Technology Startups and Industry-Specific Regulations

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Contents

Executive Summary

Entrepreneurship has long been studied as an important determinant for the long-term health and growth of an economy. Many studies highlight how higher levels of government regulation can impede business activity, firm entry, and entrepreneurship. Others have shown that regulation can affect small businesses to a greater extent than medium and large businesses.

The extensive research on the relationship between regulation and entrepreneurship has yet to examine the relationship between regulation and young, high-growth technology startups.

Technology startups and technology entrepreneurs are at the heart of innovation. These companies are unique in that they do not fit neatly into the traditional categories of small businesses (or small- and medium-sized enterprises) or large and established companies. Many technology startups are young and fast-growing and thus of interest for their potential impact on job creation. Studies have found that high-growth businesses (which are disproportionally young firms) account for almost 50 percent of job creation in the United States.

The relationship between regulation and technology startups may also be different than that between regulation and a typical small or large business. This is because technology startups that grow quickly and become "large" are often market disruptors or emerge from undefined, unclear, or regulatory gray areas. Some technology startups have even been described as engaging in "regulatory entrepreneurship" because they are involved in changing regulations by mobilizing their consumer base, and they operate despite industry-specific regulations.

This study provides a first look at the relationship between regulation and technology startups in the United States and in Canada. It examines whether more regulated industries tend to be associated with fewer startup entries and more startup deaths. The industries studied are: pharmaceutical and medicine manufacturing; ambulatory health care services; software publishing industries; data processing, hosting, and related services; information services; credit intermediation and related activities; securities, commodity contracts, and other investments; and insurance carriers and related activities.

This study includes 16,672 active and 2,913 closed technology startups in the United States and Canada that were founded between January

2012 and June 2019. Of the total 19,585 startups, 14,834 are headquartered in the United States and 4,751 in Canada.

The results suggest that more regulated industries may exhibit lower rates of entry and that more regulated industries are associated with a greater likelihood of a startup closing. These results are stronger for the United States than for Canada. This may be because the study includes more US-based than Canadian-based startups. It may also be that the regulatory and/or market environments differ in the US and Canada such that the impact of regulation differs. For instance, the Canadian regulations may be less relevant for Canadian-based startups if the goal is to expand to the relatively larger US market.

Why would more regulation lead to more startups closing? Several studies have found that factors such as higher costs of regulatory compliance burden small companies more than larger and incumbent companies. While compliance cost is one important avenue affecting startup closings, another potential avenue is the availability of investor funding.

Angel investors (typically early investors of a startup) and institutional investors such as venture capitalists provide funding for technology startups in exchange for equity in the startup. Venture capitalists are especially important once a startup has established its concept and is ready for the growth stage. Venture capitalists invest in startups with the intent of getting significant returns in a short time. More specifically, the goal of venture funds is to achieve returns in the order of 20 percent or more per year within a 10-year period. Because of this, they are seeking to finance companies that have shorter time horizons and greater capital efficiency. Since heavier regulations add a layer of bureaucracy, increase capital requirements, and lengthen the time horizon of investment returns, startups in more regulated industries could attract less venture capital funding. This study discusses this avenue and points to some preliminary evidence suggesting that some venture capital investors are deterred from investing in startups in more regulated industries.

Introduction

Entrepreneurship has long been studied as an important determinant for long-run economic growth. As such, scholars follow various measures of entrepreneurial activity and analyze cross-country differences and trends in entrepreneurial activity over time. Much of this research is also directed toward understanding how to encourage and spur entrepreneurship and determining what conditions can burden entrepreneurs. The institutional environment has been identified as having an impact on the extent of productive entrepreneurial activity (Baumol, 1990; Boettke and Coyne, 2009; Landes, Mokyr, and Baumol, 2012).

