

SKILLS GAP ESTIMATES FOR INSTITUTIONAL AND INDIVIDUAL DECISION-MAKING: A PROGRESS REPORT

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STATEMENT OF THE PROBLEM

This report is intended to narrow a communication gulf about the popular *skills* gap topic. The main communities of interest and action we seek to reach through this report are public and non-profit education, training and economic development leadership teams. We hope this report advances convergence toward a shared understanding about whether and how available skills gap estimates should be used in specific defined applications.

A communication gulf exists between researchers that prepare skills gap estimates and recipients of these estimates that then act, in part, on the new information. Researchers typically pay attention to more nuances about the links in the logic chain from adoption of a skills gap definition, through measurement, to presentation of findings, than the recipients of these estimates have time to absorb and consider with regard to a pending decision.

The communication gulf matters because some important decisions are made based in part on beliefs about the existence, magnitude, composition and trajectory of skills gaps. These decisions have consequences. Some impacts are far-reaching. Some are unintended. Some are either irreversible or very costly to undo.

ORGANIZATION OF THE REPORT

The next section introduces the skills gap concept through selective references to how the topic has been treated in the past, both distant and recent. We then turn to explanation of the public data sources that were used to carry out analytics specific to Maryland. This is followed by presentation of findings using these data sources. A concluding section looks ahead with recommendations for strategic next step priorities that build upon this platform of new information.

THE SKILLS GAP CONCEPT

There has been a long-standing dominant, but some would say too limited, perspective about what a skills gap means—that ‘demand’ exceeds ‘supply’ ($D>S$). A gap can also mean that ‘supply’ exceeds ‘demand’ ($S>D$), or that there is not enough ‘demand’ to absorb the available ‘supply’. The action relevance and stakeholder impacts of these two gaps— $D>S$ or $S>D$ —differ.

The words *gap* and *shortage* are often adopted as meaning the same thing. But, as one of us reported decades ago, there are multiple definitions of *shortage*, and each suggests a different closure action/inaction recommendation.¹

Nine definitions of *shortage*, as they appear in the 1976 monograph, are presented next.

- “1. One might appeal to relative earnings and define a shortage to exist if the number of qualified people offering their services increases less rapidly

¹ David W. Stevens (1976), *Employment Projections for Planning Vocational-Technical Education Curricula: Mission Impossible?* pp. 17-18, available at http://www.ubalt.edu/jfi/jfi/reports/mis_impos_76mono.pdf.

than the number demanded at recently observed salary levels. Under such conditions rising relative earnings should be observed if earnings are accepted as an accurate signal of labor market imbalance. This definition does not take the cost of skill acquisition into account at all in defining the existence of a shortage.

2. Or, we might adopt the rate of return criterion and define a shortage as existing whenever the rate of return in an occupation is higher than in other occupations, or if it has been rising relative to others. This definition does consider costs, but there is no explicit link between this concept and the existence of job vacancies.
3. A third concept has been called a dynamic shortage to characterize its temporary nature. This definition has been applied when relative earnings are temporarily too low to immediately clear the market for a particular skill. This type of shortage is important for vocational-technical education planning activities. Adjustment flows are already underway to achieve balance.
4. A fourth shortage concept has been popular in the examination of markets for health occupations. This definition of shortage includes all social demand, not just effective demand. Recall that *effective demand* is backed up by a willingness and ability to employ qualified applicants up to a designated number at the stated compensation level. *Social demand* includes a stated preference, or need, for qualified people, but not necessarily accompanied by a willingness or ability to employ them. The supply shortfall in this type of calculation might never be extinguishable because of continuing adjustments in the concept of social need. The physician shortage concept illustrates this case. There are varying opinions as to what the proper physician/ population ratio should be, and whether it should be the same in rural and urban areas. This ratio currently varies widely among countries, and among areas within a given country. By applying a single high physician/population ratio observed in one area, one can create an impression that there are shortages in all other areas that exhibit lower ratios. But there may be few or no existing or forecast job vacancies (effective demand minus the currently employed) in these areas. Would newly emerging physicians be absorbed into these rural sectors to reduce the asserted imbalance in physician/population ratios? Not without some reallocation of *effective demand* to these areas, that is a desire to employ coupled with an ability to pay the requisite salary. Of course, what has occurred in recent years is that most medical school graduates have entered practice in metropolitan areas where their presence has reduced the earnings potential of their predecessors below what it would have been otherwise, while at the same time increasing the interregional disparity in physician/population ratios.
5. A fifth shortage concept introduces the cost of acquiring labor market information. The number of qualified applicants may fall short of effective demand only because of information imperfections. Increased expenditure on recruitment of already qualified people

who are not currently employed would contribute to a reduction of this type of shortage.

6. A sixth concept involves interdependencies and rigidities in relative earnings, so that necessary market adjustments cannot occur or occur with long lags. This may be one of the most important causes of long-term imbalance in some markets.
7. A seventh shortage concept assumes that the availability of qualified persons is inflexible, particularly over a short time-span. This inflexibility may be associated with the time necessary to produce the necessary qualifications or with barriers to entry into the occupation or into the training pipeline prior to job-entry.
8. An eighth shortage concept takes account of the possibility that the stated job qualifications may be absolutely fixed in quantity, in which case observed market imbalance measured by any of the preceding indices should evoke no response other than to perhaps advise the actors in the marketplace of the situation.
9. A final shortage concept is adopted by those individuals or groups who simply assert that our priorities are misguided—we need more people with skill x. This is similar to that described as the fourth concept above (social demand).

The concept of a skill shortage is vague in common usage.”

The alleged existence of a skills gap should not, by itself, be embraced as a signal to act. Consciously chosen inaction may be preferred to the best available action. Reflecting on the *shortage* definitions cataloged 38 years ago, we adopt exclusive use of the word *gap* in the sections of this report leading up to the concluding section. There we address the action-inaction recommendations that might follow release of a *shortage* estimate. In this report, the *gap* investigation focuses on the imbalance between labor demand and supply, for a certain skill level, for a discipline, in an industry, with an occupation, or in a geographic area. This imbalance often does not necessarily mean a shortage of skills supply; it could often imply the shortage of skills demand.

Skill and *education* are often treated as interchangeable words. Frequent reference is heard and seen to *education* requirements² associated with personnel recruitment activities, when probing may have revealed that a preferred candidate *skill* or *skill mix* is sought, without caring where, and perhaps even when, the skill was acquired.

² David Neumark, Hans P. Johnson and Marisol Cuellar Mejia (2011), “Future Skill Shortages in the U.S. Economy,” *NBER Working Paper* 17213, available at <http://www.nber.org/papers/w17213>, 41 pp.; R. Jason Faberman and Bhashkar Mazumder (2012), “Is there a skills mismatch in the labor market?”, *Chicago Fed Letter*, Federal Reserve Bank of Chicago, 4 pp.; Megan Loritz, Ben Nerad, Phil Sletten and Jennifer Cunha (2013), *Examining the Skills Gap in Wisconsin*, Madison, WI: Robert M. LaFollette School of Public Affairs, 78 pp.; and a series of recent publications available from the Georgetown University, McCourt School of Public Policy, Center on Education and the Workforce, available at <http://cew.georgetown.edu/publications>, including Anthony P. Carnevale, Nicole Smith and Jeff Strohl (2013), *Recovery: Job Growth and Education Requirements Through 2020*, 111 pp.

We, like most previous authors and those that will publish future skills gap estimates, usually rely upon available data sources that are not designed to collect detailed information about the supply of and demand for individual skills and combinations of skills. We rely in this report on *education* data only, because reliable *skills* data are not easily accessible. Due to measurement disparities, it is also controversial to combine skills supply data from formal education, job trainings, and various credential. Relying on *education* data is a frustrating, but necessary, compromise for the skills supply measure.

Having made the education proxy for skill acquisition accommodation, we asked ourselves at the outset of the research: “Is this proxy good enough to proceed?” Our answer was, and remains, “yes” because the new findings, specific to Maryland, point to a clear short-list of priority high-impact next steps to better inform future decision-making.

As for the skills demand, previous literature also often used job vacancies³ or job openings⁴ to measure employment demand. However, job vacancies or job openings are not necessarily a true indication of employment demand. Projected or real-time job openings are often hypothetical but not yet completed measures; moreover, there are multiple incentives to post job openings that do not necessarily mean an actually job needed to be filled. In this report, we used *hires* that are actual filled jobs to measure demand at a referenced time period and compared this demand data series to our skills supply measure.

PUBLIC DATA SOURCES USED

We use three datasets to specifically focus our analysis on Maryland:

- American Community Survey (ACS) Public Use Microdata Sample (PUMS) files.
- Longitudinal Employer-Household Dynamics (LEHD) Program Quarterly Workforce Indicators (QWI) and Origin-Destination Employment Statistics (LODES).
- Maryland Higher Education Commission (MHEC) Degree Information System (DIS).

American Community Survey (ACS) Public Use Microdata Sample (PUMS)

US Census Bureau 3-year American Community Survey (ACS) Public Use Microdata Sample (PUMS) files were used to produce Figure 3 through Figure 11. The PUMS contains a sample of actual responses to ACS survey questions. The ACS is a nationwide survey designed to provide communities with reliable and timely demographic, social, economic, and housing data every year. The ACS produces estimates of socioeconomic and housing characteristics for defined time spans. The survey is designed to provide estimates that describe the average

³ Ihlanfeldt, K.R., and D.L. Sjoquist (1998). “The spatial mismatch hypothesis: A review of recent studies and their implication for welfare reform,” *Housing Policy Debate* 9(4):849–892.

⁴ Clark, K. A. (2012), “What an Indicator of Labor Demand Means for U.S. Labor Market Analysis: Initial Results from the Job Openings and Labor Turnover Survey,” *Bureau of Labor Statistics.*, available at <http://www.bls.gov/osmr/pdf/st030150.pdf>.

characteristics of an area over the defined time span⁵. The ACS sample was selected from all counties across the nation. Geographic details available in ACS, from counties down to Census Tracts, are often not available in any other survey. Such geographic details allow us to focus on Maryland and even within Maryland as needed.

According to the US Census Bureau⁶, the 3-year and 5-year PUMS files are multiyear combinations of the 1-year PUMS file with appropriate adjustments to the weights and inflation adjustment factors. The 2010-2012 PUMS sample is the same sample found in each of the 1-year PUMS files for the years 2010, 2011 and 2012. The sample contains three percent of the housing units and three percent of the group quarters (GQ) persons plus some imputed GQ persons in the United States, weighted to represent the average population during three years.

