Australian Government
IP Australia

The economic impact of innovation patents - APPENDICES

IP Australia Economic Research Paper 05

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Reference:

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http://www.ipaustralia.gov.au/about-us/what-we-do/economics/

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Appendix 1.1: The available evidence on second-tier patent systems

Table 8: Countries with second-tier patent systems

Albania	Ecuador	Malaysia
Angola	Egypt	Mexico
Argentina	Estonia	OAPI
ARIPO	Ethiopia	Peru
Armenia	Finland	Philippines
Aruba	France	Poland
Australia	Georgia	Portugal
Austria	Germany	Republic of Korea
Azerbaijan	Greece	Republic of Moldova
Belarus	Guatemala	Russian Federation
Belize	Honduras	Slovakia
Brazil	Hungary	Spain
Bolivia	Indonesia	Taiwan
Bulgaria	Ireland	Tajikistan
Chile	Italy	Trinidad and Tobago
China	Japan	Turkey
Colombia	Kazakhstan	Ukraine
Costa Rica	Kuwait	Uruguay
Czech Republic	Kyrgyzstan	Uzbekistan
Denmark	Laos	

Intellectual Property Government Open Data

The Intellectual Property Government Open Data (IPGOD) includes over 100 years of Intellectual Property (IP) rights administered by IP Australia comprising patents, trade marks, designs and plant breeder's rights. The data is highly detailed, including information on each aspect of the application process from application through to granting of IP rights. The data, as well as accompanying papers that illustrate its use, is freely available for download at www.data.gov.au

Appendix 2.1: Break test for change in number of applications

Both the petty patents system and the innovation patents systems are referred to as second tier patent systems; secondary to the standard patents system. In 2001 Australia transitioned from a petty patent system to an innovation patent system. Linear regression and chow tests were used to assess whether the transition entailed a series break in the number of second tier patents filed and certified, with detailed results at the bottom of this appendix.

The analysis indicated that there were structural breaks in both the time series of the number of second tier patents filed per year and the number of second tier patents granted enforceable rights per year. Specifically, the tests indicated:

- a statistically significant increase in the number of second tier patents filed after the innovation patent system was introduced, as well as an increase in the rate at which new second-tier patent applications were filed, and
- a statistically significant decrease in the number enforceable rights granted after the innovation patent system was introduced, with ambiguous evidence as to whether the decrease was a ‘one off’ change and/or a change in the rate.

The Chow test is commonly used to test for the presence of known structural breaks in a time series. Unknown structural breaks may be present where the possible location of the structural break in the series is unknown. The Chow test is appropriate given that the date of transition from the Petty Patents system to the Innovation Patents system is known.

Chow Test

Hypothesis to be tested: That the change from the petty patent system to the innovation patent system increased the usage of second-tier patents.

Methodology: Chow test can be used with number of applications received as the dependent variable to identify a structural break between the periods when petty patents were replaced by innovation patents.

Model: A Chow test can demonstrate whether the coefficients in two linear regressions on different data sets are equal through regressing with a dummy variable at the change of the data set. For this purpose the dummy variable becomes active in June 2001 to denote the changeover from the petty patent to innovation patent system.

The null hypothesis asserts that the coefficients for the period before and after the implementation of the innovation patent are equal – i.e. the change had no discernible impact on the growth rate of patent applications.

The Chow Test statistic is:

$$\frac{(S_C-[S_1+S_2])/k}{(S_1+S_2)/(N_1+N_2-2k)}$$

Where S_C is the sum of squared residuals from the combined data, S_1 is the sum of squared residuals from the first group, and S_2 is the sum of squared residuals from the second group. N_1 and N_2 are the number of observations in each group and *k* is the total number of parameters.

The test may use numbers of standard patent applications as well as a time variable as dependent variables to denote a baseline growth for patents generally (noting these are two variables are collinear).

The Chow test is reliable where the series is homoscedastic across the two series intervals, before and after the second tier patents system transition. That is, the Chow test is reliable where the variance of the series is the same before and after the structural break. Levene's robust test was used to assess the equality of variances for the time period before and after the introduction of the innovation patent and found a change in variance for applications received, and a possible change in variance for the number of enforceable rights granted. This change in variance contends the use of the Chow test. However, simple linear regression does show a statistically significant difference on the intercept and slope of second-tier patent applications in the period before and after the introduction of the innovation patent. Conceptually it is also expected that a reduction of inventive threshold and a reduction in cost of an innovation patent would realise increased demand for innovation patents and not simply increased variance in the demand for innovation patents.

The decrease in numbers of second-tier applications granted enforceable rights is also clear. 357 applications received in the year 2000, under the petty patent system, were granted enforceable rights. Despite 13 years of patent filing growth, no year under the innovation patent system has met this number. The uncertainty on the issue lies only on what model best describes this decrease in enforceable rights.

Further econometric modelling is possible that could demonstrate more rigorously that the introduction of the innovation patent caused a structural break and both an increase in applications and a reduction in enforceable rights. However, the limited relevance of the findings to the report's conclusions, and the limited resources of the team saw it sufficient to conclude that on the basis of available evidence a structural break did occur.

Regression was undertaken with both time and GDP (chain volume measures from ABS Catalogue: 5206 Table 2, Original Series) as explanatory variables. Statistically significant results were found in both circumstances, with the only difference related to whether a change in slope or change in intercept best describes the decrease in numbers of enforceable rights granted. The following tables show the output data from the analysis:

Table 9: Linear regression results of transition to innovation patent impact on intercept, with time as explanatory variable

Dependent variable: number of second-tier patent applications received

Explanatory Variables	**Coef.**		**Std. Err.**	**t**	**P>|t|**
Time	2.143	***	0.155	13.870	0.000

Dummy variable indicating change in system	107.604	***	12.749	8.440	0.000
Constant	-19.845	**	8.017	-2.480	0.015
R-squared	0.919				
Adj R-squared	0.918				
n	138				

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 10: Linear regression results of transition to innovation patent impact on intercept, with GDP as explanatory variable

Dependent variable: number of second-tier patent applications received

Explanatory Variables	**Coef.**		**Std. Err.**	**t**	**P>|t|**
GDP - chain volume measure	0.001	***	0.000	15.890	0.000
Dummy variable indicating change in system	75.864	***	13.004	5.830	0.000
Constant	-166.067	***	15.634	-10.620	0.000
R-squared	0.931				
Adj R-squared	0.930				
n	138				

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 11: Linear regression and chow test results of transition to innovation patent impact on intercept and slope, with time as explanatory variable

Dependent variable: number of second-tier patent applications received

Explanatory Variables	**Coef.**		**Std. Err.**	**t**	**P>|t|**
Time	1.659	***	0.136	12.210	0.000
Dummy variable indicating change in system	-184.954	***	35.196	-5.260	0.000
Time multiplied by dummy (slope)	2.884	***	0.332	8.690	0.000
Constant	1.428		6.886	0.210	0.836
R-squared	0.948				
Adj R-squared	0.947				
n	138				
Chow test that dummy variable and time			F(2,134) = 90.01		

multiplied by dummy variable= 0		***	Prob > F = 0.000		

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 12: Linear regression and chow test results of transition to innovation patent impact on intercept and slope, with GDP as explanatory variable

Dependent variable: number of second-tier patent applications received

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
GDP - chain volume measure	0.001	***	0.000	11.210	0.000
Dummy variable indicating change in system	-130.587	***	46.298	-2.820	0.006
GDP multiplied by dummy (slope)	0.001	***	0.000	4.620	0.000
Constant	-119.678	***	17.698	-6.760	0.000
R-squared	0.941				
Adj R-squared	0.939				
n	138				
Chow test that dummy variable and GDP			F(2,134) = 155.9		
multiplied by dummy variable= 0		***	Prob > F = 0.000		

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 13: Variance test between groups: number of second-tier patent applications received

	Mean	Std. Dev.	Freq.
Petty patent	74.425	45.068	87
Innovation patent	329.863	82.494	51
Levene robust test statistic	**Score**	**P - Value**	
W0 - mean	22.127	0.000	***
W50 - median	13.629	0.000	***
W10 - trimmed mean	17.965	0.000	***

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Results for break test analysis on the number of second-tier patent applications granted enforceable rights are available under Appendix 3.1.

Appendix 2.2: R&D and patent filings

Kanwar and Evenson (2003: 236) “shows, unambiguously, that intellectual property protection (proxied by an index of patent rights) has a strong positive effect on technological change (proxied by R&D investment expenditures).” A key difference between their work and our problem is that we are considering the effects of the innovation patent system – a system unique to Australia in its scope and application – not an index of all IP rights. Given the uniqueness of the innovation patent system a cross-country study would involve comparing Australia’s R&D intensity to the rest of the world – a study that would be affected by many more and much stronger external factors than the existence of the innovation patent. At the country level Arora *et al* (2008) construct a model to estimate the incentive effect of standard patents in the US, but this requires long R&D data series at the firm level, and estimates of propensities to undertake R&D and patent which is not available for Australia.

We link the Department of Industry and Science database of firms claiming the R&D tax credit to IPGOD and look at all firms in the period 2001-2013 where matches between the two datasets exist. Using a propensity score matching approach, we match using the Mahalanobis method (Rosenbaum & Rubin, 1985) on log of employment, whether the firm is a foreign subsidiary, and on geography in terms of longitude and latitude. The resulting dataset has 620 firms that have filed at least one innovation patent and 3,367 firms that filed only standard patents and made use of the R&D tax credit since 2001.

The maximum likelihood estimations test to see if there is an average treatment effect on the treated firms, and report the average effect by ANZSIC classification of the firm. We test to see if there is an average difference in R&D staff or R&D expenditure two years before filing patents, for similar firms that file no patents, those that file at least one innovation patens, and those that only file standard patents.

The results suggest that firms that patent spend more on R&D than firms with no patents. These results are statistically significant at the 5% level for standard patent applicants in the mining, manufacturing, professional, scientific & technical services and the healthcare & social assistance industries. It was not possible to estimate the effect on firms that only file innovation patents as there was not enough data, so we instead look at firms that have filed at least one innovation patent and may have standard patent applications as well. In this case only the manufacturing sector sees a statistically significant positive relationship between innovation patents and R&D expenditure as well as R&D staff. Table 14: below reports all results that are statistically significant at the 10%, 5% and 1% level.

Table 14: Relationship between R&D and patenting

	Innovation patenting to no patenting		Only standard patenting to none		Innovation patenting to only standard		Any type of patenting to no patenting	
Div	**R&D**	**R&D staff**	**R&D**	**R&D staff**	**R&D**	**R&D staff**	**R&D**	**R&D staff**
A					* -0.66			
B			** 6.24				** 5.11	

C	***	2.58	**	6.49	***	1.27	***	4.71					***	1.54	***	5.08
D							**	4.07	**	1.40						
E	*	-12.31													**	-7.15
G															*	1.29
I	*	47.07														
M					***	1.02	***	2.20	***	-1.08			***	0.93	***	2.00
N									*	-0.19	***	-3.50				
P					**	-0.09							***	-0.09		
Q					**	0.31							**	0.31		
R					***	1.76	***	10.42								

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

These results do not imply a causal link where the patent incentivised R&D expenditure, which is beyond the scope of this paper, and not possible with the available data. Only a few empirical papers have been published on the incentive effect, and they have focussed on large firm surveys and standard patent data from the US (e.g. Arora et al. 2008). What this does show is that firms that file patent applications are those that undertook more R&D than similar firms – indicating that the patent system, and for manufacturing the innovation patent system, is used as a way to protect successful R&D expenditure.

The following tables show the results of the treatment effect analysis. A table of ANZSIC divisions by primary classification is also below for reference. ANZSIC divisions that do not appear in the following tables have been excluded because no observations were found of firms in those sectors both holding patent stock and claiming the R&D tax incentive.

In each table, ATET refers to the Average Treatment Effect on the Treated and shows the average effect each test condition has on each variable. Time *t* is a yearly measurement and reflects the time the patent was filed. t-2 is therefore two years before the filing date.

