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Economic Impact Analysis – Victorian Medical Technologies & Pharmaceuticals Sector

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Centre for Transformative Innovation

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Executive Summary

The Department of Economic Development, Jobs, Transport and Resources (the Department) commissioned this report with the aim of measuring the effect of the medical technologies, pharmaceuticals and biotechnology sectors (the Sector) on the Victorian economy. The Department advised that the Sector definition should include firms engaged in the following activities:

- Pharmaceutical manufacturing and development
- Life science and biotechnology manufacturing and development
- Medical technology manufacturing and development
- Vitamins, supplements and topical product manufacturing and development
- Service providers – contract research organisations, clinical trial providers etc.

The Sector does not fit one single standard industrial classification. It is therefore not possible to evaluate the size of the Sector using 'off-the-shelf' statistics published by the Australian Bureau of Statistics (ABS). To measure the impact of the Sector we first identify all firms engaged in relevant activities. A complete list of the firms included in the analysis is included in Appendix A. The economic impact of the Sector was measured by aggregating the activity of these firms using data on firm financials from Business Activity Statements (BAS) collected by the Australian Tax Office. These aggregate data are produced from the ABS' Business Longitudinal Analysis Data Environment (BLADE).¹ Key findings include:

- We identified 651 relevant Victorian companies with financial data reported to the Australian Tax Office in 2013-14, the latest available data.
- Aggregate turnover of the Sector is estimated to be \$12.7 billion and total employment of 23 thousand (18 thousand full time equivalent) workers meaning the Sector is of comparable economic importance to the Victorian economy as the Victorian automotive industry.
- Sector value added, defined as the difference between turnover and operating expenditure, is estimated at \$2.2 billion.
- The Sector contributes \$1.3 billion in exports, which is approximately 3.6 per cent of total state exports. This is comparable to the states \$1.4 billion exports in motor vehicles in 2014-15.

- The Sector contributes approximately \$10 billion to aggregate demand of other sectors via the purchase of intermediate inputs. The largest supplying industry groups are *Transport, Postal and Warehousing*, responsible for \$1.5 billion; and *Rental, Hiring and Real Estate Services*, supplying \$1.2 billion.
- The main caveat to the measured direct impact is that operations in Victoria of firms based in other states has not been included. Similarly, no adjustment is made for any possible economic activity outside Victoria by Victorian firms. On balance, we expect the overall impact of these considerations mean the estimates of economic impact presented in the report are conservative.

Acknowledgements

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Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the Department or ABS. All results have been reviewed to ensure that no confidential information is disclosed.

Glossary

ABN	Australian Business Number
ABS	Australian Bureau of Statistics
ABR	Australian Business Register
ANZSIC	Australian and New Zealand Standard Industry Classification
ARC	Australian Research Council
BAS	Business Activity Statement
BLADE	Business Longitudinal Analytical Data Environment
CTI	Centre for Transformative Innovation
The Department	Department of Economic development, Transport, Jobs and Resources
FTE	Full Time Equivalent
GDP	Gross Domestic Product
IP	Intellectual Property
IPC	International Patent Class
IPGOD	Intellectual Property Government Open Data
MRCF	Medical Research Commercialisation Fund

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Introduction

This report was commissioned by the Department of Economic Development, Jobs, Transport and Resources (the Department) with the aim of measuring the effect of the medical technologies, pharmaceuticals and biotechnology sectors (the Sector) on the Victorian economy. The Sector encompasses elements of life science and medical biotechnology, pharmaceuticals, vitamins and supplement, and medical devices and has been identified by the Victorian government as one of six priority sectors of the Victorian economy.²

Comprehensive information regarding the aggregate economic impact of the Sector has not previously been available. However, preliminary evidence suggests that the impact of the Sector on the Victorian economy is large. Victoria hosts a large biotechnology precinct in Parkville and a manufacturing hub in Clayton that both include a number of high performing research organisations and universities. Evidence indicates that Australia exhibits a competitive advantage in medical technology in terms of research performance and exports. Trade data reveals that medical equipment, measuring instruments and medical devices represent an area of success in manufacturing exports from Australia, particularly in the case of component trade.³ Data on international patent filings also suggest that Australian industry is relatively specialised in medical devices and medical technology in that Australian firms generate more inventions in these technologies than is predicted by the size of our economy.⁴

An important difficulty in estimating the impact of the Sector is that does not fit neatly into any standard statistical industrial category. The method developed in this report aggregates economic activity of the population of firms in the Sector. Aggregate statistics on total turnover, operating expenditure, employment, investment and research and development (R&D) spending are reported. The data reveal that turnover of the Sector is \$12.7 billion and total employment of just under 23 thousand (18 thousand FTE). The Sector is therefore of comparable economic importance as the Victorian automotive industry which had total employment of 29 thousand and turnover of \$13.6 billion in the same year.⁵

The distribution of flow on effects of the Sector are estimated based on the flow on effects of Australian and New Zealand Industry Classifications (ANZICs) known to comprise the population of firms using Input-Output tables produced by the ABS. Analysis of Australian Input-Output tables tracks the supply chain effects of the Sector on other industries in Victoria.

The approach of aggregating across all firms in the Sector provides a comprehensive view of the economic impact of business activity. Caveats and limitations are discussed focusing specifically on two impacts that are not well captured by the firm level financial data: the sale of a Victorian firm to an overseas buyer; and the contribution of the Sector is in attracting Australian Government research funding to Victorian Universities. A discussion on the treatment of overseas activity by multinationals in firm level tax data is presented.

The report concludes with a discussion of potential measures that may be included in the Victorian State Government Budget Papers to capture the portfolio objective relevant to the Sector.

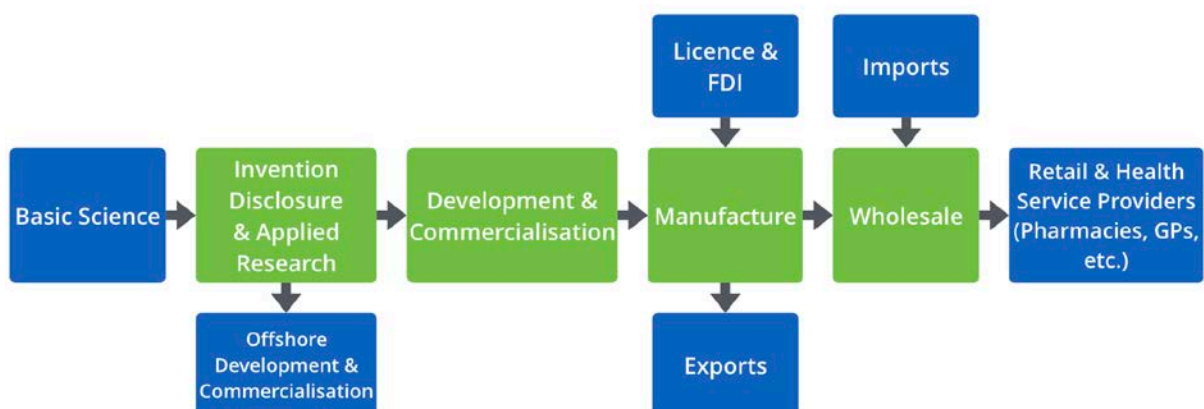
Defining the Sector

The purpose of this report is to estimate the economic impact of the medical technology, pharmaceutical, and biotechnology industries (the Sector) on the Victorian economy. The Department advised that the Sector definition should include firms engaged in the following activities:

- Pharmaceutical manufacturing and development
- Life science and biotechnology manufacturing and development
- Medical technology manufacturing and development
- Vitamins, supplements and topical product manufacturing and development
- Service providers – contract research organisations, clinical trial providers etc.

The most policy relevant Sector definition groups firms that are interconnected and that have shared success factors, supporting industries, infrastructure or labour markets. A common way to define a sector is along supply chains. An example of a supply chain is depicted in Figure 1. Firms active in the Sector in Victoria may be involved in activities from Basic Science to wholesale trade. Firms in the Sector perform activities across a range of industry sectors defined in the Australian and New Zealand Standard Industry Classifications (ANZSICs).

Figure 1: Representative sector supply chain



It is not possible to directly use industry level statistics on economic activity collected by the Australian Bureau of Statistics (ABS) because the Sector comprises incomplete parts of several ANZSICs. To measure the impact of the Sector on the Victorian economy, a comprehensive list of relevant active firms was developed. The firms were identified based on the relevance of their activity. The population was identified from the following sources:

- Firms in the Department contact list.
- Firms registering relevant intellectual property, identified by screening global patent databases.
- Firms included in proprietary CTI datasets that focus on dedicated biotechnology firms & participants in the market for embryonic technology.

The final list contains **794** firms that are headquartered in Victoria operating in the Sector over the period 2013-14.⁶ Appendix A details the process undertaken to generate this list of firms. The Australian Business Numbers (ABNs) associated with these firms are used to link the list with confidential tax and survey data compiled in the Business Longitudinal Analytical Data Environment (BLADE), an ABS database. Indicators of economic impact of the Sector are then constructed by aggregating across the list of firms. The reliability of this estimate depends crucially on the integrity of the list of firms identified.

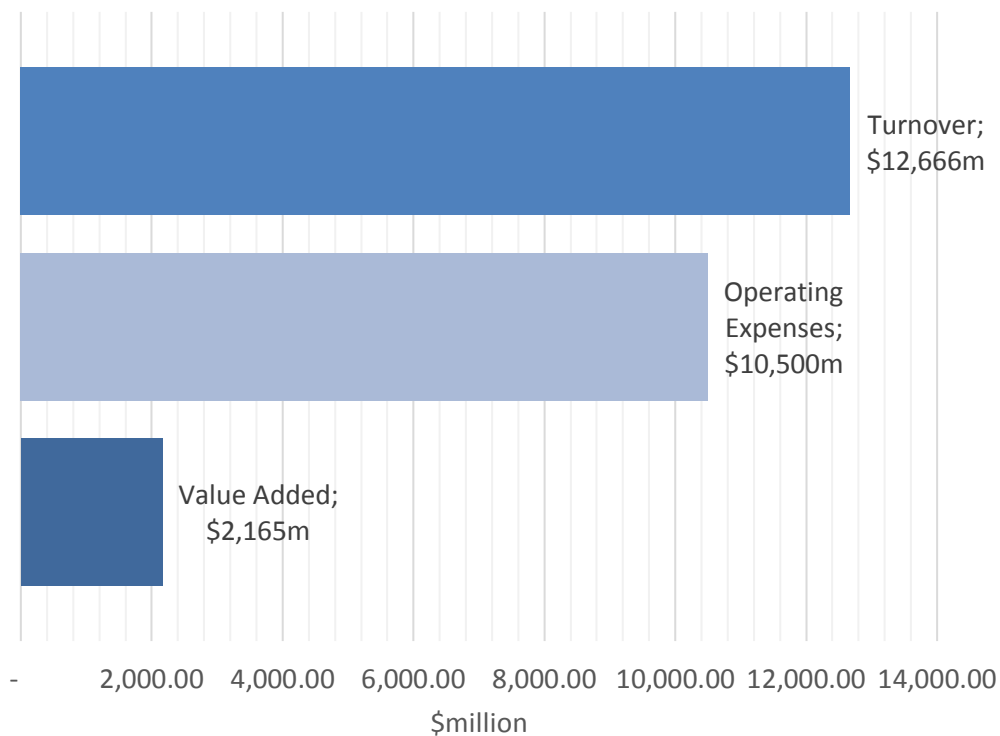
Of the 794 firms identified, financial information was recorded with the ABS for 651. The other 133 firms do not report business activity. The list was populated using information current at 2016. However, the latest available year for company financial information (BLADE) 2013-14, so any new firms will not be included.

The Economic Impact of the Sector

Direct Impact

The Australian Bureau of Statistics Business Longitudinal Analytical Data Environment (BLADE) database is the only comprehensive data of financial operations of every business in Australia. Financial data based on annual business tax records and survey data are aggregated across all firms in the Sector to generate the measure of economic impact, total value added. Supplementary measures considered include employment, exports and investment. See appendix C for additional caveats and assumptions, which apply to ABS BLADE data.