We used the 2010-2012 3-year person-level ACS PUMS files to analyze Maryland data. Our unit of analysis is individuals, not households. We used the 3-year person-level ACS PUMS data, not 1-year or 5-year. The 1-year data is the most current, but has the smallest (i.e., one percent) sample size. The 5-year data has the largest sample size, and therefore should be the most accurate; however, the current 5-year time span coverage is 2008-2012, so the averaged data values incorporate both recession and post-recession years. Economic conditions impact skills gaps, so we used the post-recession 3-year 2010-2012 ACS PUMS data, to have a relatively large sample size without cluttering the data values with noise from different economic conditions.

Longitudinal Employer-Household Dynamics (LEHD) Program Data

The Longitudinal Employer-Household Dynamics (LEHD) provides statistics on employment, earnings, and job flows at detailed levels of geography and industry and for different demographic groups.⁷ These statistics are available both by place of residence and place of work, because LEHD draws on administrative data at the person and firm level, as well as household survey data. Similar to our usage of ACS PUMS, we also draw on LEHD's geographic details to analyze Maryland data.

LEHD is a partnership between the Census Bureau at the federal level and state departments responsible for labor market information. Under the Partnership, states share Unemployment Insurance earnings data and the Quarterly Census of Employment and Wages (QCEW) data with the Census Bureau. The LEHD program links these administrative data, to

⁵ The Census Bureau releases ACS single-year and multiyear estimates. The ACS replaces the former decennial long form as the source for detailed information. Instead of collecting data from about 1 in every 6 households once every 10 years, the ACS samples about 1 in every 40 addresses annually, or 250,000 addresses each month. For areas with large populations (65,000 or more), survey estimates are based on 12 months (1 year) of ACS data. For all areas with populations of 20,000 or more, the survey estimates are based on 36 months (3 years) of ACS data. The Census Bureau produces estimates for all areas, down to the census tract and block group levels, based on 60 months (5 years) of ACS data. Each record in the file represents a single person, or--in the household-level dataset--a single household. In the person-level file, individuals are organized into households, making possible the study of individuals within the context of family and other household members. The PUMS contains data on approximately one percent of the United States population. In the case of ACS single-year estimates, the period is the calendar year (e.g., the 2012 ACS covers January through December 2012). In the case of ACS multiyear estimates, the period is either 3 or 5 calendar years (e.g., the 2010–2012 ACS estimates cover January 2010 through December 2012, and the 2008–2012 ACS estimates cover January 2008 through December 2012). The ACS multiyear estimates are similar in many ways to the ACS single-year estimates, however they encompass a longer time period. More details can be found from the http://www.census.gov/acs/www/data_documentation/public_use_microdata_sample/.

⁶ American Community Survey (ACS) Public Use Microdata Sample (PUMS) files, available at http://www.census.gov/acs/www/data_documentation/public_use_microdata_sample/.

⁷ The Longitudinal Employer-Household Dynamics, the United States Census Bureau, <http://lehd.ces.census.gov/>

additional administrative data available through the Internal Revenue Service (IRS) and the Social Security Administration (SSA), as well as survey data such as census.

We used two LEHD data files: (1) LEHD Quarterly Workforce Indicators (QWI); and (2) the LEHD Origin-Destination Employment Statistics (LODES).

Our analysis of Maryland net hires by sex, race and ethnicity is based on LEHD Quarterly Workforce Indicators (QWI) data. *Net hires* are the difference between estimated numbers of workers who started a new job in the specified quarter, designated as *All Hires*,⁸ and the estimated number of workers whose job with a given employer ended in the previous quarter, designated as *Separations*.⁹ We used separations in the previous quarter because we believe this to be the best estimate of churning data available from LEHD. The formula below shows the calculation.

Net Hires= *All Hires*(*t*)-*Separations*(*t*-1), *t* refers to the current time period.

Estimates of Maryland All Hires and Separations are available by sex, race and ethnicity. All LEHD data were extracted for Maryland using the LEHD extraction tool available on the LEHD Program website.¹⁰

To mirror the time frames of Maryland Higher Education Commission Degree Information System data (described in the next subsection), annual net hires were calculated based on school year rather than calendar year. For example, MHEC new graduates in 2001 include graduates from the second half of 2001 and the first half of 2002, so the timeframe for corresponding net hires derived from LEHD data is the 3rd and 4th quarter of 2001 and the 1st and 2nd quarter of 2002.

We wanted to calculate estimated net hires by educational attainment, but the LEHD Program does not report educational attainment for ages less than 25 because educational attainment is dynamic—meaning that sequential attainments over a short time-span are more common within this age group. The quality of a static educational attainment definition for this age range was thought to be too low to release.¹¹ The MHEC on-line public access data (described in the next subsection) do not permit age-based sorting, so we could not align net hires by education with Maryland postsecondary degree awards.¹²

The LEHD on-line Origin-Destination Employment Statistics (LODES) data series was also used. The LODES feature was developed for use in the LEHD Program's OnTheMap component. Version 7 of LODES was enumerated by 2010 census blocks. Data files are state-based and organized into three types: Origin-Destination (OD), Residence Area Characteristics (RAC), and Workplace Area Characteristics (WAC), all at the census block level of geographic

⁸ Page 12, Quarterly Workforce Indicator 101, The Longitudinal Employer-Household Dynamics, the United States Census Bureau, available at http://lehd.ces.census.gov/doc/QWI_101.pdf

⁹ Page 12, Quarterly Workforce Indicator 101, The Longitudinal Employer-Household Dynamics, the United States Census Bureau, available at http://lehd.ces.census.gov/doc/QWI_101.pdf

¹⁰ LEHD Extraction Tool, Quarterly Workforce Indicators, available at <http://ledextract.ces.census.gov/>

¹¹ Erika McEntarfer, LED Data Enhancements: Introducing New Quarterly Workforce Indicators by Worker Race, Ethnicity, and Education, available at http://lehd.ces.census.gov/doc/workshop/2011/McEntarfer%20Workshop_2011_REE_rev.pdf

¹² MHEC DIS does include an age data element, so further analysis is possible in the future if this data element becomes available for external research use.

detail. Data are available for most states for the years 2002–2011¹³. We used the most current 2011 LODES data.

Maryland Higher Education Commission (MHEC) Degree Information System (DIS)

The Maryland Higher Education Commission (MHEC) collects enrollment and degree information from all public higher education institutions in Maryland. These data are maintained in MHEC's Enrollment Information System (EIS) and Degree Information System (DIS) respectively.

We extracted Maryland statewide total new graduates from MHEC degree data by institution.¹⁴ New graduates by sex, race and ethnicities are also available online.¹⁵

Public Online Data Sources Used in the Presentation of Findings

Figure\	Data Source	ACS PUMS	LEHD	MHEC DIS
Figure 1			X	X
Figure 2			X	X
Figure 3		X		
Figure 4		X		
Figure 5		X		
Figure 6		X		
Figure 7		X		
Figure 8		X		
Figure 9		X		
Figure 10		X		
Figure 11		X		
Figure 12		X		
Figure 13			X	
Figure 14			X	

FINDINGS

Our approach to measurement of skills gaps in Maryland is summarized in a series of introductory observations:

- *Educational attainment* is adopted as the single necessary proxy for direct measurement of a *skill* or *skill mix*, neither of which is available.

¹³ Longitudinal Employer-Household Dynamics, LEHD Origin-Destination Employment Statistics, available at <http://lehd.did.census.gov/data/>.

¹⁴ Degree Trend Data collected from Maryland institutions of higher education 1999-2012, available at <http://data.mhec.state.md.us/TrendData.asp>

¹⁵ Trends in Degrees and Certificates by Race and Gender, Maryland Institutions of Higher Education, 2003-2012, available at <http://mhec.maryland.gov/publications/research/AnnualReports/2012%20Degrees%20RandG%20Final.pdf>

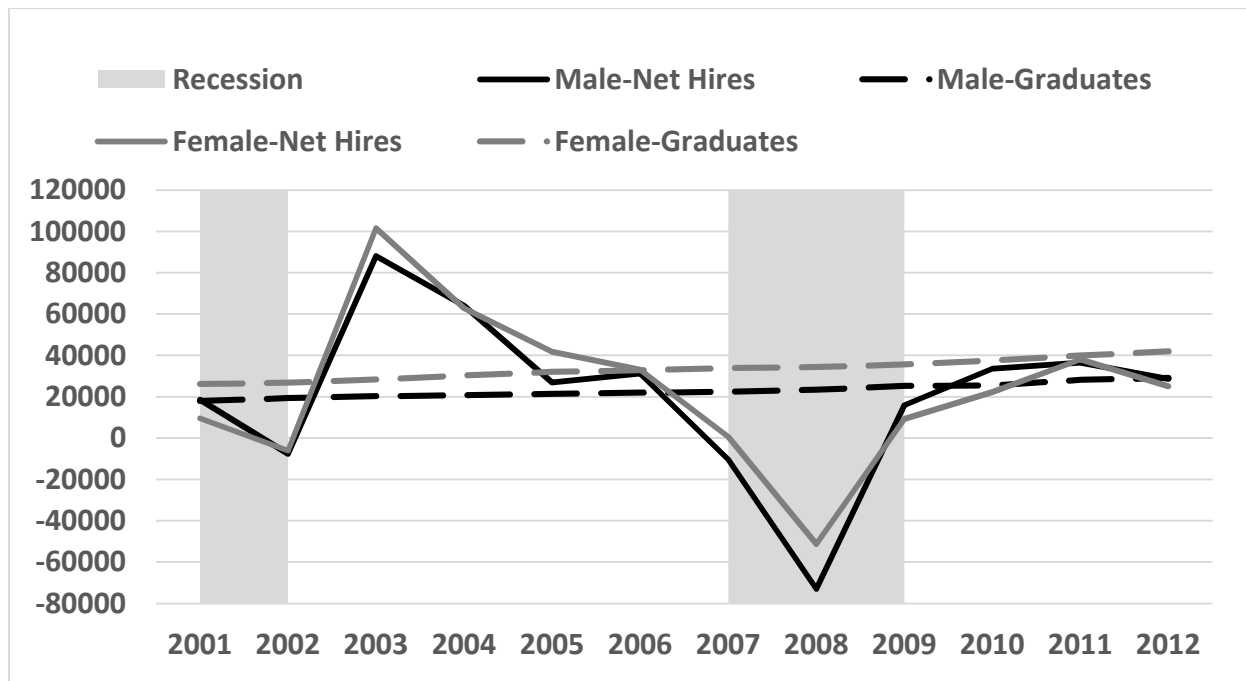
- We acknowledge that educational attainment can be thought of as a dynamic, or changeable, concept—an individual can acquire a new credential after reporting of the attainment metric that is available for research use. This new credential can be at a higher, more advanced, attainment level, or it can be at the same level but in a different field or major. In fact, simultaneous award of multiple credentials is not unusual. However, for practical use, only one educational attainment measure is adopted for each individual.
- Maryland's economy is 'open', meaning that there are frequent movements of individuals in and out of the State. Some Maryland residents work out-of-state. Some of the employees working in Maryland businesses, non-profit organizations and government agencies live out-of-state. Some students enrolled in Maryland education institutions leave Maryland when they complete or interrupt their studies. Some employees working in Maryland organizations received their formal education elsewhere.
- The 'open' economy alert is important for placing our *gap* estimates in a practical context for assessing relevance for particular types of decisions. Our basic approach, like that of many predecessors, is to compare an estimate of Maryland's annual educational credential awards (a 'supply' metric) with an estimate of Maryland's annual net hires (a 'demand' metric). Again, as described in the *Data Sources* section of this report, 'net hires' is calculated by subtracting separations from all hires in the same time period.
- Calculation of 'supply' and 'demand' alignment, as we and others are able to measure these concepts to arrive at a *gap* estimate, implicitly assumes that Maryland is a 'closed' economy—that employers only recruit from our in-state educational institutions and that students exiting these institutions can only find an in-state job.

