Economic Impacts of the California Institute for Regenerative Medicine (CIRM)

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Executive Summary

Introduction

The California Institute for Regenerative Medicine (CIRM) is a government agency established in 2004 to accelerate stem cell treatments to patients with unmet medical needs. CIRM has funded innovative stem cell research and its applications in California universities, research institutions, and companies that produce stem cell therapies. It is intended not only to improve the health and well-being of citizens of the state but also to help promote economic growth in California by attracting scientific talent, additional funding, and commercial enterprises as the research and development process progresses. Through the end of year 2018, it has committed more than $2.67 billion across six broad categories of grants to fund physical and institutional infrastructure, basic research, education and training, research translation, research application, and clinical trials.

This report focuses on the various economic impacts of CIRM over and above its main functions of improving health and well-being. These increases in economic output, employment and tax revenues represent valuable *co-benefits* of CIRM activities. Such benefits emanate not only from CIRM direct funding commitments but also from co-funding, partnership funding, follow-on funding, and additional leveraged funding. We quantify not only the direct impacts but also various indirect impacts as CIRM and related expenditures ripple throughout the economy. The impacts are estimated both for California and the United States as a whole.

Results

The total quantified economic impacts of CIRM on the California economy are estimated to be:

- $10.7 billion of additional gross output (sales revenue)
- $641.3 million of additional state/local tax revenues and $726.6 million of additional federal tax revenues
- 56,549 additional full-time equivalent (FTE) jobs, half of which offer salaries considerably higher than the state average
- About 50.2% of the gross output increase and 46.4% of jobs created are concentrated in medical and health related research, manufacturing, and service sectors

The total quantified economic impacts of CIRM on the economy of the rest of U.S. are estimated to be:

- $4.7 billion of additional gross output
- $198.7 million of additional state/local tax revenue and $208.6 million of additional federal tax revenues
- 25,816 additional jobs

Therefore, the total quantified economic impacts of CIRM on the entire U.S. economy are estimated to be:

- $15.4 billion of additional gross output

- $840 million of additional state/local tax revenue and $935.2 million of additional federal tax revenues
- 82,365 additional jobs
- About 38.4% of the gross output increase and 36.0% of jobs created are concentrated in medical and health related research, manufacturing, and service sectors

The quantified estimates are based on the economic stimulus created by CIRM grants, co-funding, partnership funding, leverage funding of Alpha Stem Cell Clinics, follow-on funding, and CIRM operating expenditures. Nearly half of these impacts emanate from the $2.67 billion CIRM grants themselves.

The major sectors of the California economy impacted by CIRM direct and related funding are: Scientific Research and Development Services, Health Care Services, Construction of New Nonresidential Commercial and Health Care Structures, Professional Services, and Real Estate. However, because of the strong relationships of sectors in the California economy, all sectors in the state benefit from the existence of CIRM.

In addition, a qualitative analysis was performed of further funding downstream as commercialization of CIRM research progresses. This includes venture capital, licenses, and contributions to biotechnology clusters in the state. These impacts are sizable as well.

The research team adapted the Impact Analysis for Planning (IMPLAN) Model, to perform the quantitative estimation. IMPLAN is the largest provider of regional input-output (I-O) models in the U.S. These models characterize the economy as a set of interrelated supply chains and are thus especially adept at estimating indirect impacts. Primary data on wage and salary payments associated with the spending of CIRM grants and other funding flows were obtained from the CIRM database and injected into the I-O Models for California and the U.S. IMPLAN estimates of in-state purchases from the various goods and services sectors were used in the impact analysis for California, as were additional parameters relating to taxes and employment per unit of sectoral output. Corresponding parameters at the national level were used in the impact analysis for the U.S. economy.

CIRM has led to California stem cell research and development becoming a leader among the states. In terms of economic impacts, the state's investment in CIRM has paid handsome dividends in terms of output, employment, and tax revenues for California.

Economic Impacts of the California Institute for Regenerative Medicine (CIRM)[*]

I. Introduction

The California Institute for Regenerative Medicine (CIRM) is a government agency established in 2004 to foster innovative stem cell research and its applications in the state's universities, research institutions, and companies that produce stem cell therapies. It promised not only to improve the health and well-being of citizens of the state but also to help promote economic growth in California by attracting scientific talent, additional funding, and commercial enterprises as the research and development process progressed. Through the end of year 2018 it has committed $2.67 billion across six broad categories of grants to fund physical and institutional infrastructure, basic research, education and training, research translation, research application, and clinical trials.

This report focuses on the various economic impacts of CIRM over and above its main functions of improving health and well-being. These represent valuable co-benefits of CIRM activities. Such benefits emanate not only from CIRM direct funding commitments but also from co-funding, partnership funding and additional leverage funding.

The economic impacts to be evaluated in this report include:

1. Major macroeconomic indicators of output, personal income, and employment.
2. Tax revenue impacts on local, state, and federal governments
3. Occupational impacts

We quantify not only the direct impacts of these various economic impacts but also various indirect impacts as CIRM and related expenditures ripple throughout the economy. In some cases, such as licensing arrangements and industry cluster effects, we are only able to provide a qualitative analysis.

This report does not include the estimates of the following additional benefits of CIRM: value of life saved and other direct and indirect health benefits, reduction of medical costs, and stimulus to other medical research and practice from research and technical advances stimulated by CIRM and CIRM-related expenditures. However, the long-term health and pubic benefits of CIRM funded research, innovation, and clinical trials of therapies for cancer, diabetes, eye disease, and strokes are evaluated and presented in a companion report (Goldman et al., 2019).

Note that the analysis in the final report is limited to CIRM expenditure commitments and various related expenditures through the end of calendar year 2018. It represents an update and expansion of previous reports by the Berkeley Research Group (Alberro, 2011, 2012). Studies of stem cell research institutions and spending in other states were also reviewed in the preparation of this report.

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This report is divided into six sections. In the next section, we first provide a brief overview of the different types of CIRM-related funding/expenditure categories, and summarize the relationships of these funding streams. In Section III, we present an overview of the input-output model and key concepts in its application. Section IV presents the aggregate and sectoral impacts of each individual type of CIRM-related funding or expenditure on the California economy and the U.S. economy as a whole. The occupational impacts of CIRM are presented in Section V. Section VI presents a summary and conclusions.

II. Summary of Types of CIRM-Related Funding and Expenditures

A. CIRM Grants

CIRM grants can be categorized into six broad programs: Infrastructure, Discovery, Education, Translational, Translational & Clinical, and Clinical. According to CIRM (2018a), these programs are defined as the following:

Infrastructure Programs are designed to fund the constructions of new research buildings and laboratories, and the establishment of research and clinic development resources.

Discovery Programs are designed to "support exploratory research leading to the discovery of novel stem cell technologies to improve patient care."

Education Programs provide funding to support trainings, conferences, symposiums, and other stem cell educational outreach efforts.

Translational Programs are designed to "support promising stem cell-based projects that accelerate completion of translational stage activities necessary for advancement to clinical study."

Clinical Programs are intended to "speed up support for clinical stage candidate stem cell treatments that demonstrate scientific excellence." Funding is provided to support "eligible projects that are completing late stage preclinical development through any stage of clinical trial activity."

Table 1 presents the distribution of the CIRM grants across the six program categories for each year from 2006 to 2023. The numbers represent CIRM funding (paid or scheduled to be paid) that was committed by the end of year 2018, which amounted to more than $2.67 billion. The pie chart in Figure 1 indicates that since 2006, 36% of CIRM grants were used to support Discovery projects, 21% were for construction of new research infrastructures, 9% for educational purposes, and the remaining were for Translational and Clinical projects. Many of the larger Infrastructure grants were awarded before 2010. The relatively very large spending on infrastructure in 2008 is due to the fact that 10 out of CIRM's 12 Major Facilities awards were launched that year. Table 1 also shows the general trend of increasing CIRM grants in the Translation and Clinical programs but decreasing expenditures on Infrastructure and Discovery programs in recent years.

Table 1. Distribution of CIRM Grants by Program by Year (in millions of 2017$)[a]

Year	Infrastructure	Discovery	Education	Translation	Translation & Clinical[b]	Clinical	Total
2006	0.0	0.0	13.9	0.0	0.0	0.0	13.9
2007	1.4	40.7	13.1	0.0	0.0	0.0	55.1
2008	234.4	47.0	8.1	0.0	0.8	0.0	290.4
2009	65.0	58.8	9.3	0.0	0.0	0.0	133.1
2010	17.2	103.4	24.6	0.0	56.2	0.0	201.5
2011	18.6	121.6	24.9	0.0	61.0	6.9	233.0
2012	25.1	103.6	24.2	0.0	55.1	0.0	208.0
2013	12.8	119.2	25.4	0.0	70.4	2.9	230.7
2014	22.2	93.8	23.7	0.0	59.9	9.1	208.7
2015	24.2	77.3	15.0	6.1	42.1	28.8	193.6
2016	25.4	53.0	9.9	24.4	37.0	35.0	184.6
2017	23.6	41.3	9.1	26.7	16.5	99.7	216.9
2018	30.8	36.1	9.2	18.6	19.5	111.8	226.0
2019	10.6	24.4	8.8	16.9	5.3	93.4	159.4
2020	8.7	8.9	7.9	9.8	0.5	46.9	82.6
2021	4.2	1.1	3.4	1.2	0.0	18.4	28.3
2022	0.0	0.0	0.6	0.0	0.2	1.2	2.1
2023	0.0	0.0	0.1	0.0	0.0	1.2	1.2
Total	**524.2**	**930.2**	**231.1**	**103.7**	**424.7**	**455.4**	**2,669.3**

[a] This table includes committed CIRM funding as of December 2018. The numbers represent CIRM grants paid and scheduled to be paid across the six program categories.
[b] This category of grants are the CIRM Disease Team Research Awards, which covers both Translation and Clinical projects.

Source: CIRM (2018b).

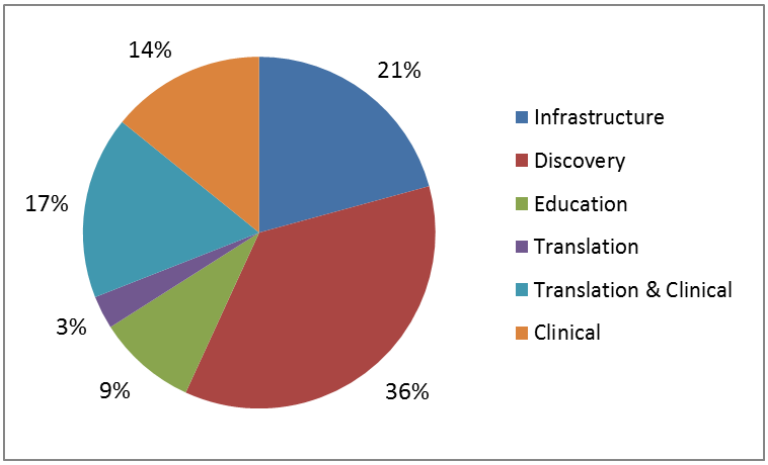


Figure 1. Distribution of CIRM Grants across Six Programs

Source: CIRM (2018b).

B. Co-Funding

Co-funding (or matching funding) refers to the funds that were specifically committed by the CIRM grant awardees to supplement a CIRM project. This can range from 10% to 100%. Table 2 presents the distribution of the co-funding to the main CIRM grants across the six program categories for each year from 2006 to 2023. The numbers represent co-funding (paid or scheduled to be paid) that was committed by the end of year 2018, which amounted to nearly $1 billion. The pie chart in Figure 2 indicates that since 2006, about 53% of the co-funding was for infrastructure projects and 41% was for Translation & Clinical and Clinical projects. Less than 5% of the co-funding went to Discovery and Education projects. Again, over 80% of the Infrastructure co-funding took place in 2008 because of the 10 CIRM Major Facilities awards launched that year.

Table 2. Distribution of Co-funding by Program by Year (in millions of 2017$)[a]

Year	Infrastructure	Discovery	Education	Translation	Translation & Clinical	Clinical	Total
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.00
2007	0.3	0.0	0.0	0.0	0.0	0.0	0.26
2008	430.4	0.0	0.0	0.0	0.0	0.0	430.40
2009	58.2	0.7	0.4	0.0	0.0	0.0	59.34
2010	3.0	1.5	0.3	0.0	11.0	0.0	15.79
2011	6.5	3.0	1.1	0.0	11.8	0.0	22.44
2012	12.3	3.9	0.7	0.0	13.3	0.0	30.19
2013	2.7	6.1	1.3	0.0	23.1	9.2	42.41
2014	0.0	5.3	2.3	0.0	23.3	27.6	58.47
2015	2.8	4.6	0.9	1.3	5.1	68.0	82.73
2016	3.1	3.2	0.6	4.6	4.6	25.7	41.91
2017	3.2	2.1	0.3	3.6	0.6	67.2	77.03
2018	3.3	1.3	0.0	1.1	0.5	54.1	60.26
2019	1.6	0.7	0.0	1.0	0.0	39.8	43.02
2020	1.5	0.2	0.0	0.1	0.0	23.0	24.81
2021	0.0	0.0	0.0	0.0	0.0	7.6	7.64
2022	0.0	0.0	0.0	0.0	0.0	0.3	0.26
2023	0.0	0.0	0.0	0.0	0.0	0.5	0.48
Total	**529.0**	**32.5**	**8.0**	**11.8**	**93.2**	**323.0**	**997.5**

[a]This table includes committed co-funding to CIRM grants as of December 2018. The numbers represent CIRM grants paid and scheduled to be paid across the six program categories.
Source: CIRM (2018b).

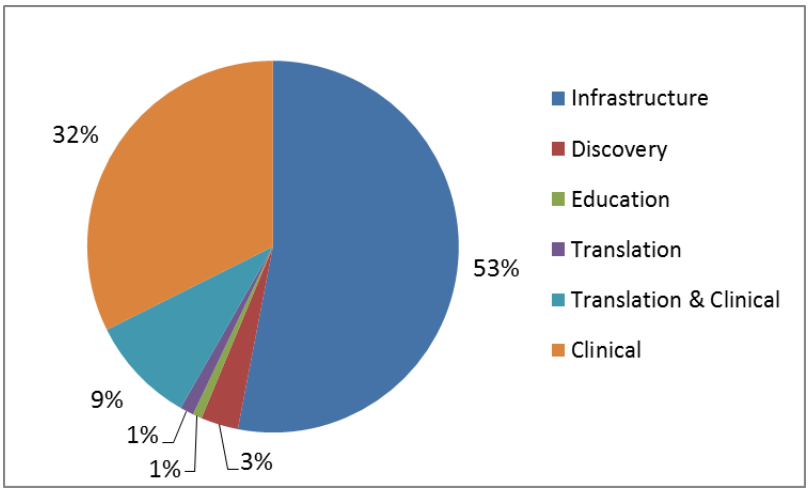


Figure 2. Distribution of Co-Funding across Six Programs

Source: CIRM (2018b).

C. Partnership Funding

The CIRM grant awardees have also been successful in attracting funding from private sectors (including strategic partners or investors). The intent of CIRM grants is to fund the development of stem cell-based treatments through especially risky phases of the projects. These encompass the preclinical development and early clinical development activities, which are essential for commercialization of a novel therapy, but are not generally funded by federal agencies and are often too risky for industry investment. The partnership funding that is tracked by CIRM is the specific amount of industry investment, in the form of equity investments, strategic partnerships, and mergers and acquisitions (M&A), that CIRM grantees have attracted to support further development and commercialization of their therapeutic candidates. Between 2015 and 2018, $1.64 billion (in 2017 dollars) in partnership funding was generated (see Table 3).

Table 3. Partnership Funding
(in million 2017$)

Disease Area	Industry Partner / Investors	Amount
Diabetes	Bain Capital, TPG, RA Capital Management	79.4
ADA-SCID	IPO	223.9
Advanced Solid Tumors	Public Offering	142.8
Diabetes	Gore	9.9
Diabetes	CRISPR Therapeutics	24.8
ADA-SCID	Deerfield, RA Capital Management, Venrock	148.9

Kidney failure	Fresenius	148.9
AML & Colon Cancer	IPO	112.2
AML	ARCH, 5AM, Celgene, Fidelity	55.6
Multiple Myeloma	Vivo, Longitude, Tavistock	30.3
Kidney failure	"equity from 29 investors"	74.5
ADA-SCID	F-Prime, ORI Capital, Cowen	110.0
AML & Colon Cancer	Wellington, Clarus, Lightspeed, GV	75.0
HIV/AIDS	CSL Behring	91.0
CLL	Oncternal, Inc.	18.4
Glioma	Mustang Bio	94.5
Cardiac	Tenaya Therapeutics	50.7
ADA-SCID	Orchard Therapeutics	28.2
AML	Forty Seven, Inc.	76.0
Neurological disorders	Neurona Therapeutics, Inc.	24.0
Bone healing	Ankasa Regenerative Therapeutics	17.3
Total		**1,636.42**

Source: CIRM (2018b).

D. Leverage Funding of Alpha Stem Cell Clinics

Leverage funding through clinical trial agreements were obtained by CIRM grant recipients to conduct non-CIRM funded clinical trials within the Alpha Stem Cell Clinics (ASCC) Network. By the end of 2017, ASCC network reports clinical trial agreements from non-CIRM-funded sponsors totaling $13,552,913 (CIRM, 2018d).[1]

E. Follow-on Funding

CIRM conducted follow-up surveys to the CIRM award Principal Investigators on any subsequent grants and awards they obtained as a result of CIRM funded research. The survey data provide information on the award amount, start date, duration, funding agency, etc. of these non-CIMR awards. Through the end of 2018, the total amount of follow-on funding successfully obtained by the CIRM award PIs is $317.6 million.

F. CIRM Administrative Expenditures

We also analyze the economic impacts stemming from the operation of CIRM itself. The operating expenses (including expenditures on external services, facilities, equipment, supplies, etc.) by the agency generate ordinary demand-side multiplier effects. Furthermore, the spending of wages and salaries by CIRM employees on consumer goods and services generates induced effects throughout the economy. Total employee compensations (including both wages/salaries and benefits) between 2005 and 2017

[1] We do not include the economic impacts on California stemming from the expenditures incurred by the 93 out-of-state patients in our analysis because of lack of data.

were $102.6 million (in 2017$). Total operating expenses were $66.1 million during the same period (CIRM, 2018e).

G. Deal Flow Funding

In Section C, we presented the dollar amounts of equity investment, funding rounds, and initial public offerings that have been attracted by CIRM grantees and categorized as "Partnership Funding" by CIRM. Those funding streams have detailed funding information by partnership event, and are included in the economic impact analysis in Section IV. In this section, we summarize additional deal-flow funding and industry investment that has not been included in the "Partnership Funding" analysis.

The preclinical and clinical development and commercialization of novel therapies requires significant capital investment. The typical development pathway for novel therapies involves several stages:

1) It starts with discovery of a candidate in laboratory and animal studies.
2) This is followed by early translational development that establishes additional preclinical proof of concept and develops manufacturing processes leading to a Pre-Investigation New Drug (pre-IND) meeting with the FDA.
3) The pre-IND meeting informs the necessary preclinical R&D activities that will enable IND filing and clinical trial initiation. These IND-enabling activities include definitive preclinical safety and efficacy studies, as well as manufacturing and analytical process development.
4) Upon IND clearance, the program shifts to the clinical stage, which involves several clinical trials to establish safety and efficacy in the target patient population. It will also establish Good Manufacturing Practice (GMP) and manufacturing capabilities for the therapeutic product.
5) This is followed by submission to the FDA for marketing approval and then commercial sales of the product.

Deal flow provides additional funding for similar purposes as partnership funding as described in Section C. Deal-flow funding usually involves several waves or rounds of capital infusion over many years, and thus it is expected that CIRM's past and current funding will attract increasing amounts of industry investment and lead to additional spending injections into the California economy in the years to come.

The "deal-flow" funding discussed in this section includes funding unrelated to basic or applied research, but rather funding toward product commercialization. This includes:

- Private and public equity investment
- Strategic partnerships
- License agreements
- Mergers & acquisitions (M&A)

Most stem cell applications involve personalized (autologous) treatment that, thus far, inhibits mass production. It also thus requires a greater role for doctors and hospitals in dispensing the treatments. Moreover, there have been advances in more generally applicable (allogeneic) therapies as well as platform technologies that encompass several viral vectors simultaneously, representing major advances in this field (Naso et al., 2017). However, there still remain significant regulatory, reimbursement and manufacturing risks associated with stem cell research.

While there are challenges with the development of stem cell-based therapies, there has been a substantial increase in recent private investment, public market investment and biopharma investment in this sector (ARM, 2018).[2] Globally, the regenerative medicine and advanced therapies industry experienced significant growth in recent years. Throughout 2018, global financings (which include IPOs, Follow-Ons, Corporate Partnerships, Venture Capital, and Private Placements) in this industry were $13.3 billion, or a 73% increase from 2017. In addition, the total value of Mergers and Acquisitions in 2018 reached $18.9 billion, or a 40% increase from 2017 (ARM, 2019).
There have been several recent high-value (in the billions of dollars range) acquisitions in the regenerative medicine industry by biotech and pharmaceutical companies. Some examples include:

- Kite Pharma acquisition by Gilead for $11.9B in Aug 2017
- Juno Therapeutics acquisition by Celgene for $9B in Jan 2018
- Avexis acquisition by Novartis for $8.7B in Apr 2018
- Pending Spark acquisition by Roche for $4.8B in Feb 2019

The significant investment in R&D in regenerative medicine has led to recent milestone regulatory approvals and commercialization of cell and gene therapies. Some of these therapies have begun to generate revenue as listed below:

Novartis - **Kymriah**
Revenue 2017: FDA approved Kymriah use, no revenue data found (Novartis, 2018a)
Revenue 2018: $76 million (Armstrong, 2019)
Revenue 2019 $103 million (first two quarters) (Novartis, 2019a; Novartis, 2019b)
Revenue forecast: reach nearly $1 billion sales per year by 2024 (Armstrong, 2019)

Kite/Gilead – **Yescarta**
Revenue 2017: FDA approved Yescarta use, no revenue data found (FDA, 2017a)
Revenue 2018: $264 million (Lash, 2019; Gilead, 2019)
Revenue 2019 (first quarter): $96 million; annual revenue in 2019 expected to nearly double (Gilead, 2019)

Spark – **LUXTURNA**
Revenue 2017: FDA approved Luxturna use, no revenue data found (FDA, 2017b)
Revenue 2018: $27 million (Spark Therapeutics, 2019)

Novartis – **Zolgensma (AVXS-101)**
Revenue 2019: FDA approved Zolgensma in May 2019; no revenue data yet.

As we presented in Partnership Funding section, CIRM grant recipients have been successful in obtaining industry investment and venture capital investment (including equity investment, funding rounds, and initial public offerings) to fund commercialization of stem cell therapies. The annual amount of such funding has increased from $40.5 million in 2015 to $1.06 billion in 2018. It is expected that the CIRM

[2] The increased investment in this industry was catalyzed by biopharma engagement, FDA approvals of gene and gene-modified cell therapies and high value of the approved therapies. Examples of companies developing autologous stem cell-based therapies that have attracted significant venture capital, biotech and pharma investments over the past decade include Juno, Kite, Novartis' Kymriah product, Orchard Therapeutics, bluebird bio, Biomarin, Sangamo, Rocket Pharmaceuticals, CRISPR Therapeutics, and Poseida Therapeutics.

grant recipients will need to maintain the deal flow to progress the therapies through clinical and commercial development. Overall, the industry-wide and CIRM-related data highlight the high commercial values of these advanced cell and gene therapies and the economic activities the continued future investment in this sector will potentially stimulate.
The next step in the process is to determine the mix of deal flow expenditures in terms of labor, capital, and materials. Since the various types of deal flow investment focus on product commercialization and clinical trials for stem cell treatments, rather than on basic education, research, and facility constructions that support these research activities, we use the weighted average budget breakdowns for CIRM projects under the Clinical Programs for the impact analysis of "deal flow."