Figure 2: Key Economic Aggregates for the Sector (2013-14)



Value added is equal to turnover net of intermediate inputs. This is consistent with the Production Approach for calculating GDP (or Gross State Product). Turnover data in the BLADE are populated from Business Activity Statements (BAS), filed by all Australian businesses with the Australian Taxation Office.⁷

Intermediate inputs, also referred to as operating expenditure is recorded as non-capital purchases is also sourced from the BAS.⁸

$$\text{Value added} = \text{turnover} - \text{operating expenses}$$

Turnover, operating expenses and value added are depicted in Figure 2. These show that turnover of \$12.7 billion, operating expenses of nearly \$10.5 billion and total value add to the economy of nearly \$2.2 billion.⁹

Employment in the Sector is presented in Figure 3. Total Sector employment is just under 23,000 individuals (over 18,000 FTE).¹⁰ For comparison purposes, employment in the total Sector is roughly one-tenth (8.6%) the size of all manufacturing employment in Victoria.¹¹ Firms in the Sector paid \$1.3 billion in remuneration in the year 2013-14. The average Sector wage is \$74 thousand per FTE worker. This is reasonably comparable to wages per FTE in Victoria in Scientific Research sector (\$76 thousand) and Financial Asset Investing (\$81 thousand).¹²



Figure 3 Employment and Wages (2013-14)

The Sector was responsible for \$1.33 billion in exports over 2013-14. This accounts for 3.6 per cent of a Victorian total of \$37 billion over the same period. This is of comparable magnitude to exports of passenger motor vehicles.¹³

Total capital investment by the Sector was \$277 million. Firms in the Sector spent \$332 million on research and development in 2013-14. For comparison, this equates to roughly one third of total billion invested by ANZIC *Professional, Scientific and Technical Services* over the same period.¹⁴

Supply chain effects

The direct economic impact of the Sector on the Victorian economy is value added (turnover net operating expenses). The Sector also contributes to aggregate demand in sectors which supply intermediate inputs, which the Department has suggested may include patent attorneys, consultants and contract research as well as primary inputs for manufacturing.

There is no known available data on where firms in the Sector purchase their intermediate inputs. We therefore estimate the impact of the Sector on other industries that are suppliers of intermediate goods using input-output tables. Input-output tables are created by the Australian Bureau of Statistics and document the relationships between Australian industries in terms of flows of intermediate inputs. That is, the tables show which industries supply intermediate inputs to which other industries.

The estimates are based on the assumption that the supply chain of the Sector is similar to the supply chain of other firms in the same ANZSIC groups that make up the Sector. That is, we assume that the structure of purchases of intermediate goods by the average firm in the ANZSICs that make up the Sector is representative of the firms in the Sector. Details of the method used for this analysis are presented in Appendix D.

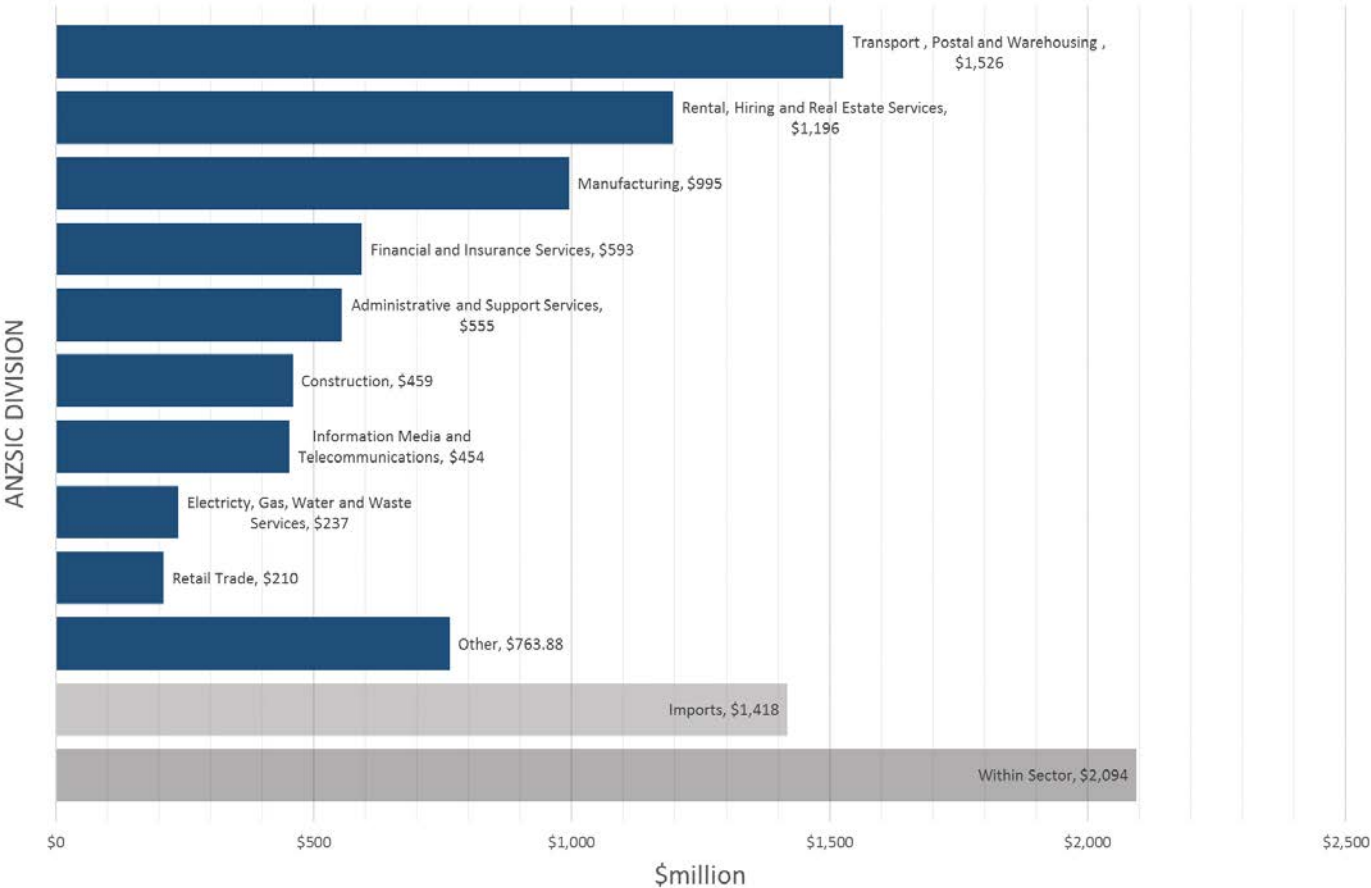
We estimate that the Sector contributes \$6.9 billion in upstream demand to other sectors in the Victorian economy. This amount is over and above the \$2.2 billion direct impact (value added). This estimate excludes the expenditure on imports that have no additional effect on the Victorian economy and intermediate goods and services purchases from other firms within the Sector.

The detailed breakdown of the distribution of sources of intermediate inputs are presented in Figure 4. Supplying industries are aggregated to the ANZSIC Division level.¹⁵ *Transport, Postal and Warehousing* is the largest supplying industry group to the Sector, supplying nearly \$1.5 billion of intermediate inputs. *Rental, Hiring and Real Estate Services* and *Manufacturing* are the next largest contributors, collectively supplying just over \$2.2 billion of intermediate inputs.

Victorian firms operating in the Sector are linked with the global innovation pathway contributing to different stages of the development and commercialisation process. Approximately 13 per cent of Sector operating expenditure goes to imports. This expenditure does not contribute further to the Victorian economy and should be excluded from the total upstream effect.

Nearly one fifth of the Sectors' operating expenditure falls under the category *Within Sector*. This group captures the expenditure on intermediate inputs by the Sector from within the Sector. Inputs purchased by other firms in the Sector will be reflected in the supplying firm turnover. Therefore, this economic impact has already been captured by our headline measure value added. This \$2 billion should be excluded from the total upstream effect.

Figure 4: Supply Chain Analysis. Total Operating Expenditure - \$10.5 billion (2013-14)



Victorian firms in the global innovation pathway

The invention, development and commercialisation of pharmaceuticals and medical technology is an extensively globalised process, with different stages of this process undertaken in different countries, often by multiple firms. Firms operating in Victoria contribute at various stages of this value chain. Perhaps most well recognised is the contribution of Victorian Universities and Medical Research Organisations to upstream biomedical scientific research. Victorian firms are involved in early stage invention, research and early stage development with technologies subsequently licenced or sold to foreign businesses (often large multinational pharmaceutical firms) to develop, commercialise and produce. Arguably, Victorian firms' successes in further down the innovation pathway- buying in or licencing in early stage technologies to develop and commercialise - are less well recognised.

Table 1 summarises the modes through which Victorian firms engage in the global value chain and includes examples of Victorian firms that have succeeded in these areas. For illustrative purposes, we divide the innovation pathway, which is really a continuum, into two broadly defined stages. The first is "Research and proof of concept" and includes those steps between the initial conception to the research and development, including proof-of-concepts and prototypes. The second stage is "Development and Commercialisation" which and includes later stage trial, later stage regulatory approval, manufacturing, distribution and sales. It is also important to consider the different modes of globalisation: economic activity performed by subsidiaries of foreign firms make a valuable contribution to the Victorian economy. We identify activities that span countries and firms (multi firm) – where local and foreign activity undertaken by separate entities; and activities which span countries but are all within the same firm (single firm). Multi-firm activities include cases where entities are coordinated (e.g., outsourcing, contract manufacture and contract research) and transfer between stages occurs after market transaction in technology (e.g., licencing) are labelled "Contract".

Cell (A) reflects contract research and product development; the case where Victorian firms take technology along the entire innovation pathway on behalf of their commissioning clients. *Invetech* is a contract product development company working along the entire innovation pathway to meet the commercial needs of their clients. Working with domestic and international companies, they develop new products from idea conception right through to final production. Having worked on over 5,000 projects, *Invetech* has experience in a multitude of fields, including those in the Sector. For example, *Invetech*

worked with a start-up to assist in transferring a new biosensor technology for medical and industrial applications into a commercial ready platform.¹⁶

Table 1: Mode of participation in global innovation pathways

	Research and Proof of Concept	Development and Commercialisation
Contract Local firm engaged to undertake research and/or product development	(A) Contract research and product development E.g., <i>Invetech</i>	
Multi-firm Local and foreign activity undertaken by separate firms	(B) Out licensing of IP, sale of start-up E.g., <i>Starpharma</i> ; <i>Fibrotech</i> ; <i>Venetoclax</i> clinical trial	(C) In licensing of IP. E.g., <i>Planet Innovation</i>
Single firm Activity in Victoria by subsidiaries of multinational or interstate firms	(D) Research subsidiary. E.g., <i>Cochlear</i>	(E) Development, commercialisation or manufacture subsidiary. E.g., <i>GlaxoSmithKline</i>

The case where Victorian firms contribute the early stage research before technology is sold or licenced to foreign company for commercialisation is indicated by (B) *Starpharma*. *Starpharma* are a drug development and delivery company who employ a “global licensing strategy”. This involves collaborating with other companies to advance a product once they have displayed proof-of-concept. Major deals include those with Ansell, Okamoto and AstraZeneca. Another example is *Fibrotech*, which was founded around technology developed by Professor Darren Kelley at Melbourne University and was sold in 2014 for upfront payments of US\$75 million with a further US\$482 million in anticipated milestone payments.

Victorian firms and hospitals also contribute to clinical trials for drugs being developed by foreign companies. For example, *Venetoclax* is a potential anti-cancer treatment co-developed and trialled at the Walter and Eliza Hall Institute in Melbourne. The Department advises that Victoria offers a favourable regulatory environment to perform clinical trials. Industry participants consulted for this report noted that Victoria is at a disadvantage to the United States in the case of later phase clinical trials, mainly due to the small population from which to draw the necessary large sample of participants.

An example of multi-firm activity where a Victorian firm is responsible for the production of technology originating abroad is provided by (C) *Planet Innovation*. In-licensing a thread technology from Harvard

University, Victorian firm *Planet Innovation* developed a low cost, high sensitivity platform for immunoassay testing. Part of this work involved collaborating with The Burnet Institute and Deakin University to transform the exclusively licensed membrane technology into a functional polymer membrane for testing. Combining this technology with internally developed high performance optics, the end device, Nplex, recently achieved higher sensitivity results than comparable products during clinical trials. This example highlights how a Victorian firm can connect the Victorian Sector to the wider global value chain. By involving Australian fibre experts of the Burnet Institute, Planet Innovation acts as a link to the global market for medical technology.^{17,18}

Cell (D) includes activities of Victorian subsidiaries of multinational or interstate firms in research development. For example, Victoria hosts the main research activities of NSW based firm Cochlear.

Cell (E) covers Victorian subsidiary developing and manufacturing technology for the multinationals global operations. For example, GlaxoSmithKline has manufacturing facilities in Boronia Victoria. The largest of the company's manufacturing sites producing sterile and non-sterile pharmaceutical products and the first with the potential to commercially produce a vaccine delivered using Blow-Fill-Seal (BFS) technology. BFS technology was developed in conjunction with researchers from Monash University and vaccine experts in Belgium and solves an important technical issue with the handling of vaccines, in that sealing requires heating plastic for sealing technology to 160 degrees Celsius while vaccines must be kept below 30 degrees Celsius.¹⁹ Blow-Fill-Seal containers offer a more sterile, robust and cost effective mode of delivery for vaccines that will be supplied to emerging markets.

Cases where Australian IP is commercialised by foreign firms, is sometimes viewed as a second best option. However, it should not be taken as given that policy should aim for Victorian firms to accomplish all stages of the innovation pathway for every technology. There is nothing inherently more or less beneficial to the welfare of Victorians by generating value added at any particular point of the innovation pathway. Success in early stages is better than failure at later stages.

