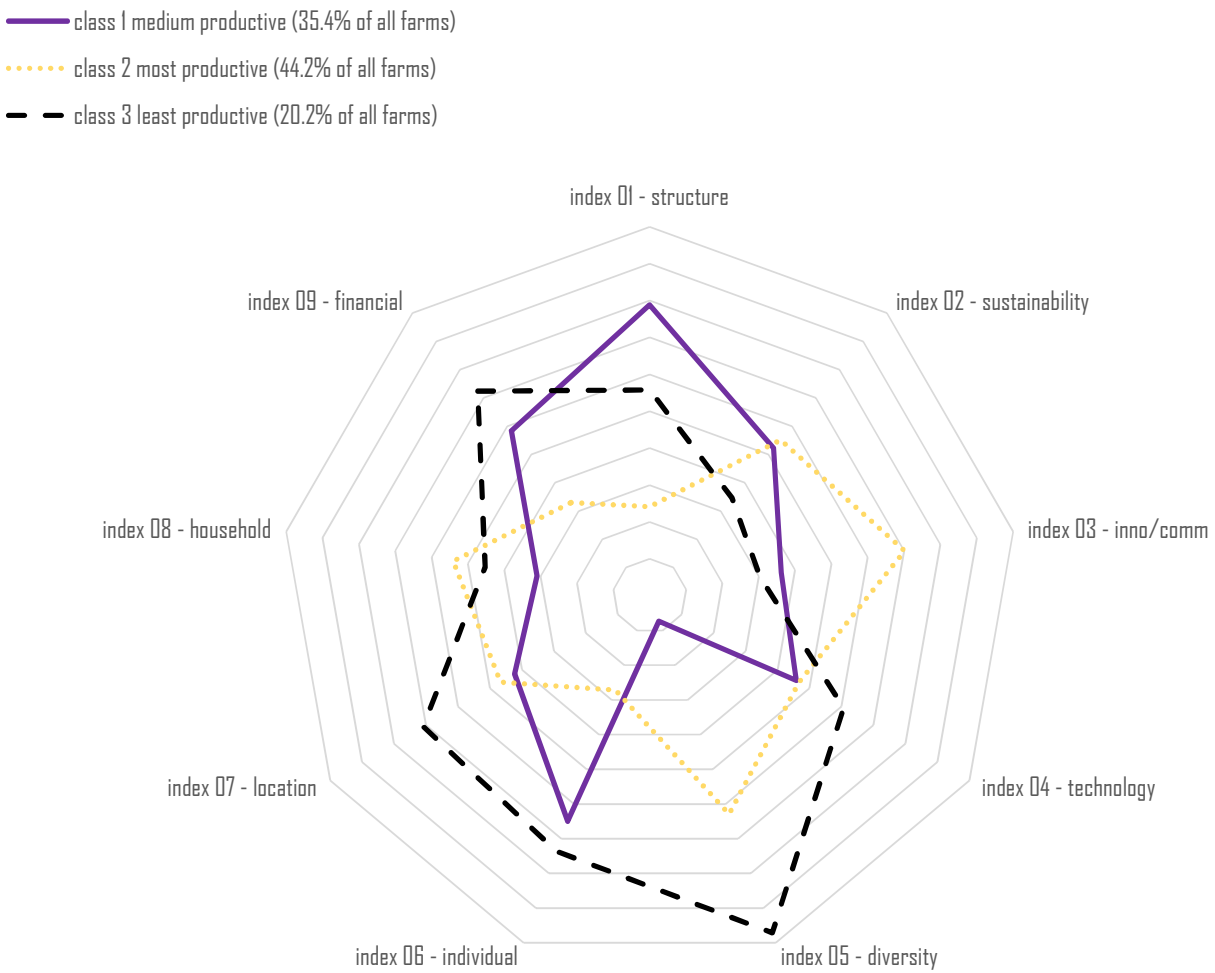
5 results - SE - crops





5 results - SE - crops

Descriptives	class 1 (36% of farms)	class 2 (44.2% of farms)	class 3 (20.2% of farms)
(at class mean)			
index 01 - structure	0.5767	-0.5173	0.1161
index 02 - sustainability	0.0449	0.1032	-0.3057
index 03 - inno/comm	-0.2762	0.4025	-0.3949
index 04 - technology	-0.0824	-0.0645	0.2133
index 05 - diversity	-0.8539	0.2580	0.9428
index 06 - individual	0.0300	-0.0457	0.0473
index 07 - location	-0.1538	-0.0663	0.4172
index 08 - household	-0.3795	0.0810	-0.0953
index 09 - financial	0.1664	-0.3388	0.4493



summary SE

- **dairy** farms: most prod = most inno, least prod = most sust = smaller|more fam, most prod = most intensive
- **crop** farms: most prod = larger/less fam, least prod = least sust, most prod = most inno