More specifically, the regulation of business activity and entry has been on the forefront of this research, and empirical studies indicate that higher levels of regulations impede business activity, firm entry, and entrepreneurship (Klapper, Laeven, and Rajan, 2006; Nyström, 2008; Bripi, 2013; Lima et al., 2014; Bransetter et al., 2014). These research papers have focused on aggregate "business entry" or entrepreneurship—often equating all small- and medium-sized businesses, large established businesses, and "high-growth" technology startups in the same category. While subsequent research has demonstrated the differential impact of regulation on small businesses (see Calcagno and Sobel, 2013; Bailey and Thomas, 2017; Chambers, 2018), there has been little research examining the relationship between regulation and young, high-growth technology startups. We fill this gap by studying that relationship.

Technology startups are unique in that they neither fit neatly into the traditional categorizations of small businesses (or small- and medium-sized enterprises) or into large and established companies. They are similar to traditional small businesses because they tend to be "small" in size, but they differ in many other ways—most importantly, technology startups tend to be high growth and innovation focused, and remain small for less than 10 years. On the other hand, "small businesses" tend to remain small for most of their existence and are not innovation or growth focused (Hurst and Pugsley, 2011). These small businesses are often referred to as "mom-and-pop shops" or "Main Street" entrepreneurs. The experience ~~of~~ with regulation is also different for startups and traditional small busi-

nesses. For example, specific labour regulations may have a greater impact on small businesses than on technology startups because of the greater use of low-skilled labour in the former. Furthermore, the incentives to comply with existing regulations may be lower for young technology startups than for a typical Main Street small business (Palagashvili, 2020).

Technology startups that grow fast and become "large" are often market disruptors or come about from undefined, unclear, or regulatory gray areas. Some technology startups have even been described as engaging in "regulatory entrepreneurship" because they are involved in changing regulations by mobilizing their consumer base and they operate despite industry-specific regulations (Pollman and Barry, 2017; Tusk, 2018). Venture capital funding has contributed to this with the mindset that with enough resources to mobilize the consumer bases, regulations can be altered to allow technology companies to enter and operate in various industries. The experience of startups with regulation may thus be different than that of small and large companies.

Many technology startups are young and fast-growing, and thus of interest for their potential impact on job creation. Decker et al. (2014) find that high-growth businesses (which are disproportionally young firms) account for almost 50 percent of job creation. Their research describes the unique role of young and fast-growing startups: Most new businesses tend to die within 10 years, and most surviving young businesses do not grow but remain small (these may be the typical Main Street or mom-and-pop businesses)—but a small portion of young businesses exhibit very high growth and contribute substantially to job creation (Decker et al., 2014). Other studies also indicate that almost all net job creation in the US has occurred in firms younger than five years old, and these are from a very small percentage of high-growth firms (Stangler and Litan, 2009; Stangler and Kedrosky, 2010).

This paper examines the relationship between industry-specific regulations and startup birth rates (entry) and startup deaths (i.e., closings)[1] in the United States and Canada from 2012 to 2019. We use the Mercatus Center's RegData dataset to capture the intensity of national-level regulations across industries in the United States and Canada. Our preliminary evidence suggests that more regulated industries may exhibit lower rates of entry and that more regulated industries are associated with a greater likelihood that a startup will close. These findings seem more robust for the US than for Canada.

Existing studies have outlined several mechanisms through which regulations may cause a greater burden on companies, especially small

1 Startup closings and exits only measure startups shutting down (i.e., failing), not startup exits due to mergers or acquisitions (M&A).

companies, including such important factors as high fixed costs of entry or high compliance costs. We suggest another potential mechanism relevant for technology startups: startup venture capital funding. Startup funding may be a key variable for technology startup closings because a lack of funding (or "running out of money") is often cited as one of the main reasons why startups fail (CB Insights, 2019). Since regulations can add layers of bureaucracy, increase capital requirements, and lengthen the time horizon for investment returns, startups in more regulated industries could attract less venture capital funding than those in less regulated industries.

The next section discusses the literature and theoretical predictions. A data description and an outline of the empirical strategy follow. We then present the main findings and discuss the results and funding as a potential mechanism. The final section concludes.

