For AAG 2015 workshop on Geographies of Production in Digital Economies of Low-Income Countries

"Locating digital production: How platforms shape participation in the global app economy"

Bryan Pon (bryan@caribou digital.net)
Caribou Digital

The app economy continues to grow in scale and economic value, with millions of app developers and estimated revenues of $87 billion in 2014.[1] Despite the potential for accessible economic opportunities for producers—digital goods such as apps can be produced (and consumed) almost anywhere, and the online marketplaces or "app stores" provide convenient distribution options for reaching consumers worldwide—participation in the formal app economy is still highly skewed, with most of the value creation and value capture occurring in the industrialized countries. While much of this unevenness simply reflects (and reinforces) the evolution of knowledge-intensive technology development and infrastructure, it is also the result of platform strategies by the two major platform firms—both of whom are based in Silicon Valley—whose governance policies shape participation and value capture. Using primary data on the location of 2,688 commercially successful app developers worldwide, this paper maps participation and contextualizes it within this new industry structure. The resulting analysis highlights three key ways in which these technologically space-less platforms are anchored in places and geographies. First, the location of successful developers shows that production is highly concentrated in the United States and East Asia, with signs of agglomeration in four major metropolitan areas. Second, the degree of participation is in some cases established at the country level, requiring agreement between nation-states and platform owners, and can result in de facto exclusion for those populations. And third, the nationalized structure of the app stores offers an advantage to local producers in smaller markets, but is insufficient to outweigh the winner-take-all dynamics and platform strategies that are increasingly favoring the larger and better-resourced developers.

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[1] ACT/App Association, "State of the App Economy 2014"

Introduction

The shift to mobile-based internet and computing is happening quickly, and in multiple forms.[2] There are now about 2 billion smartphones in use, more than the installed base of PCs.[3] By 2020, the number of smartphone connections is expected to grow to 6 billion, and 4 out of 5 of those will be in the developing world.[4] Much of the value of smartphones is based on their ability to access the internet and run packaged software "apps" that provide a wide range of utility and entertainment services. With billions of new users gaining access to these devices, the "app economy"—characterized as the buying and selling of apps through virtual "app stores"—has become an increasingly visible and financially important sector of the global economy, with revenues of approximately $87 billion in 2014.[5]

This new market may offer improved economic opportunities to a range of digital producers. For example, compared to the PC software industry, mobile app development has lower barriers to entry in terms of lower licensing costs, more accessible programming languages, and more powerful developer tools that facilitate programming.[6] Perhaps more important, however, is that apps are produced, distributed, and consumed entirely digitally; a producer of apps can build her product almost anywhere, sell to a consumer located almost anywhere, and receive financial payment, all through the transmission of bytes of data over the internet and telecommunications networks. The result is an increasingly complex, global network of "digital flows" as apps, content, and finance are uploaded and downloaded in bi-directional, one-to-many and many-to-one flows of digital data.[7]

Despite the technologically frictionless, borderless nature of the digital flows, the app economy is not an unregulated market. The vast majority of these flows of data and money are channeled through proprietary app stores, which are owned and managed by the major smartphone platform firms. These firms—especially Google and Apple, whose operating systems have captured 80% and 16% of the global market, respectively—have created market structures and processes that determine how producers and end-users can participate and capture value within the platform ecosystem. These market structures enable some producers, for example, to overcome their own marginalized geography by providing access to lucrative national markets and consumers a continent away; fulfilling in some ways the oft-cited promise of internet

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[2] Donner, Jonathan. After Access: Inclusion, Development, and a More Mobile Internet. Cambridge, Mass., USA: The MIT Press, 2015.

[3] Benedict Evans (2015) "Where do mobile numbers come from?" http://ben-evans.com/benedictevans/2015/1/25/mobile-numbers-and-the-getting-of-them

[4] Note that here "connections" refers to unique SIM cards used with a smartphone device; not unique subscribers. Source: GSMA, "Smartphone forecasts and assumptions, 2007-2020"

[5] ACT/App Association, "State of the App Economy 2014"

[6] Holzer, A., & Ondrus, J. (2011). Mobile application market: A developer's perspective. Telematics and Informatics, 28(1), 22–31.

[7] Castells, M. (1996). The rise of the network society: The information age: Economy, society, and culture (Vol. 1). Wiley.com.

technologies to level the playing field through disintermediation and shrinking of distance.[8] Yet the same structures in other instances seem to reinforce disparities, for example by making it difficult for producers in some low-income countries to receive payments through the app store.[9]

This paper develops a preliminary spatial analysis of participation and value capture within the app economy, using the location of production to illustrate how a platform-mediated digital network can both transcend and reinforce the geography of physical place. In the next section, I summarize relevant research that has sought to understand how advancements in ICTs impact the geography of economic activity. I next introduce an overview of the platform literature, and contextualize it within the smartphone app markets as virtual marketplaces. The methodology and analysis sections describe the data on the location of commercially successful app developers. Finally, I explore the data and its implications in greater detail in the discussion.

