

BUILDING A DIGITAL CITY: THE GROWTH AND IMPACT OF NEW YORK CITY'S TECH/INFORMATION SECTOR

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Prepared for the Bloomberg Technology Summit
September 30, 2013
New York City

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EXECUTIVE SUMMARY

Despite the aftermath of the financial crisis, New York City's share of the nation's private sector employment stands at the highest level since 1992. The reason: In an era of massive convergence, New York City rapidly reinvented itself as a world-class, urban tech/information hub, uniting tech startups with the city's publishing, media, design, and entertainment companies, all of whom are rapidly digitizing themselves. A key catalyst of this reinvention were policies undertaken by the city itself to improve the tech infrastructure, build and promote a tech/information community, and provide training and support for entrepreneurs.

In this study, we outline the economic dimensions of New York City's tech/information sector for the first time, drawing a fresh picture of a key growth engine. We use the term "tech/information," rather than simply "tech," to emphasize the distinctive nature of New York's convergence-fueled economic revival. Tech firms and information companies used to operate in different worlds. Today, the walls have come down, and New York has benefited.

The tech/information sector includes tech start-ups, established tech companies, and major information companies such as Bloomberg L.P. and the New York Times Company. Without these pillars of the information economy — serving as clients, investors, sources of talent and ideas, and major employers of tech workers in their own right — the New York City tech boom could not have occurred.

Some key findings:

- » As already noted, New York City's share of the nation's private sector employment has reached its

highest level in 20 years because of the growth of the tech/information sector.

- » There are 262,000 workers in the New York tech/information sector, contributing almost \$30 billion annually in wages to the local economy.
- » While the financial sector, including real estate, is the most single important engine of the New York economy, the tech/information sector is now number two, surpassing the private health care sector.
- » Between 2007 and 2012, the number of private sector jobs in NYC rose by about 4 percent, compared to a 3 percent decline nationally.
- » Since 2007, when the Great Recession started, New York City's tech/information sector has grown by 11 percent, or some 26,000 jobs, adding \$5.8 billion in additional wages to the economy. Indeed, these wage gains accounted for two-thirds of the growth in private sector wages over that stretch.
- » Using a conservative estimate, the tech/information boom was responsible for roughly one-third of the private sector job creation in New York City since 2007.
- » New York City also significantly outperformed its suburbs during this period. According to the Bureau of Labor Statistics, private sector jobs actually declined by 3.8 percent from 2007-2012 in the New York metro area outside the city. Tech/information jobs also dropped by 6.9 percent in the suburbs, compared to an 11 percent gain in the city.
- » The growth of Brooklyn's tech/information sector has outpaced every other large county in the country, with the exception of San Francisco. This includes traditional tech hubs such as Austin; Seattle; Cambridge, MA; the Research Triangle; and Silicon Valley.

INTRODUCTION

Today, New York City's share of the nation's private sector employment stands at its highest level since 1992 (figure 1). Five years ago, when Lehman Brothers collapsed, the financial sector went in a tailspin, and the country slid into a deep recession, not a single economist or city official — even the most optimistic — would have predicted that.

WHAT WENT RIGHT?

In an era of massive convergence, New York City rapidly reinvented itself as a world-class, urban tech/information hub, uniting tech startups with world-class publishing, media, design, and entertainment companies. “Silicon Alley” was a cute nickname when it first became popular in the 1990s. Now, the New York tech/information sector is a critical engine to the city's economy, creating thousands of jobs and supporting economic growth across the city.

In this study, we outline the economic dimensions of New York City's tech/information sector for the first time, drawing a fresh picture of this important, growing sector. We use the term “tech/information,” rather than simply “tech,” to emphasize the distinctive nature of New York's convergence-fueled economic revival. Tech firms and information companies used to operate in different worlds, and indeed, in different parts of the country. Today, the walls have come down, and New York has benefited.

As the name suggests, the city's tech/information sector encompasses both an amazing crop of creative and growing tech startups, and the rapidly evolving information companies which have long made New York their home. It is this synergistic combination that has made the difference to the city's economic performance.

The New York City tech/information sector is diverse. It includes tech start-ups like Fab.com (an online retailer), Shapeways (a 3D printing marketplace), and Relationship Science (a business development network); vibrant, high-growth young companies like AppNexus, Gilt Groupe, and Etsy; and large outposts of major West Coast tech companies such as Google, Facebook, Amazon, and Twitter that serve as magnets for talent.

New York's tech/information sector also includes major news/information operations such as Bloomberg L.P. and Thomson Reuters; media giants such as Viacom and Time Warner; and rapidly transforming publishers such as the New York Times Company and fashion leader Condé Nast, who are in the midst of massive efforts to digitize themselves. Without these pillars of the information economy — serving as clients, investors, sources of talent and ideas, and major employers of tech workers in their own right — the New York City tech boom could not have even begun.

Together, these companies — big and small, new and old — are a major driver of New York City's economic success. By our analysis, there are 262,000 workers in the New York tech/information sector, contributing almost \$30 billion annually in wages to the city economy (figure 2). While the financial sector, including real estate, is the single-most important engine of the New York economy, the tech/information sector is now number two, surpassing the private health care sector.

In 2012 alone, New York City's tech/information sector added almost 11,000 jobs and \$2 billion in additional wages. That's even before accounting for spillover effects, as these new jobs certainly generated addition-

al employment and spending in the city. These gains more than compensated for the continuing shrinkage of the financial sector in 2012.

Taking a somewhat longer perspective, since 2007, when the Great Recession started, New York City's tech/information sector has grown by 11 percent, or some 26,000 jobs, adding \$5.8 billion in additional wages. Indeed, these wage gains accounted for two-thirds of the growth in private sector wages over that stretch. And the gains have not been restricted just to Manhattan. The growth of Brooklyn's tech/information sector has outpaced every other large county in the country, with the exception of San Francisco. This includes traditional tech centers as Austin; Silicon Valley; the Research Triangle; Seattle; and Cambridge, MA.

This revival draws on both New York City's natural strengths and on good policy. For one, as Bruce Katz and Jennifer Bradley of the Brookings Institution write in their seminal new book, *The Metropolitan Revolution*, large cities seem to have a key advantage:

...technology, which was supposed to cut the ties between people and places and allow people everywhere to work from almost anywhere, turns out to flourish in fairly compact geographic concentrations.¹

It's becoming clear that as we shift to a data-driven economy, tech innovation depends not just on engineering talent, but on expertise in areas such as design, commerce, content creation, and user interface. These needs play to the strength of New York, and other big cities as well, that have a critical mass both of large companies and creative workers.²

But there are other cities that are dense, have large companies headquartered there, and even have

world-class engineering schools, but did not see New York's growth. The difference can be attributed to the far-sighted actions by Mayor Bloomberg's administration to act as a catalyst for the tech/information sector. These include the funding of multiple tech incubators, and training programs for entrepreneurs and small businesses; the rapid extension of broadband access throughout the city including free wi-fi in key public spaces; NYC's broad-reaching Open Data initiative; and the Applied Sciences competition, which has put Cornell-Technion on track to open a 2 million square-foot campus on Roosevelt Island plus the expansions at Columbia University and NYU-Poly in Brooklyn.

