REVIEW OF MARKETING AND AGRICULTURAL ECONOMICS
VOL. 50, NO. 1 (*April*, 1982)

Plant Variety Rights in Australia: Some Economic Issues

David Godden*

The Australian Government tabled a Bill concerning Plant Variety Rights in May 1981. This Bill would, if enacted, establish property rights in new plant varieties. Plant Variety Rights legislation has been adopted in more than twenty countries. A range of economic issues relevant to the adoption of Plant Variety Rights legislation in Australia is considered in this paper, including assessments of some of the arguments of proponents and opponents of the proposed legislation. It is concluded that differences in the physical, economic, political and institutional environments in Australia mean that the claimed effects of Plant Variety Rights in other countries may not necessarily be repeated in Australia if this legislation were enacted here.

1. Introduction

The Australian Government, in consultation with State Governments and industry groups, has been planning the introduction of Plant Variety Rights (PVR) legislation since early 1979 (Sinclair 1979; Nixon 1980*a*)[1]. In May 1981, a Bill to enact Plant Variety Rights was tabled in the Australian Parliament.

Prior to 1980, Australian interest in PVR was largely confined to agricultural technologists and the plant breeding industry, although the issue had been discussed during the enquiry of the Industries Assistance Commission (IAC)

---

* Division of Marketing and Economic Services, N.S.W. Department of Agriculture. None of the views expressed in this paper necessarily represent the policies or attitudes of the N.S.W. Department of Agriculture.

This paper was revised during July–August, 1980, from a paper presented to a combined meeting of the N.S.W. Branches of the Australian Agricultural Economics Society and the Australian Institute of Agricultural Science in Sydney on 10th June, 1980. I am deeply indebted to many friends, colleagues and critics who have provided me with information about Plant Variety Rights, and the seeds industry and agricultural uses of seeds, or who have criticized my work. I am especially indebted to my thesis supervisors, Dr R. A. Powell and Dr B. J. Standen, for their continuing criticism and support of my work in this area. I am also indebted to four anonymous referees, the Editors of the *Review* and Dr L. J. Cook for their detailed helpful comments on this paper.

Some of the references cited in this paper are difficult to obtain and are available from the author if required. See Godden (1981*b*) for more detailed references on the PVR issue.

[1] Also known as Plant Breeders' Rights (Europe, Canada, New Zealand, Australia), Plant Selectors' Rights (New Zealand) and Plant Variety Protection (U.S.A.). Patent law has also been used to create plant variety property rights (*e.g.*, U.S.A.). Plant Variety Rights is the preferred Australian terminology.

into financing rural research (IAC 1976). The Australian Agricultural Council (AAC) also investigated PVR (IAC 1976; Department of Primary Industry 1980*a*, *b*) and some discussion of PVR also took place in farmer organizations (*e.g.*, *The Land* 1979). A summary of the development of PVR legislation is contained in Edwards (1979).

Legislation similar to proposed Australian PVR has been adopted in at least twenty countries[2]. There is also an international convention on PVR called UPOV[3], and an international association of breeders supporting PVR called ASSINSEL[4].

Public opposition to enactment of PVR legislation in Australia was expressed during 1980. This opposition had two broad strands. A strand of strong opposition to PVR developed among mainly urban-based groups; opposition was expressed by a diverse array of groups who drew on a polemical overseas study of PVR (Mooney 1979). Groups opposed to, or expressing great concern about, PVR included the Food Justice Centre of Friends of the Earth, Australian Council of Churches, Free Access to Seeds Committee, the Plant Diversity Production Committee (associated with the N.S.W. Total Environment Centre), a range of organic farming/gardening groups, the Australian Democrats and the Australia Party. There was also a second strand of concern about the proposed PVR legislation which was expressed by groups associated with the rural community. Some farming groups expressed reservations about the inclusion of some plant kinds, particularly cereal grains, within PVR—see, for example, the attitudes of the United Farmers and Stockowners of South Australia reported in *Farmer and Stockowner* (1980, pp. 16–17) and the Australian Wheatgrowers' Federation and the N.S.W. Livestock and Grain Producers' Association in *Livestock and Grain Producer* (1980, p. 2)[5]. A "write-in" survey in a national farming newspaper in late 1980 elicited strong farmer opposition to PVR (*National Farmer* 1980, p. 5)[6]. The Western Australian Government has expressed reservations about a number of aspects of the proposed legislation (Western Australian Department of Agriculture 1980; Halse 1981).

---

[2] Argentina, Austria, Belgium, Denmark, Hungary, Israel, Italy, Japan, Netherlands, New Zealand, Poland, Romania, South Africa, Soviet Union, Spain, Sweden, Switzerland, U.K., U.S.A., West Germany (Department of Primary Industry 1980*b*, p. 35). France also has PVR (Thiele-Wittig 1978, p. 447).

[3] International Union for the Protection of New Plant Varieties (*L'Union Internationale pour la Protection des Obtentions Vegetales*) based on a Convention of 1961. Member states include Belgium, Denmark, France, Italy, Netherlands, South Africa, Sweden, Switzerland, U.K., Israel and Spain (Plant Varieties Office 1980, p. 15).

[4] International Association of Plant Breeders for Plant Variety Protection (*Association Internationale des Selectionneurs pour la Protection des Obtentions Vegetales*) formed in 1938 (Mastenbroek 1978, pp. 339–340).

[5] In 1981, a Working Party of the Australian Wheatgrowers' Federation and its affiliates developed a policy on PVR which does not exclude cereals from proposed PVR legislation (Sewell 1981); these proposals were subsequently endorsed by the Australian Wheatgrowers' Federation (*The Land* 1981, p. 9).

[6] Such surveys, of course, are not random and may be seriously biased for several reasons; these results must therefore be interpreted with considerable caution.

At the meeting of Australian Agricultural Council on 4th August, 1980, it was noted that there was considerable concern in the community over the proposed legislation; a timetable was adopted to table the legislation in the first half of 1981 and have the legislation debated in the second half of that year (Nixon 1980*b*). At a subsequent meeting of AAC in Hobart on 9th February, 1981, it was decided that the proposed PVR legislation "would be restricted to horticultural, ornamental and other selected pasture and fodder species as determined by Agricultural Council" but that "Major field crop and annual pasture plants would not be included" (Nixon 1981). In late February, the Industry Committee for Plant Breeders Rights—a major lobby group in favour of PVR—was reported to be mounting a campaign to have major field crops and annual pasture plants "re-included" in the proposed legislation (Woods 1981). The PVR Bill, tabled in May, 1981, is reported to have satisfied neither proponents nor opponents of the legislation (Wilks 1981).

Despite the many countries which have adopted PVR, there has been little economic analysis of the effects of PVR, either before or after their introduction[7]. The Industries Assistance Commission recommended in favour of PVR (IAC 1976); Godden (1981*a*) criticized the IAC's analysis of PVR and provided an economic analysis of methodological issues fundamental to an assessment of the social benefits and costs of PVR. Evidence on the economic effects of PVR is largely confined to non-economists' observations of the effects of PVR in other countries. One survey reporting the apparent effects of PVR on private plant breeding in the U.S.A. is available (White 1976) and another relating to the effects of PVR on public plant breeding (Hanway 1978*a*, *b*)[8].

Although a Bill for PVR in Australia has been tabled in the Australian Parliament, its enactment is by no means certain. Even if the proposed legislation is passed, an *ex ante* analysis of PVR is relevant for four reasons. Firstly, a methodological study of economic issues relating to adoption of PVR highlights a range of major issues in economic theory including property rights, economics of regulation, oligopoly and technical change (Godden 1981*a*). Secondly, an economic study of PVR adoption in Australia may guide the future adoption of PVR in other countries. Thirdly, an economic study will help identify the likely economic effects of PVR on Australian agriculture. Fourthly, a general economic study of PVR is a necessary base from which to develop economic analyses of the plant kinds and species which should be included in an Australian system of PVR.

---

[7] This forms an interesting contrast with the analogous area of patents for inventions where there has been over two centuries of still-unresolved economic debate as to the value of the patent system in general, and the value of patents in particular industrial sectors (*e.g.*, Machlup and Penrose 1950; Machlup 1958; Taylor and Silbertson 1973). There have, of course, been many enquiries into, and reports on PVR by non-economists—*e.g.*, Committee on Transactions in Seeds (1960); Crop Science Society of America (1964, 1969); Joint Committee for Plant Breeders' Rights (1973); Fryer (1974); Norris (n.d.); Hedding (n.d.). A bibliography of information relating to PVR has recently been published (Godden 1981*b*).

[8] The survey results reported in White (1976) are widely available, although this particular paper is only a roneo. The data in White (1976) is extensively reported in Dunner (1980, pp. 122–125). The data is also referenced in Ruttan (forthcoming), Department of Primary Industry (1980*a*, *b*), Industry Committee for Plant Breeders' Rights (1981*a*, *b*), Collins (1979), and Cooney (1980).

In this paper, four groups of issues are examined for their possible effects on the economic impact of PVR in Australia. In Section 2, the nature of the property right created by PVR is outlined and the philospohical and pragmatic arguments for creating such a property right are discussed. Alternative forms of creating plant variety property rights are briefly mentioned. Section 2 concludes with a discussion of the mechanisms by which intellectual property rights such as PVR are used to appropriate returns from research expenditure, and the limitations of these mechanisms. It is argued that PVR will create sufficiently strong property rights to encourage increased private investment in plant breeding.

The nature of the potential increase in plant breeding following adoption of PVR is discussed in Section 3. Observations on the effects of PVR on plant breeding are reviewed in Section 3.1 with particular attention to a U.S. survey of the effects of PVR conducted in 1976. The possible effects of PVR on public breeding are discussed together with the relationship between the adoption of PVR and market structure in the plant breeding and seeds industries.

In Section 4, the effect of adopting PVR on imports into and exports from Australia of new varieties and reproductive planting material is discussed. The types of foreign varieties likely to be imported into Australia are discussed in Section 4.2, together with a discussion as to the meaning of "availability" of foreign varieties with and without PVR. The effect of PVR on exports is discussed in Section 4.3.

Some administrative aspects of PVR are discussed in Section 5. Of particular interest is the interaction between PVR and other legislation regulating the plant breeding and seeds industries, and whether this interaction could enhance or negate the property rights created by PVR. Other issues discussed include the economic differences between the "American" and "European" systems of PVR, and the implications of Australia's joining the UPOV Convention.

It is concluded that proponents and opponents of PVR have exaggerated the likely economic effects of PVR in Australia. This exaggeration appears to arise because it has been too-readily assumed that the alleged effects of PVR in other countries will be exactly repeated in Australia. Contrarily, it is argued below that the uniqueness of Australian agriculture would lead to consequences of PVR which would diverge from the experience of other countries.

2. PVR as a Property Right

2.1 Brief description of PVR

Plant Variety Rights are a property right in plant material. A grant of PVR gives legal title in a new plant variety[9] to the breeder or discoverer of a newly-developed or newly-discovered variety. The objective of establishing PVR is similar to the purpose of UPOV which has been described as:

[9] "Variety" is used in preference to, but as synonymous with, "cultivar" (cultivated variety).

> . . . to recognize and to secure to the breeder of a new plant variety . . . the right to require . . . his prior authorization for the production, for the purposes of commercial marketing, and for the offering for sale or marketing, of the reproductive or vegetative propagating material of his new variety. (Mast 1975, p. 378).

"Prior authorization" for the reproduction of planting material enables breeders to generate revenue that might otherwise be difficult to appropriate. Prior authorization presents breeders with two broad, but not mutually exclusive, choices. Firstly, breeders may elect to remain solely as plant breeders, and license their varieties granted to PVR on condition that a royalty is paid on subsequent seed sales.[10] Secondly, breeders may choose to undertake seed multiplication as well as plant breeding, arrange the total marketing of their varieties, and gain return on their plant breeding—as well as their seed multiplication activities—by way of users' purchases of seed.

Eligibility for PVR is determined by government bodies analogous to Patent Offices. To be eligible for a grant of PVR, a variety must generally satisfy the following criteria:

(i) be new—*i.e.*, not be previously known;

(ii) be distinguishable through identifying characteristics from existing varieties—*i.e.*, "distinct";

(iii) be sufficiently homogeneous by having acceptable variation in its identifying characteristics among individuals—*i.e.*, "uniform";

(iv) be stable between generations by exhibiting minimal changes in its identifying characteristics over time; and

(v) have an approved name.

Two differing approaches have been adopted to determine whether a variety satisfies the criteria of distinctness, uniformity and stability. In countries following the original UPOV Convention[11], field trials have been required to assess these characteristics (*e.g.*, Mast 1975). In the U.S.A., by contrast, the breeder's description of a variety is compared with descriptive records of varieties of the same species; if there is no exact match, a grant of PVR is made (USDA 1972, Sections 180.100 and 180.105).

2.2 Justification for creating a property right like PVR

The U.K. Committee on Transactions in Seeds (COTIS 1960) presented two basic justifications for creating an intellectual property right in plant varieties (*i.e.*, PVR). These arguments were, firstly, that breeders should be

[10] "Seed" is used in a generic sense to denote reproductive material—*i.e.*, seeds, cuttings, buds, rhizomes, corms, *etc.*

[11] Amendments to the UPOV Convention in 1978 permitted member countries to grant PVR on the basis either of field trials or breeders' descriptions (UPOV 1979*a*); by February, 1981, although 16 countries had signed the 1978 revised Convention, no country had ratified it (Crofts 1981, Table 2; see also Plant Varieties Office 1980) and hence the revised Convention is not yet in force.

granted PVR on equity grounds because inventors, who performed a similar service, had access to patents; and, secondly, that PVR would encourage additional plant breeding. These two arguments also underlie Australian arguments for PVR (*e.g.*, Department of Primary Industry 1980*a*, *b*; Industry Committee for Plant Breeders Rights 1981*a*, *b*). By adopting as one argument in favour of PVR the *relative* argument that plant breeders should have access to PVR because inventors have access to patents, the justification for PVR on "equity" grounds therefore regresses to a justification for patents *per se*. This regress suggests that it would be useful to examine the grounds on which patents have been justified. The second justification in COTIS (1960) for PVR—*viz.*, encouragement of additional plant breeding—is similar to a conventional argument for patents—*i.e.*, to encourage additional research. The potential advantage of examining the justifications for PVR by analogy with patents is strengthened by the strong parallels between patents and PVR (*e.g.*, Godden 1981*a*; Godden and Powell 1981)[12].

Machlup (1958, pp. 20–24) outlined four basic ethical and pragmatic grounds on which patents have been advocated, and discussed post-1850 economic opinion of these arguments. These grounds were (Machlup 1958, p. 21):

(i) the "natural law" thesis, which "assumes that man has a natural property right in his own ideas" and that "enforcement of exclusivity in the use of a patented invention is the only appropriate way for society to recognize this right";

(ii) the "reward by monopoly" thesis, which "assumes that justice requires that a man receive reward for his services in proportion to their usefulness to society" and that the most appropriate way to secure such rewards for inventors "is by means of temporary monopolies in the form of exclusive patent rights"[13];

---

[12] See also Industry Committee for Plant Breeders Rights (1981*a*, emphasis added):

> PVR are basically a system of patents applicable to newly developed cultivars used commercially . . .
>
> Although the rights conferred by PVR are akin to those given under patent legislation, in most countries separate legislation has been enacted.
>
> The essential difference between Patent and PVR legislation is that patents are granted only when an *invention* has been made, whereas PVR cover new varieties usually produced by well established genetical procedures as well as mutations and plant findings.