Geography of production

Understanding the factors shaping the location of production is a key research interest in economic geography. The rapidly globalizing economy, along with continued advancements in information and communications technology (ICT) and knowledge-based work, have only increased interest and urgency in this area.[10] Previous research on how ICTs, and the internet specifically, are changing the geographical organization of production has been primarily focused on digitally enabled processes or business models, such as e-commerce, off-shoring, or telework.[11] Yet there has been relatively little empirical work that explores the geography of production and consumption when the goods themselves are digital.

The distinction is important, as wholly digital goods have different economic properties, including a marginal cost that approaches zero (making digital copies, whether 10 or 10,000, is essentially costless and exhibits no degradation) and the trait of non-rivalry, meaning they can be "consumed" by multiple people without affecting the good.[12] Just as importantly, the cost of transporting digital goods over telecommunications networks is also low and trending toward

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[8] Graham, M. (2008). Warped geographies of development: The Internet and theories of economic development. Geography Compass, 2(3), 771–789.

[9] Wagner, S., & Fernandez-Ardevol, M. (2015). Local content production and the political economy of the mobile app industries in Argentina and Bolivia. New Media & Society.

[10] Malmberg, A., & Maskell, P. (2002). The elusive concept of localization economies: towards a knowledge-based theory of spatial clustering. Environment and Planning A, 34, 429–450.

[11] For example, Leamer, E., & Storper, M. (2001). The economic geography of the internet age (Vol. 3). Retrieved from http://www.nber.org/papers/w8450; Malecki, E. J., & Moriset, B. (2007). The digital economy: Business organization, production processes and regional developments. Routledge.

[12] Shapiro, C., & Varian, H. (1999). Information rules: A strategic guide to the network economy. Academy of Management Review. Harvard Business Press.

zero.[13] These characteristics enable consumption to occur simultaneously and in multiple places around the world, leading to multi-scalar and multi-spatial flows of virtual trade.

A compelling question is therefore how the "placeless" nature of digital goods[14] affects the location of economic activity. In principle, if the production function is divorced from the benefits of spatial proximity to customers (i.e., reduced shipping costs), there should be more dispersed firm location.[15] Yet for industries characterized by high levels of innovation and knowledge-based work—such as app development—close face-to-face contact is critical, and provides a strong countervailing force of agglomeration.[16] Importantly, this tension is also dependent on the maturity of the industry: as technologies and processes become established and codified, firms are more likely to pursue vertical disintegration and more specialized divisions of labor.[17]

Among the empirical studies that locate digital production in space, Matthew Zook[18] used domain name registrations as a proxy for location of internet content creation, showing a clustering of domain registrations in the major world cities, and at the national scale. His data showed clear market dominance by the United States followed by Western Europe, with almost no representation by emerging economies.[19] The work by Mark Graham[20] on Wikipedia entries and Google Maps tags, also showed dramatically fewer contributions from the developing world. Both of these authors have highlighted the disparities between North-South participation in digital production, and in doing so challenged the discourse of ICT and digital technologies as tools for equalizing access to economic opportunities.

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[13] There are undoubtedly large disparities in the relative cost to end-users for data transmission over cellular networks, and for hundreds of millions of users, this cost is not negligible. However, compared to transporting physical goods on ships and trucks, digital goods enjoy huge cost savings, especially for producers; for example, the producer of a physical book who sells 1,000 copies has to pay shipping costs for 1,000 units, while the producer of a digital book who sells 1,000 copies can upload the file to the server once, for minimal cost. In virtually all markets, network costs for bandwidth and data speed show steady declines over time.

[14] Quah, D. (2003). Digital goods and the new economy.

[15] Moriset, B., & Malecki, E. J. (2009). Organization versus space: The paradoxical geographies of the digital economy. Geography Compass, 3(1), 256–274.

[16] Feldman, M. P. (2002). The Internet revolution and the geography of innovation. International Social Science Journal, 54(171), 47–56; Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. Progress in Human Geography, 28(1), 31–56.

[17] Mudambi, R. (2008). Location, control and innovation in knowledge-intensive industries. Journal of Economic Geography, 8(July), 699–725.

[18] Zook, M. (2000). The web of production: the economic geography of commercial Internet content production in the United States. Environment and Planning A, 32, 411–426.; Zook, M. (2001). Old hierarchies or new networks of centrality? The global geography of the Internet content market. American Behavioral Scientist.; Zook, M. (2005). The geography of the internet industry: Venture capital, dot-coms, and local knowledge. Wiley. com.

[19] Zook, M. (2005): p.19

[20] Graham, M. (2014). Inequitable Distributions in Internet Geographies: The Global South Is Gaining Access, but Lags in Local Content. Innovations, 9(3-4), 3–19.; Graham, M. (2013). The knowledge based economy and digital divisions of labour. Forthcoming, Graham, M, 189–195.

