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U.S. App Economy Update

Dr. Michael Mandel
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About the author

Dr. Michael Mandel is chief economic strategist at the Progressive Policy Institute (PPI) in Washington. Dr. Mandel is currently Senior Fellow at the Mack Institute for Innovation Management at the Wharton School at the University of Pennsylvania. Dr. Mandel started two businesses: South Mountain Economics LLC, a consulting firm focusing on emerging occupations and emerging industries; and Visible Economy LLC, which produced news and education videos for the college market. Dr. Mandel is the author of four books, including *The High Risk Society* and *Rational Exuberance: Silencing the Enemies of Growth and Why the Future Is Better Than You Think*. His essentials-level economics textbook from McGraw-Hill, *Economics: The Basics*, is into its third edition. Dr. Mandel received a PhD in economics from Harvard University, and taught at New York University's Stern School of Business.

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INTRODUCTION

When Apple introduced the iPhone in 2007, that initiated a profound and transformative new economic innovation.

While central bankers and national leaders struggled with a deep financial crisis and stagnation, the fervent demand for smartphones was a rare force for growth. Today, there are four billion smartphone subscriptions, an unprecedented rate of adoption for a new technology.[1] Use of mobile data is rising at 55 percent per year, a stunning number that shows its revolutionary impact.[2]

More than just hardware, the smartphone also inaugurated a new era for software developers around the world. Apple's opening up of the App Store in 2008, followed by Android Market (now Google Play) and other app stores, created a way for iOS and Android developers to write mobile applications that could run on smartphones anywhere.

The iPhone and the App Store were the beginnings of a global App Economy: an army of app developers writing mobile applications for billions of users. For the most part, these developers are not hobbyists writing games in their basements. Instead, as more and more

people are linked to the Internet through their smartphone and mobile data connections, mobile apps have become an essential way for businesses, nonprofits, and governments to interact with their customers, members, and citizens. (Indeed, data shows that people spend most of their internet time interacting with apps).

> Use of mobile data is rising at 55 percent per year, a stunning number that shows its revolutionary impact.

Moreover, the long-term growth prospects of the App Economy are still strong. Yes, the great surge of new game, media, and ecommerce apps is probably close to its peak. However, the rise of the Internet of Things means that more and more objects and physical processes will be connected to the Internet.

Increasingly, individuals will be using mobile apps as their interface to their home, travel, entertainment, car, schools, health providers, and state and local governments. Employees in many enterprises are using mobile apps to monitor or control work processes. These apps will be highly functional and sophisticated, serving an essential role in interacting with our environment.

THIS PAPER

Building on previous work, this paper examines the number of jobs created by the App Economy in the United States. Our first estimate of App Economy employment in the United States was issued in February 2012, based on fall 2011 data.[4] This figure of 466,000 was widely reported in the media at the time.[5] We then published additional estimates in October 2012; July 2013, which coincided with the fifth anniversary of the launch of the Apple App Store; and January 2016.[6]

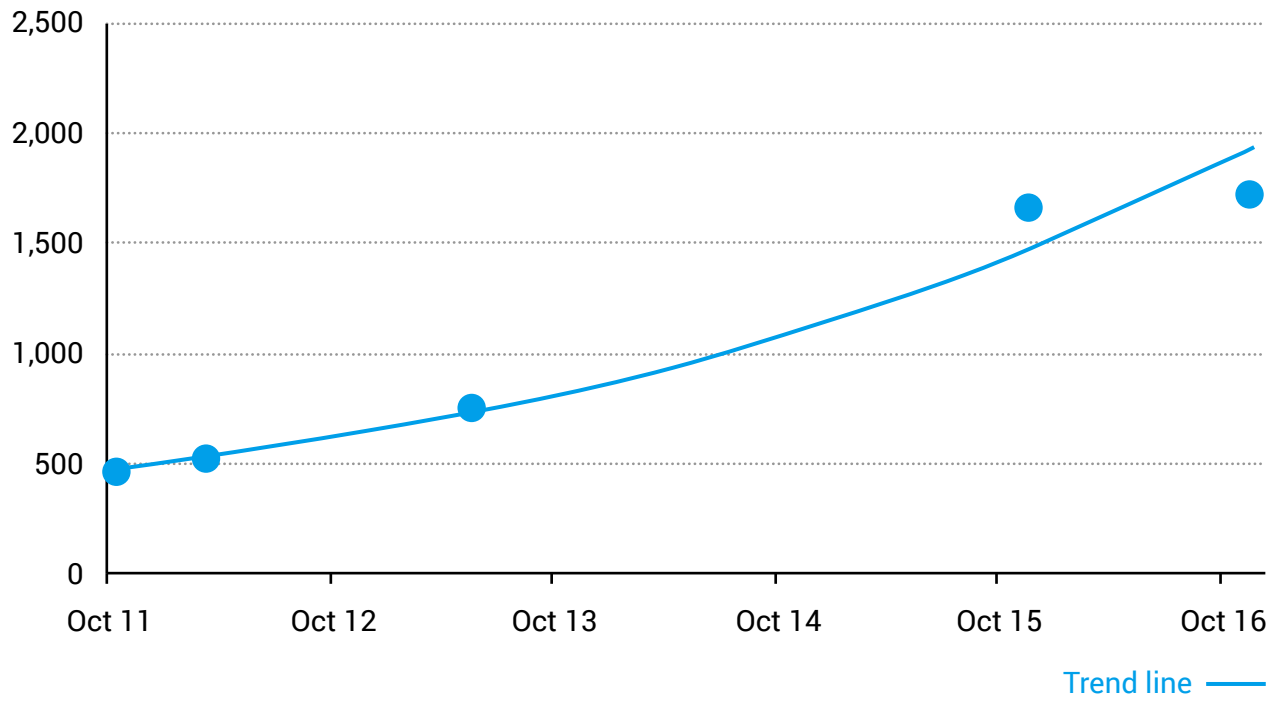
In this paper we update our most recent release, and estimate that App Economy employment in the U.S. totaled 1.729 million as of December 2016 (Table 1). In other words, by our estimate, the number of App Economy jobs in the United States has nearly quadrupled over the past five years, growing at a 30 percent annual rate (Figure 1).

