Producer Engagement in Research Funding

IHARF Soil and Crop Management Seminar

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CAIRN
AN ERCA RESEARCH NETWORK

Outline

- The producer returns to research
- Sources of research investment
- Models for funding elsewhere
- Options for funding crop research in Canada

Measuring the Returns to Research

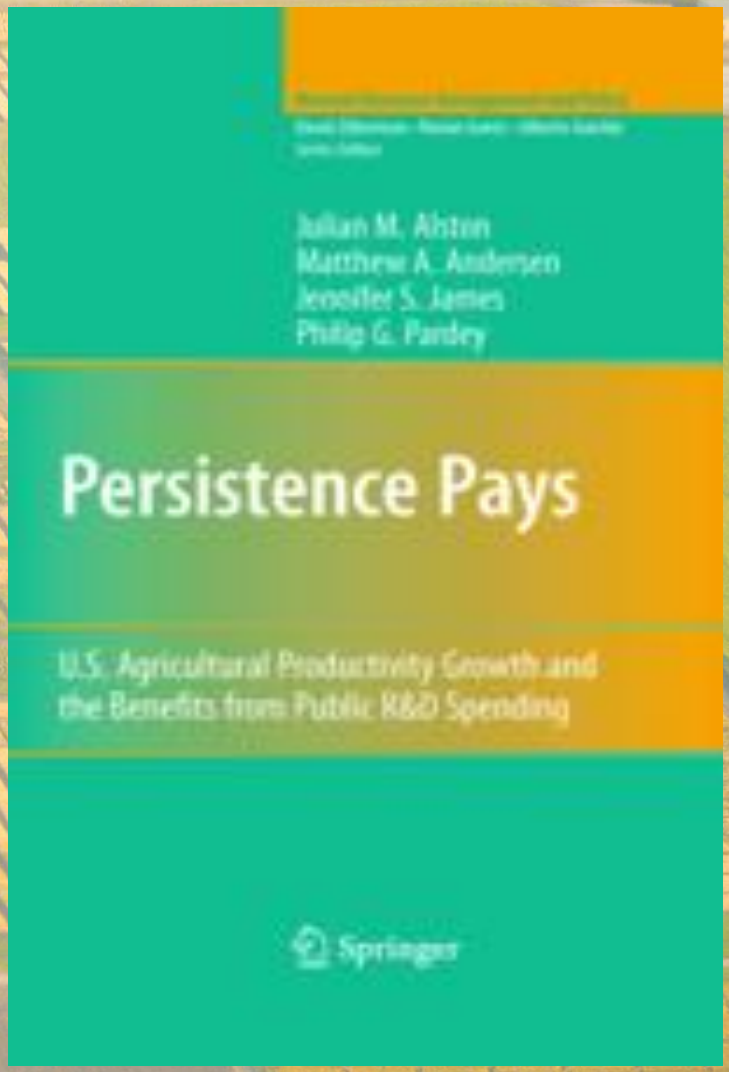
- Present Value recognizes that "time is money"
  - Getting a dollar today is worth more that getting the dollar a year or five years from now. A 5% discount rate is used in most studies
- Benefit Cost Ratio = PV Benefits/PV Costs
- A B/C equal to 1:1 implies a 5% rate of return
- A B/C ratio of 2:1 is a very good investment

Other Evidence

Persistence Pays: U.S. Agricultural Productivity Growth and the Benefits from Public R&D Spending.

J.M. Alston, M.A. Andersen, J.S. James, and P.G. Pardey

Springer, January 2010



Marginal Returns to U.S. Public Agricultural R&E

Returns to	Benefit-Cost Ratio (3% real discount rate)	
	Own-State	National
	ratio	
State R&E		
48-State Average	**21.0**	**32.1**
48-State Minimum	**2.4**	**9.9**
48-State Maximum	**57.8**	**69.2**
USDA Research		**17.5**

Source: Persistence Pays – Alston et al. 2010

The Returns to WGRF cereal research 1994-2030

Varietal Type/Class	Benefit/Cost Ratio	Internal Rate of Return %
All Wheat	20.40	36%
CWRS	31.13	42%
CWHW	2.22	
CWAD	35.91	44%
CPS	-	
CWES	0.22	
CWRW	1.26	
CWSWS	28.42	
All Barley	7.56	28%
2-R Malt	6.51	26%

Source: Gray, Nagy, Guzel (2012)

The Returns to Zero Tillage Research

- Awada, Gray and Nagy 2015 (Canadian Journal of Agricultural Economics

Benefits from Zero Tillage Adoption on the Prairies 1985-2012 (Million $2010)

Variables	Alberta	Saskatchewan	Manitoba	Total Prairies
Onsite Benefits				
Short Run Benefits				
· Reduced machinery Cost	393.00	668.42	158.54	1,229.96
· Reduced labour Cost	141.96	241.45	57.27	440.68
· Reduced fuel Cost	367.19	715.28	127.08	1,209.55
· Reduced other inputs Cost	49.14	56.15	19.00	124.29
· Increased production-reduced fallow	1,858.18	3,802.95	269.82	5,930.95
Total Short Run Onsite benefits	**2,809.47**	**5,484.25**	**631.71**	**8,925.43**
Long Run Benefits				
· Reduced Wind Erosion	147.29	346.07	67.96	561.32
· Increasing Soil Organic Matter	1,139.99	2,212.37	352.09	3,704.45
· Reduced Soil salinity	38.34	87.82	8.92	135.08
· Increased Production (soil quality)	1,233.07	2,940.83	450.49	4,624.39
Total Long Run Onsite benefits	**2558.69**	**5587.09**	**879.46**	**9025.25**
Total Onsite Benefits	**5,368.16**	**11,071.34**	**1,511.17**	**17,950.70**
Offsite Benefits				
1. Reduced Carbon Dioxide				
Soil carbon sequestration	223.48	415.10	62.34	700.92
Fuel emission reduction	14.12	28.01	4.12	46.25
2. Reduced NO_x	5.66	8.54	2.30	
Total Offsite Benefits	**243.27**	**451.65**	**68.76**	**763.67**
Total Zero Tillage benefits	**5,611.43**	**11,522.99**	**1,579.93**	**18,714.37**

Present Value RD&E Expenditure on Zero Tillage Projects 1960-2009 (Million $2010)

Sources of Funds	Zero Tillage RD&E projects	General RD&E	Data Source/Total
	($Millions)	($Millions)	
Public Sector			
Federal Institutions	26.232	12.678	ICAR
Federal tax credit	4.044		Private Machinery Firms
Provincial Institutions			
• Saskatchewan	16.645	0.409	ICAR; ADF; SSCA
• Alberta	3.623	0.694	ICAR; ACTS
• Manitoba	1.084	0.168	ICAR; ManDak
Universities	0.583	0.515	ICAR
Public – Private Sector[a]:			
Public/NGOs/Private	1.879	2.848	ICAR
Total Public Expenditures	**$54.089**	**$17.312**	**$71.401**
Private Sector	**$56.745**		Private Machinery
Total RD&E Expenditure	**110.834**	**17.312**	**128.146**

PV Benefits from Zero Tillage RD&E on the Prairies 1985-2012 (Mil. $2010)