Platforms and markets

Like many industries in ICT, the smartphone sector is largely defined by software-based platforms, which can be understood as meta-organizations of standardized technologies, processes, firms, and institutions that are coordinated to create value through economies of scope and scale.[21] Interest and research on software platforms has grown in recognition of the increasingly important role they play across the information and communications technology (ICT) industry. Starting with early work studying companies such as Microsoft and Intel,[22] management scholars have used theories from the literature on standards, engineering design, and industrial economics to develop a framework for understanding the dynamics of platforms and how firms can harness them.[23]

Much of this interest is due to the distinct economic characteristics of platforms, especially the presence of externalities or "network effects," where the value of joining the network increases as the network grows.[24] For example, the more people who use Skype, the more valuable the service becomes (because you can connect with a greater number of people). The positively reinforcing cycle of network effects leads to a fundamental shift in the economic model for network industries, where instead of the equilibrium-seeking effects of decreasing returns to scale, networks foster increasing returns and the potential for winner-take-all-markets.[25] This phenomenon operates at multiple layers within the smartphone industry, with the main platform of the device (e.g., Android) being the foundation for other, more specialized app platforms such as Facebook, Line, or Dropbox. As these examples suggest, once a platform or network-based service has become dominant, the user lock-in and barriers to entry make it very difficult for new firms to compete.[26]

App stores as virtual markets

When Apple launched the iPhone in 2007, 3rd-party developers were not permitted to create apps. Perhaps bowing to pressure from developers, Apple opened up the platform by releasing

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[21] Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. Research Policy.

[22] Cusumano, M., & Yoffie, D. B. (1998). Competing on internet time: Lessons from netscape and its battle with microsoft. Simon and Schuster.; Cusumano, M., & Gawer, A. (2001). Driving High-Tech Innovation : The Four Levers of Platform Leadership, (October).

[23] Gawer, A. (2014). Bridging differing perspectives on technological platforms: Toward an integrative framework. Research Policy.

[24] Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. The American Economic Review, 75(3), 424–440.; Katz, M. L., & Shapiro, C. (1994). Systems competition and network effects. Journal of Economic Perspectives, 8, 93.

[25] Arthur, W. B. (1989). Competing technologies, increasing returns, and lock-in by historical events. The Economic Journal, 99(394), 116–131.; Arthur, W. B. (1994). Increasing returns and path dependence in the economy. University of Michigan Press.

[26] Shapiro, C., & Varian, H. (1999). Information rules: A strategic guide to the network economy. Academy of Management Review. Harvard Business Press.

an SDK and launching the App Store in July 2008; there were 552 apps available at launch. In early 2015, the App Store has 1.2 million apps, and paid out $10 billion to developers in 2014.[27] The rise of Google Play is no less spectacular. It too launched in 2008, with only a dozen apps, but now hosts 1.4 million, growing 50% year-on-year in 2014 and now featuring over 400,000 developers to whom it paid out $7 billion in 2014.[28]
For a relatively low one-time or annual fee,[29] developers can submit their apps to the app store, and if a user pays for the app, or makes an "in-app purchase," the developer will receive 70% of that revenue, with the other 30% going to the platform owner.[30] In early 2015, the vast majority of apps are free to download, and monetize via in-app purchases of virtual goods (e.g., to unlock another level of a game) or via advertising.

While the app economy is overtly global in its interconnectedness, the marketplaces for both Google and Apple are actually made up of country-level stores, which helps to ensure that the associated commerce abides by all country-specific content policies and tax laws. This allows, for example, the exclusion of an app in specific countries if it violates local regulations. This granularity of control also extends to developers, who have the ability to easily designate for each app they create which of the national app stores they would like it to appear in. While the Apple and Google stores are by far the most dominant globally, there are also stores for each of the other major platforms—Amazon Appstore, Windows Phone Store, BlackBerry World, and Firefox Marketplace—as well as hundreds of 3rd-party stores that typically feature either Android apps or an assortment of apps from multiple platforms.

Each of these smartphone platforms is an example of a "two-sided market," whereby the platform acts as the central resource for economic trade between two distinct user groups.[31] With two-sided market platforms, the value for participating in the platform for either of the user groups is positively correlated with the amount of participation by the other side; for example, the more people using Android, the more attractive it is for developers or suppliers to produce Android apps, and vice versa.[32]

With their dominant market share worldwide, the Apple App Store and Google Play are the two-sided markets through which most developers distribute and monetize their apps, and where

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[27] Appfigures (2015) App Stores Growth Accelerates in 2014 http://blog.appfigures.com/app-stores-growth-accelerates-in-2014/; Apple (2015) App store rings in 2015 with new records http://www.apple.com/pr/library/2015/01/08App-Store-Rings-in-2015-with-New-Records.html

[28] Forbes (2015) http://www.forbes.com/sites/miguelhelft/2015/02/26/exclusive-sundar-pichais-plan-to-keep-google-almighty/

[29] For Google, one-time fee of $25; for Apple, annual fee of $99.

[30] Google claims to share out its 30% with other partners, including mobile operators

[31] Farrell, J., & Saloner, G. (1985). Standardization, compatibility, and innovation. The RAND Journal of Economics, 70–83.; Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. The American Economic Review, 75(3), 424–440.