TABLE 1: The U.S. App Economy

Total U.S. App Employment	Average annual growth since fall 2011
1.729 million Jobs	30% per year

Data: Progressive Policy Institute, Indeed, public job postings

FIGURE 1: U.S. App Economy Employment Over Time (thousands of jobs)



Data: South Mountain Economics, Progressive Policy Institute, Indeed, The Conference Board

This stunning growth in App Economy employment roughly parallels the growth in the number of iOS and Android apps, which have more than quadrupled over the same period. Meanwhile, consumers spend vastly more time on their smartphone apps today than they did in 2011.

In addition, this paper estimates the breakdown of App Economy employment by operating system, comparing the number of jobs in the iOS ecosystem with the number of jobs in the Android ecosystem. Finally, we provide a ranking of the top 25 App Economy states in the country, starting with California, New York, and Texas at the top, with states such as Missouri, Tennessee, Wisconsin, Indiana, and Utah.

CONTEXT

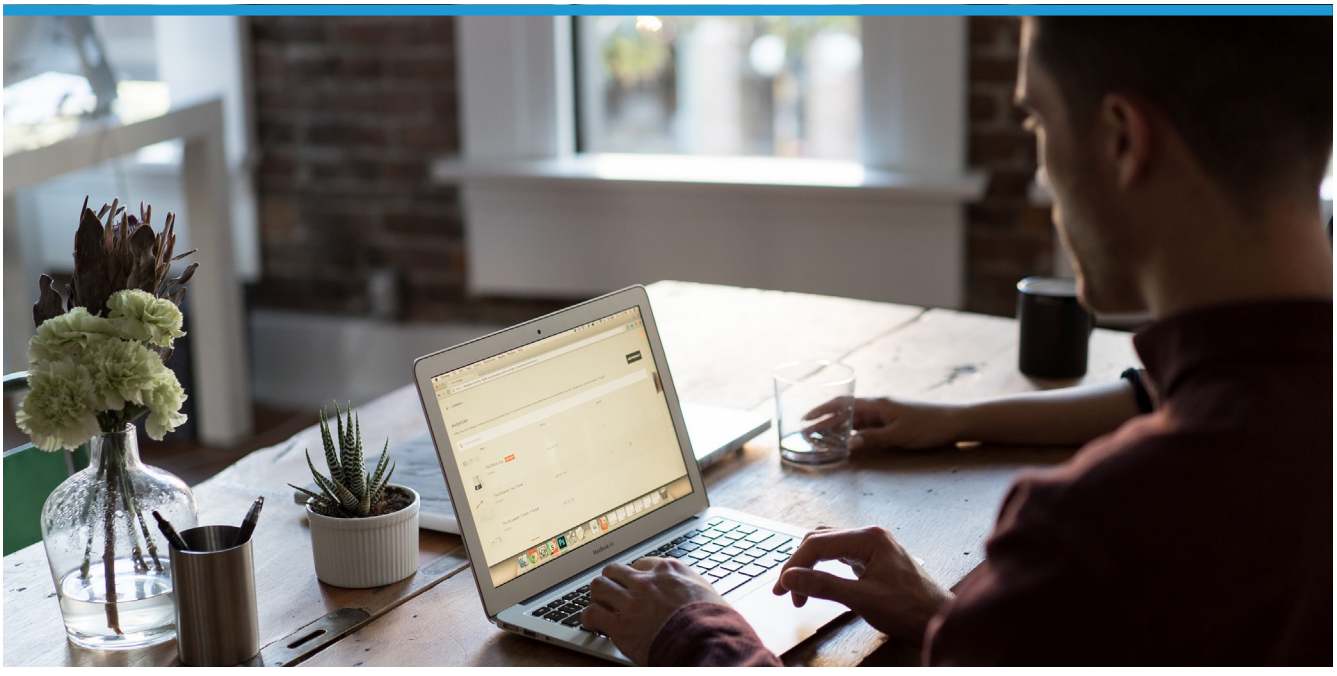
In this paper we focus on App Economy employment in the United States. However, this paper is part of a larger research project examining App Economy employment in different countries and regions, including the European Union, Japan, Australia, Mexico, Argentina, Colombia, Vietnam, Indonesia, and China.

