The Economic and Fiscal Impacts of the University of Maryland, Baltimore on the State of Maryland, FY2018

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Executive Summary

The University of Maryland, Baltimore (UMB) is one of the largest employers; is the core public provider of health and professional educational services; and is the third largest university performer of research in Maryland. UMB impacts the State of Maryland in many ways. The University has its main impact on the State of Maryland by fulfilling its education and research mission and serving as a source of skilled and educated workers and generator knowledge and new technologies for the Maryland economy. In addition to this educational and research mission, UMB also has a significant impact on the State's economy through its operations. The University is a major source of economic activity through its purchases of goods and services from Maryland suppliers and through the salaries that it pays to its Maryland workforce.

The economic activity generated by the University is presented in the Summary Table below. Total University spending of almost \$1.6 billion generates \$450 million in *Indirect Impacts*, from local purchases, and \$987 million in *Induced Impacts*, from the increase in Maryland incomes associated with the University, for a total impact on the Maryland economy of over \$3.0 billion. Total direct University employment of 7,975 and an additional 179 jobs directly generated by UMB's capital spending are augmented by an estimated 9,214 multiplier effect jobs, for a total employment impact of 17,368 jobs. There is a total of almost \$1.4 billion in labor income associated with these 17,368 jobs. The economic activity supported by the University generates an estimated \$159.9 million in combined state and local government revenues, including an estimated \$87.7 million in estimated State of Maryland revenues.

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$1,592.9	\$867.3	8,154	\$72.3
Indirect	\$449.7	\$163.8	2,761	\$22.9
Induced	<u>\$986.8</u>	<u>\$336.0</u>	<u>6,453</u>	<u>\$64.8</u>
Total	\$3,029.4	\$1,367.1	17,368	\$159.9

Table ES1: Maryland Economic Activity Generated by the University of Maryland, Baltimore

Source: UMB, JFI and IMPLAN

The fiscal impact of the University of Maryland, Baltimore can also be analyzed in terms of the level of economic activity leveraged by the State appropriation. Universities, unlike other State government activities, attract a substantial portion of their revenues from other sources. In fiscal 2018, State appropriations of \$231.8 million accounted for 19 percent of University operational revenues. This leveraging of State appropriations, combined with the economic impacts discussed above, leads to a high return on State expenditures. Dividing the total economic output activity generated by the University by the State appropriation provides an estimate of the economic returns on the State's investment in the University of Maryland, Baltimore. The University of Maryland, Baltimore generates more than \$13 in economic activity for each \$1.00 appropriated.

While the economic and fiscal impacts described above are impressive, they only tell part of the story of the contribution of UMB. The University has its most important impact on Maryland through its research and educational mission. These are described in the report, but some significant highlights include:

- UMB is a core component of Maryland's education and training system. As Maryland's only public health, law, and human services university, with six professional schools and a Graduate School, UMB confers the majority of health care, human services, and law professional degrees in Maryland each year, including 20 percent of undergraduate nursing degrees, 59 percent of medical degrees, 72 percent of Masters in Social Work and 44 percent of law degrees;
- As Maryland's flagship public health and medical university, UMB accounts for 11 percent of total and 30 percent of industry sponsored academic research and development activities in Maryland; and
- With one of Maryland's three public university-based research parks and 44 university based start-ups created, UMB also plays a critical role in Maryland's economic development efforts.

Economic and Fiscal Impact Analysis

This report provides an analysis of the economic activity supported by the operations of the University of Maryland, Baltimore in the State of Maryland. As described in the methodology section below, this analysis uses the IMPLAN model for the State of Maryland to estimate the economic impacts associated with the operations, student expenditures and other related University spending on the State of Maryland. IMPLAN is one of the most widely used and respected models in the nation. The IMPLAN input/output model estimates the broader supply chain and employee spending impacts associated with the University in order to estimate both the linkages between and impacts of the University on the larger state economy. These linkages are termed the "multiplier effects" of the University and measure UMB's contribution to the overall state economy.

University of Maryland, Baltimore Revenues and Operations in Maryland

The first step in modeling the economic impacts associated with UMB is to estimate the direct effects, or the changes in final demand in the affected industries. In this analysis, the direct effects are the revenues or spending associated with the educational, patient care, research operations and capital budget of the University of Maryland, Baltimore. Once these direct effects are estimated, they can be entered into an economic model to determine the change in output (a measure similar to business sales volume which measures the level of business and economic activity in a state or region), employment, and labor income attributable to the University of Maryland, Baltimore. UMB impacts the Maryland economy through five primary revenue and spending areas:

- <u>Operating Revenues</u> the \$1.2 billion in tuition, research, and related academic revenues of UMB and its seven component schools;
- <u>Student Expenditures</u> the \$135.7 million in living expenses by UMB's full time students. This was estimated based on full time enrollment multiplied by program-specific cost of living data for students based on available cost of attendance data;¹
- 3. <u>UMB Foundation</u> the \$26.8 million in spending by the University of Maryland, Baltimore Foundation to support the educational and research mission of the University;
- <u>FPI</u> the \$319.2 million in estimated patient care revenues associated with University of Maryland Faculty Physicians, Inc., the UMB School of Medicine's health care delivery system; and
- 5. **<u>Capital Spending</u>** the \$39.0 million in capital and construction spending by UMB in FY2018.

As presented in Table 1, in fiscal 2018, the University, its affiliated institutions, its students, and capital projects *directly generated* a total of \$1.73 billion in Maryland revenues and spending.² The University

¹ This analysis only includes the cost of living for full time students because these are the students retained in or attracted to Maryland by UMB. Part time students would presumably attend another Maryland college or university in the absence of UMB; however, because of the unique programs offered by UMB, many of which have only limited in-state competing programs, this assumption is conservative and the actual levels of student living expenses could be higher. In order to avoid double counting with UMB's operational impacts, all salaries and wages paid to students by the University were excluded from this analysis.

and its affiliated institutions directly employed or supported 7,975 workers who earned \$850.3 million in salaries and benefits. These revenues and expenditures represent the direct effects of the University of Maryland, Baltimore.

Baltimore and Its Affiliated Institutions, Fiscal 2018			
Item	Millions of \$s		
Total Revenues/Spending	\$1,732.4		
Operating Revenues	\$1,211.6		
Student Expenditures ¹	\$135.7		

UMB Foundation

Capital Spending

(1) Less Student Stipends

Total Employment (# of Jobs) Total Payroll and Fringe

MSP-FPI

Source: UMB

 Table 1: Total Revenues Employment and Payroll Associated with the University of Maryland,

 Baltimore and Its Affiliated Institutions, Fiscal 2018

\$26.8

\$319.2

\$39.0 7,975

\$850.3

The Economic	Impact of Ur	iversity of Ma	rvland. Baltimor	e on the State	of Marvland

The University of Maryland, Baltimore is a significant source of economic activity in Maryland, generating over \$3.0 billion in economic activity, supporting 17,368 jobs earning almost \$1.4 billion in labor income, and generating \$159.9 million in combined state and local government revenues. Total University spending of \$1.6 billion generates \$450 million in *Indirect Impacts*, from purchases of goods and services to support the educational, medical and research mission of the University, and \$987 million in *Induced Impacts*, from the increase in Maryland incomes associated with the University, for a total impact on the Maryland economy of over \$3.0 billion. Total direct University employment of 7,975 and 179 direct construction-related jobs generated by UMB's capital spending are augmented by an estimated 9,214 multiplier effect jobs, for a total employment impact of 17,368 jobs. There is a total of almost \$1.4 billion in salaries and wages associated with these 17,368 jobs. The economic activity supported by the University generates an estimated \$159.9 million in combined state and local government revenues, including an estimated \$87.7 million in estimated State of Maryland revenues.

² This analysis differs in approach from the prior FY2014 report, which included visitor spending, which was unavailable for this report, and also calculated student living expenses and some other direct impacts in a more conservative manner.

				State and Local
	Output	Labor Income	Employment	Government
	(Mil. \$s)	(Mil. \$s)	(Jobs)	Revenues (Mil. \$s)
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Indirect	\$449.7	\$163.8	2,761	\$22.9
Induced	<u>\$986.8</u>	<u>\$336.0</u>	<u>6,453</u>	<u>\$64.8</u>
Total	\$3,029.4	\$1,367.1	17,368	\$159.9

Table 2: Maryland Economic Activity Generated by UMB, FY2018

(1) Direct jobs include the 7,975 jobs at UMB plus 179 direct construction-related jobs associated with UMB Capital Spending.