[32] Rochet, J.-C., & Tirole, J. (2003). Platform competition in two-sided markets. Journal of the European Economic Association.; Boudreau, K. (2007). Too Many Complementors? Evidence on Software Developers.

most end-users discover, download, and pay for apps,[33] which makes them a critical control point or "bottleneck" within the industry.[34] Because the app stores established a formal structure of codified interfaces and processes, they result in arm's length transactions with producers, who no longer have to establish and maintain an active relationship with a publisher or distributor.[35] In this sense, just as codified knowledge is more easily transported over great distances without face-to-face contact, the codified processes and structures of the app markets eliminate the spatial proximity requirements between developers and distributor.[36] This break of the physical siting of the market from a central place is a defining characteristic of network-based markets for digital information goods. Yet these markets are still socially embedded in their production systems and consumption patterns, which are strongly shaped by the global geography of ICT development. Essential market functions—the facilitation of economic exchange between buyers and sellers, and the supporting institutions that enable this exchange—are mediated by this new market form and its digital systems, yet function in similar ways. The information-seeking behavior described by Geertz[37] is accomplished through an online search; the face-to-face relationship-building as a precursor to trust as described by Moriset and Malecki[38] has been substituted for online reviews and "trusted developer" icons; and the mass market retail store described by Knorr Cetina[39] is now virtualized in an online marketplace, complete with advertisements and other intermediaries.

Methodology

The study uses an original dataset of commercially successful app developers across both of the major platforms, Android and iOS, including the location of the developer and the national markets it was able to enter successfully. "Commercially successful" developers were defined as those with apps ranked within the top 500 highest-grossing apps, or top 100 highest-downloaded apps, in any of the 10 national markets studied for the date of March 31, 2014. This resulted in a total of 12,000 apps across both platforms; 5,277 of these apps were unique, made by 2,988 unique developers. Data on top-ranked apps and developers is publicly available from both the Apple App Store and Google Play; however the App Annie online tool was used instead as it simplifies historical queries. Manual online searches tried to find city and country location data for as many developers as possible, with a success rate of approximately 90%, leading to

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[33] Heitkoetter, H., Hildebrand, K., & Usener, C. (2012). Mobile Platforms as Two-sided Markets. In AMCIS.

[34] Pon, B., Seppälä, T., & Kenney, M. (2014). Android and the demise of operating system-based power: Firm strategy and platform control in the post-PC world. Telecommunications Policy, 38(11), 979–991.

[35] Holzer, A., & Ondrus, J. (2011). Mobile application market: A developer's perspective. Telematics and Informatics, 28(1), 22–31.

[36] Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. Progress in Human Geography, 28(1), 31–56.

[37] Geertz, C. (1978). The bazaar economy: Information and search in peasant marketing. The American Economic Review, 28–32.

[38] Moriset, B., & Malecki, E. J. (2009). Organization versus space: The paradoxical geographies of the digital economy. Geography Compass, 3(1), 256–274.

[39] Knorr Cetina, K. (2006). The market. Theory, Culture & Society, 23(2-3), 551–556.

a total of 2,688 unique developers with location information. The publicly available ranking data was accessed throughout the latter half of 2014, and the manual location searches were conducted from June 2014 to February 2015.

The selection of the 10 most lucrative national markets was based on industry reports on the top revenue-generating countries—that is, where consumers spent the most money on apps—on both the iOS and Android platforms for 2014, using the 10 that represented the best compromise between the two platforms and multiple report rankings. The 10 markets selected were: Australia, Canada, China, France, Germany, Japan, Russia, South Korea, United Kingdom, and United States.

While the data represent only one part of the formal app economy, they capture the top-ranked apps in the top revenue-generating national markets, and therefore likely the vast majority of revenues. As is the case with other digital marketplaces, app stores exhibit a power law dynamic whereby top-ranked products are orders of magnitude more popular than the lower-ranked products that occupy the so-called "long tail."[40] Researchers have modeled the power law for the app stores, and found that downloads and revenue drops quickly after the top 20 to 50 apps, such that the #1 ranked app in the iOS store would enjoy 150 times more downloads, and 95 times more revenue, than an app ranked #200.[41] Therefore by capturing the top 600 apps, I have confidence that the sample represents the majority of app revenues, and it certainly includes those few developers—King, Supercell, Gameloft, etc.—who make millions of dollars in revenue from a single app in a single day. However, the data cannot accurately weigh the economic value of one developer, or one app, over another, as revenue figures are unavailable. In addition, it is important to recognize that the data and analysis presented here describe the formal app economy, but as with most economic activity, there are alternatives, including a thriving informal sector that exists outside of this structure.