There are several reasons we have focused on App Economy jobs. First, the invention of the smartphone was one of the two most important technological innovations over the past decade, from the perspective of economic impact, so it's natural to want to know how many jobs it is creating.[7] These are not numbers that can be found in government statistics, which typically have trouble capturing the impact of new technologies.

The App Economy, because it doesn't fit neatly into the old economic paradigms, is particularly hard for traditional government statistics to measure. For example, statistical agencies that count exports have no category in trade statistics for the revenues generated by the export of domestically-created apps to other countries, even though these revenues may be very significant. Indeed, statisticians may not be counting these exports at all.[8]

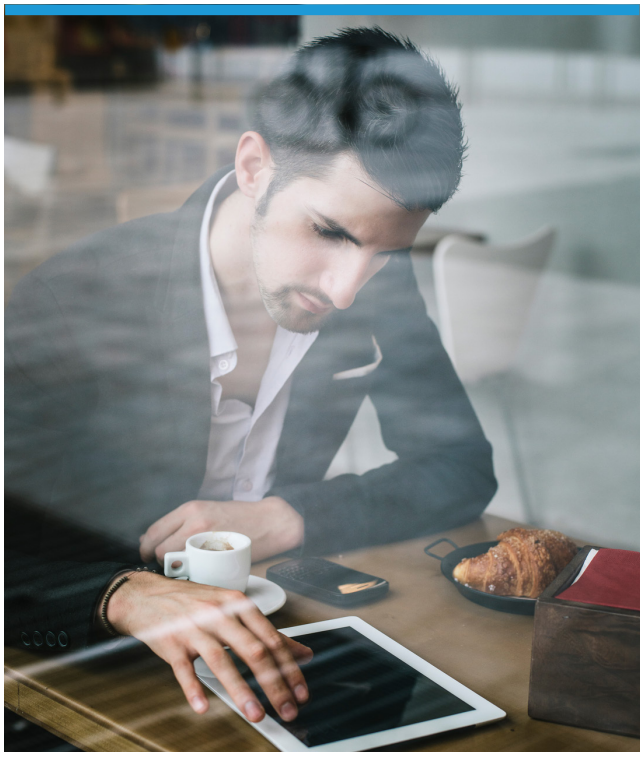
> The App Economy, because it doesn't fit neatly into the old economic paradigms, is particularly hard for traditional government statistics to measure.

The other reason we have focused on App Economy employment has to do with the broad ongoing debate about the link between technological innovation and jobs. There's a pervasive worry, especially in the aftermath of the financial crisis, that new technologies destroy jobs without creating very many new ones.[9] So we see reputable business publications like *Fortune* and the *Wall Street Journal* run articles with titles like "Silicon Valley Is Not a Job Creator" and "Wireless Jobs Evaporate Even As Industry Expands."[10,11]



Unfortunately, government economic statistics are much better at tracking the reduction of existing jobs than identifying the growth of new types of jobs. For reasons of both budget limitations and inertia, it takes years for new occupations to get their own categories in the employment statistics, if it ever happens at all. For example, the term "Web developer" was only added to the Standard Occupational Classification in 2010. However, the term was in common use at least as early as 1995, when visitors to the official White House Web page were invited to send emails "to the White House Web developers and maintainers."[12]

This lack of data made it harder to measure the employment impact of the Internet and the New Economy. Equally important, without being able to track new jobs, it's impossible to figure out if policies are succeeding or failing. Without data—specifically data about the contribution of the App Economy to individual countries—policy makers in Hanoi, or Berlin, or Washington can't make the right decisions.



MEASURING THE APP ECONOMY

The economic impact of the App Economy can be characterized by various metrics. One important metric is the total revenue flowing through the various app stores, both globally and nationally. One report pegs global app revenues at $45 billion in 2016, with the Asia-Pacific market accounting for 56 percent of that.[13] A related metric is the revenue per app, which measures the value to developers. By some reports, "the average iOS download now generates four times the revenue for developers compared to Google Play."[14]

However, the revenue metric, while important, far understates the full economic impact of the App Economy. Many heavily-used apps from non-game companies, nonprofits, and governments are free to download and have no in-app purchases, meaning they generate no revenues on an app store. For example, Facebook Messenger has 1 billion users worldwide, according to Facebook. But, as a free app, it generates no revenue through the App Store or Google Play. Similarly, visitors to Washington, D.C., can download a variety of free apps that help in navigating the local transit system. These apps generally provide no revenue, but do provide benefits for their users.