Maryland Annual Net Hires and Postsecondary Credential Awards by Gender

Figure 1 begins our presentation of findings. We concentrate first on Maryland public postsecondary awards as an important 'supply' estimate, keeping in mind the relevance of the cautions offered in the previous five dot-points.

The dashed trend lines in *Figure 1* show the annual number of female and male Maryland public postsecondary credential awards between 2001 (a recession year) and 2012 (three and one-half years after the end of the 2007-2009 national recession). Both gender-specific trends exhibit a low annual increase, but without any perceptible cyclical impact.

FIGURE 1: Maryland Annual Net Hires and Maryland Public Postsecondary Credential Awards 2001-2012, by Gender



Data Source: Net Hires data is based on LEHD QWI. Graduates data is from MHEC DIS.

The gender-specific trends of Maryland annual net hires are similar and quite cyclical, as expected. The national recession in 2007-2009 caused separations to exceed hires, resulting in negative net hires during these years.

Focusing on the two years 2003 and 2008, we see evidence that appears to confirm the phrase “timing is everything” with regard to a new graduate’s prospects for quickly finding a job. For a long time there has been widespread commentary that graduation during a recession has a ‘scarring’ effect on a graduate’s lifetime career and earnings opportunities. Recent research studies question the uniformity of location-specific impacts of a graduate’s opportunity differential associated with economic conditions at the time of credential award.¹⁶

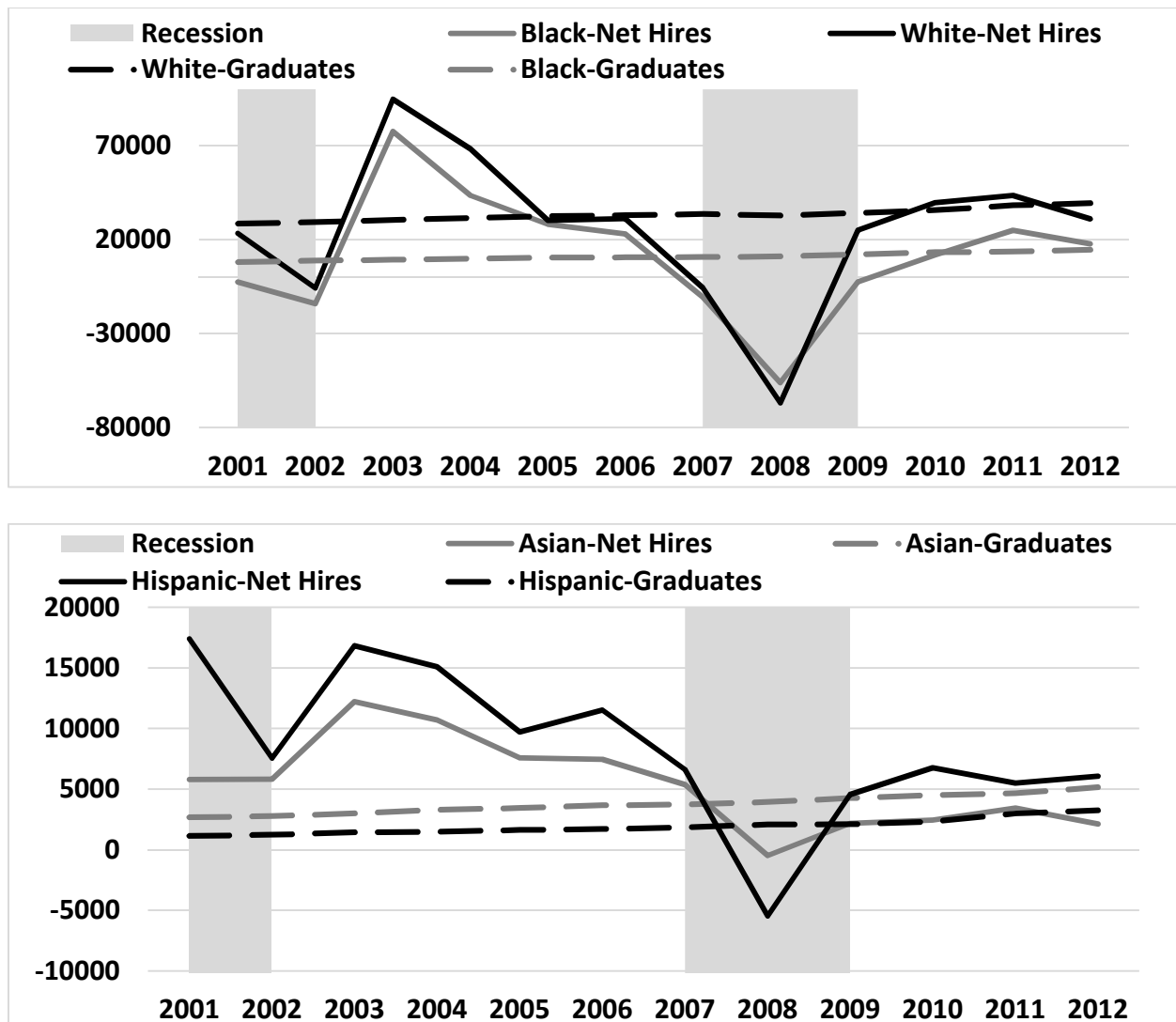
The appearance in *Figure 1* of gender-specific supply and demand balance in the three post-recession years 2010-2012 is new, remembering the implicit closed economy caution. We do not speculate here about future projections of the recent trends.

Maryland Annual Net Hires and Postsecondary Credential Awards by Race/Ethnicity

The two panels of *Figure 2* present paired trend comparisons of Maryland annual net hire and public postsecondary credential awards, with the first panel on this page comparing the relatively large White and Black subpopulations and the second panel on the following page comparing the smaller subpopulations of Asians and Hispanics.

¹⁶ See: Aaiji Kawaguchi and Tetsushi Murao (April 2014), “Labor Market Institutions and Long-Term Effects of Youth Unemployment,” *IZA DP* No. 8156, available at <http://ftp.iza.org/dp8156/pdf>; and Brian Clark, Clement Joubert and Arnaud Maurel (May 2014), “The Career Prospects of Overeducated Americans” *Working Paper* 20167, available at <http://www.nber.org/papers/w20167>.

FIGURE 2: Maryland Annual Net Hires and Maryland Public Postsecondary Credential Awards 2001-2012, by Race/Ethnicity



Data Source: Net Hires data is based on LEHD QWI. Graduates data is from MHEC DIS.

Being sure to observe that the y-axis vertical scales differ in the two panels of *Figure 2*, we see that the general trend profiles are similar to the gender-specific trends, but the 2001-2002 recession appears to have had little impact on net hiring of Asian graduates, and the 2007-2009 recession had less impact on net hires of Asian graduates than on Black, Hispanic and White graduates. Since the end of the recent recession, Hispanic graduates have experienced a more favorable net hiring environment.

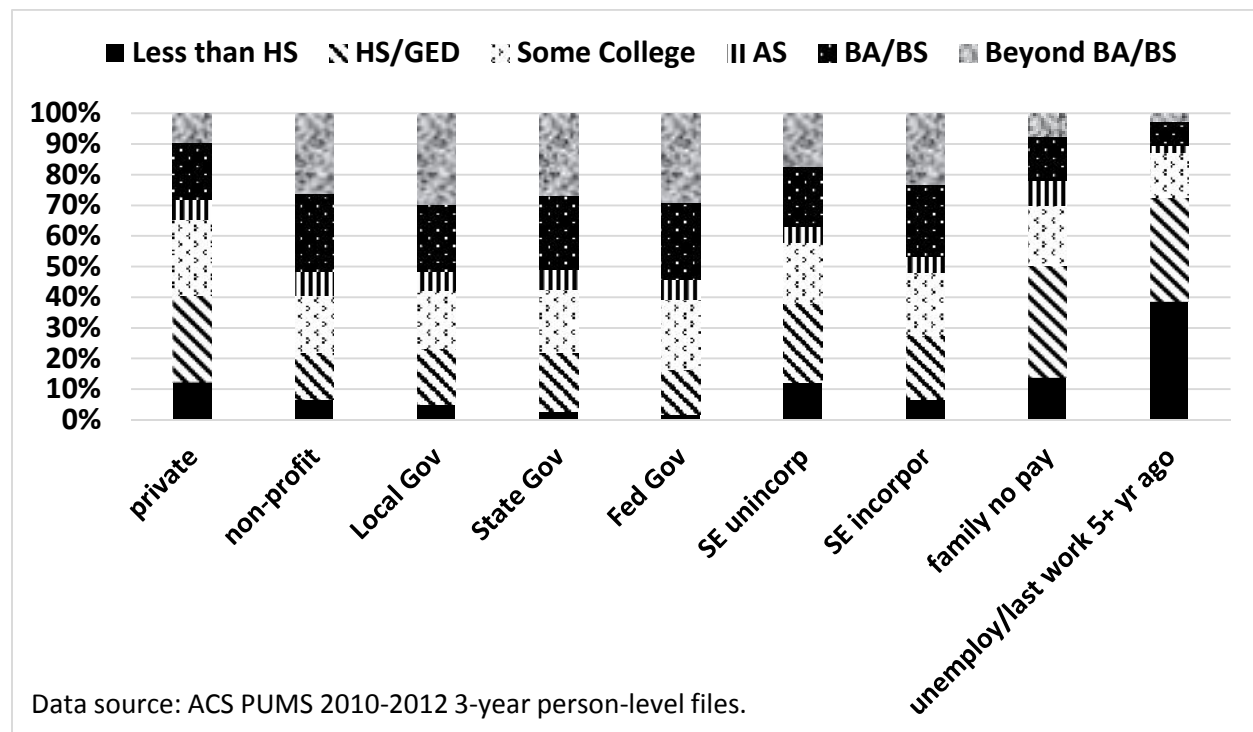
Educational Attainment Composition by Employer Affiliation of Maryland Residents

Figure 3 on the next page broadens our perspective from the limited public postsecondary credential attainment seen in *Figure 1* and *Figure 2*, to six levels of attainment ranging from less-than-high school to more-than-baccalaureate degree.