Yet another impact of CIRM funding is its contribution to the establishment of regional industry clusters, which provide additional benefits to stem cell research organizations. A cluster is a geographic area with a high concentration of businesses related to a specific industry (the main biotechnology clusters in California are located in San Francisco, San Diego, and Los Angeles) (University of Southern California, 2015; Los Angeles County Economic Development Corporation, n.d.).

Biotechnology companies have well established industry clusters. These clusters are frequently located near research and academic institutions (United States Cluster Mapping Project, n.d.a). Prior to the establishment of CIRM, 48 percent of biotechnology companies were in Northern California, San Diego, and Boston (Powell et al., 2010). Between 1998 and 2016, California had the largest growth in employment share for biopharmaceuticals (United States Cluster Mapping Project, n.d.b).

The primary benefit of industry clusters is the regional supply of talent and materials (Porter, 2000). Workers can move between companies locally, rather than across distances. Local suppliers can also decrease costs for shipping and transportation. According to Porter (2000), startup companies are typically founded in regions with existing industry clusters. Some relevant CIRM-related examples include:

1. Novo Nordisk recently acquired Asterias Therapeutics' stem cell GMP manufacturing facility in Fremont, CA. Asterias is a CIRM-funded company that was using the facility to supply its CIRM-funded trial for spinal cord injury. Novo Nordisk plans to manufacture stem cell technology that it licensed from UCSF.

2. Orchard Therapeutics is a UK-based company but has established a physical presence in San Francisco Bay Area, CA, in part to support the CIRM-funded trials of its gene therapies at UCLA. Orchard has broken ground on an $84.5M 150,000 square foot gene therapy manufacturing facility in Fremont, California, that will result in 100 new full-time jobs.

3. City of Hope is now a world-renowned academic cGMP manufacturing facility for cell and gene therapies. The facility was able to expand its footprint and staffing and establish its world-leading reputation due to critical funding from CIRM grants. This came in two forms: Firstly, CIRM supports several COH therapeutic development projects and, secondly, external for-profit and non-profit CIRM grantees contract with COH for manufacturing and process development activities.

All of these represent magnets for attracting funding and talent to these new facilities and projects. This enhances the synergies and agglomeration economies of research and development, which improves their products and their competitiveness (Porter, 2000). All of this leads to additional increases in output, personal income, employment, and tax revenues. Only some of these impacts have been captured by the estimates in this report, which is confined to organizations receiving CIRM funding and other funding from their more direct partners and other financial supporters through the research and development process. It does not, however captures the various spillover effects on other organizations involved in stem cell research and the broader biotechnology field.

H. Funding Streams for Grant Recipients

In this sub-section we provide a general overview of funding streams available for CIRM grant recipients in an effort to outline the potential impact of CIRM on an organization's ability to raise further funding for research and to commercialize funded research. We provide a description of a generalized funding stream for CIRM grant recipients. The reader is referred to Appendix A for specific examples for and Humacyte and the University of California, Los Angeles.[3]

In the discussion below we consider the following primary sources of funding:

- Partnership funding
- Co-Funding
- Main license agreement
- Government grants

There are additional spending injections into the California economy that we consider under the rubric of "deal flow", which is a term adapted to refer to secondary investment or investment spillovers (see also Section II.G). In the context of our report, deal flows refer to funding of the commercialization efforts that follow from the basic or applied research on stem cell development. Other objectives of deal flow funding include development of platform technology, development of human capital and increased collaboration between private and public sector initiatives. Deal flow includes private and public equity investment, strategic partnerships, license agreements, and M&A as we discussed in Section G.

Figure 3 outlines a generalized funding stream for CIRM grant recipients (deal flows are distinguished from other funding in the diagram below by shaded objects). At the start of the CIRM grant, the organization may have existing partnerships or may receive co-funding from a separate organization to support the research (McCormack, 2018). This is one of several forms of "leveraged" funding that provides additional resources from a separate organization as a result of receiving a grant from CIRM.

Many research organizations work with private companies to develop research projects in preparation for commercialization. Main license agreements involve CIRM grant recipients and a separate entity or company. In some instances, the companies are founded by the principal investigator of the initial CIRM grant (CIRM, 2018). The private company may then receive additional funding from investors interested in the developing technology. Government grants may be received, such as funding from the National

[3] These grant recipients were chosen from a sample of awards provided by CIRM because extensive information was available on their funding pattern.

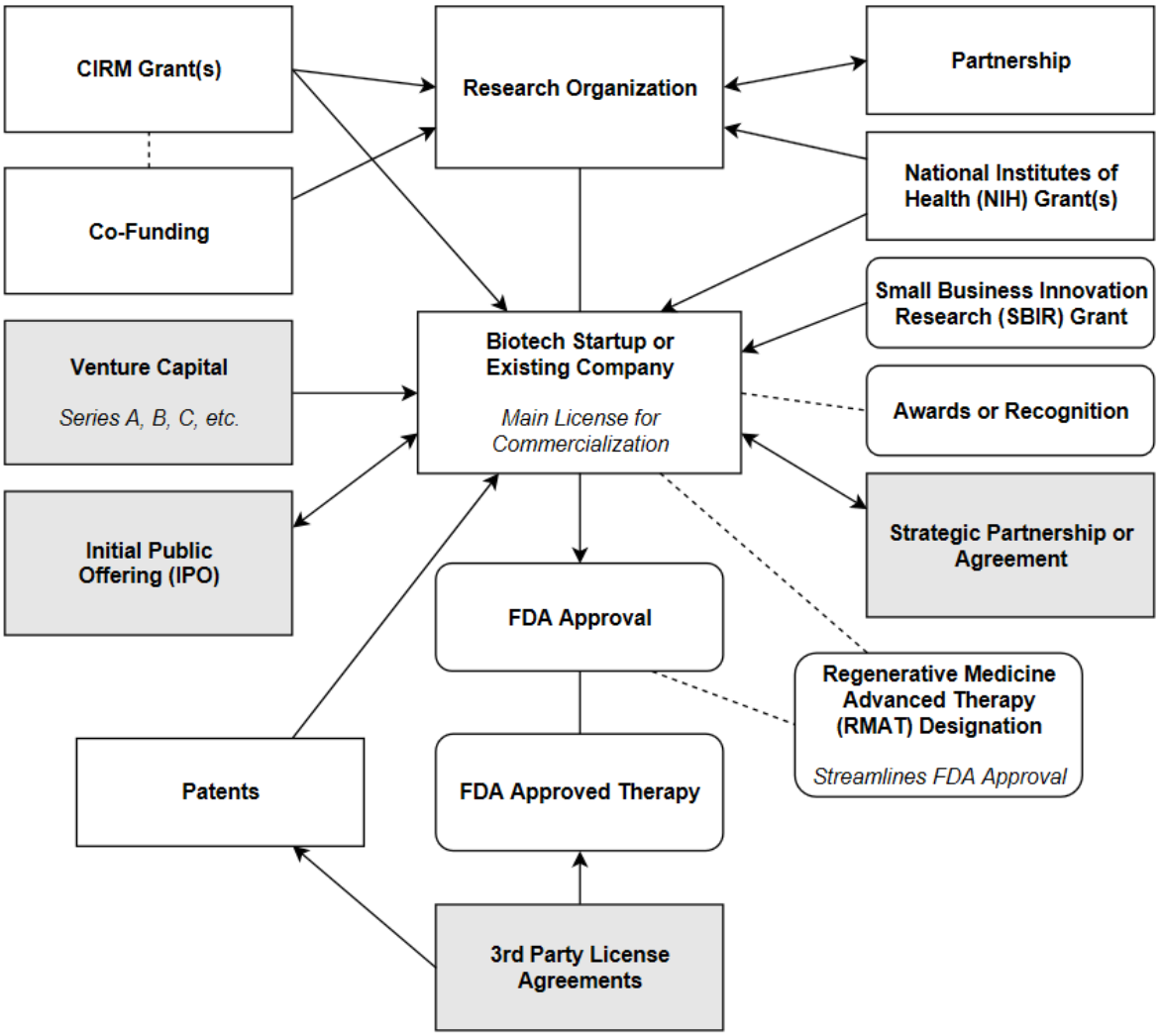
Institutes of Health (NIH). Receiving a government grant should not change ownership of the developed technology (Patent and Trademark Act, 1980).[4]

Investors often contribute capital through "follow-on" funding, or "series" financing. Follow-on funding refers to additional financing provided after an initial investment by the same investor. Series financing refers to rounds of funding from venture capital or other investors (Biotech Newswire, 2018b). The company may go through several series financing rounds, starting with Series A and using subsequent letters for each additional round.

The development of regenerative medicine technologies may result in designations, which may provide direct commercialization benefits. For example, the Regenerative Medicine Advanced Therapy (RMAT) Designation is issued by the United States Food and Drug Administration (FDA, n.d.b). This Designation provides a streamlined process for therapies to receive FDA approval.

Once the therapy receives FDA approval, it may also receive exclusivity benefits that limit competition from other companies (FDA, n.d.a). Length and qualification of exclusivity will vary between applications and therapies. The developed technology may also benefit from patent protection, typically prior to FDA approval (FDA, n.d.a). The organization may also license its product to a separate entity, providing additional funding streams.

[4] The Patent and Trademark Act of 1980, also known as the Bayh-Dole Act, allows research organizations to own and commercialize technologies developed during government-funded research projects.



*Ovals indicate non-monetary support and dashed lines indicate connections.

Also, some of the various types of funding may enter the funding stream at junctures other than those depicted in Figure 1.

Figure 3. Generalized CIRM Recipient Funding Streams

III. Economic Estimation Methodology

The research team considered several economic analysis approaches to estimating the economic impacts of CIRM, including input-output (I-O), computable general equilibrium (CGE), and macroeconometric (ME) analysis. We deemed I-O analysis to be the most appropriate. We also note that practically every previous study of the impacts of stem cell research has applied I-O analysis (see, e.g., Alberro, 2011, 2012; Weinstein and Clower, 2008). Moreover, the research team has extensive experience in refining and applying I-O methodologies to a variety of topics (see, e.g., Rose et al., 2011; Wei and Chatterjee, 2012; Wei et al., 2015; Wei and Rose, 2016; Rose et al., 2018), as well as the application of the other modeling approaches to health issues (Prager et al., 2017) and other public policy concerns (Wei and Rose, 2014).

I-O, developed by Nobel laureate Wassily Leontief, is the most widely used tool of regional economic impact analysis in the U.S. and throughout the world. It is especially adept at estimating ripple, or multiplier, effects of changes in economic activity. I-O can be defined as a static, linear model of all purchases and sales between sectors of an economy, based on the technological relationships of production (Rose and Miernyk, 1989).

Essentially, I-O depicts the economy as a set of interconnected supply-chains. It is especially adept at translating direct impacts into total impacts, the difference consisting of indirect effects (the stimulus generated by change in economic activity by one sector on its upstream suppliers) and induced effects (the stimulus of industry payments to providers of production factors translated into their spending on consumer goods and services). These second-order effects are the basis for the multipliers that are embodied in the I-O table, where, in general, they represent the ratio of total impacts on the entire economy to the direct impact on an individual sector (see, e.g., Miller and Blair, 2009).

I-O modeling has both "demand-side" and "supply-side" versions (Miller and Blair, 2009). The demand-side I-O model is the standard version, where a change in demand affects the economy by causing product supply to respond through a set of upstream supplier linkages. The supply-side I-O model is a variant of the standard model, where the change in production affects the economy by stimulating demand through a set of downstream customer linkages. In this study, however, only demand-side I-O model is utilized, since the programs and services provided by the CIRM and related funding are consumed mainly by "end-use customers," and thus do not result in further downstream demand. This is apart from the ability of CIRM to stimulate additional leverage spending and contribute to biopharmaceutical industry clusters, which cannot be estimated with the use of any form of I-O analysis (because it involves agglomeration economies) and will be analyzed qualitatively in this report.

I-O's major strengths are its full-accounting of all inputs, disaggregation of the economy into separate sectors, and the ability to capture general physical aspects of economic interdependence. Its weaknesses are that it is inherently linear, omits the workings of prices and markets, and does not incorporate any constraints on the availability of inputs. However, none of these limitations has a major influence in this study.

We adapted the most widely used source of regional I-O tables, the IMPLAN System (IMPLAN, 2018). This system consists of three components: 1) study region (state, county, or sub-county) data base, 2) a set of algorithms capable of generating I-O tables for any state, county or sub-county group, and 3) a computational capability for calculating multipliers and performing impact analyses. The IMPLAN sectoring scheme is currently based on the North American Industrial Classification System (NAICS), and includes the details of 536 sectors (IMPLAN, 2018). In this study, we aggregate the IMPLAN sectors into 115 sectors corresponding primarily to the 3-digit NAICS codes, but retain the disaggregated sectors relating to health care, medical and clinical equipment and supplies manufacturing, scientific research and development services, and biopharmaceutical industry at 5- to 6-digit NAICS level. In the study, we used I-O tables for three different years (2010, 2012, and 2016) to reflect changes in underlying economic conditions over the course of the historical operation of CIRM.[5] The details of the 115 sectors, including their correspondence to the IMPLAN sectors and NAICS codes, are shown in Appendix Tables

[5] We applied the Year 2010 I-O model to analyze the economic impacts of CIRM grants for each year between 2006 and 2010; Year 2012 I-O model for years 2011 to 2014; and Year 2016 I-O model for years 2015 to 2023.

B1 and B2.[6] We also supplemented the basic I-O model with an industry-occupation matrix, which depicts the distribution of occupational categories hired by each sector.

IV. Economic Impact Analysis Results

A. CIRM Grants

Table 4 summarizes the economic impacts on the California economy stemming from the expenditures of the $2.67 billion CIRM grants since 2006.

The second column of Table 4 presents the direct CIRM grant payments to the awardees in each year. These are then translated into in-state final demand increase by multiplying the direct payments in the second column (by detailed expenditure categories as explained in Appendix D) by the default Regional Purchase Coefficient (RPC) of the relevant economic sectors obtained from IMPLAN. The RPC of a given economic sector represents the proportion of in-state demand of goods and services that is fulfilled from in-state production. For example, if the RPC of a given sector is 0.60, that means 60% of the increased demand of goods from this sector will be produced and supplied by suppliers with the state; the remaining 40% will be supplied by imports from rest of the U.S. and/or from other countries. Only the 60% will stay, circulate, and stimulate the economy of California; the other 40% of the expenditures on imports represent leakages or out-flows of investment to regions outside of California. Appendix E presents the default RPCs by sector for the 2010, 2012, and 2016 IMPLAN I-O models.

Column 3 to Column 6 in Table 4 present the economic impacts of the CIRM grant payments for the following macroeconomic indicators: gross output (sale revenue), value-added, personal income, and employment.[7] The disbursement of the $2.67 billion CIRM grants are estimated to increase the gross output, value-added, and personal income in California by $5.0 billion, $3.15 billion, and $2.41 billion, respectively. They are also expected to increase employment by 27,208 person-year full-time equivalent (FTE) jobs[8] over the period of 2006 and 2023.

Economic activities stimulated by CIRM grants also generate additional tax revenues to state/local government and federal government. The last two columns of Table 4 present the impacts on tax

[6] Through 2012, a 440 sectoring scheme was used by IMPLAN. Appendix B presents the mapping of both the 440 and 536 IMPLAN sectors to the 115 sectors used in the I-O model for this study.

[7] Gross Output corresponds to the sales price of goods and services, which corresponds to total production costs, including returns to primary factors of production (wages/salaries to labor and various forms of compensation, such as interest, dividends and royalties, to owners of capital), as well as the cost of intermediate goods (e.g., materials and services). Value-added corresponds to the net additional value generated by production, and therefore only includes returns to primary factors of production and excludes the cost of intermediate goods, the inclusion of which would amount to double-counting. It also includes depreciation and indirect business taxes. Personal income represents returns to primary factors of production, but excludes depreciation and indirect business taxes. Employment is measured in person-year equivalence of full-time employment. Note that employment numbers in a given year do not entirely represent new jobs, but rather the combination of continuation of jobs created in previous years and any new jobs created in the given year.

[8] A job is defined as a person-year of employment full-time equivalent. Results presented for a given year represent the jobs in place that year whether they are new jobs or carryovers from past years.

revenues. About $294 million in tax revenues are estimated to accrue to the state/local governments, and $318 million to the federal government.[9]

Note that we partition Tables 4 into two parts. The first relates to CIRM grants made by the end of our study period – 2018. The second partition relates to the spending from these grants in subsequent years. The reason that the spending impacts in years after 2018 is smaller than that in the first partition is that it does not include any new grants that will be forthcoming in these years.

Table 4. Economic Impacts of CIRM Grants on the California Economy

	CIRM Grant Payments (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2006	13.9	30.0	19.3	14.7	187	1.7	1.7
2007	55.1	117.0	76.6	58.0	725	6.8	6.8
2008	290.4	558.3	283.0	196.3	2,875	25.3	24.1
2009	133.1	265.7	152.6	110.9	1,491	13.6	13.5
2010	201.5	419.1	271.7	205.1	2,555	24.1	24.6
2011	233.0	431.7	282.1	223.4	2,540	26.0	28.8
2012	208.0	385.8	248.6	196.5	2,257	23.0	25.2
2013	230.7	429.5	280.6	221.6	2,519	25.9	27.9
2014	208.7	388.0	251.1	197.8	2,250	23.2	24.5
2015	193.6	342.1	222.3	172.4	1,703	21.7	26.1
2016	184.6	325.7	211.6	164.3	1,622	20.7	24.9
2017	216.9	385.7	252.9	198.8	1,933	24.7	30.6
2018	226.0	399.1	266.2	209.8	2,050	26.0	27.1
Sub-Total	***2,395.6***	***4,473.7***	***2,818.6***	***2,147.5***	***24,707***	***261.7***	***284.0***
2019	159.4	281.0	188.8	149.5	1,440	18.4	19.4
2020	82.6	146.6	99.6	79.1	760	9.7	10.3
2021	28.3	50.2	34.5	27.6	270	3.4	3.6
2022	2.1	3.7	2.5	2.0	19	0.2	0.3
2023	1.2	2.2	1.5	1.2	11	0.1	0.2
Total	**2,669.3**	**4,957.3**	**3,145.5**	**2,406.8**	**27,208**	**293.6**	**317.7**

CIRM grants also provide a stimulus to the U.S. economy apart from its impacts on California. These national impacts emanate from two sources: 1) directly imported goods (such as equipment, materials, and supplies used in the stem cell research and clinical trials) from other states that are purchased by CIRM grant recipients, as well as direct spending by employees and owners of their income on imported

[9] Various types of taxes analyzed in the study include indirect business taxes, personal income taxes, and corporate profit taxes. Indirect business taxes include excise, sales and property taxes, as well as, nontax liabilities that are chargeable to businesses like fees, fines, licenses and permits (IMPLAN, 2018).

goods;[10] and 2) indirect spending of the various chains of upstream suppliers of these goods because some of the inputs are produced in other states and countries, plus the spending of employees and owners of the upstream suppliers on imported goods.

The results of this national impact analysis of CIRM grant spending are presented in Table 5. The overall impact on the U.S. economy of CIRM grants is $7.1 billion in total gross output, $4.2 billion in value-added, and $3.0 billion in personal income over the period of 2006 and 2023. The total employment impacts rise to 39,070 person-year FTE jobs, or an increase of 46.4% over just the California employment impacts.

Table 5. National Economic Impacts of CIRM Grants

	CIRM Grant Payments (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2006	13.9	42.9	26.0	18.7	275	2.5	2.3
2007	55.1	159.8	98.5	70.9	1,013	8.2	7.4
2008	290.4	793.9	392.1	258.7	4,314	36.3	33.5
2009	133.1	369.3	202.4	139.6	2,147	18.9	18.2
2010	201.5	567.7	346.5	248.3	3,538	32.6	32.4
2011	233.0	595.2	362.9	265.6	3,452	34.8	38.3
2012	208.0	531.7	320.9	233.6	3,063	30.8	33.6
2013	230.7	596.1	362.9	265.0	3,452	34.8	37.3
2014	208.7	541.0	326.6	237.7	3,102	31.3	33.0
2015	193.6	510.0	301.6	218.7	2,579	30.6	36.6
2016	184.6	486.5	287.9	208.8	2,463	29.3	35.0
2017	216.9	566.6	340.9	250.1	2,901	34.7	42.6
2018	226.0	591.0	357.6	263.1	3,055	36.5	37.8
Sub-Total	***2,395.6***	***6,351.6***	***3,726.7***	***2,678.8***	***35,352.3***	***361.4***	***388.0***
2019	159.4	415.7	253.1	187.0	2,149	25.8	27.0
2020	82.6	215.8	132.7	98.4	1,127	13.6	14.2
2021	28.3	73.7	45.8	34.2	396	4.7	5.0
2022	2.1	5.4	3.3	2.5	29	0.3	0.4
2023	1.2	3.2	2.0	1.5	17	0.2	0.2
Total	**2,669.2**	**7,065.6**	**4,163.6**	**3,002.2**	**39,069.7**	**406.0**	**434.8**

[10] Note an important aspect of the way retail and wholesale trade is handled in an I-O Table. The dollar value of products sold in the Retail and Wholesale Trade sector is separated from the cost of doing business of the sector--the "trade margin." Thus, if a customer purchases a high-powered microscope from a scientific supply store, and if the microscope was produced in New York, the retail trade margin is assigned to California, but the production of the microscope is considered an import leakage to this other state.

B. Co-Funding

Between 2006 and 2017, $997.6 million co-funding was committed to supplement the main CIRM grants. Tables 6 and 7 present the economic impacts of co-funding. Total gross output impacts of co-funding on the California economy is $1.82 billion and provides 9,146 person-year FTE jobs. Extended to the national level this is $2.6 billion in total gross output and 13,785 jobs. The national employment impacts in this case are 51% higher than California impacts, whereas the direct CIRM funding impacts at the national level were only 44% higher. The difference is due primarily to the fact that co-funding direct spending includes a higher level of import leakages. Other notable variations between the above two types of funding pertain to year-to-year differences in spending time-paths and the categories of goods and services directly purchased.