Moreover, the revenue numbers for the app stores tell you where apps are generating revenue, but not where they are produced. Most game developers have operations around the world. For example, Gameloft—a company that makes games for iOS, Android and other platforms—is headquartered in Paris. However, it has offices in 18 countries and was advertising in October 2016 for game designers in locations

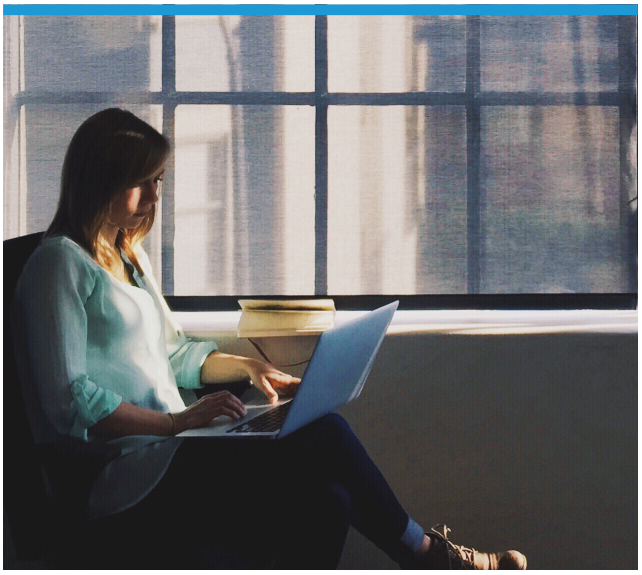
such as Mexicali (Mexico), Lviv (Ukraine), and Da Nang (Vietnam). The Da Nang location was established in 2010 and now has almost 500 employees. It would be misleading to attribute all of Gameloft's app revenue to France.[15] Similarly, a non-tech company like Walmart or BMW that offers an app may develop it internally, or hire an app developer anywhere around the world.

> The Da Nang location was established in 2010 and now has almost 500 employees.

For these reasons, we have chosen to use employment as our preferred metric for measuring the economic impact of the App Economy. Our methodology (described in the Appendix) is based on analyzing databases of online job postings. These job postings typically contain information about the skills required for the job and the location of the job. We are then able to search for jobs that require App Economy-related skills, such as knowledge of iOS or Android. In this way we can develop an estimate of App Economy jobs by country and region.

This methodology uses what is known as "organic data." As opposed to economic data collected by government statisticians using special surveys, organic data is generated by organizations in the course of doing normal business. For example, economists have successfully used the prices posted by retailers on their websites to estimate the inflation rate without the need to do the usual monthly survey of businesses.[16]

Our methodology for using online job postings to estimate the size of the App Economy was originally introduced in 2012, in a widely-quoted paper that reported the first estimate of U.S. App Economy jobs.[17] In December 2015 we extended



and standardized the original methodology so it could be applied to a wide variety of countries, languages, and economic environments. Our goal was to produce a set of globally-consistent and credible estimates for App Economy employment by individual countries, broad geographical regions, and, where possible, by the largest cities.

DEFINING THE APP ECONOMY

For this study, a worker is in the App Economy if he or she is in:

- An IT-related job that uses App Economy skills—the ability to develop, maintain, or support mobile applications. We will call this a **"core" app economy job.** Core app economy jobs include app developers; software engineers whose work requires knowledge of mobile applications; security engineers who help keep mobile apps safe from being hacked; and help desk workers who support use of mobile apps.
- A non-IT job (such as sales, marketing, finance, human resources, or administrative staff) that supports core app economy jobs in the same enterprise. We will call this an **"indirect" app economy job.**

- A job in the local economy that is supported either by the goods and services purchased by the enterprise, or by the income flowing to core and indirect app economy workers. These **"spillover"** jobs include local professional services such as bank tellers, law offices, and building managers; telecom, electric, and cable installers and maintainers; education, recreation, lodging, and restaurant jobs; and all the other necessary services. We use a conservative estimate of the indirect and spillover effects, as discussed in the Appendix.

EXAMPLES OF APP ECONOMY JOBS

Core App Economy Jobs

App Economy workers are widely distributed across the U.S. economy, both geographically and in terms of industries. Of course, top tech firms such as Apple, Google, Amazon and Facebook hire hundreds of workers with expertise in building and maintaining mobile applications and the underlying infrastructure. Mobile game companies, too, need developers with a deep knowledge of iOS and Android.

But those jobs are just the very tip of the iceberg. The App Economy has steadily expanded. Retailers such as Target, Walmart and Best Buy use apps as an essential channel for reaching consumers. Media and entertainment companies such as Disney and ESPN develop apps to deliver content right to consumers. Financial companies such as JPMorgan Chase and Bank of America develop apps as an essential part to their strategy to offer new services and to wean consumers and businesses away from expensive bank branches. Moreover, these apps have to be continually maintained and updated by app developers to keep them secure.

Airlines and other transportation companies cannot afford to be without apps these days. Neither can automakers such as GM and Ford, who are hiring app developers at a rapid pace to help them gain a foothold in the market for connected cars. Indeed, Michigan has almost as many job openings for app developers these days as for machinists.[18] And of course, the military and intelligence agencies are big hirers of App Economy talent.

Both startups and large companies are creating App Economy jobs at a rapid pace. For example, as of April 2017, Pager, a health tech startup in New York City, was looking for a senior IOS software engineer. Foursquare, founded in 2009, was looking for an Android and an iOS engineer in New York as well. In Ann Arbor, Interaction Gaming, founded in 2016, was looking for an IOS mobile developer to help with mobile apps for the lottery industry.

At the other end of the size scale, Verizon posted a position for a Senior iOS Developer in Alpharetta, Georgia. Allstate, the giant insurance company, was hiring for a senior iOS developer in Northbrook, Illinois. Charter Communications was looking for an Android Mobile Application Developer in St. Louis, MO. JP Morgan Chase was posting for a Mobile Application QA Developer in Columbus, Ohio.