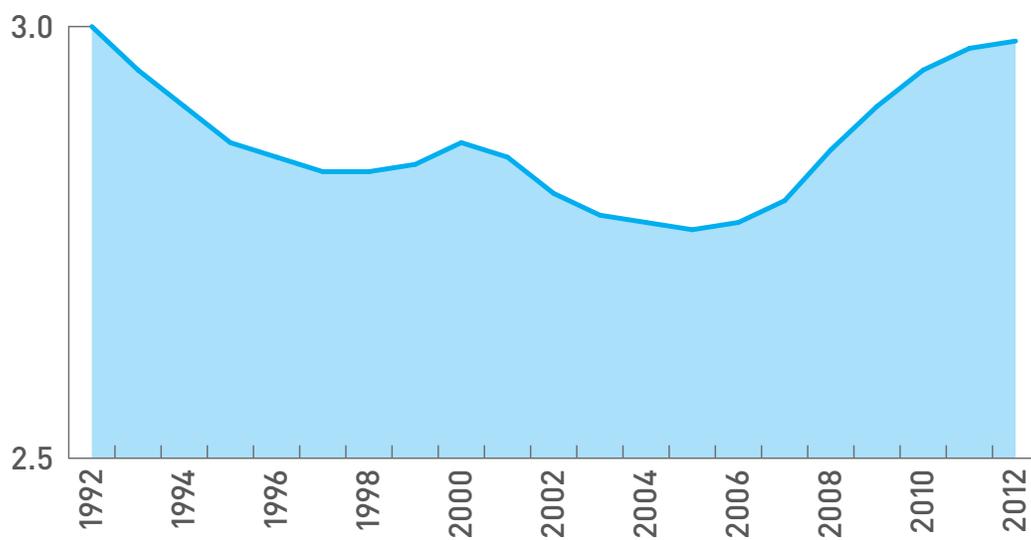
It also includes a conscious effort to create a tech community in the city, such as undertaking programs like the NYC Tech Talent Draft to attract engineering graduates to NYC companies. And in February 2013 Mayor Bloomberg and NYC Digital (part of the Mayor's Office of Media & Entertainment) launched the "Made in NY" marketing campaign to highlight local tech firms, along with the website wearemadeinny.com, which identifies NYC tech companies which are hiring. While it's still too early to say exactly what worked best and what the long-term results will be, it's clear that New York's efforts helped accelerate the growth of the tech/information sector.

The next section will outline and define New York City's tech/information sector. Based on this definition, we will explain how the tech/information sector has lifted the city's economy since 2007, in terms of jobs and economic impact. We will then outline an alternative "occupation-based" approach to the tech/information sector, which allows us to estimate the number of App Economy and Big Data workers in New York City. Finally, a methodology appendix explains in detail how the tech/information sector is constructed.

FIGURE 1

NEW YORK CITY SHARE OF U.S. LABOR MARKET HITS 20-YEAR HIGH

(NYC private jobs as share of US private jobs)



Data: Bureau of Labor Statistics, South Mountain Economics LLC

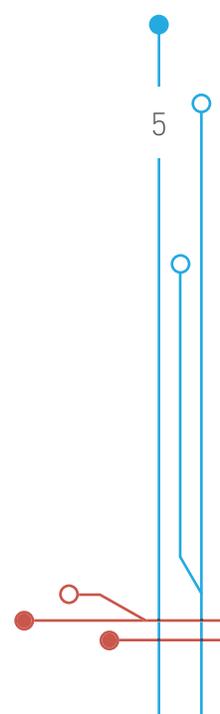


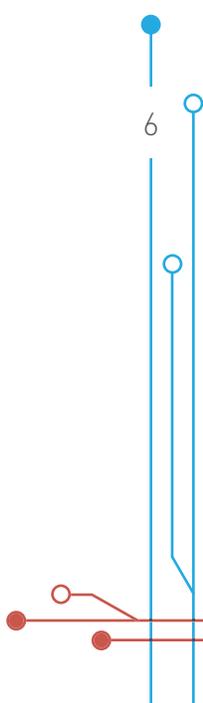
FIGURE 2

NEW YORK CITY'S TECH/INFORMATION SECTOR, 2012

Number of jobs (thousands)	262.1	
Share of NYC private sector jobs		8.1%
Job increase (thousands), 2007-12	26.0	
share of NYC private sector job increase, 2007-12		21.0%
including conservative estimate of spillover jobs		31.4%
Wages paid (billions)	29.9	
share of NYC private sector wages		11.0%
Wage increase (billions), 2007-12	5.8	
share of NYC private sector wage increase (billions), 2007-12		67.7%

Data: Bureau of Labor Statistics, South Mountain Economics LLC

Based on BLC QCEW data, which omits self-employed and proprietors. Wages include bonuses and stock options.



DEFINING NEW YORK CITY'S TECH/INFORMATION ECOSYSTEM

In the past, major tech hubs — such as Silicon Valley and Boston's Route 128 — have been built around universities and existing large tech companies. Each generation of tech successes would spawn the next generation of entrepreneurs, financed by venture capital and filled with dreams of becoming the next giants.

New York City is following a path that is similar, but different, in some important respects. On the one hand, the city is in the process of developing many of the same ingredients that made Silicon Valley great: a thriving start-up community, abundant venture capital, and supportive universities and government. For example, in the second quarter of 2013, Cook Associates surveyed 357 Internet and digital media companies with 10+ employees in New York City, and found that they had added approximately 2,200 jobs for a 7.3 percent gain.³ The city has major universities and research facilities, with Cornell-Technion on the way.

And the city is blessed with a growing and vibrant venture capital community. In 2012, the New York metro area ranked fourth in the country in venture capital dollars, behind only San Francisco, San Jose, and Boston.⁴ New York state venture investment dollars rose 3 percent year-over-year in the second quarter of 2013, out-performing the nation as a whole.⁵ In a recent blog post, Michael Moynihan, chief economist of the NYC Economic Development Corporation, wrote:

Strong exits through acquisitions demonstrate that the City is providing strong returns on prior investments in start-ups and technology. New money and a large number of companies in the pipeline suggest the virtuous cycle will continue.⁶

But New York City also possesses a unique advantage: Unparalleled world-class publishing, media, infor-

mation, advertising, and fashion companies. Moreover, these companies are heavily investing in digital and mobile, expenditures that play a critical role in creating the supporting infrastructure of capabilities that nourishes the startup community.