Source: UMB, JFI and IMPLAN

The University of Maryland, Baltimore is clearly an important source of economic activity for the Maryland economy. In order to better describe its role in the State's economy, the contribution of each of the major revenue and expenditure categories to UMB's total impact is presented in Table 3, and the contribution of each of the University's seven schools is presented in Table 4. Key highlights of these analyses are as follows:

- UMB's operating expenditures generate 73 percent of the economic activity and 74 percent of the jobs associated with the University (Table 3);
- Student expenditures generate 5 percent of the activity and 6 percent of the jobs and UMB Capital Expenditures generate 2 percent of the activity and 2 percent of the jobs associated with the University (Table 3);
- The UMB School of Medicine generates 46 percent of the economic activity and 44 percent of the jobs associated with the University (Table 4);
- University of Maryland Faculty Physicians, Inc. generate 19 percent of the activity and 16 percent of the jobs associated with the University (Table 3 and 4); and
- University Central Administration, which includes expenditures and employment that cannot be allocated to an individual school, is the third largest contributor to UMB's impacts, generating 11 percent of the economic activity and the jobs associated with the University (Table 4).

The full individual economic impact analyses for each UMB revenue and expenditure category, and for each of the six individual schools are presented in the Appendix to this report.

Table 3: Maryland Economic Activity Generated by UMB, by Revenue/Expenditure Area, FY2018

				State and Local
	Output	Labor Income	Employment	Government
	(Mil. \$s)	(Mil. \$s)	(Jobs)	Revenues (Mil. \$s)
Total	<u>\$3,029.4</u>	<u>\$1,367.1</u>	<u>17,368</u>	<u>\$159.9</u>
Operating Expenditures	\$2,199.6	\$1,079.3	12,822	\$123.0
Student Expenditures	\$161.7	\$56.2	1,082	\$10.2
UMB Foundation	\$49.2	\$24.7	378	\$2.8
MSP-FPI	\$561.0	\$186.6	2,770	\$21.6
UMB Capital Spending	\$57.9	\$20.3	316	\$2.4
Source: UMB, JFI and IMPLAN				

				State and Local
	Output	Labor Income	Employment	Government
	(Mil. \$s)	(Mil. \$s)	(Jobs)	Revenues (Mil. \$s)
Total	<u>\$3,029.4</u>	<u>\$1,367.1</u>	<u>17,368</u>	<u>\$159.9</u>
School of Dentistry	\$141.0	\$62.3	819	\$7.9
School of Law	\$80.0	\$41.2	578	\$4.8
School of Medicine	\$1,404.8	\$693.8	7,620	\$79.3
School of Nursing	\$118.0	\$55.5	991	\$6.9
School of Pharmacy	\$124.4	\$61.0	766	\$7.2
School of Social Work	\$111.4	\$52.2	834	\$6.4
Graduate School	\$39.4	\$29.5	458	\$3.1
University Central Administration	\$342.4	\$140.0	1,838	\$17.6
UMB Foundation	\$49.2	\$24.7	378	\$2.8
MSP-FPI	\$561.0	\$186.6	2,770	\$21.6
UMB Capital Spending	\$57.9	\$20.3	316	\$2.4
Source: UMB. JFI and IMPLAN				

Table 4: Maryland Economic Activity Generated by UMB, by School, FY2018

The Economic Impact of University of Maryland, Baltimore Capital Expenditures on

Maryland

The University of Maryland, Baltimore has benefitted tremendously from major capital projects to support and expand its core educational and research mission. Most recently, UMB completed its Health Sciences Facility III (HSF3), a state-of-the-art biomedical research facility that will allow for the expansion of the School of Medicine's (SOM) research operations in a facility designed to improve cross-pollination and interaction among departments, programs, centers, and institutes and increasing the SOM's standing as one of the top research institutions in the country. UMB's current largescale capital project is the \$79.0 million Central Electric Substation and Electrical Infrastructure project, a 16,128 sq. ft. facility that will house a BGE substation and recycling center. UMB will begin construction in FY2019 and the project will be completed in FY2023.

In order to describe the economic importance of UMB's capital expenditures to the State's economy, the JFI estimated the detailed economic impacts of UMB's FY2018 capital expenditures and the total impacts of projected capital spending through FY2022 were also calculated in order to describe the long term impacts of UMB's capital budget. Key results of these analyses are as follows:

- UMB's FY2018 Capital Spending of \$35.2³ million will directly create 179 construction-related jobs and when multiplier effects are included, will generate \$57.9 million in Maryland economic activity, support 316 total jobs earning \$20.3 million in labor income, and generate \$2.4 million in combined state and local government revenues (Table 5); and
- Over the next five fiscal years, UMB's capital spending will range from a high of \$35.2 million in FY2018, to between \$14 and \$18 million in FY 2019-FY2022. Over this period, UMB capital expenditures will support almost 500 direct construction related jobs and over 870 total jobs including multiplier effects (Table 6).

³ UMB FY 2018 incudes purchases of furniture, fixtures and equipment as well as construction. Only the local margin of non-construction purchases were included. Thus, the direct effects of UMB Capital expenditures is less than the \$39 million in total capital spending.

Table 5: Economic Activity Generated by UMB Capital Spending, FY2018

	Output (Mil. \$s)	Labor Income (Mil. \$s)	Employment (Jobs)	State and Local Government Revenues (Mil. \$s)
Direct	\$35.2	\$12.3	179	\$0.9
Indirect	\$10.0	\$3.7	54	\$0.7
Induced	\$12.7	\$4.3	83	\$0.8
Total	\$57.9	\$20.3	316	\$2.4

Source: UMB, JFI and IMPLAN

Table 6: Economic Activity Generated by the UMB Capital Spending FY2018-2020

	FY 2018	FY2019 -	FY2020 -	FY2021 -	FY2022 -
	Actual	Plan	Plan	Plan	Plan
Direct	\$35.2	\$17.7	\$16.8	\$14.9	\$13.8
Total Impact					
Output (Mil. \$s)	\$57.9	\$28.8	\$27.3	\$24.3	\$22.4
Labor Income (Mil. \$s)	\$20.3	\$9.9	\$9.4	\$8.4	\$7.7
Employment (Jobs)	316	155	147	131	121
State and Local Government Revenues (Mil. \$s)	\$2.4	\$1.2	\$1.1	\$1.0	\$0.9
Source: Divib, JFI and INPLAN					

The Fiscal Impacts of University of Maryland, Baltimore on Maryland

The University of Maryland, Baltimore also has an important fiscal impact on the State of Maryland. The salaries and wages earned by UMB staff and the jobs created and sustained by University operations are subject to state and local income taxes. The many private sector companies providing goods and services to the University pay state corporate income and other business-related taxes. Maryland residents holding the jobs created or supported by the University pay property, sales and other taxes and fees to state and local governments. These state and local government revenues are projected to total \$159.9 million, including an estimated \$87.7 million in estimated State of Maryland revenues.⁴

The fiscal impact of the University of Maryland, Baltimore can also be analyzed in terms of the level of economic activity leveraged by the State appropriation. Universities, unlike other State government activities, attract a substantial portion of their revenues from other sources. In fiscal 2018, State appropriations of \$231.8 million accounted for 19% of University operational revenues. This leveraging of State appropriations, combined with the economic impacts discussed above, leads to a high return on State expenditures. Dividing the total economic output activity generated by the University by the State appropriation provides an estimate of the economic returns on the State's investment in UMB. Based on this measure, the University of Maryland, Baltimore generates more than \$13 in economic activity for each \$1.00 appropriated.

⁴ The IMPLAN model estimates aggregated state and local government revenues. These were decomposed into their estimated state and local government revenue shares based on data from the U.S. Bureau of the Census government finances data.

