The Effect of Raising the Australian Statutory Inventive Step on the Australian Global Production System*

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1. INTRODUCTION

This paper analyses the effect of raising the inventive step requirements in the Patents Act 1990 on Australia's position in the global supply chain. In particular, we consider the likely effects on the intentions of foreign multinational enterprises (MNEs) to invest in Australia and the ability of Australian businesses to compete in the global market.

The design of the patent system – of which the examination threshold is an important component – has received substantial attention in the literature over the last 50 years or so, but there are still many gaps in our understanding. Here, we attempt to refine the literature by focusing our attention specifically on changing one aspect of the patent system: the effect of raising the size of the inventive step required to obtain a patent. Despite its importance, much of the literature has overlooked this issue in favour of other facets of the patent system such as changes to the enforcement regime.[1]

From an economic perspective, patent rights operate in inherently second-best markets and are crude attempts to address the potential market failure arising from the tension between providing sufficient incentives to invest in innovative activities and ensuring effective knowledge diffusion. That is, patents provide an incentive to invest but this comes at a cost since they result in higher prices and slower diffusion of knowledge (by creating a legal barrier to the free use if the knowledge). In order to concentrate patents in areas where the benefits from the incentive effect are greatest, and the costs from the slower-diffusion effect are smallest, a patented invention must satisfy three criteria: novelty, non-obviousness and utility.[2] The second requirement, non-obviousness, which means that an invention encompasses knowledge that is a step higher than existing knowledge, is the criterion of interest to us. There is, in principle, a step size such that the net benefits of knowledge creation and diffusion are maximised. This step is called the 'optimal' inventive step threshold.

However, in practice it is most probable that the optimal inventive step threshold is different across industries and technologies. In fact, Hunt (2007) argues that the size of the optimal inventive step is positively correlated with the productivity of R&D. Policy objectives aimed at protecting industries

[1] Exceptions to this statement are Hunt (1999; 2007), Gallini (2002) and Encaoua et al. (2006) who do consider the effects of the size of the inventive step on innovation.
[2] These three fundamental tenets are enshrined in the legal system of all nations that are signatories to TRIPS.

where R&D is not very productive would be best served by having a low inventive step requirement, whereas a policy objective aimed at protecting industries where R&D is more productive would be best served by a high inventive step requirement. In the latter instance, although a smaller number of patents would be granted, innovation would be more rapid in those industries. The reason for this policy recommendation is based on the logic that, by making the prize in the form of a patent grant harder to obtain, it also becomes more valuable in that the financial reward becomes greater. Since the industry enjoys very productive R&D, the prize is not beyond the reach of inventors who are fully capable of leapfrogging the previous technology. However, to simplify the discussion here, we refrain from considering varying the inventive step requirements for different industries and simply consider the average effects of raising the inventive step requirement across all industries.[3] In particular, we consider the effects of raising the 'revealed' inventive step. By revealed, we mean the size of the step that in practice is required for a patent grant. In an ideal world, the optimal inventive step should coincide with the revealed inventive step. In practice, however, many factors could cause a wedge between the optimal and the revealed inventive steps.

Since the focus is on the incentives to invest by MNEs and Australian businesses competing in the world market, we first provide a brief background discussion on the nature of global production, that is, what determines whether an MNE will choose to undertake foreign direct investment (FDI) in Australia and the factors determining the revealed inventive step. For each affected party – domestic inventors, foreign MNEs and rivals of these two groups – we consider the likely effects on behaviour under four sets of stylised circumstances. A more comprehensive review of the literature is included in the Appendix.

2. THE NATURE OF GLOBAL PRODUCTION

The success of a business often depends on the achievement of economies of scale. Scale economies can arise from the adoption of the most advanced physical technologies or by fully exploiting intangible assets. Whether a business needs to go international to achieve these economies depends on size of the domestic market and the nature of technology. At the limit, all businesses need to access global markets at some stage if they are to expand, hence their export focus depends on their stage of

[3] We do, however, discuss reasons why patents maybe more effective in some technology areas than others.

maturity. Accordingly, there is no clear distinction between domestic-orientated versus export-orientated businesses. It is partly a matter of how successful they are and their history. All Australian businesses, even those in non-traditional sectors such as childcare, job placement, cafes and welfare, are potential multinationals. Accordingly, any change to the patent system should consider the effects on all businesses, not just current exporters.

3. GOING GLOBAL: FDI OR EXPORT?

A foreign MNE wanting to supply the Australian market will make a choice between FDI in Australia or exporting (or a mix of both). Alternatively, a foreign MNE wanting to supply the world market in general will make a choice between FDI in Australia or FDI elsewhere. Both exporters and investors into Australia will require patent protection, if they have patentable products and processes. However, we expect that since FDI involves transferring the technology as well as the product, the requirements from the patenting system of MNEs considering FDI are greater. Hence, if the type and strength of protection offered by a country is critical to an FDI decision, this will have some impact on MNEs considering *how* to supply the Australian market (FDI versus export) but the impact would be even greater on MNEs considering *whether* to use Australia as a production base.

We conventionally think about FDI as an activity that involves the transfer of production facilities and its associated technologies. Historically, R&D has been kept close to headquarters and foreign-affiliate R&D was used mainly to adapt the product to local conditions (Cincera *et al.* 2005). However since the 1980s there has been an increase in the amount of FDI that is specifically R&D in nature (especially in automotive and pharmaceuticals). This trend towards Australian-based R&D (e.g., GM, Bosch) should not affect the FDI decision since what matters most is the ability to patent in the jurisdictions of the ultimate customer.

There is a considerable literature documenting the factors determining the choice between undertaking FDI and committing to export. Briefly, a foreign MNE will be more likely to undertake FDI in Australia instead of exporting to Australia or FDI elsewhere if:

- transporting the product to the consumer market is either costly relative to value or impractical, and consequently production needs to be proximate to customers (especially in services);
- cheaper production facilities exist in Australia (because of lower taxes, wages or raw materials);

- there is access to cheaper skilled labour in Australia;
- there is access to cheaper finance in Australia;
- there are lower costs in terms of accessing Australian knowledge spillovers; or
- there are lower costs in terms of controlling the seepage of knowledge into Australia (brand, patent, design protection).

In general, the first three points – transport, production and labour costs – are the most commonly cited factors. However, increasingly, there are more examples of businesses locating in high-wage countries in order to access the local knowledge base and venture capital finance. These examples refer almost exclusively to high-tech sector FDI. Nonetheless, it is the final factor above, the cost of preventing imitation of ideas (i.e., controlling outgoing knowledge spillovers), which is at the heart of our question. While preventing imitation is less commonly cited as a factor in FDI, our task is to evaluate its importance, at the margin, to decisions regarding FDI versus export, and FDI in Australia versus FDI elsewhere.

From the perspective of the patent applicant, there are four main factors affecting the ease with which to prevent imitation:

- the cost of the patent application;
- the probability of patent grant;
- the ability to detect imitation on patented ideas; and
- the effectiveness of the patent enforcement regime.

4. DETERMINANTS OF THE REVEALED INVENTIVE STEP

Changing the statutory inventive step threshold will affect the first two factors listed above: the patent application and examination processes.[4] However, the statutory inventive step is not the only factor in determining the proportion of applications that are granted. In addition to the wording of the statute, actual grant rates depend on common law and patent office protocols and procedures. We call the outcome of three interdependent forces what we call the 'revealed inventive step'.

[4] The inventive step criterion is arguably most decisive in whether or not a patent is granted. The other criteria – novelty and industrial applicability – are more easily met.