This supposed distinction between PVR and patents hinges on a colloquial concept of "invention" as referring to new *processes* of making things, whereas:

> The interpretation of "manner of manufacture" seems in effect to be fairly broad, embracing all *objects* that are man-made together with *methods* for making them, and, to some extent, *uses* for them. (Taylor and Silbertson 1973, p. 9, emphasis added).

Lumb and Ryan (1977, p. 126) suggested that the Australian Government could probably legislate for patents for plants; further, "the Australian Patent Office takes the view that the Patents Act is capable of including new plant varieties within its ambit" (Thomas 1981, p. 7).

[13] Points (i) and (ii) parallel one of the principles of the Universal Declaration of Human Rights quoted by COTIS (1960, p. 25)—but not strongly supported by COTIS—and also noted by subsequent writers:

> Everyone has the right to protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.

(iii) the "monopoly profit incentive" thesis which assumes that, since industrial progress is desirable but not necessarily sufficiently forthcoming if rewards from invention are not enhanced in some way, temporary monopolies in the form of patents for invention are the "simplest, cheapest, and most effective way" to create incentives for technical progress; and

(iv) the "exchange for secrets" thesis, which presumes that patents are a bargain between society and inventor, by which society grants a temporary monopoly in the use of an invention in exchange for the surrender of secret knowledge.

Analysis of PVR with respect to these four grounds justifying patents suggests the following arguments. Firstly, with regard to justifying PVR on "exchange for secrets" grounds, few if any PVR schemes publish the pedigree or method of breeding of a PVR-protected variety[14]. While the protected variety becomes commercially available, the methods used to create this variety —including the parent material and breeding processes—do not become publicly available as do patent specifications. Thus, PVR do not lead to an increase of knowledge in the public domain as occurs with patents and it would appear difficult to justify PVR as a monopoly grant in exchange for a secret being disclosed.

Secondly, the "natural law" thesis as outlined by Machlup rests for its justification on the concept of "natural rights" which denotes:

> that a man could have a right which, as natural, inalienable and indefeasible, had some sort of sanctity and validity transcending that of ordinary positive law. (Benn 1967, p. 195).

Three issues arise with regard to a "natural law" or "natural right" thesis, and intellectual property rights. First, from a purely philosophical point of view, it might be asked where these rights come from?—attempts to answer this question inevitably widens the issue into complex questions of metaphysics and ethics. Second, as with patents, the nature of modern plant breeding is such that, while in a philosophical sense the "breeder" is an individual, breeding relies on a range of individuals—plant breeders *per se*, agronomists, chemists, geneticists, statisticians, livestock researchers, *etc.*,—to develop commercially useful varieties. "Breeders" are thus, in general, companies, government institutions or universities. If plant breeding follows the example of industrial invention, the "plant breeders" granted PVR will invariably not be individuals but will be

[14] *e.g.*, "Applications for plant variety protection and their contents shall be kept in confidence by the Plant Variety Protection Office, by the Board, and by the offices in the Department of Agriculture to which access may be given under the regulations. No information concerning the same shall be given without the authority of the owner, unless necessary under special circumstances as may be determined by the Secretary, except that the Secretary may publish the variety names designated in applications, stating the kind to which each applies" (U.S. Congress 1970, Section 56). This provision contrasts strongly with patent law where detailed patent specifications are published.

companies or institutions, or the benefit of PVR will be assigned to such companies or institutions[15]. Since companies are "legal" rather than "natural" entities, it seems reasonable only to assign to them legal rights, privileges and responsibilities as defined in the "ordinary positive law" and not "natural rights" to which individuals have putative access. Further, while individuals may charge companies with exercising "natural, inalienable and indefeasible rights" this charge (a) would not necessarily *confer* such rights on companies; and (b) if the charge *were* held to confer such rights on the company, this would be inconsistent with such rights being "inalienable and indefeasible". Third, such "natural rights" are, even if partially recognized by general law, circumscribed by law;[16] in the particular cases of patents or PVR, the rights created by the State are *not* inalienable and indefeasible but, for example, expire after a statutorily-defined period. Therefore the proposition that there is a "natural law" or "natural right" to PVR seems tenuous at best.[17]

Thirdly, to the extent that the "reward by monopoly" thesis presumes:

> that justice requires that a man receive reward for his services in *proportion to their usefulness to society* (Machlup 1958, p. 21, emphasis added),

it might be argued that monopoly does not confer a reward "proportionate to" the social value of a commodity. The reward conferred by a monopoly will depend on the degree of market power exercised by the monopolist; thus the reward conferred by monopoly may be "large" or "small" depending on the economic rent accruing to the monopolist. In the particular cases of patent and PVR, monopoly grants for new inventions or plant varieties may permit proportionately "large" or proportionately "small" rewards to the inventor or breeder depending on the accompanying market power. The "reward by monopoly" thesis, to the extent that it is an argument about justice, is empirically empty because it is impossible to specify *a priori* whether a particular patent or PVR grant will confer a "just" reward on the grantee.

---

[15] There are a number of apparently contradictory assertions circulating in Australia as to the involvement of corporations in ownership of U.S. PVR grants. Examples include: "Last year in the U.S.A., only 17 per cent of licences for new plant varieties were issued to companies; the remaining 83 per cent were issued to public institutions and private breeders" (Sewell 1980*a*). "In the United States only 17 per cent of rights issued since 1970 were granted to only six major seed companies" (Scott 1980); "Of the 562 patent "certificates" issued by the U.S. Plant Variety Protection Office to March, 1979, over 46 per cent were issued to the dominant 17 firms who are the most active seed company buyers; only slightly over 9 per cent were issued to State Universities and Agricultural Experiment Stations" (Mooney 1979, p. 57). Official U.S. data indicates that, of the 290 certificates of PVR issued between 1st January, 1978, and 30th September, 1980, 69 per cent of certificates were issued to U.S. companies and 7 per cent to foreign companies, 3 per cent were issued to individuals, 16 per cent to public breeders in the U.S. and 5 per cent had indeterminate ownership status (*Plant Variety Protection Office, Official Journal* various issues). It is not easy however to distinguish between certificates issued to an individual who has formed a company, and other minor and major companies.

[16] *e.g.* the "right" to choose one's employment may be abrogated by the State by military or other conscription, even in peacetime.

[17] Mandeville and Lamberton (1981, p. 11) noted that:

> . . . the Senate Standing Committee on Science and the Environment took a more critical position in the light of Australia's particular circumstances. It stressed the primary function of the [patent] system as "the stimulation of indigenous industrial innovation not as a means for giving effect to the "natural rights" of inventors".

See also Senate Standing Committee on Science and the Environment (1979, pp. 129–142).

The primary justification for PVR would therefore appear to be the "monopoly profit incentive" thesis.[18] Indeed, this is the proposition most likely to appeal to economists since it concentrates attention on the actual incentives conferred in practice through a monopoly grant such as PVR. Further it implies consideration of empirical issues associated with creating new rights such as PVR—for example, the stimulation to plant breeding resulting from creation of PVR, and any other associated benefits, or costs.

While it has been argued that it is difficult to justify creation of PVR on the grounds of "natural justice", "reward by monopoly" or "exchange for secrets", the "monopoly profit incentive" thesis is, *prima facie*, a reasonable justification for their creation. As this thesis implies empirical questions as to the net social benefit arising from the creation of PVR, and the nature of the constituent elements of benefits and costs involved, the remainder of this paper is concerned with a discussion of these empirical questions.[19]

2.3 Property rights in plant material

The purpose of a property right is to give force of law to the appropriation of utility from commodities or assets. However, the appropriation of utility can occur without property rights (as with secrets), and the existence of property rights does not necessarily enable the effective appropriation of utility. With regard to plant varieties, it has been claimed that PVR are necessary to enable breeders to appropriate the value of their varieties.[20] Additionally, even with PVR, effective property rights may not necessarily exist.[21] These issues are elaborated upon in this section.

---

[18] Note that only the "natural law" thesis implies the "natural rights" of individuals. The "reward by monopoly" and "monopoly profit incentive" theses contain no presumption that it is the "natural rights" of individuals that are involved.

[19] An *a priori* argument of the "monopoly profit incentive" thesis might also proceed on ideological grounds—*e.g.*, private enterprise necessarily allocates resources more efficiently than government, or that public allocation is superior when there are significant externalities. Such propositions underlie many arguments about PVR. They should, however, be recognized as propositions of economic faith, not economic reason (*c.f.* Godden 1981*a*, Chapter 3).

[20] *e.g.*, "Without legal protection or the inbuilt biological protection of hybrid varieties, private plant breeders will not invest in the development of new plant varieties" (Smith 1980, p. 1).

[21] Loden (1978) inferred that U.S. plant breeders have sought to strengthen the basic monopoly granted through PVR. In discussing the reasons that 62 per cent of all PVR certificates to 30th September, 1977, contained an election that the variety be sold by variety name only as a class of certified seed, Loden noted that one factor leading to this result:

> may be the election by developers of proprietary varieties of this option in order to have the weight of state and federal seed control officials in the protection of these rights. . . . one of the basic concepts established for consideration of any plant variety protection system was that the protection of the rights would be the responsibility of the owners. The figures with respect to election of the certification option makes one wonder whether or not those seeking plant variety protection are as firmly convinced of the validity of this principle as was anticipated in the drafting of the legislation.

2.3.1 Appropriating utility from plant varieties without formal property rights

In the absence of formal property rights in plant varieties, breeders may appropriate utility from their varieties in several ways (Crofts 1981; Godden 1981*a*). Firstly, F_1 hybrid varieties have "in-built", "natural" features—*viz.* that these varieties do not satisfactorily reproduce from their own seed—which enable breeders to appropriate their utility without PVR as long as the breeder maintains secrecy as to the foundation lines and method of crossing (*e.g.*, COTIS 1960, p. 27). In the U.S.A. F_1 hybrids are not the subject of PVR grants (U.S. Congress 1970, section 42 (a)).

Secondly, legislation such as trademarks or seed certification may be used to enable breeders to gain returns without explicit property rights (COTIS 1960, pp. 18–24; Barry 1977, p. 21; Fitzgerald *et al* 1980, p. 39).

Thirdly, where one firm has exclusive control of the production and distribution of a particular variety, the value of that variety may be appropriated without PVR. This situation currently occurs in the N.S.W. cotton industry where commercial varieties are imported from private U.S. breeders under licence (*c.f. Annual Reports,* Cotton Seed Distributors Ltd), and could conceivably occur in the N.S.W. rice industry.

Further, since private plant breeding has occurred in the absence of PVR and without the protection afforded by hybridization, monopoly or trade marks and seed certification, there must be other mechanisms by which breeders appropriate at least some of the value of their varieties in the absence of PVR. For example, in the U.S.A. prior to PVR adoption in 1970, there was considerable private breeding in soybeans, cotton, hybrid and non-hybrid cereals, forages, turf grasses, field beans and peas, vegetables, oil crops and flowers (Crop Science Society of America 1964, 1969; White 1976), not all of which had any direct form of property right protection such as F_1 hybridization. Some of the factors leading to profitability in private plant breeding are frequent re-seeding, large amounts of seed required, peculiarities of seed production causing a high price, and little use of home-grown seed (Fejer 1966). Where these characteristics could be reinforced by factors leading to partial or effective exclusion of competition in a particular variety—*e.g.*, by creation of a brand image—some private plant breeding may be possible without PVR.

The enactment of PVR should not be seen as the *only* way by which breeders can appropriate utility from new varieties. PVR are a means of *extending* breeders' ability to appropriate utility and thus, all other things being equal, as a means of encouraging further private investment in plant breeding research.

2.3.2 Effectiveness of PVR as a property right

The effectiveness of PVR as a property right is an issue which has received little coverage in discussions of PVR. There are four issues which bear on the effectiveness of PVR. Firstly, plant breeders have at least three distinct groups of rivals against whom PVR could be used to reinforce commercial interests. These rival groups are:

(i) other breeders, who may acquire and reproduce rival breeders' varieties;

(ii) specialist seed producers who are not plant breeders, and who may acquire and multiply a variety in competition with the original breeder; and

(iii) farmers and gardeners who—especially in the case of self-pollinating cereals and asexually reproduced species—may acquire initial reproductive material from breeders and subsequently produce their own planting material.

In general, PVR only protect a breeder's interests against rival breeders and specialist seed producers; farmers and gardeners are generally permitted to freely reproduce their own planting material for their own use; in the U.S.A., PVR legislation also permits farmers to sell seed to other farmers (U.S. Congress 1970, Section 113). Thus, enactment of PVR increases breeders' control over their own varieties, but does not create absolute control. Especially where the use of home-grown planting material is significant—*e.g.*, in the Australian cereals sector—PVR may not produce an effective plant property right[22].

Secondly, PVR create property rights in new varieties analogously to the property rights in new inventions created by patents. The patent analogy suggests the following implications for property rights:

(i) infringement of PVR is in general a civil, not a criminal, offence. Thus the detection of infringement, and the legal processes to prevent infringement, are the sole responsibility of the PVR grantee (except in the U.S.A. with the seed certification option—see footnote 21 and Section 5.1);

(ii) detection of infringements of PVR is likely to be costly, and there are likely to be economies of scale in monitoring infringement;

(iii) in industry, patents are apparently looked on not only as a property right but as a business weapon (*e.g.*, Scherer 1980, pp. 449–450). A decision to infringe, or litigate an infringement of, a patent may depend not only on the monetary value of the infringement and the cost of litigation, but also on the objectives of each party with respect to the continued corporate existence of the other party, or even the cordiality of business relations between infringer and patentee (*e.g.*, Taylor and Silbertson 1973, pp. 99–101). Decisions whether to infringe PVR grants or proceed with civil action for infringement of PVR, are business decisions. That is, potential infringers and breeders will weigh, in a business context, the costs and benefits of possible action. Action against infringers may range from no action, to polite letters seeking the infringing party's adherence to the terms of the PVR grant, through to litigation; and

[22] Nicholls (1978, p. 42, emphasis added) noted for the U.K. that:

> . . . one must recognize that amongst the large cereal growers there are a few who do possess the equipment and organization as well as being able to exercise the necessary discipline in order to produce quantities of seed on their farms for further sowing. Such people are *now* tending to buy relatively small quantities of Certified First Generation Seed in order to produce an Uncertified Second Generation product. . . . One added attraction is that such a service avoids the payments of royalties. However their success has been limited by the difficulties of on-farm operation . . .

(iv) patent litigation, while relatively rare, is expensive[23]. Attempts have been made to circumvent similarly expensive procedures with relation to PVR by establishing appeal tribunals independent of the conventional judiciary and dominated by "experts" in plant breeding[24]. As the recent, turbulent history of the Australian Broadcasting Tribunal[25] has shown however the costs of hearings of such tribunals are proportional to the size of the economic interests involved. Should substantial economic conflicts arise from PVR it would be surprising if costly litigation did not result.

Thus the effectiveness of a property right such as PVR is not solely a function of the rights as legislatively defined, but also of the costs of civil redress. In particular, for a geographically dispersed industry like agriculture, the costs of monitoring for infringements of PVR could be high.

Further, it might be hypothesized that the effectiveness with which a PVR grant could be defended would partly depend on firm size. If there are economies of size in infringement detection and litigation, PVR might be a relatively more effective property right for larger firms than for small. For patents, however,

> . . . on balance, the system probably does more to stimulate invention and innovation by small entrepreneurs than by the large corporation . . . (Scherer 1980, p. 450).