Workforce Development Impacts

Colleges and universities have their primary impact on a local economy through their vitally important role in providing the skilled and educated workforce demanded by the local employer community. According to the most recent *Area Development* magazine 32nd *Annual Survey of Corporate Executives* on business site selection factors, "Labor Is Paramount." According to the survey, labor costs and the availability of skilled labor were the second and third most import factors considered by a business in choosing a location, and reports that,

The fact that about 90 percent of the Corporate Survey respondents indicate labor costs and skilled labor availability as "very important" or "important" to a location decision must not be understated and offers lessons to both companies wanting to select the optimal site and to communities seeking to grow their economic base and win projects. While incentives, tax structure, high quality of life, and access to customers/markets are always key project drivers, a community that does not have the adequate labor profile is devastating to a project's success in that location, and also limits the economic developer's ability to successfully compete for a project.⁵

Colleges and universities play a major role in a region's workforce development system, especially in a state like Maryland that is focused on growing and attracting high skilled, creative and technology based businesses.

The critical role of universities in supporting economic development by providing the skilled and educated workforce required by state and regional economies is recognized by the Association of Public Land-Grant Universities (APLU) and its Commission on Economic and Community Engagement (CECE), which identifies *Talent/Workforce Development*, along with *Innovation* and *Place Development* as the three main ways in which colleges and universities support economic and social prosperity. According to the APLU's *Advancing University-Engaged Economic and Societal Prosperity* report,

At the heart of every higher education institution is the teaching and learning mission. Universities exist to educate the nation's citizenry and workforce in every field and profession. But technological innovation, increased global competition, and a more demanding business climate require new and re-envisioned approaches to ensuring Americans are educated and equipped with the skills and competencies necessary to excel in the 21st century workplace.

According to this report, universities are at the center of talent development in the nation and must "re-commit to student and employer needs by embracing their role in talent and workforce development."⁶

⁵ http://www.areadevelopment.com/Corporate-Consultants-Survey-Results/Q1-2018/32nd-annual-corporatesurvey-14th-annual-consultants-survey.shtml.

⁶ http://www.aplu.org/library/advancing-university-engaged-economic-and-societal-prosperity/file.

Role of University of Maryland, Baltimore in Maryland Higher Education

Higher education institutions are vital components of any state or region's workforce development system. They provide their core economic impact by providing the skilled and educated workforce required to meet the needs of the employer community. Access to skilled and educated workers is of particular importance to the innovation and technology-based industries targeted by the Maryland Department of Commerce, which identifies the: Aerospace & Defense; Advanced Manufacturing; Agribusiness; BioHealth & Life Sciences; Distribution & Logistics; Energy & Sustainability; Financial Services; IT & Cybersecurity; and Military & Federal sectors as key industries for Maryland's future. While UMB's alumni can be found across these sectors, the University plays a vitally important role in the supporting Maryland's critical Bio Health & Life Sciences sector.

One of Maryland's principal economic development assets in supporting the development of its targeted growth sectors and economic development in general is it concentration of highly educated and skilled workers. According to the Maryland Department of Commerce,

- Maryland ranks third among the states in the percentage of the population age 25 and above with a bachelor's degree or higher and second in the percentage with a graduate or professional degree;
- Maryland ranks second among the states in the percentage of professional and technical workers in the workforce; and
- Maryland has the highest concentration of employed doctoral scientists and engineers. The state ranks first in employed PhD scientists and engineers per 100,000 employed workers, with a first place ranking for PhD scientists and second for PhD engineers, with a first place ranking in both biological sciences and heath doctoral scientists per 100,000 employed workers.⁷

The University of Maryland, Baltimore, with its focus on health and life sciences, plays a critical role in Maryland's workforce development system and comparative workforce advantage in having a skilled and educated workforce.

As the State's public, flagship provider of health related education, the University of Maryland, Baltimore plays a vital role in providing the workers demanded in key industry sectors, especially in Maryland's health care and life sciences sectors. UMB is Maryland's only public health, law, and human services University and with six professional schools and a Graduate School, it confers the majority of health care, human services, and law professional degrees in Maryland each year. While UMB only accounts for 3 percent of total enrollment in Maryland four-year degree granting institutions, it accounts for 14 percent of full-time graduate enrollment and almost one-quarter of public university full-time graduate enrollment.

⁷ http://commerce.maryland.gov/about/rankings-and-statistics.

	University of Maryland, Baltimore	University System of Maryland	All Four Year Institutions	UMB as a Percent of Total
Total	<u>6,777</u>	<u>176,079</u>	<u>242,588</u>	<u>3%</u>
Full-Time Undergraduate	702	86,254	118,373	1%
Part-Time Undergraduate	207	48,623	51,531	0.4%
Full-Time Graduate	4,500	17,651	31,153	14%
Part-Time Graduate	1,368	23,551	41,531	3%

Table 7: University of Maryland, Baltimore's Share of Total Maryland Enrollment at Four-Year DegreeGranting Institutions, Fall 2018

Source: Maryland Higher Education Commission

UMB is a key provider of health and professional degrees. The University of Maryland, Baltimore plays a critically important role in educating students in key areas of workforce need, especially in health related areas of study. While UMB only accounted for 4 percent of total degrees granted by public and private four-year degree granting institutions in 2016, it is a critical source of graduates in many key fields, including:

- Nursing UMB accounts for 20 percent of undergraduate nursing degrees, 47 percent of masters level nursing degrees, 50 percent of nursing doctoral degrees, and 53 percent of nurse practitioner degrees granted by all Maryland colleges and universities;
- Dentistry UMB operates Maryland's only dental school;
- Pharmacy UMB operates Maryland's largest pharmacy program and accounts for 57 percent of pharmacy degrees granted;
- Medicine UMB is Maryland's only public and largest medical school and accounts for 59 percent of medical degrees granted;
- Social Work UMB accounts for 72 percent of Masters and 50 percent of doctoral social work degrees granted in Maryland; and
- Law UMB accounts for 44 percent of law degrees granted in Maryland.

Degree/Program	University of Maryland, Baltimore	All Four Year	UMB as a Percent of Total
Total Selected Degrees	2.083	56.000	4%
	_,		
Bachelor's Degree	<u>399</u>	<u>34,632</u>	1%
Dental Hygiene	22	22	100%
Nursing	364	1,815	20%
All Other	13	32,795	0%
Master's Degree	<u>887</u>	<u>18,567</u>	5%
Social Work	465	649	72%
Nursing	243	516	47%
All Other	179	17,402	1%
Doctorate (Research/Scholarship)	<u>67</u>	<u>1,406</u>	5%
Biological and Biomedical Sciences	42	261	16%
Social Work	7	14	50%
Nursing	5	10	50%
All Other	13	1,121	1%
Doctorate (Professional Practice)	<u>730</u>	<u>1,395</u>	52%
Law	216	493	44%
Dentistry	124	124	100%
Medicine	159	270	59%
Pharmacy	152	267	57%
Physical Therapy	55	84	65%
Nursing Practice	24	45	53%
Other	0	112	0%
Source: Maryland Higher Education Comm	nission		

Table 8: Selected Degrees Awarded by University of Maryland, Baltimore and Public and PrivateColleges and Universities in Maryland, 2016

UMB is a critical source of needed workers in key Maryland occupations. As Maryland's only public health, law, and human services university, UMB plays a critical role in meeting Maryland's need for workers in key medical and professional fields. Table 9 compares the number of UMB graduates to estimated Maryland demand for workers in key occupations.⁸ UMB supplies:

- Six percent of the Dental Hygienists needed by Maryland employers;
- Seventeen percent of the Nurses needed by Maryland employers;
- Twenty two percent of Nurse Practitioners needed by Maryland employers;

⁸ Data on occupational demand are from JFI analysis of Maryland occupational openings projections from Projections Central - http://www.projectionscentral.com/Projections/LongTerm. Occupational openings were sorted in to degree area based on national degree - occupational cross walk data and the determination of the JFI.

- Thirty two percent of the Social workers needed by Maryland employers;
- Twenty two percent of doctors needed by Maryland employers;
- Forty nine percent of pharmacists needed by Maryland employers;
- Sixty Four percent of Lawyers needed by Maryland employers; and
- Seventy six percent of dentists needed by Maryland employers.⁹

Without the degree programs offered by UMB, Maryland would face critical shortages in key occupational areas.