According to the legal interpretation of the statutes, Australia has lower inventive step criteria than both the USPTO and EPO, with the latter two considered comparable in this regard. However, according to studies comparing the actual grant rates across patent offices, the United States had the lowest inventive step, followed by Australia and then the EPO (Webster *et al.* 2007, Jensen *et al.* 2006[5]). These studies report what we call the revealed inventive step, that is, the overall outcome of the statute, common law and office protocols and procedures combined.

In this paper we discuss only the effects of increasing the statutory inventive step, however we assume that this has a clear positive relationship with the revealed inventive step. That is, whatever the interdependencies between the statute, common law and office protocols and procedures, the net effect of tightening the criteria under the statute is to raise the revealed inventive step.

5. Effect of raising the threshold on Australia's position in the global supply chain

We consider the effect of two distinct changes to the inventive step threshold on Australia's position in the global supply chain: first, the inventive step criteria in the Australian statute is made *parallel* or harmonised with the United States and European Union, and second, the inventive step criteria in the Australian statutes are made *stricter* than the in United States and European Union.

Theses changes imply two distinct effects:

1. Harmonising the law to be consistent with US or EU laws will reduce transaction costs if it reduces the duplication of patent attorney drafting work for multi-jurisdiction applicants. Reductions in transaction costs are unambiguously good for investment and economic efficiency, all other things considered. This benefit accrues to Australian inventors as the result of any unilateral decision to harmonise. An additional benefit will arise if international patent offices can share the results of at least one prior art search and accordingly the total cost of application falls. However, such a benefit accrues only in the event of a multilateral agreement. Harmonisation, *of itself*, may lead to more patents being granted as applications are cheaper and easier to file.

[5] These studies only included examination decisions up until 2004 and would thereby not include the effects of the recent KSR vs Telflex decision in the US.

2. In the first instance, we expect that increasing the inventive step leads to a lower percentage of patent applications being granted. Accordingly, we need to consider the marginal economic effects of fewer patents being granted to Australian and foreign firms, which is not straightforward. We argue that these effects depend on the characteristics of the technology area of the marginal applicant, the most important of which we identify below. This 'fewer patents' effect will apply both where the Australian statute is made parallel or harmonised with the United States and European Union, and where it exceeds the US and EU standards.

The second point – the 'fewer patents' effect – needs closer examination as there can be subtle and countervailing forces at work. We do this by considering how we would expect players in the global business environment to behave in a hypothetical scenario where a patent is granted, compared with the counterfactual where it is not. In so doing we need to assume away other changes to the patent system. Accordingly, we assume that:

- it is patent applications with the smallest inventive step that would not be granted under the counterfactual (we assume that the inventive step can be measured accurately);
- the effectiveness of the enforcement regime remains unchanged; and
- other reasons for MNEs wanting to undertake FDI to Australia are unchanged.

6. Examining the 'fewer patents' effect

In the following tables, we use the available theoretical and empirical literature, as reviewed in the appendix, to try and identify the effect of 'fewer patents' on i) domestic businesses' incentive to invent; ii) foreign MNEs' intention to undertake technology transfer; and iii) the effects on rival businesses.

All investment decisions are guided by the expected economic return from the activity. In the case of a domestic invention, this return is a ratio of the net increment in the business's profits to the costs of R&D. The importance of R&D costs is straightforward. The smaller are these costs, the greater is the rate of return to an invention for all levels of positive net increment in profits. The increment to business profits depends on how well patents prevent imitation, thereby enabling patentees to earn monopoly profits. In general, patents offer better protection against imitators:

- the more codified the technology and thus the easier it is technically to replicate the invention – the IT, chemical and pharmaceutical technologies are considered highly codified;

- where alternative ways to prevent imitation are prohibitively expensive; and
- in slow-moving technologies where inventions take a long time to become obsolete.

In the contrary case, patents are considered to add little to business profits since they have a minimal effect on imitation. These are cases where:

- the technology is tacit, or difficult to express in words, and can only be fully revealed, and thereby copied, through personal contact and interaction;
- where many alternative ways exist to prevent imitation such as the use of secrecy, brand names or the sheer technical difficulty of reproducing complex production systems; and
- the technology is rapidly changing so that even a well-protected patented invention will become obsolete in a short time.

Table 1 presents the expected effect of a higher inventive step on domestic incentives to invent. We consider the situation where a patent application which would have been granted under the old regime is now rejected under the new regime. It shows that the loss of patent protection only has an impact in instances where the patent is important in sustaining monopoly profits *and* the R&D costs underlying the invention are large. In all other cases, the effects are negligible or zero. These effects will be greatest when the domestic applicant is filing a patent *only* in Australia. For cases where Australia is one of several jurisdictions where applications are being filed, the relative effect of an Australian rejection is even smaller.

Table 1: Marginal Investment effect on rejected domestic applicant's incentive to invent

Cost of invention / Patent protection	**High cost R&D**	**Low cost R&D**
Patent gives good protection against imitators - well-codified - no alternative forms of protection - slow moving technology	**Negative**	**Negligible**
Patent gives poor protection against imitators - highly-tacit - other appropriation alternatives - fast moving technology	**Negligible**	**None**

In the case of a foreign MNE, the rate of return to investing in Australia depends on how well patents intrinsically prevent imitation (as defined above) and the erosion of the foreign MNE's monopoly position through imitation in Australia. The latter is more likely to occur if Australia has strong capabilities in that technology area and is able to invent around or otherwise copy the foreign technology with ease.

Table 2 gives the four potential outcomes of this situation. As with the domestic situation, we can deduce that the effect of raising the inventive step on foreign MNE intentions to invest in Australia is significant only in technologies or industries where patents give good protection against imitators *and* Australia has strong R&D capabilities. Unless Australia builds up capabilities – a long term prospect – there should not be any effect on FDI in the weak-capability industries. Again, how much profits the MNE loses as a result of imitation of the rejected patent depends on how important the Australian market is for the MNE. This is because Australian imitators are not able to export products embodying the copied technology or idea to jurisdictions where the patent applies. A rejected surfboard patent is expected to have a large impact on foreign surfboard MNE profits, but a rejected automotive patent will not.

Table 2: Marginal effect on rejected foreign applicant's intention to invest in Australia

Local capabilities / Patent protection	**Strong Australian capability**	**Weak Australian capability**
Patent gives good protection against imitators - well-codified - no alternative forms of protection - slow moving technology	**Negative**	**None (medium term outlook)**
Patent gives poor protection against imitators - highly-tacit - other appropriation alternatives - fast moving technology	**Negligible**	**None (medium term outlook)**

Finally, Table 3 presents the effects on other patentees in proximate markets to the affected patent applicant. The effects on this group of competitors are often overlooked since the impact on them is indirect. There is reason to believe that crowding technology space with patents imparts a negative externality, that is, a negative effect on third parties. Third parties may desist from undertaking R&D or production in areas where there are so many patents that it is too expensive for them either to know what ideas are or are not patented or, if they do know, to licence from the appropriate parties. This crowding behaviour is referred to in the literature as patent flooding or patent bombing.

According to Table 3, it is only in areas of patent flooding – where patents can act in the described blocking manner – that a reduction in the number of patents on issue will have a positive effect on the Australian incentive to invent. Note that we do not expect there to be any serious interest in patent flooding in areas where patents are not effective in stopping imitation.