Table 15: List of ANZSIC divisions with ATET results

ANZSIC Division	Description
A	Agriculture, Forestry and Fishing
B	Mining
C	Manufacturing
D	Electricity, Gas, Water and Waste services
E	Construction
F	Wholesale Trade
G	Retail Trade
H	Accommodation and Food Services

I	Transport, Postal and Warehousing
J	Information Media and Telecommunications
K	Financial and Insurance Services
M	Professional, Scientific and Technical Services
N	Administrative and Support Services
R	Arts and Recreation Services

Table 16: ATET of filing at least one innovation patent compared to no patents

Variable: R&D expenditure at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	0.157		0.166	0.344	6
B	-2.907		3.897	0.456	21
C	2.584	***	0.556	0	434
D	0.379		0.55	0.491	41
E	-10.561		7.261	0.146	27
F	1.018		0.775	0.189	7
G	0.626		0.442	0.157	5
I	6.297		7.412	0.396	8
J	-1.703		1.577	0.28	19
K	63.458		65.65	0.334	9
M	0.068		0.119	0.566	34
N	-0.143		0.115	0.216	3
R	0.638		1.226	0.603	11
All	1.814	***	0.614	0.003	625

Variable: R&D staffing at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	0.792		0.952	0.405	6
B	-23.566		24.067	0.327	21
C	6.489	**	2.73	0.017	430
D	-2.872		2.484	0.248	40
E	-12.309	*	7.026	0.08	27

F	1.701		1.155	0.141	7
G	2.054		1.465	0.161	5
I	47.069	*	27.566	0.088	8
J	-1.596		2.067	0.44	19
K	100.513		127.81	0.432	9
M	0.225		0.626	0.72	34
N	-0.893		0.817	0.274	3
R	-0.975		3.396	0.774	11
All	5.423	**	2.149	0.012	620

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 17: ATET of filing standard patents only compared to no patents

Variable: R&D expenditure at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	0.124		0.290	0.670	55
B	6.242	**	2.843	0.028	149
C	1.269	***	0.269	0.000	1682
D	0.609		0.408	0.135	42
E	-0.875		1.192	0.463	59
F	-1.232		1.250	0.324	33
G	-2.314		2.204	0.294	6
I	0.166		0.820	0.840	34
J	-3.956		12.737	0.756	107
K	-10.370		17.600	0.556	48
M	1.020	***	0.213	0.000	314
N	0.011		0.054	0.833	11
O	-1.088		6.556	0.868	22
P	-0.089	***	0.025	0.000	5
Q	0.313	**	0.139	0.024	143
R	1.759	***	0.647	0.007	16
S	-0.300		0.289	0.301	9
All	0.862		0.645	0.181	2735

Variable: R&D staffing at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	-2.451		2.106	0.245	55
B	6.882		5.078	0.175	149
C	4.706	***	1.100	0.000	1677
D	4.066	**	1.906	0.033	42
E	-4.790		2.986	0.109	59
F	-11.715		8.948	0.190	33
G	0.650		0.436	0.136	6
I	2.615		5.277	0.620	34
J	-5.465		17.493	0.755	107
K	-39.503		72.499	0.586	48
M	2.198	***	0.797	0.006	313
N	0.409		0.313	0.192	11
O	0.889		38.921	0.982	22
P	-0.390		0.349	0.264	5
Q	1.234		1.831	0.500	143
R	10.416	**	4.092	0.011	16
S	1.464		3.582	0.683	9
All	2.473		2.066	0.231	2729

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 18: ATET of applicants filing at least one innovation patent compared to filing only standard patents

Variable: R&D expenditure at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	-0.661	*	0.392	0.092	6
B	-1.366		3.88	0.725	21
C	-0.716		0.773	0.354	434
D	1.396	**	0.564	0.013	41
E	-3.046		4.823	0.528	27
F	-2.031	*	1.077	0.059	7

G	1.050		0.65	0.106	5
I	7.558		7.765	0.330	8
J	-17.707		17.214	0.304	19
K	7.523		9.439	0.425	9
M	-1.082	***	0.411	0.008	34
N	-0.189	*	0.103	0.067	3
R	-1.693		1.835	0.356	11
All	-1.972	*	1.123	0.079	625

Variable: R&D staffing at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	-7.418		7.454	0.320	6
B	-12.148		8.048	0.131	21
C	-1.656		2.410	0.492	430
D	0.689		2.046	0.736	40
E	2.104		5.610	0.708	27
F	-7.814		6.664	0.241	7
G	4.354		3.208	0.175	5
I	32.710		38.044	0.390	8
J	-18.141		15.233	0.234	19
K	-116.942		112.755	0.300	9
M	-0.891		1.154	0.440	34
N	-3.500	***	0.816	0.000	3
R	-10.607		9.434	0.261	11
All	-4.485		2.823	0.112	620

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 19: ATET of applicants filing any type of patent compared to those filing no patents

Variable: R&D expenditure at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	0.127		0.262	0.628	61

B	5.112	**	2.565	0.046	170
C	1.541	***	0.249	0.000	2116
D	0.495		0.341	0.147	83
E	-3.916		2.507	0.118	86
F	-0.838		1.052	0.426	40
G	-0.978		1.296	0.451	11
I	1.333		1.744	0.445	42
J	3.617		10.864	0.739	126
K	1.287		19.098	0.946	57
M	0.927	***	0.193	0.000	348
N	-0.022		0.052	0.680	14
O	-1.039		6.271	0.868	23
P	-0.089	***	0.025	0.000	5
Q	0.310	**	0.136	0.023	147
R	0.782		0.669	0.243	27
S	-0.285		0.237	0.229	11
All	0.941		0.589	0.110	3367

Variable: R&D staffing at t-2

ANZSIC Division	ATET		Std. Err.	P-value	n
A	-2.132		1.906	0.263	61
B	3.121		5.868	0.595	170
C	5.084	***	1.177	0.000	2107
D	0.682		1.603	0.671	82
E	-7.150	**	3.185	0.025	86
F	-9.367		7.47	0.210	40
G	1.288	*	0.738	0.081	11
I	11.082		7.573	0.143	42
J	-4.924		14.933	0.742	126
K	-17.396		68.236	0.799	57
M	2.004	***	0.722	0.006	347
N	0.130		0.334	0.697	14
O	0.676		37.23	0.986	23
P	-0.390		0.349	0.264	5

Q	1.307		1.784	0.464	147
R	5.775	*	2.992	0.054	27
S	1.352		2.936	0.645	11
All	2.284		1.947	0.241	3356

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Appendix 2.3: Survival regressions

One way of evaluating the impact of the innovation patent system is to examine what effects, if any, the system has had on a firm's ability to stay in business. Using an econometric framework it is possible to answer questions such as whether innovation patents have an impact on a firm's survival in the market place, and, if so, whether the impact is positive or negative.

A hazard/survival modelling framework was used to answer these questions. In the finance literature these models have been used extensively to answer very similar questions. Essentially, the framework can provide answers to the questions "how long until an event occurs" and "what factors influence how long until an event occurs". In the current context these questions can be reframed as "does holding an innovation patent impact a firm's survival" and "is this impact positive or negative".

The paper most appropriate for the Australian context is the work by Jensen, Webster and Buddelmeyer (2008) published in the Economic Record which estimates survival ratios for Australian firms using a range of stocks in Intellectual Property. While it was not possible to replicate the exact model and methodology it has been used as the basis for our analysis.

Model

In our analysis a Cox proportional hazard framework (Cox-PH) is used to model the probability of firm deregistration or death. This model can be used to estimate the probability of a firm *i* being deregistered in time *t*+1 given that it has been survived up to time *t*.

An important characteristic of the Cox-PH framework is that it separates the hazard rate into two components, a baseline hazard and a scale factor which explains variations in the baseline hazard. This may be written as;

Eq.1 $$\lambda(t|\mathbf{x},\beta) = \lambda_0(t)\phi(\mathbf{x},\beta)$$

where $\lambda(t|\mathbf{x},\beta)$ is the hazard rate, $\lambda_0(t)$ is the baseline hazard function and is a function of *t* alone and $\phi(\mathbf{x},\beta)$ is a scaling function which imposes shifts on the baseline hazard based on firm characteristics (including stock of IP rights held).

This model is usually specified in a semi-parametric form with the functional form for $\lambda_0(t)$ left unspecified and the functional form for $\phi(\mathbf{x},\beta)$ fully specified. In the model we followed (Jensen et al. 2008) an exponential functional form is specified such that

Eq.2 $$\phi(\mathbf{x},\beta) = exp(\mathbf{x}'\beta)$$

Thus the hazard function may be written as,

Eq.3 $$\lambda(t|\mathbf{x}) = \lambda_0(t)exp(\mathbf{x}'\beta)$$

Because, in our example we have time varying regressors Eq.3 needs to be amended to allow for this such that

Eq.4 $$\lambda_i(t|x_{\boldsymbol{t}}) = \lambda_0(t)exp\left(x'_{i,t}\beta\right)$$

Where $x_{i,t}$ is a vector of time varying, firm specific variables for firm *i*.

Eq.4 decomposes the probability of a firm dying into two components, a baseline profile, generic to all firms, and a scale factor shifts the hazard rate up or down subject to the values of firm specific explanatory variables. These variables used in the scale factor will include a set of firm, industry and macroeconomic conditions measured at time *t*.

Variables

The choice of variables to include in the scale factor is guided by Jensen *et al.* (2008). They identified a number of factors affecting firm survival that were categorised into firm-level, industry-specific or macroeconomic factors. These form the basis of our explanatory variables, which are described below.

(i) Dependent Variable

The dependent variable for the model is the probability that this is the last period that the company is registered with the Australian Business Register (ABR) given that the firm is using the IP system in Australia, which is a function of time. In our analysis the unit of time being used is the number of days until failure since the firm has first used the Australian IP system.

(ii) Firm-level Explanatory Variables

The first set of firm-level variables included in the empirical model relate to innovation. For each firm the number of applications for standard patents, innovation patents, design rights and plant breeder's rights applications are included as a measure of the flow of intellectual property within a firm as they reflect current investments in innovation.

A second set of innovation related variables are intended to capture the effects of knowledge and other intangible assets on firm survival. This is done by including variables for the number of current enforceable standard patents, innovation patents, design rights and plant breeder's rights held by a firm in a particular period. Because these intellectual property rights require renewal fees to be maintained they are expected to capture more economically-valuable innovations.

Other firm level data included in the model include a series of dummy variables in the model. The first is an indicator for the size of the firm. This is included because firm size (or start-up size) has consistently been shown to be an important determinant of survival. In this study the firm size dummy variable take the value 1 if the firm has 200 or more employees and 0 otherwise.

Ownership structure of the firm has also been shown to play an important role in shaping firm survival. To account for this, we include the following dummy variables to indicate whether a firm is privately owned or not. This variable takes the value 1 if the firm has 200 or more employees and 0 otherwise.

The last dummy is used to indicate whether the company is part of a family as either a subsidiary of another firm. This variable is included as it has been argued that the hazard rate should be systematically lower for firms that are subsidiaries of incumbent firms presumably because the parent's managerial experience and other tacit knowledge can be transferred to its subsidiary. This dummy variable takes the value 1 if the firm is privately held and 0 otherwise.

(iii) Industry-level Explanatory Variables

As a measure of the competitive environment in which a firm operates a variable is included for the gross entry rates of firms into an industry. For each industry, this is calculated as the number of entrants divided by the number of incumbents according to the company's ANZSIC division. The rationale for including this variable in the model is included in the model on the basis that the number of new entrants in an industry exerts direct competitive pressure on incumbents and, therefore, affects survival. As a consequence, industries with high levels of entry are also associated with high levels of exit.

(iv) Macroeconomic Explanatory Variables

Additional variables are included to account for macroeconomic factors which influence a firm's ability to survive. There are other factors outside of a firm's control which also influence a firm's survivability. To capture this effect, we include a variable for the percentage change in GDP. This variable is lagged and equivalent of one year. Furthermore, an index of the Australian stock market is included to reflect the ease of access to external equity.

Data

Data on all firm level variables is drawn from in the Intellectual Property Government Open Data (IPGOD) which is produced by IP Australia and is available on data.gov.au. The data used to calculate the gross entry rate was taken from the Australian Business Registrar (ABR). The appropriate growth rate was able to be linked to each firm via a set of identifiers which are common to both the IPGOD and ABR data sets. Data on Australia's GDP was obtained from the Australian Bureau of Statistics while data on the stock market index was obtained from the OECD.

Results

Table 20: IP Rights impact on firm survival

Explanatory variables	Coef.		Std. Err.	z	P>|z|
Innovation Patent Applications	-0.2243	**	0.0909	-2.47	-0.014
Innovation Patents Certified	0.0599		0.1515	0.40	-0.693

Standard Patents Filed	-0.3631	***	0.0495	-7.33	0.000
Standard Patents Granted	-0.4589	***	0.0531	-8.63	0.000
Design Rights Applications	-0.0671	***	0.0170	-3.95	0.000
Design Rights Granted	0.0094		0.0855	0.11	-0.913
Plant Breeders Rights Applications	-0.8999	**	0.3964	-2.27	-0.023
Plant Breeders Rights Granted	-0.3062		0.2004	-1.53	-0.127
Large	-1.3866	***	0.1731	-8.01	0.000
Private	-0.0369		0.0616	-0.60	-0.549
Subsidiary	-0.0696		0.2320	-0.30	-0.764
Gross Entry Rate	4.1325	***	0.2171	19.04	0.000
Stock Market	0.0004		0.0011	0.32	-0.746
GDP lagged four quarters	-0.2445	***	0.0636	-3.85	0.000

A negative coefficient implies a lower propensity to exit, dependent variable firm de-registration

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Appendix 2.4: Macro effects of innovation patents

Innovation patent effects on sales growth

Assessing the impact that innovation patents have had on sales growth helps us understand the macroeconomic effects of the system as a whole. To achieve this, we adapted the work by Kim *et al* (2012) in *Research Policy* which provides a model for testing the impact of utility models in the South Korean case.

The source paper is fairly recent indicating that this methodology may be considered to be close to best practice. The model is outlined in the following box:

Box: Innovation patents and firm output

Key Source

Kim, Y. K., Lee, L, Park, W. K. & Choo, K,. (2012). Appropriate intellectual property protection and economic growth in countries at different levels of development. Research Policy 41, 358-375.

Hypothesis to be tested

That the innovation patent system has led to improved outcomes in terms of sales growth for Australian firms that make use of innovation patents compared with those that don't.

Why use this approach?

The econometric model is based upon solid macroeconomic foundations. It has been used previously to answer similar questions in other countries (Republic of Korea). The source paper is fairly recent indicating that this methodology may be considered to be close to best practice.

Model

$$\Delta \ln Y_{it} = \gamma_0 + \ln Y_{it-1} + \gamma_2 \ln U_{z_{it-1}} + \gamma_3 \ln\ P_{k_{it-1}} + \gamma_4 \ln R_{it-1} + \gamma_4 \ln N_{it} + \gamma_4 \ln A_{it} + \gamma_i + \gamma_t + \varepsilon_{it}$$

where

Y_{it} = Sale revenue

U_{it} = Number of applications for innovation patents

P_{it} = Number of applications for standard patents

R_{it} = Investment

N_{it} = Number of employees

A_{it} = Age of firm

γ_i = individual fixed effects

γ_t = time effects

ε_{it} = error term

i = subscript for firms

t = subscript for time

Estimation

The model can be estimated using a fixed and/or random effects estimator.

Interpretation

In terms of our hypotheses we are primarily interested in the parameter γ_2. If this parameter is;

a. Statistically significant then we can say that the innovation patent system has had an effect on Australian firms.
b. Positive/negative then we can say that the innovation patent system has had a positive/negative effect on Australian firms' sales growth.

Data

Y_{it}: 10 years of sales revenue data for Australia's top 2000 firms was sourced from IBISWorld.

U_{it}: The total number of innovation patents held by firms at any given time was extracted directly from IPGOD.