That sort of infrastructure, always one of the outstanding advantages of Silicon Valley, is now found in New York City. It makes it possible for talented people to move to New York City and know that they have a choice: If the start-up doesn't work out, they can find a job in a larger tech or information company. Or if they join a larger company, they can get experience and later leave to a start-up.

Indeed, publishing and media companies have shifted their hiring to tech at an unprecedented rate. Out of the roughly 100 local job openings listed on the New York Times Company website in mid September, roughly 65-70 percent were either tech jobs or management or newsroom jobs directly connected with online, video, or mobile, with job titles such as Senior Software Engineer (Games), Mobile Home Page Editor, and Interactive News Developer. In a few years, it may be hard to tell the difference between pure-play Internet companies and ones that started in the physical world.

This long-predicted convergence between tech and information is proving to be fruitful for New York City. As the Center for an Urban Future explains:

New York's rich pool of creative, marketing and business talent is well suited for creating and running these new businesses, all of which can be built with comparatively few engineers. At the same time, today's technology revolution is much less about creating the infrastructure and plumbing for the Internet, but about applying technology to traditional industries like advertising, media,

finance, fashion and health. New York is natural for this wave of technology growth because it is a market leader in most if not all of these sectors, and boasts an unmatched concentration of talent in each of these fields.⁷

This point cannot be stressed enough. Historically, every wave of tech innovation requires a different set of skills and strengths, and a different mindset. New York City's strengths seem to be well-suited to the current wave.

That's why in this paper we have broadened the usual definition of the "tech sector" to include the entire "tech/information" ecosystem. Convergence is real, especially in New York City. Large information and media companies in New York City are either already largely tech-based, or spending immense amounts to transform themselves.

We took an industry-based approach to defining the tech/information sector (in a later section of this study we examine an alternative "occupation-based" approach). The general categories utilized in the industry approach are outlined in Figure 3, with the precise industry codes listed in the methodology appendix.⁸

The first group of industries comprises firms delivering their essential information content and services on the web. This group includes e-commerce and fashion start-ups such as Fab.com and Etsy, as well as the New York operations of Amazon; social media start-ups such as Tumblr (just purchased by Yahoo!) and Sprinklr, which does social media management for global enterprises, and the New York operations of Facebook; advertising- and search-related businesses such as

AppNexus, Collective, and the large and growing East coast offices of Google; and information and news creation and distribution operations ranging from startups such as NewsCred and BuzzFeed to large, existing companies such as the New York Times Company and Bloomberg L.P.

The second group of industries focuses on the creation and distribution of visual and sound content, particularly, but not restricted to, entertainment. This category includes venture-funded video start-ups such as Innovid, which makes online video advertising. It also includes all the major movie, video, music, radio, television, and cable content production operations that operate out of New York City. These large companies have become increasingly tech-focused over time, as they have become more oriented towards digital and mobile. Viacom, for example, posted or updated about 70 New York City job openings in the last week of August and first three weeks of September, and at least half of them were directly concerned with mobile or online, including Web and Mobile Producer for Spike TV. What's more, these large companies are an essential part of the infrastructure, supporting a large network of suppliers that are available to start-ups as well.

The third group of group of companies is about developers — app developers, web developers, software developers. It includes app developers such as Fueled, FiftyThree, and TENDIGI, based in Brooklyn; and software start-ups such as Booker Software and Sailthru, which makes personalization marketing software. It also includes New York jobs at big software companies such as Microsoft and Oracle.

Also included are the New York City employees of infrastructure companies such as AT&T, Verizon, and other telecom and cloud providers. These are the companies that build and maintain the underlying structures that make the New York City tech/information economy work. In the same spirit, we include IT systems consulting and implementation operations, which may not be sexy, but are a major source of tech jobs in New York City.

And finally, there are manufacturing and the associated scientific, engineering, and industrial design services. We believe that 3D printing and other new manufacturing technologies to come are an important part of New York City's future, especially given the Applied Sciences initiative. However, the government statisticians still have not caught up with these new trends – there is no category yet for 3D printing, and

it's impossible to know if the government even classifies companies such as Shapeways and Makerbot as manufacturing.⁹ Perhaps for that reason, the government statistics show manufacturing in NYC continuing to shrink. As a result, for the purposes of this current study, we have omitted manufacturing industries from our definition of the tech/information sector.¹⁰

Retained in this classification are scientific, engineering, and industrial design services as part of the tech/information sector. These companies are an essential part of the tech/information sector, and could be much more important in the future as 3D printing takes off.¹¹

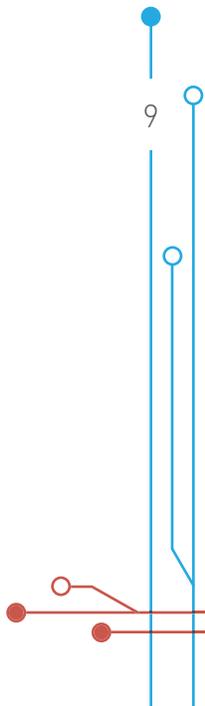


FIGURE 3

WHAT COMPANIES ARE IN THE TECH/INFORMATION SECTOR?

INFORMATION AND INTERNET SERVICES:

Online shopping, web search, news organizations, social media

MEDIA PRODUCTION:

Video, music, radio, television and cable

SOFTWARE DEVELOPERS

App developers, web developers, custom and prepackaged software

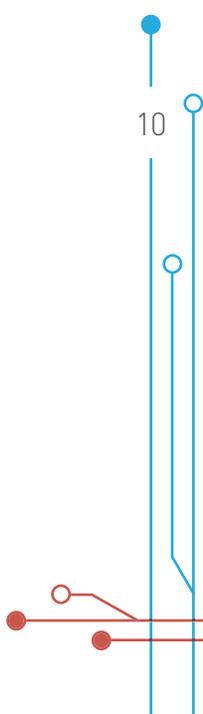
INFRASTRUCTURE

Telecom providers, cloud providers, hosting

SCIENTIFIC, ENGINEERING, AND INDUSTRIAL DESIGN SERVICES

IT SYSTEMS CONSULTING AND IMPLEMENTATION

Data: South Mountain Economics LLC



OUTPACING THE COUNTRY

Between 2002 and 2007, the country went through a housing boom, where construction and finance were the main drivers of growth. New York was no different. Over that period, the city added more than 35,000 jobs in construction and financial activities, and only 3,500 in the tech/information sector.