Table 3: Rival businesses marginal investment effect

Strategic behaviour / Patent protection	**Patents block rivals (patent flooding)**	**Patents do not block rivals**
Patent gives good protection against imitators - well-codified - no alternative forms of protection - slow moving technology	**Positive**	**Negligible**
Patent gives poor protection against imitators - highly-tacit - other appropriation alternatives - fast moving technology	**Not applicable**	**None**

Over time there may be follow-on effects from this positive impact on rivals' patents. As the power of each patent to prevent imitation of *genuine* inventions grows, we expect there would be a greater incentive for businesses to engage in R&D and apply for patents.

7. CONCLUSION

Raising the inventive step required to qualify for a patent grant will only be expected to have negative effects on the Australian incentive to invent in one scenario: where patents are known to be important for eliminating imitation *and* R&D costs are high. Similarly, raising the inventive step is only expected to deter FDI in one scenario: where patents are known to be important for eliminating imitation *and* Australian R&D capabilities are high. On the other hand, raising the inventive step is expected to have a positive effect on domestic innovation where patents are known to be effective in blocking rival R&D efforts. In the first two cases, the negative effects are smaller where the rejected patent application is more marginal and less economically significant. In addition, the less important the Australian market is for the MNE, the smaller is the effect on investment decisions.

Harmonising laws to minimise the need for the applicant to pay for multiple application drafts will have clear and unambiguously positive effects on both the domestic incentive to invent and MNE FDI into Australia.

We caution that the above analysis ignores the *long-term* impact of raising the inventive step on economic and inventive activities. While raising the inventive step would likely result in a decrease in the overall number of patents granted in the short run, it is less clear what would happen in the long term. It is worth noting that patents that are granted under a higher inventive step threshold ought to be more valuable to businesses, since there will be fewer competitors in the market place. Given that a patent in effect grants the inventor a monopoly position, this monopoly position is stronger if there are fewer competing products. That is, it raises the power of the patentee to appropriate returns from the invention (in other words, it increases the patent's economic value). In the long run this stronger monopoly position should provide a greater incentive to undertake R&D.

Furthermore, is it also not clear what would happen to patent granting *rates* in the long run. Increasing the inventive step threshold may result in the rejection of applications that would otherwise have been granted, which seems to imply that the patent granting rate would fall from, say, 80 per cent to 70 per cent. But this is not necessarily so in the long run, since it is quite likely that as applicants learn about the new inventive step threshold they will reduce the number of applications with low inventive steps (and therefore low probability of being granted). Thus the patent granting rate may in fact stay at its pre-existing level of 80 per cent (assuming this is some sort of equilibrium grant rate). This simple example highlights the importance of dynamics in any analysis of patent parameter changes.

APPENDIX: REVIEW OF THE LITERATURE

Much of the empirical literature we consider in this report examines what happens when changes are made to one aspect or another of a country's patent regime. Such studies consider the effects of patent regime changes on variables such as R&D expenditure, trade flows and foreign direct investment (FDI). The usefulness of these empirical findings for policy purposes depends on how well the authors have understood and measured changes to the patent system. At best, the author(s) define and carefully detail the nature of the change in the patenting institutions and laws. However, more often than not authors simply use composite measures of a patent regime which typically conflate changes to the statute or administrative rules with changes in patent scope and enforcement mechanisms.

While there have been numerous examples of jurisdictions making changes to their enforcement mechanism and redefining the scope of patentable inventions, especially following the establishment of TRIPS, cases where the inventive step threshold has changed are more scarce. The most well recognised example occurred during the 1980s in the United States where the effect of the courts relaxing the non-obviousness requirement for all inventions was believed to have flowed through to the examination procedures at the USPTO (Hunt 1999; Barton 2000; Kingston, 2001; Merges, 1999).[6]

In fact, there are no empirical studies that actually measure the effect of changes in the inventive step threshold on economic performance, and only a limited number that consider the issue from a theoretical stand-point (Hunt 1999; Gallini 2002; Encaoua et al. 2006; Jensen and Webster 2004). Nevertheless, these theoretical studies enable us to gain some insight into how and why a change in the inventive step threshold may shape the pattern of R&D expenditure and other economic factors. One probable cause of the dearth of empirical studies on the effect of such changes is that inventiveness is difficult to observe: it is essentially a subjective measure. Patent examiners are provided with tools and techniques aimed at providing a rigorous basis for evaluating an application's inventiveness, but it still remains in the realm of a subjective measure.

[6] Although the National Research Council makes the point that there is no rigorous evidence that the size of the inventive step had changed. The view that it had changed is based more on anecdotes (Cohen 2005).

Defining the issues

There are many interpretations of ‘changing patent regimes’ in the literature.[7] Most of the studies consider ‘strengthening’, ‘broadening’ or ‘expanding’ an already existing patent regime. In general, the studies consider ‘strengthening’ rather than ‘weakening’ patent rights, since Lerner (2002) demonstrates that this has been the prevailing trend over the last 150 years. But ‘strengthening’ can be interpreted in various ways such as: increasing patent scope to cover new technologies; changing the patent scope to cover multi-claim applications; increasing the length of the patent term; or changing the conditions of legal enforcement of patents. In fact, most empirical studies consider this last issue: the effect of changing the enforcement conditions. In this report, we are not concerned with patent enforcement *per se*. Rather, we focus on the effect of a unilateral increase in the size of the inventive step requirement at the patent examination stage.

Having said this, it is not easy to separate the issue of patent examination (and the inventive step threshold) from patent enforcement. In fact, there is an important nexus between the two since changing the patent examination standards (including the inventive step threshold) may have no discernible effect if the courts don’t uphold the validity of granted patents. Nevertheless, we attempt to differentiate between the two here by focusing on the inventive step threshold solely and *assuming that the status quo prevails in the enforcement of patents*.[8] Given there are no empirical studies that consider the effects of increasing the inventive step threshold, we summarise the major findings from the broader literature where relevant if it has an indirect bearing on issues associated with the inventive step. Many studies of changing patent enforcement parameters, however, have no direct bearing on the issue we are addressing. We selectively include findings in our summary so the reader is clear about red-herring arguments.

[7] A ‘patent regime’ refers to all aspects of the patent system such as the laws governing patent requirements, administrative procedures covering the patent examination process and judicial protocols.

[8] However, we acknowledge that it is difficult to separate the discussion of examination standards from patent enforcement even if we assume that the legal and institutional mechanisms of enforcement remain unchanged. To the extent that the inventive step threshold is increased, it should be easier for the patent owner to obtain a favourable outcome should a patent dispute occur. For example, if the dispute goes to the Court, one should expect that the Court is more likely to find the disputed patent valid, given that the patent was granted through a more stringent set of standards and there are likely to be fewer close patents in existence.

As mentioned, use of the term 'strengthening patent rights' is commonplace in the literature. It can, however, be quite confusing since it may refer, as we have just argued, to many different aspects of the patent system. This is unfortunate since it is important to highlight the differences between aspects such as inventive step threshold, scope of patentable subject matter and enforcement practices in terms of the effect on innovative activity. In talking about the complexities and confusion regarding the effects of different types of patent changes, Gallini (2002) stated that: '…the problem of patents being granted more easily highlights a recurring theme: the same policies that are perceived to have strengthened patent rights in certain ways have also weakened them' (p.147). Encaoua et al. (2006) further highlights the confusion when stating that: 'Some countries have arguably experienced a weakening of the standard criteria for granting patents (justified by the belief that "more patents is better")' (p.1424). For example, studies that make the simple assumption that increasing patent durations implies a strengthening of the patent regime are ignoring the negative effects of patent extension on other inventors. We believe that in general the use of the term 'strengthening of the patent regime' is suggestive and misleading. It implies that the ability of patentees – or even inventors as a whole – to appropriate profits has increased, whereas this is the actual proposition we are testing, not a prior assumption. Where possible, we avoid using the terms 'strengthening' and 'patent regimes' and instead define the actual specific change in the parameters of the patent system.