It is beyond the scope of this report to delve deeply into the factors that may facilitate maximum value generation through Victorian firms' contribution to the global commercialisation pathways. On first principles, it stands that the contribution of Victorian firms should focus on the areas of comparative advantage. Stakeholders consulted for this report believe that Victoria has a comparative advantage in basic science largely due to the scale and renown of the medical research precinct in Parkville and the University of Melbourne. One stakeholder commented that while two of Australia's largest bio-medical companies are based in Sydney (Cochlear and Resmed) the environment for entrepreneurship is better in

Victoria. The importance of collaboration, information and trust suggests that the strength of basic science in Victoria may also underpin a comparative advantage in medical-bio-tech venture capital. Policy may play a productive role in enhancing value generated by expanding activity down the innovation pathway. The importance of investor experience and trust in overcoming potentially market failure in financing early stage technology is well recognised. Australia is reputed to have a deeply developed financial market for high risk mining prospecting projects, but a much thinner market for financing early stage medical technology – though according to Brandon Capital managing director Dr Chris Nave, the time between investment and return are a relatively similar 12 and nine years, respectively.

Other Impacts and Caveats

Industry impact presented in this report are based on aggregating across a comprehensive list of firms engaged in relevant activities. This method provides an accurate measure of the total value added, sales and employment of the Sector. A few impacts will not be captured by this approach:

- Return on investment generated by the sale of company to foreign buyer
- Investment in Victorian Universities through attracting ARC funding via linkage grants

These impacts are discussed below. This section then includes a short discussion of how the methodology accommodates foreign activity of large Victorian based firms.

Sale of company to foreign buyer

A remaining limitation of the analysis relates to the sale of a Victorian firm to an overseas buyer. When a company that is built in Victoria and owned by Victorians is sold to overseas investors, the sellers benefit in much the same way as if they had exported a product – though of course the events are recorded in very different ways. The measures of economic impact provided in this report relied on Business Activity Statements of companies in the Sector. In general, payments made for the purchase of a company from an overseas buyer will not be record as turnover in the operating activity of the firms themselves and therefore will not be in the BLADE firm level data. While it has not been possible to measure the overall value of this return for the bespoke set of firms comprising the Sector list, the rate of return generated by investment funds and returned to Australian investors does contribute to the income of Australians and, in principle, comprises part of national value added (GDP).

The broad implications for the Victorian economy of the sale of a firm to a foreign owner depend on whether the new owner moves the firm's operations overseas or keeps them in Victoria. In the case where the firm's operations remain in Victoria, value added is still generated in the Victoria although the transfer of future profits reduce the share of future value added captured by Victorians. An example of this is the sale of an 83 per cent stake of *Swisse* to Hong Kong listed company *Biostime International*. With the company headquarters remaining in Melbourne, activity by this firm will be captured in our measure of value added. The change in ownership in this case will simply be reflected in the Financial Account of the National Balance of Payments. Future profits will be transferred to the new owners abroad.

If operations are moved overseas, Victoria will miss out on continued employment and ongoing return on capital future value added. However, despite this apparent loss, the purchase price reflects the transfer of a share of expected future value added. That is, the sale price reflects (to some degree) discounted future profits. So while Victorians take only a share of the expected future value generated by the technology, the overall value generated by the company may be enhanced by moving abroad due to market access, capital advantages or some other factor. It can be better to have a small share of a successful commercialisation than a large share of a technology that fails to meet its market potential due to lack of capital, expertise or market access.

Case Study: Fibrotech Therapeutics sale to Shire

Fibrotech Therapeutics, an Australian biotechnology company, was sold to Shire Pharmaceuticals in 2014 for an upfront payment of US\$75 million and milestone payments of a further US\$482.5 million contingent on the achievement of key milestones.²⁰ When Professor Darren Kelly spun *Fibrotech* out of Melbourne University, the company was working on a class of treatments for fibrosis (tissue scarring). The lead compound now under further development by Shire Pharmaceuticals is FT011, an antifibrotic that prevents the kidney tissue scarring associated with diabetes. In light of the large potential market for the treatments, the company founders estimate the potential future value of sales of the drug to be in the order of \$5 billion for treating diabetes related fibrosis, which is an illness that will affect nearly 20 per cent of the population of the developed world over their lifetime.

Future revenue and value added associated with FT011 and the other intellectual property sold accounted for as revenue for Shire Pharmaceuticals. The sale of the company does not appear in our measure of value added. The US\$75 million upfront payment and subsequent milestone payments go to the company's owners and investors who seeded the initial \$7m to the start-up. All investors were Australian: the principle investors in *Fibrotech* was the Victorian based investment fund, the Medical Research Commercialisation Fund (MRCF). Established in 2007, the MRCF is an investment collaboration that focuses on early stage development and commercialisation opportunities stemming from Australian research institutes.²¹ Investment into the MRCF is only institutional, including principally Australian Superannuation funds and government. This means the proceeds of the sale were effectively shared across any superannuation account holder with exposure to the MRCF. Significant returns also flowed to the inventor and to Melbourne University.

The founders estimate that a further four to five more years of development are required for it to reach the market, at a cost of between \$100 and \$200 million further investment. While the founders believe

the science will lead to viable clinical treatments, ongoing development is subject to some risk including competing treatments and products. *Fibrotech Therapeutics* was sold to Shire Pharmaceuticals after the completion of a Phase Ia trial which established safety and tolerability of the drug in healthy adults for doses up to 1000mg. Nonetheless, it was believed at the time that an investment of an additional \$20m would have taken the technology through to Phase 2 and could have achieved a total sale value closer to \$1 billion. Unsuccessful attempts were made at that time to raise the capital on the Australian market.

The sale to Shire included all IP and all data for all applications of the technology, with the important exception of ocular. Prior to the sale of *Fibrotech*, compounds related to the treatment of retinal fibrosis and inflammation were spun out to a new venture called OccuRx. The decision was made on the basis that Shire Pharmaceuticals did not have commercial interest in ocular therapeutics. OccuRx will likely generate further value add to the Victorian economy, whether that be through the sale of the company or by bringing a final product to market.

Dr Chris Nave, the founder of MRCF, believes that an important implication of the successful sale of *Fibrotech*, and other ventures backed by MRCF is the signal to other potential investors. At present, MRCF is fully subscribed. Dr Nave believes that the high rate of return achieved by MRCF, which is compounded by the low rates of return currently being seen on other assets, is generating further interest among Australian institutional investors, primarily Superannuation funds. The claim is substantiated by the second round of investment of \$200 million secured by the MRCF in 2015.²²

Brandon Capital, the group responsible for the MRCF have been selected by the Australian Federal Government to manage \$230 million of the new \$500 million Biomedical Translation Fund (BTF).²³ Part of the National Innovation and Science Agenda announced in December 2015, the BTF seeks to support early stage development to retain promising Australian medical discoveries.²⁴

Australian Research Council Linkage Projects

The Sector also attracts additional resources from the Australian Government to support research at Victorian Universities. To measure the total value of private resources contributed by the Sector to Victorian universities and to research in general, we analysed all Australian Research Council (ARC) Linkage Project awards. The ARC Linkage funding is intended to encourage cooperation between researchers and businesses, industry, community organisations and other publically funded researched agencies.²⁵ A component of this funding is the linkage program. This program provides funding to support R&D projects. Importantly, these 'Linkage Projects' require a Partner Organisation who are required to make a contribution to the project. By searching the grants dataset for each of the firms' active in the Sector, we were able to aggregate the total contribution.²⁶

From the list of 794 Sector firms, 35 firms were listed as Partner Organisations on an ARC Linkage project from 2010 to 2015. Twenty-four of the 36 firms listed as Partners over the five-year period have been granted only one linkage project; three firms are Partner Organisations for five Linkage projects over the same period.

The total funding over these 61 linkage projects is just over \$22.4 million, nearly seven per cent of all ARC linkage funding over the period (across all disciplines). Thirty-seven of these projects, with a total value of \$13.9 million, were awarded to projects with Victorian Universities (administering organisations). This corresponds to nearly 16 per cent of the total linkage program funding to Victoria over the period. The remaining 24 projects (\$8.4 million) were awarded to Universities outside Victoria – despite the fact that the main state of operations for all firms was Victoria. While these projects do not contribute to Victorian Universities, the Sector still benefits from being a Partner Organisation. Table 2 lists the total funding of the Sector by State

Table 2: ARC Linkage Funding by State (2010-2015)

STATE	FUNDING AMOUNT
Victoria	\$13,867,818
New South Wales	\$3,516,680
Queensland	\$1,893,509
Tasmania	\$1,554,912
Western Australia	\$738,000
South Australia	\$556,291
Australian Capital Territory	\$285,000
TOTAL	\$22,412,210

The 37 Linkage Projects administered by Victorian organisations are spread across four universities. The total funding amount for each university is represented in Table 3. Monash University and the University of Melbourne were administering organisations for nearly \$12 million of the total \$13.9 million.

Table 3: Victorian ARC Linkage funding by Administering Organisation (2010-2015)

UNIVERSITY	FUNDING AMOUNT
Monash University	\$7,182,705
The University Of Melbourne	\$4,788,069
RMIT University	\$1,004,553
Deakin University	\$892,491
TOTAL	\$13,867,818

International activities of multinationals

The approach used to measure the economic impact of the Sector effectively distinguishes between domestic and international activity by Victorian based multinationals that are active in the Victorian Sector. For example, the Commonwealth Serum Laboratories (CSL) based in Parkville, Melbourne, operates in over 30 countries and hosts manufacturing facilities in seven countries²⁷ and annual global revenue of over US\$6 billion.²⁸ There are three types of multinational activity to consider: export sales, overseas production to service overseas markets; and, overseas production to service the Australian market.

Export sales will be accurately represented, both in the value added measure (turnover – operating expenditure) and in Sector exports. Regardless of whether exports are used as intermediate inputs by the multinational in another location, for Australian tax purposes they are exports of goods and services.

Where a multinational produces a product for an overseas market, this activity has no further impact on the Victorian economy. For example, CSL manufacturing and marketing a product in Europe does not affect the Victorian economy. Profits from this activity repatriated back to the Melbourne headquarters are not included in the BAS. Turnover, from G1 does not include, *“amounts received for sales not connected with Australia, unless a special rule makes the sales taxable, GST-free or input taxed”*.²⁹

Products produced overseas by the firm to service the Australian market *are* included in operating expenditure. Operating expenditure is sourced from the BAS field Non-capital purchases (G11). This field encompasses all amounts for the business other than capital purchases (G10). This includes *intangible supplies purchased from off-shore that are of a non-capital nature*. That is, non-capital purchases include those inputs purchased from offshore. Where the multinational imports intermediate goods they have produced at an overseas facility, these will be included in the value added measure as operating expenditure

Measures for the Victorian Government Budget Papers

The Department has requested that CTI discuss appropriate measures that may be included in the Victorian State Government Budget Papers to capture the portfolio objective relevant to the Sector. In this section we provide a discussion, first, of what makes a good performance measure before providing some suggested additions to the Budget Papers.

The Budget Papers describe the “...objectives and associated performance indicators departments seek to achieve over the medium term.” The Departments objectives include increasing sustainable **employment** opportunities for Victorians and building **investment** and **trade** in the Sector.³⁰ The main body of this report documents measures of Sector employment, investment and trade (exports) as well as wages, value added and turnover. The performance of the Sector can be chronicled with continued monitoring of these data. Changes in the overall performance and economic impact of the Sector provides policy context and may provide an advanced indicator of emerging issues. However, useful policy relevant performance measures should avoid confounding the role of Department interventions with other extraneous factors that affect the Sector. We argue that metrics that track the overall Sector performance, such as targeting growth in exports, are generally not good candidates for inclusion in the Budget Papers.

Budget paper measures should be closely tied to outcomes of Departmental activity and specifically related to economic outcomes desired. Measures that are poorly tied to desired outcomes can create perverse incentives to market participants. An example of a measure that has the potential to do just this is the “*Applications for intellectual property protection*”. Evidence widely supports the concern that incentivising IP applications leads to a fall in patent quality; that is, the number of patent applications rise, but the economic value of each patent falls. Another example measure that is not well linked to the underlying economic outcome desired is “*Businesses whose growth and productivity issues are resolved by the Department*”. This performance measure has the potentially perverse effect that a fall in businesses experiencing “productivity issues” may be taken to reflect poorly on Departmental performance.

The Medical Technologies and Pharmaceuticals Sector Strategy outlines 17 explicit goals for the Sectors’ development. We believe these provide an good blueprint for identifying relevant target measures.³¹ In addition, we suggest that:

- Measures should not define the Sector based on company ANZSIC. Analysis presented in this report shows conclusively that the Sector is not well captured by any collection of 4-digit ANZSIC. This unique feature of the Sector should be recognised by those measures chosen.

- Measures should not be biased based on firm size. While it is the case that firms at different stage of their life cycle require different assistance, performance measures should not incentivise the Department overlook parts of the Sector.

Proposed measures to be incorporated into the BP3

The Department have advised that the relevant Budget Paper output is *Industry Enterprise and Innovation*. “This provides access to information and connections, and builds the capacity of businesses and industry to develop and effectively use new practices and technologies to increase productivity and competitiveness in Victoria. It also helps businesses overcome barriers to competitiveness.”³²

We propose three new measures to be included in the output of Industry and Enterprise Innovation. These are outlined below.