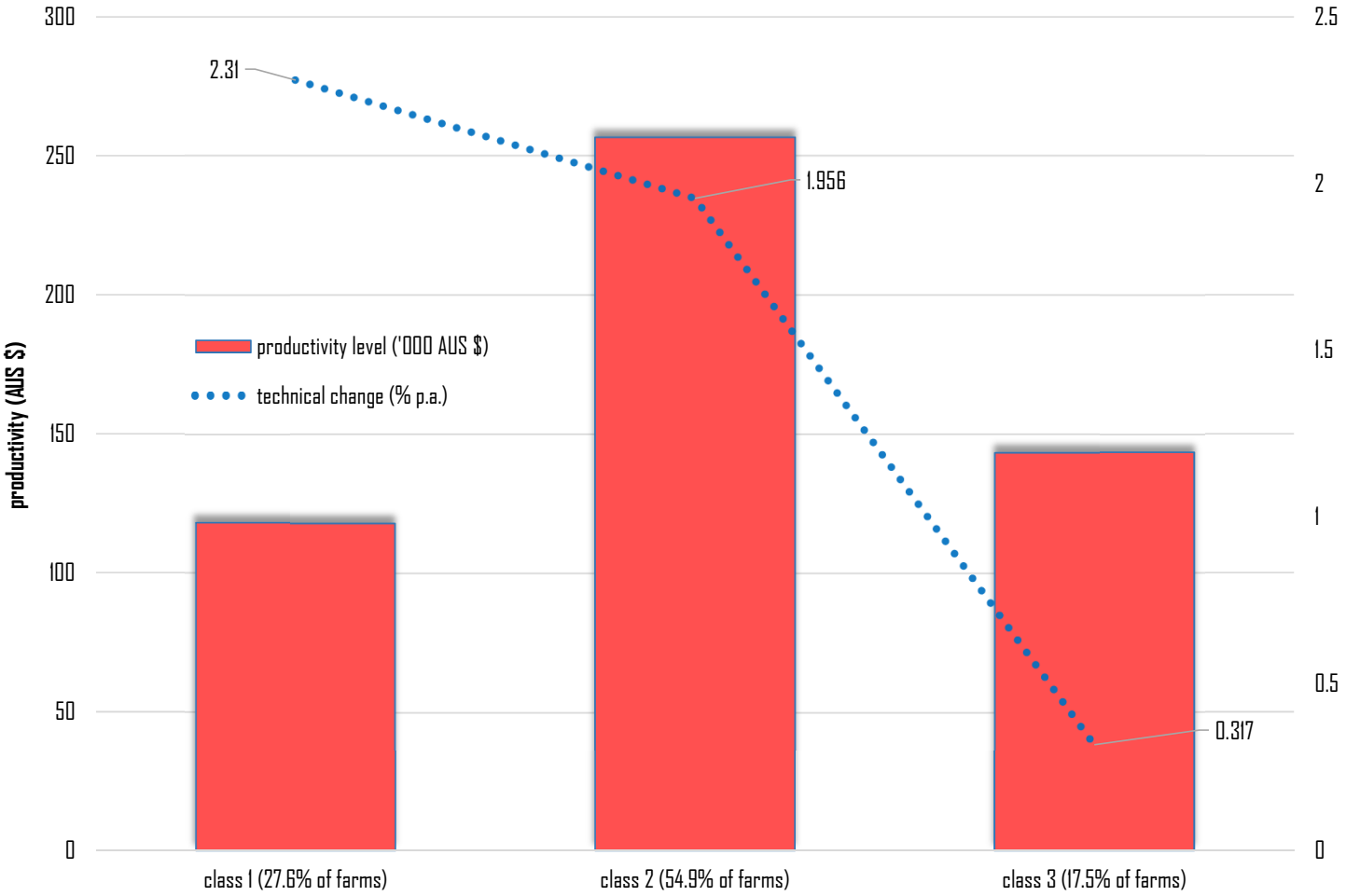
overview - UK

- dairy farms (1995-2017, 11333 obs, 3 classes, uneven distribution, significant performance differences)