In general, there are two distinct approaches to examining the effects of a change in the parameters of the patent system on economic activity: one is a single country, case study-type approach (akin to a natural experiment) and the other is a cross-country approach (possibly with a time-series dimension as well) which utilises variations in patent protection across countries (and over time) to evaluate the effects of changes in the patent parameters on patenting activity. Such cross-country empirical studies often make use of two popular indices of the nature of patent protection: the indices of Rapp and Rozek (1990) and Ginarte and Park (1997). The Rapp and Rozek index is based on the adherence of each country's patent laws to the minimum standards proposed by the US Chamber of Commerce (1987), which include guidelines for patent examination procedures, term of protection, compulsory licensing, coverage of inventions, transferability of patent rights, and effective enforcement against infringement. The index ranks the level of patent protection for each country on a scale of zero to five. Ginarte and Park (1997) construct their index using similar criteria and values, but their scoring method differs from that of Rapp and Rozek. Their index covers five equally-weighted aspects of the national patent laws: the extent of coverage (patentability), membership in international patent agreements, protection against loss rights (like compulsory licensing), enforcement mechanisms, and duration.

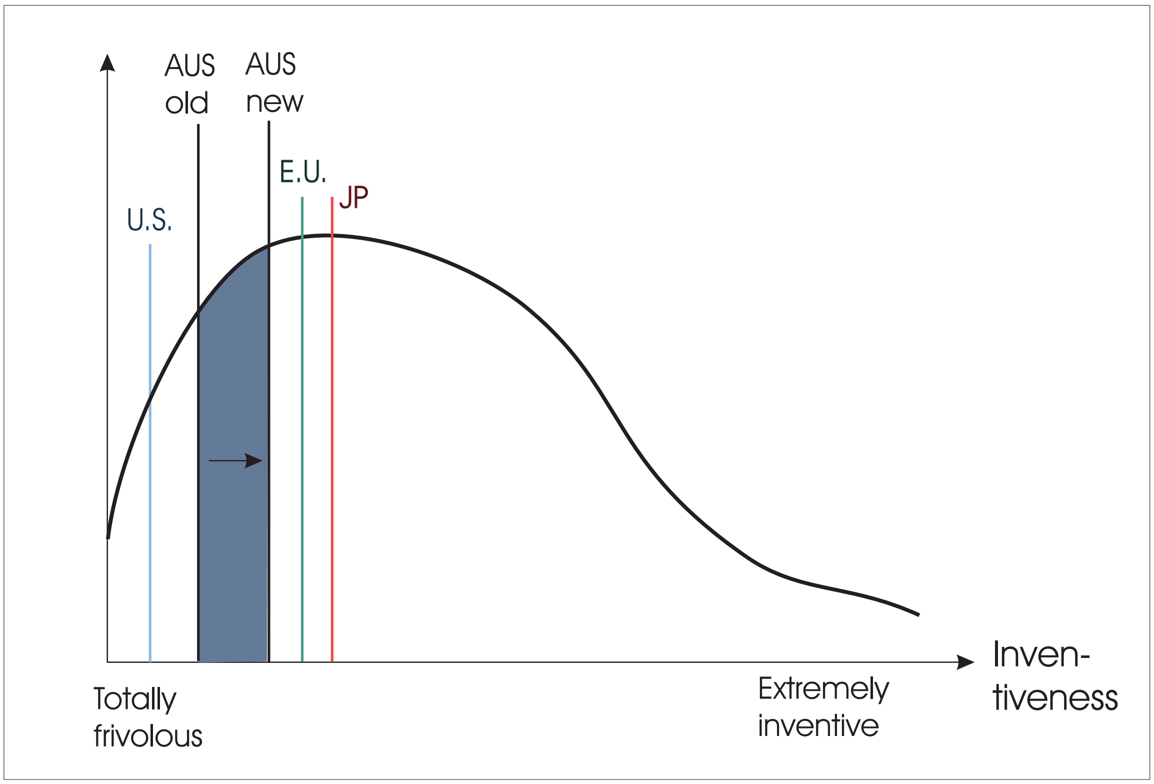
One difficulty with the Ginarte–Park approach is that there is clear evidence that a rise in R&D causes a rise in the index (Ginarte and Park, 1997). That is, the index is endogenous. Accordingly, studies which do not account in a satisfactory way for potential two-way causation will produce spurious findings. Over and above this our view is that the Ginarte–Park index is too broad-brush and conflates too many policy changes to provide useful policy recommendations. Furthermore, as discussed above, the use of the term ‘stronger patent regime’ for higher levels of the Ginarte–Park index is misleading. While a rise in the Ginarte–Park index implies stronger patent rights for some patentees (those who now get a bigger, longer or more enforceable patent), it can also imply weaker rights for other patentees and inventors, both current and prospective who are excluded from the patent system. For example, raising patent duration to 100 years may at first glance be increasing patentees’ rights, but the conclusion is less clear cut if we consider the effects on other inventors operating in the same technological space. Inventors wishing to undertake follow-on or related R&D can now only do so via licensing for 100 years and the power of ambiguously-related patents to stop infringement may remain ambiguous for 100 years, rather than the current 20.

The effects of raising the ‘revealed’ inventive step threshold

Imagine a simplified world in which we are able to rank all patent applications according to their inventiveness, as in Figure 1. The degree of inventiveness ranges from ‘totally frivolous’ to ‘extremely inventive’. The solid curve in Figure 1 approximates the frequency distribution of patent applications. We imagine that the existing Australian revealed inventive step threshold can be represented by a vertical cut-off line labelled ‘AUS old’, to the left of which are applications that are deemed to have too low a degree of inventiveness for a patent to be granted. Conversely, to the right of the cut-off line are applications that are considered to have sufficient merit in terms of the inventiveness criteria for a patent to be granted. The revealed threshold is determined by how inventive a proposed invention has to be in practice in order to qualify for a grant. It represents the outcome of the statutory law, common law and patent office protocols and procedures.

For comparison, we have also included cut-off lines representing the revealed inventive step thresholds of the United States, Europe and Japan. Figure 1 depicts the approximate current standing of these three jurisdictions vis-à-vis Australia in terms of the stringency of their respective inventive step thresholds as estimated by Jensen *et al.* (2008), who consider the examination decisions for 7,000 unique inventions which were all sent to the USPTO, JPO, EPO and APO. Since the examination decisions at these offices were conducted on patent applications for the underlying inventions, this study provides us with a unique insight into the relative inventive steps in different national patent offices.[9] We also include in Figure 1 the idea that the proposed stronger examination standards will move Australia's cut-off from 'AUS old' to 'AUS new', which is still below the European and Japanese standards.

Figure 1: Australian patent examination standards vis-à-vis United States, Europe and Japan



[9] Note that we don't know the size of the *optimal* inventive step since that depends on the relationship between the inventive step and the intensity of innovative activity, which we discuss later.