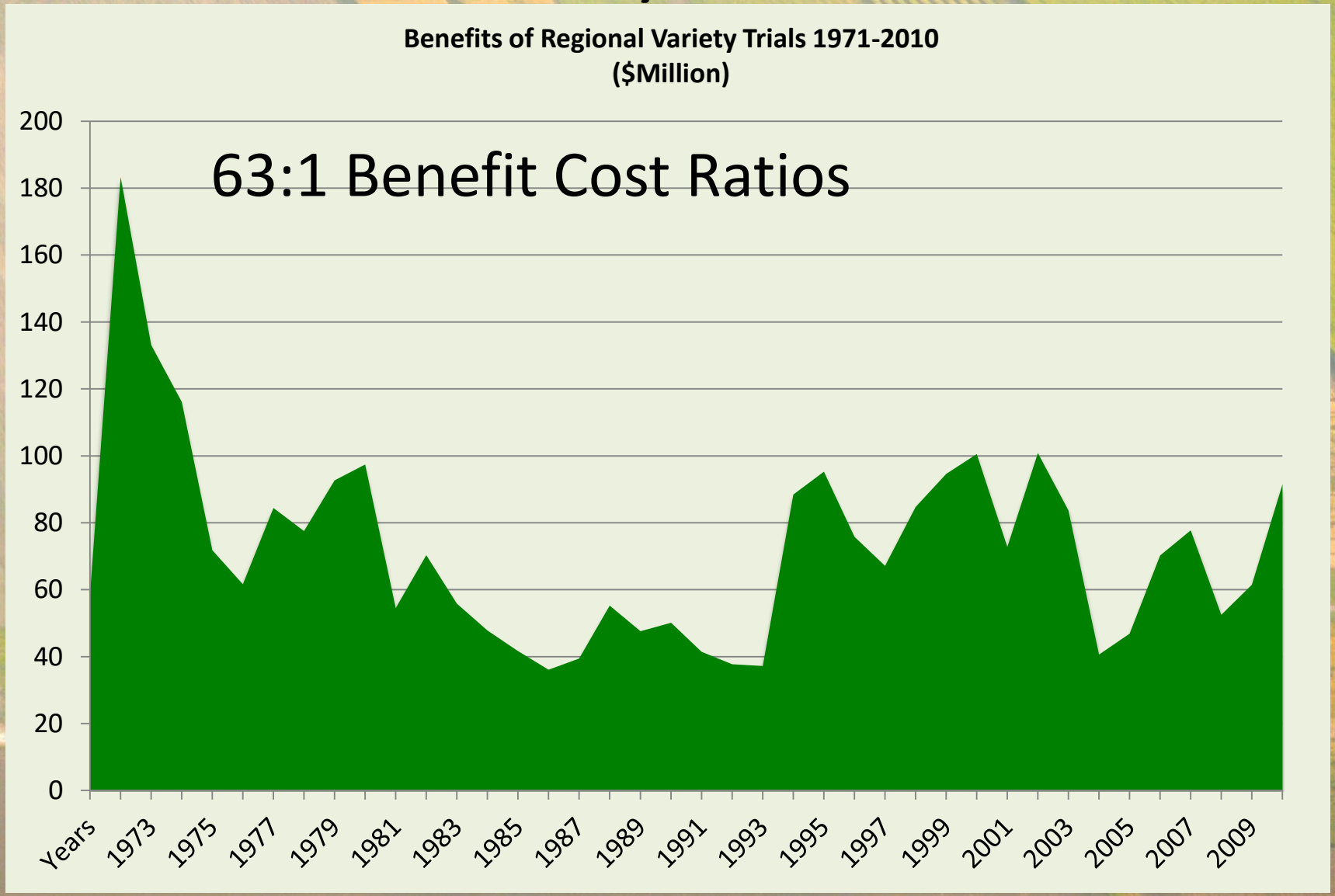
Variables	5 year delay counterfactual Base Case Scenario	2 year delay counterfactual Scenario 1	10 year delay counterfactual Scenario 2
Onsite Benefits			
Short Run Benefits			
a) Reduced machinery Cost	474.6	199.1	765.4
b) Reduced labour Cost	171.4	71.9	276.5
c) Reduced fuel Cost	431.2	180.5	695.2
d) Reduced other inputs Cost	40.3	21.5	98.8
e) Increased Production (fallow)	3,282.2	960.9	7,459.5
Total Short Run Onsite benefits	**4,399.8**	**1,433.9**	**9,295.3**
Long Run Benefits			
a) Reduced Wind Erosion	196.0	78.6	330.9
b) Increasing Soil Organic Matter	1,673.8	689.0	2,630.4
c) Reduced Soil salinity	39.5	16.1	65.2
d) Increased Production (soil quality)	1,173.5	450.4	1,959.2
Total Long Run Onsite benefits	**3,082.8**	**1,234.1**	**4,985.8**
Total Onsite Benefits	**7,482.5**	**2,668.0**	**14,281.1**
Offsite Benefits			
a) Reduced Carbon Dioxide			
Soil carbon sequestration	298.6	118.1	472.2
Fuel emission reduction	14.1	5.7	23.8
b) Reduced NO_X	6.7	2.6	10.5
Total Offsite Benefits	**319.4**	**126.3**	**506.6**
Total Zero Tillage benefits	**7,802**	**2,794.3**	**14,787.6**

Source: Awada, Gray and Nagy, 2015)

The Benefit-Cost Ratios for ZT RD&E

Benefits to:	Source of RD&E Funds	B/C 5-years Base case Scenario
Agricultural sector	Public	**109.3**
Agricultural sector	Public + Private	**60.8**

Benefits of Regional Variety Trials
Calen Covey M.Sc. 2012



SPG Pulse Research (1984- 2024)

	Genetics Research	Development Acceleration	Total Impact
Producer Ben/Cost	27.81	15.77	20.19
Producer IRR	39.5%	40.4%	
Industry Ben/Cost	26.91	23.29	24.6

Source: Gray, Galusko, Nagy and Weseen, 2008

The Underfunding of Research is Problem #1

- High B/C ratios indicate many lost opportunities
- research can increase economic growth while addressing food security
- We can learn from other *Agricultural Knowledge Systems*

Three Sources for Research Funding

- Public (government)- taxes
- Industry (producer)- check-offs
- Private (investor owned firms)- technology sales royalties

- Stronger property rights are needed to stimulate private investment…especially in wheat barley and oats