Literature Review and Theory

Regulation and Entrepreneurship

Economics research has empirically examined the relationship between regulation and entrepreneurship. Djankov et al. (2002) provide some of the most comprehensive data examining the extent of regulation of business entry in each country, and Klapper et al. (2006) use this data to investigate how stricter regulations of entry have affected European businesses. Klapper et al. (2006) find a negative relationship between regulation and the entry of new businesses in Europe, and that more regulatory procedures resulted in fewer new businesses. Similarly, Branstetter et al. (2013) find that a reform in Portugal that reduced the cost of firm entry led to an increase in new firm formation and employment. Their analysis used matched employer-employee data that provided additional characteristics of founders and employees of associated firms, and thus they also discovered that the increase in new firm formation occurred mostly among the "marginal firms"—ones they described as small firms owned by less educated entrepreneurs that operated in low-technology sectors. Bripi (2016) studies the impact of a regulatory reform that reduced the administrative burden for business startups across provinces and industries in Italy. The results indicate that lengthier and costlier regulatory procedures reduced business entry rates. Crews (2018) provides an extensive overview of the empirical literature on the relationship between regulation and startup activity.

Using data on economic freedom by country from the Fraser Institute's Economic Freedom of the World Index, Nyström (2008) finds that less regulation of credit, labour, and business tends to increase entrepreneurship, as measured by self-employment. However, using the same data on economic freedom, Bjørnskov and Foss (2008) fail to show that regulation is significantly correlated with entrepreneurship, as measured by the Global Entrepreneurship Monitor. It is possible that the different measures of entrepreneurship may be capturing different concepts, and hence lead-

ing to different results. There is also considerable literature on the relationship between capital gains tax and startup activity—Mitchell et al. (2018) provide an overview of this research and conclude that there is substantial evidence indicating that higher capital gains tax rates deter business startup activity.

Overall, these empirical studies indicate that regulations matter for entrepreneurial activity, and that greater regulation may deter entrepreneurship and business entry. Bailey and Thomas (2017) point out that most of the above-mentioned studies of regulatory burden or institutional quality are country-specific while regulation tends to be industry-specific. To address this problem, they examine the impact of industry-specific regulation on entrepreneurship and business entry. They use a novel dataset, Mercatus Center's RegData, to examine how the variation in the intensity of federal regulations by industry affects business entry, business exits, and employment in the United States. They find that industries that are more regulated experienced fewer new firm births and slower employment growth from 1998 to 2011. They also find that regulations inhibit employment growth in all firms and that large firms are less likely than small firms to leave a heavily regulated industry. Goldschlag and Tabbarok (2018) also use RegData, but find that federal regulations had little impact on the United States' declining business dynamism over the last 30 years. Thus, they failed to find a relationship (positive or negative) showing that more regulated industries experienced a greater decline in business dynamism than less regulated industries.

Other empirical studies in regulation and entrepreneurship examine how regulations may affect different types of businesses. Calcagno and Sobel (2013) find that regulations seem to operate as a "fixed cost" that results in larger firm sizes and hurts precisely the smallest firms—thus indicating that the cost of compliance presents a greater burden for small firms than large ones. Using Mercatus's RegData, Chambers et al. (2018) find that regulatory growth disproportionally burdens small businesses relative to large business—where a 10 percent growth in regulatory restrictions is associated with a reduction in the total number of small firms within that industry but has no statistically significant association with the number of large firms in that industry. Crain and Crain (2014) measure the cost of regulatory compliance for different industries, and find that, across all industries, the compliance cost per employee is greatest among small businesses and lowest among large businesses.

Regulation and technology startups

While the research on regulation and entrepreneurship is vast, there are few studies examining technology startups and regulations. Studies that do examine technology and regulation focus on specific industries or specific regulations—for example, fintech and securities regulations (Brummer, 2015; Treleaven, 2015), blockchain regulation (Henderson and Luther, 2017; Luther, 2019), regulation of medical technologies (Stern, 2017), or technology startups and challenges with intellectual property (Halt et al., 2017). While these and many other studies of specific regulations and technologies make important contributions, they do not attempt to examine on an aggregate level the relationship between regulations and technology startups.