On the number and value of patents

The effect of the patent parameters on innovative activity depends on the degree of protection they give to inventors, taken as a whole, less the deadweight losses due to impediments to further R&D. Together this amounts to the ability of inventors to conduct R&D in a cost-effective manner and to appropriate monopoly revenues from their inventions (which can be thought of as the economic value of the patent). As shown in Figure 1, raising the inventive step threshold would in effect shift the cut-off line to the right, resulting in a decrease in the number of patents granted. Hunt (1999) refers to the fall in the probability of being granted a patent as the *static effect* of raising the inventive step threshold. For these 'marginal' inventions, raising the inventive step threshold in Australia implies a decline in patent protection. Thus, for prospective inventors who are yet to undertake an R&D project, the *expected return* of doing so is lower due to the static effect.

In contrast, for inventions on the right of the new cut-off line, raising the inventive step threshold effectively confers stronger patent protection, since there will be fewer competitors in the market place in which they operate. Given that a patent in effect grants the inventor a monopoly position, this monopoly position is stronger if there are fewer substitutes in the market. That is, it raises the power of the patentee to appropriate returns from the invention (in other words, it increases the patent's economic value) in the long term. Hunt (1999) refers to this as the *dynamic effect* of raising the inventive step threshold. Thus the expected return of undertaking an R&D project is now higher under the dynamic effect. It is not clear whether the static effect dominates the dynamic effect or vice versa. *Given that both these effects will operate when we raise the inventive step threshold, it is not possible to say that a rise in the threshold is akin to increasing or decreasing the profits of all inventors*.

To further clarify the issue, consider a hypothetical situation involving two countries, D (domestic) and F (foreign) and two inventions owned respectively by companies A and B. The two inventions can be developed into two distinct commercial products that are reasonably close substitutes. Suppose Company A obtains a patent in both countries, whereas Company B successfully gets a patent in Country F but has yet to obtain one in Country D. Now suppose that Country D raises its inventive step threshold so that Company B, which could obtain a patent under the previous standards, can no longer do so. From the perspective of Company B, there is less protection for his invention as his ability to appropriate profits in Country D is reduced. From the perspective of Company A, however, its ability to appropriate profits has increased, since it does not need to compete with B in the Country D product market.[10] From Country D's perspective, whether the effect of raising the inventive step threshold is a desirable policy for that country's economy depends critically on the nationality of A and B.

It is also important to think of the relative position of a nation's inventive step threshold. For example, given that the United States operates a more liberal inventive step threshold than Australia, an increase in Australia's inventive step threshold (from 'AUS old' to 'AUS new') would decrease the number of patents granted in Australia (by the amount contained in the shaded region in Figure 1). The reference to the United States is of particular importance because although the United States does not lead in all technological fields, it leads in a significant number of areas.

Of course, patents are not the only (or even the most effective) means of appropriating returns from innovative investments. Other commonly used appropriation mechanisms include trade marks and brands, trade secrecy and organisational know-how. Following the seminal work of Levin *et al*. (1987), it is well known that the effectiveness of appropriability mechanisms varies across industries and that patents are typically rated as less effective than most other mechanisms. The effectiveness of an appropriation mechanism is likely to be affected by the underlying nature of knowledge: that is, whether the knowledge is tacit or has been codified. Inventions which are based on codified knowledge, for example, might be better protected using patents, while inventions based on tacit knowledge may be more naturally protected by trade secrecy and sheer complexity. Moreover, returns from investing in tacit technology may be easier to appropriate since the costs of imitation are typically high and may equal (or be close to) the cost of invention.

The available empirical evidence seems to support the contention that industries which rely on product inventions based on codifiable knowledge (such as the pharmaceutical industry) are relatively more likely to find patents an effective appropriation mechanism. On the other hand, industries relying on tacit knowledge are more likely to find trade secrets or organisational know-how more effective

[10] This is only true, of course, if we assume that the product is not commercialised in the absence of a patent (or that it is commercialised but can't erode any of the patent owners' profits).

appropriation mechanisms (Harabi 1995; Arundel 2001). To the extent that non-patent forms of protection are effective, the full impact of changes to the inventive step threshold will be muted.

Thus far, we have ignored the *long-term* impact of raising the inventive step threshold on patent granting *rates*. For example, we state that raising the examination standards would in effect shift the cut-off line to the right, resulting in a decrease in the number of patents granted. While this is unambiguously true, it is less clear what would happen to patent granting *rates* in the long term. Increasing the inventive step threshold may result in the rejection of applications that would otherwise have been granted, which seems to imply that the patent granting rate would fall from, say, 80 per cent to 70 per cent. But this is not necessarily correct since it is quite likely that as applicants learn about the new inventive step threshold they will reduce the number of applications with low inventive steps (and therefore low probability of being granted). Thus the left tail of the distribution in Figure 1 may shrink, such that the patent granting rate may in fact stay at its pre-existing level of 80 per cent (assuming this is some sort of equilibrium grant rate). This simple example highlights the importance of dynamics in any analysis of patent parameter changes.

Existing cross-sectional evidence, however, suggests that changes to the inventiveness of underlying applications are unlikely to restore the grant rate to the former level following a change in the inventive step threshold. Jensen *et al.* (2008) and Webster *et al.* (2007) use matched samples of international patent applications to reveal clear differences in the size of inventive step threshold between jurisdictions. As shown in Figure 1, the rank order is – from lowest to highest – the United States, Australia, Europe and then Japan. However, it is also known that overall grant rates have the same rank order as exists for thresholds, which suggests that offices with higher thresholds simply reject a greater proportion of applications. It does appear that the effect of a higher inventive step threshold is not fully absorbed by a reduction in low step applications.

On domestic R&D and research output

The fundamental economic rationale for the existence of patents is to increase the *ex ante* incentive to invest in inventive activity. Where inventors are unable to exclude others from profiting from their invention, the unfettered market will under-invest in the provision of inventive activity. In many ways, economists regard patents as a necessary evil: although they introduce static dead-weight loss associated with allowing inventors to charge monopoly prices, they aid in the creation and diffusion of knowledge that otherwise may not occur.

There are many other ways to solve the under-investment problem: government grants, prizes and contests can all be used as alternative ways to stimulate investment. Consequently, there are numerous examples of inventive activity occurring in the absence of patents (say prior to 1850) and of inventive activity which occurred in the patent age (and involved substantial costs) but was not associated with a patent at all (e.g. penicillin, Salk polio vaccine). Thus, we know from casual empiricism that patents are not necessary for many types of invention. This is particularly true in the case of basic or abstract scientific research at universities, which is typically undertaken through the provision of government grants rather than via patents. Nevertheless, patents are widely used in the developed world to stimulate applied (private sector) research and pressure is often put on developing nations to recognize patented technologies.

In this light, we examine the empirical evidence regarding the relationship between patents and inventive activity: in particular, we ask the question, does the evidence suggest that changing the parameters of the patent system will stimulate inventive activity, and, if so, how? Although there are no specific studies on the relationship between increasing the inventive step and its effect of inventive activity (e.g. R&D expenditure), there are numerous other studies which can help us understand the broader issue of the relationship between patent system changes and inventive activity.