P_{it}: The total number of standard patents held by firms at any given time was extracted directly from IPGOD.

R_{it}: Proxided by research and development expenditure. 10 years of R&D data for Australia's top 2000 firms was sourced from IBISWorld.

N_{it}: 10 years of employee data for Australia's top 2000 firms was sourced from IBISWorld.

A_{it}: Age of firm for Australia's top 2000 firms was sourced from IBISWorld.

The result from the fixed effect regression is presented in Table 21. The findings show that the quantity of innovation patents held by a firm is not statistically significant, or in other terms, the quantity of innovation patents held does not have any discernible effect on the sales growth of a firm.

The data for this regression is quite limited, in the sense that we have used data for Australia's top 2000 firms from IBISWorld, which is heavily weighted toward large firms. The time series also includes the 2008-09 Global Financial Crisis where the fall in sales and labour productivity in years afterward may have altered the relationship between some of the explanatory variables and the dependent variable.

The log of sales lagged one time period has a negative relationship with the log of sales (firm sales growth) in the current time period. This is as expected, and can be conceptually understood by the fact that it is usually easier for a firm to have stronger sales growth after a small dip or flat line in the preceding period than it is for a firm to have strong sales growth in every time period.

The log of employees in the previous period is also, as expected, positively correlated with firm sales growth, but the model explains very little of the variation in sales growth, with an adjusted r^2 of 0.05.

Table 21: No discernible impact on firm sales

Explanatory Variables	**Coef.**		**Std. Err.**	**t**	**P>|t|**
(log of sales)$_{t-1}$	-5.9720	***	0.2866	-20.84	0.00
(log of innovation patent applications)$_{t-5}$	0.1871		1.4587	0.13	0.90
(log of standard patent applications)$_{t-1}$	-0.0233		0.6663	-0.03	0.97
(log of R&D expenditure)$_{t-1}$	-0.0116		0.0729	-0.16	0.87
(log of employees)$_{t-1}$	2.8544	***	0.3294	8.67	0.00
(log of firm age)$_{t-1}$	-0.1979		0.4148	-0.48	0.63
constant	57.5725	***	3.1480	18.29	0.00
sigma_u	7.4195				

sigma_e	9.4144	
rho	0.3831	

Dependent variable: Annual sales growth rate, adapted from *Kim et al* (2012)
Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Innovation patent effects on industry sector entry rates

In the regressions used to explore any relationship between innovation patent filings and certifications and the rate of market entry by new firms other variables likely to have a bearing on the rate of market entry were included. This is done to avoid the situation where the impact of innovation patent filings and certifications are overstated as a consequence of these other variables being correlated with both innovation patent filings and certifications and the rate of market entry.

These regressions specified the quarterly rate of market entry as the dependent variable regressed on the exit rate, a quarter variable (since the entry rate data is highly seasonal), population, gross value add and lags of gross value add, plant breeders' rights granted, plant breeders' rights filed, designs filed, designs certified, standard patents sealed, standard patents filed, innovation patents filed, and innovation patents certified.

The relationship between market entry and innovation patents across all Australian industries as a whole was explored via a variety of regression techniques; fixed effects, random effects and ordinary least squares. With the exception of the firm exit rate and population, in none of the regressions were there any statistically significant (at 95% confidence) relationships between the rate of firm entry and any of the explanatory variables listed above. The results of these regressions are tabulated below.

Table 22: Impact on industry sector entry rates, fixed effects model

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
exit_rate1	0.450565	***	0.029	15.808	0.000
quarter	-0.00013		0.000	-0.760	0.448
population	-1.6E-09		0.000	-0.812	0.417
L8.GVA	2.19E-07		0.000	1.565	0.118
pbr_grant	-2E-05		0.000	-0.926	0.355
pbr_filed	-4.4E-05		0.000	-1.602	0.109
des_cert	2.66E-06		0.000	0.138	0.890
des_filed	-1.6E-06		0.000	-0.706	0.481
std_sealed	7.19E-06		0.000	1.507	0.132
std_filed	-2.5E-06		0.000	-0.438	0.662
innov_cert	-4.1E-05		0.000	-0.871	0.384
innov_filed	-1.5E-05		0.000	-0.332	0.740

_cons	0.075548	***	0.009	7.971	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 23: Impact on industry sector entry rates, random effects model

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
exit_rate1	0.46919	***	0.028	16.667	0.000
quarter	-0.00013		0.000	-0.739	0.460
population	-1.5E-09		0.000	-0.755	0.450
L8.GVA	8.8E-08		0.000	0.937	0.349
pbr_grant	-1.1E-05		0.000	-0.662	0.508
pbr_filed	-5.1E-05	*	0.000	-1.899	0.058
des_cert	3.62E-06		0.000	0.202	0.840
des_filed	-2.7E-06	*	0.000	-1.935	0.053
std_sealed	6.97E-06		0.000	1.571	0.116
std_filed	-3.5E-06		0.000	-0.670	0.503
innov_cert	-5.1E-05		0.000	-1.143	0.253
innov_filed	4.47E-08		0.000	0.001	0.999
_cons	0.073823	***	0.009	7.848	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 24: Impact on industry sector entry rates, ordinary least squares regression model

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
exit_rate1	0.463922	***	0.028	16.561	0.000
quarter	-0.00012		0.000	-0.734	0.463
population	-1.5E-09		0.000	-0.787	0.431
L8.GVA	1.08E-07		0.000	1.060	0.289
pbr_grant	-1.2E-05		0.000	-0.720	0.471
pbr_filed	-4.9E-05	*	0.000	-1.812	0.070
des_cert	4.03E-06		0.000	0.225	0.822
des_filed	-2.6E-06	*	0.000	-1.780	0.075
std_sealed	6.81E-06		0.000	1.535	0.125
std_filed	-3.4E-06		0.000	-0.653	0.514
innov_cert	-5E-05		0.000	-1.121	0.262

innov_filed	-1.4E-06		0.000	-0.036	0.971
_cons	0.074303	***	0.009	7.949	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

In addition, since the firm exit rate is positively correlated with the firm entry rate, regressions were run without the firm exit rate as an explanatory variable. This was done on the basis that it's conceivable that the firm exit rate is driven by the other explanatory variables in the model in much the same way as the entry rate might be thought to. By taking out the exit rate, which is correlated with the entry rate, other relationships might be revealed. This was done using fixed effects, random effects and ordinary least squares techniques. Again the results indicated population as an important explanatory variable, but no other explanatory variables were significant with 95% confidence. The results of these regressions are tabulated below.

Table 25: Impact on industry sector entry rates, fixed effects model without exit-rate

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
quarter	0.000138		0.000	0.716	0.474
population	-4.9E-09	**	0.000	-2.245	0.025
L8.GVA	2.54E-07		0.000	1.604	0.109
pbr_grant	-1.5E-05		0.000	-0.606	0.545
pbr_filed	-3.1E-05		0.000	-0.994	0.321
des_cert	2.62E-05		0.000	1.204	0.229
des_filed	9.11E-07		0.000	0.359	0.720
std_sealed	6.99E-06		0.000	1.293	0.196
std_filed	-6.2E-06		0.000	-0.963	0.336
innov_cert	-6.4E-05		0.000	-1.191	0.234
innov_filed	-1.9E-05		0.000	-0.380	0.704
_cons	0.10444	***	0.011	9.915	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 26: Impact on industry sector entry rates, random effects model without exit-rate

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
quarter	0.000166		0.000	0.867	0.386
population	-5E-09	**	0.000	-2.304	0.021
L8.GVA	1.01E-07		0.000	0.846	0.398
pbr_grant	-6E-06		0.000	-0.300	0.765

pbr_filed	-3.8E-05		0.000	-1.239	0.215
des_cert	3.09E-05		0.000	1.509	0.131
des_filed	-1.1E-06		0.000	-0.656	0.512
std_sealed	6.34E-06		0.000	1.245	0.213
std_filed	-7.8E-06		0.000	-1.300	0.194
innov_cert	-8.4E-05		0.000	-1.639	0.101
innov_filed	2.82E-06		0.000	0.064	0.949
_cons	0.104184	***	0.011	9.909	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 27: Impact on industry sector entry rates, ordinary least squares regression without exit-rate

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
quarter	0.000163		0.000	0.857	0.391
population	-5E-09	**	0.000	-2.321	0.020
L8.GVA	1.29E-07		0.000	1.014	0.311
pbr_grant	-7.5E-06		0.000	-0.360	0.719
pbr_filed	-3.5E-05		0.000	-1.157	0.247
des_cert	3.08E-05		0.000	1.497	0.134
des_filed	-9.1E-07		0.000	-0.494	0.621
std_sealed	6.15E-06		0.000	1.206	0.228
std_filed	-7.7E-06		0.000	-1.278	0.201
innov_cert	-8.1E-05		0.000	-1.574	0.116
innov_filed	8.46E-07		0.000	0.019	0.985
_cons	0.104382	***	0.010	9.966	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Given the varying nature of Australian industries, it’s unsurprising that a single relationship doesn’t dominate sufficiently across enough industries to show a statistically significant relationship across the economy as a whole.

To examine any possible industry specific impacts of innovation patents on firm entry independent regressions were run for each ANZSIC code. As for the regressions exploring any economy wide theme in the way innovation patents impact on competition and market contestability, these regressions included a range of other variables that potentially influence market entry. These variables are exit rate, a quarter variable (since the entry data is highly seasonal), population, gross value add and lags of gross value add, plant breeders’ rights granted, plant breeders' rights filed, designs filed, designs certified, standard patents sealed, and standard patents filed.

Across all 19 ANZSIC industry classifications, the results showed no statistically significant relationships between firm entry rates and the number of innovation patents certified or firm entry rates and the number of innovation patents filed. That is, none of the regressions for individual industries indicated any statistically significant relationship between innovation patents and competition or market contestability.

For the same reasons as given above, regressions for entry rates by individual ANZSIC codes were also run without firm exit rates. These regressions also found no statistically significant relationship between innovation patents filed or certified and firm entry rates for any of the 19 ANZSIC industry codes.

Lastly, to explore the possibility of discerning a statistically significant relationship between firm entry and innovation patents to the fullest extent, an economy wide random effects regression including industry dummy variables was run. This regression investigates the possibility that there are economy wide themes in the way innovation patents impact on competition and market contestability, controlling for some industries having consistently differentiated entry rates due to characteristics not captured by other variables in the model.

In the first instance exit rates were included. While many of the dummy variables themselves were statistically significant, indicating that some industries have, on average, higher entry rates[1], these results showed no statistically significant relationships between filed or certified innovation patents and firm entry rates. These results are in the table below.

Table 28: Impact on industry sector entry rates, with ANZSIC dummy variables

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
exit_rate1	0.450565	***	0.029	15.808	0.000
quarter	-0.00013		0.000	-0.760	0.447
population	-1.6E-09		0.000	-0.812	0.417
L8.GVA	2.19E-07		0.000	1.565	0.117
pbr_grant	-2E-05		0.000	-0.926	0.354
pbr_filed	-4.4E-05		0.000	-1.602	0.109
des_cert	2.66E-06		0.000	0.138	0.890
des_filed	-1.6E-06		0.000	-0.706	0.480
std_sealed	7.19E-06		0.000	1.507	0.132
std_filed	-2.5E-06		0.000	-0.438	0.662
innov_cert	-4.1E-05		0.000	-0.871	0.384

[1] This tells us nothing about the impact of innovation patents or their impact on entry rates.

innov_filed	-1.5E-05		0.000	-0.332	0.740
anzsic_a	-0.00769	***	0.002	-5.124	0.000
anzsic_b	-0.00375		0.002	-1.566	0.117
anzsic_c	-0.00604		0.007	-0.837	0.403
anzsic_d	0.004558	***	0.001	3.728	0.000
anzsic_e	-0.00048		0.002	-0.198	0.843
anzsic_f	0.001751		0.002	0.935	0.350
anzsic_g	0.000959		0.002	0.559	0.576
anzsic_h	0.008865	***	0.001	7.488	0.000
anzsic_i	-0.0005		0.002	-0.302	0.763
anzsic_j	0.001941		0.001	1.644	0.100
anzsic_k	-0.0031		0.003	-1.119	0.263
anzsic_l	0.000869		0.001	0.624	0.532
anzsic_m	0.002725		0.006	0.459	0.646
anzsic_n	0.007889	***	0.001	6.226	0.000
anzsic_o	-0.00451	**	0.002	-2.424	0.015
anzsic_p	-0.00209		0.002	-0.944	0.345
anzsic_q	-0.00228		0.002	-1.127	0.260
anzsic_r	-0.0007		0.001	-0.550	0.582
_cons	0.075651	***	0.010	7.839	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Finally, economy wide random effects regressions with industry dummy variables and without the exit rate as an explanatory variable also failed to show any relationship between innovation patent filings or certifications and firm entry rates. These results are in the table below.