Media and retail companies need high-quality mobile apps in order to survive. As of April 2017, Target was looking for a senior Android engineer in Brooklyn Park, Minnesota, outside of Minneapolis. Showtime was looking for an iOS/tvOS Developer in New York City. In Austin, Texas, Cox Automotive, which owns brands such as Kelley Blue Book and Autotrader, was looking for a senior mobile software engineer to build iOS apps. Rue La La, a Boston-based

ecommerce leader, was looking for a senior iOS developer. Papa John's, the national pizza chain, was looking for an iOS developer in Louisville, KY, who was willing to tackle new devices such as connected vehicles and wearables. New Balance was posting for a mobile architect to join its ecommerce division in St. Louis, Missouri.

The federal government, the Department of Defense and intelligence agencies are also major sources of demand for App Economy jobs. For example, as of April 2017, Ball Aerospace was looking for a "Software Developer-Mobile Apps" in Dayton Ohio who was able to get a Department of Defense security clearance. And the NSA, of course, was advertising for a mobile applications developer who would contribute to both "Computer Network Defense" and "Computer Network Exploitation."

Probably the fastest growing sector of the App Economy is the Internet of Things, which is the application of information technology . As of April 2017, John Deere was looking for a mobile application developer in Urbandale, Iowa, outside of Des Moines. DuPont Pioneer was looking for a mobile architect in Johnston, Iowa. Cricut, a maker of personal electronic cutting machines, was posting for a Senior Android Mobile Engineer in South Jordan, Utah. Emerson, a Fortune 500 company, was looking for a senior engineer experienced with iOS and Android to join its operations in St. Louis, MO. ForeFlight , which produces apps for pilots and operators, was looking for an iOS mapping developer in Portland Maine. Of course, as the posting suggested, "a pilot-coder, or individual looking to pursue his or her private pilot license, is a plus."

The App Economy is becoming a crucial part of security and support. In April 2017, Ernst & Young was searching for a senior security consultant for mobile and infrastructure, based out of Alpharetta, GA. Yudrio was looking for a Mobile Device Security Analyst

in Reston, Virginia. And Bluegrass Cellular, in Elizabethtown, Kentucky, was looking for a helpdesk support coordinator with "exceptional knowledge" of Android and Apple email and browsing systems.

Social and religious organizations are investing in mobile apps as well. OkCupid, the dating website, was looking to hire a Senior iOS Engineer in New York City to help attract more daters. Life.Church in Edmond, Oklahoma, was looking for an iOS software engineer to help build and maintain bible apps.

And then of course the auto industry has embraced the connected car with a vengeance. Ford Motor Company was looking for "innovative and highly skilled iOS Mobile Development Engineers" to join its Advanced Mobile/ Embedded Apps team in Dearborn, Michigan. Meanwhile Systems Technology Group was hiring for fifty available positions for iOS or Android developers for a "large Fortune 500 Automotive firm" in Michigan. This is the wave of the future.

Indirect App Economy Jobs

App developers do not work in a vacuum. Other workers at the same enterprise generally support them. These positions include the sales and marketing staff; human resources, financial and legal professionals; and the office and administrative staff.

When we examine the distribution of occupations in software-related industries, we find that employees in computer and statistical occupations represent roughly half the workforce.[19] In other ways, each tech occupation job in an enterprise is associated with roughly one other non-tech job. We use that as our multiplier for indirect App Economy jobs within an enterprise. In other words, the data is consistent with an assumption that each App Economy job created adds another job at the same enterprise.

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Spillover Jobs

How much impact does the creation of a core App Economy job have on the broader economy? This is a very important question, since we want to know whether the benefits of the App Economy spread out to the parts of the workforce that are not necessarily technically trained.

Typically, economists who study economic development distinguish between Type 1 and Type 2 "multiplier effects." Type 1 multiplier effects refer to the additional jobs created by increased purchases by the enterprise hiring the App Economy worker. Type 2 multiplier effects refer to the additional jobs created because the newly hired App Economy worker is spending more in the area. So, if a mobile game development firm purchases additional services and goods from local law firms and office suppliers, that's a Type 1 multiplier. If the game company's workers go home and make appointments to have dental work at the local dentist, that's a Type 2 multiplier.

A review of the existing literature, including the employment requirements tables put together by the Bureau of Labor Statistics, suggests that the Type 1 multiplier effect from an additional job at a software company is likely to have a broad impact across the whole service sector.[20] That means more jobs at local healthcare and

education institutions, professional services firms, building management, entertainment, culture, financial institutions, real estate, retailers, hotels, and restaurants. So we would expect a broad increase in service sector employment as a spillover effect from the expansion of the App Economy, including a wide range of occupations. That might include demand for additional commercial real estate brokers, for example, as growing companies need more space.

We want to be conservative about the size of the spillover multiplier for the purposes of this paper. Therefore, we assume that each core App Economy job generates one indirect job in the same enterprise and one spillover job in the rest of the economy, with the benefits accruing to a wide range of occupations.