Comparing *government* and *non-profit* employees to *private* sector employees in Maryland, overall, Maryland *private* sector employees reported lower average education attainment. The *private* business affiliation type of employment, extreme left vertical bar in *Figure 3*, shows the mix of self-reported educational attainment of those employed in these Maryland private sector businesses. Two-thirds of these private-sector workers reported having less than a postsecondary two-year associate credential. This includes the complete age-range of the workers. Less than half of the educational attainment composition of the workers in the three types of government affiliation and non-profit organizations is found in these less than two-year associate attainment levels. And, while only ten percent of those employed in the private sector had achieved an educational attainment level higher than a baccalaureate degree, thirty percent of local and federal government workers had reached this level.

Figure 3 is an entry point for thinking about the sub-state geographic concentrations of the different types of employer affiliation, which has implications for strategic planning of individual and institutional supply and demand decisions.

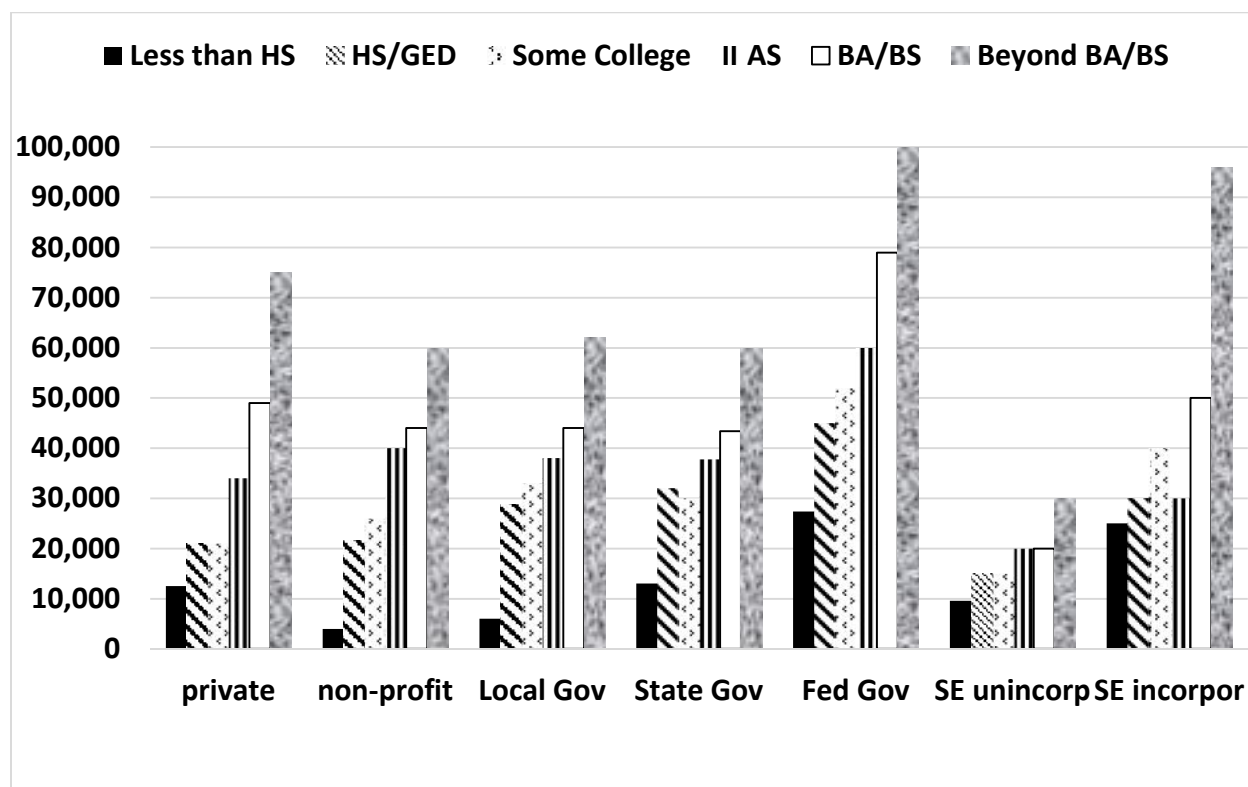
FIGURE 3: Educational Attainment Composition by Employer Affiliation of MD Residents



Annual Earnings of MD Residents by Educational Attainment and Employer Affiliation

Figure 4 introduces self-reported median annual earnings amounts for each of the types of employer affiliation, again by the same six educational attainment levels as those defined in Figure 3.

FIGURE 4: Median Annual Earnings of Maryland Residents by Educational Attainment and Type of Employer Affiliation



Note: Earnings are only shown if cohort includes greater than 3000 individuals.

Data source: ACS PUMS 2010-2012 3-year person-level files.

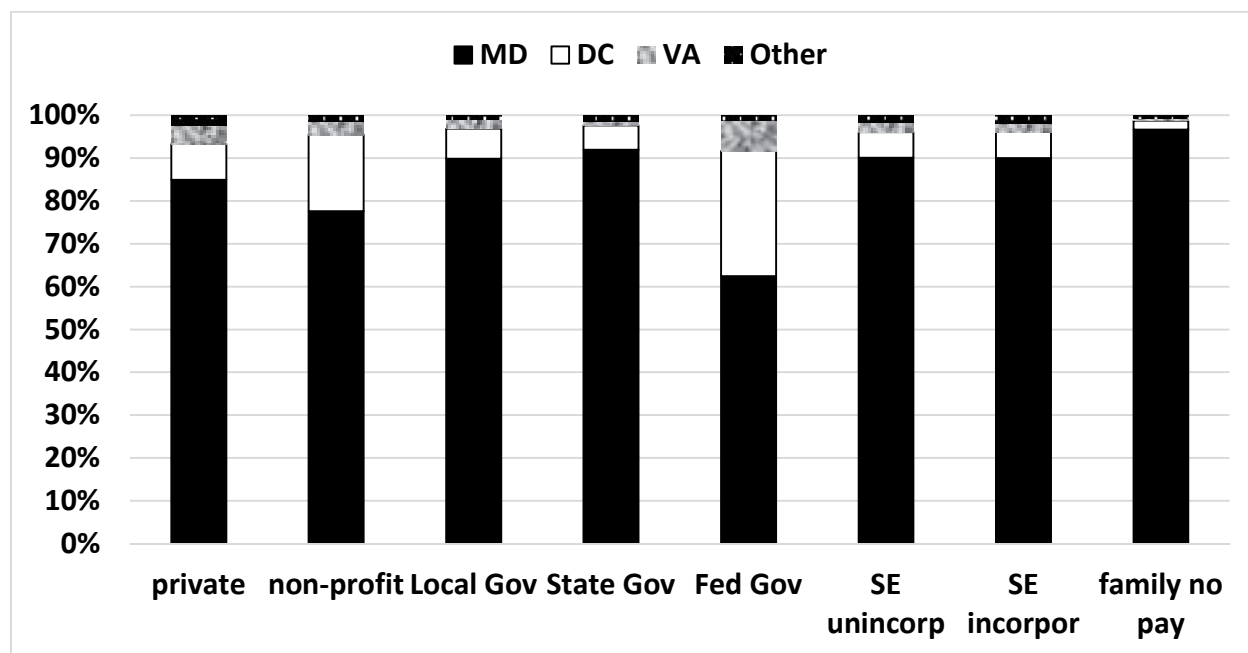
The overall ascending stair-step profile associated with higher levels of educational attainment, seen in Figure 4, is gratifying, given the large individual and collective investments that have been made in education. Federal government employment is a clear positive outlier among the types of employer affiliation—the Federal government median earnings amount is higher for each level of educational attainment compared to the other affiliation types. Notice, too, that among private sector employers there is no difference in median annual earnings of those with high school/GED and those having completed some college but less than an associate credential.

For Maryland residents that are employed by state government this situation is reversed, with a slightly higher median earnings for those that reported high school and GED education attainment than those that reported some college but less than an associate credential. One caution is that in Figure 4 only median earnings appear. As shown in several later figures, the earnings distribution is important beyond just median earnings.

Composition of Employment Location by Type of Employer Affiliation

Figure 5 is similar in format to *Figure 3*, but now the composition of each vertical bar—employer type—shows the place-of-work location of Maryland resident employment—Maryland, District of Columbia, Virginia or Other. *Figure 6* then follows using the same format as *Figure 4*, but now showing median annual earnings by type of employer affiliation and in-state or out-of-state location of employment.

FIGURE 5: Composition of Maryland Resident Employment Location by Type of Employer Affiliation



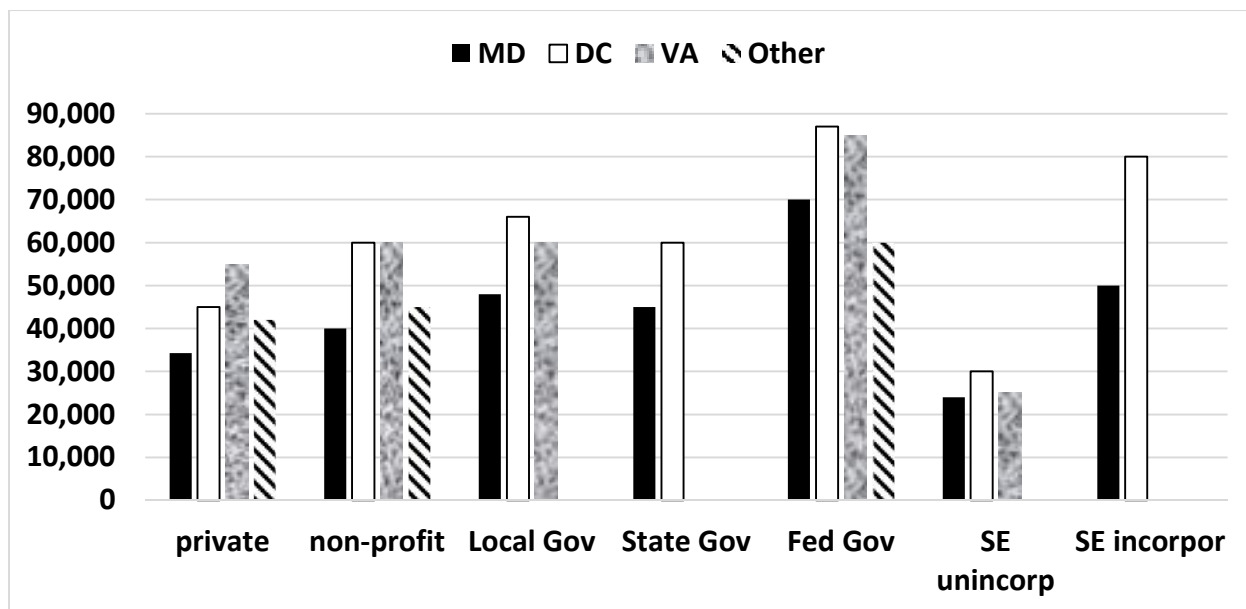
Data source: ACS PUMS 2010-2012 3-year person-level files.