Table 6. Economic Impacts of Co-funding of CIRM Grants on the California Economy

	Co-funding Payments (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2006	0.0	0.0	0.0	0.0	0	0.0	0.0
2007	0.3	0.5	0.2	0.2	2	0.0	0.0
2008	430.4	807.0	374.3	249.9	3,919	33.6	31.2
2009	59.3	111.2	51.8	34.6	541	4.7	4.3
2010	15.8	32.0	19.8	14.8	186	1.8	1.8
2011	22.4	40.2	23.6	18.4	220	2.2	2.4
2012	30.2	54.4	31.0	24.1	297	2.9	3.1
2013	42.4	76.9	48.9	38.5	436	4.5	4.8
2014	58.5	106.6	69.0	54.4	607	6.4	6.7
2015	82.7	143.4	94.3	74.6	707	9.3	11.6
2016	41.9	73.8	49.2	38.8	372	4.8	6.0
2017	77.0	134.5	90.0	71.4	675	8.8	11.1
2018	60.3	104.9	70.3	56.1	526	6.9	8.7
Sub-Total	***921.3***	***1,685.4***	***922.5***	***675.8***	***8,489.0***	***86.0***	***91.7***
2019	43.1	74.3	49.8	39.8	372	4.9	6.3
2020	24.8	42.7	28.8	23.2	215	2.8	3.7
2021	7.6	13.0	8.7	7.0	65	0.9	1.1
2022	0.3	0.4	0.3	0.2	2	0.0	0.0
2023	0.5	0.4	0.2	0.1	2	0.0	0.0
Total	**997.6**	**1,816.4**	**1,010.4**	**746.2**	**9,145.5**	**94.5**	**102.9**

Table 7. National Economic Impacts of Co-funding of CIRM Grants

	Co-funding Payments (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2006	0.0	0.0	0.0	0.0	0	0.0	0.0
2007	0.3	0.7	0.3	0.2	4	0.0	0.0
2008	430.4	1,163.7	535.9	341.8	6,047	49.1	44.1
2009	59.3	160.7	74.3	47.5	838	6.8	6.1
2010	15.8	43.6	25.6	18.1	262	2.4	2.4
2011	22.4	56.9	32.1	22.6	310	3.1	3.3
2012	30.2	75.9	41.9	29.1	407	4.0	4.2
2013	42.4	108.8	64.8	47.0	615	6.2	6.6
2014	58.5	151.2	91.4	66.7	863	8.8	9.2
2015	82.7	214.8	128.6	94.5	1,079	13.1	16.3
2016	41.9	109.9	66.6	49.0	563	6.8	8.4
2017	77.0	199.8	121.2	89.7	1,016	12.4	15.5
2018	60.3	155.8	94.7	70.3	791	9.7	11.7
Sub-Total	***921.2***	***2,441.9***	***1,277.3***	***876.3***	***12,793.9***	***122.4***	***127.6***
2019	43.0	110.7	67.2	50.0	561	6.8	8.4
2020	24.8	63.6	38.9	29.1	324	4.0	4.9
2021	7.6	19.5	11.8	8.8	99	1.2	1.5
2022	0.3	0.7	0.4	0.3	3	0.0	0.1
2023	0.5	0.8	0.4	0.3	4	0.0	1.0
Total	**997.5**	**2,637.2**	**1,396.0**	**964.8**	**13,785.2**	**134.5**	**143.5**

C. Partnership Funding

Between 2015 and 2018, the CIRM grant recipients successfully attracted $1.64 billion partnership funding from strategic partners and private investors to further advance the CIRM funded research. The economic impacts of the partnership funding are summarized in Table 8 and Table 9. Partnership funding impacts are smaller than the impacts of the main CIRM grants but are higher than the impacts of the co-funding presented above. Partnership funding adds significantly to impacts on major macroeconomic indicators, including a total of 21,594 additional jobs at the national level.

Table 8. Economic Impacts of Partnership Funding on the California Economy

	Partnership Funding* (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2015	10.1	17.9	12.3	9.8	92	1.2	1.5
2016	48.2	84.8	54.1	41.5	398	5.3	6.2
2017	145.2	259.7	173.2	135.8	1,290	17.0	20.5
2018	409.1	722.2	482.5	381.2	3,595	47.2	58.6
Sub-Total	***612.6***	***1,084.6***	***722.2***	***568.3***	***5,375.0***	***70.7***	***86.9***
2019	399.0	704.3	470.2	371.5	3,503	46.1	57.1
2020	360.9	637.3	428.5	339.8	3,197	42.0	52.4
2021	264.0	462.5	309.3	245.4	2,305	24.1	30.7
Total	**1,636.4**	**2,888.7**	**1,930.1**	**1,525.0**	**14,380.8**	**182.7**	**227.0**

* Partnership funding includes license agreements, equity investment, funding rounds, and initial public offerings and totals $1.64 billion (in 2017$) through 2018. Spending from these agreements is allocated annually across four years starting from the initial investment year based on data provided by CIRM and public documents.

Table 9. National Economic Impacts of Partnership Funding

	Partnership Funding (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2015	10.1	25.7	16.1	11.9	134	1.6	2.1
2016	48.2	127.1	74.0	53.1	617	7.5	8.8
2017	145.2	382.8	231.8	169.8	1,933	23.7	28.5
2018	409.1	1,068.2	647.6	477.3	5,398	66.2	81.7
Sub-Total	***612.6***	***1,603.8***	***969.5***	***712.1***	***8,082.2***	***99.0***	***121.0***
2019	399.0	1,042.5	631.6	465.3	5,265	64.5	79.6
2020	360.9	941.1	573.6	424.2	4,782	58.6	72.9
2021	264.0	685.3	415.8	307.4	3,465	33.5	41.9
Total	**1,636.4**	**4,272.8**	**2,590.5**	**1,909.0**	**21,593.7**	**255.7**	**315.3**

D. Leverage Funding of Alpha Stem Cell Clinic

The economic impacts of the $13.6 million non-CIRM leverage funding on ASCC clinical trials are presented in Tables 10 and 11. Given the relatively very low level of direct spending on this more advanced stage of research, it adds little to the total impacts. However, given the small base expenditures in 2015-17, one would expect much higher relative growth in this funding stream in the future. This conclusion is based on reference to the standard logistic (S-shaped) curve of technology adoption that reflects slow starts being followed by an accelerated path that eventually tapers off.

Table 10. Economic Impacts of ASCC Leverage Funding on the California Economy

	ASCC Leverage Funding (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2015	4.5	8.4	6.1	4.9	46	0.6	0.8
2016	4.5	8.4	6.1	4.9	46	0.6	0.8
2017	4.5	8.4	6.1	4.9	46	0.6	0.8
Total	**13.6**	**25.1**	**18.3**	**14.7**	**137**	**1.8**	**2.3**

Table 11. National Economic Impacts of ASCC Leverage Funding

	ASCC Leverage Funding (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2015	4.5	11.7	7.7	5.8	64	0.8	1.0
2016	4.5	11.7	7.7	5.8	64	0.8	1.0
2017	4.5	11.7	7.7	5.8	64	0.8	1.0
Total	**13.6**	**35.1**	**23.1**	**17.4**	**191**	**2.4**	**3.0**

E. Follow-on Funding

The economic impacts of the $317.6 million non-CIRM follow-on funding are presented in Tables 12 and 13. Total gross output impacts of follow-on funding on the California economy are estimated to be $580.7 million and provides about 3,083 person-year FTE jobs. At the national level, the impacts increased to $830.7 million in total gross output and 4,421 jobs.

Table 12. Economic Impacts of Follow-on Funding on the California Economy

	Follow-on Funding (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2006	2.0	4.2	2.8	2.1	24	0.2	0.3
2007	0.7	1.4	0.9	0.7	8	0.1	0.1
2008	0.6	1.4	0.9	0.7	8	0.1	0.1
2009	0.7	1.4	0.9	0.7	8	0.1	0.1
2010	0.0	0.0	0.0	0.0	0	0.0	0.0
2011	0.5	0.9	0.6	0.5	5	0.1	0.1
2012	6.3	11.8	8.0	6.4	66	0.7	0.8
2013	24.7	46.5	31.6	25.1	262	2.9	3.1
2014	54.3	102.5	69.6	55.3	577	6.4	6.8
2015	54.0	97.3	66.0	51.8	499	6.4	7.8
2016	52.6	94.9	64.4	50.5	491	6.3	7.6
2017	43.8	78.9	53.5	42.1	410	5.2	6.3
2018	37.6	67.6	45.8	36.0	349	4.5	4.6
Sub-Total	***277.7***	***508.9***	***345.2***	***271.9***	***2,707.5***	***32.9***	***37.5***
2019	24.0	43.2	29.3	23.0	225	2.9	2.9
2020	10.6	19.0	12.9	10.1	100	1.3	1.3
2021	2.8	5.1	3.4	2.7	27	0.3	0.3
2022	1.7	3.1	2.1	1.6	16	0.2	0.2
2023	0.9	1.5	1.0	0.8	8	0.1	0.1
Total	**317.6**	**580.7**	**393.9**	**310.2**	**3,082.5**	**37.7**	**42.4**

Table 13. National Economic Impacts of Follow-on Funding

	Follow-on Funding (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2006	2.0	5.5	3.5	2.5	33	0.3	0.3
2007	0.7	1.8	1.2	0.8	11	0.1	0.1
2008	0.7	1.8	1.2	0.8	11	0.1	0.1
2009	0.7	1.8	1.2	0.8	11	0.1	0.1
2010	0.0	0.0	0.0	0.0	0	0.0	0.0
2011	0.5	1.3	0.8	0.6	7	0.1	0.1
2012	6.3	16.2	10.1	7.5	91	1.0	1.0
2013	24.7	63.8	40.1	29.6	358	3.8	4.1
2014	54.3	140.2	88.2	65.2	789	8.5	9.0
2015	54.0	141.7	87.1	64.0	732	8.9	10.7
2016	52.6	138.2	84.9	62.4	718	8.7	10.4
2017	43.8	115.1	70.7	52.0	600	7.2	8.7
2018	37.6	98.6	60.5	44.5	512	6.2	6.3
Sub-Total	***277.7***	***725.9***	***449.3***	***330.9***	***3,872.8***	***44.9***	***51.0***
2019	24.0	63.0	38.7	28.4	328	3.9	4.0
2020	10.6	27.7	17.0	12.5	146	1.7	1.8
2021	2.8	7.4	4.5	3.3	39	0.5	0.5
2022	1.7	4.5	2.7	2.0	23	0.3	0.3
2023	0.9	2.2	1.4	1.0	12	0.1	0.1
Total	**317.7**	**830.7**	**513.6**	**378.3**	**4,420.6**	**51.5**	**57.7**

F. CIRM Administrative Expenditures

The operation of CIRM itself generates significant economic impacts at the state and national levels, as presented in Tables 14 and 15. Gross output impacts at the California and national level are $434 million and $548 million, respectively. Employment impacts are 2,595 and 3,305 person-year FTE jobs at these geographic levels, respectively. Employment impacts at the national level are only 27% higher than those at the state level, because, not surprisingly, direct expenditures to suppliers of goods and services within the state are relatively higher than in the case for the other four funding streams discussed above.

Table 14. Economic Impacts of CIRM Administrative Expenditures on the California Economy

	CIRM Admin Expenditures (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2005	6.5	18.1	10.0	7.1	101	1.03	1.03
2006	7.3	19.9	11.7	8.6	120	1.20	1.22
2007	8.3	22.5	13.5	10.0	138	1.38	1.41
2008	9.8	26.5	16.0	11.9	164	1.64	1.67
2009	12.5	33.4	20.3	15.1	207	2.07	2.11
2010	14.6	38.7	23.4	17.4	236	2.39	2.44
2011	15.2	34.9	21.7	17.3	208	2.48	2.69
2012	15.6	35.3	23.1	18.7	223	2.62	2.86
2013	15.6	34.9	23.7	19.4	229	2.68	2.95
2014	15.1	33.4	22.9	18.7	218	2.58	2.84
2015	16.3	35.9	23.9	19.0	195	2.82	3.37
2016	16.7	37.0	24.7	19.6	201	2.92	3.49
2017	15.3	33.2	22.8	18.3	185	2.69	3.23
2018	13.8	30.7	21.2	17.3	170	2.51	3.04
Total	**182.5**	**434.1**	**279.0**	**218.4**	**2,595**	**31.00**	**34.33**

Table 15. National Economic Impacts of CIRM Administrative Expenditures

	CIRM Admin Expenditures (M 2017$)	Gross Output Impacts (M 2017$)	Value-Added Impacts (M 2017$)	Personal Income Impacts (M 2017$)	Employment Impacts (jobs)	State Taxes (M 2017$)	Federal Taxes (M 2017$)
2005	6.5	21.8	11.9	8.2	128	1.30	1.19
2006	7.3	24.0	13.8	9.8	150	1.51	1.39
2007	8.3	27.3	16.0	11.4	173	1.74	1.60
2008	9.8	32.2	18.9	13.5	205	2.06	1.90
2009	12.5	40.7	24.0	17.2	259	2.61	2.40
2010	14.6	47.4	27.8	20.0	298	3.03	2.79
2011	15.2	43.9	26.2	19.6	262	2.81	2.99
2012	15.6	44.3	27.5	21.0	277	2.94	3.15
2013	15.6	43.7	28.1	21.7	283	2.99	3.23
2014	15.1	41.9	27.1	21.0	270	2.88	3.12
2015	16.3	47.4	29.5	22.2	260	3.16	3.78
2016	16.7	48.8	30.4	22.9	269	3.26	3.90
2017	15.3	43.9	28.0	21.3	246	2.99	3.60
2018	13.8	40.3	25.9	20.0	224	2.76	3.36
Total	**182.5**	**547.7**	**335.1**	**249.8**	**3,305**	**36.05**	**38.42**

G. Summary Results

A comparative summary of the impacts across all spending streams is presented in Tables 16 to 19. In terms of employment impacts, the direct CIRM grants generate the highest employment impacts within the state, followed by co-funding and partnership funding, for example. This holds at the national level as well.

Overall the total employment impacts of the various spending streams are 56,549 jobs in California and 82,365 in the U.S. as a whole. Gross output impacts are $10.7 billion in California and $15.4 billion for the U.S. This is a relatively high rate of leverage of the $2.5 billion of direct CIRM grants during the study period.

Table 16. Employment Impacts of CIRM and CIRM-Related Funding on the California Economy by Funding Category by Year
(in number of Person-Year FTE jobs)

	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
2005	0	0	0	0	0	101	101
2006	187	0	0	0	24	120	331
2007	725	2	0	0	8	138	873
2008	2,875	3,919	0	0	8	164	6,966
2009	1,491	541	0	0	8	207	2,247
2010	2,555	186	0	0	0	236	2,977
2011	2,540	220	0	0	5	208	2,974
2012	2,257	297	0	0	66	223	2,843
2013	2,519	436	0	0	262	229	3,446
2014	2,250	607	0	0	577	218	3,652
2015	1,703	707	92	46	499	195	3,241
2016	1,622	372	398	46	491	201	3,130
2017	1,933	675	1,290	46	410	185	4,539
2018	2,050	526	3,595	0	349	170	6,691
Sub-Total	***24,707***	***8,489***	***5,375***	***137***	***2,708***	***2,595***	***44,010***
2019	1,440	372	3,503	0	225		5,540
2020	760	215	3,197	0	100		4,272
2021	270	65	2,305	0	27		2,667
2022	19	2	0	0	16		37
2023	11	2	0	0	8		21
Total	**27,208**	**9,146**	**14,381**	**137**	**3,082**	**2,595**	**56,549**

Table 17. Gross Output Impacts of CIRM on the California Economy by Funding Category by Year
(in million 2017$)

	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
2005						18.1	18.1
2006	30.0	0.0	0.0	0.0	4.2	19.9	54.0
2007	117.0	0.5	0.0	0.0	1.4	22.5	141.4
2008	558.3	807.0	0.0	0.0	1.4	26.5	1,393.2
2009	265.7	111.2	0.0	0.0	1.4	33.4	411.6
2010	419.1	32.0	0.0	0.0	0.0	38.7	489.8
2011	431.7	40.2	0.0	0.0	0.9	34.9	507.7
2012	385.8	54.4	0.0	0.0	11.8	35.3	487.2
2013	429.5	76.9	0.0	0.0	46.5	34.9	587.9
2014	388.0	106.6	0.0	0.0	102.5	33.4	630.4
2015	342.1	143.4	17.9	8.4	97.3	35.9	645.0
2016	325.7	73.8	84.8	8.4	94.9	37.0	624.5
2017	381.7	134.5	259.7	8.4	78.9	33.2	896.4
2018	399.1	104.9	722.2	0.0	67.6	30.7	1,324.5
Sub-Total	***4,473.7***	***1,685.4***	***1,084.6***	***25.1***	***508.9***	***434.1***	***8,211.7***
2019	281.0	74.3	704.3	0.0	43.2		1,102.8
2020	146.6	42.7	637.3	0.0	19.0		845.7
2021	50.2	13.0	462.5	0.0	5.1		530.7
2022	3.7	0.4	0.0	0.0	3.1		7.2
2023	2.2	0.4	0.0	0.0	1.5		4.1
Total	**4,957.3**	**1,816.4**	**2,888.7**	**25.1**	**580.7**	**434.1**	**10,702.3**

Table 18. Employment Impacts of CIRM on the U.S. Economy by Funding Category by Year
(in number of Person-Year FTE jobs)

	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
2005	0	0	0	0	0	128	128
2006	275	0	0	0	33	150	457
2007	1,013	4	0	0	11	173	1,201
2008	4,314	6,047	0	0	11	205	10,577
2009	2,147	838	0	0	11	259	3,256
2010	3,538	262	0	0	0	298	4,098
2011	3,452	310	0	0	7	262	4,032
2012	3,063	407	0	0	91	277	3,838
2013	3,452	615	0	0	358	283	4,709
2014	3,102	863	0	0	789	270	5,023
2015	2,579	1,079	134	64	732	260	4,847
2016	2,463	563	617	64	718	269	4,693
2017	2,901	1,016	1,933	64	600	246	6,759
2018	3,055	791	5,398	0	512	224	9,980
Sub-Total	***35,352***	***12,794***	***8,082***	***191***	***3,873***	***3,305***	***63,597***
2019	2,149	561	5,265	0	328		8,303
2020	1,127	324	4,782	0	146		6,379
2021	396	99	3,465	0	39		3,998
2022	29	3	0	0	23		55
2023	17	4	0	0	12		32
Total	**39,070**	**13,785**	**21,594**	**191**	**4,421**	**3,305**	**82,365**

Table 19. Gross Output Impacts of CIRM on the U.S. Economy by Funding Category by Year
(in million 2017$)

	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
2005	0.0	0.0	0.0	0.0	0.0	21.8	21.8
2006	42.9	0.0	0.0	0.0	5.5	24.0	72.4
2007	159.8	0.7	0.0	0.0	1.8	27.3	189.7
2008	793.9	1,163.7	0.0	0.0	1.8	32.2	1,991.6
2009	369.3	160.7	0.0	0.0	1.8	40.7	572.5
2010	567.7	43.6	0.0	0.0	0.0	47.4	658.7
2011	595.2	56.9	0.0	0.0	1.3	43.9	697.3
2012	531.7	75.9	0.0	0.0	16.2	44.3	668.1
2013	596.1	108.8	0.0	0.0	63.8	43.7	812.3
2014	541.0	151.2	0.0	0.0	140.2	41.9	874.4
2015	510.0	214.8	25.7	11.7	141.7	47.4	951.4
2016	486.5	109.9	127.1	11.7	138.2	48.8	922.2
2017	566.6	199.8	382.8	11.7	115.1	43.9	1,319.9
2018	591.0	155.8	1,068.2	0.0	98.6	40.3	1,953.8
Sub-Total	***6,351.6***	***2,441.9***	***1,603.8***	***35.1***	***725.9***	***547.7***	***11,706.1***
2019	415.7	110.7	1,042.5	0.0	63.0		1,631.9
2020	215.8	63.6	941.1	0.0	27.7		1,248.3
2021	73.7	19.5	685.3	0.0	7.4		786.0
2022	5.4	0.7	0.0	0.0	4.5		10.6
2023	3.2	0.8	0.0	0.0	2.2		6.3
Total	**7,065.6**	**2,637.2**	**4,272.8**	**35.1**	**830.7**	**547.7**	**15,389.1**

Note that we did not include some CIRM-related funding types or expenditures in our I-O impact analysis either due to the small amount involved or unknown amounts of direct spending. For example, CIRM surveyed the Principal Investigators at the end of their award whether they have received subsequent awards as a result of their research funded by CIRM. One of the PIs indicated an NIH/NEI SBIR grant for $500,000. This was not included in the current I-O impact analysis because of the relatively small amount compared to other funding streams. For the analysis of the ASCC leverage funding, we did not include the impacts of the expenditures by the 93 out-of-state patients in the analysis because of the lack of data on their direct spending incurred in California. We were also not able to analyze the impacts of the license agreements because of the unknown amounts associated with most of these agreements.

H. Sectoral Impacts

In Appendix F, we present the total gross output and employment impacts at both the state and national levels for each sector over the entire study period of 2006 to 2023. The sectors most impacted by CIRM-related funding and expenditures include: Scientific Research and Development Services; Health Care Services; Construction of New Nonresidential Commercial and Health Care Structures; Professional Services; Real Estate; Food Services; and various manufacturing sectors, such as Pharmaceutical Preparation and Medical Instrument and Supplies. For each funding category, the top 5 impacted sectors are in general the same at the state level and national level in terms of GDP impacts and employment impacts. One exception is that Real Estate is among the top 5 sectors in terms of GDP impacts, but not for employment impacts, while Food Services sector is the opposite. The reason is that the former is more capital-intensive, while the latter is more labor-intensive. Comparing across the various funding categories, Construction of New Nonresidential Commercial and Health Care Structures is among the top 5 impacted sectors for CIRM grants and co-funding, but not for the other funding/expenditure categories. This is because most of the infrastructure projects were funded primarily by CIRM grants and the associated co-funding.

The sectoral impact analysis also indicates that about 40-45% of the increase in gross output and employment are concentrated in medical and health related research, manufacturing, and service sectors at in California. These percentages are about 30-35% at the national level.

V. Occupational Impact Analysis

Table 20 disaggregates the employment impacts of CIRM grants and related funding and spending across 15 occupational categories. The categories were specified so as to provide relatively higher resolution for research and health service occupations (see rows 3 to 9 of the first column of the Table). The average salary by occupation is presented in the first numerical column, and indicates that all research/health-related sectors except Health Support staff have average salaries significantly above the weighted average in the California economy.[11] In fact, Medical Scientists and Technical Staff have the second and third highest salaries, respectively, of all occupations in the state.

The second numerical column presents the direct employment impacts of CIRM grants and CIRM-related funding and expenditures, and the next numerical column presents the proportions of this impact across all occupations. The three largest occupational impacts are found among Technical staff, Management (also well represented in the research/health sectors), and Other Life/Physical/Social Scientist categories. If we consider Management plus these seven research/health-related sectors, this group comprises 68% of direct employment stimulated by CIRM. Moreover, the weighted average salary of these direct employment stimulated by CIRM-related funding and spending across all occupations is more than $92,000, or about 80% higher than the average California salary.

Total employment impacts include these direct impacts, and also the indirect and induced employment impacts. Because the vast majority of these additional jobs are in sectors other than research and health, this waters down the relative influence of the direct occupational impacts. Overall the weighted average salary of these total employment impacts is $71,209, still significantly higher than the California

[11] See Appendix G for the details of the calculation of salaries by occupation.

average. Hence, we can conclude that CIRM funding provides relatively high paying jobs directly and indirectly.