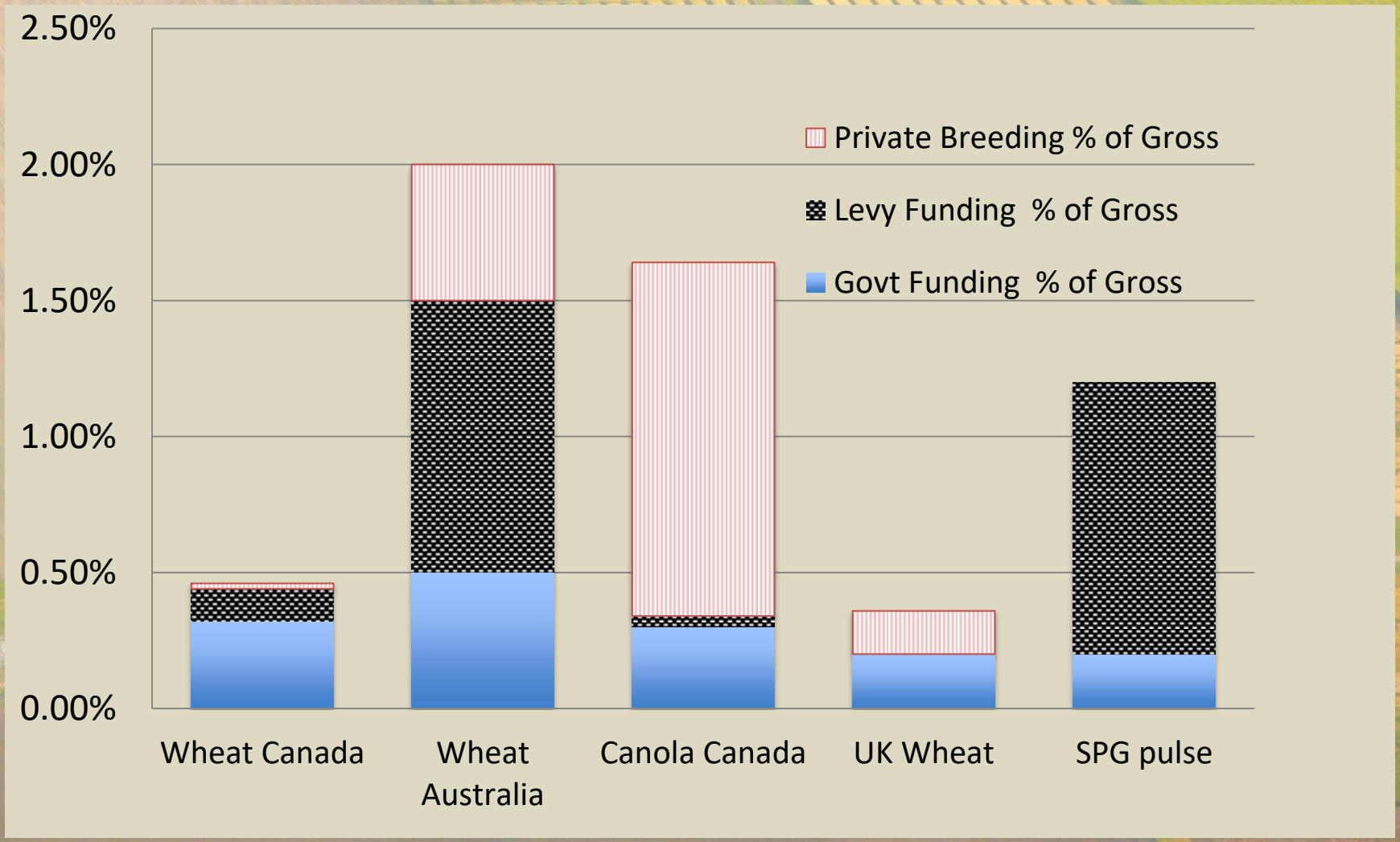
Table 1: Estimated Spending on Variety Development by Crop Kind

Item	Units	Wheat	Barley	Canola	Corn	Soybeans
Expenditures on Variety Development	*million*	**46.1**	**10.0**	**64.8**	**16.5**	**9.6**
Private (Via CSTA)	*million*	6.2	1.7	64.8	16.5	9.6
Producer	*million*	6.2	1.4			
Public (Government and Universities)	*million*	33.7	6.9			
Farm cash receipts (2013 & 2014 average)	*million*	5,628	684	7,635	2,231	2,337
Expenditures per 1 of cash receipts	*%*	0.8%	1.5%	0.8%	0.7%	0.4%
Acreage (2013 to 2015 average)	*million acres*	27.5	6.4	20.3	3.4	4.5
Expenditures/acre	*/acre*	1.67	1.27	4.18	1.32	1.83
Seed purchases (sales by seed companies)	*million*	181	51	1,219	371	364
Expenditures per 1 of Seed Sales (purchases)	*%*	25.5%	19.6%	5.3%	4.4%	2.6%
Seed purchases as a % of cash receipts	%	3.4%	7.4%	16.0%	16.6%	16.6%

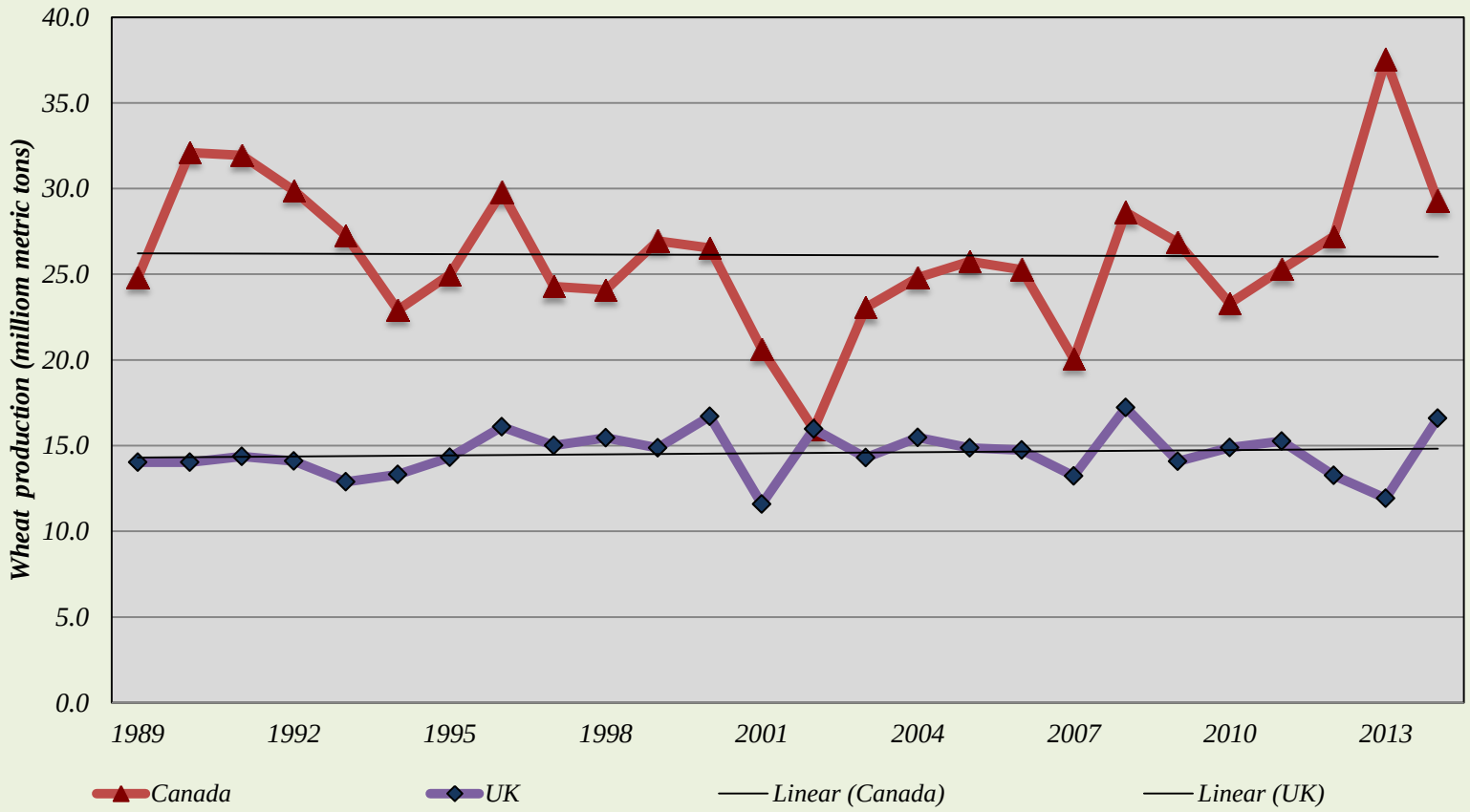
The Agricultural Growth Act 2015

- The Act provides stronger plant breeders rights
- Consistent with the international UPOV 1991 that Canada signed in 1991
- It could be used to increase royalty income for crops if producers and the industry develop a system for end point royalty collection
- This has been done in France and Australia