Analysis

Similar to other creative and innovative industries, the production of apps appears to benefit from localized interactions. The sample of 2,688 developers (firms or individuals) shows clear patterns of agglomeration, with 50% of all developers located in just 2% of the cities. Interestingly, this trend is even more pronounced for the top-ranked developers: While the top four cities (Seoul, Tokyo, SF Bay Area, and Beijing) account for 37% of all developers, they account for 46% of those developers with a highly ranked (top 20) app. While the data cannot determine any causality, this finding supports empirically the idea that commercially successful knowledge work is more likely to be clustered spatially.[42]

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[40] Brynjolfsson, E., Hu, Y. J., & Smith, M. D. (2006). From niches to riches: Anatomy of the long tail. Sloan Management Review, 47(4), 67–71.

[41] Garg, R., & Telang, R. (2013). Inferring app demand from publicly available data. MIS Quarterly, 37(4), 1253–1264. Also, see Distimo: http://www.distimo.com/blog/2011_12_quora-answering-series-download-volume-needed-to-hit-the-top-charts/

[42] Feldman, M. P. (2002). The Internet revolution and the geography of innovation. International Social Science Journal, 54(171), 47–56.; Asheim, B. T., & Gertler, M. S. (2006). The Geography of Innovation: Regional Innovation Systems. In Oxford Handbooks Online.

App development is taking place in some of the largest metropolitan areas, but with a significant shift away from the world cities of the West[43] and toward East Asia: Seoul, Beijing, and Tokyo claim the top three positions, while London, Paris, and New York are in seventh through ninth place, respectively. Interestingly, a combined San Francisco Bay Area (including Silicon Valley), which in many ways is the epicenter for the smartphone and software industries, and features the headquarters for both Google and Apple, is only fourth on the list in total developers, highlighting the degree to which U.S. developers are more dispersed throughout the country instead of concentrated in one capital city. At the country level, the dominance by East Asia is a significant reversal from the distribution of internet content production documented by Zook in 1999,[44] where China, Japan, and South Korea together had only about 3% of the global total of domain registrations, compared to, for example, Germany with 6.8% and Canada with 4.7%. In this study, China alone has 19% of all developers.

Figure 1. Cities and countries with the highest number of developers (n = 2,688)

Rank	City	Country	Developers
1	Seoul	South Korea	318
2	Beijing	China	252
3	Tokyo	Japan	250
4	SF Bay Area	United States	162
5	Shanghai	China	88
6	Moscow	Russia	81
7	London	United Kingdom	78
8	Paris	France	69
9	New York	United States	51
10	Shenzhen	China	49
11	Hong Kong	Hong Kong	47
12	Berlin	Germany	32
13	Guangzhou	China	27
14	Hangzhou	China	26
15	Seattle	United States	24

Rank	Country	Developers	Dev/cap*
1	China	517	0.83
2	United States	511	1.92
3	South Korea	339	7.96
4	Japan	304	2.77
5	United Kingdom	171	2.97
6	Germany	151	2.23
7	Russia	150	1.70
8	France	118	2.18
9	Canada	58	1.92
10	Australia	57	2.97
11	Hong Kong	48	9.00
12	Sweden	23	2.53
13	Israel	20	3.51
14	Switzerland	20	3.25
15	Austria	18	0.83

[43] For comparison, see: Zook, M. (2005). The geography of the internet industry: Venture capital, dot-coms, and local knowledge. Wiley.com.

[44] Zook, M. (2001). Old hierarchies or new networks of centrality? The global geography of the Internet content market. American Behavioral Scientist.

** Devs/capita is a weighted measure of developers per 1 million inhabitants with internet access. All data on population and internet penetration from GSMA, Mobile Development Intelligence.*

Also immediately apparent in the data is the almost complete absence of developers from the emerging economies. For all of Africa, only two developers (both from South Africa) were able to enter any of these markets. South America had four developers, three from Brazil and one from Chile. Southeast Asia fared slightly better, with 19 developers, most from India. Just to be clear, this does not indicate there are only 19 app developers in Southeast Asia, but that only 19 developers were able to crack the top 600 apps in any of the top 10 national markets. If the analysis included the Brazilian or South African markets, for example, there would be many more local developers from Brazil and South Africa in the data (however, the revenue available in those app markets is significantly lower than the top 10 markets). Furthermore, of these developers from emerging economies, only four were able to enter the U.S. market, which is the most lucrative (and competitive), suggesting that there are additional barriers within the platform markets for these developers.

The overall lack of participation by developers from the emerging economies is likely due to multiple factors, including lower levels of infrastructure, accessibility, technical literacy, venture capital, and so on, which are well-described in the ICT4D literature.[45] However, another reason is likely the platform policy of Google, which only allows developers in approved countries to receive payments from the app store. Developers who want to earn revenue from Android apps on the Google Play app store are required to set up a merchant account, which is what links their bank account to Google so that they can receive funds from the app store. However, Google merchant accounts are only available in 64 countries, with most of sub-Saharan Africa and much of Latin America excluded.[46] A Google employee attributed this to difficulties reaching agreement with state governments over issues such as "tax laws, currency exchange, and export laws."[47] While not every developer is trying to directly commercialize her apps, it is reasonable to assume that the inability to monetize one's app directly through the app store is a deterrent for participation[48]—of the 2,688 total developers, only 30 developers, or 1%, hailed from a country that is not allowed to directly monetize through the Google Play app store. Here the controlling logic of the dominant global platform sets policy that establishes boundaries of exclusion at the physical borders of the state; although one layer of the platform network is available—that is, the virtual marketplace and all services are available to end-users—the layer of developer engagement is prohibited, which likely results in a skewed adoption process.