Figure 5 shows that a larger percentage of Maryland residents that are employed by the Federal government or a non-profit organization work in the District of Columbia than do those employed by the other employer classifications. The largest percentage working in Virginia is also seen in the Federal government bar—undoubtedly because of Pentagon and other military unit employment.

Median Annual Earnings by Employment Location and Employer Affiliation

Figure 6 returns to the in-state or out-of-state location of Maryland resident employment by type of employer affiliation, but now showing median earnings by location of employment, not the similar in appearance format of *Figure 4* that shows composition by educational attainment.

FIGURE 6: Median Annual Earnings of Maryland Residents by Employment Location and Type of Employer Affiliation



Note: Earnings are only shown if cohort includes greater than 3000 individuals.
Data source: ACS PUMS 2010-2012 3-year person-level files.

Figure 6 shows a higher median annual earnings amount for each of the three out-of-state employment locations for Maryland residents working in the private sector, for a non-profit organization, or for a local government entity, compared to those working in Maryland. Note that the median earnings of the categories with less than 3000 individuals after applying the ACS PUMS weighting were omitted in the graph to avoid potential small sample bias.

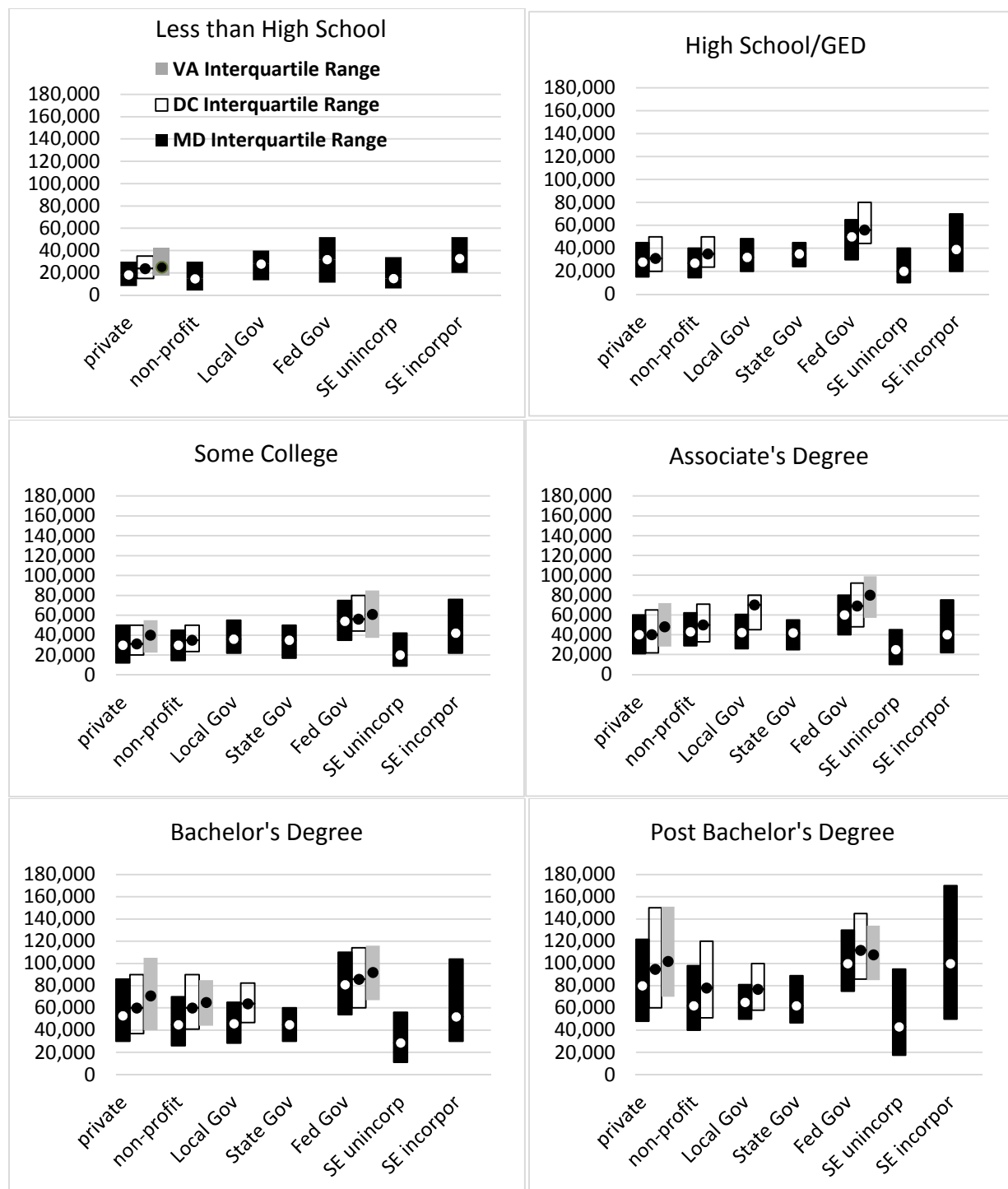
Earnings Metrics by Educational Attainment, Employment Location and Affiliation

As indicated earlier, median earnings does not necessarily reflect actual average earnings. *Figure 7* on the next page returns attention to multiple Maryland resident annual earnings distributions by combinations of educational attainment with type of employer affiliation and in-state or out-of-state location of the employment. Each of the six panels of *Figure 7* shows the earnings measures associated with a single level of educational attainment—starting with less than high school on the upper left and ending with post baccalaureate on the lower right section of the page. Within each panel three earnings metrics are shown:

- Median annual earnings.
- 25th percentile earnings.
- 75th percentile earnings.

Within each of the six panels of *Figure 7* earnings measure vertical bars are presented by type of employer affiliation and location of employment—Maryland, District of Columbia, or Virginia; the location category ‘Other’ is omitted because the number of observations falls below the minimum number necessary to achieve statistical reliability of the estimate. Similarly, the number of location-employer affiliation combinations that appear varies among the six panels, again because of the statistical reliability standard that was applied.

FIGURE 7: Median Annual Earnings and Interquartile Ranges of Maryland Residents by Education, Employment Location and Type of Employer Affiliation



Notes: Earnings are only shown if the reference cohort includes more than 3000 individuals. The dots are median earnings values.

Source: ACS PUMS 2010-2012 3-year person-level files.

Within a panel of *Figure 7* showing a particular level of educational attainment, if the minimum cohort size threshold of 3,000 is satisfied for combinations of location and type of employer affiliation, we see that Maryland residents that were employed in the District of Columbia and Virginia private sector or by the Federal government consistently reported higher earnings than those employed in the Maryland private sector or Federal government affiliations. The absence of either District of Columbia or Virginia data, or both, in a panel of *Figure 7* means that the cohort threshold size criterion was not met.

The earnings profiles shown are a starting point for thinking about what future Jacob France Institute partnership with MHEC, the Department of Labor, Licensing and Regulation, the Department of Business and Economic Development, the Governor's Workforce Investment Board, and county-level counterparts can produce together to provide practical reliable data-based insights to advance the State's sector-based strategic planning for economic growth.

Baccalaureate and Post- Baccalaureate Degree Fields of Study and Subsequent Industry Affiliations

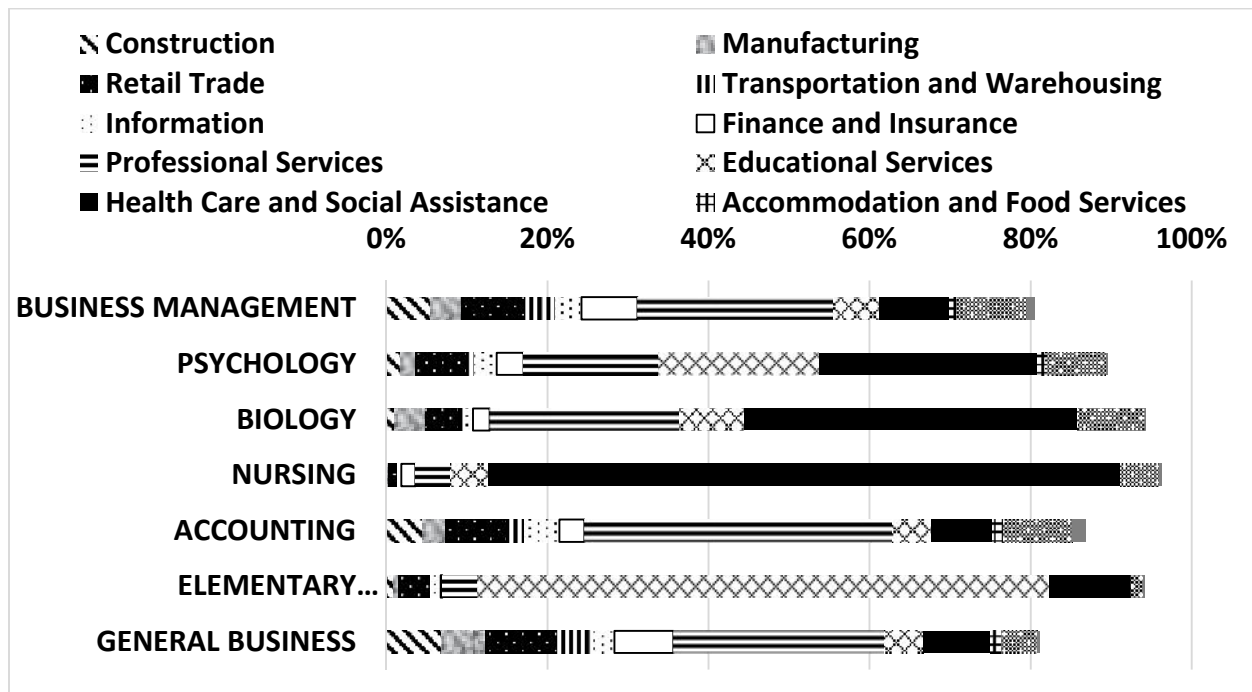
Figure 8 introduces educational field of study and occupational information. The field of study is only for those that reported a baccalaureate or post- baccalaureate degree. The 2010 Standard Occupational Classification (SOC) taxonomy was adopted. *Figure 8* combines self-reported major educational field of study from the 2010-2012 ACS PUMS data source with industry classification of self-reported employment drawn from the same ACS PUMS data source. We present in this report only the seven fields of study that include the largest number of individuals found in the 2010-2012 ACS PUMS data source when sorted by this data element.