Approximate Crop Research % of Gross Selected Crops 2010



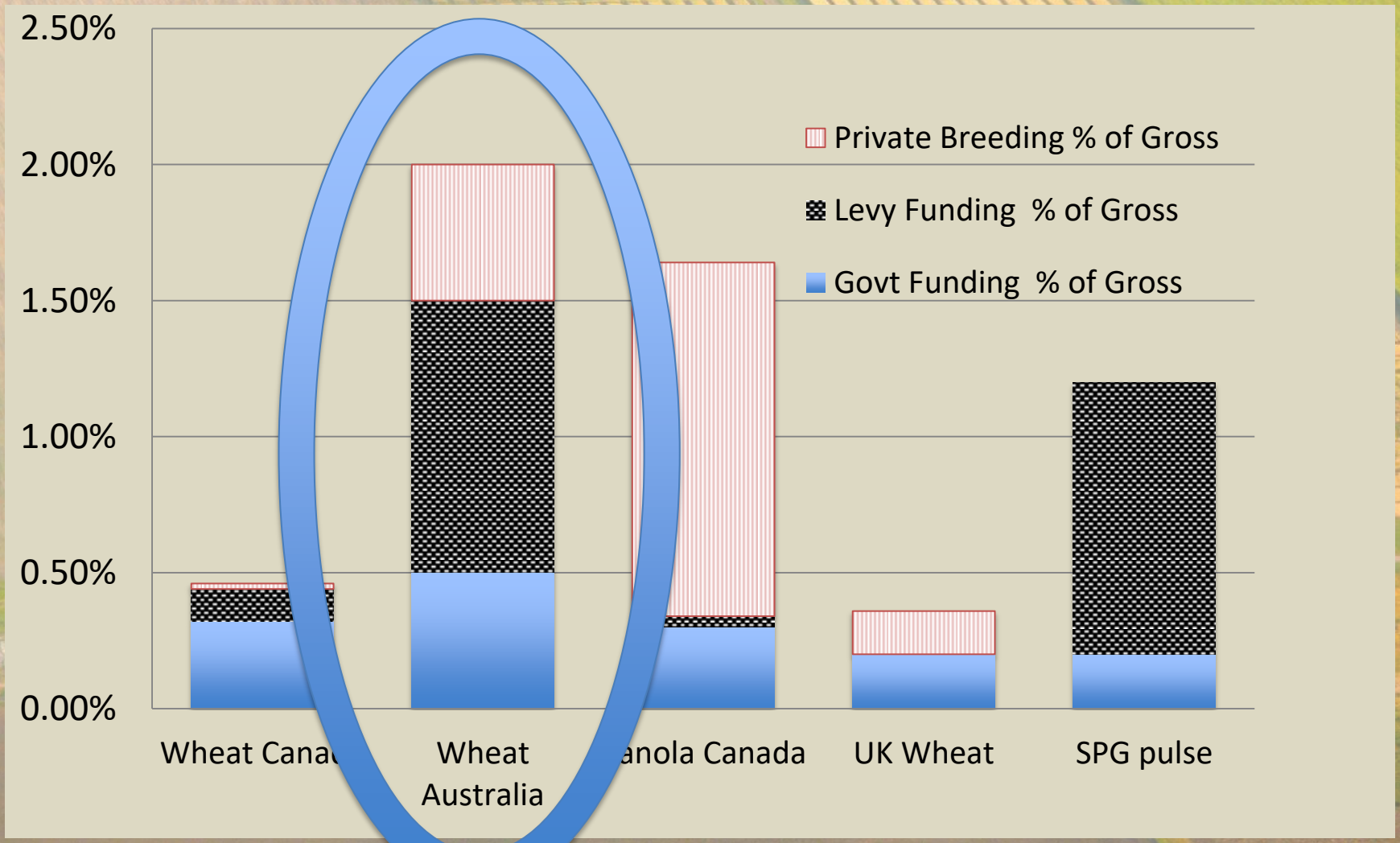
Canadian and UK wheat production 1989-2014
Source: FAOSTATS



Avoid the UK wheat model

- IPRs are too weak - 53% of average royalty paid on saved seed, which also limits royalties
- $27 million revenue is split between six very small breeding programs with little or no private upstream research
- 15 year gap in partnership with public research
- “the get out of the way and they will come” approach did not work well – several elements were missing

Approximate Crop Research % of Gross Selected Crops 2010



Australia's balanced approach

- Matched (1% + .5 %) (non- refundable) check-off funding of Gross industry sales for 27 grains
- GRDC became the driver of the whole system
- Continued public support for basic research
- Strong IPRs and creation of three breeding firms with private-producer-public shareholders

End Point Royalties

- *End Point Royalties (EPRs)* collected on the sale of harvested grain
- This reduces producer risk
- Full royalties even with farm saved seed
- *EPRs* are now generating enough revenue to support breeding firms but it took 15 years to get there

Aussie Wheat PPPPs

Australian Grain Technologies Pty Ltd (2002)-

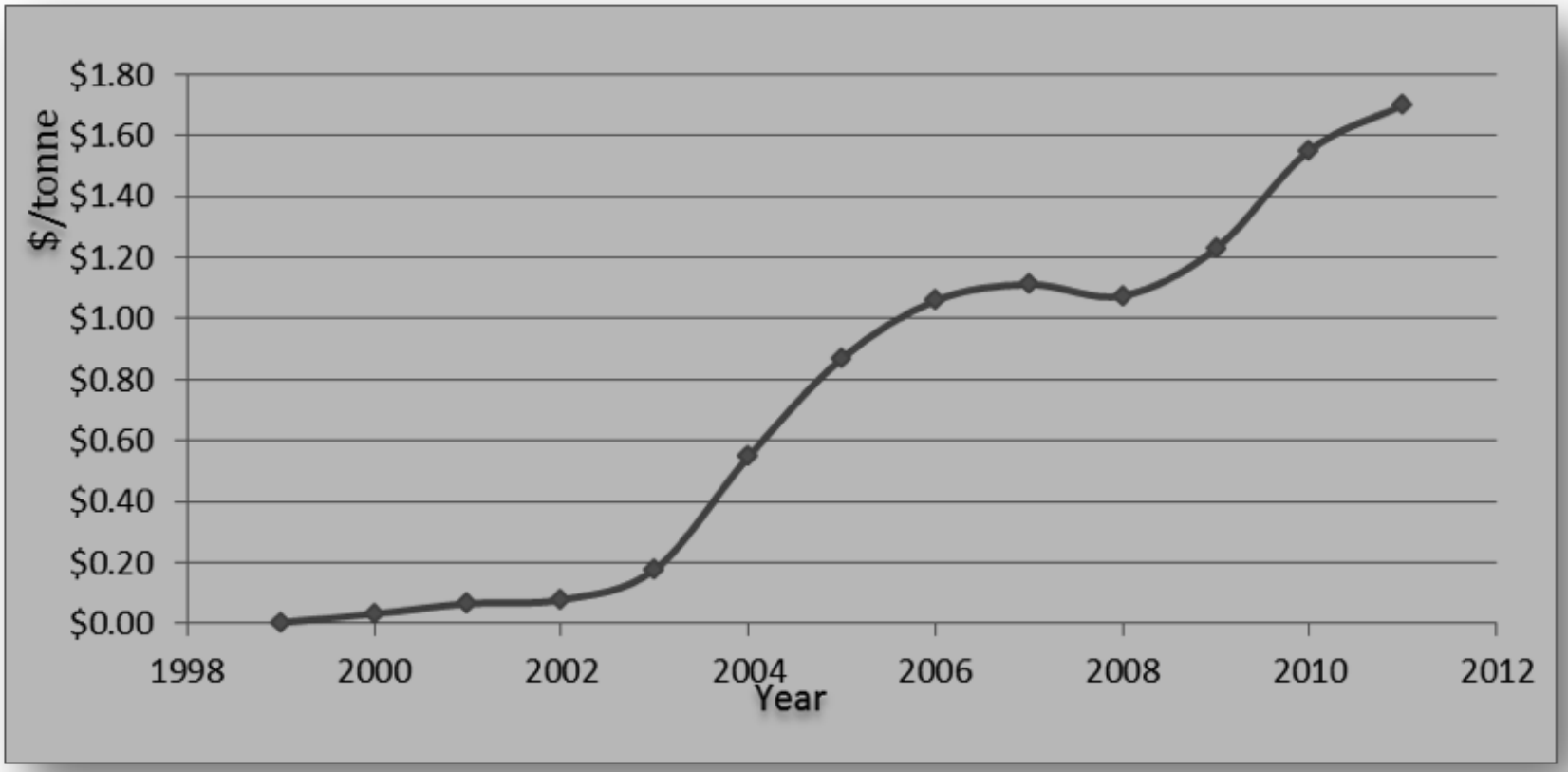
- 48% of wheat market share
- Mace wheat variety is dominant
- Scepter 2016 – 7% higher yielding than Mace
- The dominant breeder