Table 29: Impact on industry sector entry rates, with ANZSIC dummy variables and no exit rate

Explanatory Variables	**Coef.**		**Std. Err.**	**t**	**P>|t|**
quarter	0.000138		0.000	0.716	0.474
population	-4.9E-09	**	0.000	-2.245	0.025
L8.GVA	2.54E-07		0.000	1.604	0.109
pbr_grant	-1.5E-05		0.000	-0.606	0.545
pbr_filed	-3.1E-05		0.000	-0.994	0.320
des_cert	2.62E-05		0.000	1.204	0.229
des_filed	9.11E-07		0.000	0.359	0.720

std_sealed	6.99E-06		0.000	1.293	0.196
std_filed	-6.2E-06		0.000	-0.963	0.335
innov_cert	-6.4E-05		0.000	-1.191	0.234
innov_filed	-1.9E-05		0.000	-0.380	0.704
anzsic_a	-0.01145	***	0.002	-6.822	0.000
anzsic_b	-0.0068	**	0.003	-2.516	0.012
anzsic_c	-0.01117		0.008	-1.368	0.171
anzsic_d	0.003425	**	0.001	2.478	0.013
anzsic_e	0.00016		0.003	0.059	0.953
anzsic_f	-0.00099		0.002	-0.471	0.638
anzsic_g	0.001063		0.002	0.548	0.584
anzsic_h	0.012476	***	0.001	9.484	0.000
anzsic_i	0.000418		0.002	0.224	0.823
anzsic_j	0.001973		0.001	1.476	0.140
anzsic_k	-0.00546	*	0.003	-1.741	0.082
anzsic_l	-0.00239		0.002	-1.530	0.126
anzsic_m	0.002783		0.007	0.414	0.679
anzsic_n	0.012046	***	0.001	8.581	0.000
anzsic_o	-0.00333		0.002	-1.582	0.114
anzsic_p	-0.00324		0.003	-1.293	0.196
anzsic_q	-0.00569	**	0.002	-2.493	0.013
anzsic_r	0.000801		0.001	0.557	0.577
_cons	0.105278	***	0.011	9.819	0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

From the comprehensive investigation of the data via a variety of models in combination with an absence of any statically significant effects of innovation patents on firm entry, we can conclude that the data shows no discernible evidence of an impact of innovation patents on competition or market contestability.

Appendix 3.0: The origin of foreign filings differ from innovation to standards

The standard patent system has long been dominated by applications from the United States, accounting for approximately 43% of applications since 2001. Other countries in the top 5 include Australia, Japan, Germany and the United Kingdom.

Innovation patents fit an entirely different international profile. Australian applications account for nearly 80% of innovation patent applications, while Japan, Germany and the United Kingdom combine to around 1.5%. The United States is still a top five user at 4% but entirely marginal compared to their dominance of standard patents. Instead the top 3 originating countries for innovation patents include Taiwan and China.

Table 30: Taiwan is the top foreign origin for innovation filings

Innovation patents			Standard patents		
Country	Number of applicants	% of applications	Country	Number of applicants	% of applications
Australia	14,564	79%	United States	149,643	43%
Taiwan	1,023	6%	Australia	35,496	11%
China	967	5%	Japan	24,621	7%
United States	776	4%	Germany	21,445	6%
New Zealand	257	1%	United Kingdom	16,632	5%

This difference in originating country composition highlights a key difference in how the innovation and standard patent systems are used. Standard patents undergo substantive examination or they expire. Innovation patents can reach full-term and never be examined, albeit in this case they are never granted any enforceable rights. This has resulted in significantly lower rates of rights granted for innovation patents than standard patents (about 18% of innovation vs 67% of standard patent applications pass an examination).

These differences in certification rates largely explain the differences in the top five originating countries. Certification rates for applicants from the top 5 countries for innovation patent applications include: Australia – 18%, New Zealand – 24%, China – 6%, Taiwan – 3.5%, and the United States - 50%. If we consider the top source countries for innovation patents that pass examination, China and Taiwan are replaced with the US and UK.

It is unexpected that applicants from different countries would realise such different rates of certification, especially considering the exceptionally low rates of China and Taiwan. The low certification rates of China can be explained by an additional piece of key information that has distorted outcomes – subsidies by the Chinese government. The Chinese government has provided subsidies to Chinese firms that file international patent applications at a rate of approximately $6,000 AUD per application, [2] capped at $200,000 AUD per applicant per year.[3] This subsidy did not require certification, just the granting of the patent.

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[2] 13 January 2015 exchange rate of 1 CNY to 0.20 AUD. The actual subsidy amount is for a maximum of 30,000 CNY according to http://www.techmonitor.net/tm/images/f/f1/13oct_dec_sf2.pdf

[3] As above, with the capped subsidy amount of 1,000,000 CNY

Advice exists for how firms from other countries might take advantage of the Chinese subsidy (noting that a Chinese entity must still own the patent).[4] Apart from this, it is unclear why Taiwanese applicants have such low certification rates.

Appendix 3.1: Break test for change in number of applications granted enforceable rights

Appendix 2.1 sets out the method and context of the structural break tests that were used to determine both an increase in the number of applications granted and a decrease in the number of applications granted enforceable rights in the period after the innovation patent system was implemented. Key findings of the analysis for both tests are also available in Appendix 2.1, along with the output of the analysis on the change in number of applications.

This section includes the results of the analysis for the change in number of applications granted enforceable rights.

Table 31: Linear regression results of transition to innovation patent impact on intercept, with time as explanatory variable

Dependent variable: number of second-tier patent applications with enforceable rights

Explanatory Variables	**Coef.**		**Std. Err.**	**t**	**P>|t|**
Time	0.971	***	0.052	18.740	0.000
Dummy variable indicating change in system	-54.127	***	4.274	-12.660	0.000
Constant	3.628		2.688	1.350	0.179
R-squared	0.739				
Adj R-squared	0.735				
n	138				

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 32: Linear regression results of transition to innovation patent impact on intercept, with GDP as explanatory variable

Dependent variable: number of second-tier patent applications with enforceable rights

Explanatory Variables	**Coef.**		**Std. Err.**	**t**	**P>|t|**
GDP - chain volume measure	0.001	***	0.000	16.210	0.000

[4] See Intellectual Property Magazine, *Strategies to Leverage Chinese patent subsidies*, at http://www.marshallip.com/content/uploads/2014/10/Strategies-to-leverage-Chinese-patent-subsidies_JK.pdf for more information

Dummy variable indicating change in system	-61.046	***	5.243	-11.640	0.000
Constant	-52.622	***	6.303	-8.350	0.000
R-squared	0.680				
Adj R-squared	0.676				
n	138				

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 33: Linear regression and chow test results of transition to innovation patent impact on intercept and slope, with time as explanatory variable

Dependent variable: number of second-tier patent applications with enforceable rights

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
Time	0.975	***	0.057	17.120	0.000
Dummy variable indicating change in system	-51.161	***	14.752	-3.470	0.001
Time multiplied by dummy (slope)	-0.029		0.139	-0.210	0.834
Constant	3.412		2.886	1.180	0.239
R-squared	0.739				
Adj R-squared	0.733				
n	138				
Chow test that dummy variable and time multiplied by dummy variable= 0		***	F(2,134) = 79.63 Prob > F = 0.000		

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 34: Linear regression and chow test results of transition to innovation patent impact on intercept and slope, with GDP as explanatory variable

Dependent variable: number of second-tier patent applications with enforceable rights

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
GDP - chain volume measure	0.001	***	0.000	15.720	0.000
Dummy variable indicating change in system	2.747		19.269	0.140	0.887
GDP multiplied by dummy (slope)	0.000	***	0.000	-3.430	0.001
Constant	-66.956	***	7.365	-9.090	0.000
R-squared	0.706				
Adj R-squared	0.700				

n	138		
Chow test that dummy variable and time multiplied by dummy variable= 0		***	F(2,134) = 79.08 Prob > F = 0.000

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Table 35: Variance test between groups: number of second-tier patent applications granted enforceable rights

	Mean	Std. Dev.	Freq.
Petty patent	46.333	26.532	87
Innovation patent	59.176	22.553	51
Levene robust test statistic	**Score**	**P - Value**	
W0 - mean	3.117	0.080	*
W50 - median	2.626	0.107	
W10 - trimmed mean	3.152	0.078	*

Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Appendix 3.2: SME involvement in patent system

Regression results for follow-on patenting

This section outlines the analysis used to determine whether firms that take out innovation patents are more likely to file standard patents afterwards, when compared to firms that did not apply for an innovation patent. This work was based on a model by Hausman and Griliches, as applied by Kim *et al* (2012).

Box: Do applicants that file innovation patents file standard patents afterwards?

Key Source

Kim, Y. K., Lee, L, Park, W. K. & Choo, K,. (2012). Appropriate intellectual property protection and economic growth in countries at different levels of development. Research Policy 41, 358-375.

The model used in this approach is based upon work by Hausman and Grilliches.

Hypothesis to be tested

That existence of the innovation patent system has stimulated further filing of standard patents by Australian firms.

Model

$$\ln P_{it} = \rho_0 + \rho_1 \ln P_{it-1} + \rho_2 \ln P_{it-2} + \rho_3 \ln U_{it-5} + \rho_4 \ln U_{it-6} + \rho_5 \ln R_{it-1} + \rho_5 \ln R_{it-2} + \gamma_4 \ln D51_{it} + \gamma_4 \ln D300_{it} + \gamma_4 \ln D1000_{it} + \rho_i + \rho_t + v_{it}$$

where

P_{it} = Number of standard patent applications

U_{it} = Number of utility patent applications

R_{it} = Research and development expenditures

$D51_{it}$ = Dummy variable for firms with between 51 and 300 employees

$D300_{it}$ = Dummy variable for firms with between 301 and 1000 employees

$D1000_{it}$ = Dummy variable for firms with more than 1000 employees

ρ_i = individual fixed effects

ρ_t = time effects.

v_{it} = error term

i = subscript for firms

t = subscript for time

Estimation

The model can be estimated using a fixed and/or random effects estimator.

Interpretation

In terms of our hypotheses we are primarily interested in the parameters ρ_3 and ρ_4. If these parameters are;

a. Statistically significant then we can say that the innovation patent system has impacted the filing of standard patents.
b. Positive/negative then we can say that the innovation patent system has increased/decreased the number of standard patents filed by firms.

Data

P_{it}: The total number of standard patents held by firms at any given time was extracted directly from IPGOD.

U_{it}: The total number of innovation patents held by firms at any given time was extracted directly from IPGOD.

R_{it} = Research and Development expenditure of a firm. We inputted 10 years' worth of R&D data for Australia's top 2000 firms into the model. This data was sourced from IBISWorld.

$D51_{it}$ = Dummy variable for firms with between 51 and 300 employees. This data was sourced from IBISWorld.

$D300_{it}$ = Dummy variable for firms with between 301 and 1000 employees. This data was sourced from IBISWorld.

$D1000_{it}$ = Dummy variable for firms with more than 1000 employees This data was sourced from IBISWorld.

i = subscript for firms

t = subscript for time

Table 36: Filing an innovation patent does not encourage future standard patent applications

Explanatory Variables	Coef.		Std. Err.	t	P>|t|
(log of standard patent applications)$_{t-1}$	0.2905	***	0.0198	14.70	0.00
(log of standard patent applications)$_{t-2}$	-0.0760	***	0.0190	-4.01	0.00
(log of innovation patent applications)$_{t-5}$	-0.1305	***	0.0370	-3.53	0.00
(log of innovation patent applications)$_{t-6}$	-0.1790	***	0.0443	-4.04	0.00
(log of R&D expenditure)$_{t-1}$	-0.0029		0.0020	-1.46	0.14
(log of R&D expenditure)$_{t-2}$	0.0012		0.0018	0.64	0.52
Firm size dummy (51-300 employees)	0.0067		0.0108	0.62	0.53
Firm size dummy (301-1000 employees)	0.0048		0.0097	0.50	0.62
Firm size dummy (more than 1000 employees)	0.0107		0.0108	0.99	0.32
constant	0.0757	***	0.0062	12.27	0.00
sigma_u	0.3399				
sigma_e	0.1205				
rho	0.8883				

Dependent variable is the log of standard patent applications; lags replicate *Kim et al* (2012) exactly.
Statistical significance indicated by asterisks at the 10% level * | 5% level ** | 1% level ***

Applicants that file their first standard and innovation patent at the same time

In addition to the categories of applicants outlined in the Chapter (those that file innovation only, those that file innovation before standard, and those that file innovation after standard) a number of applicants belong to a fourth category – those that filed their first innovation patent at the same time that they filed their first standard patent.

These results have not been included in the main text as they did not alter the outcomes or conclusions of the analysis and instead distracted the reader from the issues at hand. For the sake of completeness, they are available below.

283 applicants filed their first innovation and standard patent at the same time. These include:

- 7 large firms,
- 88 SMEs,
- 87 private inventors and
- 101 international applicants.

217 (77%) of the applicants in this category filed one standard and one innovation patent, and then discontinued use of both systems. 55 (19%) continued to use one or both of the systems lightly, with 2 to 4 standard and/or innovation patents filed. 11 (4%) filed under one or both systems more extensively, with 5+ standard and /or innovation patents filed.

Table 37: Filing behaviour of applicants that filed their first innovation and standard patent simultaneously

Total patents applied for	1 standard patent	2 to 4 standard patents	5+ standard patents
1 innovation patent	217	23	5
2 to 4 innovation patents	18	14	1
5+ innovation patents	1	3	1

These applications tended to have good full-term and certification rates, with 44% of applications renewed to full-term (against an overall of 23%) and 22% certification rates (against an overall of 19%). Primarily this is explained by the variation between firm sizes in this category and firm sizes overall:

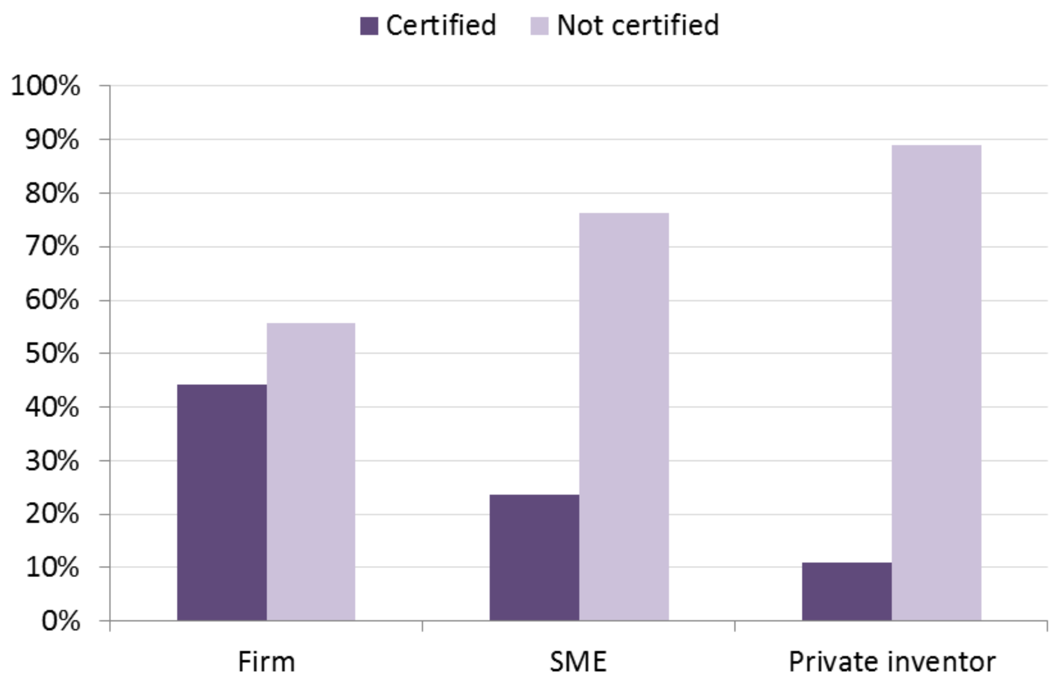
Table 38: Firm size of applicants filing innovation and standard together against average

	Large firm	SME	Private inventor	Int'l
Percentage of applications by firm size of applicants filing their first standard and innovation patent together	6.0%	30.9%	27.6%	35.5%
Percentage of applications by firm size of innovation patent applicants overall	4.8%	25.6%	47.3%	22.3%

The relative reduction in applications by private inventors is the most significant cause of the overall improvements to certification and full-term rates, as applications filed by private inventors have the lowest certification and full-term rates.