 Table 9: Role of University of Maryland, Baltimore in Meeting Maryland Occupational Demand in Key

 Selected Occupations

Occupation	Maryland Occupational Demand	University of Maryland, Baltimore Graduates, 2017	UMB as a Percent of Total Demand ¹
Total	<u>7,000</u>	<u>1,909</u>	27%
Dental Hygienists	350	20	6%
Nurses ²	3,330	554	17%
Social Workers	1,320	428	32%
Physical Therapists	320	56	18%
Nurse Practitioners	220	49	22%
Dentists	170	130	76%
Physicians	740	161	22%
Pharmacists	320	157	49%
Lawyers	580	374	64%

(1) Degree holders may work in other occupations or outside of Maryland and thus, the total number of graduates can exceed State demand.

(2) Registered Nurses

Source: JFI analysis of Maryland occupational openings projections from Projections Central http://www.projectionscentral.com/Projections/LongTerm - and MHEC data on Degrees Granted.

Role of University of Maryland, Baltimore in Maryland's Human Capital

Not only are UMB's graduates a vitally important source of skilled and educated labor for the Maryland economy, higher education represents an investment in a state's human capital. Research by the Federal Reserve Bank of New York found that colleges and universities can raise local human capital levels by increasing both the supply of and demand for skilled labor.¹⁰ Measuring human capital is difficult. One method used is to analyze the increased earnings associated with completing a higher education degree. The Jacob France Institute has used this earnings/human capital approach to

⁹ Data on 2017 Degrees granted b UMB was available on the MHEC website and were used for this occupational demand analysis. The data in Table 8 (above) as for 2016 – the latest year for which data on all degrees granted was available for analysis.

¹⁰ https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr401.pdf.

measuring the economic impact of the University System of Maryland.¹¹ In this report, the JFI calculated the impact of the public's investment in higher education by comparing the state's expenditures on higher education to the tax revenues derived from the increased earnings power of its graduates. Conducting a similar human capital based assessment of UMB was outside of the scope of this report; however, the JFI did prepare a high level assessment of UMB's contribution to human capital formation, in the form of the increased earnings of its alumni living in Maryland.

Higher Education Pays. One of the most important benefits of higher education is the increased standard of living gained by college graduates. At the national level, data from the U.S. Bureau of Labor Statistics demonstrate that as a worker's level of educational attainment increases, earnings grow and the chance of being unemployed falls. For example, nationally, in 2017, workers with a Bachelor's Degree earned \$1,173 a week compared to an average of \$907 for all workers and \$712 for workers with only a high school diploma. In 2017, only 2.5 percent of workers with a Bachelor's Degree are unemployed, compared to 3.6 percent of workers on average, 4.6 percent of workers with a High School Diploma and 6.5 percent of workers with less than a high school level of education.¹² Data on earnings by level of educational attainment for Maryland residents are presented in Table 10, with Maryland employed resident workers with a Bachelor's degree earning \$26,321 per year more than a resident worker with only a High School diploma and a worker with a Graduate or Professional Degree earning an additional \$20,792.¹³

Level of Educational Attainment	2017	Incremental Earnings
	2017	
Total	\$50,160	
Less than high school graduate	\$26,309	
High school graduate (includes equivalency)	\$35,409	\$9,100
Some college or associate's degree	\$42,707	\$7,298
Bachelor's degree	\$61,640	\$18,933
Graduate or professional degree	\$82,432	\$20,792
Source: JFI Analysis of Census –ACS Data		

 Table 10: Maryland Median Earnings¹ by Educational Attainment for the Population 25 Years And

 Over

With its focus on graduate and professional education, UMB generates strong incremental earnings for its graduates. An important measure of the impact of higher education is the incremental earnings of its graduates. By providing graduates with the education and skills demanded by local employers, UMB's graduates add more value to Maryland's knowledge-based economy. These graduates benefit from the higher wages associated with their skills, and these earnings both benefit the Maryland economy and generate state and local tax revenues. In its estimate of the human capital impacts associated with the University System of Maryland, the JFI estimated that earning a Bachelor's degree

¹¹ file:///C:/Users/Richard/Downloads/USMEconomicImpact_final-1.pdf.

¹² National data are from https://www.bls.gov/emp/ep_chart_001.htm.

¹³ Data on Maryland resident earnings are from the American Community Survey.

can result in earnings gains of over \$2.7 million over a lifetime when compared to a high school graduate; with a Master's degree generating an additional \$100-\$500,000 in earnings above a Bachelor's; a doctorate earning an additional \$300-\$700,000 and a Professional Degree adding more than an additional \$2.3 million.

The JFI prepared an analysis of the incremental earnings associated with UMB's alumni residing in Maryland. UMB provided data on the number of working age¹⁴ alumni residing in Maryland by degree. The JFI estimated the annual earnings associated with these degrees using data on occupational earnings from the Maryland Department of Labor, Licensing and Regulation¹⁵ by linking the degree earned to the likely occupation of the graduate and estimated average annual occupational earnings, which range from \$70,830 for a Bachelor's Degree recipient, to \$65,266 for Master's Degree recipients to \$143,572 for Professional Degree recipients (Table 11).¹⁶ The JFI then estimated the incremental alumni earnings associated with the receipt of a UMB degree. Based on this estimated occupational composition of employment approach, UMB alumni earn more than and a resulting higher wage premium than the average Maryland college-educated resident. For example, the average UMB Bachelor's Degree holder earns \$70,830 compared to \$61,640 for all Bachelor's degree holders in Maryland, with an annual wage premium of \$35,421 compared to the state average of \$26,231 (Table 12). These incremental earnings result in higher spending, which generates economic activity in Maryland, and are also subject to state and local government income taxes. These spending and tax impacts were estimate by the JFI using the IMPLAN model and state and local tax rates. As presented in Table 13, UMB alumni incremental earnings generate an estimated \$1.3 billion in Maryland economic activity, support 8,260 jobs earning \$434 million in labor income, and generate an estimated \$84 million in state and local government revenues, including an estimated \$45 million in State of Maryland revenues.¹⁷

¹⁴ 62 and younger.

¹⁵ http://www.dllr.state.md.us/lmi/wages/toc001.htm.

¹⁶ Earnings and average earnings by degree were based on average data for each occupation from DLLR data, with degree averages calculated as the weighted average of degree-occupational pairings. These data are estimates based on the likely occupation of the degree-holder based on occupational employment information and average earnings by degree. Not all degree recipients go on to work in the occupation most clearly associated with their degree – for instance not all law degree recipients practice law – and not all alumni are employed or work full time. Thus, this is a rough estimate of the potential earnings of alumni.

¹⁷ The IMPLAN model estimates aggregated state and local government revenues. These were decomposed into their estimated state and local government revenue shares based on data from the U.S. Bureau of the Census government finances data.

		Average
	# of	Occupational
Degree/Level	Graduates	Earnings ¹
All Graduates	32,131	
<u>Bachelors</u>	<u>8,579</u>	<u>\$70,830</u>
Dental Hygienist and BS in Dentistry	910	\$85,891
Nursing and Post Bachelor's Certificate	6,044	\$75,246
Pharmacy	590	\$32,617
Bachelor of Science/Medical Technology	1,016	\$53,584
Certificate in Clinical Research	19	\$53,584
<u>Masters</u>	<u>11,883</u>	<u>\$65,266</u>
Dentistry ²	95	\$89,568
Nursing ²	3,186	\$74,117
Social Work (All Masters and Certificate)	7,396	\$55,393
Pharmacy ²	110	\$113,726
Genetic Counseling	45	\$62,739
Public Health	117	\$95 <i>,</i> 437
Physical Therapy	256	\$86,840
Masters in Medicine/Related	561	\$113,726
Other Graduate Degree - Law	117	\$74,259
Research and Scholarship Doctorate	<u>2,360</u>	<u>\$112,948</u>
Nursing	70	\$81,561
Social Work - PhD and DSW	53	\$83,330
Pharmacy - PhD	1,741	\$91,104
Medicine - PhD (Used MDs)	479	\$198,614
Dental PhD	17	\$157,872
Professional Practice Doctorate	<u>9,309</u>	<u>\$143,572</u>
Dentistry (DDS) and PhD in Dentistry	1,392	\$157,872
Nurse Practitioner	193	\$109,842
Pharmacy - PHRMD	137	\$118,923
Law - JD and Other	4,972	\$126,479
Physical Therapy - DPT	617	\$86,840
Medicine	1,998	\$198,614
(1) Each degree area was matched to the most appropriate occupation has	ad on the datarm	ination of the IEI

Table 11: Estimated UMB Alumni Earnings

(1) Each degree area was matched to the most appropriate occupation based on the determination of the JFI with average occupation wage data from the Maryland Department of Labor, Licensing and Regulation. Where necessary - average wages were estimated across relevant occupations. Average wage data by degree level was calculated based on the estimated average earnings across degree areas.