A subset of regulation and technology startup research that generates aggregate empirical findings is centered on startup funding and how regulations can determine the existence and amount of angel and venture funding. Gompers and Lerner (1999) find that changes in regulation over pension funds in the United States led to more funding flowing to venture capital firms, thereby increasing the supply of venture capital funding. They also find that reductions in capital gains taxes in the United States increased the demand for venture capital funds. Jeng and Wells (2000) examine the determinants of venture capital funding and conclude that, among other factors, certain government policies and regulation have an impact on the extent of the venture capital market across different countries. Da Rin et al. (2006) analyze 14 European countries between 1988 and 2001 and find that reductions in corporate capital gains taxes and reductions in labor regulations stimulate aggregate venture capital investments. Pilington and Dyerson (2006) also find that factors such as the legal environment, tax system, and labour market regulations help explain the differences in venture capital development between the United States and Sweden. Bruton et al. (2002) find that regulatory changes led to the emergence of a venture capital market in Singapore and that differences between the institutional environment in Singapore and other East Asian countries help explain the differences in their respective venture capital industries. Cummings and Johan (2018) also provide an overview of the research on how a variety of legal rules have an impact on entrepreneurship and entrepreneurial finance. Many studies also analyze the institutional, legal, and policy environments and their specific impacts on equity crowd-funding (Wilson and Testoni, 2014; Micic, 2015; Hornuf and Schwienbacher, 2017).

These studies on startup funding analyze the market for such funding—i.e., how the institutional and regulatory environments affect the

existence, emergence, and amount of funding. A later section provides a preliminary discussion on funding as a potential avenue by which regulation may have an impact on startup closings.

Hypotheses

We follow Bailey and Thomas (2017) and Chambers et al. (2018) in using RegData but investigate the entries and closings of technology startups specifically.

Hypothesis One (Startup Entry): Regulation is a barrier to entry. Studies have found that greater regulations reduce business entry rates. Thus, more heavily regulated industries will be associated with fewer new technology startup births.

Hypothesis Two (Startup Closings): Regulatory compliance costs act as a fixed cost that may burden smaller firms more than larger firms. Technology startups are young and small and tend to be cash-constrained, especially in the early stages of their development. Higher costs of compliance increase the "cash burn rate" and can contribute to startup failures. More heavily regulated industries will be associated with a higher probability of startups closing.

Data

We define technology startups as young companies (no older than 7 years) whose primary business is selling technology-enabled products or services. We include only startups that have received venture capital funding and exclude those that have received funding from sources such as private equity, equity crowd funding, loans, and government and university grants. We also exclude startups that have been acquired or have gone public because our focus is exclusively on the "typical" venture-backed, young startup.[2] These parameters were chosen to ensure that large, non-startup technology companies would not enter our data.

To measure the relationship between regulation and startup entry and exits, we use data on technology startups from Crunchbase[3] along with RegData's regulatory index. Crunchbase's data on technology startups is collected and tested for accuracy in four primary ways: First, Crunchbase has a partnership with more than 3,500 global investment firms that submit monthly updates on startups in their portfolios. Second, an active community of contributors including executives, entrepreneurs, and investors provide and verify the information in Crunchbase. Third, Crunchbase uses artificial intelligence and machine learning algorithms to validate data accuracy, scan for anomalies, and alert the data team of conflicts in the data. And fourth, Crunchbase's data team manually scrubs, validates and curates the data.

Our sample contains data on 16,672 active and 2,913 closed technology startups in the United States and Canada that were founded between January 2012 and June 2019. Of the total 19,585 startups, 14,834 are headquartered in the United States and 4,751 are headquartered in Canada. Table 1 shows the top three cities for the most number of startups in the United States and Canada.