There are a number of summaries of the theoretical and empirical arguments regarding the relationship between the parameters of the patent system and local innovation (see Branstetter 2004; Encaoua et al. 2006; Gallini 2002; Hall 2007; Mazzoleni and Nelson 1998). If there is a non-linear relationship between these parameters and innovation, then the marginal effect of *changing* the patent system depends on the status quo. In a review of this literature, Branstetter (2004) concludes that, on balance, there is little evidence to support the notion that stronger patent laws increase domestic innovation; rather, stronger patents laws resulted in more foreign patent applications in the reforming country. These conclusions are based on a number of country-specific empirical studies, including those on the 1988 Japanese patent law reforms which enabled multi-claim patent applications, by Sakakibara and Branstetter (2001) and Branstetter and Nakamura (2003). In a similar vein, Kortum and Lerner (1997) show that the recently observed surge in patenting in the United States is due to technological revolution rather than the stronger enforcement provided by the creation of the Court of Appeals of the Federal Circuit. Another country-specific study was conducted by Scherer and Weisburst (1995), who demonstrate that in a particularly patent-friendly industry like pharmaceuticals, changes in Italian patent laws had no effect on domestic innovation. These conclusions arrive largely from studies on developed countries where that status quo involves broad patent scope, a potential 20 year patent life and a relatively well developed enforcement system.

There has been a proliferation of cross-country studies seeking to find a casual relationship between national patent rights and domestic innovative effort. Most papers use the Ginarte–Park index of patent regime 'strength' described above. For the most part, these studies have demonstrated results contrary to the finding of the detailed country-specific studies mentioned above. That is, they find that higher levels of the Ginarte–Park index are associated with more innovative activity (Kanwar 2007; Kanwar and Evenson 2003; Schneider 2005; Varsakelis 2000; Allred and Park 2007).[11]

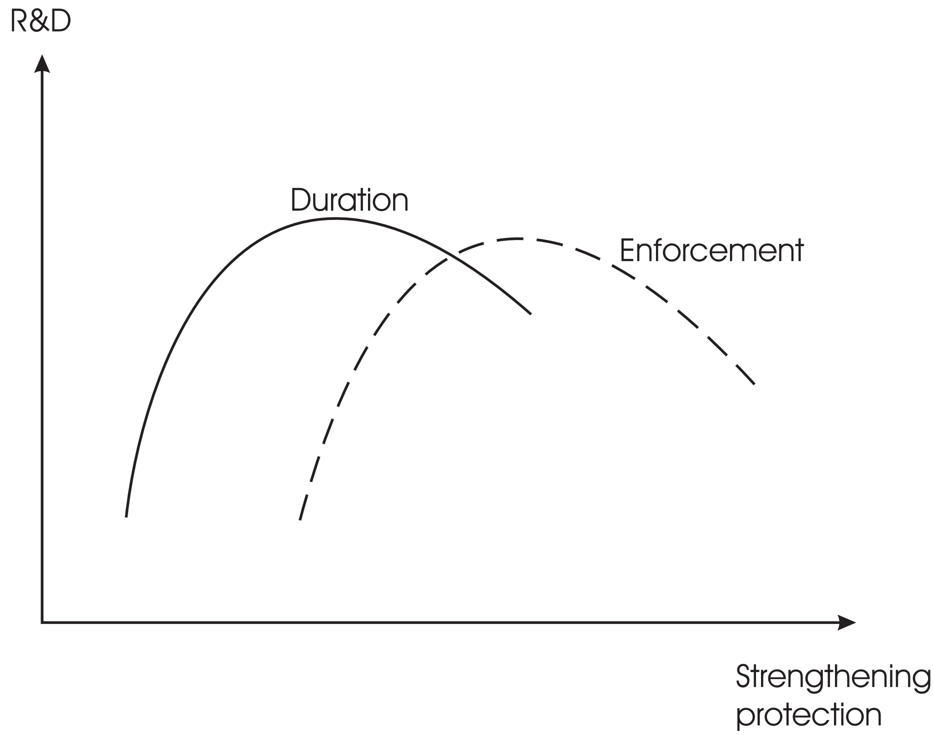
Better methods for dealing with the meaning of 'patent regime' and 'innovation' are to be found in studies that have defined a change in the parameters of the patent system more clearly. These include the studies by Qian (2007), Kortum and Lerner (2004), Sakakibara and Branstetter (1999) and Branstetter and Nakamura (2003). Qian (2007) uses a matched sample method and finds that R&D is related to the level of economic development, educational attainment and economic freedom but not the strength of national patent laws *per se*. She also finds there is an optimal level of protection above which a strengthening of patent laws reduces R&D. The absence of a positive relationship between the strength of the enforcement regime and innovation was also found by Kortum and Lerner (2004) for the United States and Sakakibara and Branstetter (1999), Branstetter and Nakamura (2003) in Japan. In a review of national patent law changes over the past 150 years, Lerner (2002) found that strengthening patent law did not have a notable effect on patent applications from local residents, but it did have an effect on applications from foreign residents.

[11] Note, however, that the relationship may not be a simple linear one: increasing patent regime strength may have a positive effect up to a point and then it decreases. This suggests that the relationship may in fact be U-shaped.

Branstetter (2004) points to a number of reasons why the *a priori* expectations regarding patent strength and innovation may not hold. First, R&D investments are cyclical and in order to invest, firms must have an expectation of a growing market. In the absence of this expectation, strong patent rights are simply insufficient to induce investment in the first place. Second, patents are not the only way to appropriate returns to investment. In the absence of strong patent rights, firms simply use other appropriation mechanisms and we have already seen that these can be quite effective. Third, strong patent rights can retard cumulative innovation if the first patentee in the chain blocks follow-on research by others. A number of theoretical models have demonstrated that strong patent rights can actually retard the level of innovation in technology areas where an innovation can be a crucial input into numerous other innovations (see Green and Scotchmer 1995; Bessen and Maskin 2000). On the empirical front, Hall and Ziedonis (2001) have shown that in an industry characterized by such cumulative innovation – for example, the semiconductor industry in the United States – stronger enforcement regimes have spawned entry by specialized firms but also encouraged more defensive patenting by large incumbent firms. Bessen and Hunt (2004) have shown that firms obtaining software patents experienced a significant decline in R&D intensity. Finally, if the local market is not perceived as being important, then changes to the local patent regime will not increase local incentive to invent.

Together, these studies suggest that the relationship between patent protection and R&D activity, if it exists, may not be linear. Figure 2 illustrates the non-linear relationship between R&D and two aspects of patent protection. Suppose there is an increase in patent duration, or additional enforcement mechanisms not previously provided for are created - this increase in patent protection has a non-linear effect on R&D, as represented by the solid curve for duration and dashed curve for enforcement. That is, an initial rise in the level of protection increases R&D, but eventually a point is reached such that the effect becomes negative – further strengthening of protection lowers R&D. The two curves also illustrate that the turning point may occur at different levels for different types of patent system change. As illustrated in Figure 2, the turning point for duration protection occurs earlier than that for enforcement, meaning that the lowering of R&D sets in earlier as compared with enforcement as the strength of duration protection is increased. From a policy perspective, this hypothetical situation implies that in order to increase R&D, it is desirable to introduce more enforcement mechanisms but not increase duration.

Figure 2: The relationship strengthening patent protection and R&D



On domestic technology transfer and commercialisation

In the literature the role, or lack thereof, of patents in aiding domestic technology transfer has been discussed as it relates to small or specialised research organisations, large established firms and easily-imitated technologies. We summarise the findings below.

Small or specialised research organisations

When a firm is small or specialises in research (e.g. a university), the best option for development is often to attract external finance or find a partner with complementary assets (Mazzoleni and Nelson 1998, Arora and Merges 2004; Orsi and Coriat 2005). This generally involves selling a patent, licensing or making an initial public offering, *inter alia*. Patents are used in this process to demonstrate to external parties that the firm has made a recognisable invention over which it has surety of ownership.