1. The number of networking events and the number of participants who have attended them.

The first proposed measure is an augmentation of the existing “*Industry roundtables and engagement forums*”. Discussions with Sector participants highlighted the importance of networking and collaboration for growing the Sector. Connections between Sector organisations furthers their ability to realise global opportunities and attract investment.³³ The Department recognises its role in facilitating the creation of these connections by explicitly targeting the number of Industry round tables and engagement events each year.

We suggest developing this target one step further and explicitly targeting the number of distinct firms who participate in one of these events, as well as other relevant forums such as the delegations to BIO. Targeting the number of participants will increase the reach of the Department within the Sector.

2. The number of firms in Departmental programs, which are included in a quantitative program, impact evaluation that use firm-level data and employ robust statistical design embodying an implicit or explicit control group.

Program evaluation is now an accepted component of good program design. Reflecting this, evaluation is increasingly budgeted for at project inception. However, across both State and Commonwealth Government, the evaluations themselves are commonly subject to concerns regarding rigour and independence, which diminish their impact on the process of ongoing improvement of program design and implementation. The most important aspect of program evaluation – whose goal should be

establishing the causal impact of programs on participating firms – is using high-quality firm-level data and a statistical design embodying an implicit or explicit control group. The standard statistical library has grown to include propensity score matching, difference-in-difference, randomised control, regression discontinuity, and bunching.

3. Growth in new capital invested in developing embryonic technology

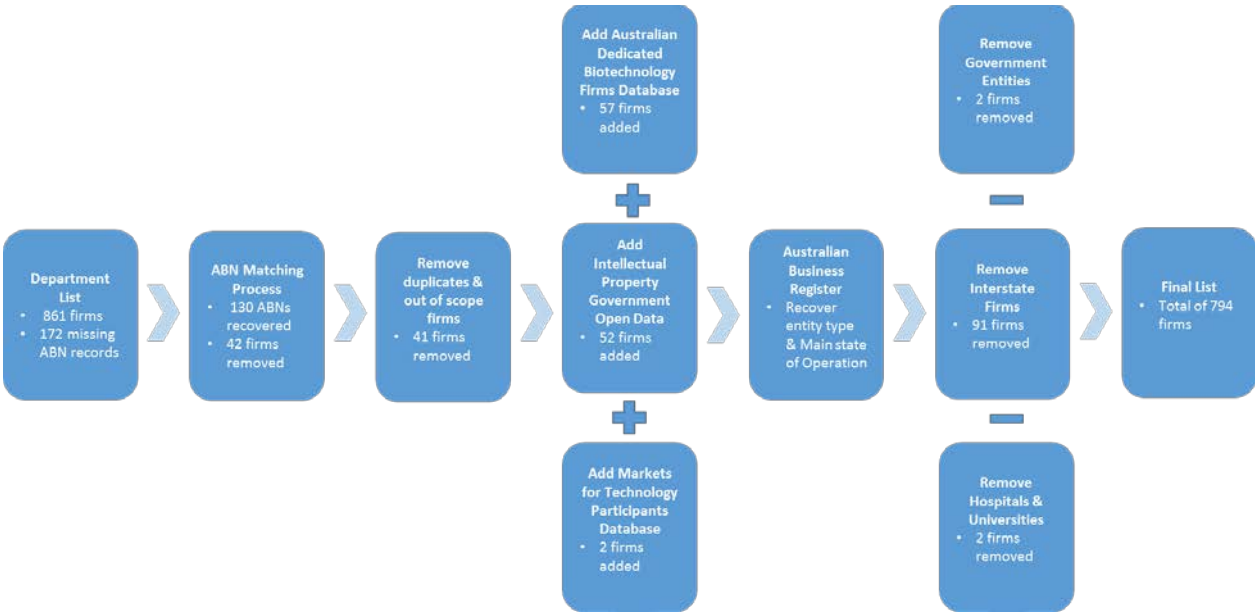
A measure based on the availability of finance for the development of Australian technology warrants careful consideration for inclusion in the Budget Papers. Evidence suggests that private capital markets are often not effective in financing the development of novel, high-risk, high-return technology. There are documented examples where greater capital availability may have increased the overall return to Victoria of technology start-ups, including persevering to later stage clinical trials before exit via buyout, or avoiding premature initial public offering. The proposed metric aims to target Departmental success in linking Victorian strengths in basic bio-science to vehicles that can commercialise them. In principle, this should capture a broad range of activities including grants, contributing to informational asymmetries via networking and related activities and developing skills and human capital in the finance sector.

This measure has the disadvantage that it is not entirely determined by Departmental activity – extraneous factors may play a substantial role. This limitation should be considered carefully. It may be possible to finesse the measure to benchmark against another relevant financial market indicator. Further consultation with a mix of both listed and unlisted firms as well as financiers would be useful in refining the details of such an appropriate measure of new capital flowing to the Sector.

Appendix A: Identifying relevant firms

This appendix details the method used to identify firms in the Sector. An outline of the key steps is presented in Figure A5.

Figure A5: Identifying relevant firms; Outline of key steps



Department List

The Department provided list of 861 firms known be in the Sector. Of the 861 firms provided by the Department, 690 had listed ABNs. To match the remaining 172 with their associated Australian Business Number using the online ABN Lookup tool.³⁴ A matched ABN was found for 130 of those firms not already linked to one, leaving 42 without. For these firms, it was not possible to determine the correct ABN match without further information. This results in a firm list containing 819 firm/ABN pairs.

Following the ABN matching procedure described above, 24 ABNs were identified as being duplicates and were removed. These duplicate ABNs were found to be the result of keeping old firm names as well as new firm names. While an attempt has been made to keep the most up to date firm name/ABN match, it is irrelevant for estimating the economic impact, as the ABS makes use of the ABN only. Removing these duplicate entries brings the number of firms included to 795.

It was not within the project scope that we evaluate the relevance of the firms provided by the Department, however we undertook some basic crosschecking and quality assurance. We checked all ABNs provided by the Department, to ensure they matched the firm name. In a handful of cases, the ABN and firm appear not to be linked. Based on firm name and ANZSIC we identified 17 firms that were found to be out of scope. Thirteen were predominately involved in Veterinary science. Four others were found to be in other non-relevant sectors or activities (*Evenrange Pty Ltd, Sapien Technology; MGB Testing; Chemist Warehouse*). Excluding these firms results in a firm list with 778 firms.

Firms added by CTI

The first method to identify additional relevant firms is to find firms that have registered patents in relevant technology classes (International Patent Class). We used the Intellectual Property Government Open Data (IPGOD), which covers all patent applications made to Intellectual Property Australia (IP Australia) over the last century. CTI and IP Australia developed the IPGOD dataset for the purpose of understanding how Australian companies are using intellectual property and the economic implications. We identified Victorian firms that have applied for patents in relevant technology classes. Technology classes are identified as International Patent Class (IPC) codes which Schmoch (2008) identifies as being Medical Technology, Pharmaceuticals and Biotechnology.³⁵ The final list of relevant IPC codes is attached to this appendix in table A4.

There are 692 Australian firms named in at least one relevant patent application were found. From these we remove firms based in other states and those already in the list. The remaining 169 firms were manually checked for relevance based on company websites. Sixty-two firms are deemed relevant. The fact that more than half of the new firms identified by this search are irrelevant to the Sector highlights two things. First, our original list is close to complete. Secondly, while IPC codes provide a useful reference point to search for relevant firms; manual checking is required to pick up unrelated businesses. This reflects the unique composition of the Sector. After merging these firms with the firm list, 52 are added.

The second method for finding relevant firms was to use the Centre for Transformative Innovation (CTI) Australian Dedicated Biotechnology Firms Database. This covering all firms engaged in the commercialisation of research and development in the area of human therapeutics and diagnostics, as well as related organisations. This database includes 124 relevant Victorian firms.³⁶ To match firms with ABNs we search the ABN Lookup using these names. In the case of multiple matches, a manual check is performed to ensure the correct ABN is assigned. This data set is merged with the Department list using

ABN as the firm identifier. Just under half of those firms identified are already included in the Department list, with 57 new firms added.

The third and final database used to identify all firms relevant to the Sector is also maintained at CTI. Comprising of firm level data on Australian consultants engaged in the market for pre-commercial technology. These include patent attorneys, venture capital firms and other brokerage firms. The database included 90 Victorian firms, two of which were found to be both relevant and not already in the list, which reflects the comprehensiveness of the other sources considered.

Geography

Many firms operate in more than one state in Australia. This adds a complexity to measuring the economic impact of the Sector as it introduces a source of measurement error to any approach based on aggregating across a sample of firms. The list of firms provided by the Department included firms that are based in another state but are understood to have significant operations in Victoria. The inclusion of these firms has the potential to overstate the economic activity by attributing interstate activity to Victoria; but the exclusion of these firms will lead to underestimation. To ensure the most transparent estimates of economic activity, only firms with Victoria as the main state of operation are included for the analysis.

To identify Victorian firms, we use self-identified Main State of Operation from the Australian Business Registry. The ABR is populated by self-reported updates on ABN characteristics by the owner of the ABN. In principle, ABN owners should update the ABR entry within 28 days of a known change in circumstance. This may be a new name, a new non-for-profit status or even a new main state of operation. However, we understand that this procedure may not always be followed. The main state of operation is the publically available address data on the ABR. Extracting this state for all 889 firms reveals 102 firms that are *currently* based interstate. Ninety-one of our firms were not based in Victoria in the year of analysis 2013-14. This leads to a firm list of 798 firms.

Hospitals, Universities and Government Agencies

Relevant activity undertaken in universities and hospitals are excluded from the analysis. The main reason for excluding them is that it is not possible to separately identify Sector relevant activities from the main activities of these organisations (education and health care) which are not part of the Sector. Where hospitals in Victoria are engaged in the Sector this will not be accounted for in our measure. For example,

in participation and undertaking clinical trials. That estimates of the Sectors economic impact exclude these firms should be considered when interpreting the results presented.

In order to avoid this issue, the list of ABNs was compared against a list of known hospital and university ABNs. Two firms were linked to university ABNS. These firms were:

1. Metabolomics Australia
2. Australian Regenerative Medicine Institute

These two research institutes are linked to the University of Melbourne and Monash University, respectively. While the work undertaken by these two centres is relevant to the Sector, we are unable to separate the activities of the two centres from the ABNS provided. These are removed from the firm list.

We also screen for two possible entity types; Commonwealth Government Entities and State Government Entities. These are removed from the firm list. In international standard systems of national accounts, non-market goods and services produced by government units are valued at cost. The two firms removed are:

1. Peter Mac Research Division; and
2. CSIRO – Molecular and Health Technologies.

We also identified each firm with Not-for-profit status and examined their website to ensure they were relevant and not primarily clinical service providers. These firms are research institutes and most if not all of their activity is correctly considered part of the Sector.

Summary of final list

The final list then contains **794** firms relevant to the Sector with Victoria as the main state of operation over the 2013-14 period. We view this as close to comprehensive, but highlight some reasons that the resulting estimate may err on the side of being marginally conservative. Our aggregates omit:

- Relevant activity occurring in Victoria by government organisations like CSIRO.
- Relevant activity occurring in Victoria by firms with an interstate headquarters.
- Relevant activity by Hospitals and Universities has been excluded.

It would also be noted that no adjustment was made for any possible economic activity outside Victoria by Victorian firms in the Sector. On balance, we expect the overall impact of these considerations suggest our estimate is conservative.

It should also be noted that the data used to populate this firm list are based on best available information in 2016. It is possible then that this list misses some firms active in the 2013-14 period that are no longer active. Furthermore, the list includes firms that have only become active since that period. It would be expected then that the number of firms from this list matched to the BLADE will increase when data that are more recent becomes available.

Table A4 Relevant IPC Codes - Schmoch (2008)

Medical Technology	
IPC	Description
A61B	Diagnosis; surgery; identification
A61C	Dentistry; Apparatus or methods for oral or dental hygiene
A61F	Filters implantable into blood vessels; prostheses; devices providing patency to, or preventing collapsing of, tubular structures of the body. E.g. stents; orthopaedic, nursing or contraceptive devices; fomentation; treatment or protection of eyes or ears; bandages, dressings or absorbent pads; first-aid kits
A61G	Transport, personal conveyances, or accommodation specially adapted for patients or disabled persons; operating tables or chairs; chairs for dentistry; funeral devices
A61H	Physical therapy apparatus, e.g. devices for locating or stimulating reflex points in the body; artificial respiration; massage; bathing devices for special therapeutic or hygienic purposes or specific parts of the body
A61J	Containers specially adapted for medical or pharmaceutical purposes; devices or methods specially adapted for bringing pharmaceutical products into particular physical or administering forms; devices for administering food or medicines orally; baby comforters; devices for receiving spittle

A61L	Methods or apparatus for sterilising materials or objects in general; disinfection, sterilisation, or deodorisation of air; chemical aspects of bandages, dressings, absorbent pads, or surgical articles; materials for bandages, dressings, absorbent pads, or surgical articles
A61M	Devices for introducing media into, or onto, the body; devices for transducing body media or for taking media from the body; devices for producing or ending sleep or stupor
A61N	Electrotherapy; magnetotherapy; radiation therapy; ultrasound therapy
H05G	X-RAY technique

Pharmaceuticals

IPC	Description
A61K	Preparations for medical, dental or toilet purposes. Does not include A61K-008 that includes cosmetics or similar toilet preparations.