(2) Used earnings for experienced worker in related field.

Source: UMB, JFI and DLLR

	Maryland Average Income ¹	ACS Wage Premium	Estimated UMB Alumni Earnings ²	Estimated UMB Wage Premium	Estimated UMB Alumni Living/ Working in MD	Estimated UMB Alumni Wage Premium (Mil. \$s)
High School Graduate	\$35,409					
Bachelor's Degree	\$61,640	\$26,231	\$70,830	\$35,421	8,579	\$304
Graduate or Professional Degree	\$82,432	\$20,792	\$100,995	\$39,355	<u>23,552</u>	<u>\$927</u>
(1) 2017 Earnings from U.	unity Survey	32,131	\$1,231			
(2) Calculated from Table	11					

Table 12: Annual Wage Premium from Degrees Conferred to Working Age UMB Alumni Residing in Maryland

(2) Calculated from Table 11.

Source: JFI and ACS.

Table 13: Estimated Maryland Activity Supported by UMB Alumni Wage Premium

	Maryland Activity
Total Output (Mil. \$s)	\$1,276
Labor Income (Mil. \$s)	\$434
Employment (Jobs)	8,260
State and Local Government Revenues (Mil. \$s) ¹	\$84
Source: JFI and IMPLAN	

Economic Development Impacts

According to the *Higher Education Engagement in Economic Development: Foundations for Strategy and Practice* report¹⁸ produced by the Association of Public Land Grant Universities and the University Economic Development Association,

Twenty-first century institutions of higher learning share in responsibilities for economic development They engage, in varying roles, as stewards of place in the communities and regions they serve. They further understand economic development and engagement as functions of the entire institution—connected with (or embedded in) core missions.

As described in this report, colleges and universities play a major role in supporting regional economic development as core components of local innovation ecosystems. While colleges and universities have their principal impact on a region through their role in talent development, by meeting a region's need for a skilled and educated workforce; they also play a major role in promoting regional economic growth and development through the generation of new technologies through *research* and the development and deployment of these technologies through *commercialization* activities. According to this report, "Innovation begins with basic research, but then builds on knowledge creation to encompass knowledge transfer and application in ways that are useful and relevant to society."¹⁹

This assessment of UMB's role in Maryland economic development focuses on the University's role in research and innovation. According to the *Higher Education Engagement in Economic Development* report, research and innovation includes all institutional efforts that lead to solutions for, or enhancements to, society. Solutions for society might include technologies that can be developed into marketable products; new practices that help businesses, government, or not-for profit organizations overcome challenges; or creative works that inform and inspire, and includes:

- Basic and research;
- Technology / knowledge transfer and commercialization;
- Business formation, incubation, and acceleration;
- Place-based strategies to support innovation, such as Collaborative research labs and other co-working spaces, Incubators and accelerators, and Research and technology parks/Innovation Districts; and
- The variety of programs, such as clinical programs (need to include the law clinic) and other programs to support technology commercialization and community and economic development.

The University System of Maryland (USM) is focused on the promotion of economic development through technology transfer as a core goal of the system. In 2011, the Board of Regents created its Committee on Economic Development and Technology Commercialization to provide strategic

¹⁸ http://www.aplu.org/library/higher-education-engagement-in-economic-development-foundations-for-strategy-and-practice/file.

¹⁹ See note 5, p. 12.

leadership for the USM's economic development, technology commercialization, and entrepreneurial initiatives. The USM has reported the following outcomes its expanded economic development and technology commercialization efforts:

- 1. An 83 percent increase in new patents filed;
- 2. \$1.28 billion in extramural funding, with USM is ranked 9th in the US in total sponsored research funding;
- 3. 547 new companies facilitated since FY 2011; and
- 4. Increased USM Technology Transfer staff from 18 to 31 personnel.

The July 2017, University System of Maryland Economic Development and Technology Commercialization report identified 5 core economic development goals for its efforts:

- 1. Strengthen the USM entrepreneurial ecosystem;
- 2. Aligning resources with market demand;
- 3. Leverage USM resources through collaborations;
- 4. Engage the investment community and enhance access to capital for USM affiliated startups; and
- 5. Enhance partnerships with state and federal programs.²⁰

As Maryland's public life sciences focused public university, UMB plays a critical role in the State and University System of Maryland's economic development efforts, especially in the critical life sciences sector. UMB Mission is "To improve the human condition and serve the public good of Maryland and society at-large through education, research, clinical care, and service." UMB's specifically highlights its economic development mission in its Vision Statement where it sets the goal that, "The University will become a dominant economic leader of the region through innovation, entrepreneurship, philanthropy, and interdisciplinary and inter-professional teamwork. The University will extend its reach with hallmark local and global initiatives that positively transform lives and our economy."²¹

UMB is active in technology commercialization and economic development through its role in both the Center for Maryland Advanced Ventures (CMAV) and UM Ventures.

• The <u>Center for Maryland Advanced Ventures</u> was created by the University of Maryland Strategic Partnership Act of 2016. CMAV was launched July 1, 2017 to facilitate technology transfer, identify research projects that could be commercialized and develop programs to support that commercialization. CMAV created a structured series of strategic and thoughtful initiatives that fulfil the goal of the legislation, while also connecting and expanding to existing UM Ventures programs that support the advancement of technology commercialization. The Baltimore Fund is the CMAV program designed to encourage the development and location of university created or sponsored technology companies in Baltimore. CMAV programs have worked collaboratively with TEDCO and the Maryland Department of Commerce to ensure they are fully integrated and complimentary to existing Maryland programs but are still under development as we continue to refine our approaches to ensure success and growth.

²⁰ https://www.usmd.edu/newsroom/docs/EDTCMonograph_2017.pdf

²¹ http://www.umaryland.edu/about-umb/umb-fast-facts/.

 <u>UM Ventures</u> is a joint initiative of the MPowering the State Program, bringing the University of Maryland, Baltimore and University of Maryland, College Park together to commercialize discoveries, and create economic impact by engaging partners in industry and social ventures. By encouraging students and faculty and providing expert advice and business services, more discoveries will reach the market. By engaging directly with external partners UM Ventures will bring new investment, expanded markets and more startup ventures.

Role in Maryland Academic Research and Development

According to National Science Foundation data, UMB is Maryland's third largest academic research and development center, accounting for 11 percent of academic R&D in Maryland (Figure 1). Since 2008, UMB's total research has remained constant at approximately \$400 million, reflecting the broader constraints in federal research funding and industry sponsored research. Based on reported Fiscal Year 2017 expenditures of \$426.9 million from all sources, the University of Maryland, Baltimore ranks 42nd in higher education R&D expenditures at public institutions and 56th among all public and private institutions. Within the Life Sciences field, UMB ranks 34th among all public and private institutions.



UMB is a vital component of Maryland's academic research infrastructure, and is the leading public university in terms of industry-sponsored R&D. Using FY2016 data from the Association of University Technology Managers,²² UMB accounts for 11 percent of total public and private academic R&D performed in reporting institutions in Maryland, 6 percent of Federally Sponsored Expenditures and 30 percent of Industry Sponsored Expenditures. Within the University System of Maryland, UMB accounts for 44 percent of total USM total academic R&D, 31 percent of USM Federally Sponsored Expenditures and 83 percent USM Industry Sponsored Expenditures.

²² JFI analysis of Association of University Technology Managers (AUTM) data. Maryland AUTM data is for USM as a total – including UMCP and UMBC. UMB data were provided by the University of Maryland Ventures, other USM is total USM less UMB.