Our assumptions for the size of the spillover effect are quite conservative. For example, the Center for Automotive Research, in a study done for Alliance of Automobile Manufacturer, estimated that every new job in the automobile industry generated 3.7 additional jobs in the rest of the economy.[21] Another analyst estimated that each job in the software publishing industry generated 3.3 jobs in rest of the economy.[22] However, our use of a low multiplier increases our confidence in the final result.

RESULTS

We estimate that total App Economy employment in the United States was 1.729 million as of December 2016. This includes core App Economy jobs, indirect App Economy jobs, and a conservative estimate of spillover jobs. Because of the nature of the methodology, the figure does not include hobbyists or the smallest companies.

TABLE 2: Estimates of App Economy Jobs over Time

DATE OF ESTIMATE	DATE OF PUBLICATION	APP ECONOMY JOBS, THOUSANDS
FALL 2011	FEBRUARY 2012	466
APRIL 2012	OCTOBER 2012	519
JUNE 2013	JULY 2013	752
DECEMBER 2015	JANUARY 2016	1,660
DECEMBER 2016	MAY 2017	1,729

Data: South Mountain Economics, Progressive Policy Institute, The Conference Board, Indeed, BLS

Note that, over the past five years, App Economy jobs have grown at an annual rate of roughly 30 percent. This growth rate in App Economy jobs is roughly in the same ballpark as other measures of app growth, such as the number of apps in the various app stores and consumer usage of apps. For example, from the fourth quarter of 2012 to the fourth quarter of 2014, Nielsen reports that time spent on apps increased at an average annual rate of 28 percent.[23]

> Note that, over the past five years, App Economy jobs have grown at an annual rate of roughly 30 percent.

To see just how far the App Economy has outperformed the rest of the economy, just take a look at Table 3. We see that the average five-year growth rate for all occupations is 1.6 percent. Employment in management and professional occupations has risen at a 2.5 percent rate, with the number of people working in computer and mathematical occupations rising at a 4.9 percent rate.

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In other words, the App Economy is one of the most dynamic parts of the economy in terms of adding jobs, but conventional statistics don't pick up these gains.

TABLE 3: Five-year growth rate of employment, Fall 2011-Fall 2016

	5-YEAR GROWTH RATE
ALL OCCUPATIONS	1.6%
MANAGEMENT AND PROFESSIONAL OCCUPATIONS	2.5%
COMPUTER AND MATHEMATICAL OCCUPATIONS	4.9%
APP ECONOMY JOBS	30.0%

Data: BLS, Progressive Policy Institute

OPERATING SYSTEM

The two major smartphone operating systems today are iOS and Android. Employers looking for App developers often specify in which operating system or systems they want their hires to have expertise. This enables us to assign jobs to either the iOS ecosystem or the Android ecosystem, or both.[24]

Table 4 shows the distribution of App Economy jobs by mobile operating system.

TABLE 4: App Economy Jobs by Operating System

	DECEMBER 2016 (THOUSANDS)
ALL APP ECONOMY JOBS	1,729
iOS ECOSYSTEM	1,530
ANDROID ECOSYSTEM	1,353

Data: Progressive Policy Institute
Note that the iOS and Android numbers add up to more than the total, because many App Economy jobs belong to both ecosystems.

LOCATION

Generally, job postings have to contain the location of the position. In particular, we can identify the state where the position is located.

Table 5 below lists the top 25 App Economy states, along with the number of App Economy workers.

TABLE 5: The Top 25 App Economy States, December 2016

		THOUSANDS OF JOBS
01	CALIFORNIA	419.1
02	NEW YORK	135.6
03	TEXAS	118.6
04	WASHINGTON	91.6
05	MASSACHUSETTS	73.6
06	ILLINOIS	72.3
07	VIRGINIA	67.0
08	FLORIDA	65.8
09	GEORGIA	51.0
10	NEW JERSEY	47.7
11	PENNSYLVANIA	46.1
12	OHIO	45.9
13	MICHIGAN	39.2

		THOUSANDS OF JOBS
14	NORTH CAROLINA	37.9
15	MINNESOTA	37.7
16	MARYLAND	36.5
17	COLORADO	31.8
18	ARIZONA	24.7
19	DISTRICT OF COLUMBIA	24.2
20	OREGON	21.9
21	MISSOURI	18.5
22	TENNESSEE	18.0
23	WISCONSIN	17.6
24	INDIANA	17.1
25	UTAH	15.6

Data: Progressive Policy Institute

We note that the order of this table is very similar to the table we published in January 2016.[25] California, New York, and Texas are still at the top of the list, although New York's number is somewhat lower because we made a slight tweak to the methodology to eliminate some spurious jobs. Washington has jumped from #10 a year ago to #4, most likely on the strength of Amazon's hiring of App Economy workers. Finally, note the large number of Midwestern states in the top 25.

CONCLUSION

There's an ongoing debate about whether the tech boom is generating enough jobs, and what kind. This debate has been hindered, in part, by a lack of good data. The categories used by government statisticians to track tech industries are too old to correctly pick up the growth in tech-related activities.

In this paper we have focused on one important slice of the tech boom: the jobs related to the development, maintenance, and support of mobile applications. We showed that starting from nothing in 2007—before Apple released the first iPhone—there are now more than 1.7 million jobs in the App Economy. Moreover, these jobs are distributed across the country and across industries.