- crop farms
- pig farms
- sheep farms

6 results - UK - dairy

OECD-FLA Network Project ‚Drivers of Farm Performance' 9-19

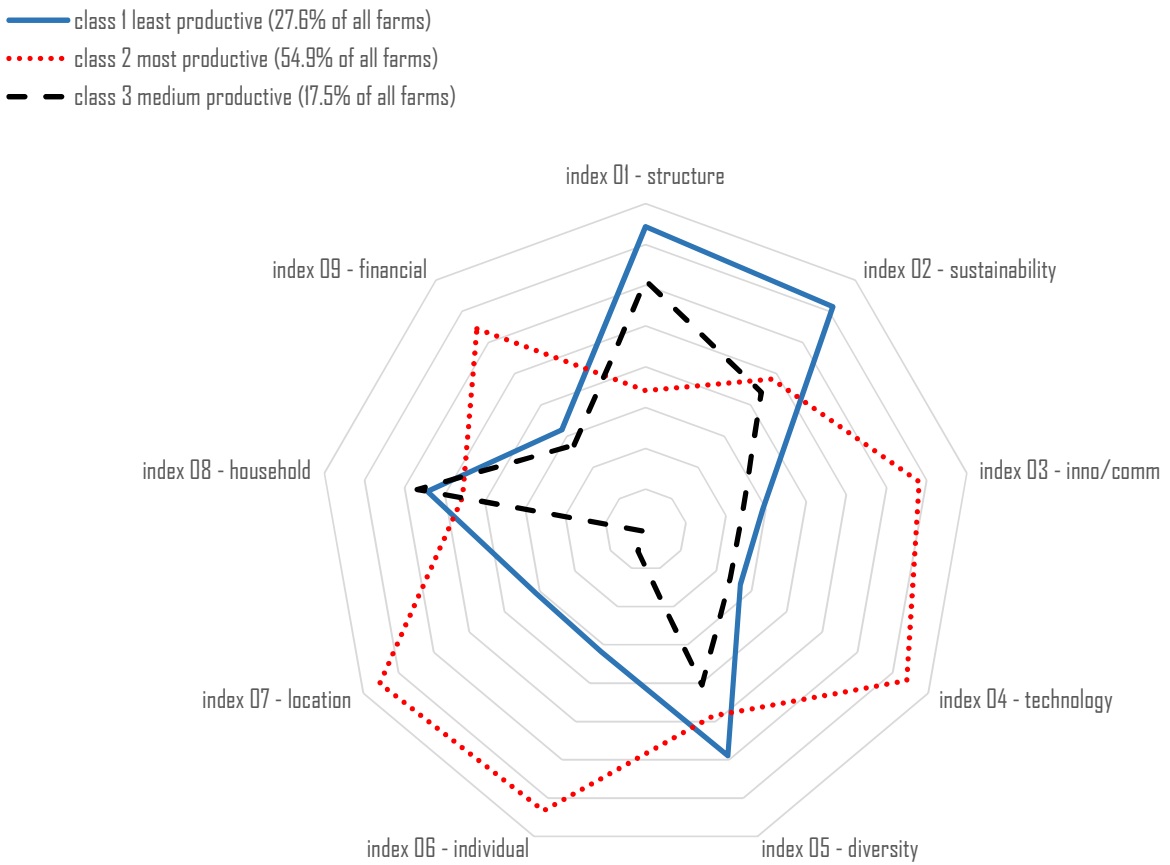






6 results - UK - dairy

Descriptives	class 1 least productive (27.6% of all farms)	class 2 most productive (54.9% of all farms)	class 3 medium productive (17.5% of all farms)
(at class mean)			
index 01 - structure	0.4878	-0.3166	0.2239
index 02 - sustainability	0.4292	-0.0346	-0.1172
index 03 - inno/comm	-0.4167	0.3625	-0.5173
index 04 - technology	-0.4642	0.4791	-0.5218
index 05 - diversity	0.1787	-0.0291	-0.1904
index 06 - individual	-0.3637	0.4662	-0.8886
index 07 - location	-0.3790	0.5056	-0.9882
index 08 - household	0.0864	-0.0873	0.1377
index 09 - financial	-0.3598	0.2879	-0.4557



summary UK

- **dairy** farms: most prod = most inno, least prod = most sust = smaller|more fam, most prod = most intensive

- **crop** farms: ..
- **pig** farms: ..
- **sheep** farms: ..

overall summary …

- **dairy farms**: (1) trade-off productivity – sustainability, (2) positive correlation productivity & innovativeness,
  (3) family-oriented & smaller farms are less productive

- **crop farms**: (1) no trade-off productivity – sustainability, (2) positive correlation productivity & innovativeness,
  (3) family-oriented & smaller farms are less productive

- **livestock farms**: (1) trade-off productivity – sustainability for beef | not for sheep,
  (2) mixed evidence for productivity & innovativeness,
  (3) family-oriented & smaller farms are more productive (not for sheep meat)