Thirdly, as with patents, PVR are unlikely to provide a complete monopoly in a species or a varietal type for the legal life of the PVR grant. Rather, PVR grants will lengthen the lead time between a breeder's release of a variety and the acquisition of identical, or substantially similar, varieties by commercial rivals. Selection among off-types of varieties granted PVR or a quick backcross programme could enable rival breeders or seedsmen to quickly acquire essentially similar varieties (Sparrow 1981, p. 3). In such cases, the effectiveness of the PVR property right may be reduced long before the statutory period of a PVR grant expires[26].

---

[23] *e.g.*, Taylor and Silbertson (1973, pp. 14, 20–22). One reason suggested by a patent attorney for reforming the Australian patent system was that "Conventional court system is not a suitable vehicle to protect the rights of smaller companies and individuals because of its high costs" (Tisdell 1979, p. 13; and see following footnote).

[24] One of the suggestions for reform of the Australian patent system arising from a survey of patent attorneys by Tisdell (1979, pp. 13–14) was to remove patent litigation from the conventional court system; several of the specific comments suggested changes that reflected the types of appeal procedures established for PVR in other countries.

[25] Extensively documented in Australian newspapers and other media, especially in 1980–81. The first Chairman of the Australian Broadcasting Tribunal was reported after his retirement as follows:

> . . . Mr Gyngell repeated his theme of previous discussions that he believed the tribunal had become too much the place of lawyers.
>
> "It descended into a situation where it became the fine points of law being debated by skilled lawyers and I frankly felt quite excluded from it", he said.
>
> The legal atmosphere got away from the real intention which was "getting some vital broadcasting going," he said. (Cromie 1981).

[26] Lead times could also be reduced by industrial espionage. The supposedly rampant "pirating" of varieties where PVR does not exist—or the potentially-rampant pirating which has inhibited development of a larger private plant breeding sector—is unlikely to be totally eliminated by PVR. Indeed, such nefarious practices may *increase*, since rewards from them may be enhanced by PVR.

The enactment of PVR should not be seen as creating a perfectly effective right in new plant varieties. Enactment of PVR legislation will reduce the capacity of commercial rivals to appropriate the utility of a breeder's variety. However, PVR will not eliminate the ability of rivals to appropriate utility at the breeder's expense. Farm-saved seed, the costs of monitoring and litigating infringement of the PVR grant, and the possibility that rivals may relatively quickly produce similar varieties will limit the effectiveness of PVR as a property right. The degree to which PVR legislation creates effective plant variety property rights is thus a consequence of economic as well as legal phenomena.

2.3.3 Summary

Although PVR create a legal framework for plant variety property rights, the extent of the right conferred depends on economic factors. Thus the effect of the adoption of PVR in stimulating plant breeding is crucially dependent upon the economic environment into which they are introduced. Overseas experience suggests that the enactment of PVR legislation will create sufficiently strong plant variety property rights to encourage increased private investment in plant breeding. The relationships between PVR, plant breeding and the Australian economic environment are discussed in following sections.

3. Effect of PVR on Plant Breeding[27]

It has been widely argued that there have been increases in the number of private plant breeders and the number of privately bred varieties following the introduction of PVR (*e.g.*, Industry Committee for Plant Breeders' Rights 1981*a*, *b*). Such increases will be beneficial if the benefits of the adoption of PVR exceed the accompanying costs. While a theoretical economic model of perfect competition might suggest that, if private plant breeding increases after enactment of PVR, economic efficiency has necessarily increased, evaluation of the net benefits of adopting PVR must take into account a wide range of issues including the rate of technical change resulting from the increased rate of private plant breeding, the relationship between private and public breeding, and the distribution of benefits between plant breeders, seed multipliers, seed users and end-use consumers. In this Section, there is a review of information concerning the effects of PVR on private and public plant breeding, and a review of theory and empirical evidence concerning the relationship between PVR and corporate structure.

3.1 Private breeding

The Industry Committee for Plant Breeders' Rights (1981*a*) noted that:

> In all countries where PVR legislation has been enacted it has greatly stimulated plant breeding by private individuals and commercial companies. This has increased the speed and efficiency of developing new improved plant varieties and it is certain that this will happen in Australia. This will result in a wider range of new, more productive plant varieties being available to Australian growers.

[27] A more detailed analysis of methods for determining the economic impact of adopting PVR is contained in Godden and Powell (1981).

Four broad sources of evidence have been proposed as support for these propositions. Firstly, there has been the personal evidence of individuals who have toured overseas countries with PVR (*e.g.*, Hedding, n.d.). Secondly, the number of varieties granted PVR in other countries has been cited as evidence of the stimulation provided by PVR to plant breeding (*e.g.*, Edwards 1979, 1980; Industry Committee for Plant Breeders' Rights 1981*a*, *b*). Thirdly, there has been one survey of private plant breeding in the U.S.A. (White 1976). Fourthly, studies of improvements in crop yields in countries where PVR have been adopted have been used in other studies to infer the existence of benefits from PVR (*e.g.*, Department of Primary Industry 1980*a*, *b*).

None of these studies is particularly satisfactory. For example, mere enumeration of the varieties granted PVR overseas ignores the relative numbers of varieties developed prior to PVR and, perhaps more importantly, the use of new varieties in product competition rather than product improvement. Studies of improvements in crop yields have generally not been specifically directed towards examining the impact of PVR (*c.f.* Godden and Powell 1981).

The best evidence relating to the impact of PVR is contained in White (1976) who reported a survey of private U.S. plant breeders conducted by the National Council of Commercial Plant Breeders. The broad findings of this survey were:

1. A large number of new firms began plant breeding and existing firms undertook new programmes in the U.S.A. during the 1960's and early 1970's in anticipation of, or as a consequence of, adoption of PVR. This trend was particularly noticeable in soybeans and, to a lesser extent, cereal grains.

2. There was a substantial increase in plant breeding research expenditure; expressed as an index, research expenditures averaged 100 in 1960, and 712 in 1976 for responding firms.

3. Research expenditure as a percentage of total sales was high at 5.3 per cent. Corresponding data for earlier periods not reported in White (1976), but apparently drawn from the same survey, were 2.9 per cent (1960), 3.6 per cent (1965) and 4.4 per cent (1969)—see Dunner (1980, p. 124).

4. A "moderate" effect of PVR on affecting research investment was reported by 40 per cent of firms and a further 31 per cent of firms reported that the availability of PVR had had a "positive" effect on research investment.

5. The availability of PVR was reported by 51 per cent of firms as causing them to initiate a breeding programme.

As White (1976) presented an analysis of this survey based on simple averages of the data collected, it is useful to examine the data presented in more detail. As White provided the original data in the publication of his study, more detailed analysis is possible.

I. *Stimulus to breeding.* Of the firms established between 1965 and 1970, one firm was breeding hybrid crops only[28] and two were breeding both hybrids and others; of the nine firms established between 1971 and 1976, one was breeding hybrids only and eight were breeding other crops only. Of the new breeding programmes established 1965–1970, seven were hybrid only programmes and nineteen were in other crops; of the nineteen in other crops, seven were soybeans. Of the new breeding programmes established 1971–76, five were hybrids only, and twenty six were in other crops of which fifteen programmes were soybeans. Since at least 20 per cent of new programmes were in hybrid crops excluded from PVR in the U.S.A., it is probable that influences other than the enactment of PVR were also stimulating U.S. plant breeding in the period 1965–76; thus, it may be incorrect to attribute *all* the new breeding programmes in "other" crops to adoption of PVR. Further, the domination of "other" new programmes by new soybean programmes (49 per cent of total) may be partially explained by characteristics of the U.S. soybean industry such as the 142 per cent rise in soybean acreage 1960–1977, the 139 per cent rise in average soybean price received by farmers 1970–1976, the 38 per cent fall in the quantity of soybeans held on farm for seed relative to the area of soybeans planted in the period 1963–1977 (USDA, 1974; 1978), and the 161 per cent increase in average U.S. seed soybean prices between 1962–1966 and 1974–1978 (USDA 1979).

II. *Research expenditure index.* The average research expenditure index contained major variations among firms: one firm had a research expenditure index of 100 in 1960 and 10 000 in 1976; eight firms had an average index value of 100 in 1960 and 1 260 in 1976; and the remaining thirty-five firms had an average index value of 100 in 1960 and 321 in 1976. No data was presented on price deflators, so it is presumed that the index was calculated in money terms; additionally no data was presented on the relative research expenditure of firms and thus it is not possible to construct a weighted research expenditure index. Consequently, the average research expenditure index data require cautious interpretation if used as an indicator of growth in private U.S. plant breeding.

As with the data relating to new breeding firms and breeding programmes, it is not possible, on the basis of the data presented, to assert categorically the proportion of the increase in plant breeding expenditure resulting from adoption of PVR.

III. *Research as percentage of sales.* As with the research expenditure index, distinct groups can be discerned: eight firms averaged 11.4 per cent of sales as research expenditure and the remaining thirty-four firms averaged 3.8 per cent. Again, as data on the relative size of firms was not provided, a weighted average of research expenditure as a percentage of sales cannot be calculated.

---

[28] The "hybrid only" crop categories were maize and sorghum; the "other" crop categories were forage crops, cereal grains, soybeans, cotton, vegetables, turfgrasses, oil crops and flowers. The "other" crop categories might have included hybrid breeding programmes (*e.g.*, in forages, cereal grains, vegetables and oil crops) or plant kinds elegible for plant patents in the U.S.A. (*e.g.*, flowers) but the existence of such programmes was not specified.

IV. *Effect of PVR on research expenditure.* Cross-tabulation of firms' responses as to the extent to which the availability of PVR affected research expenditures are, on average, consistent with the research expenditure index and the data on research expenditure as a percentage of sales[29]. The average data masks, however, considerable variation between firms: for example, one firm breeding a range of hybrid and other crops and reporting no effect of PVR on research expenditure had the second highest growth rate of all firms in research expenditure for the period 1965–1976; and 72 per cent (64 per cent) of firms reporting that PVR had had a moderate (positive) effect on research investment had growth rates in research expenditure 1970–1976 *lower* than the average of those firms claiming PVR had had no effect on their research investment. These data therefore also suggest that the reasons for growth in plant breeding research in the U.S.A. after 1965 had more complex causes than just adoption of PVR.

V. *Effect of PVR on new breeding programmes.* Cross-tabulation of types of breeding programmes no more than ten years' old with firms' responses as to whether availability of PVR had caused them to initiate a new breeding programme showed that approximately 36 per cent of new programmes had been begun by firms which responded that PVR had not caused them to begin a new programme[30]. Most significantly, 30 per cent of new soybean programmes occurred in firms which claimed PVR had not caused them to initiate a new breeding programme.

In summary, White (1976) provided interesting and thought-provoking data on the effect of PVR on private plant breeding. However, closer scrutiny of the data suggest that events other than adoption of PVR could also have partially accounted for the upsurge in private breeding in the period 1965–1976.

---

[29] (i) Extent to which availability of PVR affected research investment cross-tabulated with research expenditure index (arithmetic means of ratios of research expenditure index calculated for 1976/1970 and 1976/1965).

	Claimed effect of PVR on research expenditure		
Period	*None*	*Moderate*	*Positive*
1976/1970	2.49	2.72	4.30
1976/1965	3.17	3.87	5.15

(ii) Extent to which availability of PVR affected research expenditure cross-tabulated with research expenditure as a percentage of sales (arithmetic means).

	Claimed effect of PVR on research expenditure		
	None	*Moderate*	*Positive*
Research as percentage of sales (mean)	3.16	5.12	7.13

[30] Breeding programmes in "other" crops, no more than 10 years' old, cross-tabulated with responses as to whether PVR caused them to initiate a new breeding programme (note: a firm may have more than one breeding programme).

Did PVR cause a new breeding programme?	Forage Crops	Cereal Crops	Soybean	Cotton	Vegetables	Turfgrasses
Yes	2	6	14	1	1	3
No	2	4	6	1	1	1

Thus, it is incorrect to ascribe all the changes noted by White to adoption of PVR; the impact of PVR *per se* is not readily discernible. Further, the dominant effect of PVR suggested by the survey was in soybean breeding. Since the introduction of PVR in the U.S.A. coincided with major changes in soybean production in the U.S.A. (see I above), it is difficult to disentangle the effects of these changes from the effects of PVR in explaining the large increase in private soybean breeding in the U.S.A. Such an explanation is crucial in projecting the effects of PVR in Australia, since soybeans are not a major crop in this country. There would appear to be benefits from conducting more rigorous analyses into the effects of PVR adoption (*c.f.* Ruttan forthcoming).

Three other issues related to the effect of PVR on private plant breeding are also important. Firstly, all research may be conceived as existing on a continuum between highly abstract, basic research and applied research. Because PVR only affect the ability of plant breeders to appropriate utility from commercial varieties, the effect of PVR is less likely to extend to other aspects of plant breeding. In particular, the benefits of many activities associated with basic plant breeding research—such as collection, storage and evaluation of germplasm, development of breeding techniques, training of plant breeders—are not tightly linked to the development of new varieties, and are therefore unlikely to be substantially affected by PVR (*c.f.* Hanway 1978*a*, *b*). Thus, even if PVR enabled all breeding of commercial plant varieties to be undertaken in the private sector, externalities in basic research would probably require sustained public funding of such research.

Secondly, the activities of private firms in marketing their own varieties may accelerate the diffusion of new varieties to the farming community. Griliches (1960) showed that the diffusion of hybrid corn in the U.S. proceeded rapidly and it may be supposed that, *ceteris paribus*, PVR might accelerate diffusion of non-hybrids. Chatterton (1975, pp. 64–94; 1980) has also argued that PVR, through providing public breeders with exclusive rights on publicly bred varieties, will enable public breeders to accelerate diffusion of their varieties.

Thirdly, a major stimulus to the development of specialist activities such as plant breeding is the extent of the market. Where markets are small, it may not be profitable to manufacture products perfectly suited to the specialized characteristics of those markets. In many cases of small markets, products broadly suited to a range of similar markets may be produced, rather than the production of specialist products being tailored to the unique requirements of individual small markets. In the case of plant breeding, Australian markets for many varieties are small by world standards and may in many cases be too small to justify specialized breeding efforts solely for the domestic market (Sewell 1981, p. 3). Thus, even with PVR, domestic breeding for such local markets may not occur, and such markets may continue to rely on broadly suitable, imported plant material or varieties produced by public breeders.

3.2 Public breeding

The adoption of PVR offers government the opportunity to modify its commitment to applied plant breeding research on the assumption that private plant breeders will supply commercial varieties in place of publicly bred

varieties. Government may also reduce its commitment to basic research; however it is likely that this would reduce efficiency in plant breeding (*c.f.* Section 3.1). An element in these decisions would be whether government wished to alter the total expenditure of funds in plant breeding research, or whether it wished to vacate applied research in favour of private breeders[31].