[2] Venture capital funding is important for technology startups because almost all technology startups rely on venture capital funding to grow from early to late stages, and eventually to acquisitions or IPOs as an exit strategy

[3] Crunchbase is a platform for finding business information on innovative public and private companies

Table 1: Startup Headquarters

UNITED STATES

City	Number of Startups	Percent of Total in United States
San Francisco	2055	13.9
New York	1972	13.3
Los Angeles	832	5.61
US total	**14,834**	

CANADA

City	Number of Startups	Percent of Total in Canada
Toronto	1531	32.2
Vancouver	700	14.7
Montreal	515	10.8
Canada total	**4,751**	

The Mercatus Center collects RegData's index of regulation intensity. It is based on a text analysis of the annually published *Code of Federal Regulations* for the United States and the national regulatory code of Canada.[4] The creators of the index, Al-Ubaydli and McLaughlin (2014), put together a list of words that are likely to indicate binding constraints. These words are "shall," "must," "may not," prohibited," and "required." The index contains a count of the number of occurrences of each of the words that indicate binding constraints. The index also measures how frequently the regulations produced by a given regulatory body target a specific industry. Al-Ubaydli and McLaughlin (2014) validate RegData by investigating known episodes of regulatory growth and deregulation, and by comparing their measure to existing, cross-section measures of regulation. RegData is the first dataset to quantify the level of regulation by industry. It does so according to the NAICS two-, three-, four-, five-, and six-digit levels, where each additional digit indicates increasingly narrow industry categories. For example, the broad category "construction" is at the two-

[4] RegData includes the national regulatory code of both the United States and Canada, and the regulatory code of US states and Canadian provinces. We only use the national-level regulatory code. The RegData methodology is the same for both the United States and Canada.

digit level 23, the "construction of buildings" is at the three-digit level 236, and "residential building construction" is the four-digit level 2361.

In addition to using RegData's annual regulatory index ("Reg1"), we construct two other variables to measure the extent of regulations. Reg2 is a five-year average of RegData's regulatory index, which begins two years before and ends two years after each year in our sample. Reg3 is the average of the regulatory index for the five-year period leading up to and including each year in our sample. The purpose of the additional variables Reg2 and Reg3 is to capture the impact that expected changes in regulation may have, measured by the impact of regulation two years before and after the year of founding, and to capture any lagged impact from changes in regulation, measured by the impact of average regulation in the previous five years.

Using Crunchbase's database of startups, we match each startup to an NAICS three-digit industry code. We select three broad industry categories that are most relevant to the technology sector—these include financial technologies (FinTech), medical-related technologies (MedTech), and information and software technologies. Within financial technologies, we include the following NAICS 3-digit industries: *Credit intermediation and Related Activities* (522), *Securities, Commodity Contracts, and Investments* (523), and *Insurance Carriers and Related Activities* (524). For medical technologies, we include *Pharmaceutical and Medicine Manufacturing* (325),[5] *Medical Equipment and Supplies Manufacturing* (339),[6] and *Ambulatory Healthcare Services* (621). For information and software, we include *Software Publishing* (511), *Data processing, Hosting, and Related Services* (518), and *Other Information Services* (519).

To match NAICS codes to Crunchbase startups, we sort and group the category descriptions from Crunchbase into a relevant three-digit industry. For example, we group the category description "pharmaceutical" into industry *Pharmaceutical and Medicine Manufacturing* (325) while we group the category description "medical device" into *Medical Equipment and Supplies Manufacturing* (339). Category descriptions of startups that are related to financial, medical, or information/software, but do not fit into the three-digit level NAICS industry codes, are grouped into the three following categories: *Unclassified MedTech*, *Unclassified FinTech*,

[5] This broader industry is called *Chemical Manufacturing* (NAICS 325) but we only code companies for the sub-industry *Pharmaceutical and Medicine Manufacturing*.

[6] This broader industry is called Miscellaneous Manufacturing (NAICS 339), but we only code companies for the sub-industry *Medical Equipment and Supplies Manufacturing*. We did not include the regulatory index for industry 339 in this version of the paper because the Mercatus Center notified us that 339 has not yet met the algorithm's accuracy checks on RegData 3.0.