Institution	Total Research Expenditures	% of Total	Federally Sponsored Expenditures	% of Total	Industry Sponsored Expenditures	% of Total
Total	<u>\$3,976.2</u>	<u>100%</u>	<u>\$3,329.5</u>	<u>100%</u>	<u>\$186.4</u>	<u>100%</u>
Johns Hopkins ¹	\$2,947.4	74%	\$2,630.4	79%	\$119.1	64%
USM ²	\$1,028.8	26%	\$699.1	21%	\$67.3	36%
UMB	\$448.0	11%	\$214.6	6%	\$55.8	30%
Other USM	\$580.8	15%	\$484.5	15%	\$11.5	6%

Table 14: 2016 Research Expenditures by Major Maryland Universities, Millions of Dollars

(1) Includes APL

(2) The AUTM Data used in this analysis is reported for USM as a total - the UMB data were provided by the University of Maryland Ventures. USM data is for the major research universities. Other USM is total USM less UMB. Source: Association of University Technology Managers

Role in Technology Commercialization

Colleges and universities are major components of the national research and development system accounting for 13 percent of all national R&D, and 49 percent of basic R&D.²³ As major performers of research, colleges and universities play a vitally important role in developing new technologies. Transferring these new discoveries and technologies to the private sector for development through the technology transfer and commercialization process has become a vital part of the national innovation ecosystem. Technology transfer is not only a vital source of new products and companies for the economy, it is increasingly important to higher education institutions themselves, as a source of revenue, industry relationships, and recruiting and retaining high quality faculty. According to the Kaufman Foundation,

University research is associated with the creation of tremendous economic value—it can potentially generate revenues for universities, create research connections between academia and industry, and enhance regional economic growth and development. Over the past two centuries, academic laboratories have played a critical role in the birth of entire industries including the synthetic dye industry, the digital computer industry, and the biotechnology industry. In fact, large-scale empirical studies have found positive relationships between academic research and technology development as well as between academic research and productivity growth.²⁴

With its focus on medical and life sciences research, UMB plays a critical role in the commercialization of academic discoveries. In terms of generating new technologies for commercialization, UMB accounts for 12 percent of academic Invention Disclosures and 13 percent of New Patent Applications and 12 percent of New Patents issued by major Maryland public and private research universities. In terms of current commercialization activities, UMB accounts for 2 percent of all Gross License Income Received issued by major Maryland public and private research universities and 57 percent of Gross License

²³ JFI analysis of NSF data from https://www.nsf.gov/statistics/natlpatterns/.

²⁴ http://www.kauffman.org/microsites/state-of-the-field/topics/technology-and-innovation/university-technology-transfer#Discuss.

Income received by University System of Maryland institutions. UMB accounts for 16 percent of current Licenses and Options Generating Revenues Licenses and 14 percent of Options Executed in 2016. *It is clear from these figures that UMB is a major part of Maryland's innovation ecosystem and is a leader among the State's public colleges and universities.*

Institution	Invention Disclosures	% of Total	New Patent Applications	% of Total	U.S. Patents Issued	% of Total
Total	<u>1,141</u>	<u>100%</u>	<u>1,208</u>	<u>100%</u>	<u>258</u>	<u>100%</u>
Johns Hopkins ¹	775	68%	810	67%	182	71%
USM ²	366	32%	398	33%	76	29%
UMB	136	12%	152	13%	32	12%
Other USM	230	20%	246	20%	44	17%

Table 15: Patenting and Disclosure Activity in 2016 by Major Maryland University

(1) Includes APL

(2) The AUTM Data used in this analysis is reported for USM as a total - the UMB data were provided by the University of Maryland Ventures. USM data is for the major research universities. Other USM is total USM less UMB.

Source: Association of University Technology Managers

Table 16: 2016 Technology Transfer Activity by Major Maryland Universities

	Gross License		Licenses and			
	Income		Options		Licenses and	
	Received	% of	Generating	% of	Options	% of
Institution	(\$1,000s)	Total	Revenues	Total	Issued	Total
Total	\$60,672,925	<u>100%</u>	<u>591</u>	<u>100%</u>	<u>245</u>	<u>100%</u>
Johns Hopkins ¹	\$58,436,106	96%	405	69%	184	75%
USM ²	\$2,236,819	4%	186	31%	61	25%
UMB	\$1,276,140	2%	97	16%	34	14%
Other USM	\$960,679	2%	89	15%	27	11%

(1) Includes APL

(2) The AUTM Data used in this analysis is reported for USM as a total - the UMB data were provided by the University of Maryland Ventures. USM data is for the major research universities. Other USM is total USM less UMB.

Source: Association of University Technology Managers

The success of UMB's technology transfer activities is evident in the success of many of the technologies licensed and companies formed based on UMB technologies. Some highlights of UMB/UM Ventures technology commercialization successes include the following:

 Harpoon Medical, a UMB medical device start-up was acquired by Edwards Lifesciences for \$100 million. In addition, Edwards will pay an additional \$150 million if commercialization milestones are met. Edwards has retained Harpoon's operation in Baltimore City. The original technology was licensed from UMB in 2013. Harpoon's success was due in part to the strength of Maryland's ecosystem: it received equity investments from UM Ventures, TEDCO, and the Abell Foundation, as well as a grant from TEDCO;

- **Biogen**, a leading biotech company, began enrolling patients in Phase 3 clinical trials of a UMBinvented therapeutic to treat cerebral edema in large hemispheric infarction. BioGen purchased CIARARA from Remedy Pharmaceuticals, a UMB start-up, for \$120 million in May 2017;
- Innovate Biopharmaceuticals became a publicly traded company through a reverse merger. Innovate's lead drug candidate is Larazotide Acetate, a UMB-invented therapeutic to treat Celiac Disease. Innovate plans to start Phase 3 clinical trials on Larazotide Acetate in late 2018;
- *NextStep Robotics* raised \$750,000 in venture funding, including \$250,000 from the Maryland Momentum Fund. NextStep Robotics is developing a rehab device to address foot drop resulting from strokes, MS, Parkinson's, diabetic neuropathy, and orthopedic injuries;
- *Xcision*, a UMB start-up received FDA 510K clearance for the GammaPod Stereotactic Radiotherapy System for Breast Cancer; and
- *Educational & Scientific, LLC* (ESL) licensed technology designed to inhibit growth of prostate cancer with a specific form of the disease. The molecule was developed as a therapeutic agent by University of Maryland School of Medicine professors.

Role in Maryland University Technology-Based Business Start-ups

One of the most important outcomes of the technology commercialization process is new start-up companies formed based on university technology. UMB, through both CMAV and UM Ventures, plays a major role in supporting the start-up of university technology-based and entrepreneurial startup companies, through programs such as:

- <u>The Maryland Momentum Fund</u> (MMF) A collaboration between UM Ventures and USM, this \$10 million early stage investment fund invests in Maryland-based, USM affiliated start-up companies. CMAV funds hired a full-timed Director who is based at UMB and a 50% investment manager who is based at UMCP. The MMF staff and USM reached out to all USM institutions to solicit applications for funding. This resulted in 115 companies seeking investments from six USM campuses: Towson University, University of Baltimore, UMB, UMBC, UMCP, and UMES. With the guidance of a highly qualified and engaged external review board, the MMF approved investing in eight companies, three from UMB, three from UMCP, and two from UMBC. In FY18, MMF invested \$792,000 in three of these companies:
 - MF Fire, a UMCP start-up selling advanced wood burning fireplaces.
 - NextStep Robotics, a UMB start-up developing a rehab device.
 - NAWEC, a UMCP start-up developing a rocket engine.