Biotechnology

IPC	Description
C07G	Compounds of unknown constitution
C07K	Peptides
C12M	Apparatus for Enzymology or Microbiology
C12N	Micro-organisms or enzymes; compositions thereof; propagating, preserving or maintain micro-organisms; mutation or genetic engineering; culture media

C12P	Fermentation or enzyme-using processes to synthesis a desired chemical compound or composition or to separate optical isomers from a racemic mixture
C12Q	Measuring or testing processes involving enzymes or micro-organisms; compositions or test papers therefor; processes of preparing such compositions; condition-responsive control in microbiological or enzymological processes
C12R	Indexing scheme associated with subclasses C12C-C12Q

Appendix B: Sector firm list

COMPANY LIST		
360 BIOLABS PTY LTD	ELEVATE TECH	NEUREN PHARMACEUTICALS
4DX PTY LTD	ELISAKITS	NEURO THERAPEUTICS
4G VACCINES	ELK OTHOBIOLOGICS LIMITED	NEURONAL NEUTRACEUTICALS
A FILIPPIS & I.T NISBET & THE FILIPPIS FAMILY TRUST & THE NISBET FAMILY TRUST	ELMORE OIL COMPANY	NEUROSCIENCE AUSTRALIA (NSA)
A.J.T. (AUST) PTY LTD	ELYPTOL	NEUROSCIENCES VICTORIA
AARON LABORATORIES	EMEIS COSMETICS PTY LTD (AESOP)	NEUROVANCE AUSTRALIA
AB SCIEX AUSTRALIA PTY LTD	EMERITUS RESEARCH	NEW AGE BOTANICALS PTY LTD
ABCO HEALTH CARE PTY LTD	EMU RESEARCH CORPORATION OF AUSTRALIA PTY LTD	NIDOR PTY LTD
ACCORD HEALTHCARE PTY LTD	ENDOGENE PTY LTD	NMK CONSULTING PTY LTD
ACRUX LIMITED	ENSIGN LABORATORIES PTY LIMITED	NORWOOD IMMUNOLOGY
ACTAVIS	ENT TECHNOLOGIES PTY LTD	NOVARTIS CONSUMER HEALTH
ACUNEEDES AUSTRALIA PTY LTD	ENTERPRISE ACCELERATORS	NPLEX PTY. LTD.
ACUPAK PTY LTD	ENTTEX PTY LTD	NUCLEUS NETWORK*
ADALTA PTY LTD	EPREP PTY LTD	NUTRI-GREEN PTY LTD
ADHEALTH	ERIS PHARMACEUTICALS AUSTRALIA	NUTRI-PHARM AUSTRALIA PTY LTD
ADMINISTRATION AND MARKETING SOLUTIONS PTY LTD	ES CELL INTERNATIONAL AUSTRALIA	NUTRITION CARE PHARMACEUTICALS PTY LTD
ADP TECHNOLOGY	ESSOLOGY	NUVASIVE (AUST/NZ) PTY LTD
ADVANCED BIOMEDICAL PTY LTD	EUCALYPTUS BIOSCIENCES PTY LTD	O'BRIEN INSTITUTE*
ADVANCED CLINICAL SYSTEMS INTERNATIONAL PTY LTD	EVADO PTY LTD	OCCURX PTY LTD
ADVANCED DNA LABORATORIES PTY LTD	EXTEL TECHNOLOGIES PTY LTD	OFF DOT
ADVANCED MOLECULAR TECHNOLOGIES PTY LTD	EXTEND-A-CARE PTY. LTD.	OKEDRO PTY LTD
ADVANCED NATURAL BEAUTY SALONS PTY LTD	EYENAEMIA	OLIVIA NEWTON-JOHN CANCER RESEARCH INSTITUTE*
ADVENT PHARMACEUTICALS PTY LTD	EZZI VISION PTY LTD	OLYMPUS AUSTRALIA PTY LTD
AFFINITY BIOSCIENCES	FAIRMONT MEDICAL PRODUCTS PTY LTD	OMNIBLEND INNOVATION
AGENIX LIMITED	FARADAY PTY LTD	ONQ SOFTWARE PTY LTD
AGILENT TECH AUSTRALIA M	FEIL ALAN	OPAL BIOSCIENCES
AGILENT TECHNOLOGIES AUSTRALIA PTY LTD (VIC)	FELTON GRIMWADE & BOSISTO'S PTY LTD	OPAL THERAPEUTICS
AINSCORP PTY LTD	FIBROTECH THERAPEUTICS PTY LTD	OPTHEA PTY LTD
AIR AROMA INTERNATIONAL PTY LTD	FIREBRICK PHARMA PTY LTD	OPTIMAL IVF PTY LTD
AIS HEALTHCARE	FISHER & PAYKEL HEALTHCARE PTY. LIMITED	OPTIMUS LIFE SCIENCE PTY LTD
AKAAL PHARMA PTY LTD	FLEET PHARMACEUTICALS PTY. LTD.	OPTISCAN
ALBACMAT	FLORA LABORATORIES PTY LTD	OPTISCAN LTD

ALCHEMY BIOSCIENCES	FLOYD INSTRUMENTS	OPTOTECH PTY LTD
ALCHEMY BIOSCIENCES INTERNATIONAL	FLUOROTROP	ORAL AIR PTY LTD
ALIMTYPE PTY LTD	FOCUS PATHOLOGY	ORPHARMA PTY LTD
ALLERGENIX	FORME MEDICAL	ORTHOMOLECULAR MEDISEARCH LABORATORIES PTY LTD
ALLTECH ASSOCIATES (AUSTRALIA) PTY LTD	FORMULTICA	ORTHOPAEDIC APPLIANCES PTY LTD
ALTERNATIVE SERVICES PTY LTD	FRED IT GROUP	ORTHOTICS AUSTRALIA
ALTNIA OPERATIONS	FRESCHÉ BIOSCIENCE PTY LTD	OSPREY MEDICAL PTY LTD
ALTRUTEC	FRESENIUS MEDICAL CARE SEATING (AUSTRALIA) PTY. LTD.	OSTEON MEDICAL PTY LTD
AMAZING SUPER HEALTH	FRONTLINE INNOVATIONS	OUTERSPACE DESIGN
AMAZON PHARMA PTY LTD	FUSION BIOSCIENCES	P & M HEBBARD PTY LTD
AMBLYOPTICA (HOLDING) PTY LTD	FWEE	PACIFIC LABORATORY PRODUCTS PTY. LTD.
ANALYTICAL REFERENCE LABORATORIES	G I THERAPIES PTY LTD	PARAGON CARE LIMITED
ANATOMICS PTY LTD	GALLAY MEDICAL & SCIENTIFIC PTY LTD	PARAGON MEDICAL PTY LTD
ANATOMIZE PTY LTD	GARELAG	PARANTA BIOSCIENCES LIMITED
ANDATECH CORPORATION PTY LTD	GBC SCIENTIFIC EQUIPMENT PTY LTD	PARGENEX PHARMACEUTICALS
ANSELL LIMITED	GE HEALTHCARE AUSTRALIA	PARKER HEALTHCARE PTY LTD
ANTISENSE THERAPEUTICS LIMITED	GENERA BIOSYSTEMS LIMITED	PASPA PHARMACEUTICALS
APE ENTERPRISES	GENERIC HEALTH PTY LTD	PATIENT CARE PRODUCTS
APOLLO MEDICAL IMAGING TECHNOLOGY PTY LTD	GENERIC PARTNERS HOLDING CO PTY LTD	PATRY'S LIMITED
APS INNOVATIONS PTY LTD	GENESFX HEALTH PTY LTD	PAUL L CLARK AND ASSOCIATES
AQUA DIAGNOSTICS	GENETIC TECHNOLOGIES LIMITED	PEARCE PHARMACEUTICALS
AQUARIAN INDUSTRIES PTY LTD	GENETICS AUSTRALIA CO-OPERATIVE LIMITED	PEARL DENTAL
ARANA THERAPEUTICS (VIC) PTY LTD	GENSCREEN PTY LTD	PEPTIDE SOLUTIONS
ARROW LABORATORIES LTD	GENVARTEC	PERFECT SCENTS COSMETICS
ARROW PHARMACEUTICALS PTY LTD	GEOSUNPHARMA	PERFECTLIFE PRODUCTS & SOLUTIONS
ASAP SKIN PRODUCTS	GHOSSAN	PERFUSION SOLUTIONS PTY LTD
ASCEND BIOPHARMACEUTICALS	GILEAD SCIENCES PTY LTD	PERKINELMER AUSTRALIA
ASCENT PHARMAHEALTH LIMITED	GLAXOSMITHKLINE AUSTRALIA	PHARMACEUTICAL PACKAGING PROFESSIONALS
ASHLEY BATES CONSULTING	GLAXOSMITHKLINE AUSTRALIA PTY LTD	PHARMORE PTY LTD
ASHWORTH HOLDINGS	GLOBAL COLD CHAIN SOLUTIONS PTY LTD	PHARMOUT PTY LTD
ASSUREQUALITY AUSTRALIA PTY LTD	GLOBAL HEALTH LIMITED	PHOSPHAGENICS LTD
AUS BIO LIMITED	GLOBAL KINETICS CORPORATION	PICORAL
AUSBIOTECH LTD	GLUTAGEN	PICSAFE MEDI
AUSIMED LIMITED*	GM MEDICAL PTY LTD	PLANET INNOVATION
AUSMEDI INTERNATIONAL PTY LTD	GMDX PTY LTD	PNL HOLDINGS PTY LTD
AUSPEP	GO FORWARDS CO	POD ACTIVE PTY LTD
AUSTAR PHARMACEUTICALS PTY. LTD.	GOLDEN AGE BIOTECH	POLYACTIVA

AUSTIN RESEARCH INSTITUTE*	GOLLMAN AUSTRALIA PTY LTD	POLYBART PTY LTD
AUSTLINX INTERNATIONAL PTY LTD	GORDAGEN PHARMACEUTICALS PTY LTD	POLYNOVO BIOMATERIALS PTY LIMITED
AUSTRALIAN BIOCLOUD	GORMAN PROMED	PRANA BIOTECHNOLOGY
AUSTRALIAN BIOLOGICS PTY LTD	GRALE SCIENTIFIC PTY LTD	PREMAX PTY LTD
AUSTRALIAN BIOMEDICAL CO	GRAND DAME PTY LTD	PRESCIENT THERAPEUTICS LIMITED
AUSTRALIAN BOTANICAL PRODUCTS	GREY INNOVATION	PRIME PHARMACY GROUP PTY LTD
AUSTRALIAN CONTACT LENSES	GRIBBLES GROUP	PROACTIVE AGEING
AUSTRALIAN HEALTHCARE SOLUTIONS	GRIBBLES MOLECULAR SCIENCE	PROBIOTEC LIMITED
AUSTRALIAN INTERNATIONAL MEDICAL SUPPLIES PTY LTD	GRIFFIN AND ROW	PROCEPT AUSTRALIA
AUSTRALIAN MEDICAL COUCHES	GRIFOLS AUSTRALIA PTY LTD	PROPANC
AUSTRALIAN NATIONAL FABRICATION FACILITY LIMITED*	GRUNBIOTICS PTY LTD	PROPHARMA PTY LTD
AUSTRALIAN NUTRITION & SPORTS PTY LTD	GRUNENTHAL AUSTRALIA PTY LTD	PROSLAB DENTAL LABORATORY PTY LTD
AUSTRALIAN ORGANIC BRANDS PTY LTD	GYTECH SCIENTIFIC	PROSPORTS NUTRITION
AUSTRALIAN PHARMACEUTICAL MANUFACTURERS PTY LTD	H.W. WOODS PROPRIETARY LIMITED	PROSTATE DIAGNOSTICS
AUSTRALIAN STEM CELL CENTRE*	HACH PACIFIC PTY LTD	PROSTHEXIS PTY LTD
AUSTRALIAN TISSUE ENGINEERING CENTRE (ATEC)*	HAEMOKINESIS	PROTEGO MEDICAL PTY LTD
AUSTRALIAN ULTRA VIOLET SERVICES OPERATIONS	HANDEL & SONS PTY LTD	PRV ENTERPRISES PTY LTD
AUSTRAMEDEX VICTORIA PTY LTD	HAPLOMIC TECHNOLOGIES PTY LTD	PULMOSONIX PTY LTD
AVEXA LTD	HATCHTECH	PURE C.D.M PTY LTD
AVIPEP PTY LTD	HC PRO	PUREMEDIC PTY LTD
AXISHEALTH PTY LTD	HE TECHNICAL SERVICES	PX BIOSOLUTIONS
AXPO PTY LTD	HEALTH IQ	Q STAT PTY LTD
AXXIN PTY LTD	HEALTH MANAGEMENT SYSTEMS PTY LTD	Q-SERA PTY LTD
BACE THERAPEUTICS	HEALTHCARE LIFTING SPECIALISTS	QIAGEN PTY LTD
BAKER HEART RESEARCH INSTITUTE*	HEALTHKIT	QUANTUM PHARMACEUTICALS
BAKER IDI HEART AND DIABETES INSTITUTE*	HEALTHMETRICS	QUBIST MOLECULAR DESIGN PTY LTD
BALDWIN MEDICAL & VETERINARY DEVICES	HEALTHRFID	QUIESCO PTY LTD
BALTECH PTY LTD	HEART SMART DIAGNOSTICS	QUINN PHARMACEUTICALS
BARLIES P/L	HELENA LABORATORIES (AUSTRALIA) PTY. LTD.	QUINTAIN CONSULTING PTY LTD
BARMED PTY LTD	HEPITOPE	RACING ANALYTICAL SERVICES LTD
BARONS MEDICAL	HEPSEEVAX	RADICAL BIOTECHNOLOGY
BARRELL ENGINEERING PTY LTD	HERB DOCTOR	RADIOMETER PACIFIC PTY LTD
BASF AUSTRALIA LTD	HERMA TECHNOLOGIES PTY LTD	RAMSEY COOTE INSTRUMENTS
BAXTER LABORATORIES	HERON COSMETICS PTY LTD	RAPINI PTY LTD
BAYLY PTY LTD	HEXIMA LIMITED	RAPP AUSTRALIA PTY LTD
BEDROCAN AUSTRALIA	HI FORM AUSTRALIA PL	RATEK INSTRUMENTS PTY LTD
BELSYME PTY LTD	HODEI PTY LTD	RATIONALE SKINCARE PTY LTD