Appendix 3.3: Certification and renewal rates

Figure 9: Certification rates by firm size



Certification rates are a simple matter to calculate, and the variance across firm size is clearly depicted in the graph above.

Survival rates are more complex to determine. On first glance, one would assume that if 100 patents were filed in 2000 and 20 patents received their 7th year renewal in 2007 that the survival rate for those original 100 patents must be 100 / 20 or 20%.

However, a myriad of other activities by applicants can complicate this matter significantly. The expiry date of a patent – the longest date the patent can live to - is not always connected to the official filing date and can relate to the earliest priority date, which can in some cases be years apart from their filing date. This can be caused by delays in the application and also cases such as conversions from other patent types and divisional links with other patents.

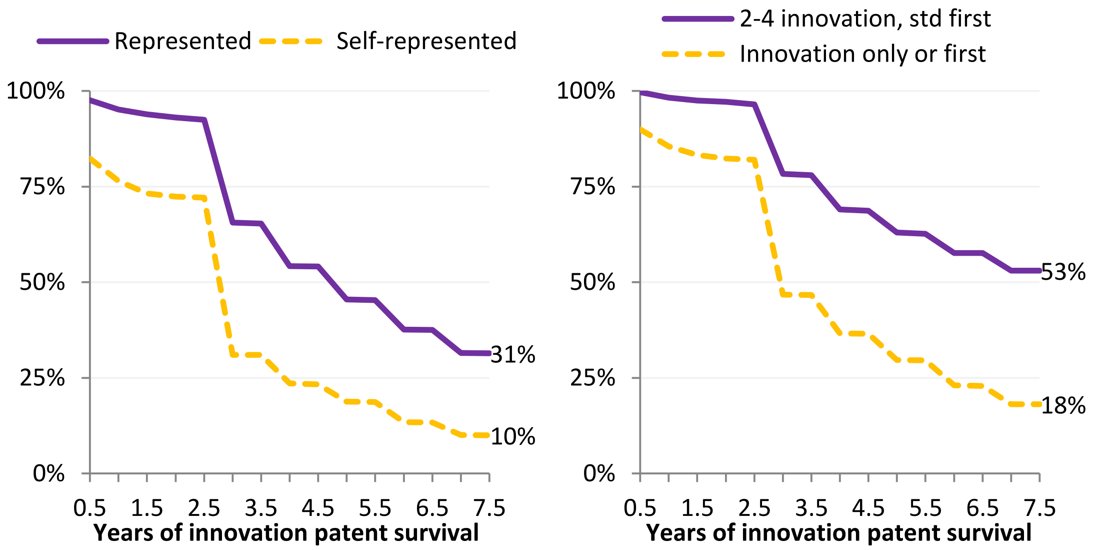
To resolve this issue the life of the patent is effectively calculated backwards from the expiry date. This leaves some strange anomalies, such as there being 25 2nd or later year renewals for innovation patents in the 2001/2002 financial year (the year the system was introduced) and 132 7th year renewals before 2008 (the first year an application originally filed as an innovation patent could have lived to 7 years of age).

This calculation method possibly has the effect of overestimating the number of patents that live to 'full-term', depending on how we conceptualise the idea. For instance, a patent filed in 2011 with a priority date of 2005 may pay just one renewal and be considered to live to full-term (as it had reached its maximum lifespan of eight years after the priority date). Another patent filed in 2005 and with a priority date in 2005 may be renewed 5 times before the applicant decides to let it expire and this would be considered not living to full-term, as the applicant had the option to renew and they passed.

This method does however give us the best information on the ratios of applicants that made a decision to let their patents expire, and this has been the information that has been most sought from this data.

The following graphs demonstrate how patent survivability drops over time according to whether the patent applicant had agent representation or not, and whether the applicant had previous experience filing standard patents or not.

Figure 10: Innovation patent survival by attorney representation and filing behaviour



As can be seen, the prior filing experience of the applicant has very significant impacts on the patent survival rates, with 18% of patents filed by applicants that have only filed innovation patents or filed innovation patents first living to full-term against 53% of patents filed by applicants that had already filed standard patents. Likewise the difference between an applicant that is self represented or has an agent representation varies between 10% living to full-term and 31% living to full-term.

Appendix 4.0 Prospective and retrospective value of patents

If an inventor files a patent application, they already have their invention; they stand only to gain the right to exclude others from it. However, if the total value of an existing patent is sought, this value will include the value of using the invention and the right to exclude others from it. This exceeds the value added by patenting an invention, since it includes the private value of the invention itself.

For many inventions the *incremental* returns generated by holding a patent on the invention, above and beyond the returns that could be earned by using the second best means will change once public disclosure of the invention is made under a patents system. Once there has been public disclosure of the invention, patents may be worth more, since other means of earning revenue from the invention may diminish.

Thus, there is a difference in the prospective value of a patent (the value added from filing a patent application) and the retrospective value of a patent (the value after the invention has been patented), where the retrospective value will be higher.

Literature on empirical private patent valuation focuses on the value of existing patents, and thus is not necessarily informative regarding the value added by patenting. Since all three standard methodologies involve valuations of patents after they have been granted, the resulting patent valuations are a mixture of the underlying value of the invention and the value-add of the patent.

Alternative measures of patent valuation

There are three main methods of valuing patents in the literature, which in ascending order of valuations are: 1. patent renewal methods (e.g. Schankerman & Pakes 1986) 2. stock market value through Tobin's Q (e.g. Hall et al. 2007), and 3. inventor surveys - which include surveys of Australian patent holders (Jensen et al. 2009) and innovation patent holders (Verve Economics 2013). Arora, Ceccagagnoli & Cohen (2008) and Arora & Athreye (2012) instead use firm-level data to estimate a patent premium and profit premium on holding a patent – this is probably the best method for estimating the impact on patents, but requires quite rich information at the firm level which we do not have for Australian firms.

Similar approaches have been taken to estimate the impact other IP rights have on profitability: Greenhalgh & Longland (2005) find a positive association between trade marking and value added per unit of input while Greenhalgh et al. (2011) uses pooled OLS and Fixed Effects to associate trade marks with productivity, employment and asset growth. Moreau & Tether (2011) studied UK design rights, finding an impact on sales per employee for UK firms that held design rights. These studies could provide a simpler framework for estimating the impact on profitability at the firm level.

Using renewal data

Some patent valuation methodologies involve using patent renewal data to estimate patent values. These involve supposing that for a given cohort of patents (within a given industry), patent values at the time of filing are distributed according to some well-defined distribution, and that these values decay at a constant rate. The initial value distribution is then inferred from data on when firms choose to cease renewal.

This method assumes perfect information and perfect foresight on behalf of the owner of the patent, in terms of revenues generated by the patent. For example, a patent owner may anticipate that over the coming year their patent will generate revenue above the cost of renewal, and they could just be wrong. Indeed, this could continue over multiple periods since a rational patent holder should continue to be forward looking and not have regard for sunk costs. It may be that there is a high level of uncertainty regarding revenue generated by patented inventions, such that methodologies that assume perfect information do not produce reliable valuation estimates.

Another feature of this methodology is its potential sensitivity to the choice of distribution used to characterise the distribution of valuations (of a cohort) of patents at the time of filing. Also, as for inventor survey data, renewal data is used to model value distributions of existing patents. Therefore these valuations also conflate the value of the underlying invention with the value-add of patenting.

Value distributions for innovation patents have, therefore, not been estimated using this methodology for the following reasons:

1) any value estimates generated by this methodology conflate the value of the invention and the value-add of patenting in the same way as those value distributions depicted in Figure 8, because they are valuations of existing patents,

2) it is reasonable to suppose that for some unknown quantity of patents there's likely to be a lot of uncertainty around the future revenues attributable to the patent, and thus the consequences of imperfect information and sunk costs may be significant in this context,

3) this methodology is potentially sensitive to the assumed distributional form of the distribution of valuations, and

4) limited resources and the time constraints on the preparation of this report were also factors in the decision to not estimate innovation patent values by this method.

Another perhaps intuitively appealing method for estimating patent values would be to construct lower bounds for the value of patents based on the costs of renewal. If this were done in a cumulative way, that is, adding expenses incurred in acquiring and maintaining a patent up to a certain point, this suffers the same issues of sunk costs and imperfect information. This means that expenses incurred in acquiring and maintaining a patent can overstate both a patent owner's expectation of revenue generated by the patent and the actual revenue generated by the patent.

Alternatively, if the cost of renewal is taken as a lower bound on the value of a patent at the time of renewal, this avoids the problem of sunk costs, but still suffers the problem of imperfect information. As described above, this issue of imperfect information means a renewal fee can overstate both a patent owner's expectation of revenue generated by the patent and the actual revenue generated by the patent.

Thus, while a method of generating lower bounds on patent values using renewal costs would by-pass sensitivity to specification on a particular distributional form, it still has problems. In addition, if such an analysis were attempted, say, comparing lower bounds of value for innovation patents with those for standard patents, the results would be more indicative of the different renewal cost structures of innovation and standard patents, rather than differences in patent values. For these reasons lower bounds on the value of innovation patents have not been constructed via the methods entertained above.

Appendix 4.1: Value of innovation and standard patents

Data in Figure 8 (repeated again below in Figure 11 for convenience) are our best estimate of the data denoted in 2014 Australian dollars. The underlying nature of the data is that survey values were mostly denoted in a mixture of differing year's currency units. This introduced ambiguity in interpreting the data and thus determining appropriate transformations to normalise it. The diagram shows best estimates of true normalisations of the data with shading to indicate upper and lower bounds of the value distributions.

The number of valuation intervals differs between the four data sources. Where a given distribution is divided into more intervals, the percentage of patents falling within each interval, or value range, will be lower. Hence for a given underlying distribution of values, a value distribution as constructed in Figure 8 with more intervals will always sit below a value distribution constructed with fewer. That is, the same value distribution could look very different depending on the number and ranges of value intervals.

Transformations to normalise data were undertaken to improve the comparability of data, however, it should be noted that differing approaches to sampling across the four surveys from which the data were taken reduces the comparability of these data.

Below is a brief description and discussion of each of the four data sources and an exposition of the transformations used to normalise the bounds of value intervals. Where prior years' Australian dollars have been inflated to 2014 dollars, average CPI indices from ABS series A2325846C have been used.

IP Australia Innovation Patents data (Verve Economics 2013)

Inventors/owners of certified, sealed, filed or expired IP Australia innovation patents were sampled at the end of 2012. They were asked

At the time your innovation patent was filed, assuming you knew everything you now know about you innovation patent (how it has been used, any commercial applications etc.), for what amount would you have been willing to sell your innovation patent to a competitor? (Please indicate that value range that best reflects your assessment.)

Since innovation patents were introduced in 2001, this means data are potentially denoted in 2001 Australian dollars through to 2012 Australian dollars. Our best estimate of these data normalised to 2014 Australian dollars supposes that on average the original data were denoted in 2006 Australian dollars and have been transposed accordingly.

However, if original data were denoted in 2001 dollars, interval bounds of valuation ranges should be 15% higher, shifting the valuation curve 15% to the right. If original date were all denoted in 2012 dollars, interval bounds of valuation ranges should be 15% lower, shifting the valuation curve 15% to the left. The likelihood is, of course, that the data is a mixture of data denoted in 2001 Australian dollars through to 2012 Australian dollars, and that the value distribution will lie somewhere between the two boundary cases.

European Patents Office standard patents data (PatVal EU Project 2005)

Data for patents held with the European Patents Office were gathered via the Pat Val survey, which was conducted from May 2003 to January 2004. The survey was directed to inventors of patents with an EPO priority date in 1993-1997. The survey asked inventors the following hypothetical:

Suppose that on the day in which this patent was granted, the applicant had all the information about the patent that is available today. In case a potential competitor of the applicant was interested in buying the patent, what would be the minimum price (in Euro) that the applicant should demand? (*sic*)

Note that the Euro was not introduced until 1999, such that the question is not readily answered in terms of a price that the applicant would have sought on their priority date in then current prices. It is somewhat unclear how survey participants might have interpreted the question in terms of denoting their answers in say, 1999 Euros or 2003 Euros, or somewhere in between.

Our best estimate assumes survey responses to be denoted in 2003 Euros, and converted these values to Australian dollars and inflated these 2003 Australian dollar values into 2014 Australian dollars, using the Australian CPI index.

An upper bound on how these values might be inflated was derived by supposing survey respondents responded in 1999 Euros. This would result in values about 10% higher than our best estimate, shifting the value distribution curve for European Patents Office data to the right.