InterGrain Pty Ltd (2007)

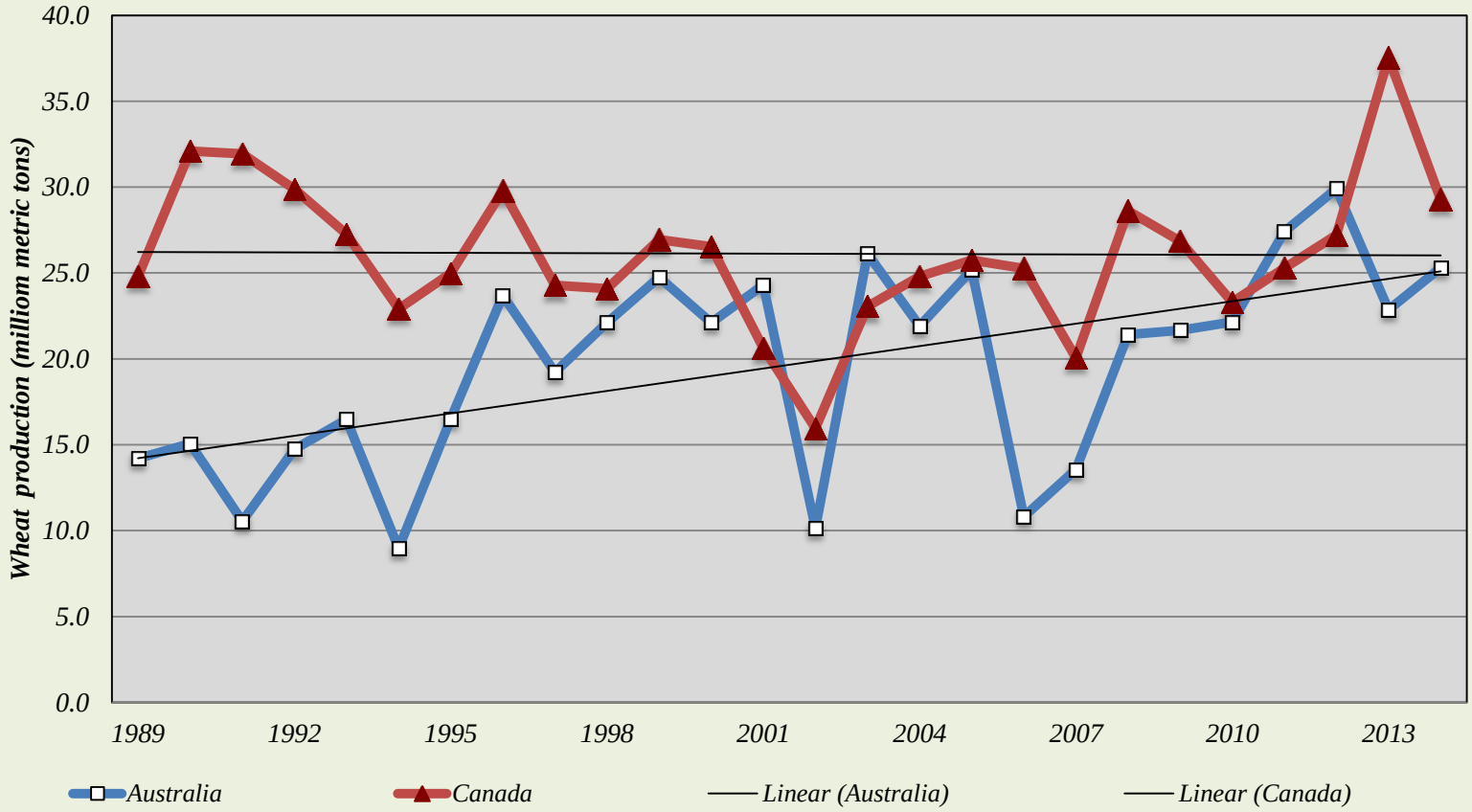
- high market share in noodle wheats,
- small overall -$5 M/yr loss

HRZ Wheats Pty Ltd (2003)