BETTA DENTAL PRODUCTS PTY LTD	HOGIES	RDDT, A VIVOPHARM COMPANY
BILLINGS LIFE*	HOPES HEALTH PRODUCTS PTY LTD	REEF PHARMACEUTICALS PTY LTD
BIO NOVA INTERNATIONAL PTY LTD	HORIZON SCIENCE PTY LTD	RESEARCH SURGICAL PTY LTD
BIO21 AUSTRALIA LTD*	HOSPIRA AUSTRALIA PTD LTD (VIC)	RESOLVINGIMAGES
BIOART DENTAL AUSTRALIA PTY LTD	HOWARD FLOREY INSTITUTE*	RFID TECH
BIOCARE HOLDINGS PTY LTD	HOWARD FLOREY INSTITUTE OF EXPERIMENTAL PHYSIOLOGY AND MEDICINE*	RHINOMED LTD
BIOCOMM SQUARE PTY LTD	HUDSON INSTITUTE*	ROBERT KLUPACS
BIOCONSULT PTY LTD	HUMAN VARIOME PROJECT INTERNATIONAL LIMITED*	ROBERT WELLER & ASSOCIATES PTY LTD
BIOSL PTY LTD	HYDRIX SERVICES PTY LTD	ROBOTRON PTY LTD
BIODEVICES INTERNATIONAL	HYPERBARIC HEALTH PTY LTD	ROFIN PTY LTD
BIODIEM LIMITED	IATIA IMAGING	ROSS COSMETICS AUSTRALIA PTY LTD
BIOLIFE SCIENCE QLD	IATIA LIMITED	ROWLOADER
BIOMEDTECH AUSTRALIA PTY LTD	IDT AUSTRALIA LIMITED	SARTORIUS AUSTRALIA PTY LTD
BIOMET VICTORIA AND TASMANIA	IKARIA AUSTRALIA PTY LTD	SCIENCE SUPPLY AUSTRALIA PTY. LIMITED
BIOMOLECULAR RESEARCH INSTITUTE	ILEXUS	SCIENTEC RESEARCH PTY LTD
BIONICS INSTITUTE*	ILLINOIS LABORATORIES PTY LTD	SCIENTEX PTY LTD
BIOPROJEX	ILLUMINA AUSTRALIA PTY LTD	SDI LIMITED
BIOREGULATORY CONSULTING PTY LTD	IM MEDICAL LIMITED	SEAGULL TECHNOLOGY PTY LTD
BIOREVIVE	IMMUNOGLOBAL GROUP PTY LTD	SECURE MY HEALTH
BIOSCIENCE MANAGERS PTY LTD	IMMURON LTD	SEDCO
BIOSCREEN AUSTRALIA	IMUGENE LTD	SEE-D4 PTY LTD
BIOSHARES	INDIGO RIDGE PTY LTD	SEERPHARMA PTY LTD
BIOSYNERGY PARTNERS	INDUSTRILEX MANUFACTURING	SELENO THERAPEUTICS PTY LTD
BIOTA HOLDINGS	INGENEUS PTY LTD	SEMACARE
BIOTA SCIENTIFIC MANAGEMENT PTY LTD	INIVAI TECHNOLOGIES PTY LTD	SEMENTIS
BIOTECH ENGINEERING PTY LTD	INR ENTERPRISES PTY LTD	SENSOLOGIX LTD
BIOTECHSMARTS PTY LTD	INTEGRA NEUROSCIENCES AUSTRALIA	SENZ ONCOLOGY PTY LTD
BIRD HEALTHCARE PTY LTD	INTELLIMEDICAL TECHNOLOGIES	SEPAL PTY LTD
BLAMEY AND SAUNDERS HEARING PTY LTD	INTELLIRAD SOLUTIONS	SEQIRUS (AUSTRALIA)
BLUECHIIP LTD	INTERNATIONAL DIABETES INSTITUTE*	SERVIER LABORATORIES (AUST) PTY LTD
BOOFHEADS HAIRCARE PTY LTD	INTERPATH PTY LTD	SGE ANALYTICAL SCIENCE
BORON MOLECULAR PTY LIMITED	INTERTEK TESTING SERVICES (AUSTRALIA) PTY. LTD.	SHARP AND SMART ENTERPRISES
BOTANI AUSTRALIA PTY LTD	INTRACEUTICALS PTY LTD	SHIU RAM
BOVOGEN BIOLOGICALS PTY LTD	INVETECH PTY LTD (VICTORIA)	SIEMENS HEALTHCARE
BOX MONITORING PTY LTD	INVITROGEN AUSTRALIA PTY LTD (ALSO TRADING AS LIFE TECHNOLOGIES)	SIENNA CANCER DIAGNOSTICS
BRENNAN AROMATICS PTY LIMITED	IONA MEDICAL PRODUCTS PTY LTD	SIGMA PHARMACEUTICALS
BRIEMAR NOMINEES PTY LTD	IPSEN	SILLIKER AUSTRALIA PTY. LTD.

BRIGGATE MEDICAL COMPANY	ISLEEP PTY LTD	SILTEX (AUSTRALIA) PTY LTD
BRISTOL MYERS SQUIBB AUSTRALIA PTY LTD	ISONEA LTD	SIMAVITA PTY LTD
BROOKER CONSULTING	ITL LIMITED	SIMPLYC
BSN MEDICAL (AUST.) PTY LTD	J A DAVEY PTY LTD	SINIUN THERAPEUTICS PTY LTD
BURNET INSTITUTE*	JAEGAR AUSTRALIA PTY LTD	SINO-EXCEL ENERGY LIMITED
BUSINESS BIOTICS GROUP	JAG PROCESS SOLUTIONS PTY LTD	SISU WELLNESS
BYS COSMETICS	JDJ BIOSERVICES PTY LTD	SKILLED MEDICAL PTY LTD
C.R. SURFACING LABORATORIES	JOMESH AUSTRALIA	SKIN HEALTH PTY LTD
C4M PHARMACEUTICALS	JOMOR HEALTHCARE	SMALL TECHNOLOGIES CLUSTER LTD
CALIBRE BIOTECHNOLOGY	KARDIATEC PTY LTD	SMART DNA PTY LTD
CALZADA LIMITED	KAYBAN PTY LTD	SMART LINK INTERNATIONAL (NESS CORPORATION PTY LTD)
CANCER THERAPEUTICS	KENELEC SCIENTIFIC PTY LTD	SMARTSTENT
CANCER THERAPEUTICS CRC PTY LTD	KENYON-SMITH LABORATORIES (AUST.) PTY LTD	SMITH AND NEPHEW PTY LTD
CANCER TRIALS AUSTRALIA*	KESEM HEALTH PTY LTD	SOCIETY OF HOSPITAL PHARMACISTS OF AUSTRALIA (SHPA)*
CANCERPROBE PTY LTD	KESTRAL COMPUTING	SOLAGRAN
CANN GROUP LIMITED	KEYSTONE HEALTHCARE SUPPLIES	SOLAGRAN
CARE ESSENTIALS PTY LTD	KIESER TRAINING AG	SOUTHERN INNOVATION INTL
CARESTREAM HEALTH AUSTRALIA PTY LTD	KINACIA	SPA ORGANICS
CARLIN MEDICAL SUPPLY PTY LTD	KINETIX MOTION PTY LTD	SPECIALISED THERAPEUTICS AUSTRALIA PTY LTD
CARON LABORATORIES PTY LTD	KINGFISHER INTERNATIONAL PTY LTD	SPECTRUM TECHNOLOGY PTY LTD
CATALENT AUSTRALIA PTY LTD.	KNIGHT PHARMACEUTICALS PTY LTD	SPHINX MILLENIUM
CATALYST THERAPEUTICS PTY LTD	KNOESIS CONSULTING PTY. LTD.	SPINIFEX PHARMACEUTICALS PTY LTD
CATAPULT GROUP INTERNATIONAL LTD	KOJA	SPINTECH OCEANIA PTY LTD
CCH PHARMA PTY LTD	KOSLEX PTY LTD	SPORTSGUARD
CEILING HOIST SOLUTIONS	KRYOCOR	SPORTSTEK PHYSICAL THERAPY SUPPLIES PTY. LTD
CELGENE AUSTRALIA PTY LTD	L&L SULLIVAN	SPOTTERS SHADES
CELL CARE AUSTRALIA PTY LTD	L.A.F. TECHNOLOGIES PTY. LTD.	ST VINCENT'S INSTITUTE*
CELL THERAPIES PTY LTD	LA CLINICA INTERNATIONAL PTY LTD	STARPHARMA HOLDINGS
CELLESTIS INTERNATIONAL PTY LTD	LA MAITRE VASCULAR	STARPHARMA PTY LTD
CELLPLEX	LAERDAL PTY. LIMITED	STARTUP HEALTHTECH PTY LTD
CELLSENSE	LARGOS SERVICES PTY LTD	STATISTICAL REVELATIONS
CENTRAL HEALTHCARE SERVICES	LEAFCANN	STELLA CONNECT
CENTRE FOR EYE RESEARCH AUSTRALIA*	LEICA BIOSYSTEMS MELBOURNE PTY LTD	STEM CELL SCIENCES (AUSTRALIA) PTY LTD
CERAMET PTY LTD	LIBERTY MEDICAL PTY LTD/HOLLISTER ANZ/DANZAC	STEP FORWARD ORTHOTICS
CERAMIC STUDIO PTY LTD	LIFE RESEARCH PTY LTD	STEPSAHEAD AUSTRALIA LTD*
CERES ONCOLOGY PTY LTD	LIFE TECHNOLOGIES AUSTRALIA	STERIHEALTH LIMITED
CERYLID BIOSCIENCES	LIMA ORTHOPAEDICS AUSTRALIA PTY LTD	STETHOCLOUD PTY LTD