Annual averages of ABS series FXREUR found in publication 5368.0 - International Trade in Goods and Services, Australia, Nov 2014, Table 16. Period Average Exchange Rates were used to convert Euros to Australian dollars.

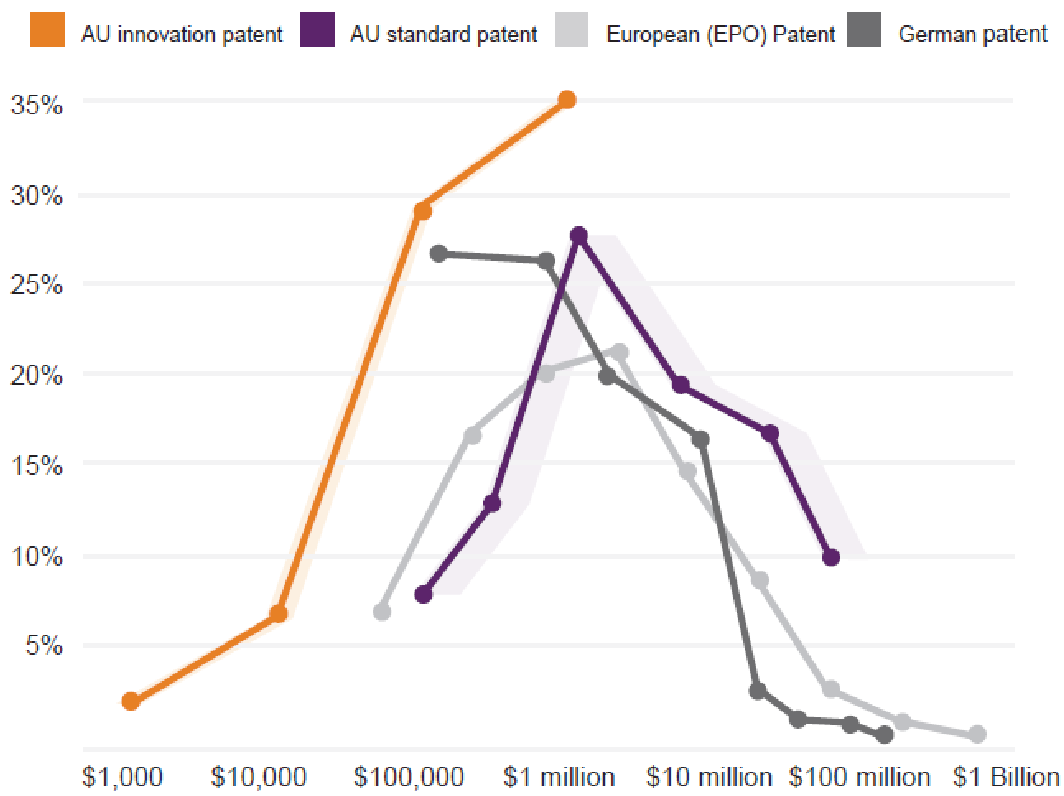
Australian Patents Office standard patents data (AIS-07 survey)

The AIS-07 survey was conducted in the latter half of 2007 and sent questionnaires to every Australian inventor who submitted a patent application to the APO between 1986 and 2005. A single patent value data point is the sum of three value components; two historical, which are the sums of cash flows from multiple previous years, and one prospective denoted in 2007 Australian dollars. This means that the retrospective components of valuation, which are cumulative totals of past revenues generated by the patent to 2007, are denoted in a mixture of 1986 Australian dollars through to 2007 Australian dollars. This makes it difficult to interpret the data. A number of factors, including the age of patents and their propensity to obsolescence, will determine the weight of earlier dollar values to later dollar values, such that appropriate discount weights will differ between data points and there is no information to determine these.

Transformation to our ‘best estimate’ normalised values used a weighted accumulation factor consistent with 50% of the value of a given data point being denoted in 2007 dollars and 50% being denoted in 1996-97 dollars, 1996-97 being the mid-point of the 1986-2005 interval from which past revenue data would have arisen.

With only access to aggregated data, there is no way to gauge the appropriateness of applying this accumulation factor to achieve normalisation to 2014 Australian dollars. We have, however, calculated the outer bounds of the possible distribution; the upper limit derived from the thought experiment that all of the data are denoted in the earliest possible dollars, 1986 dollars, and the lower limit derived from the thought experiment that all data are denoted in the latest possible dollars, 2007 dollars. The lower bound is 13.5% lower than our ‘best estimate’ (the solid line value distribution shown in Figure 11), and the upper bound is 78% higher. However, since Figure 11 is on a logarithmic scale the visual difference of shifting the Australian standard patents value distribution to one of its limiting cases does not significantly alter one’s overall impression of the distributions in relation to one another. This is demonstrated by the shading in Figure 11 to the possible limits of the distributions implied by the aggregated data.

Figure 11: Upper and lower bounds for surveyed value of patents



German Patents Office data (Harhoff 2003)

The survey was conducted in 1996 and considered all patent grants with a 1977 German priority date which were renewed to full term, i.e. expired during 1995. This sampling approach is distinct from that employed by the other surveys' data presented in Figure 11. Other survey's included patents that were not renewed to full term. Hence relative to the other surveys, and with respect to the general population of patents, there is an upward bias in the value distribution for these data.

The survey asked respondents the following: "If in 1980 you had known how its contribution to the future profitability of your enterprise would unfold, what is the minimum price for which you would have sold the patent, assuming that you had a good-faith offer to purchase?" Thus, all data are denoted in 1980 Deutsche marks, and no upper or lower bounds have been calculated as for other data sources, since the appropriate transformation for normalisation is not ambiguous in this case.

Normalisation to 2014 Australian dollars was achieved by converting to 1980 Deutsche Marks to 1980 Australian dollars (using historical annual average exchange rate data sourced from the St. Louis Federal Reserve's Federal Reserve Economic Data) and inflated to 2014 dollars in accord with the ABS CPI index series A2325846C.

Appendix 4.2: Estimating the patent premium

The expected range of the private value-add of innovation patents was estimated via a rough and ready back-of-the-envelope calculation. There are a number of issues with the methodology and the data used that impact on the reliability of this expected range. These issues are outlined within and below this exposition of methodology.

Estimation of the private value-add of innovation patents was calculated by using patent premia estimated by Arora 2008 for US standard patents. These patent premium estimates were then combined with Verve Economics 2013 data on the value distribution of Australian innovation patents.

An estimate range was derived by exploring the bounds of reasonable assumptions based on the information available. This process included alternately supposing Arora's highest and lowest conditional patent premium estimates and some exploration of the impact of supposing that Verve Economics' 2013 value distribution data set may not be representative of the value distribution of all innovation patents.

Specifically, the upper bound of the estimated range of innovation patent value-add supposed the highest conditional patent premium estimated by Arora 2008 and that value data collected by the Verve Economics 2013 survey was representative of the total population of innovation patents that had either expired at full term by end August 2012, or were filed or certified as at end August 2012.

The lower bound of the estimated range of innovation patent value-add supposed 1) the lowest conditional patent premium estimated by Arora 2008, and 2) supposed that Verve Economics data over represents patents of higher value. For the purposes of calculating a lower bound estimate it was supposed that all patents over $1m were captured by the survey, such that no other patents were valued as highly. Additionally, it was supposed that the interior value ranges over represented the proportion of innovation patents to fall within these value ranges, such that in calculating the lower bound the proportions of innovation patents to fall within these ranges were scaled down by 20%. The proportion of patents not accounted for in the top and interior value ranges were treated as if they have an average value equal to the mid-point of the bottom value range. That is, data supposed not in the mid and upper value ranges were assumed to fall in the lowest value range. Consequently, relative to Verve Economics' value distribution, the proportion of total innovation patents supposed to fall within the lowest value range ($1000 and under) increased by almost 38% (from approximately 3%).

This resulted in the estimated expectation of the value-add of innovation patents of between $10m-$40m. Further details of this methodology are provided below.

Arora 2008 patent premia

Arora 2008 estimates both expected and conditional patent premia for US standard patents in 19 product categories (Table 7, p. 1169). In Arora 2008 the conditional patent premia are those conditioned on patent certification, while expected patent premia are those expected at the time of firm R&D expenditure. Both Verve Economics 2013 data and IP Australia's data are based on innovation patents that have been filed. This means data in both the Verve Economics 2013 and IP Australia data sets are collected after firm R&D investment decisions. For this reason Arora's (2008) expected patent premia estimates are not applicable to either of these data sets. Arora's conditional patent premia estimates were used to calculate the estimate range for the private value-add of Australian innovation patents.

Arora's highest and lowest conditional patent premium estimates are 1.63 and 1.38, respectively.

These conditional patent premia should be interpreted such that a value greater than 1 indicates that patent value-add is positive, a value equal to 1 indicates no patent value add and a value less than one indicates a negative patent premium.

Mathematically,

$v^t = \mu \times v^i$,

where μ denotes a conditional patent premium,

v^i denotes invention value, and

v^t denotes total patent value inclusive of both the invention value and the value add of patenting.

A negative patent premium occurs where the sum of the costs of acquiring and maintaining patent rights plus any opportunity costs of public disclosure under an innovation patents system exceed the benefits of purchasing patent rights. This is more likely to occur for products, or in industries, where patent rights are less enforceable.

Methodology to apply Arora's US standard patent premia estimates to innovation patents

To use the above relationship to derive estimates of innovation patents' value-add we need to observe an important distinction between Arora's and Verve Economics' data. The value distribution of innovation patents provided by Verve Economics is inclusive of innovation patents certified, file and expired at full term. Arora bases their conditional patent premia estimates on certified US standard patents. Significantly, Arora's estimates are not based on data capturing uncertified patents, whereas Verve Economics' value distribution is inclusive of filed and uncertified innovation patents.

To deal with this, it is assumed that for patents that are filed and uncertified the conditional patent premium, μ_f, is equal to one. This is consistent with filed and uncertified patents being thought to have a patent premium that warranted a patent, but that the patent premium was then thought sufficiently marginal that applicants didn't both with patent examination.

This assumption will bias the estimates downwards because there will be some filed and uncertified patents within the Verve Economics data set that will at some point be certified, but were yet to be certified as at the end of August 2012 when the Verve Economics data set were collected. However, at any given time, the stock of filed and uncertified innovation patents that will never be certified is expected to be the majority of the stock of innovation patents filed and uncertified, as is indicated by the relatively small proportion of innovation patents certified to the total filed. Since the introduction of innovation patents to the end of August 2012 (the reference timeframe for the Verve Economics value data), this proportion is just under 16%.

Innovation patent value-add was estimated according to the following relationship:

$v^v = \sigma\, \mu_c\, v^i + (1-\sigma)\, \mu_f\, v^i$,

where v^v denotes the Verve Economics inventor survey value, which is inclusive of invention value and patenting value-add,

μ_f denotes the conditional patent premium of filed and uncertified innovation patents,

μ_c denotes the conditional patent premium of certified patents, and

σ denotes the ratio of certified patents to the total number of filed patents,

As outlined above, μ_f is assumed to be equal to one, such that the above equation simplifies to:

$v^v = \sigma\, \mu_c\, v^i + (1-\sigma)\, v^i$

Rearranging gives,

$v^i = v^v / (\sigma\, \mu_c + (1-\sigma))$,

where the innovation patent value add is

$v^v - v^i = v^v\, \sigma\, (\mu_c - 1)/(\sigma\, (\mu_c - 1) + 1)$

To use this equation to generate estimates data was utilised in the following way.

- v^v is the value data taken from the Verve Economics (2013) value distribution, where the equation is applied independently to each of the survey value ranges, taking the value range mid-point as indicative of the average patent value within the range.
- σ is the ratio of certified innovation patents to the total number of filed innovation patents that remained in force or had expired at full term from the introduction of innovation patents to the end of August 2012, using IP Australia's IPGOD data set. This ratio is 1737/7331. This is used as a proxy for the ratio of certified innovation patents to the total number of filed innovation patents in the Verve Economics survey, since the ratio of certified to all filed patents in the Verve Economics data was unavailable. This time period coincides with that of the Verve Economics survey.
- μ_c is the conditional patent premium derived by Arora 2008.

The total innovation patent value-add was derived by summation of the estimated patent value-add attributable to each of the patent valuation ranges in the Verve Economics Survey. The mid-point of each value range multiplied by the number of patents to fall within that range was taken as the total patent value in that value range (inclusive of both invention value and patenting value-add). The exception to this was for the upper most value range, which is for patent values over $1m. In this instance patent values were taken as exactly equal to $1m. While this will bias patent value-add downward, it offsets any upward response bias (described below) and avoids more speculative assumptions regarding average values within the upper value range.

The survey sought the present value of the patent at the time of filing (for more information on Verve Economics' survey, see Appendix 4.1). The total patent value in a value range was then divided by the period for which innovation patents were in operation to end August 2012 to attain an annual estimate of the average present value of innovation patents from their inception to end August 2012. This period is approximately 11 years and 2 months.

As outlined above the estimate range reflects the lowest and highest conditional patent premia estimated by Arora 2008. There has also been some allowance for the possibility that the Verve Economics valuation data is upwardly biased. This allowance has been incorporated because it is plausible that those with more valuable patents may be more engaged with the patents system and thus, more likely to respond to a patent survey. This would result in an upward bias in the valuations of survey respondents relative to the total pool of innovation patents filed.

Other issues affecting the reliability of the estimate range

- Arora's patent premia estimates are for US standard patents. These may not reflect patent premia for Australian innovation patents, both by virtue of being patent premia estimates based on US data and because the estimates are for a first tier, as against a second tier, patents system.
- The patent premium estimates provided in Arora 2008 are based on data gathered in 1994. Innovation patents were introduced in 2001 and the Verve Economics data spans the period from the introduction of innovation patents to the end of August 2012.
- Arora restricted their analysis to business units with 10 or more employees. A significant proportion of innovation patents are filed by individuals and businesses with less than 10 employees, and no such restriction was applied to the Verve Economics survey.