Evidence of the effect of PVR on public research is sketchy. Hanway (1978*a*) indicated that U.S. Agricultural Experiment Stations had not reduced public breeding after PVR adoption, but that there was evidence of a shift towards more basic research. Hedding (n.d., p. 16) noted that all countries which had adopted PVR had re-assessed their public breeding programmes and some—*e.g.*, Holland, Denmark—had abandoned the public breeding of commercial varieties (see also Downey 1977). Derera (1975) claimed that, in France and Holland, there was evidence of private funding of public research which appeared to be inhibiting the flow of information from public breeding. In a discussion of PVR in New Zealand, Smith (1979) noted that N.Z. government expenditure on plant breeding was being run down, but gave no indication as to whether this was a consequence of PVR adoption. Simmonds (1979, pp. 343–345) has noted:

> In continental western Europe, long established plant-varieties rights schemes have swung the balance far towards private breeding, with state organizations undertaking supporting and background research and generally discouraged by the private sector, from undertaking breeding *per se*. In Britain, with a relatively recent PVR scheme, the balance is more nearly equal but varies widely between crops. . . . The tendency, already plainly apparent, will generally be for the private sector to press for the reduction of state-supported breeding on the grounds that it offers "unfair" competition; the state institutes, it is argued, should confine themselves to research that supports commercial breeding and, perhaps, to breeding a few crops that offer insufficient promise of profit to the private breeders.

Simmonds also argued that commercial pressures, particularly where competition was less than perfect, could distort plant breeding objectives:

> So there is a rather strong argument for maintaining, in the public interest, and in effective competition with the private sector, state-supported programmes that are free to work towards different objectives. (Simmonds 1979, p. 345).

There is little detailed, objective evidence of the effect of PVR on public breeding. In Australia, the effect of future adoption of PVR on public plant breeding will depend upon the future actions of government and farmer funding bodies on the level of public funding and the types of plant breeding projects which are approved[32].

---

[31] Note possible ideological elements in such decisions—*c.f.* footnote [19].

[32] A relatively unexplored possibility for improving economic efficiency in basic plant breeding research by public breeders would be to auction publicly-evaluated germplasm to private breeders for incorporation into commercial varieties (*c.f.* Freebairn and Gruen (1977) on the auctioning of beef export entitlements to preferred markets). Downey (1977, p. 18) reported that "In Germany . . . public institutes produce cultivars and sell them to the highest bidder."

3.3 Market structure

Since PVR are designed to encourage private plant breeding, it would not be surprising if PVR increased the profitability of private plant breeding, and stimulated changes in the corporate structure of the industry. Mooney (1979) claimed that substantial changes occurred in control of plant breeding and seed firms after the adoption of PVR in the U.S.A. and Western Europe. Leenders (1976) noted that Dutch seed laws, including PVR, markedly decreased numbers of firms in the seed industry. Hedding (n.d.) argued that PVR caused a desirable increase in vertical integration in the seed industry[33].

There are four reasons for expecting an oligopoly—*i.e.* few and interdependent firms—in plant breeding with PVR:

(i) oligopoly characterizes most sectors of industrialized economies (*e.g.*, Scherer 1980, pp. 67–74) particularly where significant R & D is undertaken;

(ii) four-firm concentration ratios in the U.S. hybrid maize and sorghum seed industries, where there are natural property rights, are high at approximately 66 per cent and 59 per cent (Mooney 1979, p. 58)[34];

(iii) in Australian plant breeding where "natural" property rights exist—*e.g.*, hybrid summer crops, vegetables—there are only a few plant breeding firms[35]; and

(iv) numbers of firms in the seed industry have been reported to decline after enactment of PVR (*e.g.*, Hedding n.d.; Leenders 1976) and concentration of firms has also been reported through takeovers and mergers (Mooney 1979, Chapter 6).

If corporate plant breeding develops an oligopoly structure with PVR, this development has important implications for an assessment of the economic effects of PVR. With an oligopoly, there is a sufficiently small number of firms that individual firms can affect market prices. Oligopolists generally (although not invariably) recognize their ability to affect prices and generally (although again not invariably) refrain from price competition and concentrate their competitive energies in fields such as advertising, product differentiation, research and development, and product image.

---

[33] Mooney is a vocal Canadian opponent of PVR; Leenders was secretary general of the International Seed Trade Federation; Hedding is an officer of the Victorian Department of Agriculture who has investigated PVR overseas (Hedding n.d.) and has publicly sought to allay fears about the potential effects of PVR (*Stock and Land* 1980, p. 4).

[34] While such concentration ratios neither prove the existence of oligopoly *per se* nor measure the degree of market power exercised by the major firms, such ratios are measures of the potential for oligopoly that suggest the desirability of further analysis; *c.f.* ASSINSEL (n.d., p. 26): "To have as many as four companies fighting over only 66 per cent of the market argues for a very competitive market situation . . .".

[35] In vegetables, there are reported to be three companies with active breeding programmes—Yates Seeds, Hendersons Seeds and New World Seeds. In hybrid summer crops, five companies have been reported with active breeding programmes—Yates Seeds, Pacific Seeds, Pioneer Hi Bred, Cargill and Dekalb Shand; additionally overseas-bred varieties of Northrop King and Asgrow are marketed in Australia.

There is an established prescriptive framework for evaluating the economic efficiency of perfect competition. There is no such generally agreed upon framework for deciding whether resources are allocated efficiently in an oligopoly, nor of evaluating whether or not changes proposed within the oligopoly—*e.g.*, to change prices, advertising levels, number of rival firms—are desirable (Scherer 1980, Chapter 17). Despite this inability to evaluate oligopolistic markets prescriptively, studies have drawn attention to general trends that emerge in an oligopoly. Several of these issues are discussed with regard to plant breeding in following sections.

3.3.1 Competition

(a) *Prices.* Concern has been expressed that PVR could permit "unreasonably" high seed prices to be charged. Seed prices will be "regulated" by the market as long as there is a sufficient number of plant breeding firms that the interdependence that categorizes oligopoly is not present[36].

Even with oligopoly in plant breeding, "unreasonably" high seed prices may not emerge if there are varieties in the public domain for which royalties are not charged—*e.g.*, varieties bred by public breeders[37], varieties never granted PVR, or varieties on which PVR grants have expired. Even if public varieties have inferior yields, free access to public varieties will establish a base price for seed, and yield differences will create price differentials among public and private varieties. Alternatively, as long as there are no substantial barriers to the entry of new firms to the plant breeding industry, the threat of a potential competition may also limit seed prices[38]. Additionally, most PVR legislation contains provisions to combat "abuse" of PVR grants—*e.g.*, compulsory licensing in European legislation and public interest provisions of U.S. legislation. Restrictive trade practices legislation may also be used to combat abuse of PVR monopolies (*e.g.*, Bomberault *v.* Eisele and INRA 1978).

---

[36] Concern with oligopoly seed pricing may not be unreasonable. The General Manager of a major Australian plant breeding firm has observed with regard to Third World farmers that "one way to ensure that a farmer pays attention to the agronomic needs of a crop is to sell him expensive, high potential seed. Planting expensive seed has a psychological effect far greater than the monetary value would indicate, in ensuring that the seed receives adequate nutritional and other inputs" (Herbert 1978–79).

[37] The mere existence of publicly-bred varieties is not, however, a prophylactic against high seed prices. For example, the Working Party on Cereal Seed Royalties was established following dissatisfaction from seed merchants and farmers with royalties in the U.K. (*Agricultural Merchant* 1977); however the existence of the U.K. Working Party on Cereal Seed Royalties contrasts with the results of the international survey on PVR by Agriculture Canada (1980) which had no reference to dissatisfaction in the U.K. with seed prices.

[38] Entry barriers to plant breeding may be substantial by Australian commercial standards. It has been suggested that the cost of one plant breeder is $100,000 *p.a.*, with most varieties taking at least 10 years to develop (Department of Agriculture, N.S.W. 1980).

If varieties in the public domain are restricted or eliminated (*c.f.* Section 5) or if users refuse to accept "inferior" varieties[39], market controls on oligopoly pricing will be weakened. Further, compulsory licensing provisions will not necessarily control seed prices if an excessively legalistic interpretation is placed upon "unreasonable restriction" of a variety's availability (*c.f.* U.K. decision on compulsory licensing, *Plant Varieties and Seeds Gazette* 1968). Even if prices are considered in compulsory licensing decisions, the Pandora's box of "cost of production" would appear to be ever-present, particularly in an oligopoly with economic rents (*c.f.* Posner 1975). Further, the public interest provisions of PVR in the U.S.A. (U.S. Congress 1970, Section 44) only empower the Secretary of Agriculture to open a variety to public use when this is necessary "to insure an adequate supply of fiber, food or feed" in the U.S.A.; such a situation would be only ever likely to apply in a national emergency and thus would be of little importance in affecting ordinary market operations.

A form of price "control" via the market also occurs through the relative profitability of farm enterprises. If seed prices of a variety or species rise too much, farm enterprise shifts may occur. However, since all farm enterprises are ultimately based on plant material, the predominance of PVR protected varieties in all enterprises, if accompanied by oligopoly, could eventually limit the control of seed prices through competition among farm enterprises.

(b) *Non-price competition.* There have been no comments on the incidence of non-price competition overseas following the introduction of PVR. Tentative evidence of non-price competition in hybrid field crops in Australia suggests that the level of advertising is high; there is proliferation of apparently-similar, branded varieties; and breeders attempt to create brand images (*Queensland Graingrower* most issues, 1978–1980).

(c) *Breeding objectives.* If a simple model of profit maximization is assumed, private plant breeders' objectives would be to optimize returns from the sale of breeding material and farmers' objectives would be to optimize farm income. Economic theory suggests a market solution to conflicting objectives would result in trade-offs between breeders' and farmers' objectives. It is possible, therefore, that the net social return from public breeding may be greater than with private breeding because, in the former, the objective of maximizing returns from the sales of planting material can be ignored[40]. For example, Simmonds (1979, p. 345) noted:

> the possibility that commercial pressures, especially if competition is less than perfect, could distort [plant breeding] objectives. Thus, unnecessary [hybrid] breeding could be encouraged if [hybrid] varieties were fashionable and seed were expensive; or disease resistance breeding could be discouraged if resistant varieties were likely . . . to be "grown on" by farmers and thus need lesser supplies of seed.

---

[39] In a vertically integrated industry, end users may also be plant breeders and thus it may be in their commercial interests to refuse to accept produce grown from, or convince governments to ban the use of, allegedly inferior varieties that are in the public domain.

[40] This should not be taken to infer that public breeders necessarily pursue farmers' and consumers' objectives successfully or efficiently.

Especially where plant breeding firms are horizontally integrated with agricultural chemical companies, there may be less attention paid to genetic resistance to pests and pathogens, and weed control by plant vigour competition, on the implicit understanding that the agricultural chemical industry can continue to develop chemical controls. This argument has been exaggerated by some opponents of PVR who have claimed that such plant breeders would specifically breed for susceptibility to specific pests and diseases. Chatterton (1981) provided thoughtful comments on this issue by arguing that, in a horizontally integrated plant breeding industry, plant breeders' objectives would be integrated with the overall corporate plan of the company, and thus a subtle direction of breeding to ensure that it would not undermine profitability in other segments of the company could eventuate.

Sparrow (1981, pp. 3–4) argued that the criterion of uniformity for a PVR grant could itself affect plant breeding objectives. It was argued that, in the absence of PVR, some varieties are released which are based on early generations after the initial cross; such varieties have some inherent variability and may contain useful buffering characteristics against environmental variability[41]. With PVR, the demand for uniformity in varieties would not permit such varieties to be granted PVR, eliminating these varieties from agriculture and adding several generations of selection to breeding programmes thus delaying varietal release. Other effects of PVR on the mechanics of plant breeding—such as selection among off-types of varieties to gain PVR grants for essentially identical varieties, the problem of identifying varieties for legal purposes, variation in distinctness characteristics of varieties in different environments—were also discussed by Sparrow (1981).

Again, in the absence of detailed, objective studies of the interaction between PVR and plant breeders' objectives, it would appear desirable that comprehensive analysis of this issue were undertaken.

(d) *Germplasm availability*. PVR grants are not available for non-commercial plant material (Mast 1975, p. 379); this is intended to minimize restrictions on germplasm exchange. Clearly, however, where commercial breeders base varieties on germplasm they acquire, it is not in their interests to advertise the type of material they use, nor to make such material freely available[42]. Where plant breeding shifted from a predominantly public to a predominantly private effort, it would not be surprising if germplasm exchange were less in the latter.

---

[41] See also Simmonds (1979, p. 133): "There is, however, no compelling reason to think that uniformity is biologically necessary, or even desirable"; and Briggs (1978, p. 446): "To equate uniformity ('purity') with high quality is irrational; indeed 'gene buffering' (the presence of mixtures of genotypes) *may* be desirable in a crop".

[42] Hall (1978, p. 22) noted:

> First, I would mention the exchange of ideas. We have not always and do not today discuss freely company or industry trade secrets. Most private plant breeders or industry groups keep parental sources and other techniques well protected as trade secrets.

Further, the emergence of a major private breeding sector is likely to encourage close links between private breeders and basic research workers in the public sector, especially where public breeders concentrate on germplasm collection, evaluation and release rather than the development of commercial varieties. Such links could include increased funding of public breeders by private firms. Derera (1975, pp. 940–942) noted that, in France and Holland, the free flow of information from public breeders was apparently being restricted by their links with corporate funding bodies. Hall (1978, p. 22) noted that, with regard to new variety releases from public breeding programmes in the U.S.A. and co-operation with private industry:

> There are some difficult problems to be worked out in this process in order to keep it working smoothly. For example, complications have increased with the development and implementation of the Plant Variety Protection Act. Each release requires more careful handling and all legal requirements must be met.

3.3.2 International aspects

Where corporate activities cross national boundaries, the optimization of corporate objectives is not necessarily compatible with the optimization of that branch of a corporation's operations within a national economy. The generation of funds for investment, the location of capital investment, and choice of location of research and production facilities are determined in a global context[43]. While suspicion of transnational corporate enterprise is frequently regarded as either xenophobic paranoia, or a manifestation of political radicalism, a conventional profit-maximizing economic model suggests that the effects of transnational enterprise should at least be critically evaluated.

Where "natural" plant variety property rights are currently available in Australia—*e.g.*, the hybrid summer crops—many private plant breeding firms are wholly, or predominantly, overseas owned[44]. Further, one of the main benefits of PVR has been seen to be access to foreign varieties (Department of Primary Industry 1980*a*, *b*; Industry Committee for Plant Breeders Rights 1980*a*, *b*). The terms by which such varieties would be made available, and the corporate structure conducting such trade, may have a major effect on the distribution of the benefits of these new varieties. For example, international trade in technology and seeds may permit international aggregation of profits in low tax countries through transfer payments (*e.g.*, Lall 1979) and thus the net benefits of the development of superior plant varieties may substantially accrue outside Australia.

---

[43] *e.g.*, Ford Australia, having made a profit of $0.3 m in 1980 paid a $3.4 m dividend to its U.S. parent; the reason for this dividend was linked to the "massive problems faced by Ford in the U.S." (Woodgate 1981, p. 14).

[44] These include Pacific Seeds (owned by Continental Grain); Dekalb Shand (Dekalb Agresearch and Dalgetys); Pioneer Hi Bred (Pioneer Hi Bred, U.S.A.); Northrup King (Northrup King, U.S.A.); Cargill Seeds (Cargill, U.S.A.). Interestingly, the major Australian-owned plant breeding firm—Yates Seeds—is itself a transnational corporation with an associated company in the U.K.

Further, it may be feasible for a transnational plant breeding firm operating in Australia to locate its major plant breeding research activities for Australia at some central facility outside Australia and only have testing stations in Australia or, alternatively, Australia could become a major centre for global plant breeding research for one or more companies. In the latter case, Australia would gain from investment and increased employment, and from imports of technology. If such facilities were not established in Australia, the benefits to Australia of PVR's encouraging private breeding may be limited to new variety releases and there may be few secondary employment, investment or technology spin-offs that would otherwise result from Australian-based research.