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[45] For example, Graham, M. (2008). Warped geographies of development: The Internet and theories of economic development. Geography Compass, 2(3), 771–789.; Zook, M. (2001). Old hierarchies or new networks of centrality? The global geography of the Internet content market. American Behavioral Scientist.

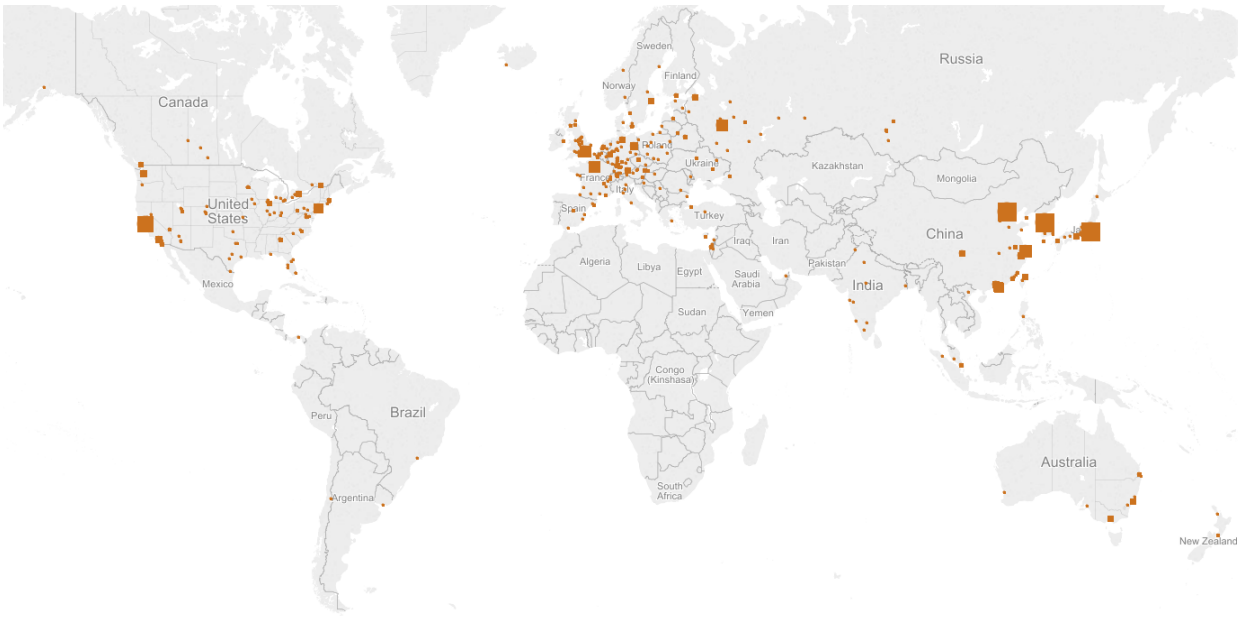
[46] Google Developer Console (https://support.google.com/googleplay/android-developer/table/3539140?rd=1)

[47] Personal email communication, Google Developer support

[48] Wagner, S., & Fernandez-Ardevol, M. (2015). Local content production and the political economy of the mobile app industries in Argentina and Bolivia. New Media & Society.

Because localized apps and content can drive adoption,[49] the exclusion of local developers may in theory slow adoption of the platform by end-users in a recursive cycle.

Figure 2. Map showing location by city of top developers (n = 2,688)



The degree to which local demand is stimulating local production is a key research question. Industry surveys indicate that the proportion of developers using either Android and iOS is roughly in line with the end-user adoption in each region; for example, across Africa, Southeast Asia, and South America, Android is the dominant platform for end-users, and also the favorite platform for developer.[50] On the other hand, the strongest markets for Apple's iOS are the U.S., Japan, Canada, and Western Europe, which show proportionally higher ratios of developers using the iOS platform. The data in this sample show developers from emerging economies are roughly evenly split, with about half developing for Android and half for iOS. This relatively high ratio of iOS developers suggests a deliberate strategy by these developers to monetize in foreign markets. Because this data set only includes the top 10 national markets, which are all industrialized economies, the analysis cannot determine the extent to which local developers in, say, Brazil or India, are serving their own domestic market. Other research indicates that for

[49] Burns, C., & Dolan, J. (2014). Building a Foundation for Digital Inclusion: A Coordinated Local Content Ecosystem. Innovations, 9(3-4), 33–42.