The row headings in *Figure 8* are field of study labels. The eleven industry sectors are defined in the *Figure 8* legend. These include some, but not all, targeted industries defined by the Maryland Governor's Workforce Investment Board.

Figure 8 matches *Figure 7* in Maryland skills gap estimating importance. *Figure 7* focused on the 'open' economy issue—some Maryland residents working out-of-state. Here, in *Figure 8*, attention concentrates on how 'tight' a bond there is between major field of study and subsequent industry affiliation. We see, for example, that approximately 80 percent of the Maryland residents that self-reported Nursing as their major field of study also reported being employed in the Health Care and Social Assistance (NAICS two-digit classification 62) sector. Similarly, approximately 75 percent of those that reported Elementary Education as their major field of study also reported Education Services (NAICS two-digit classification 61) employment. Approximately 40 percent of those having majored in Accounting or Biology reported subsequent employment in the respective industries Professional Services or Health Care and Social Assistance. As shown in *Figure 8*, very limited unemployment (grey area at the end of each bar) was reported among Maryland residents that reported having attained at least a Baccalaureate degree.

Figure 8 shows that the 'bond' between paired field of study and industry sector affiliation of employment varies. As discussed in the above paragraph, some fields of study are more specialized, consistent with a higher concentration of employment in a single targeted industry. Specialized fields of study more likely to lead to closely aligned industry affiliations include Nursing, Elementary Education, Accounting and Biology. Lower concentrations of paired major field of study and a single industry affiliation are observed for the other labeled fields of study in *Figure 8*—Business Management, Psychology and General Business.

FIGURE 8: Fields of Study and Subsequent Industry Affiliations



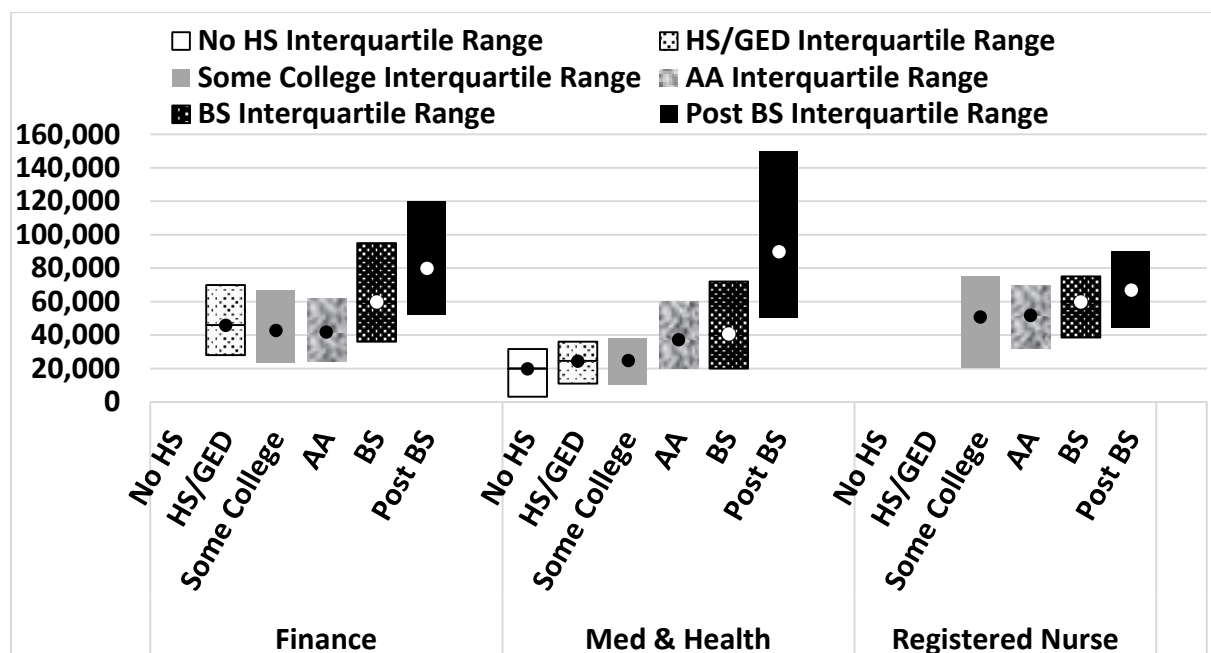
Data source: ACS PUMS 2010-2012 3-year person-level files.

Annual Earnings Metrics by Educational Attainment and Occupation

Figure 9 shows annual earnings measures—median earnings and the interquartile 25th and 75th percentiles—by educational attainment and three selected occupations targeted by the Maryland Governor's Workforce Investment Board—Finance, Medical and Health, and Registered Nurse. Cyber Security was initially selected too, but the minimum cohort size threshold criterion of 3,000 was not met.

Maryland residents that self-reported occupations in *Finance* did not achieve much increase in annual earnings until a baccalaureate degree had been achieved. Similarly, Maryland residents reporting award of an Associate or baccalaureate degree in Medical and Health received higher annual earnings than those reporting a lower level of educational attainment, and award of a post-baccalaureate degree more than doubled the median earnings for Medical and Health. The 75th percentile level of annual earnings for those that reported post-baccalaureate attainment was \$150,000, but the 25th percentile level of earnings is only \$50,000; there is a wide inter-quartile range for Medical and Health earnings.

FIGURE 9: Median Annual Earnings and Interquartile Ranges of Maryland Residents by Educational Attainment and Occupation



Note: Earnings are only shown if cohort includes greater than 3000 individuals.

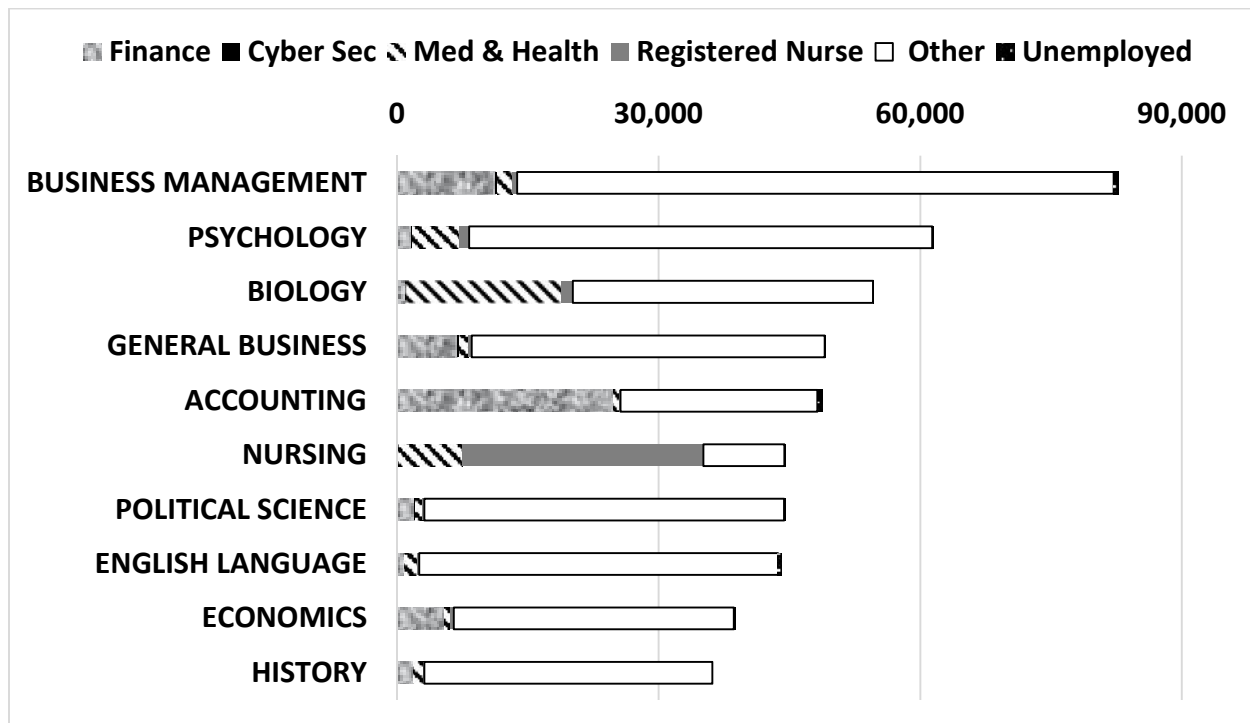
Data source: ACS PUMS 2010-2012 3-year person-level files.

Field of Study, Occupational Employment and Education Level

Figure 10 pairs the top 10 major fields of study, chosen by the number of those found in the 2010-2012 ACS PUMS 3-year person-level file, and selected occupational employment distributions.

As we expected to find, most of the individuals reporting a Nursing major field of study also reported employment as a *Registered Nurse*. Those that reported Accounting as their major field of study also reported employment in Finance occupations. And those that reported Biology as their major field of study had a modest concentration in Medical and Health occupations. The other pairings of Field of Study and Occupation exhibit much lower concentrations in a single occupational category. There is a limited unemployment in those fields of study for those who reported baccalaureate or post-baccalaureate degree fields.