Average End point royalty rates ($/t) Western Australia 1998-2012



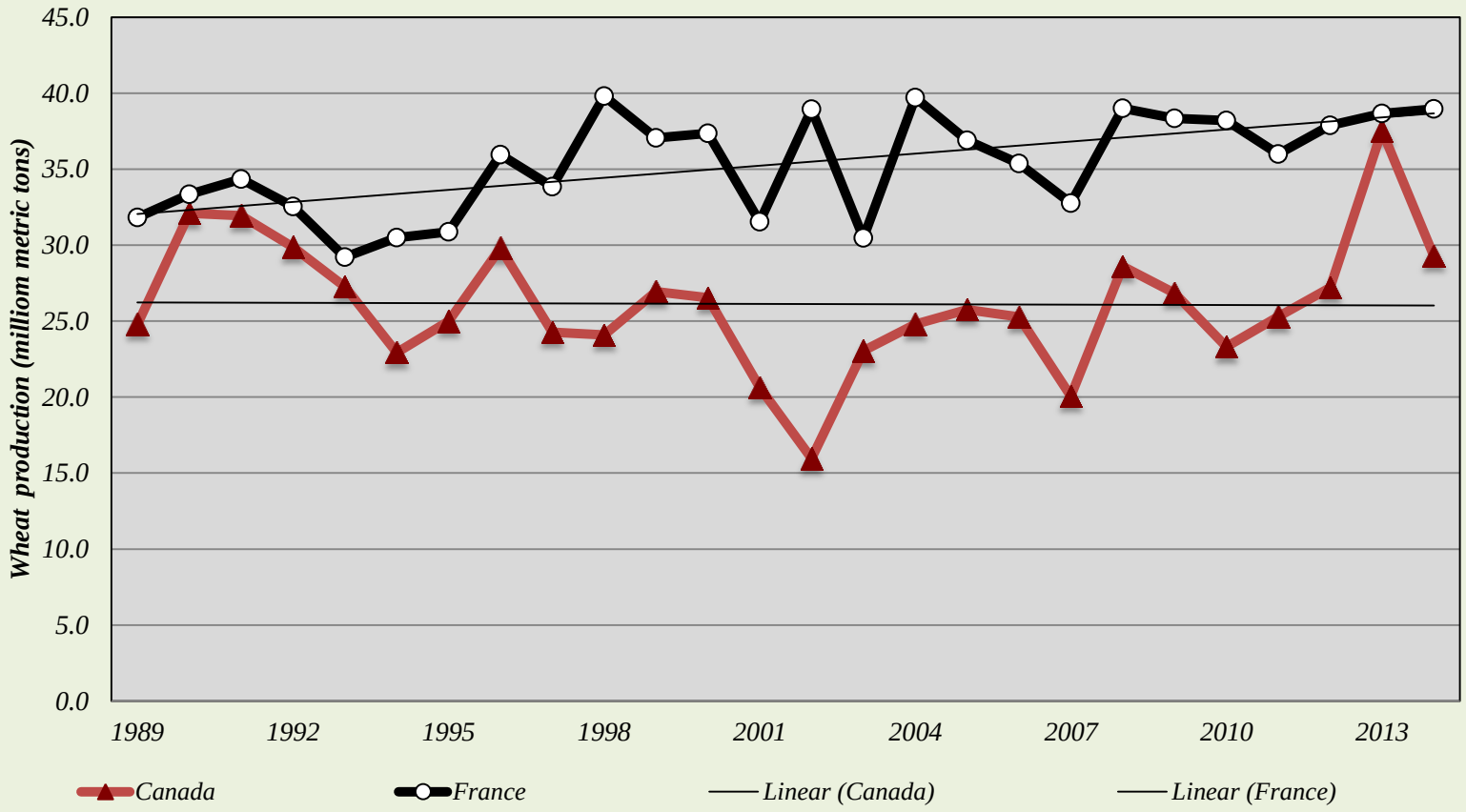
Wheat Production in Australia & Canada 1989 to 2014 (FAOSTATS 2017)



Lessons from France

- **Uniform farm saved seed royalty on all wheat varieties $1.00/t**
- **negotiated between farm organisations and the seed industry**
- **Uniform high royalty rates for all certified wheat seed and 50% of farmer purchase seed each year. > $40-$60M/yr**
- **Long history of public-private partnerships**
- ***Breedwheat* – is a large scale seven year public–private genomics research project**
- **The system appears to perform well with a large public research presence**

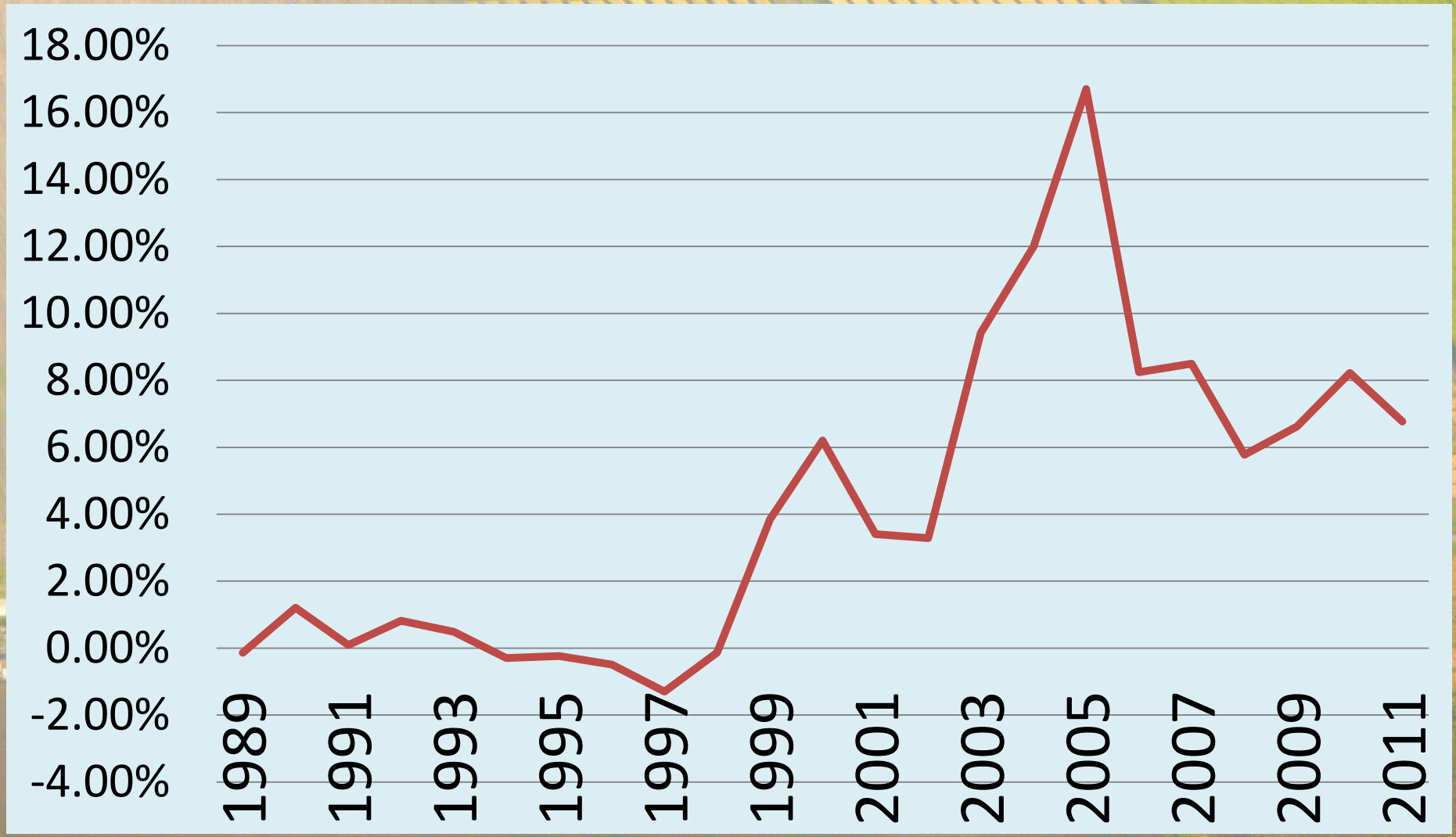
Wheat Production in Canada & France 1989 to 2014 (FAOSTATS 2017)



Evidence from the hybrid seed industry (where IPRs are very strong)

- For US Corn and Soybeans and Canadian Canola:
  - Seed costs are 10% of gross farm revenue
  - Research is about 1% of gross farm revenue
  - About 10% of rents get reinvested in R&D
- Is this Underinvestment?
  - Compared to what? Public? Producer?