There is general consensus in the literature that patents play a positive role in enabling the transfer and development of privately-financed research to privately-financed development partners (Arora, Forsfuri, Gambardella 2003; Hall 2005). Nonetheless, it is less clear how many patents a firm needs to acquire to smooth the transfer process. There is likely to be diminishing returns from acquiring additional patents beyond a certain level. Mann and Sager (2007), for example, found that in the United States having one patent compared with no patents enhances the success of a start-up, but that additional patents have no incremental effect on the probability of success.

There is less consensus over whether it is desirable to encourage the use of patents for the development of *publicly* financed inventions (Arrow 1962; Dasgupta and David 1994; Eisenberg 1987; Heller and Eisenberg 1998).[12] Generally, the more upstream or fundamental the research, the more potential gains there are from free, unrestricted diffusion but there can also be cases where the development of a downstream product can benefit from unrestricted diffusion as well (such as a public health treatment). Put another way, patents should not be used as incentives for inventions when the dead-weight losses from monopoly power are large. Accordingly, basic science and broadly-applicable technologies should be financed through general government grants (Arrow 1962). Mazzoleni (2006) argues that the need to license and pay fees acts as a hindrance to negotiations and that the way to maximise transfers is to offer licenses, sometimes non-exclusively, for minimal fees. Other factors such as trust, geographic proximity and the flexibility of the university with respect to its IP policies (Santoro and Gopalakrishnan 2001), or provision of government financial support (Niosi 2006) matter most for the success of university technology transfer.

Large established firms

Surveys from a number of countries around the world have clearly shown that large, established firms are more likely to use lead time and complementary assets than patents to recoup their investments from development (Mazzoleni and Nelson 1998; Levin *et al.* 1987; Cohen *et al.* 2000; Arundel 2001; Harabi 1997; Jensen and Webster 2006; Branstetter and Nakamura 2003). Despite this, large firms are still just as likely to take out patents as smaller firms and it is likely that this apparent anomaly occurs because large firms patent for other reasons (Jensen and Webster 2006). In the United States, it has been argued that large firms often patent strategically rather than to protect a single invention from infringement. Either firms seek to obtain a wall of patents around a given invention (a patent thicket) to

[12] Few people argue that the lure of future royalties should be an incentive to conduct research in the public sector since any attempt to exercise *ex post* monopoly power results in dead-weight losses.

hinder rivals' ability to invent around the idea, or they seek to obtain large portfolios of patents so they can make a credible threat to counter sue if a rival considers suing for infringement (a patent arms race) (Hall and Ziedonis 2001; Shapiro 2000; Blind *et al.* 2006). In both cases, the jurisdiction is flooded with patents, often of trivial value.

This flooding can act as a barrier to entry for new firms seeking to either conduct research or develop a technology, since they have to invest significant time to assess the scope of their freedom to operate. Established firms may circumvent this problem by forming a cartel and pooling knowledge within the cartel. A cartel is the best outcome from this scenario since it implies a high level of tacit consent among related parties to enable production.

A less successful outcome from this strategic patenting scenario occurs when the costs of obtaining agreements from all relevant patentees means that the product is priced out of the market. Thus, a product that is in great demand may not be produced simply because of the additional costs associated with negotiating many and varied licenses. This situation is called an 'anti-commons' (Heller and Eisenberg 1998; Cohen 2005). Under this scenario, patents and their associated registration, examination and litigation costs may be a more expensive way to induce commercialisation than other alternatives (Jaffe and Lerner 2004; Choi 2005).

Easily-imitated technologies

When the invention is easy and cheap to imitate, patents may be the only way to achieve invention profits. It is generally thought that an invention is easy or cheap when the technology has been highly codified, such as in chemistry or pharmacology.[13] If knowledge transfer requires either personal contact, the replication of a large and complex number of processes or regular servicing from the originating firm, then patents are less important for appropriation. The inventing firm can simply withhold the transfer of personnel and knowledge about systems to prevent imitation. McCaughey, Liesch and Poulson (2000) document a case where a firm relied completely on the complexity of the production process to protect its product.

[13] In a 1993 survey of 600 European manufacturing firms, Arundel and Kabala (1998) found that patent propensity rates were as low as 8 per cent in textile technologies (?). Only pharmaceuticals, chemicals, machinery and precision instruments industries apply for a patent for more than 50 per cent of their innovations.

On international trade flows

In an open global economy, international exchanges including trade, FDI, and cross-border licensing spread the benefits of innovation beyond national boundaries. A country thus does not reap all the benefits that come from protecting patented technologies within its borders. The value of patent protection varies, depending on whether the country is a technology importing or exporting country, or whether one takes a global perspective that encompasses all countries. For example, technology importing countries not only incur higher import costs under a strong patent protection regime, but also face greater restrictions in developing local R&D via imitation. In contrast, technology exporting countries tend to gain not only via larger market shares but also greater monopoly power in the market place. From a global perspective, the net effect is ambiguous since there are gainers and losers; properly accounting for their gains and losses will require cross-country comparisons that are often contentious. Recent theoretical discussion investigating the impact of patent protection from various perspectives includes Branstetter, et al. (2007), Grossman and Lai (2004), McCalman (2002) and Helpman (1993). Maskus (1998, 2000) provides a summary of these arguments and the empirical evidence for and against them.

Given that changing patent protection could produce, in theory, effects that pull in different directions, the question then becomes an empirical one. Unfortunately, the empirical literature too produces mixed results. Many factors may contribute to the often contradictory empirical findings: data, measurement and aggregation differences are probably the obvious ones. Furthermore, most empirical studies measure IP protection using the indices of Rapp and Rozak (1990) and Ginarte and Park (1997). Thus, much of the evidence focuses on changes to the patent parameters that are unrelated to changes in the inventive step, so the results should be considered in this light. To be fair, however, the index does provide some indication of the extent of patent protection in cases when a developing country joins WTO or signs IP-related international treaties. A higher index in these cases indicates correctly that a greater degree of protection has been given to IP rights as compared with the pre-WTO or pre-treaty days.

The empirical literature on IP protection and trade began in the early 1990s with the pioneering work of Ferrantino (1993), who measured IP protection regimes according to national membership in IP rights treaties and found that importing countries' patent regimes have no significant effects on total US exports. Maskus and Penubarti (1995) took the discussion one step further by distinguishing, conceptually, two opposing empirical effects of strengthening patent protection. First, stronger patent rights increase the imitation costs and lower the level of infringing activities, both of which increase the demand for the exporting firm's product. The increase in demand, called the *market expansion* effect, induces the exporting firm to supply more exports to the local market. Second, stronger patent rights enhance the market power of the exporting firm. This stronger market power, called the *market power* effect, induces the exporting firm to act monopolistically, and thus sell less to the local market.

Using the index of Rapp and Rozek (1990) to measure patent protection in their empirical investigation, Maskus and Penubarti (1995) found generally that a higher index induced greater trade flows across manufacturing sectors. However, for patent-intensive goods, they found that the market-expansion effect offset the market-power effect and as a result trade in these goods did not respond to differences in patent regimes. Later research tends to find that whether the market expansion effect dominates the market power effect depends on many factors, among which are the imitative capabilities of the importing country, characteristics of the technology, stage of development of the importing country, and R&D intensity of the exporting industries.