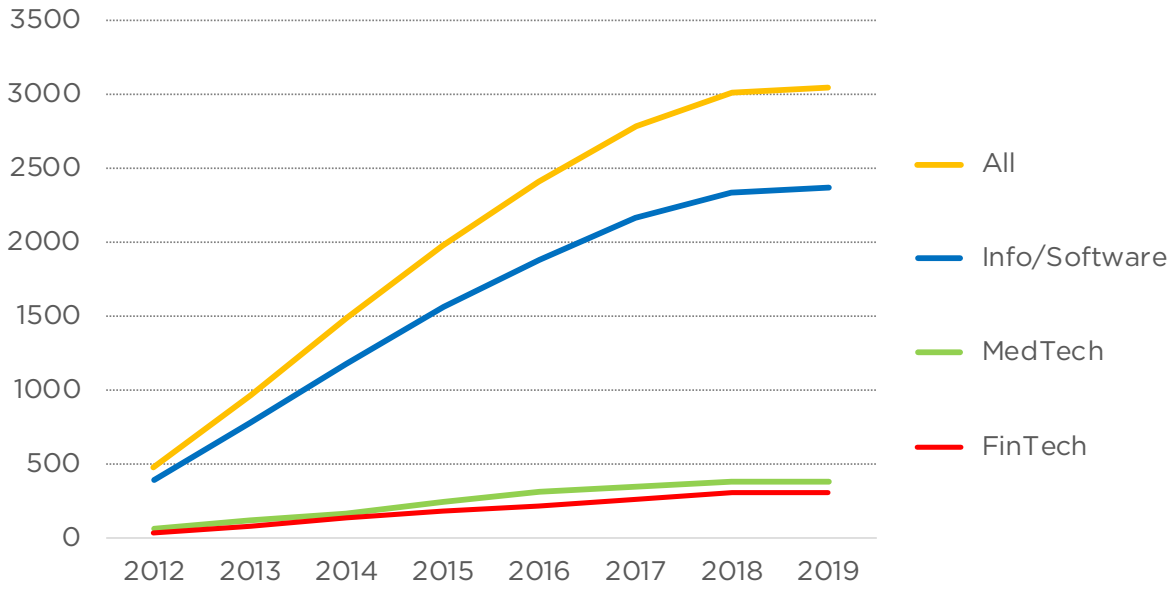
Table 2a: Summary Statistics for Canada: Birth, Closing, and Regulatory Indices

		Obs	Mean	Std. Dev.	Min	Max
	reg1	8	3162.482	594.5025	2392.148	3690.875
325	reg2	8	3165.5	465.5357	2480.207	3679.561
Pharma.	reg3	8	2873.074	424.5348	2480.207	3586.06
Med. Mfg.	births	7	0.4033	0.3798	0	0.875
	closed	69	0.0145	0.1204	0	1
	reg1	8	98.18819	4.316043	92.9975	102.738
511	reg2	8	97.98736	3.563705	92.26222	102.2467
Soft. Pub	reg3	8	95.24236	3.916124	90.17044	101.1164
Industries	births	7	0.3368	0.3238	0.0171	0.9781
	closed	1,193	0.026	0.1592	0	1
	reg1	8	50.22438	1.357224	48.4971	52.1679
518	reg2	8	49.98926	1.39331	47.51402	51.5731
Data	reg3	8	48.65458	1.98666	45.58134	51.05674
Processing	births	7	0.2703	0.2388	0.0091	0.6957
	closed	111	0.027	0.1629	0	1
	reg1	8	416.1687	15.61135	395.7129	434.7623
519	reg2	8	415.3976	13.59355	395.597	433.89
Info	reg3	8	404.7606	13.82429	386.5764	425.1013
Services	births	7	0.2755	0.3766	0	1.042857
	closed	309	0.0485	0.2153	0	1
	reg1	8	1433.703	81.29915	1303.576	1513.048
522	reg2	8	1423.286	75.63949	1277.751	1488.19
Credit	reg3	8	1331.372	147.5917	1082.536	1484.146
Interm.	births	7	0.87	1.8394	0	5
	closed	29	0.1034	0.3099	0	1
	reg1	8	936.519	15.1687	906.6861	954.1797
523	reg2	8	933.5141	9.792233	911.3611	943.6858
Securities	reg3	8	923.148	21.93293	886.4191	943.6858
CC, Invst.	births	7	0.3403	0.3457	0.013	1
	closed	78	0.0256	0.1591	0	1
	reg1	8	536.1353	14.79059	513.6546	560.5815
524	reg2	8	534.8826	7.29723	523.4044	544.2926
Insurance	reg3	8	531.0129	13.54522	506.79	544.2926
	births	7	0.3176	0.201	0	0.5714
	closed	32	0	0	0	0
	reg1	8	186.1028	26.72172	157.9716	215.5685
621	reg2	8	185.7068	20.27199	161.2699	210.7808
Amb.	reg3	8	197.8918	15.96153	170.8463	211.258
Healthcare	births	7	0.4452	0.351	0	1
	closed	11	0	0	0	0