Table 20. Occupation Impacts of CIRM-Related Funding and Expenditures

Occupation Types	Average Salary (2017$)	Direct Employment Impacts (FTE jobs)	Direct Employment Increase Proportion	Total Employment Impacts (FTE jobs)	Total Employment Increase Proportion
Management	132,220	2,834	13.6%	5,374	9.5%
Business & Financial	83,500	1,824	8.7%	4,099	7.2%
Technical Staff	103,294	6,696	32.1%	8,574	15.2%
Biological Science	93,784	1,089	5.2%	1,160	2.1%
Medical Scientists	103,875	1,268	6.1%	1,370	2.4%
Other Life, Physical, & Social Science	82,510	2,802	13.4%	3,133	5.5%
Professional Services	68,828	540	2.6%	3,366	6.0%
Healthcare Practitioners & Technical	96,130	901	4.3%	2,783	4.9%
Health Support	37,100	153	0.7%	1,026	1.8%
Other Services	36,531	315	1.5%	8,616	15.2%
Office & Administrative Support	41,820	1,720	8.2%	7,584	13.4%
Farming, Fishing, & Forestry	26,240	37	0.2%	337	0.6%
Construction & Maintenance	48,913	346	1.7%	4,862	8.6%
Production Workers	38,430	318	1.5%	1,905	3.4%
Transp. & Material Moving	37,970	21	0.1%	2,358	4.2%
Total/Weighted Average	**57,190**	**20,865**	**92,385[a]**	**56,549**	**71,209[a]**

[a] Weighted average salary across occupation types.

VI. Caveats

Several issues relating to economic impacts were not addressed in this report. We have not analyzed the question of whether the economic impacts of CIRM funding are truly "additive" to baseline economic activity. That is, in the absence of CIRM, what would have been the expenditures on stem cell research in California. Note that this is an issue applicable to all economic impact studies and not just this one, and it is difficult to confirm. Kenney and Patton (2018) point out that California researchers in stem cell arena remain competitive for funding from other sources, and thus there has been no substitution effect.[12] Data presented in Section II indicate that CIRM grant recipients are able to attract a significant amount of other funding, thereby providing further indication that the existence of CIRM did make a difference.

[12] It should be noted Kenney and Patton characterize their results as preliminary, and they are now also somewhat dated. Moreover, there are several flaws in their assessments, including misinterpretations of CIRM funding objectives and improper comparisons with stem cell and general biotech initiatives in other regions.

Another issue not addressed here are the health savings that will emanate from CIRM funding, but they are addressed in a companion piece to this report by Tysinger et al. (2019). Finally, while we have evaluated the impacts of CIRM on major macroeconomic indicators, we have not measured its return on investment.

VII. Conclusion

The California Institute for Regenerative Medicine (CIRM) is a government agency established not only to improve the health and well-being of citizens of the state but also to help promote economic growth in California by attracting scientific talent, additional funding, and commercial enterprises as the research and development process progressed. Through the end of the year 2018, it has committed more than $2.67 billion across six broad categories of grants to fund physical and institutional infrastructure, basic research, education and training, research translation, research application, and clinical trials.

This report has focused on the various economic impacts of CIRM over and above its main functions of improving health and well-being. These increases in economic output, employment, and tax revenues represent valuable *co-benefits* of CIRM activities. Such benefits emanate not only from CIRM direct funding commitments, but also from co-funding, partnership funding, follow-on funding, and additional leveraged funding. We quantified not only the direct impacts but also various indirect impacts as CIRM and related expenditures ripple throughout the economy. The impacts are estimated both for California and the United States as a whole.

The total quantified economic impacts of CIRM on the California economy are estimated to be:

- $10.7 billion of additional gross output (sales revenue)
- $641.3 million of additional state/local tax revenues and $726.6 million of additional federal tax revenues
- 56,549 additional full-time equivalent (FTE) jobs, half of which offer salaries considerably higher than the state average
- About 50.2% of the gross output increase and 46.4% of jobs created are concentrated in medical and health related research, manufacturing, and service sectors

The total quantified economic impacts of CIRM on the economy of the rest of U.S. are estimated to be:

- $4.7 billion of additional gross output
- $198.7 million of additional state/local tax revenue and $208.6 million of additional federal tax revenues
- 25,816 additional jobs

Therefore, the total quantified economic impacts of CIRM on the entire U.S. economy are estimated to be:

- $15.4 billion of additional gross output

- $840 million of additional state/local tax revenue and $935.2 million of additional federal tax revenues
- 82,365 additional jobs
- About 38.4% of the gross output increase and 36.0% of jobs created are concentrated in medical and health related research, manufacturing, and service sectors

The quantified estimates are based on the economic stimulus created by CIRM grants, co-funding, partnership funding, leverage funding of Alpha Stem Cell Clinics, and CIRM operating expenditures. The vast majority of these impacts emanate from CIRM grants themselves.

The major sectors of the California economy impacted by CIRM direct and related funding are: Scientific Research and Development Services, Health Care Services, Construction of New Nonresidential Commercial and Health Care Structures, Professional Services, and Real Estate. However, because of the strong relationships of sectors in the California economy, all sectors in the state benefit from the existence of CIRM.

In addition, a qualitative analysis was performed of further funding downstream as commercialization of CIRM research progresses. This includes venture capital, licenses, and contributions to biotechnology clusters in the state. These impacts are sizable as well.

CIRM has led to California stem cell research and development activities becoming a leader among the states. In terms of economic impacts, the state's investment in CIRM has paid handsome dividends in terms of output, income, employment, and tax revenues for California.

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Appendix A. Examples of Funding Flows to CIRM Recipients

In this Appendix, we provide some examples of financing history for both CIRM and non-CIRM funded regenerative medicine companies to demonstrate that the development of their therapies benefit from multiple rounds of capital infusion from several different industry sources. These examples are for companies that are either in late-stage clinical development or have commercialized regenerative medicine therapies. The non-CIRM examples are directly relevant to the CIRM portfolio because they involve categorically similar therapeutic modalities and disease indications. All of this information demonstrates the need for multiple rounds of capital infusion, the overall scale of investment and the high value of regenerative medicine therapies.

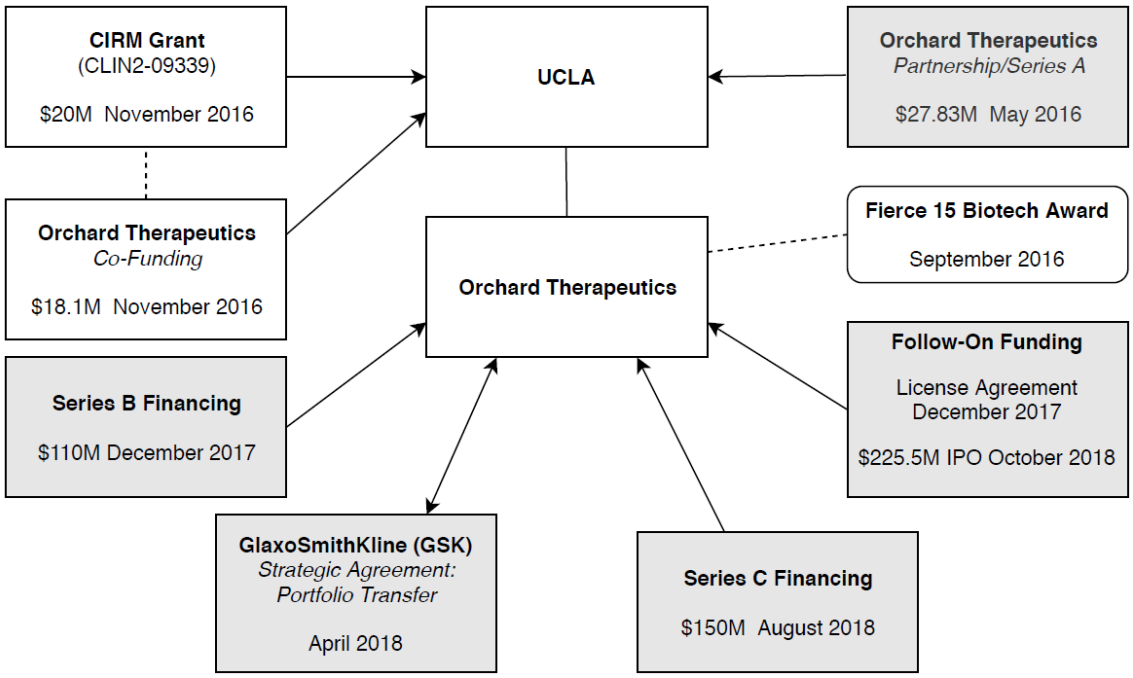
A1. Funding Flows to Orchard Therapeutics (CIRM-funded)

In 2016, the California Institute for Regenerative Medicine (CIRM) awarded a Clinical Trial grant to the University of California, Los Angeles for performing clinical trials to treat Adenosine Deaminase Severe Combined Immunodeficiency (ADA-SCID) (CIRM, 2016b). The $20 million grant was issued alongside $18.1 million in co-funding from Orchard Therapeutics. The initial grant and subsequent funding are outlined in Figure A1.

In May 2016, UCLA received $27.83 million in Partnership and Series A funding from Orchard Therapeutics.[13] Donald Kohn, the principal investigator for the CIRM grant, is an Orchard Therapeutics scientific founder and is also on the company's Scientific Advisory Board (Orchard Therapeutics, n.d.).

On September 19, 2016, Orchard Therapeutics was awarded a Fierce 15 Biotech Award, which recognizes the best in private biotechnology (Adams, 2016). The Award acknowledged the company's growth potential by highlighting the development of ADA-SCID therapy as the most likely to achieve commercialization (Adams, 2016).

[13] Series A funding refers to a company's first round of venture capital financing. As the company develops and seeks to grow, additional funding rounds may occur using subsequent letters (e.g., Series B and C). The company's valuation changes for each funding round with later rounds posing relatively lower risk for investors (compared to previous funding rounds).



Appendix Figure A1. CIRM Funding Stream: UCLA

In December 2017, Orchard Therapeutics received follow-on funding from venture capital companies, F-Prime and ORI Capital, and the investment banking company Cowen in addition to raising $110 million in Series B financing (Biotech Newswire, 2018b). In April 2018, Orchard Therapeutics' growth resulted in a strategic agreement with the pharmaceutical company GSK, transferring a portion of GSK's portfolio of rare gene therapies to Orchard (GSK, 2018).

In August 2018, Orchard Therapeutics received Series C financing of $150 million to continue the development of ADA-SCID clinical trials (Biotech Newswire, 2018b).

In October 2018, Orchard Therapeutics raised its initial public offering of $225.5 million.

A2. Funding Flows to Humacyte, Inc. (CIRM-funded)

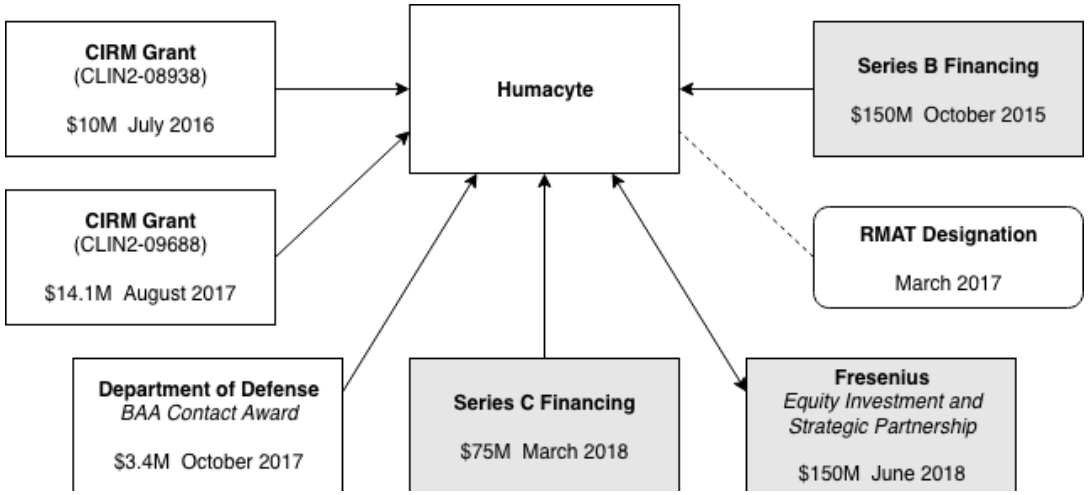
CIRM has awarded two clinical phase grants to Humacyte for its development of bioengineered blood vessels, known as Humacyl. Both grants were used for clinical trial funding for the use of Humacyl for treating different aspects of kidney failure (CIRM, 2016a; CIRM, 2017). The two CIRM grants and subsequent funding are outlined Figure A2.

The initial CIRM grant was awarded in 2016 to support the Phase 3 clinical trial of Humacyl. Prior to the 2016 clinical trial grant, Humacyte raised $150 million in Series B funding (DeBruyn, 2015). At the time, this was the largest amount raised in a single funding round for a biotechnology company in biotech history (DeBruyn, 2015).

After the 2016 CIRM grant (CLIN2-08938), Humacyl received Regenerative Medicine Advanced Therapy (RMAT) designation from the Food and Drug Administration (FDA). According to the Alliance for Regenerative Medicine, RMAT designated therapies experience an "optimized" approval pathway (Alliance for Regenerative Medicine, 2018b).[14] Humacyl is one of only twenty RMAT designations.

In September 2017, CIRM awarded its second clinical trial grant (CLIN2-09688) to Humacyte for the development of Humacyl. Soon after, Humacyte received a Broad Agency Announcement contact award from the United States Department of Defense for $3.4 million (Humacyte, 2017b).

In the following months, Humacyte raised $75 million in follow-on funding through a Series C financing round which included 29 investors (Humacyte, 2018). In March of 2018, the health care company Fresenius invested $150 million into Humacyte, and the two companies began a strategic partnership (PR Newswire, 2018).



Appendix Figure A2. CIRM Funding Stream: Humacyte

A3. Other Examples of Financing History for CIRM-funded and non-CIRM Funded Regenerative Medicine Companies

Gene-Modified CAR-T Cell Therapy (CIRM Funded): Poseida Therapeutics
Dec 2015: $30M Series A (VC)
Dec 2017: $20M CIRM Award
Apr 2018: $30.5M Series B (VC)
Sep 2018: $4.5M CIRM Award

[14] The RMAT Designation results in optimization by providing increased interactions with the Food and Drug Administration. These interactions allow companies to improve likelihood of approval by providing direct and frequent communication of feedback about developing therapies (Alliance for Regenerative Medicine, 2018b). The Designation may also result in "priority approval" (Alliance for Regenerative Medicine, 2018a).

Apr 2019: $142M Series C (VC)

Summary: Poseida Therapeutics is developing next generation CAR-T therapies for cancer. They have received two CIRM awards that have enabled additional VC investment. The company expects to file an application for FDA marketing approval of the CIRM-funded multiple myeloma CAR-T lead candidate in 2020.

Cancer Immunotherapy (CIRM Funded): Forty Seven, Inc.
Mar 2010: $20M CIRM Award (Stanford)
Jun 2014: $6.5M CIRM Award (Stanford)
Feb 2016: $75M Series A
Jan 2017: $10M CIRM Award
Oct 2017: $75M Series B
Nov 2017: $3.2M CIRM Award
June 2018: $113M IPO

Summary: CIRM funded the discovery and preclinical development of Forty Seven's core antibody technology at Stanford University thereby enabling the launch of Forty Seven. Forty Seven raised $150M VC financing, $113M public financing and an additional $13.2M to develop a portfolio of antibody therapy candidates for various cancers.

Gene Therapy: Avexis
Series A/B: Unknown
Jan 2015: $10M Series C (VC)
Sep 2015: $65M Series D (VC)
Feb 2016: $95M IPO
Jun 2017: $270M Follow-on Public Offering
Jan 2018: $432M Follow-on Public Offering
Apr 2018: $8700M Novartis Acquisition

Summary: Avexis raised successively larger rounds of private and public investment as it progressed clinical development of AVXS-101 spinal muscular atrophy gene therapy toward FDA marketing approval. Novartis acquired Avexis for $8.7B prior to the product being approved for marketing. In May 2019, FDA approved Zolgensma (AVXS-101) for spinal muscular atrophy. Novartis set the list price for Zolgensma at $2.1M for this one-time gene therapy.

Gene Therapy: Spark Therapeutics
Oct 2013: $50M Series A
May 2014: $72.8M Series B
Jan 2015: $161M IPO
Aug 2017: $380M Follow-on Public Offering
Feb 2019: $4800M Pending Roche Acquisition

Summary: Spark Therapeutics received the first gene therapy approval in the US for Luxturna in Dec 2017 to treat a rare genetic form of retinitis pigmentosa. Luxturna carries a list price of $425K/eye. Spark's acquisition by Roche Therapeutics for $4.8M is currently pending.

Gene-Modified CAR-T Cell Therapy: Juno Therapeutics (CAR-T cells for cancer)

Dec 2013: $120M Series A
Apr 2014: $56M Series A extension (VC)
Aug 2014: $134M Series B (VC)
Dec 2014: $264.6M IPO
Sep 2017: $319M Follow-on Public Offering
Jan 2018: $9,000M Celgene Acquisition

Summary: Juno Therapeutics raised $310M in VC financing, $584M in public financing and then was acquired by Celgene for $9B. Its CAR-T portfolio, including several partnerships, is still in clinical development.

Appendix B. I-O Model Aggregation Scheme

In this study, we aggregate the 536 sectors used in the 2016 IMPLAN data and the 440 sectors used in the 2012 and 2010 IMPLAN data into 115 sectors corresponding primarily to the 3-digit North American Industrial Classification System (NAICS) codes. However, we also retained the disaggregated sectors relating to health care, medical and clinical equipment and supplies manufacturing, scientific research and development services, and biopharmaceutical industry at 5- to 6-digit NAICS level. We provide mappings between the 115 sectors (including their corresponding NAICS codes) used in our I-O models and the sectors in the IMPLAN data in Appendix Tables B1 and B2.

Appendix Table B1. Mapping of 115 I-O Model Sectors to 440 IMPLAN Sectors and NAICS Codes

#	I-O Model Sector	NAICS Code	IMPLAN Sectors
1	Crop Production	111	1-10
2	Livestock	112	11-13
3	Animal production, except cattle and poultry and eggs	1122, 1124-5, 1129	14
4	Forestry and Logging	113	15-16
5	Fishing, Hunting and Trapping	114	17-18
6	Support Activities for Agriculture and Forestry	115	19
7	Oil and Gas Extraction	211	20
8	Mining	212	21-27
9	Mining Services	213	28-30
10	Electric power generation, transmission, and distribution	2211	31, 428, 431
11	Natural gas distribution	2212	32
12	Water, sewage and other systems	2213	33
13	Construction of new nonresidential commercial and health care structures	230	34
14	Other Construction	230	35-40
15	Food Manufacturing	311	41-69
16	Beverage and Tobacco Product Manufacturing	312	70-74
17	Textile Mills	313	75-85
18	Textile Products and Apparel Manufacturing	314-315	86-91
19	Leather and Allied Product Manufacturing	316	92-94
20	Wood Product Manufacturing	321	95-103
21	Stationary product manufacturing	32223	110
22	Paper Manufacturing	322	104-109, 111-112
23	Printing and Related Support Activities	323	113-114
24	Petroleum and Coal Products Manufacturing	324	115-119
25	Other basic inorganic chemical manufacturing	325188	125
26	Other basic organic chemical manufacturing	32519	126
27	Medicinal and botanical manufacturing	325411	132

28	Pharmaceutical preparation manufacturing	325412	133
29	In-vitro diagnostic substance manufacturing	325413	134
30	Biological product (except diagnostic) manufacturing	325414	135
31	Other Chemical Manufacturing	325	120-124, 127-131,136-141
32	Plastics and Rubber Products Manufacturing	326	142-152
33	Nonmetallic Mineral Product Manufacturing	327	153-169
34	Primary Metal Manufacturing	331	170-180
35	Fabricated Metal Product Manufacturing	332	181-202
36	Optical instrument and lens manufacturing	333314	211
37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	333415	216
38	Scales, balances, and miscellaneous general purpose machinery manufacturing	333992, 333997, 333999	230
39	Other Machinery Manufacturing	333	203-210,212-215,217-229,231-233
40	Electronic computer manufacturing	334111	234
41	Analytical laboratory instrument manufacturing	334516	254
42	Irradiation apparatus manufacturing	334517	255
43	Other Computer and Electronic Product Manufacturing	334	235-253,256-258
44	Electrical Equipment, Appliance, and Component Manufacturing	335	259-275
45	Transportation Equipment Manufacturing	336	276-294
46	Institutional furniture manufacturing	337127	299
47	Furniture and Related Product Manufacturing	337	295-298,300-304
48	Surgical and medical instrument manufacturing	339112	305
49	Surgical appliance and supplies manufacturing	339113	306
50	Dental equipment and supplies manufacturing	339114	307
51	Ophthalmic goods manufacturing	339115	308
52	Dental laboratories	339116	309
53	Office supplies (except paper) manufacturing	33994	313
54	Other Miscellaneous Manufacturing	339	310-312,314-318
55	Wholesale Trade	42	319
56	Motor Vehicle and Parts Dealers	441	320
57	Furniture and Home Furnishings Stores	442	321
58	Electronics and Appliance Stores	443	322
59	Building Material and Garden Equipment and Supplies Dealers	444	323
60	Food and Beverage Stores	445	324
61	Health and Personal Care Stores	446	325
62	Gasoline Stations	447	326
63	Clothing and Clothing Accessories Stores	448	327
64	Sporting Goods, Hobby, Book, and Music Stores	451	328
65	General Merchandise Stores	452	329
66	Miscellaneous Store Retailers	453	330
67	Non-store Retailers	454	331

68	Air Transportation	481	332
69	Rail Transportation	482	333
70	Water Transportation	483	334
71	Truck Transportation	484	335
72	Transit and Ground Passenger Transportation	485	336, 430
73	Pipeline Transportation	486	337
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	487	338
75	Postal Services, Couriers and Messengers	492	339, 427
76	Warehousing and Storage	493	340
77	Publishing Industries (except Internet)	511	341-345
78	Motion Picture and Sound Recording Industries	512	346-347
79	Broadcasting (except Internet)	515	348-349
80	Telecommunications	516-517	350-351
81	Data Processing, Hosting and Related Services	518	352
82	Other Information Services	519	353
83	Monetary Authorities	521	354
84	Credit Intermediation and Related Activities	522	355
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	523	356
86	Insurance Carriers and Related Activities	524	357-358
87	Funds, Trusts, and Other Financial Vehicles	525	359
88	Real Estate	531	360-361
89	Rental and Leasing Services	532	362-365
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	533	366
91	Scientific research and development services	5417	376
92	Other Professional, Scientific, and Technical Services	541	367-375,377-380
93	Management of Companies and Enterprises	551	381
94	Administrative and Support Services	561	382-389
95	Waste Management and Remediation Service	562	390
96	Junior colleges, colleges, universities, and professional schools	6112-3	392
97	Other Educational Services	6111, 6114-7	391,393
98	Offices of physicians, dentists, and other health practitioners	6211-3	394
99	Home health care services	6216	395
100	Medical and diagnostic labs and outpatient and other ambulatory care services	6214-5, 6219	396
101	Hospitals	622	397
102	Nursing and community care facilities	623	398
103	Social Assistance	624	399-401
104	Performing Arts, Spectator Sports, and Related Industries	712	402-405
105	Museums, Historical Sites, and Similar Institution	712	406
106	Amusement, Gambling, and Recreation Industries	713	407-410
107	Accommodation, including Hotels and Motels	721	411-412