FIGURE 10: Field of Study and Concentration of Selected Occupational Affiliations



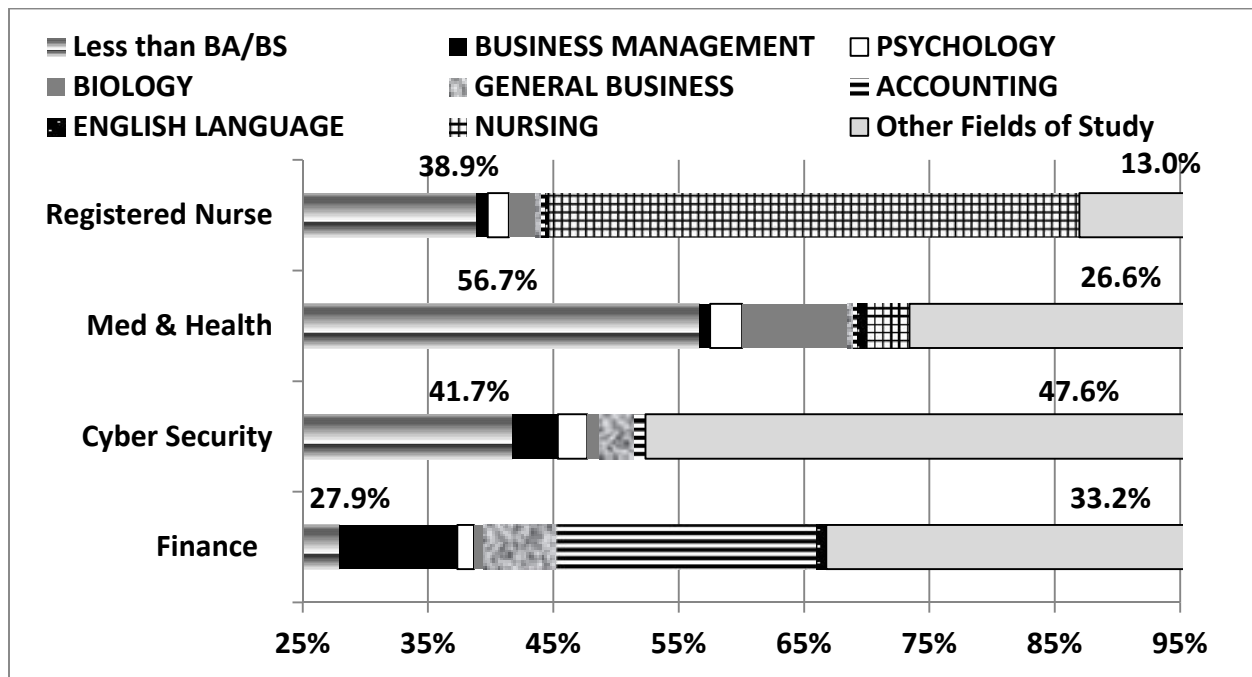
Data source: ACS PUMS 2010-2012 3-year person-level files.

Similar but different from *Figure 10*, *Figure 11* pairs the selected occupational sectors and distributions in the top 7 major fields of study, chosen by the number of those found in the 2010-2012 ACS PUMS 3-year person-level file. This time, the row headings in *Figure 11* are selected occupation sectors. The top 7 major fields of study are defined in the *Figure 11* legend. Also included in the figure are those who reported education attainment less than a baccalaureate degree, as well as other fields of study with at least a baccalaureate degree.

Maryland residents reported less than a baccalaureate degree composed an important part in employment. Over half of the *Medical and Health* occupations, around 40% of *Registered Nurse* and *Cyber Security* occupations, and 28% of *Finance* occupations are filled by individuals who reported to have attained education less than a baccalaureate degree.

For the four selected occupation sectors, although the employment came from one or a few dominant fields of study, there is still a mix of many different fields. Even for the most specialized occupation sector, *Registered Nurse*, although slightly over 40% of *Registered Nurse* occupations come from at least a baccalaureate degree in Nursing, other baccalaureate and beyond degrees, including Biology, Psychology and others, still filled 13% of *Registered Nurse* occupations. However, the diversity of fields of study in a specific occupation sector does not mean a shortage of skills to fill in certain occupations; rather, it is because of the complexity of each occupation and different skill sets needed. For example, each of the four selected occupation sectors, even Cyber Security, draws skills from psychology because psychology feeds a unique need for those occupations.

FIGURE 11: Selected Occupational Affiliations and Concentration of Field of Study

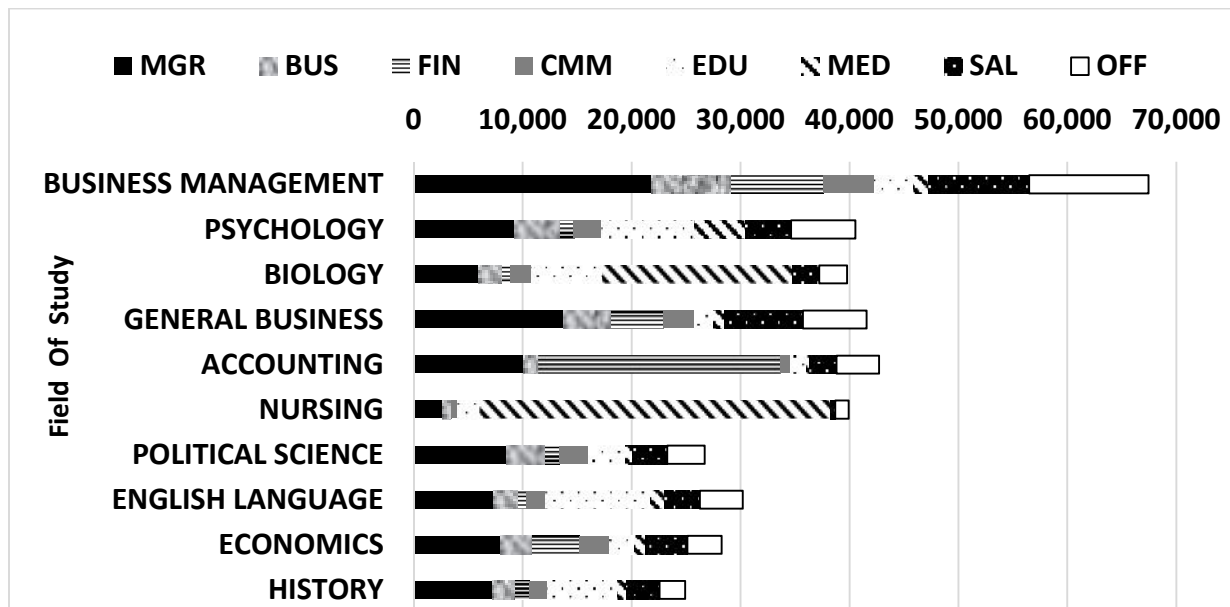


Data source: ACS PUMS 2010-2012 3-year person-level files.

Pairings of Most Frequent Fields of Study with Most Frequent Occupations

Figure 12 follows the *Figure 10* format, but now for the occupation sectors with highest levels of employment. As expected, and consistent with what we reported earlier, a majority of Maryland residents that reported Nursing and Biology as the major field of study reported a Medical occupation; and a majority of Accounting majors reported employment in Finance occupations. Similar to what we presented in *Figure 8*, much lower occupational concentrations are seen in *Figure 12* for the other major field of study categories.

FIGURE 12: Fields of Study and Subsequent Occupation Affiliations



Data source: ACS PUMS 2010-2012 3-year person-level files.

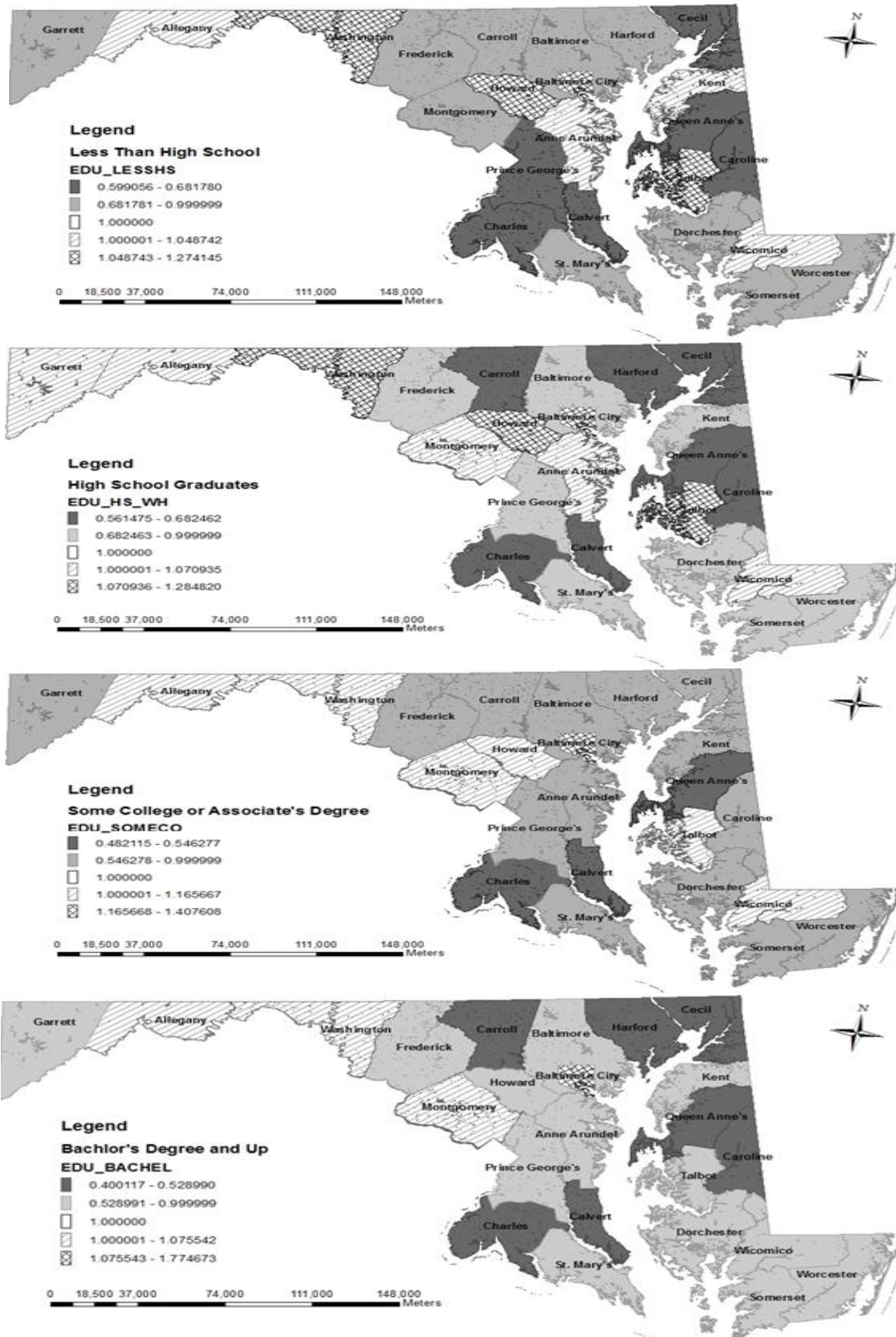
Maryland County-Specific Ratios of In- and Out-Commuting by Educational Attainment

Figure 13 begins our spatial mismatch findings from use of online 2011 LEHD Program Origin-Destination Employment Statistics files. The *Figure 13* legend defines the Maryland county-specific ratios of those working in a reference county (numerator) to those residing in this reference county (denominator). Solid shades indicate a ratio value less than 1, with the darker shading indicating a lower ratio value or a smaller numerator value (in-commuters) than the corresponding denominator value (out-commuters). Patterned areas indicates a ratio value larger than 1, with the cross pattern indicating a higher ratio value or a larger numerator value (in-commuters) than the corresponding denominator value (out-commuters),

Each of the four panels of *Figure 13* includes one of four mutually exclusive educational attainment cohorts, moving from Less Than High School in the top panel to Baccalaureate or Higher in the bottom panel. For example, when looking at the bottom panel, only four counties had more in-commuters than out-commuter who had attained at least a Baccalaureate degree; all the other Maryland counties were the opposite.