Approximate Canola Seed Rents (% of Gross Income) Canada 1989-2011



The Canadian Canola Outcome

- Hybrid seed IPRs are secure
- faster yield increases than publically funded wheat
- However:
  - Two firms dominate
  - Seed costs $60 per are or 15% of gross revenue – these exceed land rents! and are steadily increasing
  - About 9% of $770 Million in rents gets reinvested in breeding
- Hybrid corn and GM soybeans look similar concentration/pricing/investment

Implications for Crop Innovation in Canada

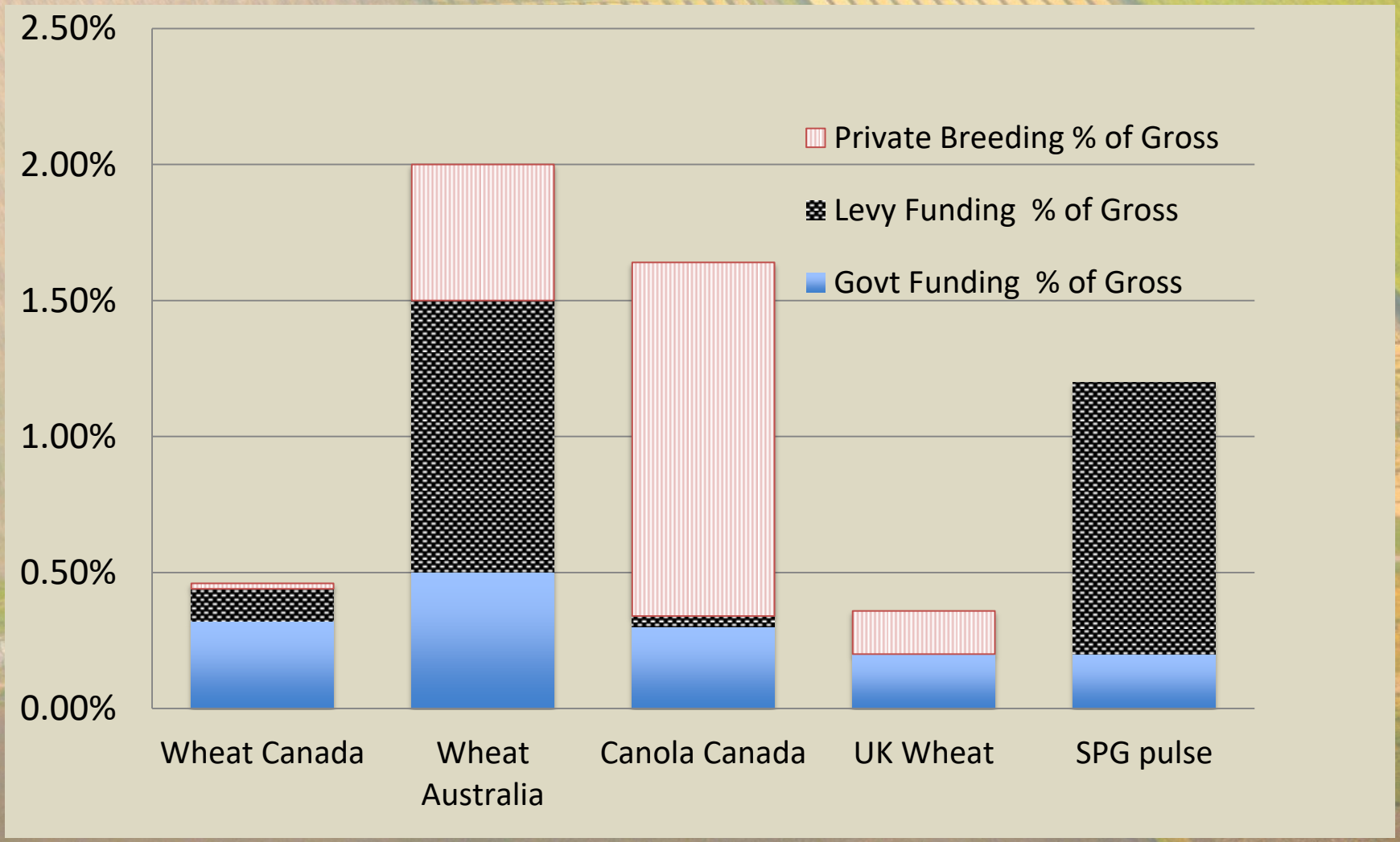
A balanced “4P” approach is needed

- 4P: Private-Producer-Public Partnerships
- Balance is required for:
  - greater overall funding
  - to provide industry goods and public goods while tapping into global knowledge owned by multinationals

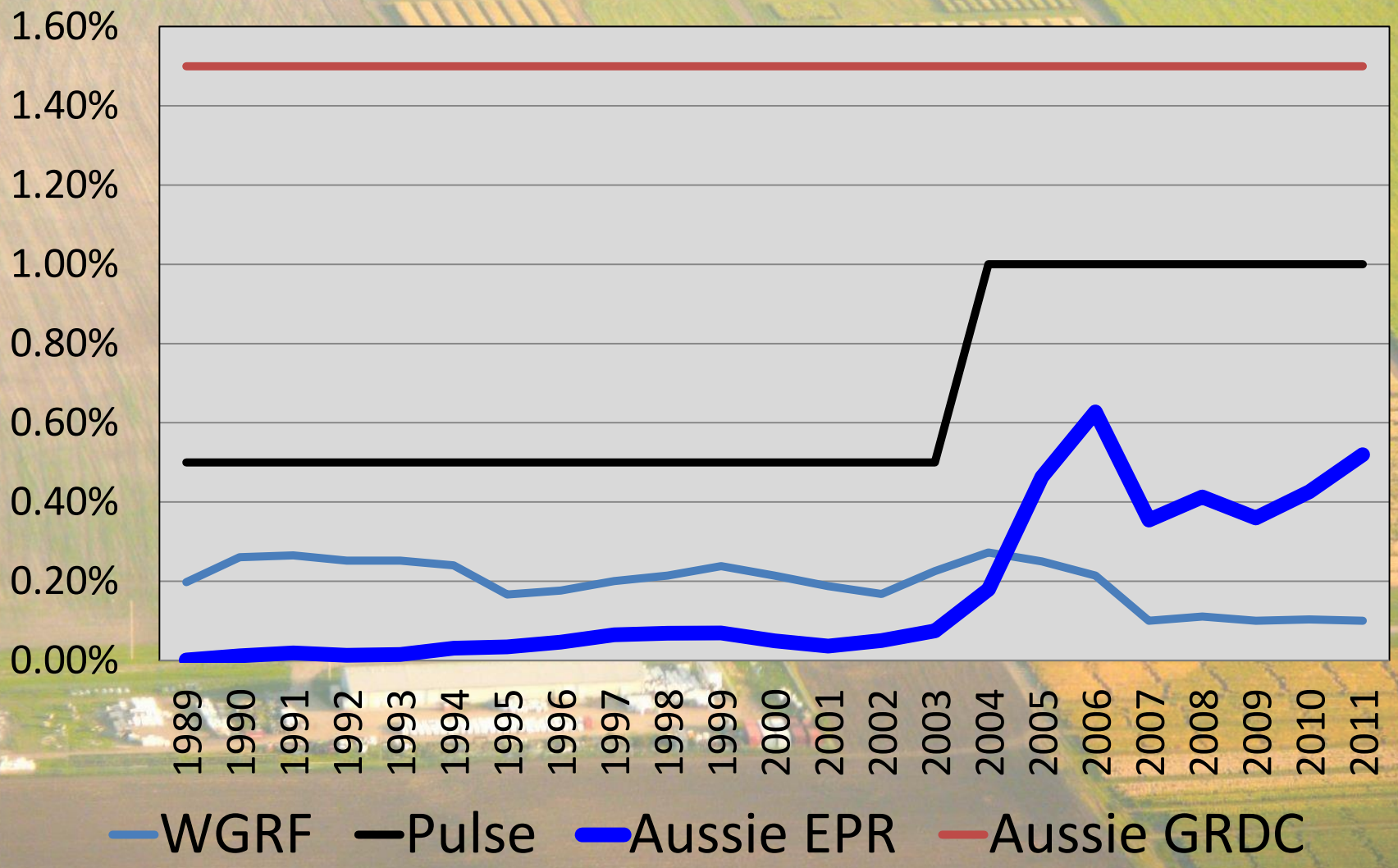
3 Types of Knowledge Inputs for Innovation