Table 2b: Summary Statistics for the United States: Birth, Closing, and Regulatory Indices

		Obs	Mean	Std. Dev.	Min	Max
	reg1	6	57072.37	1394.87	55337.91	59115.86
325	reg2	8	57116.2	1466.003	54409.36	58684.47
Pharma.	reg3	8	55692.4	2187.602	52178.57	58140.08
Med. Mfg.	births	7	0.3384	0.3846	-0.0224	1.1429
	closed	139	0.1007	0.302	0	1
	reg1	6	394.8467	7.48312	387.5639	407.4557
511	reg2	8	384.9528	24.3298	333.1853	407.4557
Soft. Pub	reg3	8	355.8181	48.971	270.2487	395.649
Industries	births	7	0.3355	0.3787	-0.0172	1.056
	closed	4,009	0.1594	0.3661	0	1
	reg1	6	623.6808	180.3967	414.4835	871.1967
518	reg2	8	661.2183	168.8299	403.6126	871.1967
Data	reg3	8	527.6432	173.8613	299.9419	756.9849
Processing	births	7	0.3369	0.4339	-0.0076	1.209
	closed	419	0.1575	0.3647	0	1
	reg1	6	3685.359	540.8609	2584.842	3981.586
519	reg2	8	3507.58	421.176	2584.842	3905.462
Info	reg3	8	3669.32	145.4359	3483.528	3905.462
Services	births	7	0.2161	0.3135	-0.0149	0.8687
	closed	971	0.2626	0.4403	0	1
	reg1	6	38260.77	2424.161	34400.37	40780.16
522	reg2	8	38119.16	2948.932	32386.21	40780.16
Credit	reg3	8	34997.39	5027.452	26766.45	39907.12
Interm.	births	7	0.306	0.3914	-0.0488	1
	closed	141	0.2128	0.4107	0	1
	reg1	6	16829.15	1279.133	15166.31	18313.47
523	reg2	8	16924.18	1412.974	14371.32	18313.47
Securities	reg3	8	15603.65	1995.905	12535.57	17901.8
CC, Invst.	births	7	0.3477	0.3797	-0.0168	1.0741
	closed	198	0.2172	0.4134	0	1
	reg1	6	7297.509	1103.406	5601.837	8493.419
524	reg2	8	7494.933	960.5432	5867.038	8493.419
Insurance	reg3	8	6688.571	1186.141	5028.667	8176.861
	births	7	0.702	0.863	0	2.5
	closed	96	0.0833	0.2778	0	1
	reg1	6	4245.213	377.1466	3762.882	4880.432
621	reg2	8	4314.523	371.5962	3720.342	4880.433
Amb.	reg3	8	3976.382	454.2861	3264.067	4514.085
Healthcare	births	7	0.2719	0.3268	-0.0167	0.9487
	closed	182	0.0385	0.1928	0	1

Figure 1: Number of Startups in Canada



or *Unclassified Information/Software*. For example, a "Genetics" technology startup is related to MedTech, but it does not fit into any of the three relevant NAICS medical technology industries, and thus is categorized as *Unclassified MedTech*. We excluded startups that do not match any of the three broader categories of MedTech, FinTech, and information/software.[7] Appendix A provides the category descriptions for each industry code.