CERYLID PTY LTD (NO LONGER TRADING)	LIQUID NITROGEN SERVICES	STIEFEL RESEARCH (AUSTRALIA) HOLDINGS PTY LTD
CHARLWOOD DESIGN PTY LTD	LIQUITAB SYSTEMS	STRAUMANN AUSTRALIA P/L
CHEM-HAWK PTY LTD	LIVAC PTY LTD	STRAXCORP PTY LTD
CHEMICAL ANALYSIS PTY LTD	LMA PACMED PTY LTD	STRAY FAMILY TRUST
CHEMOCOPEIA PTY LTD	LOOK3D PTY LTD	SUKIN ORGANICS
CHEMSKILL	LOVELL SURGICAL SUPPLIES	SUN PHARMA(OPIATES DIVISION) AUSTRALIA PTY LTD
CHIRON MIMOTOPES	LUDWIG INSTITUTE FOR CANCER RESEARCH (MELBOURNE TUMOUR BIOLOGY BRANCH)*	SUNSPOT PTY LTD
CIPLA AUSTRALIA PTY LTD	LYPPARD AUSTRALIA	SUPACHILL TECH
CIRCA GROUP PTY LTD	MALINDI	SURECYCLE PTY LTD
CIRCADIAN TECHNOLOGIES LIMITED	MAMMA GUARD PTY LTD	SURGICAL TISSUE ENGINEERING
CIRCINUS PHARMACEUTICALS PTY LTD	MANAGEBGL PTY LTD	SURGICLAMP PTY LTD
CK SURGITECH	MANALTO LIMITED	SWIRL TECH
CLARINOX TECHNOLOGIES	MANCINE COSMETICS PTY LTD	SWISSE WELLNESS PTY LTD
CLINUVEL PHARMACEUTICALS LIMITED	MARTIN & PLEASANCE WHOLESALE PTY. LTD.	SYMBION/SYMBION HEALTH
CNSBIO PTY LTD	MARTIN HOGAN PTY. LTD.	SYNCHROTRON LIGHT SOURCE AUSTRALIA PTY. LTD*
CNSDOSE	MARY KAY COSMETICS PTY. LTD.	SYNDET WORKS PTY LTD
COCKATOO BLUE MEDICAL PRODUCTS	MASSONS HEALTHCARE	SYNGENE
COGENTUM	MATRIX SURGICAL	SYNKINASE PTY LTD
COGNIS AUSTRALIA PTY LTD	MAXICARE PROMOTIONS	SYNTHESIS MED CHEM PTY LTD
COGSTATE LIMITED	MAYNE PHARMA GROUP LIMITED	SYNTHESIS RESEARCH
COLBAR QSR PTY LTD	MCFARLANE MEDICAL EQUIPMENT (HOLDINGS) PTY. LTD.	SYPHARMA PTY LTD
COLOPLAST PTY LTD	MCVAN INSTRUMENTS PTY. LTD.	SYRINX PHARMACEUTICALS PTY LTD
COMMERCIAL EYES	MECRX PTY LTD	TAG MEDICAL PTY. LTD.
COMPUMEDICS LIMITED	MED-CON PTY. LTD.	TECHNOLOGICAL RESOURCES
CONNECT FURNITURE	MEDADVISOR PTY LTD	TEELEOSTIN
CONNETICS AUSTRALIA	MEDELA AUSTRALIA	TELEZON LIMITED
CONNI	MEDHEALTH P/L	THE FLOREY INSTITUTE OF NEUROSCIENCE AND MENTAL HEALTH*
CONSTELLA GROUP	MEDI-DENT	THE HEARING CRC*
CONTINENTAL TRADING GROUP	MEDICAL CONCEPTS AUSTRALIA PTY. LTD.	THE PHARMACEUTICAL PLANT COMPANY P/L
CONVATEC (AUSTRALIA) PTY LIMITED	MEDICAL DEVELOPMENTS AUSTRALIA	THE SOCIAL SCIENCE
COOL MOBILITY PTY LTD	MEDICAL DEVELOPMENTS INTERNATIONAL LTD	THE TRUSTEE FOR THE COBALT DESIGN UNIT TRUST
CORAZON SYSTEMS	MEDICAL PLUS	THE WALTER AND ELIZA HALL INSTITUTE OF MEDICAL RESEARCH*
CORE PLUS	MEDICINES DEVELOPMENT LIMITED*	THERAPEUTIC INNOVATION AUSTRALIA*
CORTICAL DYNAMICS LTD	MEDIPLAS	THERAPON PTY. LTD.
CORTICAL PTY LTD	MEDIPOINT	THERMASORB PTY LTD

COSMETICO PTY LTD	MEDITRON PTY LIMITED	THERMOFISHER SCIENTIFIC AUSTRALIA
COSMEX INTERNATIONAL	MEDIX INTL	TINNITUS RESEARCH CORPORATION PTY LTD
COTTAGE LANE PTY LTD	MEDMONT INTERNATIONAL PTY LTD	TOM ORGANIC PTY LTD
CPL INNOVATIONS PTY. LTD.	MEGA LIFESCIENCES PTY LTD	TOXIKOS
CRABTREE & EVELYN AUSTRALIA	MELBOURNE BRAIN CENTRE - AUSTIN CAMPUS*	TPI ENTERPRISES LTD
CRC FOR BIOMARKER TRANSLATION	MENTAL HEALTH RESEARCH INSTITUTE*	TRAJAN HOLDINGS PTY LTD
CRC FOR BIOMEDICAL IMAGING DEVELOPMENT	MENTHOLATUM AUSTRALASIA PTY. LTD.	TRAJAN SCIENTIFIC & MEDICAL PTY LTD
CRC FOR MENTAL HEALTH LTD*	MERCK PTY LTD (VIC)	TRAN KHAI
CRESCENT HEALTHCARE	MESOBLAST LIMITED	TRENDBIO PTY LTD
CRYOLOGIC PTY LTD	META	TRIALWISE PTY LTD
CRYPTOPHARMA	METABOLIC PHARMACEUTICALS LIMITED	TROBIO PTY LTD
CSL BEHRING (AUSTRALIA) PTY LTD	METRON MEDICAL AUSTRALIA PTY LTD	TS INNOVATIONS PTY LTD
CSL LIMITED	MICRO-X PTY LTD	ULTRA MIX (AUST) PTY LTD
CYCLOTEK (AUST) PTY LTD	MICROGENETIX PTY LTD	ULTRALIFT AUSTRALIA
CYLITE PTY LTD	MIHOPHARM PTY LTD	ULTRAMIX PTY LTD
CYNATA THERAPEUTICS LIMITED	MILK & CO PTY LTD	UNITED PACIFIC INDUSTRIES
CYTENTIA PTY LTD	MILLENNIUM SCIENCE PTY LTD	UNIVERSAL BIOSENSORS PTY LTD
CYTOMATRIX PTY. LTD.	MIMOTOPES	UROTECH
CYTOPIA	MINIFAB (AUST) PTY LTD	USPA GLOBAL PTY LTD
DANIELS CORPORATION INTERNATIONAL PTY LTD	MINWA (AUST) PTY LTD	UTT BIOPHARMA
DAVIES & MOLLER	MIRRM PTY LTD	V-KARDIA PTY LTD
DE SOUTTER MEDICAL AUSTRALIA PTY LTD	MITCHELL CLINICAL CONSULTING PTY LTD	V2V PTY LTD
DEFRIES INDUSTRIES PTY LTD	MOBILE HEALTH SOLUTIONS	VAISALA PTY LTD
DEJOUR SANITARY PRODUCTS PTY LTD	MONASH HERBAL PHARMACEUTICALS PTY. LTD.	VEGENICS
DENDY PHARMACEUTICALS PTY LTD	MONASH INSTITUTE OF MEDICAL RESEARCH (MIMR)*	VELACOR THERAPEUTICS
DENTA-MED TECHNOLOGY AUSTRALIA PTY LTD	MONASH IVF PTY LTD	VERVA PHARMACEUTICALS LTD
DENTIST IN A BOX	MONSANTO AUSTRALIA LIMITED	VETOMED HOSPITAL PRODUCTS
DENTSPLY (AUSTRALIA) PTY. LTD.	MONTASER	VICTORIAN CANCER BIOBANK*
DENYERS PTY LTD	MONTECH MEDICAL DEVELOPMENTS	VICTORIAN LASER & SKIN CLINIC PTY LTD
DHILLON JONES	MOONTIDE PTY LTD	VIIV HEALTHCARE
DIAGNOSTIC ARRAY SYSTEMS	MOTION.3D PTY LTD	VISION SYSTEMS ENGINEERING PTY LTD
DIAGNOSTIC SOLUTIONS PTY LTD	MTMM PTY LTD	VITA LIFE SCIENCES LTD
DIAGNOSTICA STAGO PTY LTD	MURANEX PTY LTD	VITAL DIAGNOSTICS (MANUFACTURING) PTY LTD
DIAGNOTECH	MURDOCH CHILDRENS RESEARCH INSTITUTE*	VITAL RESOURCES PTY LTD
DNA SOLUTIONS PTY. LTD.	MURIGEN	VITALITY DEVICES PTY LTD
DORSAVI PTY LTD	MYCROLAB DIAGNOSTICS	VITAMIN ME

DOW CHEMICAL (AUSTRALIA) LTD - VIC	MYOSTIN THERAPEUTICS PTY LTD	VITAMINHAUS PTY LTD
DOWARD INTERNATIONAL PTY LTD	NARHEX LIFE SCIENCES LIMITED	VOLKER AUSTRALIA PTY LTD
DR RAJ MADAM INC	NATIONAL AGEING RESEARCH INSTITUTE*	WARANA ADAPPTIONS PTY LTD
DRAEGER MEDICAL AUSTRALIA PTY LTD	NATURAL BEAUTY CARE	WARNER & WEBSTER PTY LTD
DRAGER AUSTRALIA	NATURAL PHARMACEUTICAL LABORATORY PTY LTD	WAVE BIOTECH PTY LTD
DRAWBRIDGE PHARMACEUTICALS PTY LTD	NATURAL WORLD OF ALOE VERA	WESTLAB PTY LTD
EASYSURE TECHNOLOGIES PTY LTD	NATURES ORGANICS PTY LTD	WHOLESOME BIOPHARM
ECHIDNA SURGICAL SOLUTIONS PTY LTD	NCOUNTERS AUSTRALIA	WIDEX AUSTRALIA
ECO-SAFE	NEO-NATURALS PTY LTD	WOLFSON DYNAMIC HEARING
EGO PHARMACEUTICALS PTY LTD	NEON COSMETICS PTY LTD	XENO TRANS LIMITED
EIKONIC R&D PTY LTD	NEOPEC	XERION LIMITED
EIMERIA	NEOSPHINCTER TECHNOLOGIES PTY LTD	ZENA PHARM PTY LTD
EISNER AUSTRALIA	NEUPROTECT	ZENYTH OPERATIONS

Appendix C: Note on Business Longitudinal Analytical Data Environment

These estimates have been compiled using Business Activity Statement (BAS) and Business Income Tax (BIT) data supplied to the Australian Bureau of Statistics (ABS) by the Australian Tax Office (ATO).

Complex business structures where a Type of activity unit (TAU) is created for business entities within an enterprise group may not be accurately represented in this data. Some TAUs have multiple ABNs and at the individual ABN level, the ANZSIC classes may be different to the TAU. This is not accounted for in these data. Please note that the ANZSIC classes in the BAS and BIT data are based on self-coding. The estimates should therefore be treated as experimental.

In some cases, BAS data may be partially missing for an individual business (for example, data may be available for three out of four quarters). In other instances, BAS data may be complete but BIT data are missing (and vice versa). No imputation is applied for missing data.

Users should take into consideration that any discussion of the data limitations or weaknesses is in the context of using the data for statistical purposes, and is not related to the ability of the data to support the ATO's core operational requirements.

Users should also be aware that there are specific reporting requirements for businesses with 'Pay As You Go' withholding payments. These requirements may affect values for wages and salaries shown in BAS data

Refer to the ATO website (www.ato.gov.au) for more information about BAS and BIT reporting requirements.

Appendix D: Supply Chain Analysis

The purpose of this appendix is to detail the method used for the supply chain analysis. The estimates reported here are based on the assumption that the supply chain of the Sector is similar to the supply chain of other firms in the same ANZSIC group. That is, we assume that the structure of purchases of intermediate goods by the average firm in the ANZSICs that make up the Sector is representative of the structure of purchases by firms in the Sector.

Input-output tables created by the Australian Bureau of Statistics and document the relationships between Australian industries in terms of flows of intermediate inputs. That is, the tables show the dollar value of the intermediate goods produced by each industry and used by each industry. To determine the upstream effect of the Sector we have derived an input-output table for the Sector.

Our approach consists of three steps:

1. Calculate the input shares each supplying industry provides to each of the using industries. That is, convert the dollar value of flows of intermediate goods to input shares.
2. Take the weighted average input share across all using industries that are represented by the Sector. The weights reflect the using industry's contribution to the top 11 ANZSICs that make up the Sector.
3. Multiply the input shares by total operating expenditure calculated previously (\$10.5 billion).