> Apple released the first iPhone in 2007—there are now more than 1.7 million jobs in the App Economy.

These results directly address the question of job creation by the tech sector. Indeed, we see that the investments tech and telecom companies have made in the operating systems for smartphones, in the hardware for smartphones, and in the mobile networks have paid off with job growth, not just in the US, but around the world.

Methodology Appendix

Even today, most studies of job creation rely on government-generated survey data. To estimate the size of App Economy employment, however, requires an innovative methodology based on "organic data." Organic data is generated by organizations in the normal course of doing business. In the past, organic data was not easily accessible to analysts. However, much more data is available on a consistent basis.

Our methodology for estimating the number of App Economy jobs uses the continually updated database of online job postings put together by Indeed.com. Indeed bills itself as "the world's #1 job site, with over 200 million unique visitors every month from over 60 different countries."[26] Using Indeed, we can search for online job postings containing specific key words and phrases.

In this Appendix, we will describe how the baseline December 2015 estimate (published January 2016) was calculated. Then we will describe how the December 2016 update was constructed.

DECEMBER 2015 BASELINE ESTIMATE

To estimate the number of core App Economy jobs in December 2015, we used a multi-step procedure based on data from the universe of online job postings. Our first observation is that online job postings typically describe the skills and knowledge being sought by the employer. For example, if a job posting requires that the job candidate have experience developing apps for iOS—the iPhone/iPad operating system—then we can reasonably conclude the posting refers to a core App Economy job.

In practice, we compiled a short list of key words and phrases that would generally be associated with App Economy-related skills. These included iOS, Android, Blackberry, Windows Phone, Windows Mobile, and app. We applied these search terms to the real-time database of job postings developed by Indeed, which gave us an unadjusted count of job postings for core App Economy jobs.

However, that's only the start. Job postings for an occupation are only a fraction of the number of people employed in that occupation, since most positions are not empty.[27] We develop an estimate for the ratio between the number of job postings for tech jobs and overall tech employment.[28] This ratio is applied to the number of App Economy job postings to generate a provisional estimate of core App Economy employment. Crucially, we used a validation procedure to ensure we are actually counting job postings that correspond to core App Economy jobs.

How do we tell which jobs require App Economy skills? The key is to look at help wanted ads—also called job postings—where enterprises actually describe the skills and knowledge they are looking for. The heart of the analysis is the list of key words and phrases generally associated with App Economy-related skills. In previous studies we have built up extended keyword lists. However, because we intend this analysis to be repeatable across a wide range of countries, we simplified the search terms.

THE METHODOLOGY CONSISTED OF SEVEN DISTINCT STEPS.

1. Identification of App Economy job postings

Using summary statistics generated by searches on indeed.com, we identified job postings ads for App Economy jobs containing one of the following key words: iOS, Android, Blackberry, Windows Phone, Windows Mobile and app.

2. Validation

Invariably, some job postings identified in Step 1 will not fit the criteria of an App Economy worker (e.g. a job posting for a truck driver using an app). We therefore validated the sample by manually examining a sample of the job postings from Step 1 to eliminate those that do not fit our criteria of an App Economy worker. This allows us to estimate a validation ratio that we applied to the results of Step 1.

3. Identification of IT job postings in the United States, and estimation of the ratio of job postings to employment for overall IT occupations

We constructed a keyword list to identify job postings for IT occupations in the U.S. This included a core list of English words and phrases commonly found in job postings for IT occupations (such as "java" and "database" and "app").

We then validated the outcome using the same methodology as Step 2, manually examining a sample of job postings to assess which actually correspond to IT occupations. Then the resulting number was used to estimate the ratio of job postings to employment for overall IT occupations.

4. Estimation of App Economy core jobs for the United States

We multiplied the ratio generated in Step 3 and the validated number of App Economy job postings generated in Step 2. The result gave us the estimate of core App Economy jobs for the United States in December 2015.

5. Estimation of total App Economy employment for the United States

Using the same multipliers as in our previous work, we estimated the total number of App Economy jobs in the United States. We assumed that each core App Economy job is supported by one job-equivalent at the same company (e.g. managers, human resources, accounting). Then we assume that each company job generates one job in the rest of the economy. This is a very conservative assumption for spillovers.

6. Estimation of the total employment in the iOS and Android ecosystems in the United States

Out of the set of job postings containing the terms "iOS" or "Android", we identified the share that contain terms belonging to the iOS ecosystem (Apple, iPad, iPhone, iOS) and the share belonging to the Android ecosystem (Android, Google). Then those shares were applied to all App Economy employment.

7. Estimation of App Economy employment by states

The Indeed database enabled us to identify App Economy job postings by state. We therefore could rank states by App Economy employment.

DECEMBER 2016 UPDATE

Organic data, such as online job postings, are produced by organizations in their normal course of business. As such, these organizations have an incentive to make sure their data reflects the realities of the economy as soon as possible. That means organic data are continuously improving, making them a wonderful tool for studying emerging occupations. By contrast, it can take a decade or more for government statisticians to update the official statistical categories to match the realities of the economy.