The MMF Director actively helped these three companies raised an additional \$3.9 million from external investors, far surpassing our goal of a 2 to 1 match. The companies have 13 employees. Investments also have been approved in two additional companies, a cyber security company affiliated with UMBC and a therapeutic company affiliated with UMB;

• <u>Life Sciences IP Fund</u> is providing proof-of-concept funding to accelerate commercialization of technologies at UMB and UMCP. \$605,685 was committed to support nine early stage

technologies (six from UMB and three from UMCP) move towards commercialization. This funding is generally provided for external validation and analysis. One of these technologies was licensed for commercialization with a corporate partner in early FY2019;

- <u>M1 Venture Accelerator</u> UM Ventures teamed with Johns Hopkins University, Plank Industries, and Brown Advisory to create the M1 Venture Accelerator, a four-month program to support wearable health informatics companies. From a pool of 40 companies, six were selected and four successfully completed the program. One of the companies, b.well, a health informatics company, was the first tenant in the GRID in the University of Maryland BioPark. b.well has grown from 4 to 15 employees in Baltimore City with another 10 employees across the country and it has raised a total of \$8.2 million;
- <u>Anchor Ventures</u> UM Ventures teamed with USM and JHU to create "Anchor Ventures." Supported by a \$125,000 competitive matching grant from TEDCO, Anchor Ventures is holding monthly networking and educational programs with over 800 attendees to date. Anchor Ventures supports the collaboration and education of the innovation ecosystem in Baltimore with active participation with the universities, key stakeholders, entrepreneurs and investors;
- <u>Trajectory Next</u> UM Ventures partnered with Betamore, Johns Hopkins Technology Ventures supported by a \$125,000 competitive matching grant from TEDCO. Trajectory Next worked with 7 local life science entrepreneurs to focus on their sales process. The program provided sessions with key supply chain representatives from healthcare and medical systems as well as direct sales process training. Lessons learned were implemented real time by the participants and most have realized direct benefits. NextStep Robotics, a firm created with UMB licensed IP was able to open negotiations with a national distributor for their product as a direct result of participation in Trajectory Next; and
- The <u>Baltimore Fund</u> was created to encourage University created or sponsored technology companies in Baltimore. 13 companies participated to create/retain 200 jobs in Baltimore City to date.

According to the FY2016 AUTM data analyzed, UMB accounts for 44, or 19 percent, of the total of 232 Maryland public and private university technology-based start-ups still in operation today. These 44 UMB-technology based startups include many success stories including,

- University of Maryland, Baltimore-born startup *Breethe* Inc. is looking to raise about \$5 million in new equity funding. Breethe is developing a wearable artificial lung that patients can take home with them from the hospital. The company was founded by Dr. Bartley Griffith, a transplant surgeon at the University of Maryland Medical Center, who has been working on the tech for about 20 years;
- **CoapTech** has raised \$2.35 million in seed funding, as the company works to get its new medical device cleared by the U.S. Food and Drug Administration. CoapTech was formed as a result of the University of Maryland, Baltimore's UM Ventures initiative. It is based around technology developed by faculty at the University of Maryland School Of Medicine. CoapTech created a new

feeding tube placement technique designed to be less invasive and less expensive than traditional methods; and

• Gliknik, a privately held biopharmaceutical company working to ease human suffering by creating new therapies for people living with cancer and immune disorders that has received \$25 million in upfront payments from Pfizer for its preclinical lead recombinant stradomer.



Figure 3. Cumulative Public and Private University Technology Based Start-ups Through 2016

Place-Based Economic Development

According to the Higher Education Engagement in Economic Development: Foundations for Strategy and Practice report, place-based strategies are the third major area of higher education involvement in economic development. *Place-based Strategies* are defined as the many and diverse ways in which institutions contribute to making attractive, competitive communities—places where people want to live; create and take jobs; raise their families; participate in civic life; and age and retire. Key examples of university place based efforts include: incubators and accelerators; innovation districts; research parks; mixed-use development; and other real estate and urban development, redevelopment, renewal projects.

UMB is very active in promoting place based strategies to promote economic development. Its core place based economic development project is the *University of Maryland BioPark*. The BioPark is the core of an emerging Innovation District, a live-learn-play-work environment in Baltimore's west side. The UMB BioPark extended the activities of the University across Martin Luther King Boulevard, which had divided the campus and Baltimore's central business district from mostly poor neighborhoods to the west. Once completed, at full build-out, the BioPark will consist of 12 buildings totaling 1.8 million square feet, parking garages, landscaped parks, and \$1 billion of capital investment concentrated in 12acres. Approximately 3,000 people will work in the BioPark. Since its creation in 2003, the BioPark has:

- Acquired 12 acres of land;
- Constructed two commercial research buildings, a new State of Maryland Forensic Medical Center, the Maryland Proton Treatment Center and one parking garage with 638 parking spaces;
- Created 800 jobs; and
- Generated \$204 million in capital investment.

Some major projects in the BioPark that have been recently completed or are now underway include:

- The *Lion Brothers Building*, opened in 2017 and fully leased by 2018, is the UM BioPark's first historic rehab office building. The 38,000 square foot historic Lion Brothers building has been repurposed to provide a new home for Baltimore's growing companies and institutions; and
- **UM BioPark Gateway** is a A new 260,000 square foot lab and office building is being proposed for the northwest corner of West Baltimore Street and Martin Luther King Blvd. The project is in final design stage. Wexford Science & Technology, the developer of the project, and the UM BioPark are working on pre-leasing for the building.

As with many urban colleges and universities around the country, UMB recognizes its role as an "anchor institution" with a core role in promoting equitable economic growth in their surrounding communities. According to the Initiative for a Competitive Inner City,

Anchor organizations play significant roles in their local economies due to purchasing power, real estate, employment, and a long-term interest in seeing their local communities thrive. Their history, relationships, institutional mission, and investments root them in their local communities. The sustainability of anchor organizations is inextricably linked to the vitality of their surrounding communities. It affects demand for their goods and services, employee attraction and retention, business operations and overall competitiveness. It is in an anchor's interest, therefore, to build a strong, healthy local economy.²⁵

UMB recognizes its importance as an anchor institution in its 2017-2021 strategic plan and is a member and supporter of the Baltimore Integration Partnership, a collaborative partnership of twelve anchor institutions, funders, nonprofits and public organizations focused on establishing economic inclusion as the business culture of norm in the Baltimore region. In fulfilling its mission as an anchor institution, UMB and the BioPark are investing in the community surrounding the campus and BioPark through the UMB Community Engagement Center. The UMB Community Engagement Center marshals the University's people, resources, and scholarship to help improve the lives of its West Baltimore neighbors and partners with them in sustaining and accelerating progress toward community goals. The University and its partners use the center to provide direct services to West Baltimore residents — for instance, health screenings and referrals, job readiness counseling, community-organizing workshops — and to collaborate with them in scholarship and projects that meet community-identified needs.

²⁵ http://icic.org/research/anchor-initiatives/.

Summary and Conclusion

The University of Maryland, Baltimore not only makes important economic and fiscal contributions to the State of Maryland, it is a critical component of both Maryland's workforce development system and technology development ecosystem. As Maryland's leading public health and professional education campus, UMB impacts the State's economy through the economic and fiscal impacts associated with its operations. More importantly, by fulfilling its educational and research mission, UMB improves Maryland's competitiveness.

UMB is a Critical Economic Driver – with direct University operating, foundation and capital expenditures of \$1.6 billion and with 7,975 employees, UMB is an important source of economic activity:

- UMB generates widespread economic impacts through its purchases of goods, services, and labor and generated over \$3.0 billion in economic activity in the Maryland economy, supported 17,368 jobs earning almost \$1.4 billion in labor income, and generated \$160 million in State and local government revenues;
 - UMB's operating expenditures generate \$2.2 billion in economic activity, support 12,822 jobs earning \$1.1 billion in labor income;
 - University of Maryland Faculty Physicians, Inc. medical revenues generate \$561.0 million in economic activity, support 2,770 jobs earning \$186.6 million in labor income;
 - UMB capital spending generates \$57.8 million in economic activity, support 316 jobs earning \$20.3 million in labor income;
 - UMB student expenditures generate \$161.7 million in economic activity, support 1,082 jobs earning \$56.2 million in labor income; and
 - UMB Foundation expenditures generate \$49.2 million in economic activity, support 378 jobs earning \$24.7 million in labor income.

UMB is a good investment -- State appropriations of \$231.8 million accounted for 19 percent of University operational revenues. By leveraging these appropriations with tuition, research, healthcare and related revenues, UMB generates \$13 in economic activity for each \$1.00 appropriated.

UMB is a critical source of talent - As Maryland's leading public health and professional education campus, UMB accounts for 8 percent of graduate enrollment in Maryland and generates 5 percent of Master's degrees awarded, 5 percent of Doctoral degrees, and 52 percent of Professional degrees awarded by all Maryland public and private four-year colleges and universities. UMB is Maryland major source of health related workers and other key professions in Maryland.

