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*Growing Places: An Empirical Assessment
of the Economic Influence of Plant
Variety Protection in the TRIPS Era*

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GROWING PLACES: AN EMPIRICAL ASSESSMENT OF THE ECONOMIC INFLUENCE OF PLANT VARIETY PROTECTION IN THE TRIPS ERA

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Disclaimer: The views expressed are those of the author and do not necessarily reflect those of the OECD or its Member countries.



Overview – Presentation Elements

1. Reform of plant variety protection: key changes
 2. Relation of stringency of reform to registrations of new varieties
 3. Relation of new varieties to performance in illustrative economic indicators
- Existing literature focused mainly on legal aspects, qualitative assessments, & economics of specific cases; this study: broad, international, innovation & economic scope



Reform of plant variety protection (PVP)

- Extensive reforms since 1990:
 - WTO: Agreement on Trade-Related Aspects of Intellectual (TRIPS), 1995 enters into force
 - International Union for the Protection of New Plants (UPOV): 1991 Act, International Convention for the Protection of New Varieties of Plants, 1998 enters into force
- Concerns: incentivising innovation, protecting property rights, offer clear policy flexibility, food security, among other issues



TRIPS & Plants

- IPR protection to apply in all WTO Members, with some transition periods (now expired, except for LDCs in 2021)
- Patent protection to be available for substantially all fields of technology
- Plant varieties may be protected via patents or a *sui generis* system or both
- Enforceable via WTO dispute settlement body

- UPOV provides the leading *sui generis* system: 71 members adhere (1978 or 1991 Act)
- Sui generis systems can take account of the specifics of plant breeding: long lead times, reliance on inputs from among existing plant varieties, high costs in some cases, implications for food supply, among other aspects
- Convention guarantees national treatment
- Titles granted separately in each nation for new varieties that are distinct, uniform and stable



UPOV 1978 vs 1991 Acts

- 1978 Act:
 - Breeder's right for 15 years minimum (18 for vines & certain trees)
 - Protection for certain listed plant genera & varieties
 - Does not address “farmer's privilege”, nor harvested material
- 1991 Act:
 - Breeder's right for 20 years min (25 for trees & vines)
 - Covers all plant genera & species (after transition period)
 - Covers broad range of acts (propagation, exporting, importing, etc)
 - Permits dual protection via patents and PVP titles
 - Protects essentially derived varieties (i.e., very similar)
 - Provides recourse to harvest material if obtained via unauthorised use
 - Permits members to exclude seed saved & used on a farm (farmer's privilege)



Hypotheses

- H1: Strengthened PVP associated with tendency for increased registrations (flow & stock), residents and non-residents
- H2: New title registrations associated with increased value of plant seed imports
- H3: New title registrations and seed imports associated with improved econ performance in terms of real domestic value added in ag exports & crop yields
- H4: These relationships apply in developed & developing countries

Sample

- 1995-2010 (three 5 year periods); 31 countries (12 developed, 23 developing); 99 observations (max. 4 per country); unbalanced panel

Variables

- Index of PVP (1991-2000; 2001-2010)
- New title grants data from UPOV (stocks & flows)
- Seed imports from ComTrade
- Crop yields from World Bank (cereals) & FAO (fruits)
- Domestic value added in ag exports (foreign final demand) from OECD-WTO Trade in Value Added database
- Main controls: land, GDP, R&D & BERD, legal effectiveness, freedom to trade, university-industry research collaboration



Index of Intellectual Property Protection in Plant Varieties (Campi & Nuvolari, 2013)

| <u>Component</u> | <u>Score Range</u> | <u>Normalized Score</u> |
|-------------------------------------|--------------------|-------------------------|
| 1) Ratification of UPOV Conventions | 0-3 | [0,1] |
| -- 1961 | 0-1 | |
| -- 1978 | 0-1 | |
| -- 1991 | 0-1 | |
| 2) Length of Membership | 0-51 | [0,1] |
| -- At most 51 years | | |
| 3) Exceptions | 0-3 | [0,1] |
| -- No compulsory license | 0-1 | |
| -- No farmer's exception | 0-1 | |
| -- Essentially derived variety | 0-1 | |
| 4) Duration | 0-35 | [0,1] |
| -- At most 35 years | | |
| 5) Patentability | 0-4 | [0,1] |
| -- Pharmaceuticals | 0-1 | |
| -- Microorganisms | 0-1 | |
| -- Food | 0-1 | |
| -- Plants and animals | 0-1 | |
| | | |
| Total Index | 0-96 | [0,5] |