But there's a downside to this business-driven urge for improvement: The organizations that generate the data have no incentive to keep it consistent over time. Quite the contrary, if organizations see a way of changing or rearranging their data to better improve its usefulness for customers, they will do that, even if it breaks the statistical continuity over time.

For example, a job site such as Indeed collects its data from multiple job boards and companies. If a new job board opens up, that has the potential to increase the count of reported job postings, even though nothing fundamental has changed in the labor market.

As a result, tracing organic data over time can be misleading unless appropriate care is taken. In this case, we will use the "job trends" data produced by Indeed, which, for any set of keywords, gives a consistent estimate over time of the share of job postings fitting those criteria compared to all job postings.[29]

We then use the job trends data to estimate the percentage increase in the total number of core App Economy jobs over time, as well as the percentage increase in the size of the iOS and Android ecosystems. We then apply those percentage increases to the December 2015 App Economy estimates in order to derive the December 2016 estimates. In other words, we estimate the rate of growth, and then use that rate of growth to estimate the level a year later.

Notes

1 "Ericsson Mobility Report: Interim Update," February 2017, https://www.ericsson.com/res/docs/2016/mobility-report/emr-interim-february-2017.pdf

2 Ibid

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10 "Silicon Valley Is Not a Job Creator," Fortune, December 4, 2015. http://fortune.com/2015/12/04/silicon-valley-is-not-a-job-creator/

11 "Wireless Jobs Evaporate Even as Industry Expands," Wall Street Journal, July 17, 2011. See my analysis at https://innovationandgrowth.wordpress.com/2011/07/24/misinterpreting-data-how-the-wsj-got-the-wireless-jobs-story-wrong/

12 White House, (1995). "Send mail to the developers," https://clinton1.nara.gov/White_House/Mail/html/Mail_Developers.html, downloaded November 3, 2016.

13 "App revenue to hit $81B by 2020," Mobile World Live, October 6, 2016. http://www.mobileworldlive.com/apps/news-apps/app-revenues-to-hit-81b-by-2020/

14 "Apple's iOS App Store now generating 4x revenues per app vs Android Google Play," AppleInsider, July 19, 2016. http://appleinsider.com/articles/16/07/19/apples-ios-app-store-now-generating-4x-revenues-per-app-vs-android-google-play

15 Unfortunately, it is common for analysts to attribute all economic benefits of app development to the home country of the app developer. For example, a 2016 report, "Winners & Losers in the Global App Economy" (Caribou Digital) tried to identify flows of app-related trade by looking at a large sample of top apps in each market, and then identifying the city and country location for the developer. However, they explicitly assumed that, "for larger firms with multiple offices, the headquarters location was selected" as the location of production (Page 15). This assumption is like treating all of GE's $120 billion in global revenues as if it was produced in Connecticut, simply because that is where the company is headquartered.

16 Rigobon, R. and Cavallo, A., (2016) "The Billion Prices Project: Using Online Prices for Inflation Measurement and Research," Journal of Economic Perspectives, Vol 30(2):151-78.

17 Michael Mandel, "The App Economy: Where the Jobs Are," February 2012, South Mountain Economics LLC.

18 As of the end of April 2017, there were roughly 290 job postings in Michigan that contained the words "mobile", "iOS", or "Android" in their title. At the same time, there were roughly 350 job postings with the word "machinist" in their title.

19 In particular, we looked at the distribution of occupations in NAICS codes 5415, 5112, and 519. See index here https://www.bls.gov/oes/current/oessrci.htm#54

20 The employment requirements tables of the BLS show "the employment generated directly and indirectly across all industries by a million dollars production of a given industry's primary product." https://www.bls.gov/emp/ep_data_emp_requirements.htm

21 Center for Automotive Research, 2015, "Contribution of the Automotive Industry to the Economies of All Fifty States and the United States"

22 See, for example, EMSI, "Job Multipliers: Silicon Valley vs. The Motor City," August 31, 2012, http://www.economicmodeling.com/2012/08/31/job-multipliers-silicon-valley-vs-the-motor-city/

23 "So Many Apps, So Much More Time For Entertainment," Nielsen (June 11, 2015). http://www.nielsen.com/us/en/insights/news/2015/so-many-apps-so-much-more-time-for-entertainment.html

24 Adding in the Blackberry and Windows Mobile operating systems does not change the result significantly.

25 http://www.progressivepolicy.org/blog/app-economy-jobs-part-2/

26 https://www.indeed.com/about We thank Indeed for the use of the data it collects. Indeed bears no responsibility for the content in this paper.

27 For example, the Indeed database, as of late December 2015, contained roughly 390,000 job postings for the search "'registered nurse' or RN". That's compared to an estimated employment of 3 million registered nurses, for a ratio of one job posting for roughly every eight jobs.

28 The ratio in the U.S. was roughly one tech job posting for every nine tech jobs in 2015. Our work shows that this ratio varies by country, as one would expect. In addition, this ratio would vary by broad occupation, depending on the hiring practices in that occupation.

29 https://www.indeed.com/jobtrends

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Progressive Policy Institute
1200 New Hampshire Ave NW,
Suite 575
Washington, DC 20036

Tel 202.525.3926
Fax 202.525.3941

info@ppionline.org
progressivepolicy.org