108	Food Services and Drinking Places	722	413
109	Repair and Maintenance	811	414-418
110	Personal care services	8121	419
111	Death care services	8122	420
112	Other Personal and Laundry Services	812	421-422
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	813	423-425
114	Private Households	814	426
115	Government & Non NAICs	92	429, 432-440

Appendix Table B2. Mapping of 115 I-O Model Sectors to 536 IMPLAN Sectors and NAICS Codes

#	I-O Model Sector	NAICS Code	IMPLAN Sectors
1	Crop Production	111	1-10
2	Livestock	112	11-13
3	Animal production, except cattle and poultry and eggs	112990	14
4	Forestry and Logging	113	15-16
5	Fishing, Hunting and Trapping	114	17-18
6	Support Activities for Agriculture and Forestry	115	19
7	Oil and Gas Extraction	211	20-21
8	Mining	212	22-36
9	Mining Services	213	37-40
10	Electric power generation, transmission, and distribution	2211	41-49, 519, 522, 525
11	Natural gas distribution	2212	50
12	Water, sewage and other systems	2213	51
13	Construction of new nonresidential commercial and health care structures	230	52, 58
14	Other Construction	230	53-57, 59-64
15	Food Manufacturing	311	65-105
16	Beverage and Tobacco Product Manufacturing	312	106-111
17	Textile Mills	313	112-118
18	Textile Products and Apparel Manufacturing	314-315	119-130
19	Leather and Allied Product Manufacturing	316	131-133
20	Wood Product Manufacturing	321	134-145
21	Stationary product manufacturing	322230	151
22	Paper Manufacturing	322	146-150, 152-153
23	Printing and Related Support Activities	323	154-155
24	Petroleum and Coal Products Manufacturing	324	156-160
25	Other basic inorganic chemical manufacturing	325180	164
26	Other basic organic chemical manufacturing	325190	165
27	Medicinal and botanical manufacturing	325411	173
28	Pharmaceutical preparation manufacturing	325412	174
29	In-vitro diagnostic substance manufacturing	325413	175
30	Biological product (except diagnostic) manufacturing	325414	176
31	Other Chemical Manufacturing	325	161-163, 166-172, 177-187
32	Plastics and Rubber Products Manufacturing	326	188-198
33	Nonmetallic Mineral Product Manufacturing	327	199-216
34	Primary Metal Manufacturing	331	217-230
35	Fabricated Metal Product Manufacturing	332	231-261
36	Optical instrument and lens manufacturing	333314	272
37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	333415	277

38	Scales, balances, and miscellaneous general purpose machinery manufacturing	333997, 333999	300
39	Other Machinery Manufacturing	333	262-271, 273-276, 278-299
40	Electronic computer manufacturing	334111	301
41	Analytical laboratory instrument manufacturing	334516	320
42	Irradiation apparatus manufacturing	334517	321
43	Other Computer and Electronic Product Manufacturing	334	302-319, 322-324
44	Electrical Equipment, Appliance, and Component Manufacturing	335	325-342
45	Transportation Equipment Manufacturing	336	343-367
46	Institutional furniture manufacturing	337127	372
47	Furniture and Related Product Manufacturing	337	368-371, 373-378
48	Surgical and medical instrument manufacturing	339112	379
49	Surgical appliance and supplies manufacturing	339113	380
50	Dental equipment and supplies manufacturing	339114	381
51	Ophthalmic goods manufacturing	339115	382
52	Dental laboratories	339116	383
53	Office supplies (except paper) manufacturing	339940	387
54	Other Miscellaneous Manufacturing	339	384-386, 388-394
55	Wholesale Trade	42	395
56	Motor Vehicle and Parts Dealers	441	396
57	Furniture and Home Furnishings Stores	442	397
58	Electronics and Appliance Stores	443	398
59	Building Material and Garden Equipment and Supplies Dealers	444	399
60	Food and Beverage Stores	445	400
61	Health and Personal Care Stores	446	401
62	Gasoline Stations	447	402
63	Clothing and Clothing Accessories Stores	448	403
64	Sporting Goods, Hobby, Book, and Music Stores	451	404
65	General Merchandise Stores	452	405
66	Miscellaneous Store Retailers	453	406
67	Non-store Retailers	454	407
68	Air Transportation	481	408
69	Rail Transportation	482	409
70	Water Transportation	483	410
71	Truck Transportation	484	411
72	Transit and Ground Passenger Transportation	485	412, 521, 524
73	Pipeline Transportation	486	413
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	487,488	414
75	Postal Services, Couriers and Messengers	492	415, 518
76	Warehousing and Storage	493	416
77	Publishing Industries (except Internet)	511	417-422

78	Motion Picture and Sound Recording Industries	512	423-424
79	Broadcasting (except Internet)	515	425-426
80	Telecommunications	517	427-429
81	Data Processing, Hosting and Related Services	518	430
82	Other Information Services	519	431-432
83	Monetary Authorities	521	433
84	Credit Intermediation and Related Activities	522	434
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	523	435-436
86	Insurance Carriers and Related Activities	524	437-438
87	Funds, Trusts, and Other Financial Vehicles	525	439
88	Real Estate	531	440
89	Rental and Leasing Services	532	441-445
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	533	446
91	Scientific research and development services	5417	456
92	Other Professional, Scientific, and Technical Services	541	447-455, 457-460
93	Management of Companies and Enterprises	551	461
94	Administrative and Support Services	561	462-470
95	Waste Management and Remediation Service	562	471
96	Junior colleges, colleges, universities, and professional schools	6112-3	473
97	Other Educational Services	6111, 6114-7	472,474
98	Offices of physicians, dentists, and other health practitioners	6211-3	475-477
99	Home health care services	6216	480
100	Medical and diagnostic labs and outpatient and other ambulatory care services	6214-5, 6219	478-479, 481
101	Hospitals	622	482
102	Nursing and community care facilities	623	483-484
103	Social Assistance	624	485-487
104	Performing Arts, Spectator Sports, and Related Industries	711	488-492
105	Museums, Historical Sites, and Similar Institution	712	493
106	Amusement, Gambling, and Recreation Industries	713	494-498
107	Accommodation, including Hotels and Motels	721	499-500
108	Food Services and Drinking Places	722	501-503
109	Repair and Maintenance	811	504-508
110	Personal care services	8121	509
111	Death care services	8122	510
112	Other Personal and Laundry Services	812	511-512
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	813	513-516
114	Private Households	814	517
115	Government & Non NAICs	92	520, 523, 526-536

Appendix C. I-O Impact Methodology Details

In this study, we utilized a modification of the standard input-output computations to simulate the economic impacts of CIRM-related funding and the operations themselves (the goods and services and labor and capital inputs needed to run the Institute, as opposed to various funds that it disperses).

The standard method was used to simulate most of the funding streams associated with CIRM direct and indirect funding. This involved inserting the values of the grants/funding of recipients into final demand of equipment, materials/supplies, services for their appropriate sectors based on the detailed budget breakdowns of the grants and using the I-O model to calculate the total impacts (this process automatically adds indirect and induced effects to the direct effects input into final demand). For example, grant expenditures on constructions of new facilities, purchases of lab equipment and materials, office supplies, and spending on travel are linked to final demand increases in the sectors that produce these goods or provide the services in California.

The one exception relates to the operation of CIRM itself and the direct recipients of CIRM-related funding. We could have simply entered the total amount of CIRM operating expenses and the total funding amount as an increase in final demand of the Scientific Research and Development Services Sector as in the usual method. However, this would have utilized the I-O table Scientific Research and Development Services Sector production function (mix of inputs) which is a weighted average of all entities in that sector in California, and is based on secondary data. Since we received superior primary data on its operating expenditures from CIRM itself on how the funding was spent across different budget categories, we adapted the standard computational methodology to make the best use of these data.

For expenditures on wages and salaries for CIRM employees and for key/non-key personnel and administrative personnel working on the funded stem cell research, this involved entering the expenditures on wages/salaries and capital-related income into final demand, after utilizing IMPLAN adjustment factors for spending leakages relating to taxes, savings and purchase of imported goods. This enabled us to calculate the indirect and induced effects of this spending. We then added the direct wage/salary and capital-related income from the original primary data we received from CIRM (unadjusted for spending leakages) to compute the total effect on personal income. We also converted the expenditures on wages and salaries to direct employment impacts, and add these to the employment impacts resulting from the direct and indirect effects of the expenditures on facility construction, equipment, supplies, etc.

However, when we calculate the direct gross output impacts on CIRM and the funding recipients, the method for spending on goods and services differs from that for wages/salaries and related income. In the latter case, we only captured the effects of direct expenditures from these income payments, not the value of the income payments themselves. In the case of goods and services this method does in fact capture the direct spending for goods and services within California. All that is missing is the difference between the gross expenditures (which matches the data received from CIRM) and the part of its total gross output vs. the leakage adjustment. Hence, in this case, we only added the difference between the total CIRM expenditures on goods and services described above and the leakage adjusted expenditures to obtain the total impacts.

Appendix D. Methodology to Distribute Direct Funding among Relevant Expenditure Categories

This appendix summarizes the methods we adopted to determine the disbursement of CIRM grants and other types of funding among various budget and expenditure categories.

For all CIRM grants issued after December 2010, detailed budget breakdown information was obtained for each individual project. These budget categories include: Key Personnel Costs, Trainee Annual Tuition & Fees, Additional Personnel Costs, Travel Costs, Supplies, Equipment Costs, Collaborators/Consultants/Subcontracts, Facilities Costs, and Indirect Costs.

For CIRM grants issued before December 2010, however, grant applications were submitted by hard copies, and thus the budget breakdown information is not readily available. Using a stratified sampling approach, we drew a sample of 50 grants among the total of 439 grants that were approved before December 2010. Budget breakdown data for these sample grants were manually obtained from the hardy copy grant application documents. The budget distribution percentages among the various budget categories are calculated based on the sample data, and then applied to other projects fall under the same program types.

The following data and assumptions are adopted to further distribute travel, equipment, supplies, facilities, and indirect costs.

Travel Costs

In order to analyze the economic impacts of travel-related expenditures on the economy of California, we first assume the following percentage of travels that will take place within the state: 100% in-state travel for SPARK (a summer intern program for California high school students) and 50/50 split between in-state vs. out-of-state travels for "Conference" and travel expenditures for all other types of CIRM funded research projects. We then use the BEA (2018) travel expenditure data for Business Trips to further distribute the travel spending across various commodity types (see Appendix Table D1).

Appendix Table D1. Percentage Travel Expenditure by Commodity Category

Commodity	Percentage
Traveler accommodations	21.1%
Food and beverage services	14.7%
Domestic passenger air transportation services	15.3%
International passenger air transportation services	5.9%
Passenger rail transportation services	0.4%
Passenger water transportation services	0.0%
Intercity bus services	0.1%
Intercity charter bus services	0.0%
Local bus and other transportation services	0.8%
Taxicab services	1.0%
Scenic and sightseeing transportation services	0.2%
Automotive rental and leasing	10.7%

Other vehicle rental and leasing	0.3%
Automotive repair services	1.4%
Parking	0.2%
Highway tolls	0.1%
Travel arrangement and reservation services	10.8%
Motion pictures and performing arts	0.8%
Spectator sports	0.8%
Participant sports	0.4%
Gambling	0.0%
All other recreation and entertainment	0.3%
Gasoline	8.9%
Shopping	5.7%
Total	100.0%

Equipment Costs

The expenditures on equipment are distributed among the following equipment types: incubators, microscopes/cameras, computers, freezers, centrifuges, biosafety cabinets. The distribution was based on the average retail prices as well as an estimate on how often these items are purchased for CIRM funded projects. In the third column of the table below, an estimate on the frequency each item is purchased using biosafety cabinet (which is bought the least often) as the baseline.

Equipment Type	**Unit Price**	**Frequency of Purchase**
Incubators	$5,000	2x
Microscopes/Cameras	$12,000	3x
Computers	$3,500	4x
Freezers	$15,000	2x
Centrifuges	$1,500	4x
Biosafety Cabinets	$10,000	1x

Based on the above information, we calculated the proportion of expenditure on each equipment type using the following formula:

$$Proportion_i = \frac{Price_i \times Frequency\ Factor_i}{\sum_i Price_i \times Frequency\ Factor_i}$$

incubators	9.4%
microscopes/cameras	34.0%

computers	13.2%
freezers	28.3%
centrifuges	5.7%
biosafety cabinets	9.4%

Supplies Costs

We assume a 75/20/5 split among wet-lab-based supplies, medical/clinical supplies, and office supplies. Furthermore, we assume an even distribution of expenditures among the six sub-categories of the wet-lab-based supplies as listed below.

Wet-laboratory-based supplies (75%)
Consumables/disposables (12.5%)
Various reagents (12.5%)
Antibodies (12.5%)
Animal purchases (12.5%)
Cell culture media (12.5%)
Chemicals (12.5%)

Medical/clinical supplies (20%)

Office supplies (5%)

Total Facilities Costs

For this budget category, on average, about 40% goes to "Operations & Maintenance" expenses like utility bills (for which we distributed among electricity, water, and sanitary) and other facilities operating costs; 40% goes towards "Depreciation and Use Allowances"; 15% goes towards "Interest on Capital Debt", and 5% goes to "Library Expenses."

Indirect Costs

This refers to administrative overhead and generally covers administrative/office-type personnel. We simulate this as increases in household expenditures for the income group in which the administrative/office-type personnel fit in.

For co-funding, we assume that the budget breakdown for each project is the same as the associated main CIRM grant. For partnership funding, we assume that the budget breakdown is the same as the CIRM grant that the PI originally received. For follow-on funding, since most funding agencies of these non-CIRM grants are NIH and non-profit foundations, we use the weighted average budget breakdown of CIRM Discovery projects for these non-CIRM grants, except for those cases where the PIs explicitly indicated under the "research objective" question of the survey that the funding is for clinical trials. For the ASCC leverage funding, we use the weighted average budget breakdown for the clinical trial projects funded by CIRM grants.

Appendix E. IMPLAN Regional Purchase Coefficients

The Regional Purchase Coefficient (RPC) of a given economic sector represents the proportion of in-state (or domestic) demand of goods and services that is fulfilled by in-state (or domestic) production. The table below presents the default RPCs by sector for the 2010, 2012, and 2016 California and U.S. IMPLAN I-O models. The various types of CIRM-related funding payments are multiplied by the sectoral RPCs to translate the direct payments into in-state (or domestic) final demand increases used in the I-O analysis.

#	I-O Model Sector	CA			US		
		2010	2012	2016	2010	2012	2016
1	Crop Production	0.509	0.424	0.485	0.870	0.884	0.804
2	Livestock	0.651	0.718	0.627	0.992	1.000	0.977
3	Animal production, except cattle and poultry and eggs	0.161	0.169	0.112	0.902	0.902	0.779
4	Forestry and Logging	0.533	0.537	0.467	0.843	0.772	0.810
5	Fishing, Hunting and Trapping	0.084	0.103	0.112	0.348	0.258	0.209
6	Support Activities for Agriculture and Forestry	1.000	1.000	1.000	0.984	0.843	1.000
7	Oil and Gas Extraction	0.088	0.102	0.163	0.374	0.354	0.514
8	Mining	0.203	0.349	0.323	0.918	0.956	0.955
9	Mining Services	0.907	0.959	0.352	1.000	0.988	0.994
10	Electric power generation, transmission, and distribution	0.710	0.585	0.347	0.990	1.000	0.990
11	Natural gas distribution	0.966	0.968	0.953	1.000	1.000	1.000
12	Water, sewage and other systems	1.000	0.992	1.000	1.000	1.000	1.000
13	Construction of new nonresidential commercial and health care structures	1.000	0.987	0.999	1.000	1.000	1.000
14	Other Construction	0.999	0.918	0.981	1.000	0.972	1.000
15	Food Manufacturing	0.628	0.623	0.501	0.940	0.937	0.944
16	Beverage and Tobacco Product Manufacturing	0.636	0.621	0.596	0.914	0.884	0.917
17	Textile Mills	0.322	0.306	0.137	0.642	0.644	0.708
18	Textile Products and Apparel Manufacturing	0.211	0.179	0.141	0.231	0.189	0.296
19	Leather and Allied Product Manufacturing	0.042	0.050	0.009	0.084	0.108	0.127
20	Wood Product Manufacturing	0.505	0.478	0.420	0.841	0.890	0.801
21	Stationary product manufacturing	0.867	0.619	0.537	0.985	0.996	0.939
22	Paper Manufacturing	0.444	0.428	0.389	0.893	0.954	0.894
23	Printing and Related Support Activities	0.494	0.497	0.510	0.916	0.905	0.904
24	Petroleum and Coal Products Manufacturing	0.786	0.761	0.799	0.886	0.859	0.864
25	Other basic inorganic chemical manufacturing	0.307	0.257	0.286	0.660	0.692	0.697
26	Other basic organic chemical manufacturing	0.249	0.286	0.016	0.744	0.717	0.639
27	Medicinal and botanical manufacturing	0.118	0.127	0.871	0.214	0.224	0.983
28	Pharmaceutical preparation manufacturing	0.697	0.669	0.694	0.826	0.838	0.741
29	In-vitro diagnostic substance manufacturing	0.933	0.936	0.480	1.000	0.986	0.490

30	Biological product (except diagnostic) manufacturing	0.366	0.319	0.146	0.627	0.551	0.221
31	Other Chemical Manufacturing	0.439	0.401	0.331	0.894	0.946	0.906
32	Plastics and Rubber Products Manufacturing	0.456	0.470	0.342	0.794	0.859	0.803
33	Nonmetallic Mineral Product Manufacturing	0.612	0.683	0.600	0.847	0.957	0.836
34	Primary Metal Manufacturing	0.332	0.433	0.191	0.702	0.860	0.664
35	Fabricated Metal Product Manufacturing	0.538	0.582	0.461	0.855	0.942	0.821
36	Optical instrument and lens manufacturing	0.072	0.074	0.112	0.127	0.121	0.364
37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	0.268	0.221	0.176	0.799	0.707	0.743
38	Scales, balances, and miscellaneous general purpose machinery manufacturing	0.035	0.024	0.068	0.070	0.042	0.264
39	Other Machinery Manufacturing	0.328	0.283	0.165	0.754	0.764	0.738
40	Electronic computer manufacturing	0.552	0.506	0.912	0.673	0.657	0.914
41	Analytical laboratory instrument manufacturing	0.429	0.295	0.318	0.623	0.468	0.654
42	Irradiation apparatus manufacturing	0.194	0.125	0.110	0.591	0.498	0.636
43	Other Computer and Electronic Product Manufacturing	0.427	0.445	0.383	0.624	0.730	0.603
44	Electrical Equipment, Appliance, and Component Manufacturing	0.271	0.273	0.219	0.611	0.637	0.572
45	Transportation Equipment Manufacturing	0.225	0.187	0.200	0.681	0.738	0.725
46	Institutional furniture manufacturing	0.080	0.107	0.168	0.184	0.252	0.514
47	Furniture and Related Product Manufacturing	0.388	0.401	0.310	0.648	0.678	0.686
48	Surgical and medical instrument manufacturing	0.548	0.540	0.510	0.813	0.787	0.835
49	Surgical appliance and supplies manufacturing	0.490	0.419	0.257	0.753	0.688	0.710
50	Dental equipment and supplies manufacturing	0.600	0.592	0.527	0.747	0.734	0.746
51	Ophthalmic goods manufacturing	0.326	0.250	0.318	0.683	0.439	0.519
52	Dental laboratories	0.720	0.788	0.657	1.000	0.971	0.901
53	Office supplies (except paper) manufacturing	0.277	0.252	0.051	0.608	0.653	0.534
54	Other Miscellaneous Manufacturing	0.282	0.268	0.234	0.422	0.416	0.430
55	Wholesale Trade	0.993	0.999	1.000	1.000	1.000	1.000
56	Motor Vehicle and Parts Dealers	0.794	0.876	0.967	1.000	1.000	1.000
57	Furniture and Home Furnishings Stores	0.973	0.999	0.997	1.000	1.000	1.000
58	Electronics and Appliance Stores	1.000	0.997	0.996	1.000	1.000	1.000
59	Building Material and Garden Equipment and Supplies Dealers	0.846	0.911	0.925	1.000	0.997	1.000
60	Food and Beverage Stores	1.000	0.997	1.000	1.000	1.000	1.000
61	Health and Personal Care Stores	0.922	0.982	0.998	1.000	1.000	1.000
62	Gasoline Stations	0.999	0.818	0.957	1.000	0.998	1.000
63	Clothing and Clothing Accessories Stores	0.966	0.983	0.998	1.000	0.999	1.000
64	Sporting Goods, Hobby, Book, and Music Stores	1.000	0.995	0.997	1.000	0.998	1.000
65	General Merchandise Stores	0.826	0.902	0.954	1.000	0.999	1.000
66	Miscellaneous Store Retailers	0.999	1.000	0.998	1.000	0.995	1.000
67	Non-store Retailers	0.877	1.000	0.995	1.000	0.989	1.000
68	Air Transportation	0.518	0.584	0.785	0.692	0.715	0.815
69	Rail Transportation	0.729	0.624	0.527	0.989	1.000	0.993

70	Water Transportation	0.686	0.623	0.858	1.000	0.919	1.000
71	Truck Transportation	0.923	0.932	0.932	0.974	1.000	0.984
72	Transit and Ground Passenger Transportation	0.954	0.828	0.941	1.000	0.971	1.000
73	Pipeline Transportation	0.477	0.298	0.178	1.000	0.847	1.000
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	0.982	0.893	1.000	1.000	0.960	1.000
75	Postal Services, Couriers and Messengers	0.918	0.833	0.951	1.000	0.964	0.994
76	Warehousing and Storage	0.973	0.889	0.969	1.000	0.941	1.000
77	Publishing Industries (except Internet)	0.702	0.833	0.931	0.971	0.950	0.975
78	Motion Picture and Sound Recording Industries	0.968	0.971	0.982	0.974	0.975	0.949
79	Broadcasting (except Internet)	0.987	1.000	0.950	1.000	1.000	1.000
80	Telecommunications	1.000	0.895	0.954	1.000	1.000	1.000
81	Data Processing, Hosting and Related Services	0.982	0.903	1.000	0.999	0.960	0.997
82	Other Information Services	0.850	0.565	0.850	1.000	0.914	1.000
83	Monetary Authorities	0.894	0.803	0.816	0.996	0.968	1.000
84	Credit Intermediation and Related Activities	0.897	1.000	1.000	1.000	1.000	1.000
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	1.000	0.933	0.958	1.000	0.976	1.000
86	Insurance Carriers and Related Activities	0.652	0.542	0.675	0.908	0.827	0.921
87	Funds, Trusts, and Other Financial Vehicles	0.917	0.967	1.000	1.000	0.990	1.000
88	Real Estate	1.000	0.977	0.999	1.000	0.987	1.000
89	Rental and Leasing Services	0.940	0.990	0.996	0.998	1.000	1.000
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	0.995	0.875	1.000	1.000	0.826	1.000
91	Scientific research and development services	1.000	1.000	0.975	0.987	1.000	0.975
92	Other Professional, Scientific, and Technical Services	0.983	0.977	0.962	0.987	0.963	0.970
93	Management of Companies and Enterprises	0.826	0.899	0.929	1.000	1.000	1.000
94	Administrative and Support Services	0.948	0.930	0.935	0.999	0.969	0.998
95	Waste Management and Remediation Service	0.984	0.999	1.000	0.999	0.998	0.999
96	Junior colleges, colleges, universities, and professional schools	0.624	0.914	0.991	0.996	0.996	0.996
97	Other Educational Services	0.829	1.000	0.954	1.000	0.983	1.000
98	Offices of physicians, dentists, and other health practitioners	0.875	0.976	0.858	1.000	1.000	1.000
99	Home health care services	0.497	0.726	0.749	1.000	1.000	1.000
100	Medical and diagnostic labs and outpatient and other ambulatory care services	0.997	0.976	1.000	1.000	0.947	1.000
101	Hospitals	0.655	0.891	0.901	1.000	1.000	0.997
102	Nursing and community care facilities	0.679	0.762	0.896	1.000	1.000	1.000
103	Social Assistance	0.835	0.967	1.000	1.000	1.000	1.000
104	Performing Arts, Spectator Sports, and Related Industries	0.970	0.955	0.958	0.997	0.982	0.998
105	Museums, Historical Sites, and Similar Institution	0.923	0.998	1.000	1.000	1.000	1.000
106	Amusement, Gambling, and Recreation Industries	0.949	0.934	0.958	1.000	1.000	1.000
107	Accommodation, including Hotels and Motels	0.179	0.169	0.176	1.000	0.994	1.000
108	Food Services and Drinking Places	0.972	0.977	1.000	1.000	0.994	1.000

109	Repair and Maintenance	0.973	0.951	0.986	0.978	0.961	0.988
110	Personal care services	0.898	0.978	0.999	1.000	1.000	1.000
111	Death care services	0.910	0.806	0.853	1.000	1.000	1.000
112	Other Personal and Laundry Services	1.000	0.994	1.000	1.000	0.971	1.000
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	0.762	0.911	0.839	1.000	0.970	1.000
114	Private Households	0.996	1.000	0.999	1.000	1.000	1.000
115	Government & Non NAICs	0.874	0.826	0.894	0.884	0.859	0.891

Appendix F. Sectoral Impact Results

In Tables F1 to F4, we present the total gross output and employment impacts at both the state and national levels for each sector over the entire study period of 2006 to 2023. The results are presented for each individual funding type and the total sectoral impacts across all funding types.