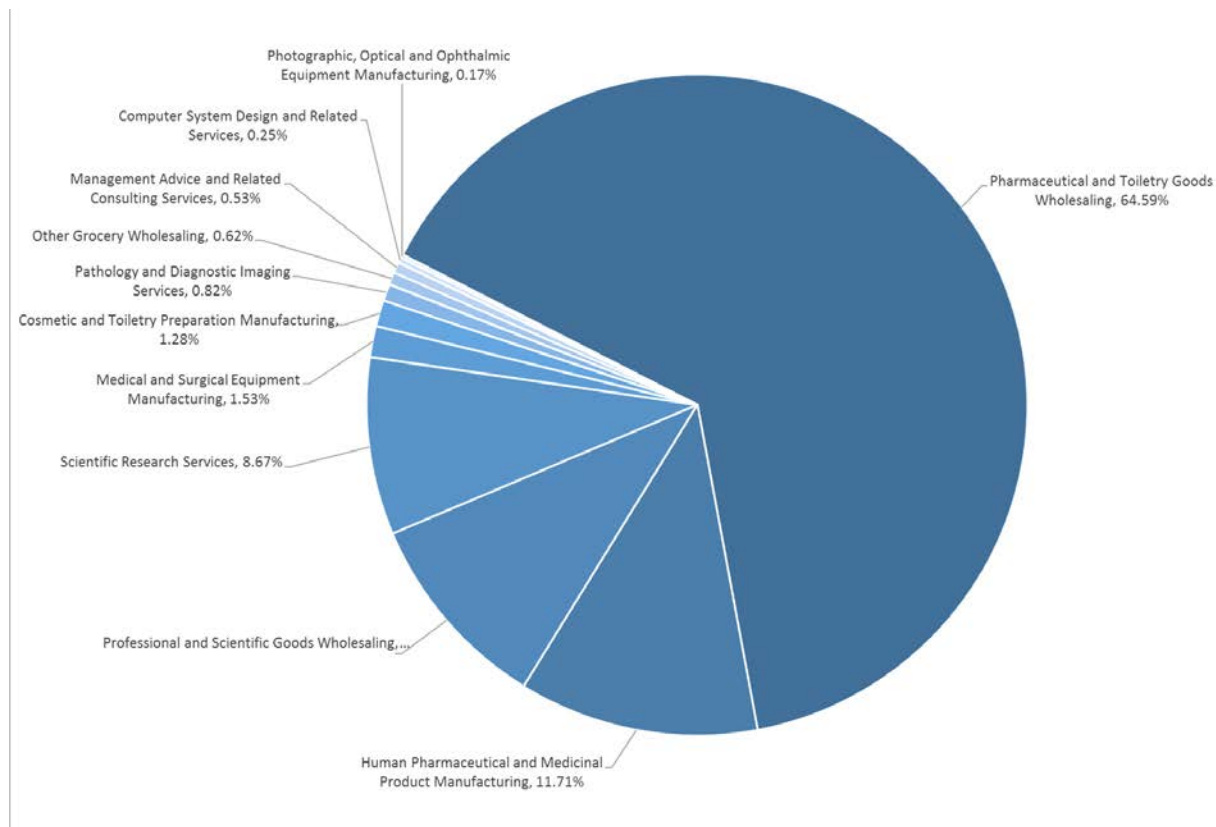
We rely on ABS to determine the industry composition of the Sector.³⁷ The distribution of these ANZSIC codes provide the industry breakdown used for the supply chain analysis. There are 108 ANZSIC codes represented in the 794 firms that make up the Sector. A small number of firms represents the majority of these ANZSICs. In order to prevent the identification of individual firms, operating expenditure data for these ANZSICs are suppressed. Data are available for 11 ANZSICs with over 10 contributors to the Sector.³⁸ Together these account for over 80 per cent of Sector operating expenditure. We base the representative group on these 11 ANZSIC. These 11 ANZSIC groups are:

1. 3720 - Pharmaceutical and Toiletry Goods Wholesaling
2. 1841 - Human Pharmaceutical and Medicinal Product Manufacturing
3. 3491 - Professional and Scientific Goods Wholesaling
4. 6910 - Scientific Research Services
5. 2412 - Medical and Surgical Equipment Manufacturing

6. 1852 - Cosmetic and Toiletry Preparation Manufacturing
7. 8520 - Pathology and Diagnostic Imaging Services
8. 3609 - Other Grocery Wholesaling
9. 6962 - Management Advice and Related Consulting Services
10. 7000 - Computer System Design and Related Services
11. 2411 - Photographic, Optical and Ophthalmic Equipment Manufacturing

The distribution of the operating expenditure in the Sector that can be assigned to these 11 ANZICs is shown in Figure C6. The four largest ANZICs are responsible for over 90 per cent of operating expenditure in the Sector. These shares are used to determine the upstream effect on the Victorian economy based on total Sector operating expenditure in 2013-14.

Figure C6: Share of 2013-14 Sector Operating Expenditure. Leading 11 ANZSIC, (%)



Input – Output tables are not calculated at the four-digit ANZSIC level. Instead, Input Output Industry Groups (industry groups) are used to represent the different sectors of the Australian economy. While some of these groups correspond to single ANZSIC classes, a one-to-one mapping is not always possible. To maintain comparability between current and previously published input-output tables, it is often the

case that similar ANZSICs are grouped within one industry group. The top 11 ANZSIC contributors to the Sector map to seven industry groups.³⁹ These are,

1. 3301 - Wholesale Trade
2. 1801 - Human Pharmaceutical and Medicinal Product Manufacturing
3. 6901 - Professional, Scientific and Technical Services
4. 2401 - Professional, Scientific, Computer and Electronic Equipment Manufacturing
5. 1804 - Cleaning Compounds and Toiletry Preparation Manufacturing
6. 8401 - Health Care Services
7. 7001 - Computer Systems Design and Related Services

For those industry groups with more than one ANZSIC code, the shares of total operating expenses are summed. The result is seven weights that allocate Sector operating expenditure across seven industry groups. Weights are set to zero for the remaining industry groups not represented in the Sector.

Calculating the input shares

Input-Output tables created by the Australian Bureau of Statistics document the relationships between Australian industries in terms of flows of intermediate inputs. Each column of the input-output table corresponds to a using industry group. The rows of the input-output table show the supplying industry group. Each cell then shows the total use of the row industry group by the column industry group, expressed in basic prices.⁴⁰ Imports are also included in the input-output table. Summing down the column gives the total intermediate inputs of the using industry group. For each of the seven industry groups that define the Sector, the relative importance of each row industry group is calculated.⁴¹

The scaled columns (which reflect the share) are multiplied by the using industry group share of operating expenditure. For those using industry groups not represented in the Sector, the weight is set to zero. Multiplying the input-output table by these weights gives the relative importance of each using industry group to the seven using industry groups that make up the Sector. Each row total is the share of the Sectors intermediates inputs from that supplying industry group, conveying its' importance to the Sector.

Supplying industry groups are aggregated to the ANZSIC Division level to allow for a broader interpretation of the Sectors upstream impact. Multiplying the Division shares by the total operating expenditure of \$10.5 billion, results in Figure 4 (see main report).

Caveats & Assumptions

It should be noted that these estimates are based on number of assumptions. First, we assume that the top 11 ANZSIC codes are representative of the Sector as a whole. These accounts for 80 per cent of Sector operating expenditure. Data constraints prevent us from mapping the remaining 20 per cent of Sector operating expenditure to the remaining 97 ANZSIC codes. The fact that such a large number of ANZSICs are responsible for this small a share of operating expenditure suggests this distortion should be minimal.

Second, we assume that the firms that make up the 11 ANZSIC codes considered have the same supply chains as the typical firm in their ANZSIC. That is, a firm in the Sector with ANZSIC code *1841 – Human Pharmaceutical and Medicinal Product Manufacturing* is supplied by the typical firm in this ANZSIC. If they do not, the input-output table will not accurately reflect the input structure of the Sector, regardless of the weights used. Without additional information about the firms in the Sector and their operating expenditure, this approach is the best available.

Third, we assume that the sectoral composition of national supply chains is representative for Victorian firms. Input-Output tables presented by the ABS are calculated for the Australian economy. There is no strong a priori case that supply chains in Victoria should be markedly different than Australian supply chains.

Fourth, in measuring the flow-on effects of the Sector, we do not include any purchases of intermediate goods from firms in the same product groups. This would reflect a form of double counting if intermediate goods are purchased from other firms in the Sector, since their value added is already included in direct effects. However, if the intermediate goods are purchased from firms outside the Sector this does in fact represent additional contribution to demand in the Sector (and therefore State Product). It is very likely that some component of *Within Sector* operating expenditure reflect flow on effects to the rest of the economy. That is, Sector flow on effects have been underestimated to the extent that intermediate inputs used by firms in the Sector list are purchased from firms in the same industry groups although not in the Sector.

Finally, the measures of industry importance closely resemble ‘Direct Effect Coefficients’ that are published by the ABS. These coefficients only take into account for the direct impact on other industries for a given increase in one industries output. What is not considered is the following flow effects that occur after this direct impact. The focus on the direct impact here allows for a clear interpretation of the flow on effects of the Sector on the Victorian economy. The reader is reminded that the flow on effects

of the Sector do not stop here. Spending on each of the industry groups represented has further flow on effects on the Victorian economy.

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- ¹ Note the authors do not have direct access to unit record data about these firms.
- ² Victoria, I. (2016) *Victoria's future industries strategy - a jobs and economic growth plan - invest Victoria*. Available at: <http://www.invest.vic.gov.au/news-and-events/2016/mar/victorias-future-industries-strategy-a-jobs-and-economic-growth-plan> (Accessed: 15 January 2017).
- ³ Athukorala, P., Talgaswatta, T., Majeed, O., (2016), *Global Production Sharing and Australian Manufacturing, Canberra: Department of Industry Science and Innovation (forthcoming)*.
- ⁴ CTI derived from PATSTAT 2015
- ⁵ Australian Bureau of Statistics (2015) *Australian Industry, 2013-14*, 'Table 2 Manufacturing industry by States and territories by ANZSIC subdivision', time series spreadsheet, cat no. 8155.0, Available at: www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/8155.02013-14?OpenDocument, (Accessed: 3 October 2016)
- ⁶ Only firms who list their main state of operation as Victoria are considered for this analysis. See Appendix A for more detail.
- ⁷ Specifically, turnover is sourced from the BAS field Total sales (G1), covering all sales made by the firm. This includes those exempt from GST such as Export Sales (G2) and Other GST-free sales (G3).
- ⁸ Our measure of operating expenses is populated from Non-capital purchases (G11) on the BAS. It includes all business purchases not reported as capital expenditure. This figure does not include salary and wage payments made by the firm.
- ⁹ Unless otherwise stated, all dollar amounts are in Australian dollars.
- ¹⁰ Headcount reflects persons employed over the course of a financial year. FTE employment data are modelled (by the ABS) based on headcount and the aggregate of wages earned by that headcount. In this way, FTE accounts for multiple individuals filling the same job over the course of the year.
- ¹¹ Derived from ABS BLADE data
- ¹² Derived from ABS BLADE data
- ¹³ DFAT (2016) *Australia's trade by state and territory*. Available at: <http://dfat.gov.au/about-us/publications/Pages/australia-s-trade-by-state-and-territory.aspx> (Accessed: 3 October 2016)
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- ¹⁵ The ANZSIC system has four levels. Divisions are the broadest level.
- ¹⁶ Invetech (2016) *Critical care whole blood analysis instrument — point of care — Invetech*. Available at: www.invetech.com.au/portfolio/point-of-care/critical-care-whole-blood-analysis-instrument (Accessed: 20 October 2016).
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- ²¹ MRCF (2016) *About us*. Available at: www.mrcf.com.au/about-us (Accessed: 10 November 2016).
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- ²³ SBS (2015) *\$500m life sciences fund set to launch*. Available at: <http://www.sbs.com.au/news/article/2016/12/13/500m-life-sciences-fund-set-launch> (Accessed: 20 January 2017)
- ²⁴ MRCF (2016) *Brandon Capital to lead Biomedical Translation Fund Consortium in government initiative to make Australia a global leader in life science research commercialisation*. Available at:

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²⁵ ARC (2014) *Linkage program*. Available at: <http://www.arc.gov.au/linkage-program> (Accessed: 1 November 2016).

²⁶ ARC (2014) *Grants Dataset*. Available at: <http://www.arc.gov.au/grants-dataset> (Accessed: 1 December 2016).

²⁷ CSL (2016) *CSL Limited Annual Report 2015-2016*. Available at:

http://www.csl.com.au/docs/527/647/CSL_AR16_Sec,0.pdf (Accessed: 5 January 2017)

²⁸ Ibid.

²⁹ Australian Taxation Office (2013), *GST – completing your activity statement*. (Accessed: 10th January 2017)

³⁰ Victorian State Government, (2016), *Getting it done – Victorian Budget 16/17, Service Delivery, Budget Paper No. 3*, (Accessed: 3 November 2016)

³¹ Victorian Government Department of Economic Development, Jobs, Transport & Resources (2016) *Medical Technologies and Pharmaceuticals – Sector Strategy*, Available at: www.dtf.vic.gov.au/State-Budget/2015-16-State-Budget/Service-Delivery (Accessed: 3 November 2016)

³² Victorian State Government, (2016), *Getting it done – Victorian Budget 16/17, Service Delivery, Budget Paper No. 3*, (Accessed: 3 November 2016)

³³ Ibid.

³⁴ ABR (2014) ABN lookup. Available at: <http://abr.business.gov.au/> (Accessed: 10 August 2016).

³⁵ Schmoch, U. (2008). Concept of a technology classification for country comparisons. *Final report to the world intellectual property organisation (WIPO)*, WIPO.

³⁶ Organisation types considered relevant are; Australian dedicated biotechnology firms; Australian public research organisation; Australian other biotech company, including CROs, lab equipment and; Australian pharmaceutical company.

³⁷ The ANZSIC for each ABN is not published on the Australian Business Register though the Department provided list contains partial ANZSIC information. The ABS is able to provide a count of the ANZSICs represented in the Sector where this count is large enough not to identify individual firms.

³⁸ Data for those ANZSICs with less than 10 contributors are suppressed.

³⁹ The concordance used is IOIOG – ANZSIC06.

⁴⁰ Amount received by the producer from the purchaser for a unit of a good or service, minus any tax payable, plus any subsidy receivable. Note that basic prices used by I-O tables include transport charges.

⁴¹ Each row entry is divided by the column total. The column now sums to 100 per cent with supplying industry groups weighted by their relative importance to the final use IOIG.