After 2007, employment in construction and financial activities collapsed in both the country and the city. Given that New York was the epicenter of the financial crisis, it would have been natural to predict that the New York economy was going to underperform the national economy for some years. The collapse or purchase of such New York-based financial firms such as Bear Stearns, Lehman, AIG, and Merrill Lynch in a relatively short time erased tens of thousands of jobs from the local economy, and should have dragged down the city.

In fact, the reverse was true, as the New York economy outperformed the national economy. Between 2007 and 2012, the number of private sector jobs in NYC rose by about 4 percent, compared to a 3 percent decline nationally. As a result, as of 2012, New York City's share of U.S. private sector jobs had risen to its highest level since 1992, two decades ago. Think about it: In 1992 the web browser did not exist, very few people had heard of the Internet, and no one had a smartphone. Today, the economy is much different — much more global, much more tech-oriented — and New York City is thriving.

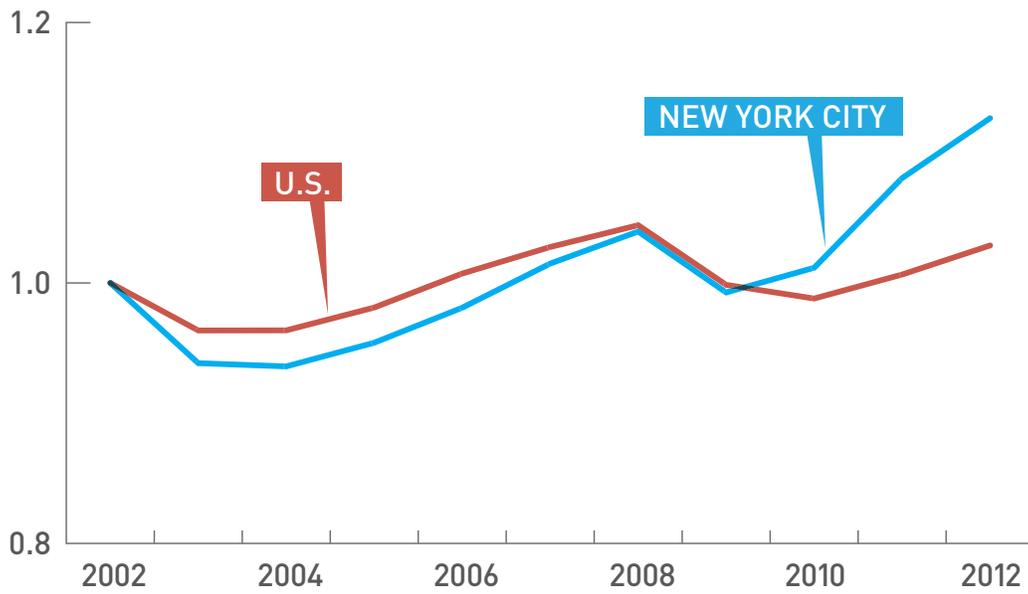
What happened? The U.S. has been through a vast job drought since 2007, with only the health care/education sector showing substantial growth. On a national basis, even tech/information jobs have been virtually flat (figure 4).

But New York City, along with some other cities such as San Francisco and Boston, has been able to nurture and ride the tech/information boom to withstand this downturn. In New York City, tech/information jobs grew by 11 percent — or 26,000 — between 2007 and 2012, defying the Great Recession. In 2012 alone, the city's tech/information sector added almost 11,000 jobs.¹²

It must be pointed out that it is New York City itself that has significantly out-performed during this period — surpassing not only the rest of the country, but the New York City suburbs as well. According to data from the Bureau of Labor Statistics, private sector jobs actually shrunk by 3.8 percent from 2007 to 2012 in the New York metro area suburbs (Figure 5). The same disparity shows up in the tech/information jobs, which declined by 6.9 percent in the New York suburbs compared to an 11 percent gain in the city.

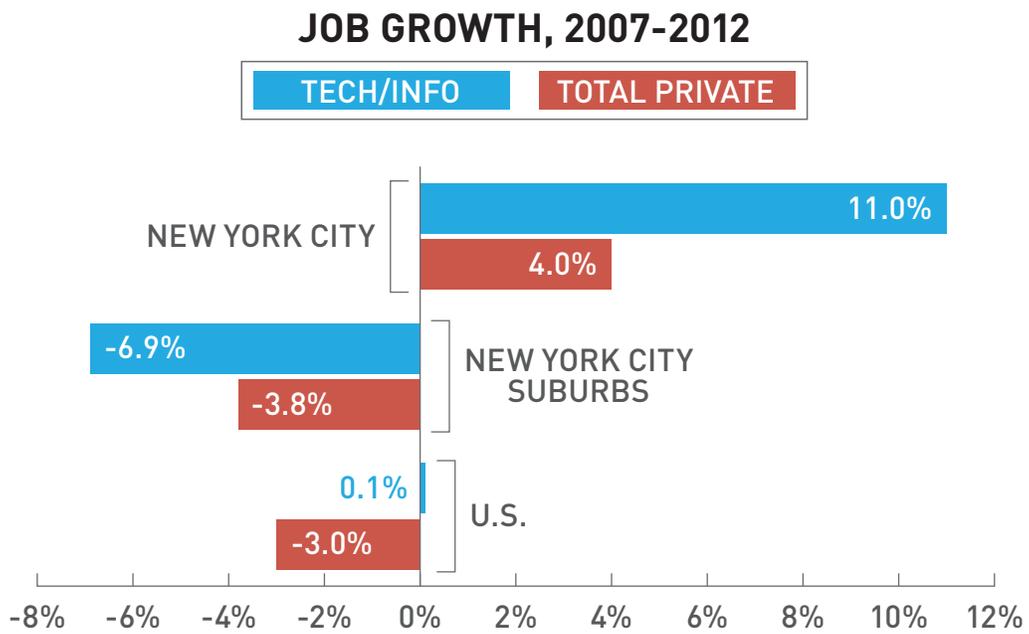
FIGURE 4

NEW YORK CITY VS. THE U.S.: TEN YEARS OF TECH INFORMATION JOB GROWTH (2002=1)



Data: Bureau of Labor Statistics (QCEW), South Mountain Economics LLC

FIGURE 5



New York City suburbs includes all counties in the New York metro area outside of the city

Data: Bureau of Labor Statistics (QCEW), South Mountain Economics LLC

WHOM DOES THE TECH/INFORMATION BOOM HELP?