Smith (1999) demonstrated that the imitation capabilities of the importing country are an important consideration. A country with strong imitative capabilities poses a strong threat to the exporting firm, especially if the patent rights protection (in the local/importing country) is weak. Table 2 summarizes the possibilities. If a country has strong imitative capabilities and weak patent protection, an increase in its patent protection will have a positive effect on imports since the market expansion effect tends to dominate, i.e., exporting firms are likely to increase their exports to the country. In contrast, the opposite effect on trade occurs for a country with weak imitative abilities but strong patent protection; increasing its patent protection further will result in excessive market power for the foreign exporting firm, which could exploit its market power by restricting exports.

Table 4: The threat of imitation and strengthening patent protection in local economy (adapted from Smith 1999)

Imitative Capabilities in local/importing economy	Patent rights protection in local/importing economy	
	Strong	*Weak*
Strong	Moderate threat of imitation ambiguous effect (?)	Strong threat of imitation market expansion effect (+)
Weak	Weak threat of imitation market power effect (-)	Moderate threat of imitation Ambiguous effect (?)

Generally, the empirical literature lends support to the notion that the threat of imitation plays an important role in determining whether a higher degree of patent protection, in the sense of the Rapp–Rozak or Ginarte–Park index, affects trade flows (see Smith 1999 and Rafiquzzaman 2002). Smith (2001) further found a positive relationship not only for US exports, but also affiliate sales and licensing; and the effect is particularly large for countries with strong imitative capabilities. Co (2004) found that stronger patent protection had a positive effect on trade for R&D intensive goods, but negative effects for non-R&D intensive goods for a country with 'average' imitative capability in her sample. Liu and Lin (2005) also found, in relation to three knowledge-intensive industries, a positive relationship between foreign patent rights and exports when the importing country exhibits a strong threat of imitation. However, for agricultural trade, for which the imitation costs are low, Yang and Woo (2006) did not find any significant effects. It is worth pointing out that all these studies made use of either the Rapp-Rozak or Ginarte-Park index to measure the level of patent rights protection. It is not known whether and to what extent changes in the indices could be related to changes to the inventive step.

On FDI

According to Dunning (1981), there are three necessary conditions for firms to be willing to undertake FDI abroad: (i) Ownership advantage – the firm must possess a non-rivalrous asset (know-how or brand names); (ii) location advantage – there is a potential market in the foreign location; (iii) internalisation advantage – the non-rivalrous asset requires personal transmission and is not suitable for arms-length licensing. Within this framework, patent rights protection in principle can have two opposing effects: on the one hand, it enhances the location advantage of the host country since the foreign firm's investments are less likely to be undermined by imitation. On the other hand, stronger protection reduces the internalisation advantage of foreign firms undertaking FDI, as other forms of exploiting intellectual property (e.g., licensing) may become more attractive (see Javorcik 2004 and Smith 2001).

We briefly summarise the empirical literature below. We reiterate that that empirical studies of FDI are fraught with difficulty and the findings can be sensitive to issues such as: measurement problems related to patent protection, the use of highly aggregated FDI data, measures of industry and country characteristics, the nature of technologies, and substitution possibilities between FDI and other forms of patent use (e.g., licensing) beyond national borders. These limitations notwithstanding, empirical studies generally uncover a positive relationship between the Rapp–Rozak or Ginarte–Park index and FDI. An early example is Lee and Mansfield (1996), who conducted a survey of 100 US firms and found that a country's IP rights protection is positively correlated with the volume of US FDI inflows into that country. A more aggregate approach that came to the same conclusion is OECD (2003), which found that the patent rights index is positively associated with FDI. However, the same study also cautioned that the positive relationship appeared to be diminishing as the index increases. Thus, a higher index does not always raise FDI.

Several later studies examine not only the level but also the quality of FDI, technology characteristics of investments, country characteristics such as imitative capabilities and other variables. Nunnenkamp and Spatz (2004) noted that stronger IP rights protection may help induce high-quality FDI, where the quality of an investment was measured by the technology content, value added and exports generated by the FDI. Javorcik (2004) found that countries with more effective patent rights were more likely to be chosen as an investment location by multinationals, especially in high-technology sectors like chemicals or drugs, for which IP rights play an important role. Weak protection encouraged foreign investors to set up distribution facilities rather than to engage in local production. Branstetter et al. (2007) found that more rights for successful patent applicants slowed imitation and increased FDI from multinationals in the developed countries, particularly in technology-intensive industries.

However, there are also several studies that found either insignificant or no relationship between IP rights protection and FDI. For the chemical processing industries, Fosfuri (2004) found no evidence of a significant impact from IP rights protection on international activity, including FDI. Pfister and Deffains (2005), in examining the location choice of French multinationals, found that stronger patent protection in countries with high GDP or a low R&D intensity tended to reduce the attractiveness of FDI for French firms. In a study that takes into account the substitution possibilities between FDI, direct exports and licensing among the decision variables of multinationals, Smith (2001) found that stronger patent rights protection had a stronger effect on FDI than on US exports, but the effect was less pronounced than that on licensing. These results were corroborated by Yang and Maskus (2001), who showed that royalties and license fees received by US companies rose with stronger IP rights protection in 23 partner countries.

Branstetter *et al.* (2006) investigated the effects of increases in the monopoly power of the patentee (i.e. reforms to reduce uncertainty over the grant decision, the expansion of patentable subject matter, increased control of patentee over licensing and imitation) on FDI from the United States to 16 mainly middle-income countries over the period 1982–1999. The results provide strong evidence that US multinationals respond to an increase in recipient-country patent reform by increasing technology transfer to reforming countries. The patterns in affiliate R&D spending, which complements the transfer of technology, indicate that at least some component of increased royalty payments reflects increases in the volume of technology transferred and not merely increases in the price of technology transferred. How well these effects translate to Australia as either a recipient or source of FDI is less clear.

On balance, the empirical evidence seems to suggest a positive but non-linear relationship, as depicted in Figure 2 above, between patent rights protection and FDI. More rights for successful applicants may induce more FDI initially, as exports are replaced with direct investments. However, as the level of protection is further strengthened, multinationals may prefer licensing to FDI. This explains the observation that, in advanced host countries with strong IP rights protection, FDI was increasingly replaced by licensing (Nunnenkamp and Spatz 2004). Thus, whether a strengthening of patent protection raises FDI depends, inter alia, on the initial level of IP protection in the host country and the substitutability between FDI, exports and licensing.

Effects of the reduction in US inventive step threshold

As mentioned above, we believe that the decline in the US inventive step threshold during the 1980s is the only actual change to inventive step thresholds that has been analysed in the literature. Cohen (2005) presents an overview of this literature. He argues that the main effect of reducing the threshold was to increase uncertainty about the ultimate validity of any given patent, which in turn reduced investment in the development of the associated technology. It also diminished investment in competing technologies in cases where rivals believe that such investments may be at risk of infringing the existing (low quality) patent. That same uncertainty also generated litigation in instances where would-be infringers believed that it was worth the risk of ignoring a patent, given that the chance of a finding of invalidity in the event of a suit had increased.

Jaffe (2000) further argues that a lowering of the bar of non-obviousness creates more confusion over who owns what. On the one hand, a relaxed threshold permits other parties to patent an invention that is technologically close to the first patent – effectively limiting the scope of this first patent. However, by lowering the standard of non-obviousness, the technological space a firm can claim to be within its patent will likely be larger.

According to Levin and Levin (2003), patents on known or only trivially modified inventions confer potential market power to restrict access and raise prices, and enable the patent holder to use litigation as a competitive weapon without providing incentives for making genuine advances or disclosing such advances to the public. They offer no public benefit in exchange for the benefit given to the patentee. Granting patents for inventions that are not new, useful and non-obvious unjustly rewards the patent holder at the expense of consumers.

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