3.4 Summary

Economic theory and empirical evidence suggest that the effect of PVR on private breeding is likely to be concentrated at the applied end of the plant breeding research spectrum. Government reaction to adoption of PVR will determine whether an increase in total plant breeding research occurs after enactment of PVR, whether public breeders concentrate on more basic plant breeding research or whether a simple substitution of private for public funds occurs in plant breeding.

If, as appears probable, an oligopoly industry structure in plant breeding is accentuated by PVR, and if this oligopoly is extended into seed multiplication, evaluation of the economic effects of PVR becomes considerably more complex than has previously been suggested. Considerably more research is required, both in Australia and overseas, to test the range of hypotheses surveyed above, and to provide more conclusive evidence of the economic effects of PVR on plant breeding and the private breeding industry.

4. Effect of PVR on Trade

It is generally argued that adoption of PVR improves a country's access to foreign varieties and enhances its ability to benefit internationally from domestic breeding (*e.g.*, Industry Committee for Plant Breeders' Rights 1980*a*, *b*). The areas of trade in seed and varieties that PVR might affect are the acquisition of commercial plant varieties from overseas; the bulking-up of foreign varieties for re-export; and the sale overseas of Australian varieties via royalties as well as seed.

As trade in seeds exists without PVR, this section commences with a review of this trade. This review is followed by an evaluation of the potential effect of PVR on imports and exports. It is concluded that the likely net effect of PVR adoption on Australian trade in seeds and plant varieties has been overstated.

4.1 Trade without PVR

Trade in reproductive plant material exists without PVR. In 1977–78, Australian imports of plant material for reproductive purposes were valued at $6.55 million and corresponding exports were $10.88 million[45]. There are a number of important factors influencing trade in reproductive plant material without PVR. Firstly, trade in hybrid varieties is unlikely to be affected by adoption of PVR because these varieties have "natural" property right protection. Secondly, trade in varieties in the public domain—*i.e.*, varieties for which PVR may not be granted, or for which PVR are not applied—is unaffected by the absence of PVR. Thirdly, it is possible for an Australian firm to gain PVR grants in countries with PVR by establishing subsidiary breeding firms in those countries. In the U.K., foreign breeders may apply for PVR regardless of whether their own countries have PVR (Fryer 1974). Fourthly, Australian firms currently sell Australian-produced seed in countries with PVR in successful competition with PVR-protected varieties—*e.g.*, Yates Seeds Ltd exports vegetable seeds to Britain, Netherlands, France, Germany and Italy (*Overseas Trading* 1979, p. 588). Fifthly, where a company has a domestic monopoly of sales of a particular species, it is possible to acquire PVR-protected varieties from overseas—*e.g.*, Cotton Seed Distributors Ltd acquires cotton seed under licence from two breeders in the U.S.A. (*Annual Reports*, Cotton Seed Distributors Ltd).

Hedding (n.d., p. 17) suggested that, while PVR had stimulated an internationally-orientated plant breeding industry, the lack of PVR was not a necessary, nor the only, barrier to Australian imports of foreign varieties. While foreign horticultural breeders exhibited the strongest resistence to varietal exports to Australia, most breeders of agricultural crops were "wary of but not opposed to" releasing material for seed multiplication and re-export, but were "a little more concerned" about the use of their varieties for production in Australia[46]. Hedding also noted the role of quarantine restrictions—and not the absence of PVR—in inhibiting entry of new material for testing[47].

Some claims of deleterious effects on trade of not adopting PVR appear to be exaggerated. For example, it has been claimed that "New Zealand has stolen a march on Australia and Canada with PVR and has already benefited with better access to a wide range of new cultivars" (Smith 1979); however, by May, 1979, grants of PVR had only been made in New Zealand for 23 varieties, of which 17 were roses and 6 were barley (Whitmore 1979). Further, it has been inferred that some Australian agricultural industries face bleak futures through lack of access to foreign varieties that would be eliminated by adoption of PVR.

---

[45] These figures are exclusive of trade in varieties as opposed to trade in plant material. For example, the reproduction of F_1 hybrid varieties under licence in Australia may be associated with royalty payments to the overseas owners of these varieties without associated trade in seed. No data is available on trade in varieties or related plant breeding technology not associated with physical trade in seed.

[46] *c.f.* Mullett (1976, p. 20) who noted that, while some U.K. breeders evinced interest in 1976 in expanding cereal and vegetable seed production into Australia on the basis that Australia had PVR, these breeders did not consider the U.S. registration scheme was adequate. An officer at the National Institute of Agricultural Botany "shared this opinion and stated that major European companies would not be interested in working under any system less controlled than the UPOV scheme."

[47] Note, for example, that "Imports of potato genetic material are only approved for introduction by government agencies" (Department of Health 1979, pp. 2–8).

For example, it has been claimed that one of the main problems of the Tasmanian apple industry is that existing varieties are outmoded and lack of PVR is preventing the acquisition of better varieties (Edwards 1979, p. 2; and see also Newport *et al* 1975, p. 3785)[48]. The following comments suggest this claim is exaggerated. Firstly, as shown by Curran and Roberts (1974) and BAE (1975) the decline of the Tasmanian apple industry has much more complicated origins than just a lack of suitable varieties. Secondly, Curran and Roberts (1974) argued that Australia's traditional markets in Europe were dominated by traditional varieties. Thirdly, Miller (1981, p. 20) identified two major problems on export markets for apples, pears and canning fruits—*viz.* the relatively high costs of shipping and transport for these commodities and excessive protection in the E.E.C. Fourthly, where serious problems of lack of suitable varieties have arisen—*e.g.*, following the lucerne aphid epidemic in the late 1970's—it has proved possible to acquire foreign varieties for Australian agriculture.

PVR are not essential to continued Australian exports or imports of reproductive plant material, but are likely to affect the quantity and type of plant material in which Australia trades[49]. Subsequent sections examine the potential effect of PVR on Australian trade in reproductive plant material.

4.2 Effect of PVR on imports

4.2.1 Economic superiority of foreign commercial varieties

Apart from their potential use in domestic breeding programmes, foreign commercial varieties may be directly used in commercial Australian agriculture because of their potential for improving yields. Potentially greater yields derive from botanical factors governing seed or fruit set, or dry matter production; resistance to pests and diseases; greater competitiveness with weeds; ability to withstand adverse weather; or responsiveness to other inputs such as fertilizer and irrigation. Not all varieties with desirable characteristics are, however, adaptable to Australian agricultural conditions[50].

The degree to which the improved yield potential of a foreign variety is actually expressed in commercial Australian agriculture is not, however, simply a function of the genetic characteristics of the variety and its geographical adaptability. "High yield" varieties are frequently varieties which respond well

---

[48] This claim appears to have wide currency; in 1980, the author heard it quoted by a patent attorney as evidence for adoption of PVR. The example is typical of many Australian quests for simple technological answers to complex socio-economic problems of Australian agriculture. While some problems do have technological solutions—*e.g.*, myxomatosis, cactoblastis insect, trace elements—many do not. An analogy can be drawn between the claims of Newport *et al* (1975) concerning the Tasmanian apple industry, and the belief in parts of the N.S.W. north coast dairy industry during the 1960's that the development of tropical legumes would "save" dairying in that region.

[49] Canada was the world's second largest exporter of seed potatoes (Rowberry and Howells 1979) although it did not then have PVR.

[50] For example:

> Australian agriculture will only gain if plant breeders produce more improved plant varieties. It could gain if it had access to improved plant varieties from overseas countries, although differences in climate limit these potential gains. (Western Australian Department of Agriculture 1980, p. 4).

to purchased inputs such as fertilizer and crop chemicals, and the optimal quantity of inputs—and thus the yield level achieved—is a function of economic parameters such as input and output prices.

Australian agriculture, apart from horticultural industries and intensive livestock production, is oriented to export markets. Export markets have generally lower and less stable returns than the domestic markets for agricultural products of industrially developed countries. Further, because of the relatively small markets for many Australian inputs and the dependence upon imports—*e.g.* farm machinery, chemicals—the costs of purchased inputs are generally higher in Australia[51]. In addition, land is relatively cheap. Thus efficient agricultural production is oriented to large area, low input farming with low physical yields (Binswanger 1978, p. 28; Sparrow 1981, p. 1). These factors imply that a foreign variety, even if agronomically adaptable to Australia, is unlikely to achieve yield levels similar to those obtained in North America, and more especially in Western Europe[52].

Conversely, the production of horticultural crops is oriented predominantly to higher-priced, stable, domestic markets, and hence cultural techniques using high levels of inputs—fertilizers; chemicals to control soil pathogens, pests, diseases and weeds; mechanical cultivation; irrigation; glasshouse production; labour; *etc.*—are generally profitable. Thus overseas-bred horticultural varieties are likely to be appropriate to Australian agriculture.

The effect of adopting PVR on the acquisition of commercial varieties from overseas partly depends on the suitability of overseas varieties to Australian agriculture. Many commercial overseas varieties may not be suitable for Australia if such varieties are only economic when used in a high-input agriculture. It is probable that the major effect of PVR will be to aid the acquisition of PVR-protected varieties of horticultural crops of (i) non-hybrid varieties reproduced by seed; and (ii) asexually-reproduced varieties. Enactment of PVR in Australia may also aid the acquisition of foreign varieties for species in which little or no Australian breeding is currently undertaken; in this case, any new variety may be potentially useful.

---

[51] There do not appear to be major comparative international studies of the relationships between agricultural input and output prices. Using FAO and BAE data (FAO 1978, 1980; BAE 1981), the price of wheat relative to prices of phosphate, nitrogen and potassium fertilizers were calculated for five European countries (France, West Germany, Netherlands, Italy and U.K.), two North American countries (Canada and U.S.A.) and Australia. Geometric mean price ratios were:

	wheat/phosphate	wheat/nitrogen	wheat/potassium
European	0.36	0.40	0.88
North American	0.20	0.22	0.54
Australia	0.32	0.22	0.36

The Australian relative wheat to phosphate price is comparatively high because of the low Australian price for phosphate. The Australian wheat/nitrogen price is low compared to the European ratio and comparable with the North American. The Australian wheat/potassium price is considerably lower than in Europe and North America. No other relative output: input prices could be readily calculated and compared.

[52] This may partly explain the "yield clubs" conducted by private plant breeders in summer crops; these yield clubs appear to be attempts to raise Australian yields of varieties predominantly sourced overseas (see *Queensland Graingrower* various issues).

4.2.2 The availability of foreign PVR protected varieties

In discussion of the Australian availability of varieties granted PVR in other countries, two distinct issues are frequently confused. These issues concern legal and moral aspects of variety availability, and the more general economic issues of acquiring overseas plant varieties.

(a) *Legal availability and moral issues.* Purchases of reproductive plant material of a PVR-protected variety may be made in other countries. As long as other countries permit export of the material[53], and where Australia's quarantine laws permit its entry and release[54], plant material may be imported to Australia, multiplied up and distributed[55]. No law has been broken because other countries' PVR laws do not have jurisdiction in Australia.

The acquisition of PVR-protected varieties from overseas without associated royalty payments, although legal, may be seen to raise moral issues. In particular, is it morally right to acquire material subject to a property right in one country for use in another country where that property right is not recognized? Some related issues were canvassed in Section 2.2, and these ethical questions will not be pursued in detail. Two brief points may, however, be made. Firstly, as with many moral or ethical issues, there may be a wide variety of conflicting opinions as to whether it is proper to recognize in a country without PVR legislation such a property right granted elsewhere.

Secondly, it might be noted that nearly all Australian commercial plant varieties have been acquired, and are continuing to be acquired, directly from overseas, or bred from exotic materials, with indemnity neither to their personal owners (if any) nor to their collective owners (*i.e.*, the countries from which they have been imported)[56]. Thus, it might be argued, since Australia has ignored moral rights in the development of its agriculture in the past, there is little point in belatedly recognizing a very narrow type of moral right with regard to ownership of commercial plant varieties in the future.

There is unlikely to be unanimous agreement on these moral issues. It is, nevertheless, conceptually important to distinguish them from the commercial considerations of PVR and trade.

---

[53] Note, however, that:

> In (West) Germany, the (PVR) law expressly gives the breeder an exclusive right to produce and market propagation material for his varieties in Germany; the exclusive right is expressly extended to exports to countries that do not afford equivalent (PVR) protection. (Bomberault *v.* Eisele and INRA 1978, p. 441).

[54] *c.f.* footnote [47].

[55] In the European Economic Community, the only seed that is available to farmers in a wide range of species is basic seed and two generations of certified seed (*Plant Varieties and Seeds Gazette* 1972; National Institute of Agricultural Botany 1976, 1977). Thus, if such seed were available for export to Australia, seed no more than three generations from breeders' seed could be acquired. In self-pollinating species, and to a lesser extent cross-pollinating species with adequate quality control, it would be possible to produce commercial quantities of seed of satisfactory quality from such imported varieties.

[56] A recent American visitor to Australia claimed, in a non-citeable but widely circulated article in the *Australian Seed Science Newsletter* that Australian seed firms have a "reputation" overseas for "re-naming" foreign vegetable varieties, and that this was causing "antagonism and confusion overseas". An overseas-owned, Australian seed company has been quoted as saying that "Australia has a very bad name internationally for stealing varietal material . . ." (*Queensland Graingrower* 12 August, 1981, p. 14). If these claims are true, the cost of acquiring foreign varieties may rise significantly with PVR.

(b) *Commercial availability*. The commercial availability of PVR-protected varieties has two aspects. Firstly, if Australian imports of foreign, PVR-protected varieties are currently restricted this could arise either from the lack of PVR in Australia, or from the likelihood that Australia will adopt PVR in the near future. If overseas breeding companies believed that Australia *would not* adopt PVR, they would have nothing to lose by releasing their PVR-protected varieties to Australia, especially if they could conclude licensing agreements with all, or dominant, Australian distributors or could sell the first release of seed at a high price. Conversely, if overseas breeders believed that Australia *would* adopt PVR, they would be likely to defer release of their PVR-protected varieties until PVR is adopted so that their returns from the Australian market could be maximized. Thus, claims that the lack of Australian PVR is inhibiting variety imports (*e.g.*, Edwards 1979; Department of Primary Industry 1980*a*, *b*; Industry Committee for Plant Breeders Rights 1981*a*, *b*) should be treated with some caution in the current Australian context of adopting PVR. Were there currently no prospect of PVR adoption in Australia, it is unclear as to what the commercial availability of varieties granted PVR overseas would be[57].

Secondly, although it may be conceivable for an individual or a company not involved in commercial plant breeding or plant importing to acquire PVR-protected varieties from overseas without paying royalties, this action may not be open to commercial plant breeders or plant importers. Breeders and importers may be subject to commercial retaliation if they ignore overseas PVR rights. Such retaliation may take the form of restrictions on the availability of otherwise available varieties, restrictions on the availability of germplasm for breeding purposes, or reciprocal appropriation of Australian-bred varieties without compensation.

The question of the commercial, as opposed to legal, availability of PVR-protected varieties raises a further question as to the distribution of benefits of variety imports resulting from PVR adoption in Australia. If PVR were adopted in Australia, the importing of overseas varieties protected by PVR would probably be concentrated in commercial firms because international licensing agreements are likely to be expensive to conclude—especially in terms of the costs of information search to determine which varieties to acquire—and there are probably significant economies of scale in this activity. The adoption of PVR may therefore have the commercial consequence of precluding individuals from introducing PVR-protected varieties, while considerably enhancing the capacity of corporations to do so. Thus the lobbying by Australian plant breeding firms for adoption of PVR cannot be divorced from considerations of the significant commercial benefits that may accrue to them as a consequence of such lobbying.