Regression Models

$$(1) \ln (\text{New plant variety title grants}_{n,t}) = a_0 + a_1 \ln (\text{PVP Index}_{n,t}) + a_2 \ln (Z_{n,t}) + \text{Error term}$$

$$(2) \ln \Delta(\text{New plant variety title grants}_{n,t}) = a_0 + a_1 \ln \Delta(\text{PVP Index}_{n,t}) + a_2 \ln \Delta(Z_{n,t}) + \text{Error term}$$

$$(3) \ln (\text{Seed imports}_{n,t}) = a_0 + a_1 \ln (\text{New plant variety title grants}_{n,t}) + a_2 \ln (Z_{n,t}) + \text{Error term}$$

$$(4) \ln (\text{Agriculture value added}_{n,t} \text{ or Crop yields}_{n,t}) = a_0 + a_1 \ln (\text{New plant variety title grants}_{n,t} \text{ or Seed imports}_{n,t}) + a_2 \log (Z_{n,t}) + \text{Error term}$$



Association of Titles (stock) & PVP Index

| Dependent Variable: Titles in Force (total stock) | | | | |
|---|--------------|--|--------------|--|
| | (2) | | (5) | |
| Plant variety protection index | | | 1.199961 *** | |
| | | | 0.362502 | |
| Plant variety protection index (lagged 1 period) | 1.249434 *** | | | |
| | 0.427393 | | | |
| Real GDP p/c | 0.221786 *** | | | |
| | 0.071582 | | | |
| Land availability* | 0.354772 *** | | 0.025214 | |
| | 0.053291 | | 0.100367 | |
| R and D (%GDP) | 0.281311 * | | 0.397454 ** | |
| | 0.144387 | | 0.151067 | |
| Periods Included | 2 | | 4 | |
| Years | 2000-2005 | | 1995-2010 | |
| Adjusted R2 | 0.659197 | | 0.6027 | |
| N | 30 | | 68 | |
| Countries Covered | 19 | | 29 | |



Association of Change in Titles (stock) to Change in PVP Index

| Dependent Variable: Change in Titles in Force (stock) | | | | |
|---|-----------|----|-----------|-----|
| | (2) | | (3) | |
| Δ Plant variety protection index | 0.995087 | ** | 2.459963 | *** |
| | 0.427231 | | 0.568806 | |
| Land availability* | 0.049364 | * | 0.034358 | |
| | 0.027457 | | 0.025696 | |
| Δ R & D (%GDP) | -1.049377 | | | |
| | 0.675786 | | | |
| Δ BERD - AG | | | 0.231540 | *** |
| | | | 0.059725 | |
| Δ Real FDI Inflows | 0.272400 | | -0.512048 | |
| | 0.322728 | | 0.509138 | |
| Periods Included | 3 | | 3 | |
| Years | 2000-10 | | 2000-10 | |
| Adjusted R2 | 0.149314 | | 0.715088 | |
| N | 39 | | 16 | |
| Countries Covered | 25 | | 8 | |



Association of Title Grants (flows) to Residents and PVP Index

| Dependent variable: Title grants to residents (flow) | | |
|--|-----------|----|
| | (6) | |
| Plant variety protection index | 1.215657 | ** |
| | 0.465391 | |
| Real GDP p/c | -0.085248 | |
| | 0.157843 | |
| Land availability* | 0.533606 | ** |
| | 0.074866 | * |
| R and D (%GDP) | 0.992362 | ** |
| | 0.169362 | * |
| Patent Rights Protection | -1.336669 | |
| | 1.308051 | |
| Trademark protection index | | |
| | | |
| Periods Included | 4 | |
| Years | 1995-2005 | |
| Adjusted R2 | 0.624464 | |
| N | 53 | |
| Countries Covered | 24 | |



Association of Title Grants (flows) to Non-Residents and PVP Index

| Dependent variable: Title grants to non-residents (flow) | | |
|--|-----------|-----|
| | (5) | |
| Plant variety protection index | 1.737323 | *** |
| | 0.359192 | |
| Plant variety protection index (lagged 1 period) | | |
| Real GDP p/c | | |
| Land availability* | -0.086383 | |
| | 0.090274 | |
| R and D (%GDP) | 0.029981 | |
| | 0.144776 | |
| BERD_AG | | |
| Real FDI Inflows | 0.233417 | ** |
| | 0.094858 | |
| Patent Rights Strength | | |
| Trademark protection index | -1.120205 | ** |
| | 0.467372 | |
| Periods Included | 3 | |
| Years | 1995-2005 | |
| Adjusted R2 | 0.468827 | |
| N | 45 | |
| Countries Covered | 21 | |