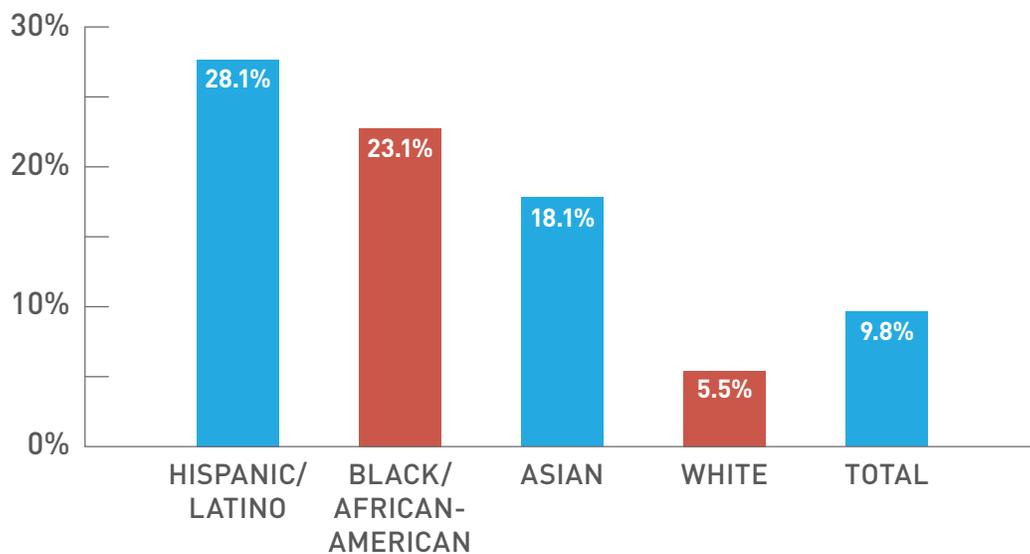
Nationally, minorities are entering computer and mathematical occupations at a rapid pace. Over the past two years, the number of Hispanic or Latino workers in computer and mathematical occupations has risen by 28 percent, the number of Black or African-American workers by 23 percent, and the number of Asian workers by 18 percent (figure 6). By contrast, the number of white workers in computer and mathematical occupations has risen by only 5.5 percent.

While it will take several years before enough data accumulate to tell for sure, these numbers suggest that the tech/information boom in New York City – a main driver of the country's tech boom – is creating new opportunities for Hispanics/Latinos, Blacks/African-Americans, and Asians as well.

FIGURE 6

DIVERSITY GAINS IN TECH FIELDS NATIONALLY

(percentage change in computer and mathematical occupations, August 2011-August 2013)



Based on 12-month average ending in August for national employment in computer and mathematical occupations

Data: Bureau of Labor Statistics, South Mountain Economics LLC

THE ECONOMIC IMPACT OF THE TECH/INFORMATION SECTOR IN NEW YORK CITY

A growing tech/information sector affects the New York City economy in many ways from local purchasing to city tax revenues to spillover jobs created in other parts of the local economy.

One of the biggest economic impacts of this growth is the wages paid out by the tech/information sector. In 2012, the tech/information sector in New York City paid out approximately \$30 billion in wages, including bonuses and exercised stock options (Figure 7). While one-third of the \$90 billion in wages paid out by the financial activities sector, this amount still makes tech/information the second biggest contributor to New York City's private sector economy, just ahead of health care.

Perhaps more important is the contribution that the tech/information sector made to cushioning the blow from the financial crisis. From 2007 to 2012, the financial activities sector saw wages decrease by \$13 billion (figure 8). This is the equivalent of the entire retail trade industry in New York City disappearing.

This fall was damaging, but not as bad as it could have been without the tech/information sector, which increased its wage payments by \$5.8 billion over this period, or 24 percent. The only private non-finance industry sector that comes close to that size is health care and social assistance. The big difference is that even private health care and social assistance organizations get a significant amount of their revenue either directly or indirectly from the government, while tech/information firms are much more oriented towards private sector clients.

Another way to put this into perspective is to consider that over the period 2007 to 2012, total private sector wages in New York City increased by \$8.6 billion. That means two-thirds of the gain in private sector wages in New York since the Great Recession started was generated by the tech/information sector.

It's important to note this number likely *underestimates* the importance of the tech/information sector to the New York City economy. We have not factored in the role of spillovers — that is, jobs and wages created in other industries when the tech/information sector adds jobs. Economists usually describe this spillover by means of “multipliers.” By one estimate, the multiplier for tech jobs is as high as five, so that over the long run, each tech job generates five additional jobs in the local economy.¹³ However, other estimates of local multipliers are much lower, varying over a wide range.¹⁴

Because of the lack of consensus, our practice in previous studies, such as the 2012 paper “Where the Jobs Are: The App Economy,” has been to use very conservative multipliers. In particular, that paper used a multiplier of only 0.5 to obtain its results.

If we adopt the same conservative approach here, then the 26,000 tech/information jobs created in New York from 2007 to 2012 generated an additional 13,000 jobs in the rest of the local economy. That means the tech/information boom was responsible for roughly one-third of the private sector job creation in New York City since 2007.

FIGURE 7

WAGES PAID BY SELECTED NYC PRIVATE INDUSTRIES, 2012

	Billions of dollars	Share of total private wages
Financial activities	91.3	33.8%
Tech/information	29.9	11.0%
Health care and social assistance	28.4	10.5%
Wholesale and retail trade*	23.4	8.6%
Leisure and hospitality	13.2	4.9%
Management of companies	12.1	4.5%
Legal services	10.1	3.7%
Administrative and waste services	9.8	3.6%
Educational services	8.6	3.2%

Private sector only

*small overlap with tech/information sector

Data: Bureau of Labor Statistics (QCEW), South Mountain Economics LLC

FIGURE 8

RESPONDING TO THE FINANCIAL CRISIS, 2007-2012

	change in NYC wages (billions of dollars)
Financial activities	-13.4
Tech/information	5.8
Health care and social assistance	4.3
Wholesale and retail trade*	2.3
Leisure and hospitality	2.8
Management of companies	1.3
Legal services	0.1
Administrative and waste services	0.8
Educational services	2.3

Private sector only

*small overlap with tech/information sector

Data: Bureau of Labor Statistics (QCEW), South Mountain Economics LLC

WIDESPREAD GAINS: THE CASE OF BROOKLYN

A traditional lament heard in New York is that economic booms overlook the outer boroughs. And indeed, bringing economic development and growth to these boroughs has been a focus of the Bloomberg Administration. True, the tech/information sector is mostly concentrated in Manhattan, with 88 percent of the jobs and more than 90 percent of the wages. However, Brooklyn, and to a lesser extent Queens, have shown strong growth in this part of the economy in recent years. From 2007 to 2012, tech/information employment grew by 24 percent in Brooklyn, and 6 percent in Queens. Tech/information total wages rose by 54 percent and 20 percent, in Brooklyn and Queens, respectively.