[50] Vision Mobile, 2014 "Developer Economics Q3 2014"

developers in small or non-lucrative markets, targeting foreign markets is perceived as a strategy for being able to earn revenue when little is available in the home market.[51]

Discussion

The emerging app economy is a highly visible demonstration of how digital goods and virtual markets can transcend distance and connect spatially remote producers and consumers via electronic networks. The ability of firms located in geographically peripheral locations such as Helsinki (e.g., Rovio/Angry Birds) and Melbourne (e.g., Halfbrick Studios/Fruit Ninja) to successfully enter competitive national markets on the other side of the world is a testament to the reach and scale of these platform-mediated networks. Yet this effect does not seem to extend to those locations that are not already participating in software development; digital producers in the developing world are still rarely able to enter the much more lucrative foreign markets. [52] Therefore despite the disintermediation that the app store model creates, the new value chain is still inaccessible to many producers.

Furthermore, while the platform marketplaces connect the producer and consumer more directly, they do so in a way that transfers more risk to the producer.[53] For example, console video games are typically built by developers in conjunction with publishers, who will sign agreements with the console manufacturers to produce a game, secure an advance, and so on. While this structure meant a lower percentage of the overall revenues went back to the developer, it did offer a degree of financial security via the advance; in the case of a flop, the developer was partially shielded.[54] In contrast, the app market is essentially a consignment-only market, where the developers take on all the risk and cost of producing and marketing the product; if it fails, they bear all the impact, while Apple and Google are unaffected.[55] For less well-resourced developers in emerging markets, this may translate into higher relative levels of risk.

The limitations on Android developers being able to be receive app store revenue in certain countries is a clear example of how the platform can shape participation in space. As in this example, the state is often the key actor within the network, as it is typically both the spatial scale and the political entity that negotiates with the platform owner. We do not know whether the issue with Google merchant accounts is due to simple policy issues that will be resolved in

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[51] Wagner, S., & Fernandez-Ardevol, M. (2015). Local content production and the political economy of the mobile app industries in Argentina and Bolivia. New Media & Society.

[52] The case of the globally successful Flappy Bird, produced in Vietnam, is often held up as a counter example. However, I assert that the probabilities for truly viral hits from developing countries are very low, and decreasing over time.

[53] Parker, R., Cox, S., & Thompson, P. (2014). How technological change affects power relations in global markets: remote developers in the console and mobile games industry. Environment and Planning A, 46(1), 168–185.

[54] Johns, J. (2006). Video games production networks: value capture, power relations and embeddedness. Journal of Economic Geography, 6(June 2005), 151–180.

[55] Kenney, M. (forthcoming). Value and work in the platform economy.

time, or if those governments have deeper philosophical differences with the platform. If the latter, there are risks to a strategy of excluding the digital flows of the app economy, which would likely be only a temporary isolation, but one that may have lasting economic impact as stronger network ties are made outside of that national market.[56]

The prominent counterfactual to this is of course China's ban of Google services, including the Google Play Store. The decision is in line with China's protectionist policies that have sought to bar foreign internet and technology firms from accessing the Chinese market, giving domestic companies the space to gain critical mass without foreign competition.[57] As a result of such policies, just as Chinese companies have created local substitutes for American services—Baidu for Google Search, Renren for Facebook, WeChat for What'sApp, Sina Weibo for Twitter, and so on—firms such as Xiaomi, Baidu, and Alibaba have used the open-source code of Android as a base to build their own, proprietary operating systems and app store markets.[58] Because these versions of the OS don't connect to Google or any of Google's services, they are not subject to the Chinese state's bans. The success of Xiaomi, for example, shows that the vast size of the Chinese market gives these firms a large enough market to establish economies of scale, and the potential to expand internationally as well (Xiaomi has recently entered the Indian market, and is reportedly targeting Thailand, Russia, Mexico, Brazil, and Turkey next).[59] On the other hand, China has allowed Apple to establish its retail operations and its virtual app store on the mainland, and Apple has seen tremendous growth.[60] The case of China is therefore an example of state-based negotiation with the platform owner, resulting in the exclusion of hundreds of millions of users from the official services of Google, but not those of Apple. Importantly, however, as the data show, the exclusion of official Google services has not curtailed domestic app development, as the open source version of Android has sufficient compatibility for Chinese developers to export their products.

The app store structure represents another key way in which the platforms are anchored in geographic space. As a highly networked industry, the app economy is dominated by network effects and the winner-take-all dynamics they lead to.[61] Apps such as Line, Facebook, and WhatsApp have become dominant in their categories in large part because they experience network effects. But the winner-take-all nature also extends to gaming, where smash hits like Clash of Clans, Candy Crush Saga, and Flappy Bird have captured audiences everywhere.

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[56] Castells, M. (1999). Grassrooting the space of flows. Urban Geography, 20(4), 294–302.

[57] Jiang, M. (2012). Internet companies in China: Dancing between the Party line and the bottom line. Asie Visions

[58] Pon, B., Seppälä, T., & Kenney, M. (2014). Android and the demise of operating system-based power: Firm strategy and platform control in the post-PC world. Telecommunications Policy, 38(11), 979–991.