Table F1. Gross Output Impacts on California by Funding Type and by Sector

Sector	Description	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
1	Crop Production	7.8	2.7	3.3	0.0	0.8	0.6	15.3
2	Livestock	5.9	1.7	2.2	0.0	0.6	0.5	10.9
3	Animal production, except cattle and poultry and eggs	8.8	1.8	5.0	0.0	1.1	0.0	16.7
4	Forestry and Logging	0.3	0.2	0.1	0.0	0.0	0.0	0.6
5	Fishing, Hunting and Trapping	0.2	0.1	0.1	0.0	0.0	0.0	0.3
6	Support Activities for Agriculture and Forestry	1.1	0.4	0.5	0.0	0.1	0.1	2.2
7	Oil and Gas Extraction	4.9	1.8	1.7	0.0	0.5	0.4	9.3
8	Mining	1.3	0.4	0.7	0.0	0.2	0.1	2.6
9	Mining Services	0.3	0.1	0.1	0.0	0.0	0.0	0.5
10	Electric power generation, transmission, and distribution	39.5	10.6	17.8	0.2	4.8	1.9	74.8
11	Natural gas distribution	11.6	4.0	2.6	0.0	0.9	1.1	20.0
12	Water, sewage and other systems	36.8	7.4	27.0	0.3	6.5	0.1	78.2
13	Construction of new nonresidential commercial and health care structures	239.6	292.2	0.0	0.0	0.0	3.0	534.8
14	Other Construction	24.6	7.3	13.4	0.1	3.1	1.7	50.1
15	Food Manufacturing	56.2	17.2	24.0	0.2	6.0	4.6	108.2
16	Beverage and Tobacco Product Manufacturing	17.1	5.4	9.0	0.1	2.0	1.4	35.1
17	Textile Mills	2.1	1.1	0.2	0.0	0.1	0.1	3.8
18	Textile Products and Apparel Manufacturing	3.0	1.0	1.4	0.0	0.3	0.3	6.0
19	Leather and Allied Product Manufacturing	0.2	0.1	0.0	0.0	0.0	0.0	0.3
20	Wood Product Manufacturing	4.5	3.8	1.2	0.0	0.2	0.2	10.0
21	Stationary product manufacturing	7.6	1.5	4.8	0.0	0.9	0.0	14.9
22	Paper Manufacturing	7.3	2.7	3.5	0.0	0.8	0.5	14.8
23	Printing and Related Support Activities	4.3	1.6	2.1	0.0	0.5	0.4	8.8
24	Petroleum and Coal Products Manufacturing	47.9	20.3	13.2	0.1	4.0	4.1	89.7
25	Other basic inorganic chemical manufacturing	8.8	2.0	6.6	0.0	1.2	0.0	18.5
26	Other basic organic chemical manufacturing	5.1	0.8	0.5	0.0	0.4	0.0	6.8
27	Medicinal and botanical manufacturing	1.3	0.4	1.4	0.0	0.2	0.0	3.3
28	Pharmaceutical preparation manufacturing	71.5	18.3	46.1	0.2	9.1	2.3	147.6
29	In-vitro diagnostic substance manufacturing	1.2	0.4	0.4	0.0	0.1	0.1	2.2

30	Biological product (except diagnostic) manufacturing	23.4	4.2	10.1	0.0	2.5	0.0	40.3
31	Other Chemical Manufacturing	12.3	5.1	4.7	0.0	1.1	0.8	24.1
32	Plastics and Rubber Products Manufacturing	9.4	4.9	3.4	0.0	0.8	0.6	19.0
33	Nonmetallic Mineral Product Manufacturing	9.7	8.2	2.2	0.0	0.5	0.4	21.0
34	Primary Metal Manufacturing	3.8	2.8	0.7	0.0	0.2	0.2	7.8
35	Fabricated Metal Product Manufacturing	18.6	15.4	4.4	0.0	0.9	0.7	40.0
36	Optical instrument and lens manufacturing	3.5	3.2	1.5	0.0	0.1	0.0	8.3
37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	17.8	19.7	4.0	0.0	0.3	0.0	41.8
38	Scales, balances, and miscellaneous general purpose machinery manufacturing	0.6	0.6	0.3	0.0	0.0	0.0	1.5
39	Other Machinery Manufacturing	3.4	3.0	0.8	0.0	0.2	0.1	7.5
40	Electronic computer manufacturing	27.2	21.9	13.4	0.0	1.3	0.5	64.2
41	Analytical laboratory instrument manufacturing	15.9	17.4	4.1	0.0	0.3	0.0	37.7
42	Irradiation apparatus manufacturing	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	Other Computer and Electronic Product Manufacturing	14.7	8.1	6.3	0.0	1.2	0.9	31.2
44	Electrical Equipment, Appliance, and Component Manufacturing	4.9	3.5	1.5	0.0	0.3	0.3	10.4
45	Transportation Equipment Manufacturing	9.5	3.4	5.7	0.1	1.1	0.8	20.6
46	Institutional furniture manufacturing	2.6	2.2	1.2	0.0	0.1	0.0	6.0
47	Furniture and Related Product Manufacturing	4.4	2.7	1.7	0.0	0.4	1.3	10.5
48	Surgical and medical instrument manufacturing	27.6	6.1	19.4	0.1	3.7	0.1	56.8
49	Surgical appliance and supplies manufacturing	39.4	16.7	17.4	0.1	3.6	0.1	77.3
50	Dental equipment and supplies manufacturing	0.2	0.1	0.1	0.0	0.0	0.0	0.5
51	Ophthalmic goods manufacturing	0.5	0.2	0.3	0.0	0.1	0.0	1.1
52	Dental laboratories	0.4	0.1	0.2	0.0	0.0	0.0	0.8
53	Office supplies (except paper) manufacturing	2.0	0.3	0.5	0.0	0.2	0.6	3.6
54	Other Miscellaneous Manufacturing	3.7	1.2	1.9	0.0	0.4	0.3	7.6
55	Wholesale Trade	113.7	41.7	61.4	0.5	12.9	7.9	238.1
56	Motor Vehicle and Parts Dealers	22.4	7.2	11.7	0.1	2.6	1.9	46.0
57	Furniture and Home Furnishings Stores	6.7	2.2	3.7	0.0	0.8	0.6	14.0
58	Electronics and Appliance Stores	6.8	2.2	1.8	0.0	0.6	0.6	12.1
59	Building Material and Garden Equipment and Supplies Dealers	11.6	3.7	8.0	0.1	1.5	1.0	25.8
60	Food and Beverage Stores	27.0	8.7	14.9	0.1	3.2	2.3	56.3
61	Health and Personal Care Stores	13.0	4.1	7.5	0.1	1.6	1.1	27.4
62	Gasoline Stations	9.9	3.4	5.4	0.0	1.0	1.1	20.8
63	Clothing and Clothing Accessories Stores	15.5	4.8	8.7	0.1	1.9	1.3	32.3
64	Sporting Goods, Hobby, Book, and Music Stores	5.3	1.7	2.6	0.0	0.6	0.5	10.7
65	General Merchandise Stores	26.0	8.2	16.3	0.2	3.3	2.3	56.3
66	Miscellaneous Store Retailers	9.8	3.2	4.3	0.0	1.0	0.9	19.3
67	Non-store Retailers	23.1	6.8	17.8	0.2	3.4	1.9	53.2
68	Air Transportation	16.3	5.6	12.2	0.1	2.0	2.0	38.2
69	Rail Transportation	2.6	1.1	1.0	0.0	0.2	0.2	5.1

70	Water Transportation	2.0	0.5	1.3	0.0	0.3	0.1	4.3
71	Truck Transportation	21.7	8.7	12.3	0.1	2.5	1.6	46.9
72	Transit and Ground Passenger Transportation	6.6	2.3	4.8	0.0	0.8	0.6	15.1
73	Pipeline Transportation	0.8	0.4	0.2	0.0	0.1	0.1	1.5
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	7.9	2.9	5.6	0.1	1.0	0.7	18.2
75	Postal Services, Couriers and Messengers	11.9	4.1	6.1	0.1	1.3	1.1	24.5
76	Warehousing and Storage	7.0	2.6	4.8	0.0	0.9	0.5	15.8
77	Publishing Industries (except Internet)	35.6	12.6	22.8	0.2	5.1	3.7	80.1
78	Motion Picture and Sound Recording Industries	10.6	3.7	5.5	0.1	1.2	1.0	22.0
79	Broadcasting (except Internet)	13.5	5.3	9.1	0.1	1.7	1.2	30.8
80	Telecommunications	64.9	24.5	37.6	0.3	7.6	8.7	143.7
81	Data Processing, Hosting and Related Services	9.0	3.2	4.9	0.0	1.0	1.0	19.2
82	Other Information Services	8.4	2.5	11.6	0.1	1.8	1.0	25.4
83	Monetary Authorities	66.9	24.2	27.4	0.3	6.9	8.0	133.6
84	Credit Intermediation and Related Activities	28.7	12.8	13.1	0.1	2.5	3.0	60.3
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	64.0	22.8	31.7	0.3	6.9	6.5	132.2
86	Insurance Carriers and Related Activities	63.0	20.8	38.5	0.3	7.6	6.1	136.3
87	Funds, Trusts, and Other Financial Vehicles	22.3	6.6	12.8	0.1	2.8	2.0	46.6
88	Real Estate	261.7	85.3	81.4	0.8	24.2	28.2	481.6
89	Rental and Leasing Services	99.2	32.5	133.3	1.3	19.7	7.5	293.5
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	10.1	4.1	5.8	0.0	1.1	1.7	22.8
91	Scientific research and development services	1,905.6	561.8	1,408.4	12.4	245.7	188.6	4,322.5
92	Other Professional, Scientific, and Technical Services	141.8	62.0	72.1	0.7	15.3	24.4	316.1
93	Management of Companies and Enterprises	36.5	13.3	25.0	0.2	4.6	3.2	82.9
94	Administrative and Support Services	64.9	22.2	37.8	0.3	7.7	27.2	160.1
95	Waste Management and Remediation Service	46.3	10.4	32.1	0.4	7.8	1.0	97.9
96	Junior colleges, colleges, universities, and professional schools	84.5	6.9	13.4	0.1	5.4	1.7	112.1
97	Other Educational Services	17.0	5.2	9.6	0.1	2.0	1.5	35.5
98	Offices of physicians, dentists, and other health practitioners	81.7	25.5	43.6	0.4	9.7	6.9	167.8
99	Home health care services	7.2	2.3	5.1	0.1	1.0	0.6	16.2
100	Medical and diagnostic labs and outpatient and other ambulatory care services	30.9	10.1	18.5	0.2	3.8	2.6	66.0
101	Hospitals	212.7	43.6	85.7	0.4	40.9	6.2	389.5
102	Nursing and community care facilities	19.9	6.2	10.3	0.1	2.4	1.7	40.5
103	Social Assistance	22.3	7.0	14.6	0.1	2.9	1.9	48.8
104	Performing Arts, Spectator Sports, and Related Industries	14.6	4.9	9.4	0.1	1.8	1.4	32.3
105	Museums, Historical Sites, and Similar Institution	2.2	0.7	1.0	0.0	0.2	0.2	4.2
106	Amusement, Gambling, and Recreation Industries	19.0	6.1	11.8	0.1	2.4	1.7	41.1
107	Accommodation, including Hotels and Motels	5.5	1.9	3.1	0.0	0.6	1.2	12.4
108	Food Services and Drinking Places	100.5	32.3	62.4	0.6	12.6	9.0	217.4
109	Repair and Maintenance	29.3	11.0	20.0	0.2	3.7	2.4	66.6

110	Personal care services	9.7	3.0	5.5	0.1	1.2	0.8	20.2
111	Death care services	1.8	0.6	0.7	0.0	0.2	0.2	3.5
112	Other Personal and Laundry Services	11.2	3.7	5.4	0.1	1.2	1.0	22.6
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	31.2	10.7	15.0	0.1	3.4	2.7	63.1
114	Private Households	3.2	1.1	1.8	0.0	0.3	0.3	6.6
115	Government & Non NAICs	55.8	18.8	34.3	0.3	6.7	4.6	120.5
	Total	**4,957.3**	**1,816.4**	**2,888.7**	**25.1**	**580.7**	**434.1**	**10,702.3**

Table F2. Employment Impacts on California by Funding Type and by Sector

Sector	Description	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
1	Crop Production	35	12	21	0	4	3	75
2	Livestock	17	5	5	0	2	1	30
3	Animal production, except cattle and poultry and eggs	87	14	24	0	9	0	135
4	Forestry and Logging	2	2	1	0	0	0	4
5	Fishing, Hunting and Trapping	2	1	1	0	0	0	5
6	Support Activities for Agriculture and Forestry	24	7	8	0	2	2	43
7	Oil and Gas Extraction	18	7	7	0	2	2	36
8	Mining	5	2	2	0	0	0	9
9	Mining Services	1	0	1	0	0	0	2
10	Electric power generation, transmission, and distribution	43	12	15	0	4	2	77
11	Natural gas distribution	11	4	4	0	1	1	20
12	Water, sewage and other systems	120	23	76	1	20	0	241
13	Construction of new nonresidential commercial and health care structures	1,607	1,927	0	0	0	19	3,552
14	Other Construction	148	43	71	1	18	10	290
15	Food Manufacturing	108	34	49	0	12	9	211
16	Beverage and Tobacco Product Manufacturing	29	9	16	0	4	2	60
17	Textile Mills	9	5	1	0	0	1	16
18	Textile Products and Apparel Manufacturing	20	7	10	0	2	2	41
19	Leather and Allied Product Manufacturing	1	0	0	0	0	0	2
20	Wood Product Manufacturing	24	22	5	0	1	1	54
21	Stationary product manufacturing	19	4	11	0	2	0	35
22	Paper Manufacturing	16	6	7	0	2	1	31
23	Printing and Related Support Activities	28	10	13	0	3	3	57
24	Petroleum and Coal Products Manufacturing	7	3	3	0	1	1	14
25	Other basic inorganic chemical manufacturing	10	2	7	0	1	0	21
26	Other basic organic chemical manufacturing	3	1	0	0	0	0	4
27	Medicinal and botanical manufacturing	2	1	2	0	0	0	5
28	Pharmaceutical preparation manufacturing	41	10	22	0	5	1	80
29	In-vitro diagnostic substance manufacturing	2	1	1	0	0	0	4
30	Biological product (except diagnostic) manufacturing	34	6	14	0	4	0	57
31	Other Chemical Manufacturing	13	6	5	0	1	1	26
32	Plastics and Rubber Products Manufacturing	29	16	10	0	2	2	59
33	Nonmetallic Mineral Product Manufacturing	33	29	7	0	1	1	71
34	Primary Metal Manufacturing	7	6	1	0	0	0	15
35	Fabricated Metal Product Manufacturing	77	67	17	0	4	3	168
36	Optical instrument and lens manufacturing	10	9	4	0	0	0	23

37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	51	55	9	0	1	0	117
38	Scales, balances, and miscellaneous general purpose machinery manufacturing	2	2	1	0	0	0	5
39	Other Machinery Manufacturing	9	9	2	0	0	0	21
40	Electronic computer manufacturing	16	12	9	0	1	0	38
41	Analytical laboratory instrument manufacturing	36	39	9	0	1	0	85
42	Irradiation apparatus manufacturing	0	0	0	0	0	0	0
43	Other Computer and Electronic Product Manufacturing	26	15	12	0	2	2	56
44	Electrical Equipment, Appliance, and Component Manufacturing	14	10	4	0	1	1	29
45	Transportation Equipment Manufacturing	18	7	10	0	2	1	39
46	Institutional furniture manufacturing	12	10	6	0	0	0	28
47	Furniture and Related Product Manufacturing	25	16	9	0	2	7	58
48	Surgical and medical instrument manufacturing	62	13	37	0	8	0	121
49	Surgical appliance and supplies manufacturing	105	45	37	0	9	0	196
50	Dental equipment and supplies manufacturing	1	0	0	0	0	0	1
51	Ophthalmic goods manufacturing	2	1	1	0	0	0	4
52	Dental laboratories	5	1	2	0	1	0	9
53	Office supplies (except paper) manufacturing	9	1	2	0	1	3	16
54	Other Miscellaneous Manufacturing	16	6	9	0	2	1	35
55	Wholesale Trade	517	202	238	2	53	37	1,049
56	Motor Vehicle and Parts Dealers	173	55	71	1	18	15	333
57	Furniture and Home Furnishings Stores	57	18	28	0	6	5	114
58	Electronics and Appliance Stores	50	16	25	0	5	4	102
59	Building Material and Garden Equipment and Supplies Dealers	104	33	61	1	13	9	220
60	Food and Beverage Stores	322	104	153	1	35	28	644
61	Health and Personal Care Stores	124	39	60	1	14	11	249
62	Gasoline Stations	68	22	38	0	7	7	144
63	Clothing and Clothing Accessories Stores	174	56	79	1	19	15	343
64	Sporting Goods, Hobby, Book, and Music Stores	80	26	37	0	9	7	159
65	General Merchandise Stores	324	104	170	2	37	30	667
66	Miscellaneous Store Retailers	162	51	74	1	18	14	320
67	Non-store Retailers	175	56	95	1	20	15	362
68	Air Transportation	42	15	25	0	4	5	91
69	Rail Transportation	7	3	3	0	1	1	14
70	Water Transportation	3	1	2	0	0	0	6
71	Truck Transportation	147	63	70	1	15	11	307
72	Transit and Ground Passenger Transportation	108	38	76	1	14	10	246
73	Pipeline Transportation	1	0	0	0	0	0	2
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	51	19	29	0	6	5	110
75	Postal Services, Couriers and Messengers	100	36	49	0	11	9	205
76	Warehousing and Storage	70	26	44	0	8	5	154

77	Publishing Industries (except Internet)	74	27	49	1	11	8	169
78	Motion Picture and Sound Recording Industries	27	9	12	0	3	3	54
79	Broadcasting (except Internet)	28	13	10	0	2	3	56
80	Telecommunications	106	43	39	0	10	15	214
81	Data Processing, Hosting and Related Services	24	8	14	0	3	3	51
82	Other Information Services	12	3	15	0	2	1	35
83	Monetary Authorities	154	56	67	1	16	18	313
84	Credit Intermediation and Related Activities	170	78	67	1	13	18	347
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	373	137	164	1	37	39	751
86	Insurance Carriers and Related Activities	252	83	140	1	29	25	530
87	Funds, Trusts, and Other Financial Vehicles	50	15	29	0	6	4	105
88	Real Estate	739	233	273	3	75	78	1,401
89	Rental and Leasing Services	92	38	56	1	11	10	206
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	5	2	4	0	1	1	12
91	Scientific research and development services	9,728	2,046	6,813	69	1,225	954	20,835
92	Other Professional, Scientific, and Technical Services	953	428	441	4	97	166	2,089
93	Management of Companies and Enterprises	151	58	89	1	17	14	329
94	Administrative and Support Services	940	326	511	5	107	402	2,290
95	Waste Management and Remediation Service	199	45	136	1	33	4	419
96	Junior colleges, colleges, universities, and professional schools	755	60	108	1	45	15	984
97	Other Educational Services	312	94	183	2	38	27	656
98	Offices of physicians, dentists, and other health practitioners	610	191	322	3	72	51	1,250
99	Home health care services	116	37	82	1	16	10	261
100	Medical and diagnostic labs and outpatient and other ambulatory care services	162	52	87	1	19	14	335
101	Hospitals	1,389	256	436	2	281	36	2,400
102	Nursing and community care facilities	298	94	143	1	34	25	595
103	Social Assistance	490	154	334	3	65	41	1,088
104	Performing Arts, Spectator Sports, and Related Industries	122	42	78	1	15	12	270
105	Museums, Historical Sites, and Similar Institution	14	5	8	0	2	1	30
106	Amusement, Gambling, and Recreation Industries	201	64	108	1	24	18	416
107	Accommodation, including Hotels and Motels	45	16	25	0	5	10	101
108	Food Services and Drinking Places	1,231	397	707	7	148	111	2,600
109	Repair and Maintenance	230	86	146	1	28	19	511
110	Personal care services	156	48	117	1	22	13	358
111	Death care services	15	5	5	0	1	1	27
112	Other Personal and Laundry Services	137	43	114	1	20	11	327
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	288	95	143	1	33	25	585
114	Private Households	244	82	72	1	21	23	442
115	Government & Non NAICs	404	140	209	2	43	34	833
	Total	**27,208**	**9,146**	**14,381**	**137**	**3,082**	**2,595**	**56,549**