This growth puts Brooklyn near the top of the table – behind only San Francisco – when it comes to tech/information job growth in our nation's large counties. According to BLS data we analyzed, Brooklyn beat out long-time tech centers such as Santa Clara County (Silicon Valley), King County (Seattle), Middlesex County (Cambridge, MA), and the Research Triangle in North Carolina.

Who's hiring in Brooklyn? It's a whole range of startups. As of mid-September 2013, Looove Music, a music technology startup based in Williamsburg, is advertising for a VP of Engineering, a front end web developer, and a senior “ruby on rails” developer, as well as a facilities manager and an office manager. Uncommon Goods, an e-commerce and catalog company based in Brooklyn, is advertising for positions ranging from web developer to security manager to assistant buyer. CHARGED.fm, a Brooklyn startup building a new ticketing system, is looking for a user interface developer. Etsy is advertising for about 25 Brooklyn-based positions, while Amplify, an edtech firm, has about 20 open positions ranging from art director to games research assistant.

Are these gains going to continue? August 2013 help-wanted data from The Conference Board shows that want ads for computer and mathematical jobs in Brooklyn are up about 20 percent over a year earlier. That suggests the tech/information boom in Brooklyn is nowhere near over.¹⁵

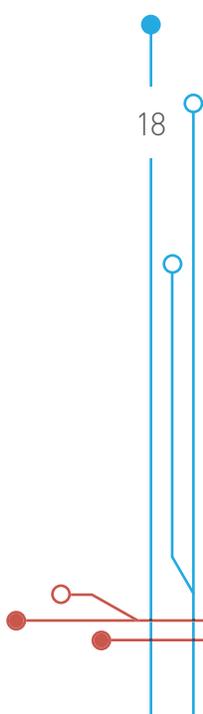


FIGURE 9

SAN FRANCISCO AND BROOKLYN AT THE TOP (growth of tech/information sector, 2007-2012)*

1	San Francisco County, California	51.8%
2	Kings County, New York	21.0%
3	Wake County, North Carolina	18.2%
4	Santa Clara County, California	15.5%
5	King County, Washington	13.5%
6	Travis County, Texas	12.5%
7	Middlesex County, Massachusetts	12.2%
8	Kern County, California	11.1%
9	New York County, New York	9.9%
10	Mecklenburg County, North Carolina	8.8%

*Because of data limitations, calculations based only on the subset of the tech/information sector, that includes the information industries (NAICS 51) and computer systems design (NAICS 5415). Nationally these two NAICS codes account for about 70 percent of tech/information employment.

Based on all counties with 2012 population of 800,000 or higher

Data: Bureau of Labor Statistics (QCEW), South Mountain Economics LLC

AN ALTERNATIVE PERSPECTIVE: AN OCCUPATION-BASED APPROACH

This paper has used a definition of the tech/information sector that captures the dynamism of the New York City economy. This is the best approach, by our assessment. But it falls short in one important way: It omits the financial sector. That's a problem if we are trying to size the impact of tech on New York City, because financial firms, such as JP Morgan Chase, are among the biggest employers of computer personnel in the city. Indeed, New York's investment banks, hedge funds, and securities exchanges are all prodigious spenders on information technology.

Our definition of the tech/information sector also omits the scientists and engineers employed in health and education, or potentially employed in NY's high-tech manufacturing industries such as 3D printing. These workers are not very numerous, but they are important for NY's future.

To identify these workers, in this section we will describe an alternative approach for sizing New York City's tech/information sector by occupations rather than industries. In particular, South Mountain Economics has developed a methodology for using online help-wanted ads as a tool for tracking trends in tech employment.¹⁶ These ads have the advantages of being real-time, finely detailed in terms of describing the needed skills, and usually identifying the location of the job. Our methodology adjusts for the fact that different occupations may have different processes for filling jobs (see methodology section).

We utilized this methodology to identify the total number of tech, science, engineering, and math jobs in New York City (Figure 10). We also estimated the

number of the App Economy and Big Data workers in the city. An App Economy worker is one with App Economy skills, such as knowledge of how to develop an app for an Android phone. A Big Data worker has skills such as knowledge of Hadoop or Cassandra, important big data programs.

We make several observations about the results presented in Figure 10. First, there are 348,000 jobs in New York City's "broad" tech/information economy, calculated using this occupation-based approach. This figure includes STEM workers and supporting non-tech jobs in the same organization, such as HR and management. This is substantially greater than the 262,000 estimated by the industry-based approach, which also includes both tech and non-tech workers. This difference is exactly what we would have expected, since the occupation-based approach accounts for STEM workers in finance, health, and education.

Second, we see that New York City has a relatively low share of all STEM workers, compared to its roughly 3 percent share of the nation's private sector workforce. By the same yardstick, the city has a relatively high share of those with App Economy and Big Data skills. Without much high-tech manufacturing — at least so far — New York is relatively light on engineers and scientists compared to other parts of the country. On the other hand, Big Data is an important part of marketing, finance, and social media, all strengths of New York. We note that this occupation-based approach can be used to track the rise of new industries and capabilities, such as 3D printing. It can also be used to compare cities in different countries.

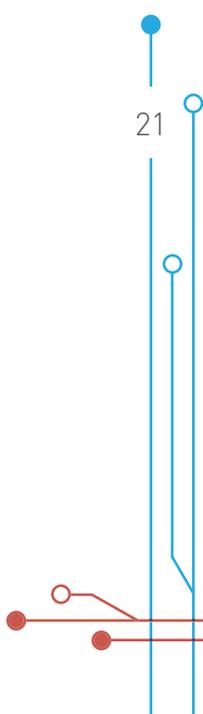
FIGURE 10

AN ALTERNATIVE LOOK AT NEW YORK CITY'S TECH WORKFORCE

	thousands of workers	share of national total
Tech and other STEM workers	348.0	2.4%
Tech workers with App Economy skills	23.3	4.7%
Tech workers with Big Data skills	19.5	6.4%

Based on tracking online help-wanted ads as of June 2013. Includes tech, science, engineering, math workers, and supporting non-tech jobs, in the same organization, as described in methodology.

Data: The Conference Board, South Mountain Economics LLC



CONCLUSION

The combination of the city's natural strengths plus good policy enabled New York City to grow one of the nation's largest tech/information sectors and rebound from the financial crisis faster than anyone would have expected.

This growth is evident in the number of jobs created as well as the wages these jobs added to the economy. In addition, New York City itself is where the tech/information job growth is, outperforming the New York suburbs and the country as a whole. Moreover, substantial rates of tech/information job growth are evident in Brooklyn, demonstrating the expanding reach of New York City's tech/information sector.