- previous results are largely confirmed

current work

	Crop farms	Dairy farms	Pig farms	Sheep farms
France				
United Kingdom				
Ireland				

- estimates for UK crop/pig/sheep, F dairy/crop/pig/wine(?), Irl dairy/crop/pig
- refinement of quantitative results & interpretation of implications
- OECD report sections for OECD APM Mar 20
- ABARES policy brief (WC work visit Munich)
- 1-3 peer-reviewed papers (1: prod-sust trade-off in livestock farming, 2: dairy or sheep in more depth)
- conceptualize phase II

8 plans phase II

OECD
Organisation for Economic Co-operation and Development

TAD/CA/APM/WP(2019)21

For Official Use — English - Or. English

3 May 2019

TRADE AND AGRICULTURE DIRECTORATE
COMMITTEE FOR AGRICULTURE

Working Party on Agricultural Policies and Markets

Farm Performance Dynamics and Policy Effects

Scoping paper

27-28 May 2019
OECD Conference Centre
Paris, France

This scoping paper is presented for DISCUSSION under Item 12 of the Draft Agenda of the 77th session of the Working Party on Agricultural Policies and Markets, held on 27-28 May 2019.

Contact: Catherine Moreddu (Catherine.moreddu@oecd.org).

JT03447070

phase II

OECD, scoping paper May 19:

„Based on the estimated farm technology classes for various production types and countries, the proposed work would consist of the following components that are of high policy relevance:

1) the identification, description and evaluation of essential characteristics of farms and their respective technologies in each class;

2) the systematic analysis of farms' class membership over time, its dynamics and potential significant class switching patterns;

3) the evaluation of significant drivers for class switching patterns with a strong focus on the potential **effect of policy measures**; and

4) the **identification of effective and efficient policy measures** to increase the probability of farms' switching to more productive, sustainable and innovative technologies.

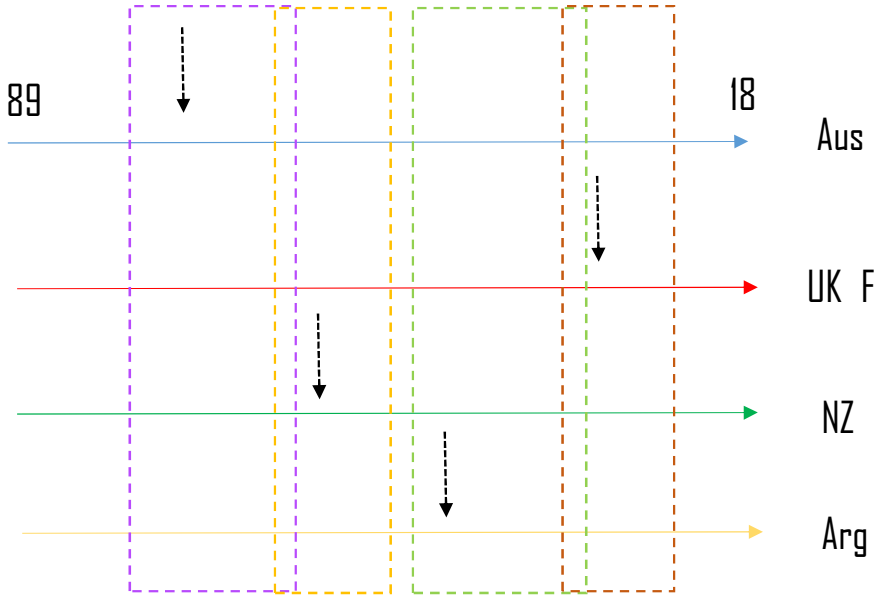
The proposed analyses will be exemplary applied on representative country cases covering relevant production types (i.e. dairy, arable, and pig production) in line with previous work. The choice of representative countries will be conditional on data availability, policy relevance and quality of statistical estimates resulting from the completion of the current project phase."

Australia, UK, France … NZ, Argentina …

phase II

- e.g. dairy | beef | sheep:
  - impact of deregulation policy on farm performances
  - impact of policy process on farm performances
  - with/without & before/after… (diff-in-diff, psm, me…)
- steps, timing, outcome
- budget: oecd - plus country contributions needed:

  „While this work is part of the PWB, financial contributions from countries would be most welcome to increase the number of country cases and allow for a better coverage of diversity."
- work stay JS at ABARES in 2-3/20 (work, travel, subs costs)
- resources request AUS, UK, F others?



Final notes

To thank: TMAD, ABARES farm survey team
DEFRA, Jordbruksverket