Table F3. Gross Output Impacts on the U.S. by Funding Type and by Sector

Sector	Description	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
1	Crop Production	30.0	9.6	14.2	0.1	3.3	2.0	59.1
2	Livestock	24.6	7.7	13.4	0.1	2.9	1.7	50.3
3	Animal production, except cattle and poultry and eggs	59.0	12.6	37.9	0.1	7.6	0.3	117.4
4	Forestry and Logging	2.2	1.5	0.8	0.0	0.2	0.1	4.8
5	Fishing, Hunting and Trapping	0.9	0.3	0.4	0.0	0.1	0.1	1.7
6	Support Activities for Agriculture and Forestry	5.2	1.6	3.9	0.0	0.7	0.3	11.7
7	Oil and Gas Extraction	33.5	12.3	14.6	0.1	3.6	2.3	66.4
8	Mining	13.2	5.1	8.9	0.1	1.7	0.6	29.6
9	Mining Services	2.5	1.0	2.1	0.0	0.3	0.1	6.1
10	Electric power generation, transmission, and distribution	124.9	36.5	99.6	0.9	19.8	6.1	287.7
11	Natural gas distribution	17.8	6.5	5.8	0.0	1.5	1.3	32.9
12	Water, sewage and other systems	37.6	7.7	27.6	0.3	6.7	0.1	80.1
13	Construction of new nonresidential commercial and health care structures	240.2	292.4	0.0	0.0	0.0	3.0	535.6
14	Other Construction	43.4	13.6	24.6	0.2	5.4	2.7	90.0
15	Food Manufacturing	152.4	48.1	88.4	0.7	18.2	10.8	318.7
16	Beverage and Tobacco Product Manufacturing	35.5	11.7	20.9	0.2	4.3	2.7	75.2
17	Textile Mills	8.6	4.0	3.4	0.0	0.8	0.5	17.3
18	Textile Products and Apparel Manufacturing	5.6	1.8	4.2	0.0	0.8	0.4	12.9
19	Leather and Allied Product Manufacturing	0.8	0.2	0.5	0.0	0.1	0.1	1.7
20	Wood Product Manufacturing	12.7	8.9	5.5	0.0	1.0	0.7	28.9
21	Stationary product manufacturing	12.2	2.7	8.5	0.0	1.6	0.0	25.0
22	Paper Manufacturing	35.0	13.0	20.8	0.1	4.0	2.1	75.0
23	Printing and Related Support Activities	12.1	4.5	6.5	0.1	1.4	1.0	25.5
24	Petroleum and Coal Products Manufacturing	84.3	34.0	29.2	0.2	7.7	6.2	161.6
25	Other basic inorganic chemical manufacturing	24.3	5.8	18.3	0.1	3.3	0.2	52.0
26	Other basic organic chemical manufacturing	31.3	8.1	21.2	0.1	4.0	0.5	65.2
27	Medicinal and botanical manufacturing	2.8	0.8	2.5	0.0	0.4	0.1	6.7
28	Pharmaceutical preparation manufacturing	97.8	26.2	58.0	0.3	12.0	3.5	197.8
29	In-vitro diagnostic substance manufacturing	1.7	0.5	0.7	0.0	0.2	0.1	3.2
30	Biological product (except diagnostic) manufacturing	41.3	7.2	16.1	0.1	4.3	0.1	69.1
31	Other Chemical Manufacturing	89.4	34.4	49.3	0.3	9.9	4.8	188.1
32	Plastics and Rubber Products Manufacturing	33.7	15.6	18.6	0.1	3.5	1.9	73.4
33	Nonmetallic Mineral Product Manufacturing	19.4	14.6	6.6	0.1	1.3	0.8	42.7
34	Primary Metal Manufacturing	29.9	20.0	11.7	0.1	2.1	1.1	64.8
35	Fabricated Metal Product Manufacturing	52.9	37.0	19.9	0.1	3.8	2.2	116.0

36	Optical instrument and lens manufacturing	8.1	6.4	5.1	0.0	0.3	0.0	20.1
37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	62.5	65.1	18.7	0.0	1.3	0.1	147.6
38	Scales, balances, and miscellaneous general purpose machinery manufacturing	1.7	1.3	1.2	0.0	0.1	0.0	4.3
39	Other Machinery Manufacturing	17.6	11.6	8.3	0.1	1.5	0.7	39.9
40	Electronic computer manufacturing	33.2	26.9	14.9	0.1	1.6	0.7	77.3
41	Analytical laboratory instrument manufacturing	25.6	26.2	8.7	0.0	0.6	0.0	61.1
42	Irradiation apparatus manufacturing	0.1	0.0	0.1	0.0	0.0	0.0	0.2
43	Other Computer and Electronic Product Manufacturing	40.2	21.1	18.8	0.1	3.5	2.3	85.9
44	Electrical Equipment, Appliance, and Component Manufacturing	19.1	13.1	7.6	0.1	1.4	0.9	42.1
45	Transportation Equipment Manufacturing	57.0	20.0	37.9	0.3	7.3	4.1	126.7
46	Institutional furniture manufacturing	6.7	5.4	3.7	0.0	0.2	0.0	15.9
47	Furniture and Related Product Manufacturing	10.6	5.9	5.7	0.0	1.1	2.5	25.8
48	Surgical and medical instrument manufacturing	45.2	10.4	34.3	0.1	6.2	0.2	96.4
49	Surgical appliance and supplies manufacturing	79.4	31.5	50.7	0.2	8.7	0.3	170.9
50	Dental equipment and supplies manufacturing	0.4	0.2	0.2	0.0	0.0	0.0	0.9
51	Ophthalmic goods manufacturing	1.2	0.4	0.6	0.0	0.1	0.1	2.6
52	Dental laboratories	0.8	0.3	0.4	0.0	0.1	0.1	1.7
53	Office supplies (except paper) manufacturing	7.7	1.7	5.1	0.0	1.0	1.7	17.1
54	Other Miscellaneous Manufacturing	8.2	2.8	4.9	0.0	1.0	0.6	17.7
55	Wholesale Trade	186.8	69.9	117.2	0.9	22.2	11.5	408.6
56	Motor Vehicle and Parts Dealers	33.4	11.3	17.5	0.2	3.8	2.7	68.8
57	Furniture and Home Furnishings Stores	9.0	3.0	5.4	0.0	1.1	0.7	19.2
58	Electronics and Appliance Stores	8.7	3.0	2.8	0.0	0.8	0.7	16.1
59	Building Material and Garden Equipment and Supplies Dealers	17.3	5.7	12.7	0.1	2.3	1.3	39.4
60	Food and Beverage Stores	35.3	11.7	21.2	0.2	4.3	2.8	75.5
61	Health and Personal Care Stores	17.7	5.9	10.9	0.1	2.2	1.4	38.2
62	Gasoline Stations	15.2	5.3	8.8	0.1	1.6	1.3	32.3
63	Clothing and Clothing Accessories Stores	20.7	6.6	12.6	0.1	2.6	1.6	44.3
64	Sporting Goods, Hobby, Book, and Music Stores	6.9	2.3	3.8	0.0	0.8	0.6	14.5
65	General Merchandise Stores	38.6	12.8	24.9	0.2	4.7	3.1	84.4
66	Miscellaneous Store Retailers	12.8	4.3	6.3	0.1	1.4	1.0	25.8
67	Non-store Retailers	31.7	9.7	25.6	0.2	4.6	2.4	74.2
68	Air Transportation	28.4	10.4	20.5	0.2	3.3	2.5	65.3
69	Rail Transportation	10.2	4.0	5.8	0.0	1.2	0.6	21.8
70	Water Transportation	4.1	1.1	2.8	0.0	0.6	0.2	8.8
71	Truck Transportation	40.3	16.0	25.5	0.2	4.8	2.6	89.4
72	Transit and Ground Passenger Transportation	10.4	3.7	7.9	0.1	1.4	0.8	24.2
73	Pipeline Transportation	4.7	1.7	2.6	0.0	0.5	0.3	9.8
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	13.0	4.7	10.6	0.1	1.8	1.0	31.2
75	Postal Services, Couriers and Messengers	21.2	7.5	11.9	0.1	2.4	1.7	44.8

76	Warehousing and Storage	13.0	5.0	9.6	0.1	1.7	0.9	30.2
77	Publishing Industries (except Internet)	50.4	20.0	30.0	0.3	6.5	4.9	112.0
78	Motion Picture and Sound Recording Industries	15.1	5.5	8.4	0.1	1.7	1.3	32.1
79	Broadcasting (except Internet)	18.3	7.2	12.4	0.1	2.3	1.4	41.7
80	Telecommunications	103.3	38.4	64.4	0.6	12.5	11.2	230.3
81	Data Processing, Hosting and Related Services	14.7	5.2	9.5	0.1	1.8	1.3	32.7
82	Other Information Services	9.7	2.9	12.8	0.1	1.9	1.0	28.5
83	Monetary Authorities	116.6	42.3	54.5	0.5	12.6	12.0	238.3
84	Credit Intermediation and Related Activities	44.5	21.0	20.1	0.2	3.7	4.2	93.6
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	99.0	35.4	55.2	0.5	11.3	8.7	210.0
86	Insurance Carriers and Related Activities	138.6	46.3	89.8	0.8	17.3	12.2	304.9
87	Funds, Trusts, and Other Financial Vehicles	30.6	9.3	18.9	0.2	3.9	2.5	65.5
88	Real Estate	365.4	123.6	137.0	1.2	35.6	34.2	697.0
89	Rental and Leasing Services	140.0	46.3	186.0	1.7	27.0	9.7	410.6
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	20.1	8.5	12.5	0.1	2.2	2.2	45.5
91	Scientific research and development services	1,911.7	564.2	1,409.4	12.4	246.2	188.8	4,332.7
92	Other Professional, Scientific, and Technical Services	230.9	96.8	137.6	1.2	26.8	29.1	522.3
93	Management of Companies and Enterprises	80.5	30.8	55.8	0.4	9.9	5.7	183.0
94	Administrative and Support Services	112.7	39.9	72.9	0.6	13.7	31.2	271.2
95	Waste Management and Remediation Service	51.4	12.1	36.0	0.4	8.5	1.2	109.5
96	Junior colleges, colleges, universities, and professional schools	106.3	10.6	19.0	0.2	6.5	2.4	145.0
97	Other Educational Services	22.5	7.3	13.6	0.1	2.7	1.8	48.0
98	Offices of physicians, dentists, and other health practitioners	119.6	39.4	71.9	0.6	14.7	9.4	255.5
99	Home health care services	15.4	5.1	10.4	0.1	2.0	1.2	34.2
100	Medical and diagnostic labs and outpatient and other ambulatory care services	39.3	13.1	26.0	0.2	5.0	3.0	86.6
101	Hospitals	272.0	63.9	126.6	0.7	48.2	9.9	521.3
102	Nursing and community care facilities	35.3	11.6	18.6	0.2	4.1	2.8	72.5
103	Social Assistance	31.9	10.4	21.3	0.2	4.1	2.5	70.4
104	Performing Arts, Spectator Sports, and Related Industries	22.4	7.7	15.1	0.1	2.8	1.9	50.1
105	Museums, Historical Sites, and Similar Institution	2.8	0.9	1.4	0.0	0.3	0.2	5.6
106	Amusement, Gambling, and Recreation Industries	26.8	8.9	18.4	0.2	3.5	2.1	59.9
107	Accommodation, including Hotels and Motels	39.0	14.2	24.5	0.2	4.3	3.3	85.5
108	Food Services and Drinking Places	140.3	47.1	92.2	0.8	17.6	11.2	309.2
109	Repair and Maintenance	44.2	16.7	31.9	0.3	5.7	3.2	102.1
110	Personal care services	13.2	4.3	7.7	0.1	1.6	1.0	27.9
111	Death care services	3.0	1.0	1.4	0.0	0.3	0.2	5.9
112	Other Personal and Laundry Services	14.9	5.1	8.0	0.1	1.7	1.2	31.0
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	49.5	18.2	26.2	0.2	5.4	4.0	103.5
114	Private Households	4.0	1.4	2.4	0.0	0.5	0.3	8.7
115	Government & Non NAICs	86.7	30.9	54.7	0.5	10.3	6.3	189.5

	Total	**7,065.6**	**2,637.2**	**4,272.8**	**35.1**	**830.7**	**547.7**	**15,389.1**

Table F4. Employment Impacts on the U.S. by Funding Type and by Sector

Sector	Description	CIRM Grants	Co-funding	Partnership Funding	Leverage Funding of ASCC	Non-CIRM Follow-on Funding	CIRM Admin Expenditures	Total
1	Crop Production	191	63	92	1	21	13	381
2	Livestock	110	35	70	1	14	7	237
3	Animal production, except cattle and poultry and eggs	701	143	404	1	84	4	1,337
4	Forestry and Logging	17	11	8	0	1	1	37
5	Fishing, Hunting and Trapping	9	3	5	0	1	1	19
6	Support Activities for Agriculture and Forestry	112	34	67	0	13	6	233
7	Oil and Gas Extraction	107	42	52	0	11	7	220
8	Mining	34	14	19	0	4	2	72
9	Mining Services	10	4	10	0	2	1	27
10	Electric power generation, transmission, and distribution	129	40	76	1	17	7	269
11	Natural gas distribution	19	7	9	0	2	1	39
12	Water, sewage and other systems	144	28	95	1	24	1	293
13	Construction of new nonresidential commercial and health care structures	1,754	2,163	0	0	0	21	3,938
14	Other Construction	268	87	141	1	32	17	546
15	Food Manufacturing	275	89	164	1	33	20	582
16	Beverage and Tobacco Product Manufacturing	38	13	24	0	5	3	83
17	Textile Mills	33	16	11	0	3	2	65
18	Textile Products and Apparel Manufacturing	35	11	25	0	5	3	79
19	Leather and Allied Product Manufacturing	4	1	2	0	0	0	9
20	Wood Product Manufacturing	63	48	22	0	4	4	141
21	Stationary product manufacturing	32	7	21	0	4	0	64
22	Paper Manufacturing	61	23	34	0	7	4	128
23	Printing and Related Support Activities	74	28	39	0	8	6	155
24	Petroleum and Coal Products Manufacturing	15	6	8	0	2	1	32
25	Other basic inorganic chemical manufacturing	28	7	21	0	4	0	60
26	Other basic organic chemical manufacturing	20	5	13	0	2	0	41
27	Medicinal and botanical manufacturing	5	1	5	0	1	0	12
28	Pharmaceutical preparation manufacturing	65	17	35	0	8	2	127
29	In-vitro diagnostic substance manufacturing	3	1	1	0	0	0	6
30	Biological product (except diagnostic) manufacturing	58	10	22	0	6	0	96
31	Other Chemical Manufacturing	68	28	40	0	7	4	147
32	Plastics and Rubber Products Manufacturing	104	51	53	0	10	6	224
33	Nonmetallic Mineral Product Manufacturing	67	53	20	0	4	3	146
34	Primary Metal Manufacturing	49	36	19	0	3	2	109

35	Fabricated Metal Product Manufacturing	209	154	77	1	14	9	463
36	Optical instrument and lens manufacturing	25	20	15	0	1	0	61
37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	182	188	45	0	4	0	419
38	Scales, balances, and miscellaneous general purpose machinery manufacturing	6	5	4	0	0	0	15
39	Other Machinery Manufacturing	44	31	20	0	4	2	101
40	Electronic computer manufacturing	21	17	11	0	1	0	50
41	Analytical laboratory instrument manufacturing	61	63	20	0	1	0	144
42	Irradiation apparatus manufacturing	0	0	0	0	0	0	0
43	Other Computer and Electronic Product Manufacturing	78	44	37	0	6	4	169
44	Electrical Equipment, Appliance, and Component Manufacturing	48	34	18	0	3	2	107
45	Transportation Equipment Manufacturing	90	33	54	0	11	7	195
46	Institutional furniture manufacturing	30	25	18	0	1	0	75
47	Furniture and Related Product Manufacturing	57	34	27	0	5	13	137
48	Surgical and medical instrument manufacturing	111	24	72	0	14	0	222
49	Surgical appliance and supplies manufacturing	215	87	114	0	22	1	439
50	Dental equipment and supplies manufacturing	1	1	1	0	0	0	3
51	Ophthalmic goods manufacturing	5	2	2	0	0	0	9
52	Dental laboratories	9	3	4	0	1	1	18
53	Office supplies (except paper) manufacturing	31	7	21	0	4	7	69
54	Other Miscellaneous Manufacturing	39	14	25	0	5	3	86
55	Wholesale Trade	848	340	463	4	92	53	1,799
56	Motor Vehicle and Parts Dealers	278	94	120	1	29	23	546
57	Furniture and Home Furnishings Stores	80	27	43	0	9	7	167
58	Electronics and Appliance Stores	83	28	38	0	9	7	164
59	Building Material and Garden Equipment and Supplies Dealers	165	56	105	1	20	13	360
60	Food and Beverage Stores	491	165	259	2	56	40	1,013
61	Health and Personal Care Stores	184	62	97	1	21	15	379
62	Gasoline Stations	180	63	104	1	19	15	382
63	Clothing and Clothing Accessories Stores	248	83	125	1	27	20	506
64	Sporting Goods, Hobby, Book, and Music Stores	120	41	61	1	13	10	246
65	General Merchandise Stores	535	181	293	3	60	44	1,115
66	Miscellaneous Store Retailers	247	81	130	1	28	20	507
67	Non-store Retailers	269	90	157	1	32	22	571
68	Air Transportation	77	29	46	0	8	7	169
69	Rail Transportation	26	11	14	0	3	2	56
70	Water Transportation	7	2	3	0	1	0	13
71	Truck Transportation	271	115	149	1	29	18	583
72	Transit and Ground Passenger Transportation	170	63	117	1	21	14	386
73	Pipeline Transportation	6	2	3	0	1	0	13
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	91	34	59	1	11	7	202

75	Postal Services, Couriers and Messengers	184	67	100	1	20	15	387
76	Warehousing and Storage	136	53	91	1	16	9	305
77	Publishing Industries (except Internet)	139	56	82	1	18	13	308
78	Motion Picture and Sound Recording Industries	50	18	23	0	5	4	102
79	Broadcasting (except Internet)	46	20	21	0	5	4	95
80	Telecommunications	174	69	81	1	18	20	362
81	Data Processing, Hosting and Related Services	47	17	31	0	6	4	105
82	Other Information Services	19	6	19	0	3	2	49
83	Monetary Authorities	311	114	159	1	35	32	651
84	Credit Intermediation and Related Activities	280	135	107	1	21	27	571
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	541	196	290	2	60	48	1,138
86	Insurance Carriers and Related Activities	516	173	280	2	59	47	1,077
87	Funds, Trusts, and Other Financial Vehicles	73	22	45	0	9	6	156
88	Real Estate	1,163	387	594	5	130	107	2,386
89	Rental and Leasing Services	136	58	78	1	15	12	300
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	9	4	8	0	1	1	23
91	Scientific research and development services	9,836	2,071	6,868	70	1,240	957	21,042
92	Other Professional, Scientific, and Technical Services	1,626	699	890	8	179	209	3,611
93	Management of Companies and Enterprises	341	135	214	2	39	25	756
94	Administrative and Support Services	1,654	597	960	8	189	474	3,882
95	Waste Management and Remediation Service	232	55	162	2	38	6	494
96	Junior colleges, colleges, universities, and professional schools	1,047	102	180	2	63	24	1,418
97	Other Educational Services	431	136	267	2	53	35	924
98	Offices of physicians, dentists, and other health practitioners	852	282	496	4	103	67	1,805
99	Home health care services	277	92	189	2	36	22	617
100	Medical and diagnostic labs and outpatient and other ambulatory care services	254	84	155	1	31	20	545
101	Hospitals	1,883	426	753	4	339	67	3,472
102	Nursing and community care facilities	559	187	274	2	62	44	1,128
103	Social Assistance	680	224	432	4	85	54	1,479
104	Performing Arts, Spectator Sports, and Related Industries	269	97	155	1	31	23	576
105	Museums, Historical Sites, and Similar Institution	21	7	13	0	3	2	45
106	Amusement, Gambling, and Recreation Industries	315	105	178	2	37	26	663
107	Accommodation, including Hotels and Motels	327	121	201	2	35	28	714
108	Food Services and Drinking Places	1,864	633	1,150	10	225	151	4,032
109	Repair and Maintenance	378	144	257	2	47	28	855
110	Personal care services	228	74	178	2	32	17	531
111	Death care services	30	10	11	0	3	2	57
112	Other Personal and Laundry Services	208	68	170	1	30	16	493
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	521	181	288	3	60	41	1,094
114	Private Households	324	109	122	1	31	28	615

115	Government & Non NAICs	748	275	424	4	82	56	1,588
	Total	**39,070**	**13,785**	**21,594**	**191**	**4,421**	**3,305**	**82,365**

Appendix G. Estimation of Average Salary by Occupation and Occupation Distribution by Sector

In order to evaluate the quality of job gains for the employment directly and indirectly stimulated by CIRM-related activities, we use wages and salaries as a metric. Accordingly, we obtained data from Occupational Employment Statistics (OES) compiled by the United States Department of Labor's Bureau of Labor Statistics (BLS) 2017 California data on average wages for the OES occupation types in California in 2017 (BLS, 2017). We then mapped the OES types to the 15 occupation categories used for this study (see Appendix Table G1). For each of the two occupation categories of Biological Science and Medical Scientists, we combined the relevant OES occupation types at the 6-digit level. For Technical Staff, Professional Services, Other Services, and Construction, Maintenance, & Mining, we aggregated the relevant OES occupation types at the 2-digit level. For all the remaining occupation categories, we used the corresponding 2-digit OES occupation types. For any of the 15 occupation categories for which we combine two or more OES occupation types, we took the weighted average of the relevant OES wages to calculate the average salary for that occupation type, using OES employment data as the weights. The average salary for each of the 15 occupation categories is presented in Appendix Table G2.

Appendix Table G1. OES occupation sector mapping

	Occupation Category	OES Occupation Types	
1	Management	11-1011	Chief Executives
		11-1021	General & Operations Managers
		11-0000	Other Management Occupations
2	Business & Financial Operations	13-0000	Business & Financial Operations
3	Technical Staff	15-0000	Computer & Mathematical
		17-0000	Architecture & Engineering
4	Biological Science	19-1021	Biochemists & Biophysicists
		19-1022	Microbiologists
		19-1029	All Other Biological Sciences
5	Medical Scientists	19-1041	Epidemiologists
		19-1042	All Other Medical Scientists
6	Other Life, Physical, & Social Scientists	19-0000	Other Life, Physical, & Social Science Occupations
7	Professional Services	21-0000	Community & Social Service
		23-0000	Legal
		25-0000	Education, Training, & Library
		27-0000	Arts, Design, Entertainment, Sports, & Media
8	Healthcare Practictioners & Technical	29-0000	Healthcare Practitioners & Technical Occupations
9	Healthcare Support	31-0000	Healthcare Support Occupations
10	Other Services	33-0000	Protective Services
		35-0000	Food Preparation & Service Related
		39-0000	Personal Care & Service
		41-0000	Sales & Related
11	Office & Administrative Support	43-0000	Office & Administrative Support Occupations
12	Farming, Fishing, & Forestry	45-0000	Farming, Fishing, & Forestry Occupations

13	Construction, Maintenance, & Mining	37-0000	Building/Grounds Cleaning & Maintenance
		47-0000	Construction & Extraction
		49-0000	Installation, Maintenance, & Repair
14	Production Workers	51-0000	Production Occupations
15	Transportation & Material Moving	53-0000	Transportation and Material Moving Occupations

Appendix Table G2. Average Salary by Occupation (in 2017 dollars)

	Occupation	Average Salary
1	Management	132,220
2	Business & Financial Operations	83,500
3	Technical	103,294
4	Biological Science	93,784
5	Medical Scientists	103,875
6	Other Life, Physical, & Social Scientists	82,510
7	Professional Services	68,828
8	Healthcare Practioners & Technical	96,130
9	Healthcare Support	37,100
10	Other Services	36,531
11	Office & Administrative Support	41,820
12	Farming, Fishing & Forestry	26,240
13	Construction, Maintenance, & Mining	48,913
14	Production	38,430
15	Transportation & Material Moving	37,970
	All Occupations	57,190

Occupation Proportions of Employment by Input- Output Sector

We utilized the BLS data to create an occupation distribution matrix for total employment by sector. The BLS data provide the state employment numbers in an "industry by occupation matrix." The rows of the table are industries at 2, 3, and 4-digit levels of the North American Industry Classification System (NAICS) codes. The columns are occupation types at 2- to 6-digit OES occupation categories as described above.