Most Maryland county-specific ratios in the panels of *Figure 13* indicate that residents with higher educational attainment are more likely to work outside the reference county, except for Allegany County, Baltimore City, and Montgomery and Washington counties. This offers some insight about why Maryland residents employed in Maryland reported a lower median level of earnings than those with the same educational attainment and type of employer that were employed in Washington DC or Virginia. This finding has important implications for workforce and economic development, and transportation planning—most county-level elected officials seek to retain and attract well educated residents that want to live and work in close proximity.

FIGURE 13: Maryland County-specific Ratios of Workers to Residents by Educational Attainment



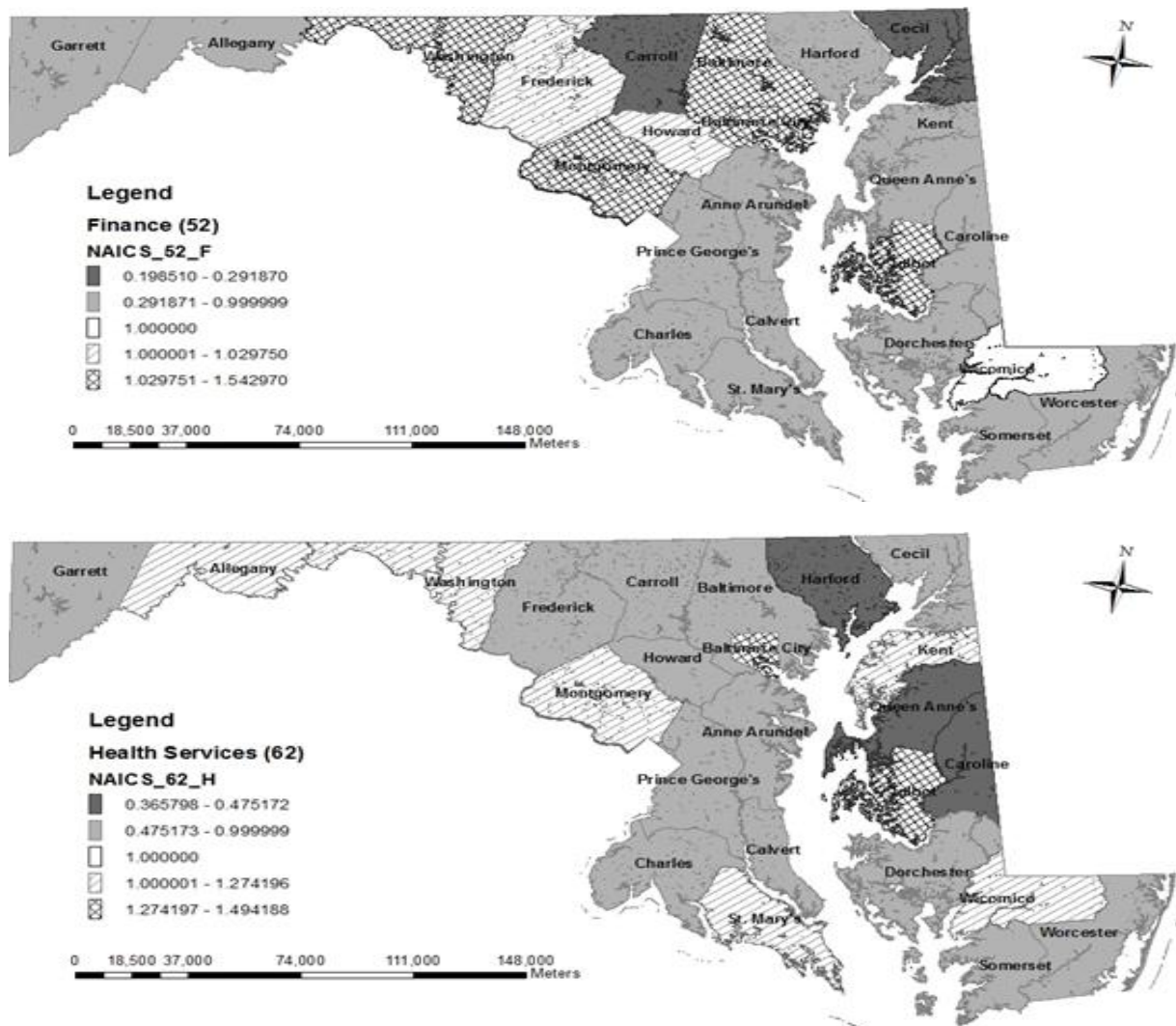
Data source: LODES 2011 data files.

Maryland County-specific Ratios of In- and Out-commuting by Industry Affiliation

Figure 14 follows the Figure 13 format, but now by selected industry sectors instead of by educational attainment level. Similar to our earlier industry and occupational selections, we chose Finance (52) and Health Services (62) as representative.

Figure 14 shows that Baltimore County, Baltimore City, and Frederick, Howard, Montgomery and Talbot counties have more Finance (NAICS two-digit classification 52) sector in-commuters than out-commuters. Allegany County, Baltimore City, Kent, Montgomery, St. Mary's, Talbot, Washington and Wicomico counties attract more Health Services (NAICS two-digit classification 62) in-commuters than local residents working in this sector elsewhere.

FIGURE 14: Maryland County-specific Ratios of Workers to Residents by Selected Industry Sectors



Data source: LODS 2011 data files.

CONCLUSIONS AND RECOMMENDED NEXT STEPS¹⁷

We recognize that what action, or inaction, is preferred depends upon one's organizational or individual interest in the matter; skin in the game. Examples follow.

- A business or government human resources person charged with successful recruitment of highly qualified candidates at low cost will favor external creation and sustainability of a large pool of qualified candidates—'external creation' being a euphemism for 'not at our expense'. There is a clear incentive to broadcast the existence of a skills gap that jeopardizes the competitive viability of the organization.
- A school, particularly a postsecondary institution, shares the human resources person's incentive to promote a belief in a persisting skills gap that should be attacked by public investment in targeted enrollment growth. Of course, simultaneous funding allowing multiple institutions to narrow the gap raises the specter of possible over-shooting of a moving target. If so, who bears the cost of the mistake?
- A student might easily be drawn into enrollment in a program-of-study that appears to offer a bright prospect for immediate employment upon completion and rapid advancement thereafter, both based on beliefs about skills gap evidence that has been brought to the student's attention.

Regardless of the nature of the estimated imbalance of 'supply' and 'demand', the decision-relevant question to be answered is "So what?" Now believing that there is a gap, what action(s) should be taken by whom? This is where decision-making silos and layers come into the picture—when new gap information is broadcast, who if anyone keeps track of the responses or consciously strategically chosen absence of action?

At this point, we urge readers to return to pages 2 and 3, revisiting the nine definitions of a skills *shortage* and also committing to a careful reading of the important research studies referenced in footnotes 2, 16, 17 and 18. Together, these advance the case that there is an urgent need for a response to the current and persisting communication gulf between researchers and those that are tasked with making informed policy decisions about priorities for private and public investments in skills enhancement.

Looking ahead, we conclude with our own short-list of high priority research topics. Public-facing portals offer access to most of the data sources that will be needed to conduct these refined studies. However, some required data elements will only be available through successful negotiation of memoranda-of-understanding between the data owner organization(s) and external research teams, authorizing selected uses of non-public data sources. One important example of the latter is the age, or date-of-birth, data element collected by the Maryland Higher Education Commission in its Enrollment and Degree Information Systems.

¹⁷ Bryan Wilson (June 2014), *How Many More Skilled Workers Do We Need? Using Supply and Demand Reports for State Workforce Planning*, Washington, D.C.: National Skills Coalition, 16 pp., was released after drafting of our report had been completed. Wilson's report includes two figures based on three years of Maryland StateStat data—2009-2012; see p. 3. We encourage reading of Wilson's report as a complement to our own document. We differ on some important methodology issues as these translate into recommended uses of skills gap estimates, but Wilson has been, and remains, a national leader in seeing gap estimates through from conceptualization to delivery of objective technical assistance supporting informed policy decisions.

Our selection of future high priority research topics in the skills gap arena follows.

- More granular detail of industry and occupational stratifications is needed than has been presented in this report.¹⁸
- Further investment is needed to refine field of study, industry and occupation combinations that are adopted for presentation of skills gap estimates.
- Pursuit of an ongoing conversation should be opened with communities of interest and action about decision-relevant differences between the gap and shortage concepts. We urge, and will be personally engaged in, accelerated convergence toward agreement about appropriate definitions, application of estimates, and action/inaction guidance.
- Just as ‘all politics is local’, many important institutional and individual decisions that can benefit from reliable skills gap information require local spatial granularity of estimates. The maps that appear on pages 22 and 23 above illustrate this point. Much more can be done at modest cost. It is worth noting that research capabilities to work with customized spatial boundaries continue to improve and expand.
- We place a particularly high priority on convening of a forum to debate the merits of different metrics of the demand for individual skills and combinations of skills. We express a preference for completed transactions data points, such as the *hires* measure that was used in this report, when compared with hypothetical (not yet completed) measures, such as projected and real-time openings. In expressing this preference we acknowledge that the widely available *hires* data series does not include explicit skills content.

¹⁸ Martin Libicki, David Senty and Julia Pollak (2014), *H4CKER5 WANTED: An Examination of the Cybersecurity Labor Market*, Santa Monica, CA: The RAND Corporation, 110 pp.; available at http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR430/RAND_RR430.pdf.