New York City's tech/information sector is now a major force for national private sector job growth. This underscores the importance of a continued effort to pursue smart policies to nurture this expansion for both the future of the city and the country. Ultimately, New York City's ability to transform itself and outperform the national economy offers lessons for other urban areas that are looking to build innovation-based growth.

APPENDIX: METHODOLOGY

Identifying the boundaries of the tech/information sector is a tricky proposition.¹⁷ For that reason, in this study we use two different approaches. The first approach is industry-based, using official government statistics from the Bureau of Labor Statistics to identify tech/information jobs and wages. For confirmation, we also use a second occupation-based approach, using online help-wanted data from The Conference Board to track the prevalence of STEM jobs in the New York City economy. This approach builds on a methodology originally developed in a series of papers from South Mountain Economics on the App Economy.¹⁸

INDUSTRY-BASED APPROACH

The data for the industry-based approach, comes from the Bureau of Labor Statistics QCEW program. This program provides annual figures on jobs and wages by county and by detailed industry. For example, the QCEW program tells us that the number of people working in the “electronic shopping” industry in Brooklyn went from 420 in 2007 to 1008 in 2012.

So it seems like the question is a simple one: Which industries belong in the tech/information sector? However, there are several important issues that make the problem more complicated. First might be called the New York Times Company problem. It obviously puts out a print newspaper. Simultaneously, the company is also very heavily invested in its online and mobile operations, as noted earlier in this study.

So how does the Bureau of Labor Statistics handle the print/digital split at the New York Times Company? By practice, each “establishment” is assigned to only one industry. And it is almost certain that all the

jobs at the Times — including the large online and mobile staff — are assigned by the BLS to the newspaper publishing industry, not to the Internet publishing industry. Thus, the number of digital news jobs in New York would be greatly understated if we ignored the publishing industry.

The second problem is that there is no central list of which companies or establishments are assigned to which industries. Indeed, the Bureau of Labor Statistics and the Census Bureau maintain separate industry-company lists, and by law they are not allowed to exchange these lists. A 2006 study found that 33 percent of firms examined were classified in different industries by the two agencies.¹⁹ This means that figuring out which industry corresponds to which company is a bit of a guessing game. For example, we might think that ad-tech firms such as AppNexus, which runs major online advertising networks, would be assigned to “other services related to advertising.” However, the BLS figures for that industry show no gain at all in jobs in Manhattan, even though ad-tech has been booming in the city. That suggests that ad-tech firms are showing up in other industries, perhaps media buying or even custom computer programming.

The third problem is that many temporary tech jobs are actually reported on the books of employment firms, rather than the industry where they are actually working. The size of this “outsourcing” is unknown but could be enormous.

Keeping these problems in mind, we developed a list of industries to cover the tech/information sector. Our starting point was the excellent matrix of tech sector in-

dustries that has been developed by the New York City Economic Development Corporation, which we then modified to cover the tech/information sector.²⁰ First, we focused on service sector industries rather than manufacturing industries. We believe in the long-term importance of advanced manufacturing for New York. Unfortunately, manufacturing employment fell sharply in the city in the Great Recession, as it did all over the country. As a result, keeping these industries in the mix will produce distorting results.

Second, we considered carefully whether publishing and media – two bedrock industries for NYC – belong in the tech/information sector. To put it another way, are large NYC publishing and media companies part of the same ecosystem as smaller digital media, social networking and e-commerce startups?

At least today, the answer has to be yes. Virtually all of the major NYC news, publishing, and media organizations – the New York Times Company, Bloomberg L.P., Thomson Reuters, Hearst magazines, Viacom – are pouring major resources into their online and mobile operations. We already noted the large number of tech, online, and mobile job openings at the New York Times Company and Viacom.

Moreover, Internet- and mobile-savvy workers move back and forth between the large companies and the small startups. That's the mark of a well-functioning ecosystem. Indeed, the large publishing and media companies serve much the same anchor function in New York City as the large tech companies do in Silicon Valley.

Another issue arises because the large accounting and consulting firms such as Deloitte and Accenture are among the largest advertisers for tech workers in

New York City, as reported in The Conference Board HWOL database. After careful examination, we assessed that these workers, used for IT consulting and implementation, were probably showing up in the management consulting industry.

Our list of industries for the tech/information sector in New York City included:

NAICS codes:

- » 454111 Electronic shopping
- » 454112 Electronic auctions
- » 51 Information
- » 54133 Engineering services
- » 54142 Industrial design services
- » 5415 Computer systems design and related services
- » 5417 Scientific research and development services
- » 54161 Management consulting (30 percent)
- » 54183 Media buying agencies

Several notes are important here.

- » The information sector (NAICS 51) includes publishing, packaged software companies (such as Microsoft), movie and recording companies, broadcasting, telecom, web search, and information services such as news syndicates.
- » Electronic shopping could include everything from Amazon to Fab.com.
- » Computer systems design and related services includes custom computer programming services. Therefore, many app developers, web developers, and virtually any type of software-intensive tech startup could justifiably be assigned to this industry.
- » We take 30 percent of management consulting as reflecting IT consulting and implementation. The final results are not very sensitive to this percentage.
- » The BLS QCEW data, which we use, leaves out

the self-employed and proprietors. Consequently, our totals will undercount the true employment in industries with lots of startups. The wage figures include total compensation paid during the year, including bonuses and stock options.

» We tested an alternative definition that added in advertising as well. It made the sector larger without substantially changing its behavior.

OCCUPATION-BASED APPROACH

The industry approach gives us a consistent set of official job and wage numbers that can be tracked over time. For that reason, we have chosen to use the industry approach as our primary measure.

However, as noted above, the industry approach has many problems. In particular, neither finance nor health/education are part of our definition of the tech/information sector. That's disturbing, because, some of the biggest employers of tech workers in NYC are the financial firms, such as JP Morgan Chase, Citigroup, the investment banks, and the various hedge funds. Indeed, these companies in many ways are engaged in a technological arms race. Similar, many scientists in New York City, such as the ones doing medical research, are employed by the health and education sector.