Data processing and cleaning are necessary because the employment numbers at the more disaggregated levels (4-digit) do not added up to the total employment at the 3-digit or 2-digit levels, mainly because employment numbers for many disaggregated sectors of small size are non-disclosable in the Occupational Employment Statistics by BLS. Since most of the sectors in the 115-sector I-O model we constructed for this study are at the 3-digit or even more disaggregated levels, we created an "other" category under each 3-digit NAICS code in the matrix as the difference between the total employment at the 3-digit level and the sum of employment at the sub-levels of that corresponding 3-digit NAICS code. We then eliminated any redundant rows in the table (e.g., the rows of employment for 3-digit NAICS codes were removed if we have included the rows for all the sub-sectors at the 4-digit level of that 3-digit NAICS code).

After removing the redundant rows, we aggregated the columns (OES occupation types) in the matrix into the 15 occupation categories according to the scheme in Table G1. We also mapped the industries in the rows to the 115 I-O model sectoring scheme. Finally, we calculated the percentage distribution of employment among the 15 occupation categories for each CIRM study sector. The results are presented in Appendix Table G3.

Appendix Table G3. Employment Distribution among Occupation Categories by Sector

	I-O Model Sector	Manage-ment	Business & Financial	Technical	Biological Science	Medical Science	Other Life, Physical, & Social Science	Profes-sional Services	Healthcare Practi-tioners & Technical	Health Support	Other Services	Office & Adminis-trative Support	Farming, Fishing, & Forestry	Construc-tion, Mainte-nance, & Mining	Production	Transport-ation & Material Moving
1	Crop Production	1.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	2.3%	86.5%	1.9%	3.4%	4.1%
2	Livestock	1.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	2.3%	86.5%	1.9%	3.4%	4.1%
3	Animal production, except cattle and poultry and eggs	1.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	2.3%	86.5%	1.9%	3.4%	4.1%
4	Forestry and Logging	2.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.8%	73.7%	3.7%	0.0%	14.2%
5	Fishing, Hunting and Trapping	1.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	2.3%	86.5%	1.9%	3.4%	4.1%
6	Support Activities for Agriculture and Forestry	1.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	2.3%	86.6%	1.9%	3.4%	4.0%
7	Oil and Gas Extraction	9.2%	9.0%	21.7%	0.0%	0.0%	8.1%	0.0%	1.4%	0.0%	1.0%	5.5%	0.0%	28.6%	15.6%	0.0%
8	Mining	4.8%	1.2%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	7.8%	0.0%	51.4%	14.9%	17.1%
9	Mining Services	5.4%	2.1%	5.5%	0.0%	0.0%	1.6%	0.0%	0.9%	0.0%	0.7%	6.9%	0.0%	57.4%	9.7%	9.8%
10	Electric power generation, transmission, and distribution	11.3%	17.3%	11.7%	0.0%	0.0%	2.2%	0.5%	0.3%	0.0%	2.8%	14.1%	0.0%	31.0%	8.8%	0.0%
11	Natural gas distribution	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.4%	56.0%	0.0%	17.6%	22.0%	0.0%
12	Water, sewage and other systems	8.8%	4.1%	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	24.1%	1.6%	20.4%	36.0%	1.2%
13	Construction of new nonresidential commercial and health care structures	15.9%	6.8%	3.9%	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	1.0%	12.6%	0.0%	57.2%	1.3%	1.0%
14	Other Construction	7.1%	3.8%	1.6%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	2.2%	9.7%	0.0%	72.2%	1.4%	1.8%
15	Food Manufacturing	4.8%	2.2%	0.7%	0.0%	0.0%	1.0%	0.2%	0.1%	0.0%	8.5%	7.8%	1.5%	7.4%	48.6%	17.2%
16	Beverage and Tobacco Product Manufacturing	6.9%	4.0%	1.0%	0.0%	0.0%	1.1%	0.8%	0.0%	0.0%	22.6%	11.3%	6.9%	7.5%	28.6%	9.2%
17	Textile Mills	5.5%	1.6%	0.4%	0.0%	0.0%	0.4%	0.8%	0.0%	0.0%	2.1%	10.7%	0.0%	2.6%	70.1%	5.8%
18	Textile Products and Apparel Manufacturing	5.6%	2.0%	0.4%	0.0%	0.0%	0.0%	3.4%	0.0%	0.0%	4.4%	11.6%	0.0%	1.9%	65.6%	5.1%
19	Leather and Allied Product Manufacturing	5.1%	4.0%	0.0%	0.0%	0.0%	0.0%	2.5%	0.0%	0.0%	4.7%	14.9%	0.0%	0.0%	63.0%	5.8%
20	Wood Product Manufacturing	4.3%	1.3%	1.0%	0.0%	0.0%	0.3%	0.3%	0.0%	0.0%	3.1%	7.8%	0.5%	6.6%	59.1%	15.7%
21	Stationary product manufacturing	6.3%	2.3%	0.7%	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%	3.6%	11.5%	0.0%	5.1%	50.7%	17.8%

22	Paper Manufacturing	6.4%	2.4%	0.8%	0.0%	0.0%	0.0%	1.9%	0.1%	0.0%	3.4%	11.4%	0.0%	5.4%	50.7%	17.4%
23	Printing and Related Support Activities	6.7%	2.2%	0.7%	0.0%	0.0%	0.0%	5.8%	0.0%	0.0%	4.7%	17.2%	0.0%	1.1%	53.0%	8.6%
24	Petroleum and Coal Products Manufacturing	6.0%	6.6%	14.7%	0.0%	0.0%	3.9%	0.0%	1.0%	0.0%	1.7%	6.1%	0.0%	12.9%	43.2%	3.8%
25	Other basic inorganic chemical manufacturing	10.7%	5.1%	7.0%	0.0%	0.0%	10.5%	0.0%	0.0%	0.0%	1.2%	10.2%	0.0%	11.1%	38.5%	5.7%
26	Other basic organic chemical manufacturing	10.7%	5.1%	7.0%	0.0%	0.0%	10.5%	0.0%	0.0%	0.0%	1.2%	10.2%	0.0%	11.1%	38.5%	5.7%
27	Medicinal and botanical manufacturing	13.8%	10.2%	12.3%	2.6%	3.5%	11.8%	1.1%	0.8%	0.1%	1.7%	8.4%	0.0%	4.6%	25.5%	3.5%
28	Pharmaceutical preparation manufacturing	13.8%	10.2%	12.3%	2.6%	3.5%	11.8%	1.1%	0.8%	0.1%	1.7%	8.4%	0.0%	4.6%	25.5%	3.5%
29	In-vitro diagnostic substance manufacturing	13.8%	10.2%	12.3%	2.6%	3.5%	11.8%	1.1%	0.8%	0.1%	1.7%	8.4%	0.0%	4.6%	25.5%	3.5%
30	Biological product (except diagnostic) manufacturing	13.8%	10.2%	12.3%	2.6%	3.5%	11.8%	1.1%	0.8%	0.1%	1.7%	8.4%	0.0%	4.6%	25.5%	3.5%
31	Other Chemical Manufacturing	12.3%	7.8%	8.7%	1.7%	2.1%	9.3%	0.8%	0.7%	0.1%	2.5%	10.6%	0.0%	5.2%	33.5%	4.8%
32	Plastics and Rubber Products Manufacturing	6.8%	2.0%	1.9%	0.0%	0.0%	0.1%	0.4%	0.1%	0.0%	3.7%	10.4%	0.0%	6.7%	60.9%	7.0%
33	Nonmetallic Mineral Product Manufacturing	5.6%	2.2%	1.8%	0.0%	0.0%	0.1%	0.5%	0.2%	0.0%	3.2%	9.5%	0.0%	9.7%	45.1%	22.1%
34	Primary Metal Manufacturing	6.5%	2.1%	2.4%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	2.4%	9.6%	0.0%	8.0%	56.9%	11.8%
35	Fabricated Metal Product Manufacturing	7.0%	3.0%	3.7%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	2.0%	11.4%	0.0%	5.4%	63.7%	3.6%
36	Optical instrument and lens manufacturing	9.8%	5.7%	7.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%	12.8%	0.0%	5.3%	50.8%	4.7%
37	Air conditioning, refrigeration, and warm air heating equipment manufacturing	6.0%	3.5%	4.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	12.5%	0.0%	8.8%	57.2%	2.1%
38	Scales, balances, and miscellaneous general purpose machinery manufacturing	8.7%	4.8%	11.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.6%	13.4%	0.0%	5.1%	51.0%	1.8%
39	Other Machinery Manufacturing	9.5%	5.8%	14.9%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	3.0%	11.5%	0.0%	5.1%	46.7%	2.7%
40	Electronic computer manufacturing	13.4%	11.8%	55.7%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%	2.4%	5.7%	0.0%	0.8%	9.1%	0.2%
41	Analytical laboratory instrument manufacturing	12.7%	10.6%	38.7%	0.0%	0.0%	0.6%	1.0%	0.0%	0.0%	3.1%	9.5%	0.0%	3.0%	19.6%	1.2%

42	Irradiation apparatus manufacturing	12.7%	10.6%	38.7%	0.0%	0.0%	0.6%	1.0%	0.0%	0.0%	3.1%	9.5%	0.0%	3.0%	19.6%	1.2%
43	Other Computer and Electronic Product Manufacturing	13.0%	8.9%	39.6%	0.0%	0.0%	0.3%	1.0%	0.1%	0.0%	3.2%	8.3%	0.0%	2.0%	22.5%	1.1%
44	Electrical Equipment, Appliance, and Component Manufacturing	8.9%	5.5%	15.5%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	4.4%	12.0%	0.0%	2.0%	48.8%	2.6%
45	Transportation Equipment Manufacturing	6.3%	8.2%	23.1%	0.0%	0.0%	0.1%	0.5%	0.2%	0.0%	1.7%	8.3%	0.0%	8.1%	41.2%	2.3%
46	Institutional furniture manufacturing	4.6%	2.2%	1.3%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	3.8%	10.8%	0.0%	2.4%	68.3%	6.2%
47	Furniture and Related Product Manufacturing	5.1%	2.5%	1.8%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%	3.7%	10.9%	0.0%	6.3%	63.8%	5.3%
48	Surgical and medical instrument manufacturing	9.6%	7.6%	14.0%	0.1%	0.3%	0.9%	1.1%	0.6%	0.0%	2.9%	15.3%	0.0%	3.2%	42.4%	2.1%
49	Surgical appliance and supplies manufacturing	9.6%	7.6%	14.0%	0.1%	0.3%	0.9%	1.1%	0.6%	0.0%	2.9%	15.3%	0.0%	3.2%	42.4%	2.1%
50	Dental equipment and supplies manufacturing	9.6%	7.6%	14.0%	0.1%	0.3%	0.9%	1.1%	0.6%	0.0%	2.9%	15.3%	0.0%	3.2%	42.4%	2.1%
51	Ophthalmic goods manufacturing	9.6%	7.6%	14.0%	0.1%	0.3%	0.9%	1.1%	0.6%	0.0%	2.9%	15.3%	0.0%	3.2%	42.4%	2.1%
52	Dental laboratories	9.6%	7.6%	14.0%	0.1%	0.3%	0.9%	1.1%	0.6%	0.0%	2.9%	15.3%	0.0%	3.2%	42.4%	2.1%
53	Office supplies (except paper) manufacturing	7.4%	3.9%	2.9%	0.0%	0.0%	0.0%	4.0%	0.0%	0.0%	4.3%	14.8%	0.0%	4.5%	52.3%	5.9%
54	Other Miscellaneous Manufacturing	8.7%	6.1%	9.8%	0.1%	0.2%	0.6%	2.1%	0.4%	0.0%	3.3%	15.2%	0.0%	3.5%	46.7%	3.3%
55	Wholesale Trade	8.7%	5.8%	4.8%	0.0%	0.1%	0.1%	1.6%	0.3%	0.0%	22.7%	25.8%	0.5%	4.8%	4.5%	20.4%
56	Motor Vehicle and Parts Dealers	4.7%	2.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	39.6%	12.0%	0.0%	26.1%	0.2%	14.7%
57	Furniture and Home Furnishings Stores	4.4%	1.7%	0.4%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	58.5%	16.2%	0.0%	5.0%	1.8%	9.4%
58	Electronics and Appliance Stores	2.7%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	75.0%	12.8%	0.0%	7.9%	0.0%	1.0%
59	Building Material and Garden Equipment and Supplies Dealers	3.4%	1.5%	0.1%	0.0%	0.0%	0.0%	2.1%	0.0%	0.0%	56.0%	19.6%	0.6%	3.9%	2.2%	10.6%
60	Food and Beverage Stores	2.4%	0.8%	0.0%	0.0%	0.0%	0.0%	0.2%	0.6%	0.1%	55.8%	21.1%	0.1%	1.3%	9.9%	7.8%
61	Health and Personal Care Stores	3.8%	0.8%	0.2%	0.0%	0.0%	0.0%	0.3%	29.7%	6.5%	44.7%	9.4%	0.0%	0.5%	1.2%	2.8%
62	Gasoline Stations	3.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	82.5%	7.2%	0.0%	2.3%	0.0%	4.7%
63	Clothing and Clothing Accessories Stores	4.3%	0.8%	0.2%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	84.1%	8.8%	0.0%	0.1%	1.1%	0.1%
64	Sporting Goods, Hobby, Book, and Music Stores	3.9%	1.0%	0.3%	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%	74.8%	12.2%	0.0%	4.4%	0.9%	1.1%

65	General Merchandise Stores	1.3%	0.6%	0.0%	0.0%	0.0%	0.0%	0.9%	2.0%	0.3%	56.5%	27.6%	0.0%	2.0%	1.6%	7.3%
66	Miscellaneous Store Retailers	4.4%	1.9%	0.8%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	67.0%	11.7%	0.0%	2.7%	1.2%	7.7%
67	Non-store Retailers	7.8%	8.7%	8.3%	0.0%	0.0%	0.0%	3.1%	2.2%	0.0%	12.2%	32.2%	0.0%	4.9%	1.7%	19.0%
68	Air Transportation	2.2%	1.3%	0.5%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	1.3%	26.1%	0.0%	9.3%	0.0%	59.3%
69	Rail Transportation	0.0%	1.9%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	25.1%	0.0%	8.6%	0.0%	62.9%
70	Water Transportation	7.9%	6.6%	4.7%	0.0%	0.0%	0.7%	0.0%	0.0%	0.0%	1.3%	10.0%	0.0%	2.3%	0.0%	66.5%
71	Truck Transportation	3.6%	1.4%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%	16.3%	0.1%	4.2%	0.3%	72.5%
72	Transit and Ground Passenger Transportation	2.5%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.4%	12.4%	0.0%	4.8%	0.0%	78.2%
73	Pipeline Transportation	4.3%	4.9%	19.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%	0.0%	22.3%	22.8%	17.9%
74	Scenic and Sightseeing Transportation and Support Activities for Transportation	4.0%	1.1%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%	33.6%	14.4%	0.0%	4.6%	0.0%	41.2%
75	Postal Services, Couriers and Messengers	2.2%	1.2%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	15.0%	0.0%	1.6%	0.0%	78.3%
76	Warehousing and Storage	3.0%	2.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	2.0%	27.5%	0.0%	3.6%	2.3%	58.9%
77	Publishing Industries (except Internet)	9.8%	12.7%	34.4%	0.0%	0.0%	0.0%	13.9%	0.0%	0.0%	11.3%	11.2%	0.0%	0.4%	2.6%	3.7%
78	Motion Picture and Sound Recording Industries	3.0%	4.9%	1.6%	0.0%	0.0%	0.0%	51.3%	0.3%	0.1%	14.9%	13.9%	0.0%	3.8%	0.6%	5.7%
79	Broadcasting (except Internet)	9.2%	7.2%	5.3%	0.0%	0.0%	0.0%	44.3%	0.0%	0.0%	11.6%	12.3%	0.0%	9.5%	0.0%	0.6%
80	Telecommunications	4.4%	8.7%	17.6%	0.0%	0.0%	0.0%	1.3%	0.1%	0.0%	17.4%	14.5%	0.0%	35.8%	0.0%	0.2%
81	Data Processing, Hosting and Related Services	12.4%	13.6%	46.5%	0.0%	0.0%	0.0%	2.6%	0.0%	0.0%	9.7%	14.7%	0.0%	0.5%	0.0%	0.0%
82	Other Information Services	14.1%	14.0%	38.8%	0.0%	0.0%	0.0%	8.5%	0.0%	0.0%	13.8%	10.6%	0.0%	0.2%	0.0%	0.0%
83	Monetary Authorities	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
84	Credit Intermediation and Related Activities	8.2%	25.3%	4.5%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	15.3%	46.2%	0.0%	0.1%	0.0%	0.0%
85	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	9.1%	39.3%	3.9%	0.0%	0.0%	0.0%	1.3%	0.0%	0.0%	17.9%	28.3%	0.0%	0.2%	0.0%	0.0%
86	Insurance Carriers and Related Activities	7.4%	22.8%	5.1%	0.0%	0.0%	0.0%	2.5%	0.9%	0.1%	20.8%	40.3%	0.0%	0.0%	0.0%	0.0%
87	Funds, Trusts, and Other Financial Vehicles	18.1%	36.2%	3.4%	0.0%	0.0%	0.0%	3.4%	0.0%	0.0%	5.2%	33.6%	0.0%	0.0%	0.0%	0.0%

88	Real Estate	16.7%	7.1%	1.2%	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%	28.8%	22.1%	0.2%	21.6%	0.0%	0.9%
89	Rental and Leasing Services	5.8%	1.6%	0.4%	0.0%	0.0%	0.0%	3.5%	0.2%	0.0%	35.0%	12.3%	0.0%	14.5%	0.6%	26.1%
90	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	22.5%	25.7%	4.4%	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%	23.7%	22.5%	0.0%	0.0%	0.0%	0.0%
91	Scientific research and development services	14.1%	9.0%	33.7%	5.5%	6.3%	14.1%	2.6%	1.6%	0.2%	1.4%	8.1%	0.2%	1.5%	1.6%	0.1%
92	Other Professional, Scientific, and Technical Services	9.1%	16.4%	28.1%	0.1%	0.1%	2.4%	11.8%	1.6%	1.0%	5.4%	20.4%	0.1%	1.6%	1.2%	0.7%
93	Management of Companies and Enterprises	23.5%	23.6%	11.9%	0.0%	0.1%	0.2%	4.2%	1.1%	0.1%	6.0%	24.2%	0.0%	1.7%	1.0%	2.4%
94	Administrative and Support Services	3.3%	4.6%	3.2%	0.0%	0.0%	0.3%	1.3%	2.1%	1.1%	19.9%	21.2%	0.2%	22.7%	8.0%	12.0%
95	Waste Management and Remediation Service	5.1%	2.2%	0.9%	0.0%	0.0%	0.3%	0.0%	0.1%	0.0%	1.7%	14.0%	0.0%	24.3%	3.7%	47.8%
96	Junior colleges, colleges, universities, and professional schools	5.5%	6.4%	4.1%	0.6%	0.8%	2.7%	50.5%	2.0%	0.4%	4.8%	17.6%	0.0%	4.2%	0.1%	0.3%
97	Other Educational Services	3.7%	1.2%	0.7%	0.0%	0.0%	0.6%	72.1%	1.0%	0.4%	8.1%	7.6%	0.0%	3.9%	0.0%	0.6%
98	Offices of physicians, dentists, and other health practitioners	2.1%	1.6%	0.5%	0.0%	0.2%	0.7%	2.4%	35.5%	25.4%	0.6%	29.9%	0.0%	0.6%	0.4%	0.0%
99	Home health care services	5.2%	1.7%	0.2%	0.0%	0.0%	0.0%	4.1%	39.9%	15.7%	21.5%	10.4%	0.0%	0.4%	0.0%	0.9%
100	Medical and diagnostic labs and outpatient and other ambulatory care services	5.7%	2.5%	0.9%	0.0%	0.7%	0.7%	7.4%	45.1%	13.4%	1.2%	19.5%	0.0%	1.8%	0.1%	0.8%
101	Hospitals	3.8%	3.0%	1.3%	0.0%	1.1%	0.6%	2.7%	56.9%	11.0%	3.0%	11.6%	0.0%	4.4%	0.4%	0.2%
102	Nursing and community care facilities	3.3%	1.0%	0.0%	0.0%	0.0%	0.2%	6.8%	16.9%	26.8%	32.7%	4.9%	0.0%	5.9%	0.9%	0.5%
103	Social Assistance	7.6%	2.2%	0.3%	0.0%	0.0%	0.4%	40.5%	0.9%	0.7%	33.1%	8.5%	0.0%	3.7%	0.2%	1.9%
104	Performing Arts, Spectator Sports, and Related Industries	9.7%	7.6%	1.6%	0.4%	0.0%	0.8%	22.5%	0.3%	0.2%	36.9%	10.2%	0.2%	8.3%	0.0%	1.3%
105	Museums, Historical Sites, and Similar Institution	9.7%	7.6%	1.6%	0.4%	0.0%	0.8%	22.5%	0.3%	0.2%	36.9%	10.2%	0.2%	8.3%	0.0%	1.3%
106	Amusement, Gambling, and Recreation Industries	3.3%	1.7%	0.2%	0.0%	0.0%	0.0%	6.1%	0.4%	0.3%	68.4%	5.8%	0.0%	12.1%	0.4%	1.3%
107	Accommodation, including Hotels and Motels	5.1%	1.8%	0.2%	0.0%	0.0%	0.0%	0.3%	0.0%	0.8%	38.9%	16.4%	0.0%	33.6%	1.8%	1.0%

108	Food Services and Drinking Places	3.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	93.1%	0.9%	0.0%	0.6%	0.9%	1.2%
109	Repair and Maintenance	3.4%	2.5%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.1%	11.2%	0.0%	45.1%	7.5%	23.5%
110	Personal care services	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	14.0%	71.9%	11.0%	0.0%	1.2%	0.1%	0.0%
111	Death care services	8.9%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.8%	16.9%	0.0%	20.5%	0.0%	2.3%
112	Other Personal and Laundry Services	2.6%	1.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.2%	6.4%	47.7%	8.9%	0.0%	3.7%	12.4%	16.5%
113	Religious, Grantmaking, Civic, Professional, and Similar Organizations	10.2%	14.8%	1.8%	0.0%	0.0%	0.9%	25.1%	0.8%	0.3%	18.1%	20.5%	0.2%	6.3%	0.1%	0.9%
114	Private Households	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	92.1%	1.3%	0.0%	2.0%	0.0%	2.6%	0.7%	0.7%	0.0%
115	Government & Non NAICs	5.1%	12.4%	7.4%	0.3%	0.1%	3.5%	10.9%	3.4%	0.6%	22.2%	18.0%	0.4%	9.8%	1.8%	4.2%