UMB is a technology commercialization leader – As Maryland's third largest research university, UMB accounts for 11 percent of total academic research and development activity and 30 percent of industry-sponsored academic research and development. The discoveries and technologies created by UMB create jobs in Maryland. With a 12 acre research park, 44 start-ups, and generating more than half of the University System of Maryland technology transfer activities, UMB is a major component of Maryland's entrepreneurial and technology ecosystem.

By the objective measures presented in this report, UMB is a critical driver of economic prosperity in Maryland, though the economic and fiscal impacts of its operations, as a source of well-educated and skilled workers to Maryland's employer community, and through its important contributions to economic development and technology commercialization.

Economic Impact Methodology and Terms

This economic impact analysis of the Maryland economic activity supported by UMB used the IMPLAN input-output model for the State of Maryland. IMPLAN is one of the most widely used models in the nation, and can be used to analyze the impacts of companies, projects, or of entire industries. An input-output analysis examines the relationships among businesses and among businesses and final consumers. Input-output analysis is based on the use of multipliers, which describe the response of an economy to a change in demand or production. Multipliers measure the effects on an economy from a source of economic activity, in this case the revenues and expenditures associated with UMB, its students, its affiliated institutions, and capital spending.

The economic activity generated in a city, county, region or state is greater than the simple total of spending associated with the event or activity being studied. This is because as this money is earned it is, in turn, spent, earned and re-spent by other businesses and workers in the state economy through successive cycles of spending, earning and spending. However, the spending in each successive cycle is less than in the preceding cycle because a certain portion of spending "leaks" out of the economy in each round of spending. Leakages occur though purchases of goods or services from outside of the region and federal taxation. The IMPLAN multipliers used in this analysis capture the effects of these multiple rounds of spending. This analysis focuses on four measures of economic impact:

- Output. The total value of production or sales in all industries;
- **Employment**. The total number of full and part time jobs in all industries;
- **Labor Income**. The wages and salaries, including benefits, and other labor income earned by the workers holding the jobs created; and
- State and Local Government Revenues. The revenues accruing to the State of Maryland, county, city and municipal governments.

Four measures of the economic activity and impact of the Maryland economic activity associated with UMB are included in this report:

- **Direct effects**. The change in economic activity being analyzed—in this case the revenues and expenditures associated with UMB, its students, its affiliated institutions, and capital spending;
- Indirect effects. The changes in inter-industry purchases, for example the purchase of goods and services to support UMB's operations, that occur in response to the change in demand from the directly affected industries;
- **Induced effects**. The changes in spending from households as income and population increase due to changes in production; and
- Total effects. The combined total of direct, indirect and induced effects.

Appendix Tables Detailed Economic Impacts of University of Maryland, Baltimore – By Spending Category and School

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				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$1,211.6	\$757.6	6,721	\$63.0
Indirect	\$308.5	\$91.2	1,678	\$15.0
Induced	<u>\$679.5</u>	<u>\$230.4</u>	<u>4,423</u>	<u>\$44.9</u>
Total	\$2,199.6	\$1,079.3	12,822	\$123.0
Source: UMB	, JFI and IMPLA	AN		

Appendix Table 1: Maryland Economic Activity Generated by UMB Operating Expenditures

Appendix Table 2: Maryland Economic Activity Generated by UMB Student Expenditures

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$0.0	\$0.0	0	\$0.0
Indirect	\$0.0	\$0.0	0	\$0.0
Induced	<u>\$161.7</u>	<u>\$56.2</u>	<u>1,082</u>	<u>\$10.2</u>
Total	\$161.7	\$56.2	1,082	\$10.2

Source: UMB, JFI and IMPLAN

Appendix Table 3: Maryland Economic Activity Generated by the UMB Foundation

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$26.8	(*)	(*)	\$1.4
Indirect	\$6.8	\$19.4	277	\$0.3
Induced	<u>\$15.5</u>	<u>\$5.3</u>	<u>101</u>	<u>\$1.0</u>
Total	\$49.2	\$24.7	378	\$2.8

(*) The Direct jobs created by the UMB Foundation are treated as Indirect Impacts. Source: UMB, JFI and IMPLAN

Appendix Table 4: Maryland Economic Activity Generated by FPI

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$319.2	\$97.3	1,254	\$7.0
Indirect	\$124.3	\$49.5	752	\$6.9
Induced	<u>\$117.4</u>	<u>\$39.8</u>	<u>764</u>	<u>\$7.8</u>
Total	\$561.0	\$186.6	2,770	\$21.6
Source: UMB, JFI and IMPLAN				

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$66.4	\$37.7	350	\$3.3
Indirect	\$16.9	\$5.0	92	\$0.8
Induced	<u>\$57.6</u>	<u>\$19.6</u>	<u>377</u>	<u>\$3.7</u>
Total	\$141.0	\$62.3	819	\$7.9

Appendix Table 5: Maryland Economic Activity Generated by the UMB School of Dentistry

Source: UMB, JFI and IMPLAN

Appendix Table 6: Maryland Economic Activity Generated by the UMB School of Law

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$35.0	\$26.2	291	\$2.0
Indirect	\$8.9	\$2.6	48	\$0.4
Induced	<u>\$36.1</u>	<u>\$12.4</u>	<u>238</u>	<u>\$2.3</u>
Total	\$80.0	\$41.2	578	\$4.8
Indirect Induced Total	\$8.9 <u>\$36.1</u> \$80.0	\$2.6 <u>\$12.4</u> \$41.2	48 <u>238</u> 578	\$0.4 <u>\$2.3</u> \$4.8

Source: UMB, JFI and IMPLAN

Appendix Table 7: Maryland Economic Activity Generated by the UMB School of Medicine

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$750.1	\$480.0	3,560	\$39.4
Indirect	\$191.0	\$56.5	1,039	\$9.3
Induced	<u>\$463.7</u>	<u>\$157.3</u>	<u>3,021</u>	<u>\$30.6</u>
Total	\$1,404.8	\$693.8	7,620	\$79.3

Source: UMB, JFI and IMPLAN

Appendix Table 8: Maryland Economic Activity Generated by the UMB School of Nursing

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$48.8	\$32.2	547	\$2.6
Indirect	\$12.4	\$3.7	68	\$0.6
Induced	<u>\$56.8</u>	<u>\$19.6</u>	<u>377</u>	<u>\$3.7</u>
Total	\$118.0	\$55.5	991	\$6.9

Source: UMB, JFI and IMPLAN

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$56.9	\$38.5	338	\$3.1
Indirect	\$14.5	\$4.3	79	\$0.7
Induced	<u>\$53.0</u>	<u>\$18.2</u>	<u>350</u>	<u>\$3.4</u>
Total	\$124.4	\$61.0	766	\$7.2

Appendix Table 9: Maryland Economic Activity Generated by the UMB School of Pharmacy

Source: UMB, JFI and IMPLAN

Appendix Table 10: Maryland Economic Activity Generated by the UMB School of Social Work

				State and Local	
	Output	Labor Income	Employment	Government Revenues	
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)	
Direct	\$48.3	\$31.1	431	\$2.5	
Indirect	\$12.3	\$3.6	67	\$0.6	
Induced	<u>\$50.8</u>	<u>\$17.5</u>	<u>336</u>	<u>\$3.3</u>	
Total	\$111.4	\$52.2	834	\$6.4	

Source: UMB, JFI and IMPLAN

Appendix Table 11: Economic Activity Generated by the UMB Graduate School

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$3.5	\$17.1	220	\$0.8
Indirect	\$0.9	\$0.3	5	\$0.0
Induced	<u>\$35.0</u>	<u>\$12.1</u>	<u>233</u>	<u>\$2.2</u>
Total	\$39.4	\$29.5	458	\$3.1

Source: UMB, JFI and IMPLAN

Appendix Table 12: Maryland Economic Activity Generated by UMB Central Administration Expenditures

				State and Local
	Output	Labor Income	Employment	Government Revenues
	(Mil. \$s)	(Mil. \$s)	(Jobs)	(Mil. \$s)
Direct	\$202.7	\$94.9	984	\$9.3
Indirect	\$51.6	\$15.3	281	\$2.5
Induced	<u>\$88.1</u>	<u>\$29.9</u>	<u>574</u>	<u>\$5.8</u>
Total	\$342.4	\$140.0	1,838	\$17.6

Source: UMB, JFI and IMPLAN