To deal with these problems, we develop an alternative measure of “tech” for New York City that relies on an occupation-based approach. This methodology was originally developed by South Mountain Economics for tracking App Economy jobs.²¹ We use the database of online help-wanted ads from The Conference Board (known as HWOL) – which is updated daily – to track tech/information jobs in New York City.²² These ads contain very useful information on occupation, skills, and location of jobs. We benchmark the want ads to

national occupation data from the Bureau of Labor Statistics, and then perform validation procedures to make sure that the ads are accurately picking up the content and location of job.²³

Using this want-ad methodology, we are able to estimate New York City employment of

- » STEM workers in New York City
- » App Economy workers
- » Big Data workers

To assess STEM jobs, we tracked June 2013 want ads for computer and mathematical occupations, engineers and engineering technicians, life and physical scientists, and related technicians.²⁴ There are broader definitions of STEM jobs, but they did not seem appropriate for this study.²⁵

To estimate the other groups, we constructed sets of relevant key words, as described in the earlier paper. For example, keywords for App Economy workers include words and phrases such as iOS, Android, and “Facebook API.”

One important note: The industry figures presented earlier in this paper include both tech workers, such as software developers, and non-tech workers, such as marketing, legal, HR, and so forth. By contrast, the initial results that come out of the occupation-based approach just provide an estimate of the tech workers. To make the two numbers comparable, we use a rule of thumb that each tech workers supports or is supported by one non-tech worker in the same company.²⁶ This assumption was developed and supported in our previous studies.

ABOUT THE AUTHOR

Dr. Michael Mandel, president of South Mountain Economics LLC, is one of the country's leading experts in emerging occupations and emerging industries. In the 1990s, he was one of the first economists to identify the emergence of the tech-driven New Economy. In the 2010s, Mandel has focused on the emergence of the data-driven economy and the app economy, with more than 700,000 new jobs created.

Mandel is also chief economic strategist at the Progressive Policy Institute (PPI) in Washington, where he supervises PPI's research and policy work across a wide range of topics, including state and local policies to achieve a high-growth economy, the impact of regulation on innovation, and policies to improve production, investment and job growth. He is currently Senior Fellow at the Mack Institute for Innovation Management at the Wharton School at the University of Pennsylvania.

Mandel, who received a PhD in economics from Harvard University, formerly served as chief economist at *BusinessWeek* (now *Bloomberg BusinessWeek*), where he directed the magazine's coverage of the domestic and global economies. While there, Mandel was named one of the top 100 business journalists of the 20th century for his writings on innovation and growth. He received multiple awards for his work, including the Gerald Loeb Award for Business and Financial Journalism. He is the author of four books including *Rational Exuberance: Silencing the Enemies of Growth* and *Why the Future Is Better Than You Think*. Mandel grew up in Brooklyn, where his parents still live.

ENDNOTES

- 1 Bruce Katz and Jennifer Bradley, *The Metropolitan Revolution*, Brookings Institution Press, 2013.
- 2 For more on the data-driven economy, see Michael Mandel, "Beyond Goods and Services: The (Unmeasured) Rise of the Data-Driven Economy," Progressive Policy Institute, October 2012.
- 3 "Second Quarter 2013 Internet And Digital Media Jobs Index," August 7, 2013, Cook Associates.
- 4 Richard Florida, "America's Leading Metros for Venture Capital", June 17, 2013 <http://www.theatlanticcities.com/jobs-and-economy/2013/06/americas-top-metros-venture-capital/3284/>
- 5 "Exploring Venture Capital Investment in New York," Q2 Analysis, August 2013, NYCEDC.
- 6 "New York City's Tech Boom," Michael Moynihan, March 18, 2013 <http://www.nycedc.com/blog-entry/new-york-citys-tech-boom>
- 7 *New Tech City*, Center for an Urban Future, May 2012.
- 8 An important note: We identify some companies here, but as discussed in the appendix, it is actually impossible to know which industry a particular company is actually being listed under. Indeed, different government agencies might assign the same company to different industries.
- 9 See methodology appendix for a further explanation of this problem.
- 10 However, we do pick up tech-based manufacturing jobs in our occupation-based analysis of the New York City economy, discussed in a later section.
- 11 "3D Printing On The Rise In New York City," July 2013. New York City Economic Development Corporation.
- 12 This 2012 gain in the tech/information sector is larger than the 8,700 new tech jobs in 2012 reported by the New York City Economic Development Corporation ("Exploring Venture Capital Investment in New York, Q2 Analysis," August 2013).
- 13 Enrico Moretti, *The New Geography of Jobs*, 2012.
- 14 Indeed, the whole question of multipliers became a political football during the Washington debate over fiscal stimulus in the early years of the Obama Administration.
- 15 We thank The Conference Board for the use of its very important HWOL database here and in the next section. The Conference Board bears no responsibility for the conclusions and analysis.
- 16 For more details, see Michael Mandel, "Where the Jobs Are: The App Economy" (February 2012) and Michael Mandel and Judith Scherer, "The Geography of the App Economy" (October 2012). <http://southmountaineconomics.com/papers/> Please note: The App Economy estimates in these papers include both "indirect" jobs (non-tech supporting jobs within the same company) and "spillover" jobs (jobs generated in other parts of the economy). By contrast, the calculations in Table 10 include non-tech supporting jobs in the same company, but omit spillover jobs. We make this choice to make Figure 10 comparable with the industry-based approach used in this study.
- 17 For an early analysis of the dimensions of the tech sector, see Michael Mandel, "Just How Big is High Tech?" *BusinessWeek*, March 31, 1997.
- 18 Michael Mandel, "Where the Jobs Are: The App Economy" (February 2012) and Michael Mandel and Judith Scherer, "The Geography of the App Economy" (October 2012). <http://southmountaineconomics.com/papers/>
- 19 This well-known "data synchronization problem" arises because Census Bureau lists are partly based on tax return data, which cannot be shared with other agencies without legislation. See, for example, "General Explanations of the Administration's Fiscal Year 2014 Revenue Proposals," Department of Treasury, April 2013, p.235. See also Adrienne Pilot, "Data Synchronization: Leveraging Existing Business Data to Better Measure the Economy," *Amstatnews*, November 2011. <http://magazine.amstat.org/blog/2011/11/01/data-synchronizationscpolicy/>

ENDNOTES (CONT.)

- 20 As expected, our definition of the tech/information sector gives a substantially larger number of jobs than NYCEDC's definition of the tech sector, as reported on page 3 of "Exploring Venture Capital Investment in New York, Q2 Analysis," August 2013.
- 21 See "Where the Jobs Are: The App Economy" and "The Geography of the App Economy."
- 22 <http://www.conference-board.org/data/helpwantedonline.cfm>
- 23 A full description of this methodology can be found in "The Geography of the App Economy."
- 24 We followed, with some modifications, Appendix Table 1 from "STEM: Good Jobs Now and for the Future," from the Department of Commerce, July 2011
- 25 For example, Jonathan Rothwell of Brookings, in "The Hidden STEM Economy" (June 2013), argues for looking at jobs with STEM skills rather than STEM jobs.
- 26 This assumption is not related to the job multiplier of 0.5 discussed earlier in this study.