Appendix 4.3: Regulatory cost falls mainly on SMEs and private inventors

Regulatory costs have been calculated according to the Office of Best Practice Regulation (OBPR) Guidelines, and include time spent:

- filing patents,
- renewing patents,
- requesting examination and subsequent amendments for examination,
- in disputes, both for applicants and defendants of the dispute.

These costs have been calculated using a tool developed by IP Australia to determine the net costs and benefits of regulatory changes to the IP system.

The tool uses underlying assumptions on time required per activity, derived from a report produced by KPMG to aid in IP Australia's 2014 regulatory audit. These time are multiplied across standard cost bases agreed by OBPR and the proportion of applicants in each relevant class (self-representative, domestic applicant with a representative, and international applicant with a domestic representative) to determine a total time-based cost incurred by applicants in undertaking each activities. Each activity was calculated separately, and added together for the total regulatory cost of $11.6m per annum.

The next section provides a fully detailed outline of how the regulatory cost calculator determines ongoing costs. Following that are the figures and outcomes used in the calculation of the innovation patent system regulatory costs.

Regulatory cost – how the calculator works

Typically, ongoing costs for IP regulatory changes involve a change in the amount of time it takes a customer or their agent to complete the activity that is changed by the proposal. They apply to activities that will continue to be completed for the foreseeable future. For example, if there was a change to streamline the filing of an application (the activity), the savings would be the time saved by a customer in filing their application more quickly, or the reduced fees for an agent who can file their customer's application more quickly.

In broad terms, the ongoing regulatory costs are calculated by the following basic formula:

A x (B / 60) x C = D

Where:

A = the annual volume of activities per year.

B = the change in time taken to complete the activity in minutes.

C = the relevant hourly rate of the person completing the activity.

D = the total change in annual regulatory compliance costs.

However, due to a number of variables that must be accounted for a number of specific sub-calculations are required.

Calculation

Three sub-calculations are used when calculating the ongoing regulatory cost for each year. These reflect three types of interactions (each with different costs):

- Unrepresented Australian customers (1)
- Represented Australian customers – this includes the cost of instructing the attorney (2) and the cost of purchasing the attorney's services (3)
- Attorneys representing foreign applicants (4)

These sub-calculations are performed in relation to both lower and upper estimates of the volume of activities and the change in time to complete a single activity. Where the volume is expected to vary significantly from year to year (other than ordinary annual increases in line with economic growth) the sub-calculations are performed separately for each year up to 10 years and then averaged.

Sub-calculation 1 – unrepresented Australian customers

For a given yearly volume the change in internal labour costs of completing the relevant activity for unrepresented Australian customers is as follows:

$A_1 \times (B_1 / 60) \times C_1 = D_1$

Where:

A_1 = the total number of times the changed activity will be completed by unrepresented applicants for the relevant IP right(s) in a year.

B_1 = the change in time in minutes for an unrepresented customer to complete the changed activity.

C_1 = the internal hourly rate of a professional employee of the unrepresented Australian customer.

D_1 = the annual change in cost for this type of customer.

Sub-calculation 2 – Attorneys representing Australian applicants and the applicants represented by those attorneys

Represented Australian customers have two costs. The first cost is the cost of an employee of the customer instructing an agent to do the task. The second cost is the purchase costs of the agent's services. For example, if the agent and an employee of the customer spend an hour conferring on a particular task, the cost to the customer is not only the cost of the agent's fees for the hour, but also the cost of paying their employee for that hour.

For a given yearly volume and range, the change in costs for represented Australian customers is as follows:

$(A_2 \times (B_2 / 60) \times C_2) + (A_3 \times (B_3 / 60) \times C_3) = D_{2,3}$

Where:

A_2 = the total number of times the changed activity will be completed by represented Australian customers for the relevant IP right(s) in a year.

B_2 = the change in time in minutes for a represented customer to instruct their agent to complete the changed activity.

C_2 = the internal hourly rate of a professional employee of the represented Australian customer.

A_3 = the total number of times the activity will need to be completed by represented Australian customers in a year for the relevant IP right(s).

B_3 = the change in time in minutes for an agent to complete the changed activity.

C_3 = whichever of the following rates is appropriate:

(a) If the change in cost is not passed on[5] by the agent, either:

a. the internal hourly rate of an administrative employee of the agent
b. the internal hourly rate a professional employee of the agent

(b) If the change in cost is passed on by the agent, either:

a. the hourly charge-out rate for work done by an administrative employee of the agent
b. the hourly charge-out rate for work done by a professional employee of the agent.

$D_{2,3}$ = the annual change in cost for this type of customer, including both the internal wage costs of the customer's employee instructing the agent, and the costs of the agent's time to do the activity.

Sub-calculation 3 – Australian agents of foreign customers

For a given yearly volume and range, the change in internal labour costs of completing the relevant activity for an agent of a foreign customers is as follows:

$A_4 \times (B_4 / 60) \times C_4 = D_4$

Where:

A_4 = the total number of times the activity will need to be completed by represented foreign customers in a year for the relevant IP right(s).

B_4 = the change in time in minutes for an agent to complete the changed activity.

C_4 = either[6]:

(a) the internal hourly rate of a professional employee of the agent.

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[5] Note that the assumption is that agents would pass on changes in cost to their client (at the higher charge-out rate) if the change involved:

- creating a new activity or removing an existing activity, as the activity would be a discrete billable item
- increasing the time it takes to perform an existing activity
- reducing the time it takes to perform an existing activity, where the reduction is more than 60 minutes per activity.

Where the change would reduce the time taken to perform an activity by less than 60 minutes, we assume that agents would not pass on the savings to their customers and the savings would instead accrue to the agent at the lower internal wage rates.

[6] Note that, as only regulatory compliance costs to Australian businesses are included, we are not concerned with the external charge-out rate that Australian attorneys charge foreign customers. Instead we are concerned with the internal costs to Australian attorneys when they are performing services for foreign customers.

(b) The internal hourly rate of an administrative employee of the agent.

D_4 = the annual change in cost for agents of this type of customer.

Calculation – total ongoing costs for Australian customers and agents

The total change in ongoing costs for a given year (E) is the sum of the annual change in costs for each type of customer/agent in sub-calculations 1 – 3:

$D_1 + D_{2,3} + D_4 = D$

Note that if the volume (A) is expected to vary from year to year, this calculation is performed separately for each year over 10 years and is then averaged.

Note that, where ranges of lower and upper estimates of inputs are provided for either volume (A) or change in time (B) an absolute lower estimate and an absolute upper estimate is calculated. That is, the lower estimate of costs is calculated using both the lower estimates of volume and change in time, whereas the upper estimate of cost is calculated using both the upper estimates of volume and change in time. Once lower and upper estimates of cost have been calculated, a mid-point between the lower and upper is taken.

Inputs

For the calculations in the previous section the following constant inputs are used:

$A_1 – A_4$ = the estimates of annual number of times that activity will be completed by the relevant type of customer, for the particular IP right, in a given year.

To get A_1 - A_4 for each of the options costed we need to use the further sub-calculation A_V x A_P, where:

A_V = Specific inputs for the number of times an activity is estimated to occur in a given year are provided in the *Costs of individual proposals/options* below.

A_P = the percentages of the relevant type of customer for each IP right (as a proportion of the total number of customers for that right) are as follows:[7]

Table 39: Percentages of each type of customer by IP Right

Type of right	Unrepresented Australian Customer	Represented Australian Customer	Represented International Customer
All rights	29.44%	20.51%	49.74%
Designs	15.45%	24.92%	56.69%
Patent - standard	0.68%	9.08%	90.14%

[7] Internal IP Australia Data based on filed applications in 2013.

Patent - provisional	24.70%	70.80%	4.01%
Patent - innovation	25.61%	41.85%	31.94%
Plant Breeder's Rights	6.63%	33.98%	49.67%
Trade marks	44.84%	17.72%	34.37%

$B_1 – B_4$ = Specific inputs for the change in time for each type of customer/agent are provided in the *Costs of individual proposals/options* below.

$C_1 – C_4$ = the various hourly wage rates used are as follows:

Table 40: Hourly wage rates used for regulatory costs calculations

Type of person	**Initial Hourly rate**	**On-cost multiplier**[8]	**Final Hourly Rate**
Customer - internal wage rate for generic professional employee[9]	$43.70	1.75	76.48
Agent – internal wage rate for administrative employee (eg secretary)[10]	$34.20	1.75	59.85
Agent – internal wage rate for professional employee (eg patent attorney)[11]	$49.40	1.75	86.45
Agent – charge-out rate for administrative employee (eg secretary)[12]	$140.00	N/A	140.00
Agent – charge-out rate for professional employee (eg patent attorney)[13]	$400.00	N/A	400.00

[8] Where the hourly rate refers to the internal cost to a business an on-cost multiplier of 1.75 should be used to account for overheads etc: see OBPR, *Regulatory Burden Measurement Framework Guidance Note*, p15. Where the hourly rate reflects the external charge-out rate of an agent the on-cost multiplier is not used as overheads are factored into the fees that agents charge their clients.

[9] IP applications would ordinarily be handled by a professional or managerial employee in most businesses, so the previous OBPR wage rate for professionals of $43.70 is used instead of the default economy-wide wage rate.

[10] Default economy-wide wage rate: see OBPR, Regulatory Burden Measurement Framework Guidance Note, p 15.

[11] The Australian Bureau of Statistics (ABS) provides data for the cost of employing attorneys, in particular category 271214: Intellectual Property Lawyers (which, for the purposes of the data, includes patent and trade marks attorneys), are estimated to earn $49.40 per hour on average.

[12] This estimate of the charge-out rate for experienced administrative staff is derived from consultations conducted by KPMG on behalf of IP Australia with attorney profession in preparing IP Australia's regulatory audit.

[13] The hourly charge-out rate for lawyers ranges from $200 per hour for a junior solicitor in a small firm to $800 per hour for a partner in a large firm: . http://www.legallawyers.com.au/legal-topics/law-firm-sydney/solicitor-prices/ . Anecdotal evidence suggests that patent and trade marks attorneys are

Regulatory cost – inputs and outputs of the calculator

This section details the inputs and outputs of the regulatory calculator in a series of tables. The inputs include the number times each activity occurs, as well as the time in minutes spent by each class of applicant in completing each activity, based upon KPMG consultations. The output includes the upper, lower and mid-point estimates on the costs of the activity, as well as a confidence level of the results based upon the following scale:

- **High confidence:** where the lower and upper cost estimates are less than 10% from the mid-point.
- **Medium confidence:** where the lower and upper cost estimates are between 10% and 50% from the mid-point.
- **Low confidence:** where the lower and upper cost estimates are greater than 50% from the mid-point.

Note the following tables do not include fees or the time taken by international applicants.

Table 41: Filing costs

Description	**Opportunity cost of filing applications for innovation patents**		
Inputs for ongoing costs			
Input	Lower	Upper	Notes
Volume (A_{V1} – AV_4)	1788	2054	The upper and lower bounds of applications reflect the highest and lowest number within the last three years: 1788 being 2013 and 2054 being 2012.
Time (B_1) - unrepresented Australian customers	-2250	-2250	Time spent by unrepresented applicants. Derived from IP Australia’s 2014 regulation audit which is based on consultation with attorneys and IP Australia’s own estimates.
Time (B_2) - represented Australian customers	-900	-4500	Time spent by represented applicants instructing their attorney. Derived from data from IP Australia’s 2014 regulation audit.

likely to employ a similar pricing structure. $400 per hour has been chosen as a likely rate for a typical IP lawyer or attorney.

Time (B_3) – agents of Australian customers	-600	-1500	Time spent by agents representing domestic applicants. Derived from data from IP Australia's 2014 regulation audit.
Time (B_4) – agents of foreign customers	-150	-450	Time spent by agents representing international applicants. Derived from data from IP Australia's 2014 regulation audit.
Type of agent staff doing work	Professional		
Inputs for one-off costs			
Input	Lower	Upper	Notes
Time to reconfigure IT systems (B_5)	0	0	Not required
Time to train staff (B_6)	0	0	Not required
Type of agent staff to be trained	Administrative		
Time to read new legislation (B_7)	0	0	Not required
Estimates of Regulatory Cost			
	Lower	Upper	Mid-point
Average annual cost	-$5,288,097.47	-$15,460,246.07	-$10,374,171.77
Confidence in mid-point estimate	Medium		

Table 42: Renewal costs

Description	**Opportunity cost of filing renewals for innovation patents**		
Inputs for ongoing costs			
Input	Lower	Upper	Notes
Volume (A_{V1} – AV_4)	3300	3300	The number of renewals of 2013 was used as an approximation.
Time (B_1) - unrepresented Australian customers	-30	-60	Time spent by unrepresented applicants. Derived from IP

			Australia's 2014 regulation audit which is based on consultation with attorneys and IP Australia's own estimates.
Time (B_2) - represented Australian customers	-10.2	-19.8	Time spent by represented applicants instructing their attorney. Derived from data from IP Australia's 2014 regulation audit.
Time (B_3) – agents of Australian customers	-7.5	-30	Time spent by agents representing domestic applicants. Derived from data from IP Australia's 2014 regulation audit.
Time (B_4) – agents of foreign customers	-21.4	-86	Time spent by agents representing international applicants. Derived from data from IP Australia's 2014 regulation audit.
Type of agent staff doing work	Professional		
Inputs for one-off costs			
Input	Lower	Upper	Notes
Time to reconfigure IT systems (B_5)	0	0	Not required
Time to train staff (B_6)	0	0	Not required
Type of agent staff to be trained	Administrative		
Time to read new legislation (B_7)	0	0	Not required

Estimates of Regulatory Cost			
	Lower	Upper	Mid-point
Average annual cost	-$151,822.32	-$506,299.91	-$329,061.11
Confidence in mid-point estimate	Low		