Public Goods (non-excludable)	Industry Goods (non-excludable)	Private Goods (excludable)
Basic Science Research	Crop genomics, germplasm, unprotected varieties	IP Protected crop varieties/traits/processes
Science literacy/ ecology /chemistry/ biology	Agronomy/ best management practices	Protected production process
Business management	knowledge dissemination product, input testing	Patentable mechanical innovations
Human and model crop Genomics	Crop disease research, biological control systems	Chemical Pesticides Inoculants
Pathogen Research	Quality standards/systems Market access	product and market development

Approximate Crop Research % of Gross Selected Crops 2010



EPRs and Levies % of Gross Income 1989-2011



The 4P balanced approach for Canada (Private)

- Governments should work with industry to pass regulations that will create a one-percent End Point Royalty on the sale of all crops that would be paid to variety owners
  - This would provide a large and immediate stream of revenue for all successful crop breeders without a long phase in period
  - It would allow private industry to also invest -in non-hybrid non-GM platforms

The 4P balanced approach for Canada (Producer)

- The federal government should use its research mandate to facilitate the creation of producer-controlled, non-refundable check-offs that would automatically matched by government (tax credits)
- Accountability can be enhanced with a share structure
- Corporations similar to the Australian RDC models could undertake applied R&D and extension for the benefit of the sector
- As in Australia, these corporations would also be in a position to foster 4P partnerships with the private and public sector

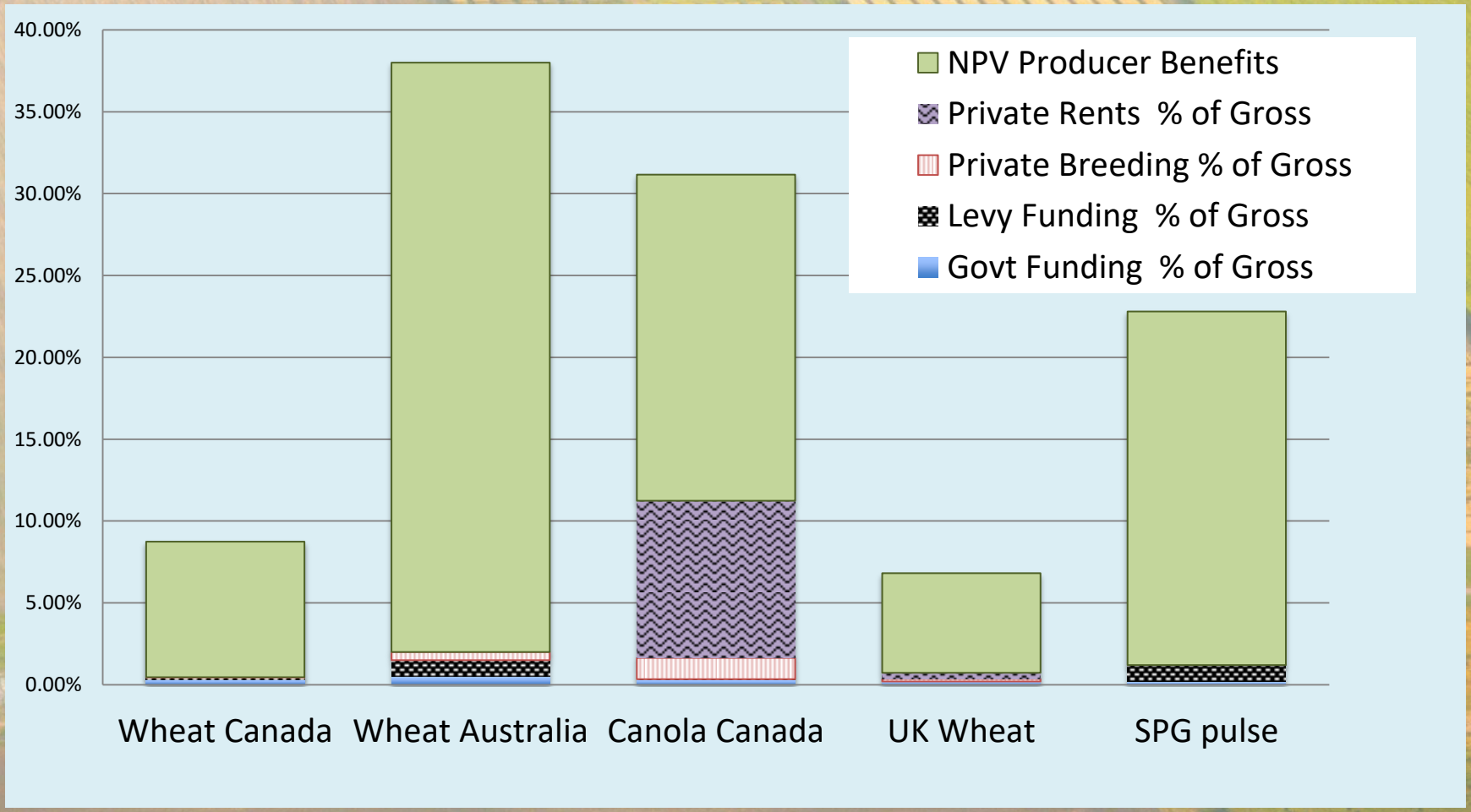
The 4P balanced approach for Canada (Public)

- Government should continue their public support for basic and applied scientific research
- Long term and/or matching commitments would help ensure future contributions
- Producer engagement in the process in critical
- The Grain Roundtable has a **Value Creation Working Group** co-chaired by Harvey Brooks from SaskWheat and Tom Steves for AlbertaWheat

Summary

- High rates of return to research indicate lost opportunities to benefit from more ag research
- Innovation systems work best through 4P partnerships
  - Broad uniform EPR mechanisms to create demand pull for private applied research
  - Levy-funded producer run national research organisations for industry goods and leadership.
  - Long term government commitments to fund public research

Approximate Crop Research Intensity and Returns (% of Gross) Selected Crops 2010



Approximate Crop Research Intensity and Returns (% of Gross) Selected Crops 2010

	Govt Funding % of Gross	Levy Funding % of Gross	Private Breeding % of Gross	Private Rents % of Gross	NPV Producer Benefits	Total Research Intensity	Benefit-Cost Ratio
Wheat Canada	0.32%	0.12%	0.02%	0	8.28%	0.46%	18.00
Wheat Australia	0.50%	1%	0.50%	0.00%	36.00%	2.00%	18.00
Canola Canada	0.30%	0.04%	1.30%	9.60%	19.92%	1.64%	18.00
UK Wheat	0.20%	0	0.16%	0.37%	6.09%	0.36%	18.00
SPG pulse	0.20%	1.00%	0.00%	0.00%	21.60%	1.20%	18.00