---

[57] Chatterton (1981, pp. 6–7) argued that, since the Australian Government had announced its intention to introduce PVR legislation, (i) it would be foolish to release a variety now and forego potential royalties; and (ii) overseas breeders would not "undermine their Australian colleagues most powerful argument (for PVR) by freely releasing varieties during this period of public debate". Chatterton also argued that, while a wide range of ornamentals had been unavailable, there had been no complaints of restrictions on wine grape varieties. It was also noted that there had been no difficulty in acquiring privately bred lucerne varieties following the lucerne aphid introduction. Western Australian Department of Agriculture (1980, p. 9) has also drawn attention to the importance of the price of varieties in determining whether a variety is introduced into Australia.

(c) *Economic availability*. If the enactment of Australian legislation for PVR stimulates the commercial importation of foreign varieties, the benefits and costs of these imports should be related to the overall benefits and costs of adopting PVR. One particular cost of importing large numbers of varieties will be the cost of farmers' acquiring reliable information on the value of imported varieties. The Western Australian Department of Agriculture (1980, pp. 4–6) has expressed considerable concern about the likelihood of considerably increased numbers of varieties on which farmers would press for objective assessment.

Viewed in isolation, the issue of evaluation of varieties is an economic one of either determining the optimal allocation of public resources to merit testing and providing such testing as an unpriced good, or determining an appropriate schedule of testing charges and creating a "market" in varietal evaluation. However, in the context of decisions about enacting PVR with the knowledge that more varieties will undoubtedly become available, consideration of PVR *cannot* be divorced from consideration of varietal testing[58].

There are at least three possible solutions to this problem in the economics of information. One solution would be to rely on the information disseminated by commercial firms as to the value of their imported varieties. A second possible solution would be to conduct official trials on commercial varieties, and for Departments of Agriculture *etc.*, to disseminate these results; this option raises the further questions as to whether to charge for such a testing service and, if so, how to determine the appropriate charges. A third approach—widely adopted in Western Europe—would be for governments to create lists of legally-tradeable varieties (National Lists) or Recommended Lists of suitable varieties. While the National List approach has been rejected by Australian Governments, the adoption of some government mechanism for evaluating and controlling new varieties resulting from PVR has been recommended (*e.g.*, Australian Seed Producers' Federation 1980; Johnson 1980; *The Land* 1980).

If the adoption of PVR results in greater complexity of decision making concerning choice of varieties, more evaluation is required of the best mechanisms for facilitating the provision of information about varieties to farmers.

4.3 Effect of PVR on exports

The effect of PVR on Australian trade involves two issues. The first issue concerns the effect of PVR on exports of reproductive plant material, and the second concerns exports of other plant material.

---

[58] Simmonds (1979, pp. 222, 224) has noted that:

> VCU [Value for Cultivation and Use] requirements are historically adventitious; it would be perfectly possible to have them without PVR . . . but, in fact, the idea has grown up alongside PVR.
>
> This situation (PVR with the necessary DUS but not VCU) would be perfectly stable if left alone; in practice it is transient, or has been in Europe in recent years, to a much more restrictive situation . . . in which the VCU criterion is used to shorten the list of permissible cultivars.

Australian exports of reproductive plant material fall into two broad categories. Horticultural species (vegetable, tree and flower seeds) are sold predominantly into developed countries who have adopted PVR. This trade appears to occur primarily in overseas-bred varieties for which PVR have not been granted, and arises from the geographical suitability of Australia for seed production in a number of species. Although the absence of PVR is not an absolute barrier to multiplication of varieties granted PVR elsewhere, adoption of PVR would probably expand the number of varieties which could be multiplied in Australia and re-exported[59].

Secondly, the major markets for pasture and forage seeds are divided between developed and undeveloped countries. As with horticultural species, adoption of PVR would be likely to expand the range of domestically bred and overseas pasture and forage varieties which could be multiplied in Australia and re-exported. With undeveloped countries, however, even if PVR led to the availability of superior new varieties for export, it may be more efficient for undeveloped countries with limited foreign exchange to purchase "inferior" varieties if new varieties granted PVR become available only at higher prices[60].

If enactment of PVR stimulates Australian plant breeding, this may well result in expanded export markets. There are, however, several factors that may limit the potential export possibilities. New Australian-bred varieties

---

[59] At the IAC enquiry into financing rural research, the Australian Seed Producers' Federation noted:

> Although still embryonic, there is a movement towards the "bulking-up" of overseas cultivars for re-export . . .. This area of seed production has great potential . . . However this is not the area having the greater "flow-on" effect for Agriculture in Australia. The principal area of concern to the Federation is that Seed Producers are able to efficiently produce Australia's annual internal usage of seed and that this seed usage is increased to the benefit of Australian Agriculture (Sewell 1975, p. 2315).

A later submission to the same enquiry by the Victorian Farmers' Union and Australian Seed Producers' Federation (n.d., p. 6) noted:

> Currently, many professional Australian seed growers are bulking-up, under contract, overseas cultivars of pasture and oilseeds for re-export in entirety, back to the country of origin. These cultivars are not available in Australia . . .

Sinclair (1979, pp. 5–6) noted:

> One success story in your own field is that of a Victorian horticulturalist who induced European seed merchants, market gardeners, and Government agricultural advisory services to send their stock "breeder" vegetable seed to Australia for bulk seed production during our summer season. The result is that his firm now provides a vegetable seed production service to hundreds of customers in Europe, Britain, the United States, and Japan. That effort, I am sure, can be duplicated by others . . .

Sewell (1980*b*) noted that, while there was "presently a very strong interest in the production of seed under contract in Australia for re-export", the lack of PVR and lack of varietal testing facilities in Australia to determine the feasibility of bulking-up particular varieties were major obstacles to continued seed exports.

[60] In the pharmaceutical industry which has interesting parallels to plant breeding with PVR, new products have generally stable prices once released, at least until the relevant patent expires. Price changes generally occur through newly-released products, rather than through adjustments to list prices. It is possible that a similar price-changing mechanism might be adopted in a predominantly private plant breeding industry (Godden 1981*a*, p. 155).

may not be geographically or economically adaptable in other countries (*c.f.* Section 4.2.1; Sewell 1980*b*, p. 10). In most European countries, new Australian varieties would have to gain entry to the appropriate National and Recommended Lists; Sewell (1980*b*, p. 10) noted that there have always been problems in gaining the necessary listings. While-ever Australian production in any particular variety is small, there will be problems of assembling a marketable quantity of that variety for export (Sewell 1980*b*, p. 10). Finally, the capacity of Australia to provide additional quantities of seed has not yet been tested; increased volumes of seed exports presume that the elasticity of seed supply in Australia is sufficiently high.

The second area of Australian exports relates to trade in plants rather than trade in reproductive plant material. Ranford (1981, p. 5) suggested that export opportunities are being lost in such trade because Australia does not have PVR. While there is apparently no analysis of Australian exports of plants, it should be noted that such trade currently exists. Sinclair (1979) drew attention to one exporter's success in developing a trade in multiplying overseas varieties in Australia (see footnote [59]). Woods (1979) reported developments in export markets for traditional pot-plants and Australian native species in the Middle East, the U.S.A. and Europe. *Overseas Trading* (1981) reported the success of a Sydney nurseryman in exporting palms and Norfolk Island Pines. Woods (1981) reported good export prospects for nursery products, particularly Australian native species, in the context of PVR.

Even in the absence of analyses of Australian exports of plants, some hypotheses may be proposed as to the effects of PVR on such trade. Firstly, enactment of PVR will only create new markets for plants where superior new varieties are bred or where PVR induces additional marketing expenditure to be denoted to plant sales. Secondly, PVR will stimulate marketing of plant material only where species are covered by PVR; species not included in PVR systems are unlikely to be beneficially affected. Thirdly, PVR is only one element in export marketing performance. As shown by the examples illustrated by Sinclair (1979) and *Overseas Trading* (1981), marketing expertise can succeed without PVR; it is unlikely, however, that PVR will stimulate exports without marketing expertise.

One particular area of export marketing for which PVR is predicted to have an effect relates to Australian indigenous species. Ranford (1981, p. 5) suggested that other countries are taking over production and export of Australian indigenous species to the detriment of potential Australian exports. Israel was singled out as one country participating in such trade. Ranford suggested that Australian PVR would assist Australians in benefiting from this trade. It should be noted, however, that PVR would only affect newly-bred or newly-discovered varieties of Australian indigenous species. Since the range of varieties in the large number of indigenous species is also very large, competition from the existing public varieties may make it difficult to recover breeding costs from new varieties of indigenous species. Further, the cost of administering PVR in these species could be very large given the numbers of such species and varieties. Finally, the exploitation of export markets of Australian indigenous species expanded by PVR depends upon whether other countries include these species within their PVR systems. Even Israel, singled out by Ranford (1981,

p. 5) as being engaged in trade in Australian indigenous species, had specifically included, to 1st May, 1977, only one Australian indigenous species[61]. It is not known that any other country has included Australian indigenous species in its PVR system. It is improbable, therefore, that any present trade in Australian indigenous species has been stimulated by PVR. Thus, while PVR may stimulate future Australian exports of indigenous species, the degree to which this will occur is presently not known. The economics of such trade, compared to the likely costs of including these species in Australian and other countries' systems of PVR, is even more uncertain.

4.4 Summary

The major effect on trade of Australian adoption of PVR appears likely to be to facilitate import of foreign horticultural varieties by major plant breeders (governments, universities, private firms), major seed merchants and nurserymen. The effect of PVR adoption on imports of field crops and pastures is likely to be relatively small, since many varieties of these species may not be agronomically or economically suited to Australian production. Similarly, seed exports of field crops and pastures are unlikely to be substantially influenced by adoption of PVR. Exports of new Australian horticultural varieties and re-export of overseas PVR-protected varieties may be stimulated by PVR.

5. Economic Implications of Administrative Aspects of PVR

The way in which PVR is administered in Australia may have a significant impact upon the economic effects of PVR. Some potentially important economic issues are discussed below.

5.1 Interaction of PVR and other legislation

Associated government regulation may be synergistic[62] with PVR; that is, although other regulations may have developed independently of PVR, they may reinforce the effects of PVR.

An interesting example of regulatory synergism appears to occur with PVR in the U.S.A.. Section 83 (a) of the Plant Variety Protection Act, 1970, enables breeders whose varieties are granted PVR to elect that their varieties may only

[61] The only Australian species listed by UPOV (1979*b*) as being covered by PVR in Israel was *Duboisia leichardtii* F. Moell. This species is not an ornamental but the pharmaceutical products hyoscine and atropine are extracted from its leaves. Israel also included the family *Orchidaceae* in PVR, but no indigenous Australian species were listed as having been included.

[62] Synergism: co-operative action of discrete agencies such that the total effect is greater than the sum of the two or more effects taken independently.

be reproduced as certified seed; certified seed production is governed by the Federal Seed Act. The link between PVR and seed certification has the following effects:

(a) if unauthorized reproduction of uncertified seed is detected, breeders do not necessarily have to take civil action to protect their PVR grant but may request the USDA to prevent sale of the uncertified seed. If sale has already occurred, civil action would be required to recover damages;

(b) breeders' costs of detecting unauthorized reproduction of certified seed are minimal, since they may obtain lists of seed producers who are reproducing certified seed of their varieties; and

(c) breeders' administrative costs of licensing seed producers are low as they can obtain full lists of both the seed producers of their varieties, and the amount of seed of each variety certified on behalf of each seed producer (Guerry 1971, p. 93; Hedding n.d., p. 8).

Given these benefits of following the "seed certification route" for PVR in the U.S.A., it is not surprising that a major proportion of PVR grants for field crops in the U.S.A. occurred by this route (White 1976; Loden 1978; *Plant Variety Protection Office, Official Journal* 1978–79). What *is* surprising is that the use of this "seed certification route" was not expected in the U.S.A. (Loden 1978; and *c.f.* footnote [21]).

A second example of synergism appears to exist in the EEC. Mooney (1979) expressed concern at a possible relationship between PVR and other regulation of plants and seeds. His attention focused on the "Common Catalogue" of the EEC Seed Directives; as reported in *Plant Varieties and Seeds Gazette* (1972), these Seed Directives:

(i) only permit the marketing of approved varieties of demonstrated agricultural merit ("Common Catalogue");

(ii) ban the sale of uncertified seed;

(iii) limit the number of generations between basic and certified seed; and

(iv) impose compulsory minimum seed standards.

Whether or not the development of the EEC Seed Directives was independent of PVR legislation[63], it appears probable that these Directives will substantially reinforce the benefits of PVR to plant breeders. For example, the rationalization of available varieties through the Common Catalogue will reduce the number of varieties in the public domain competing with PVR-protected varieties. Such rationalization may occur through administrative decree to eliminate synonyms. Rationalization may also occur if firms nominated as maintainers of varieties in National Lists—and who may also be breeders of new varieties granted PVR—decline to act as maintainers of old varieties[64].

---

[63] *c.f.* footnote [58].

[64] In a perfectly competitive market with perfect knowledge, other firms could be assumed to take on the role of maintaining varieties for National List purposes. In an imperfect market, and particularly in an oligopoly characterised by norms of competitive behaviour, it cannot be automatically assumed that new maintainers would be forthcoming.

As most new varieties will be PVR-protected, the Common Catalogue—and thus the range of commercially available varieties—will become more rapidly dominated by PVR-protected varieties. Thus, the maintenance of price competition by competition between varieties granted PVR and varieties in the public domain will be eroded over time.

Banning the sale of uncertified seed and imposing minimum seed standards will probably increase seed prices to farmers and reduce the farmers' ability to choose seed on the related criteria of quality and price. Further, the higher the certification standards, the greater the probability of seed crops' failing to meet those standards; hence the area of seed crops sown is likely to be higher than otherwise, and thus sales of basic seed by breeders will be higher[65]. The severe limitation on the number of generations between basic and certified seed—*e.g.*, two generations for cereal seed—will also help increase breeders' sales of basic seed. Concern has been expressed about the EEC Seed Directives by British seed firms with regard to elimination of uncertified seed sales (Beaven 1976, p. 37).

There are, no doubt, other opportunities for the benefits of PVR to be reinforced through associated seed and plant legislation. For example, if the OECD seed schemes which certify seed in international trade were restricted to PVR-protected varieties, and if countries only permitted trade in OECD certified seed, the benefits of PVR to breeders could be greatly enhanced by eliminating competition from non-PVR-protected varieties.

The effects of possible interactions between existing legislation and regulation governing plants in Australia, and proposed PVR legislation, do not appear to have been extensively analysed, although this interaction may substantially affect the economic effects of PVR. Additionally, future legislation or regulation by government or statutory authorities may also modify the impact of PVR, and evaluation of such proposed regulation should consider potential interaction with PVR.

5.2 "U.S." v. "European" systems of PVR

There has been considerable debate as to whether an Australian system of PVR should follow the "U.S." or "European" administrative models for determining novelty, distinctness, uniformity and stability (*c.f.* Section 2.1). In the European model, field trials are used to determine the status of these four characteristics, with experts assessing whether "new" varieties are actually novel and distinct, and whether there is satisfactory uniformity and stability.

[65] Hadfield and Marshall (1980, p. 24) reported special royalties on basic seed for varieties bred by the Crop Research Division of the New Zealand DSIR. For the U.K., the Working Party on Cereal Seed Royalties recommended that *additional* levies on basic seed sales should be restricted to the first year of sale of the basic seed of a new variety in other than the most exceptional circumstances (*Agricultural Merchant* 1977).