Table 43: Examination costs – clear report

Description	**Opportunity cost of filing for examinations that are cleared on their first report (note that each category of examination costs incur different time costs and**

	have been calculated separately)		
Inputs for ongoing costs			
Input	Lower	Upper	Notes
Volume (A_{V1} – AV_4)	169.62	179.64	First the total number of examinations was calculated based on the upper and lower bounds for applications in the years 2010,2011,2012 (2013 data was incomplete). This gave an upper and lower bound of 440 and 466. These numbers were then multiplied by the ratio of applications that pass examination with a clear report on their first attempt – 38.55%.
Time (B_1) - unrepresented Australian customers	-36	-36	Time spent by unrepresented applicants. Derived from IP Australia's 2014 regulation audit which is based on consultation with attorneys and IP Australia's own estimates.
Time (B_2) - represented Australian customers	-30	-30	Time spent by represented applicants instructing their attorney. Derived from data from IP Australia's 2014 regulation audit.
Time (B_3) – agents of Australian customers	-120	-165	Time spent by agents representing domestic applicants. Derived from data from IP Australia's 2014 regulation audit.
Time (B_4) – agents of foreign customers	-120	-165	Time spent by agents representing international applicants. Derived from data from IP Australia's 2014 regulation audit.
Type of agent staff doing work	Professional		
Inputs for one-off costs			
Input	Lower	Upper	Notes
Time to reconfigure IT systems (B_5)	0	0	Not required

Time to train staff (B_6)	0	0	Not required
Type of agent staff to be trained	Administrative		
Time to read new legislation (B_7)	0	0	Not required

Estimates of Regulatory Cost			
	Lower	Upper	Mid-point
Average annual cost	-$70,863.47	-$101,325.28	-$86,094.38
Confidence in mid-point estimate	Medium		

Table 44: Examination costs – adverse report

Description	**Opportunity cost of filing for examinations that are cleared after at least one adverse report (note that each category of examination costs incur different time costs and have been calculated separately)**		
Inputs for ongoing costs			
Input	Lower	Upper	Notes
Volume (A_{V1} – AV_4)	56.54	59.881	First the total number of examinations was calculated based on the upper and lower bounds for applications in the years 2010,2011,2012 (2013 data was incomplete). This gave an upper and lower bound of 440 and 466. These numbers were then multiplied by the ratio of applications that pass examination after at least one adverse report– 12.85%.
Time (B_1) - unrepresented Australian customers	-600	-2292	Time spent by unrepresented applicants. Derived from IP Australia's 2014 regulation audit which is based on consultation with attorneys and IP Australia's own estimates.
Time (B_2) - represented Australian customers	-480	-1830	Time spent by represented applicants instructing their attorney. Derived from data from IP

			Australia's 2014 regulation audit.
Time (B_3) – agents of Australian customers	-225	-585	Time spent by agents representing domestic applicants. Derived from data from IP Australia's 2014 regulation audit.
Time (B_4) – agents of foreign customers	-225	-585	Time spent by agents representing international applicants. Derived from data from IP Australia's 2014 regulation audit.
Type of agent staff doing work	Professional		
Inputs for one-off costs			
Input	Lower	Upper	Notes
Time to reconfigure IT systems (B_5)	0	0	Not required
Time to train staff (B_6)	0	0	Not required
Type of agent staff to be trained	Administrative		
Time to read new legislation (B_7)	0	0	Not required
Estimates of Regulatory Cost			
	Lower	Upper	Mid-point
Average annual cost	-$66,897.35	-$217,108.79	-$142,003.07
Confidence in mid-point estimate	Low		

Table 45: Examination costs – adverse report and no certification

Description	**Opportunity cost of filing for examinations that are not cleared but received at least one adverse report (note that each category of examination costs incur different time costs and have been calculated separately)**		
Inputs for ongoing costs			
Input	Lower	Upper	Notes
Volume (A_{V1} – AV_4)	119.46	126.519	First the total number of examinations was calculated

			based on the upper and lower bounds for applications in the years 2010,2011,2012 (2013 data was incomplete). This gave an upper and lower bound of 440 and 466. These numbers were then multiplied by the ratio of applications that never pass examination and have at least one adverse report– 27.15%.
Time (B_1) - unrepresented Australian customers	-564	-2256	Time spent by unrepresented applicants. Derived from IP Australia's 2014 regulation audit which is based on consultation with attorneys and IP Australia's own estimates.
Time (B_2) - represented Australian customers	-450	-1800	Time spent by represented applicants instructing their attorney. Derived from data from IP Australia's 2014 regulation audit.
Time (B_3) – agents of Australian customers	-105	-420	Time spent by agents representing domestic applicants. Derived from data from IP Australia's 2014 regulation audit.
Time (B_4) – agents of foreign customers	-105	-420	Time spent by agents representing international applicants. Derived from data from IP Australia's 2014 regulation audit.
Type of agent staff doing work	Professional		
Inputs for one-off costs			
Input	Lower	Upper	Notes
Time to reconfigure IT systems (B_5)	0	0	Not required
Time to train staff (B_6)	0	0	Not required
Type of agent staff to be trained	Administrative		
Time to read new legislation (B_7)	0	0	Not required

Estimates of Regulatory Cost			
	Lower	Upper	Mid-point
Average annual cost	-$91,435.69	-$387,354.85	-$239,395.27
Confidence in mid-point estimate	Low		

Note, the remaining 21.45% of examinations that are not included above are not seen to incur any substantive costs as they represent withdrawals or examinations cleared that did not require a report.

Table 46: Opposition costs – complete

Description	**Opportunity cost of completed disputes related to innovation patents (in addition to this are incomplete disputes that were settled or otherwise withdrawn early)**		
Inputs for ongoing costs			
Input	Lower	Upper	Notes
Volume (A_{V1} – AV_4)	1	1	The innovation patent system has seen an average of roughly 3 oppositions per year, 2/3 of which finish ‘incomplete’ and 1/3 which is complete. Therefore 1 complete opposition has been assumed as an average yearly cost.
Time (B_1) - unrepresented Australian customers	-22500	-45000	Time spent by unrepresented applicants. Derived from IP Australia’s 2014 regulation audit which is based on consultation with attorneys and IP Australia’s own estimates.
Time (B_2) - represented Australian customers	-11250	-22500	Time spent by represented applicants instructing their attorney. Derived from data from IP Australia’s 2014 regulation audit.
Time (B_3) – agents of Australian customers	-18750	-75000	Time spent by agents representing domestic applicants. Derived from data from IP Australia’s 2014

			regulation audit.
Time (B_4) – agents of foreign customers	-18750	-75000	Time spent by agents representing international applicants. Derived from data from IP Australia's 2014 regulation audit.
Type of agent staff doing work	Professional		
Inputs for one-off costs			
Input	Lower	Upper	Notes
Time to reconfigure IT systems (B_5)	0	0	Not required
Time to train staff (B_6)	0	0	Not required
Type of agent staff to be trained	Administrative		
Time to read new legislation (B_7)	0	0	Not required
Estimates of Regulatory Cost			
	Lower	Upper	Mid-point
Average annual cost	-$74,286.66	-$270,455.89	-$172,371.27
Confidence in mid-point estimate	Low		

Table 47: Opposition costs – incomplete

Description	**Opportunity cost of disputes related to innovation patents that were not completed (in addition to this are completed disputes)**		
Inputs for ongoing costs			
Input	Lower	Upper	Notes
Volume (A_{V1} – AV_4)	2	2	The innovation patent system has seen an average of roughly 3 oppositions per year, 2/3 of which finish 'incomplete' and 1/3 which is complete. Therefore 2 incomplete opposition have been assumed as an average yearly cost.

Time (B_1) - unrepresented Australian customers	-15750	-31500	Time spent by unrepresented applicants. Derived from IP Australia's 2014 regulation audit which is based on consultation with attorneys and IP Australia's own estimates.
Time (B_2) - represented Australian customers	-7878	-15750	Time spent by represented applicants instructing their attorney. Derived from data from IP Australia's 2014 regulation audit.
Time (B_3) – agents of Australian customers	-13125	-52500	Time spent by agents representing domestic applicants. Derived from data from IP Australia's 2014 regulation audit.
Time (B_4) – agents of foreign customers	-13125	-52500	Time spent by agents representing international applicants. Derived from data from IP Australia's 2014 regulation audit.
Type of agent staff doing work	Professional		
Inputs for one-off costs			
Input	Lower	Upper	Notes
Time to reconfigure IT systems (B_5)	0	0	Not required
Time to train staff (B_6)	0	0	Not required
Type of agent staff to be trained	Administrative		
Time to read new legislation (B_7)	0	0	Not required
Estimates of Regulatory Cost			

	Lower	Upper	Mid-point
Average annual cost	-$104,004.52	-$378,638.25	-$241,321.38
Confidence in mid-point estimate	Low		

The total of all these costs, with lower upper and mid bounds, is in the table below:

Table 48: All regulatory costs, by low, mid and high estimates

Cost	Low	High	Mid
Filing costs	$5,288,097	$15,460,246	$10,374,172
Renewal costs	$151,822	$506,300	$329,061
Examination costs	$229,197	$705,789	$467,493
Opposition costs	$178,291	$694,094	$413,693
Total regulatory costs	$5,847,407	$17,321,429	$11,584,418

These costs have then been recalculated without costs to agents of foreign customers to exclude the costs that come from international sources.

Table 49: Total regulatory cost excluding costs to domestic agents incurred by international applicants

	Low	High	Mid
Total regulatory costs excluding international sources	$5,649,779	$16,628,406	$11,139,092

To determine the cost by firm size, the mid-range point was then multiplied by the percentage of applications originating from each category of firm size. The following figures were used:

Table 50: Percentage of applications by applicant type, excluding international

	Large firm	SME	Private inventor
Proportion of domestic applications originating from each category	5.55%	31.49%	62.96%

Full tables of high, low and mid-point costs were then calculated across firm sizes:

Table 51: All regulatory costs, by low, mid and high estimates, by firm size

Regulatory costs	Large firm	SME	Private inventor
High Filing cost	$834,436	$4,734,484	$9,465,961
High renewal cost	$20,851	$118,306	$236,537
High examination cost	$36,162	$205,180	$410,230
High opposition cost	$31,427	$178,315	$356,516
Total High costs	$922,877	$5,236,285	$10,469,245
Low Filing cost	$286,639	$1,626,355	$3,251,677

Low renewal cost	$6,622	$37,575	$75,126
Low examination cost	$11,555	$65,563	$131,084
Low opposition cost	$8,746	$49,623	$99,214
Total Low costs	$313,563	$1,779,115	$3,557,101
Mid Filing cost	$560,538	$3,180,420	$6,358,819
Mid renewal cost	$13,737	$77,940	$155,831
Mid examination cost	$23,859	$135,372	$270,657
Mid opposition cost	$20,087	$113,969	$227,865
Total mid-point costs	$618,220	$3,507,700	$7,013,173

Calculations of fees paid by domestic applicants

Total fees paid by private applicants were calculated separately to regulatory costs based on IP Australia finance data. Fees were then apportioned to firm sizes according to the degree they used the activity in question.

The following fees were considered:

- application fee – ranging from 180 to 280 depending on whether the application was filed electronically or in paper
- examination fee - $500
- renewal fee – ranging from 110 to 270 depending on whether the renewal was an early renewal or late / and whether the renewal was filed electronically or in paper as per the following table

Application Fee

Applications from Australian sources were estimated as an average of the number of domestic applications from the years 2011, 2012 and 2013:

Table 52: Average number of applications for last 3 years, by firm size

	Large firm	SME	Private inventor
2011	85	462	795
2012	91	482	778
2013	80	543	601
Average	85.3	495.7	724.7

97% of all applications were received electronically; hence 97% of applicants paid the lower fee of $180 where 3% paid $280. The total cost across firm size was calculated at:

Table 53: Application fees, by firm size

	Large firm	SME	Private inventor
Application fees	$15,616	$90,707	$132,614

Examination Fee

Examinations from Australian sources were estimated as an average of the number of domestic requests for examination from the years 2010, 2011 and 2012 (2013 was examination request data for the year was incomplete):

Table 54: Average number of examinations for last 3 years, by firm size

	Large firm	SME	Private inventor
2010	45	111	202
2011	45	133	139
2012	41	158	129
Average	43.7	134	156.7

All examinations incurred a $500 fee. The total cost across firm size is a simple calculation:

Table 55: Examination fees, by firm size

	Large firm	SME	Private inventor
Examination fees	$21,833	$67,000	$78,333

Renewal Fee

Renewals vary in cost depending on the year of the renewal and the renewal method. The costing structure is outlined below:

Table 56: Renewal fees cost structure

Renewal fee	Electronic	Paper
2nd through 4th year renewals	$110	$160
5th through 7th year renewals	$220	$270

The number of renewals for innovation patents is currently estimated at 3290 per year by IP Australia's finance group. Based on renewal data in Intellectual Property Government Open Data (IPGOD), approximately 29.2% of renewals were likely to come from international sources and 71.8% (2,329) from domestic. IPGOD renewal data suggests likely breakdown of renewal activity by firm size is as follows:

Table 57: Renewal activity, by firm size

	Large firm	SME	Private inventor	International (not costed)
Proportion of renewals by firm size	6.89%	28.65%	35.25%	29.21%

Of the 3290 renewals, it is estimated based on previous ratios that 2235 will fall into the 2-4 year renewal category and 1055 will fall into the 5-7 year renewal category. 97% of all renewals will be electronic. These figures have been used to calculate the following distribution:

Table 58: Renewal fees, by firm size

	Large firm	SME	Private inventor
Renewal fee 2-4 year	$17,170	$71,397	$87,844
Renewal fee 5-7 year	$16,101	$66,950	$82,373
Renewal fees (total)	$33,271	$138,347	$170,217

The total fees across firm size are the sum of these three fees:

Table 59: Total fees, by firm size

	Large firm	SME	Private inventor
Application fees	$15,616	$90,707	$132,614
Examination fees	$21,833	$67,000	$78,333
Renewal fees	$33,271	$138,347	$170,217
Total Fees	**$70,720**	**$296,054**	**$381,164**