[59] http://www.techinasia.com/xiaomi-changes-2014-sales-target-60-million-after-11-million-shipments-in-q1/; http://www.bloomberg.com/news/articles/2015-03-05/xiaomi-ceo-lei-forecasts-revenue-topping-16-billion-this-year

[60] New York Times (2015). "IPhone Sales in China Bolster Apple Earnings" http://www.nytimes.com/2015/01/28/technology/apple-quarterly-earnings.html

[61] Katz, M. L., & Shapiro, C. (1994). Systems competition and network effects. Journal of Economic Perspectives, 8, 93.

Some of these games utilize social gamification tools that rely on network effects, but not all do. For these types of organically "viral" apps, the winner-take-all nature has more to do with the structure of the app stores themselves: With over 1 million apps listed in both the Apple App Store and Google Play, there is an overwhelming amount of choice facing the consumer, which the stores address by showcasing the most popular apps in each category (e.g., games, education, etc.). The most popular apps are therefore seen and downloaded by more users, which helps to keep them as the most popular apps. This virtual location within the app store is analogous to the prime location within a physical marketplace; as Geertz describes, in the bazaar, preferential location helps reduce information-seeking by customers and better outcomes for sellers.[62]

For developers, this problem of "discoverability"—which is widely acknowledged in the industry[63]—may be mitigated to some degree by the nationalized app store structure, as each country's app store features its own rankings for the most popular apps. In principle, this segments the global market into more discrete, locally focused markets that create advantages for local or otherwise marginalized content from smaller producers; instead of just a single top 100 list, there are dozens. However, these smaller national markets may not offer sufficient revenues to support a broad base of producers. And in all markets, the less well-resourced producers are forced to compete against firms with increasingly large and sophisticated marketing programs to drive downloads (typically through "app install" ad campaigns) that help them stay in the top ranks. Furthermore, Google recently announced that it would be extending its core business of paid search ads to the Google Play app store, allowing developers to pay for sponsored ads to appear next to the organic search results, just as with regular search. The result, of course, is that the well-resourced app developers will more easily be able to capture users and continue to increase their presence on the app store in another positively reinforcing cycle.[64] While the platform owners have acknowledged the problem of app discoverability, platform strategy posits that maintaining high levels of competition among app producers is a key way for them to keep control of the "bottleneck" they own in the app stores.[65] This has been part of Microsoft's strategy with the Windows operating system, as it actively encouraged competition among 3rd-party complementors in both software and in hardware, those areas adjacent to its bottleneck, the operating system.[66] The incentives around the store structure are thus different for developers and the platform owners, and the vast majority of developers will continue to struggle to gain visibility and meaningful revenue outside of the long tail.

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[62] Geertz, C. (1978). The bazaar economy: Information and search in peasant marketing. The American Economic Review, 28–32.

[63] See, for example, http://www.forbes.com/sites/allbusiness/2013/08/15/app-discovery-why-cant-anyone-figure-this-out-yet/ and http://toucharcade.com/2014/06/02/new-ios-8-app-store-features/

[64] For developer reaction to the change, see: http://www.businessinsider.com/developer-reaction-to-google-play-store-search-ads-2015-3

[65] Ballon, P. (2009). Platform types and gatekeeper roles: the case of the mobile Communications industry. Druid Summer Conference.

[66] Gawer, A., & Cusumano, M. (2002). Platform leadership. Harvard Business School Press Boston.

Given the amount of attention and investment focused on incubating mobile or digital startups in the emerging economies, especially in East Africa, their lack of representation in the top national markets is notable. The rhetoric from the media or platform owners tends to champion the meritocratic, open nature of the app market—using the exceedingly rare success stories such as Flappy Bird as examples—yet platform dynamics have led to a competitive landscape heavily tilted toward larger, more established players in the more lucrative national markets. A compelling line of inquiry to extend this research would be to analyze the national markets of some of the emerging economies, such as India, Brazil, Indonesia, or Nigeria, to see to what degree local developers are able to enter their domestic market. It is possible that these smaller markets can support some level of domestic production sustainably, and thereby stimulate digital production capacity locally. But the global-scale network effects of winner-take-all markets make it likely that the bulk of industry revenue and technical capabilities will remain concentrated in the traditional technology centers.

Conclusion

This paper presented a preliminary analysis of the geography of app production, using a platform lens to explore how the spatial concentrations and patterns of participation are affected by the strategies and dynamics of the smartphone platform owners. Despite the aspatial nature of digital goods and the global reach of virtual markets, the production of apps is anchored in an economic geography that is shaped by the platforms themselves, including the agglomeration tendencies of knowledge-based work, the role of the state in determining enrollment or eligibility, and the country-level structure of the app stores. Given its global penetration, economic value, and leading role in the shift toward digital goods and commerce, the app economy offers important lessons in how value creation and capture may be distributed in our increasingly globalized world. While the hype and hyperbole emphasize the low barriers to entry and meritocratic possibilities for producers anywhere, the vast majority of app developers will not be commercially successful in the long-run. The only guaranteed winners, of course, are the platform owners, who will always take their 30%.