The European model therefore has low initial investment, and high recurring expenses in the forms of continuous field trials, to determine novelty, distinctness, uniformity and stability[66].

Contrarily, the U.S. system is based on the systematic cataloguing of objective descriptions of all existing varieties in all species subject to PVR grants. Distinctness is then determined by comparing an objective description of a putatively distinct variety with recorded descriptions of all varieties of the same species in the objective catalogue. The U.S. system has, therefore, a phase of high initial investment in which consistent, objective descriptions of existing varieties are recorded and catalogued. However, by the use of computer-based searches, recurrent expenditure for the assessment of distinctness of new varieties should be low.

It is difficult to assess the relative costs of the European and U.S. systems. Fryer (1974, pp. 8, 22) suggested that PVR systems with field testing covered about 50 per cent of their costs by fees. Data for the U.S.A. (Fryer 1974; Hedding n.d.; Leese 1978), suggests that approximately 33 per cent of costs of administering U.S. PVR for the period 1970–78 were covered by fees. Edwards (1981, p. 5) indicated that, by 1979, the U.S. Plant Variety Protection Office budgeted to cover 47 per cent of its annual costs by fees. How long it will take the U.S. system to break even, and eventually cover the initial costs, is a matter for conjecture.

5.3 The UPOV Convention

The international convention of PVR (UPOV) primarily aims to simplify the administration of reciprocity of PVR grants between countries. It may be possible, for example, that acceptance of novelty, distinctness, uniformity and stability in one UPOV country may result in qualification for PVR in another without the need for additional testing[67].

The UPOV Convention has two interesting implications for PVR in Australia. Firstly, by ratifying the Convention, the Commonwealth may be able to legislate for PVR under its external affairs power (see Coper 1978, p. 80). This issue is important because there has been some discussion as to whether PVR can be legislated for under the Commonwealth's patent power (Commonwealth Constitution, Section 51 (xviii)). Edwards (1979, p. 8) and Industry

[66] Field testing in the European model of PVR for novelty, distinctness, uniformity and stability, is commonly confused with the field testing required for entry to the EEC Common Catalogue, and by other countries outside the EEC for National Lists. Field testing for the Common Catalogue and National Lists generally requires demonstration of novelty, distinctness, uniformity and stability and, additionally, demonstration of agricultural merit. Agricultural merit may involve superior yield, better pest and disease resistance, *etc.*

[67] Both proponents and opponents of PVR have exaggerated the role of UPOV by claiming that accession to UPOV will, by accession *per se*, lead to the automatic grant of PVR in all countries following a grant of PVR in any one UPOV member (*e.g.*, Possingham 1973). Clearly, UPOV membership will not automatically override national sovereignity. However, a member of UPOV may itself decide that any grant of PVR elsewhere will automatically result in its own grant of PVR. UPOV is working towards tests for PVR in one country being acceptable in other countries (Mast 1975; Thiele-Wittig 1978).

Committee for Plant Breeders Rights (1981*b*) reported that the Commonwealth Attorney-General had advised that the patent power of Section 51 (xviii) enabled the Australian Government to legislate for PVR (see also Thomas 1981, p. 5). Contrarily a former Australian Commissioner of Patents noted that two aspects of PVR—the granting of property rights for a discovery and the non-disclosure of the parents of hybridized variety—manifestly fell outside the concept of patent law (Petersson 1973, pp. 3–4). The Western Australian Government has consistently expressed reservations about the constitutional power of the Commonwealth to enact PVR without complementary state legislation (Western Australian Department of Agriculture 1980, p. 3). It has been decided to proceed with Commonwealth legislation, subject to agreement by States as to the plant kinds to be included. Nevertheless, the potential ratification of UPOV may play a useful role in securing the Commonwealth's legislative standing.

Secondly, new member states of the UPOV Convention agree to incorporate a range of major agricultural species in their systems of PVR within a specified time period. In the 1961 UPOV Convention, member countries agreed to include certain genera within their systems of PVR within a specified time-scale (UPOV 1979*a*, pp. 6–7, 30, Article 4 and Annex). In the revised 1978 UPOV Convention, member countries:

> undertake to adopt all measures necessary for the progressive application of the provisions of this Convention to the largest possible number of botanical genera and species (UPOV 1979*a*, pp. 41–42, Article 4).

Upon entering the Convention, a country agrees to include 5 genera or species within its PVR scheme, and to cover 24 genera or species within 8 years. The 1978 revised Convention has not yet come into force. If it was decided that Australia should join UPOV, this would imply that the PVR scheme adopted would almost inevitably become wide ranging and cover most species of economic significance.

5.4 Potential benefit of late adoption

If Australia adopts PVR, one benefit of late adoption would be to take advantage of the best administrative aspects of various overseas schemes. One possibility is that the U.S. computer records of their objective descriptions of known varieties could be used as the basis for an Australian data bank of known varieties.

The possibility of using U.S. computer records has two aspects. Firstly, in many species—particularly field crops—Australian varieties may never have entered U.S. records and so considerable and costly updating of the data base may still be required. Secondly, there appears to be some disagreement as to whether these records are actually available. After a study tour of the U.S. in late 1977, Norris (n.d., p. 6) reported that the possibility of New Zealand's accessing these records was not encouraging. Conversely, Edwards (1979, p. 11) indicated that the U.S. would make these records available without charge. As the administrative cost of setting up a PVR scheme, particularly following the U.S. model, is not inconsiderable, the accessibility status of U.S. varietal records is clearly an important component of the decision to adopt PVR.

6. Conclusion

The enactment of Plant Variety Rights legislation enables extension of the range of plants in which the value of new varieties may be appropriated by breeders. The efficacy of PVR in facilitating such appropriations should not, however, be overstated: commercial plant breeding, even in non-hybrid varieties, occurs without PVR. Further, PVR does not create "perfect" property rights in plant varieties as farmers may use their own seed and as the civil law defence of these rights is likely to be associated with significant economies of scale. Use of PVR in the U.S.A. suggests that plant breeders are aware of the limitations of the rights conferred by PVR.

Seed industry observers have drawn attention to increased plant breeding following adoption of PVR. As yet, however, no satisfactory studies have examined the relationship between PVR and increased plant breeding. Further, if PVR only results in the substitution of private breeding for public breeding, adoption of PVR may only result in new sources of funds for plant breeding, rather than a net increase in plant breeding.

Where PVR—particularly if re-inforced by additional government regulation or economies of scale—results in effective plant variety property rights, the limited evidence available suggests that corporate concentration occurs. If a plant breeding oligopoly results, particularly one which is dominated by overseas firms, benefits of PVR may accrue mainly to narrow sections of the community, and perhaps predominantly overseas. Possible effects of oligopolized corporate plant breeding—*e.g.*, higher prices, brand proliferation, non-price competition—may however take a considerable time to become apparent.

Adoption of PVR may enhance Australia's ability to acquire overseas varieties and to sell Australian-bred varieties internationally. The plant kinds most likely to be affected are horticultural species—fruit, vegetables and ornamentals. Adoption of PVR will probably also reduce the scope for individuals to import varieties, while enhancing the ability of corporate plant breeders or seedsmen to import exotic varieties.

There are considerable potential benefits to plant breeders arising from the adoption of legislation which is synergistic to PVR. Such legislation already exists in Western Europe and the U.S.A. Careful consideration is required to examine not only the value of other legislation affecting plants in its own right, but also its effects when coupled with PVR.

The likely effects of PVR in Australia appear to have been overstated by both opponents and proponents of PVR. This overstatement appears to arise because commentators and lobbyists have given insufficient consideration to the special attributes of Australian agriculture which will affect the implementation of PVR in ways different to those in overseas countries. Australian characteristics which will substantially modify the effects of PVR include the geographical characteristics of Australian agriculture, its low input nature, the small size of the domestic seed market, the existing predominance of overseas breeders in commercial plant breeding in Australia, and the orientation of Australian agriculture to export markets.

If PVR are enacted in Australia, careful consideration should be given to the choice of species to be included in PVR. Additionally, careful consideration would appear warranted as to the role of public plant breeders in competition with private breeders. Finally, it would appear to be desirable to monitor the economic effects of PVR to determine whether avoidable deleterious effects of PVR do occur and, if so, policies to adopt to minimise these effects.

References[68]

Agricultural Merchant (1977), "Working Party recommends cereal seed royalty changes", 57 (12), December, page unknown.

AGRICULTURE CANADA (1980), Summary of results of a survey of effects of Plant Breeders' Rights legislation in other countries, Ottawa, May, roneo.

ASSINSEL (n.d.), *The attack on Plant Breeders' Rights legislation and the involvement of the Multi-nationals in plant breeding and the world's seeds business*, ASSINSEL, Amsterdam.

AUSTRALIAN SEED PRODUCERS' FEDERATION (1980), Government agrees to reconsider Plant Breeders' Rights legislation, Canberra, 12th March, roneo.

BARRY, S. C. (1977), "Plant Breeders' Rights—and the Canadian Seed Growers' Association", in *Plant Breeders' Rights*, Canada Grains Council, Eighth Annual Meeting, Winnipeg, 5–6 April, 1977, 21–22.

BEAVEN, L. (1976), "Are the bureaucrats aiming to kill the seedsman's initiative?" *Agricultural Merchant*, 56 (7), July, 37–38, 42.

BENN, S. I. (1967), "Rights", in P. Edwards (Ed.), *The Encyclopedia of Philosophy*, Vol. 7/8 Macmillan, New York, 195–199.

BINSWANGER, H. P. (1978), "Induced technical change: evolution of thought", in H. P. Binswanger *et al*, *Induced Innovation*, Johns Hopkins University Press Baltimore, 13–43.

BOMBERAULT *v.* EISELE and INRA (1978), "Re the agreement between Kurt Eisele and INRA", *Common Market Law Reports*, 23, 14th November, 434–459.

BRIGGS, D. E. (1978), *Barley*, Chapman and Hall, London.

BUREAU OF AGRICULTURAL ECONOMICS (1975), *Economic Policies and the Australian Apple and Pear Industry*, Industry Economics Monograph No. 4, Australian Government Publishing Service, Canberra.

BUREAU OF AGRICULTURAL ECONOMICS (1981), "Statistics", *Quarterly Review of the Rural Economy*, 3 (1), February, 105.

CHATTERTON, B. A. (1975), Evidence to Enquiry re Financing Promotion of Rural Products, *Official Transcript of Proceedings*, Industries Assistance Commission, Canberra, 12th June, roneo, 64–94.

CHATTERTON, B. (1980), "Plant Variety Rights—the pros and cons", *Newsletter*, Australian Farm Management Society, 7 (4), June, 9–10.

CHATTERTON, B. (1981), Untitled paper to National Conference: Plant Varietal Rights Legislation—Who Benefits? How? (Workers' Education Association of South Australia), Waite Agricultural Research Institute, Glen Osmond, 5th March, roneo.

COLLINS, E. P. (1979), "Plant patents", *Garden*, September/October, 15–17.

COMMITTEE ON TRANSACTIONS IN SEEDS (1960), *Plant Breeders' Rights*, Cmnd 1092, H.M. Stationery Office, London.

COONEY, K. M. (1980), "Plant Variety Rights endangered", *Seed Trade News*, 2nd January, page(s) unknown.

COPER, M. (1978), "Constitutional obstacles to organized marketing in Australia", *Review of Marketing and Agricultural Economics*, 46 (2), August, 71–102.

COTTON SEED DISTRIBUTORS LTD, *Annual Reports*, various issues.

[68] Some of the references cited are not easy to obtain. Copies may be obtained if necessary from the author. More detailed references to the PVR issue are contained in Godden (1981*b*).

CROFTS, H. (1981), "Plant Variety Rights systems and other variety protection methods", National Conference: Plant Varietal Rights Legislation in Australia—Who Benefits? How? (Workers' Education Association of South Australia), Waite Agricultural Research Institute, Glen Osmond, 5th March, roneo.

CROMIE, A. (1981), "Gyngell backs News' bid for 'strong networking'," *Australian Financial Review*, 17th June, 5.

CROP SCIENCE SOCIETY OF AMERICA (1964), *Plant Breeders' Rights*, ASA Special Publication No. 3, Madison, Wisconsin.

CROP SCIENCE SOCIETY OF AMERICA (1969), *Variety Protection by Plant Patents and Other Means*, CSSA Technical Series No. 1, Madison, Wisconsin.

CURRAN, W. R. and ROBERTS I. M. (1974), *Australian Apples and Pears: developments affecting major export markets*, Commodity Research Report No. 2, Bureau of Agricultural Economics, Australian Government Publishing Service, Canberra.

DEPARTMENT OF AGRICULTURE, N.S.W. (1980), *Plant Variety Rights*, Information from the Department of Agriculture, New South Wales, Division of Plant Industry, (Sydney).

DEPARTMENT OF HEALTH (1979), "Plant quarantine aspects of the introduction of potato germ plasm as seed and tubers", *Working Papers*, Australian Potato Research Conference, Cowes, Victoria, 2–8 to 2–10.

DEPARTMENT OF PRIMARY INDUSTRY (1980*a*), *Plant Variety Rights in Australia: an information paper*, Canberra, July.

DEPARTMENT OF PRIMARY INDUSTRY (1980*b*), *Plant Variety Rights in Australia: information paper*, Second Edition, Canberra, August.

DERERA, N. F. (1975), Evidence to Industries Assistance Commission Enquiry *re* Financing Rural Research, *Official Transcript of Procceedings*, 29th May, roneo, 910A–950.

DOWNEY, R. K. (1977), "Plant Breeders' Rights—viewpoint of a plant breeder in the public sector", in *Plant Breeders' Rights*, Canada Grains Council, Eighth Annual Meeting, Winnipeg, 5th–6th April, 1977, 17–19.

DUNNER, D. R. (1980), Testimony to Hearings before the Subcommittee on Department Investigations, Oversight, and Research of the Committee on Agriculture, House of Representatives, 96th Congress, 1st and 2nd Sessions on H.R. 999 (Plant Variety Protection Act Amendments), 19th July, 1979 and 22nd April, 1980, Serial No. 96-CCC, U.S. Government Printing Office, Washington, 113–129.

EDWARDS, E. T. (1979), "Plant Variety Protection legislation overseas and in Australia", Address to the Victorian Industrial Property Society, Melbourne, 2nd August, roneo.

EDWARDS, E. T. (1980), "Plant Variety Rights—the facts and the fiction", *Sunflower* (Australian Sunflower Association), 4 (4), November, 38–40.

EDWARDS, E. T. (1981), "The advantages of Plant Variety Rights legislation for Australia", National Conference: Plant Varietal Rights Legislation in Australia—Who Benefits? How? (Workers' Education Association of South Australia), Waite Agricultural Research Institute, Glen Osmond, 5th March, roneo.

Farmer and Stockowner (1980), "Plant breeders' varietal rights—will they help or hinder you?" July, 16–17.

FEJER, S. O. (1966), "The problem of plant breeders' rights", *Agricultural Science Review*, 4 (3), 1–7.

FITZGERALD, R. D., SIMMONS, K. V. and SOUTHWOOD, O. R. (1980), *Lucerne*, Bulletin No. P2.5.7, Division of Plant Industry, N.S.W. Department of Agriculture, Sydney.

FOOD AND AGRICULTURE ORGANIZATION (1978), *FAO Fertilizer Yearbook*, FAO Statistics Series No. 23, United Nations, Rome.