Association of PVP Title Grants (stocks & flows) and Seed Imports

| Dependent Variables=> | Seed Imports (in real USD) | | | |
|--|-------------------------------|-----|-----------|-----|
| | (1) | | (2) | |
| PVP_titles non-residents (flow) | 0.161678 | ** | | |
| | 0.071033 | | | |
| PVP_titles in force Total (stock) | | | 0.496406 | *** |
| | | | 0.078421 | |
| Real GDP p/c | 0.101090 | | | |
| | 0.106730 | | | |
| Land availability* | 0.193821 | *** | 0.298555 | *** |
| | 0.057483 | | 0.061530 | |
| Freedom to trade | 0.951763 | ** | 1.985302 | *** |
| | 0.379485 | | 0.326819 | |
| Real FDI Inflows | 0.454012 | *** | | |
| | 0.080053 | | | |
| Trademark protection index | | | -0.408035 | |
| | | | 0.462442 | |
| Periods Included | 4 | | 3 | |
| Years | 1995-2010 | | 1995-2005 | |
| Adjusted R2 | 0.730383 | | 0.617368 | |
| N | 79 | | 54 | |
| Countries Covered | 27 | | 23 | |



Association: Seed Imports & PVP Title Grants to Domestic Value Added in Ag Exports

| Dependent Variables=> | Domestic value added embodied in foreign final demand (agriculture, real USD) | | | |
|--|---|-----|-----------|-----|
| | (3) | | (4) | |
| PVP_titles in force Total (stock) | | | -0.013818 | |
| | | | 0.068813 | |
| Land availability* | 0.372619 | *** | 0.462186 | *** |
| | 0.049603 | | 0.041083 | |
| Legal effectiveness | 0.506885 | * | 0.947181 | *** |
| | 0.264638 | | 0.261832 | |
| Seed imports (real USD) | | | | |
| | 0.178185 | ** | | |
| | 0.072541 | | | |
| Fertiliser | 0.388741 | *** | 0.449563 | *** |
| | 0.112257 | | 0.115268 | |
| Periods Included | 4 | | 4 | |
| Years | 1995-2010 | | 1995-2010 | |
| Adjusted R2 | 0.706815 | | 0.675461 | |
| N | 60 | | 60 | |
| Countries Covered | 17 | | 17 | |



Association of PVP Title Grants and Seed Imports to Crop Yields

| Dependent Variables=> | Crop Yield - Cereals (kg per ha) | | | | Fruit Yields (hg per ha) | | | |
|---|----------------------------------|-----|-----------|-----|--------------------------|--|-----------|-----|
| | (5) | | (6) | | | | (7) | |
| PVP_titles in force, total (stock) | | | 0.139809 | *** | | | 0.169025 | *** |
| | | | 0.042471 | | | | 0.04796 | |
| Land availability* | 0.346103 | *** | | | | | | |
| | 0.052398 | | | | | | | |
| BERD_AG (USD 2005) | 0.082007 | ** | | | | | | |
| | 0.029508 | | | | | | | |
| Freedom to trade | | | 3.951573 | *** | | | 5.896655 | *** |
| | | | 0.181338 | | | | 0.204771 | |
| Seed imports (real USD) | 0.477960 | *** | | | | | | |
| | 0.056653 | | | | | | | |
| Fertiliser | 1.345419 | *** | | | | | | |
| | 0.110499 | | | | | | | |
| University-Industry Co-operation | | | -0.407492 | | | | -0.74646 | * |
| | | | 0.359570 | | | | 0.406035 | |
| Periods Included | 4 | | 2 | | | | 2 | |
| Years | 1995-2010 | | 2005-2010 | | | | 2005-2010 | |
| Adjusted R2 | 0.216586 | | 0.142525 | | | | 0.206617 | |
| N | 27 | | 48 | | | | 48 | |
| Countries Covered | 11 | | 32 | | | | 32 | |



Summing Up

Results confirm the general thrust of hypotheses, a positive relationship between:

- the strength of PVP and the stock of PVP titles (Plant breeders appear to respond & innovate)
- the strength of PVP and new PVP titles to residents (an indication of domestic innovation),
- the strength of PVP and new PVP titles to non-residents (an indication of potential technology transfer & access to improved plant varieties)



Summing Up (continued)

- Positive relationship of PVP protection and title grants found in developed & developing countries.
- Positive relationship between the granting of new plant variety titles and the value of seed imports.
- Seed imports: positively related to value-added embodied in foreign final demand (agricultural exports) and crop yields for cereals.
- PVP title counts positively related to crop yields for cereals and fruits (may indicate that among these new plant varieties are qualitative improvements)



Conclusions

- The strengthening of plant variety protection during 1995-2010 appears to have helped promote plant variety innovation and its diffusion, and ultimately seems to be associated with improved agricultural performance.
- Caveats: association is not the same as causality; small sample size; limited coverage of Europe
- Next steps: boost sample size via EU coverage, explore additional disaggregation of plant varieties



For more information

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