FOOD AND AGRICULTURE ORGANIZATION (1980), *Prices of Agricultural Products and Selected Inputs in Europe and North America* 1978/79, Annual ECE/FAO Price Review No. 29, Food and Agriculture Organization/Economic Commission for Europe, United Nations, New York.

FREEBAIRN, J. W. and GRUEN, F. H. (1977), "Marketing Australian beef and export diversification schemes", *Australian Journal of Agricultural Economics* 21 (1), April, 26–39.

FRYER, R. F. (1974), *Plant Breeders' Rights in New Zealand: a report on the prospects*, Report No. 16, Crop Research Division, Department of Scientific and Industrial Research, Christchurch.

GODDEN, D. P. (1981*a*), *An Economic Evaluation of Property Rights for Plant Varieties with Special Reference to Plant Variety Rights in Australia*, unpublished Master of Economics thesis, University of New England, Armidale. Published as *Economic Issues Concerning Plant Variety Rights: general and Australian perspectives*, Agricultural Economics Bulletin No. 26, Department of Agricultural Economics and Business Management, University of New England, Armidale.

GODDEN, D. (1981*b*), *Plant Variety Rights: an annotated bibliography*, Miscellaneous Bulletin No. 35, Division of Marketing and Economics, N.S.W. Department of Agriculture, Sydney, March.

GODDEN, D. and POWELL, R. (1981), "Economic aspects of Plant Variety Rights: models for examining their effects", Symposium: Economic Aspects of the Australian Patent System, Section 24 (Economics), 51st ANZAAS Congress, Brisbane, 13th May, roneo. Published in W. J. Land and R. Illingsworth (Eds.), *The Economic Implications of Patents in Australia*, Industrial Property Advisory Committee, Australian Patent Office, Canberra, (forthcoming).

GRILICHES, Z. (1960), "Hybrid corn and the economics of innovation", *Science* 132 (3422), 29th July, 275–280.

GUERRY, W. W. (1971), "Our role in implementing variety protection—seed certification", 53*rd Annual Report*, Association of Official Seed Certifying Agencies, 92–94.

HADFIELD, P. D. and Marshall, M. I. (1980), "Marketing of CRD-bred cultivars", *Field Crop News* (Crop Research Division, DSIR, New Zealand), January, 23–25.

HALL, C. V. (1978), "Co-operation between public and private breeders", *Seed World*, 116 (9), August, 22–26.

HALSE, N. J. (1981), "Plant Variety Rights: an information paper", (Western Australian Department of Agriculture), National Conference: Plant Varietal Rights Legislation in Australia—Who Benefits? How? (Workers' Education Association of South Australia), Waite Agricultural Research Institute, Glen Osmond, 5th March, roneo.

HANWAY, D. G. (1978*a*), "Agricultural Experiment Stations and the Variety Protection Act—Part 1", *Crops and Soils Magazine* 30 (5), February, 5–6.

HANWAY, D. G. (1978*b*), "Agricultural Experiment Stations and the Variety Protection Act—Part 2", *Crops and Soils Magazine* 30 (6), March, 5–7.

HEDDING, R. R. (n.d.), *A Study Tour of the Seed Industry in Holland, England, Canada and the U.S.A., March–May*, 1975, Department of Agriculture, Melbourne.

HERBERT, J. G. (1978/79), "Australia's role as a supplier of seed and seed technology to developing nations", in J. R. Cook and M. V. Reilly (Eds.), *Proceedings of Annual Conferences*, 1978–1979, Consultants Section, Australian Institute of Agricultural Science, Parkville, Victoria.

INDUSTRIES ASSISTANCE COMMISSION (1976), *Financing Rural Research*, Australian Government Publishing Service, Canberra.

INDUSTRY COMMITTEE FOR PLANT BREEDERS' RIGHTS (1981*a*), *Plant Variety Rights: vital to Australia*, Chatswood, N.S.W.

INDUSTRY COMMITTEE FOR PLANT BREEDERS' RIGHTS (1981*b*), *Plant Variety Rights Legislation: history, mode of operation and effects*, Chatswood, N.S.W.

JOHNSON, J. F. (1980), "Plant patents—some implications for pome fruit growers", Pome Fruit Industry Seminar, Batlow, N.S.W., 17th July, roneo.

JOINT COMMITTEE FOR PLANT BREEDERS' RIGHTS (1973), The Need for Plant Breeders' Rights in Australia, Seminar, Canberra, 19th November, roneo.

LALL, S. (1979), "Transfer pricing and developing countries: some problems of investigation", *World Development* 7, 59–71.

The Land (1979), "Division on rights of plant breeders", 12th July, 16.

The Land (1980), "Call for strict tests on new plant varieties", (Northern Extra), 20th November, 1.

The Land (1981), "Variety rights opposed", 26 March, 9.

LEENDERS, H. (1976), "The European view on the EEC certification rules", *Agricultural Merchant* 56 (7), July, Seeds Special, 31, 33–34.

LEESE, B. M. (1978), Progress report to the Diplomatic Conference on the Revision of the Convention of the International Union for the Protection of New Varieties of Plants, Geneva, 9th–23rd October, roneo.

Livestock and Grain Producer (1980), "Reply on Plant Variety Rights", 31st May, 2.

LODEN, H. D. (1978), "Seed industry experience with Plant Variety Protection", Address to California Seed Association, San Francisco, 15th April, roneo (reported in *Seed World* 116 (8), July, 12).

LUMB, R. D. and RYAN, K. W. (1977), *The Constitution of the Commonwealth of Australia Annotated*, Butterworths, Sydney, Second Edition.

MACHLUP, F. (1958), *An Economic Review of the Patent System*, U.S. Government Printing Office, Washington.

MACHLUP, F. and PENROSE, E. T. (1950), "The patent controversy in the nineteenth century", *Journal of Economic History* 10 (1), May, 1–29.

MANDEVILLE, T. D. and LAMBERTON, D. M. (1981), "Impact of government regulation: the case of patents", Conference on Government Regulation of Industry, Institute of Industrial Economics, University of Newcastle, 19–20 February, roneo.

MAST, H. (1975), "The organization and work of UPOV", *Seed Science and Technology* 3 (2), 377–386.

MASTENBROEK, C. (1978), "50 years NKB (Dutch Breeders' Association)", *Euphytica* 27, 339–342.

MILLER, G. (1981), "Outlook for the rural economy: Some economic issues", *Quarterly Review of the Rural Economy* 3 (1), Supplement, February, 20–27.

MOONEY, P. R. (1979), *Seeds of the Earth: a private or public resource*? Inter Pares/Canadian Council for International Co-operation/International Coalition for Development Action, Ottawa/Ottawa/London.

MULLETT, J. H. (1976), *A Study Tour of Seed Research Organizations in the U.S.A., England and Scotland*, Department of Agriculture, Victoria.

National Farmer (1980), "Big farmer 'no' to plant rights", 11th December, 5.

NATIONAL INSTITUTE OF AGRICULTURAL BOTANY (1976), *Seed Quality*, Farmers' Leaflet No. 1, Cambridge, U.K.

NATIONAL INSTITUTE OF AGRICULTURAL BOTANY (1977), *Seed Quality*, Technical Leaflet No. 1, Cambridge, U.K.

NEWPORT, A. J., EDWARDS, E. T. and ROTHWELL, P. R. (1975), Evidence to Industries Assistance Commission Enquiry *re* Financing Rural Research, *Official Transcript of Proceedings*, 2nd September, roneo, 3784–3800.

NICHOLLS, A. F. (1978), "The United Kingdom Cereal Seed Market and the EEC Influence", in P. R. Hayward *et al*, *Developments in the Business and Practice of Cereal Seed Trading and Technology*, Gavin Press, London, 40–48.

NIXON, P. (1980*a*), "Plant Breeders' Rights", Questions Without Notice, *Hansard* (House of Representatives), 27th February, 403.

NIXON, P. (1980*b*), "Plant Variety Rights", Statement by the Minister for Primary Industry, Primary Industry Media Release PI 80/113, Canberra, 4th August.

NIXON, P. (1981), "Plant Variety Rights", Statement by the Minister for Primary Industry, Primary Industry Media Release PI 81/12, Canberra, 9th February.

NORRIS, T. E. (n.d.), *Plant Varieties Rights: Report on overseas tour, 21st August to 19th September*, 1977, (Plant Varieties Office, Ministry of Agriculture and Fisheries, Lincoln, New Zealand.).

Overseas Trading (1979), "Australian vegetable seeds feed Europe", 31 (17), 31st August, 588.

Overseas Trading (1981), "Sydney nursery captures share of world foliage plant trade", 33 (7), 10th April, 210–212.

PETERSSON, K. B. (1973), "Plant Breeders' Rights and the patent law", in joint Committee for Plant Breeders' Rights (1973), roneo.

Plant Varieties and Seeds Gazette (1968), "Cama Wheat: Application for Compulsory Licence—Controllers' Decision", No. 45, October, 23–30.

Plant Varieties and Seeds Gazette (1972), "EEC Seed Directives", Special EEC Edition, February, 6–8.

PLANT VARIETIES OFFICE (1980), *Guide to Plant Selectors' Rights*, Ministry of Agriculture and Fisheries Media Services, Wellington, New Zealand.

Plant Variety Protection Office, Official Journal (1978, 1979), Agricultural Marketing Service, United States Department of Agriculture, Beltsville, Maryland.

POSNER, R. A. (1975), "The social costs of monopoly and regulation", *Journal of Political Economy* 83 (4), August, 807–827.

POSSINGHAM, J. V. (1973), "The plant breeders' viewpoint", in Joint Committee for Plant Breeders' Rights (1973).

Queensland Graingrower (weekly), Queensland Graingrowers' Association.

RANFORD, T. M. (1981), "The advantages of Plant Varietal Rights legislation in Australia: the nurserymen's point of view", National Conference: Plant Varietal Rights Legislation in Australia—Who Benefits? How? (Workers' Education Association of South Australia), Waite Agricultural Research Institute, Glen Osmond, 5th March, roneo.

ROWBERRY, R. G. and HOWELLS, A. J. D. (1979), "Potato production, marketing and use in North America", *Potato Research* 22 (3), September, 163–175.

RUTTAN, V. W. (forthcoming), *Agricultural Research Policy*, University of Minnesota Press, Minneapolis.

SCHERER, F. M. (1980), *Industrial Market Structure and Economic Performance*, Rand McNally, Chicago, Second Edition.

SCOTT, D. B. (1980), "Reply", Questions without Notice, *Hansard* (Senate), 22nd April, 1616–1617.

SENATE STANDING COMMITTEE ON SCIENCE AND THE ENVIRONMENT (1979), *Industrial Research and Development in Australia*, Australian Government Publishing Service, Canberra.

SEWELL, J. F. (1975), Evidence to Industries Assistance Commission Enquiry *re* Financing Rural Research, *Official Transcript of Proceedings*, 30th May, 2315–2322.

SEWELL, J. F. (1980*a*), "Bias blinding", Letters, *National Farmer*, 15th May, 10.

SEWELL, J. F. (1980*b*), "Overseas market requirements for Australian seed", *Rural Marketing and Policy* 10 (4), Summer, 10–12.

SEWELL, J. F. (1981), "The impact of Plant Varietal Rights legislation on Australian agriculture," National Conference: Plant Varietal Rights Legislation in Australia—Who Benefits? How? (Workers' Education Association of South Australia), Waite Agricultural Research Institute, Glen Osmond, 5th March, roneo.

SIMMONDS, N. W. (1979), *Principles of Crop Improvement*, Longman, London.

SINCLAIR, I. (1979), Address to Annual Conference Dinner of Australian Nurserymen's Association, Statement by the Minister for Primary Industry, Primary Industry Media Release PI 79/30, Canberra, 26th February.

SMITH, H. C. (1979), "Plant Breeders Rights in New Zealand—A Review", *Lincoln College Farmers' Conference*, 1979, 16th–18th May, 95–99.

SMITH, I. (1980), *Plant Variety Rights*, Information Paper, Office of the Minister of Agriculture, Melbourne, 25th June, roneo.

SPARROW, D. H. B. (1981), "Some biological implications of Plant Variety Rights in Australia", National Conference: Plant Varietal Rights Legislation in Australia—Who Benefits? How? (Workers' Education Association of South Australia), Waite Agricultural Research Institute, Glen Osmond, 5th March, roneo.

Stock and Land (1980), "PVR draft Bill at 'advanced stage'," 26 June, 4.

TAYLOR, C. T. and SILBERTSON, Z. A. (1973), *The Economic Impact of the Patent System: a study of the British experience*, Cambridge University Press.

THIELE-WITTIG, M. H. (1978), "Development and activities of UPOV from 1974 to 1977", *Seed Science and Technology* 6 (2), 447–453.

THOMAS, P. (1981), "An examination and explanation of the Plant Variety Rights Bill, 1981, as a piece of industrial property legislation", Seminar on the Plant Variety Rights Bill, 1981, Faculty of Law, Monash University, Melbourne, 19th May.

TISDELL, C. (1979), *Factors influencing the degree of patenting in Australia: a report on a survey of patent attorneys*, Discussion Paper No. 9, Department of Economics, University of Newcastle.

UPOV (1979*a*), *International Convention for the Protection of New Varieties of Plants*, UPOV, Geneva.

UPOV (1979*b*), *Newsletter*, (UPOV, Geneva), No. 18, November.

U.S. CONGRESS (1970), *Plant Variety Protection Act*, 1970, Public Law 91–577, 84 Stat. 1542–1559, Washington, D. C.

U.S. DEPARTMENT OF AGRICULTURE (1972), *Regulations and Rules of Practice under the Plant Variety Protection Act*, 1970, Title 7, Chapter I, Sub-chapter H, Part 180 of the Code of Federal Regulations, Washington, D.C.

U.S. DEPARTMENT OF AGRICULTURE (1974), *Agricultural Statistics* 1974, U.S. Government Printing Office, Washington, D.C.

U.S. DEPARTMENT OF AGRICULTURE (1978), *Agricultural Statistics* 1978, U.S. Government Printing Office, Washington, D.C.

U.S. DEPARTMENT OF AGRICULTURE (1979), *Prices Paid by Farmers for Seed*, Statistical Bulletin No. 328, Crop Reporting Board, Statistical Reporting Service, Washington, D.C.

VICTORIAN FARMERS' UNION/AUSTRALIAN SEED PRODUCERS' FEDERATION (n.d.), *Submission on Plant Breeders' Rights*, Industries Assistance Commission Enquiry into Financing Rural Research, Canberra, roneo.

WESTERN AUSTRALIAN DEPARTMENT OF AGRICULTURE (1980), *Plant Variety Rights in Australia: an information paper*, Perth, October.

WHITE, A. L. (1976), "Plant Variety Protection Update", Sixth Soybean Research Conference, American Seed Trade Association, Chicago, 9th–10th December,

WHITMORE, F. W. (1979), "Plant Varieties Office—past and planned growth", *Lincoln College Farmers' Conference*, 1979, 16th–18th May, 110–111.

WILKS, L. (1981), "Outrage greets PVR Bill", *National Farmer*, 28th May, 11.

WOODGATE, M. (1981), "Impoverished Ford sends $3.4 m to U.S.", *Australian Financial Review*, 29th April, 14.

WOODS, S. (1979), "Middle East seen as fertile market for nursery industry", *Australian Financial Review*, 4th May, 24.

WOODS, S. (1981), "Our flora's market is blooming", *Australian Financial Review*, 27th February, 18.