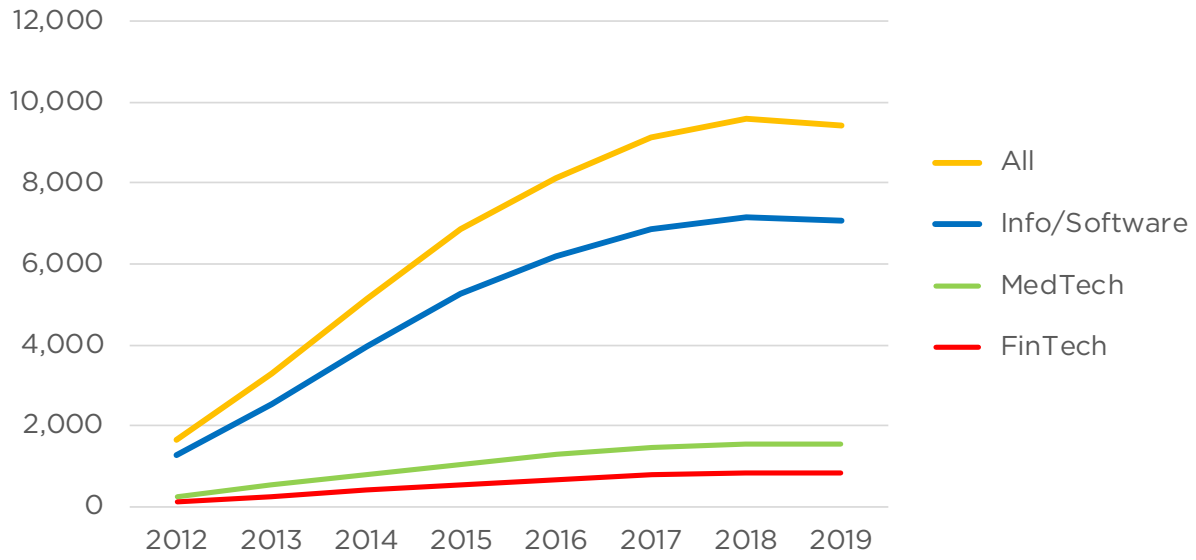
This matching method generated some startups that could potentially be assigned to multiple industries. Such startups may exist at the intersection of two or more industries. For example, a heart rate monitoring app is both MedTech and software. We conservatively include only startups that uniquely match a single NAICS code.

Tables 2a and 2b provide summary statistics of the regulatory index along with birth rates and closing rates in Canada and the United States.

Figures 1 and 2 illustrate the number of startups in Canada and United States across our main broad industries. In both Canada and the US, significantly more startups are uniquely software/info rather than MedTech or FinTech combined throughout our period. The relative

[7] 6,348 startups were dropped from the sample.

Figure 2: Number of Startups in the United States



growth rates of each of these industries are also very similar in Canada and the United States, with MedTech growing at approximately 5 percent, FinTech at 7.8 percent, and software/info at 4.7 percent from 2012 to 2019.[8]

[8] The respective growth rates for these industries in Canada are: 5.6 percent, 8.5 percent, and 5.1 percent. For the United States, the growth rates are 4.9 percent, 7.5 percent, and 4.6 percent.

Variables and Empirical Strategy

To investigate the relationship between startup births and regulation, we use our 2012-2019 panel of data by industry for the United States and Canada. We calculate the percent change in the number of startups between year t and t-1 for each year and industry. For our regulation variable, we take the natural log of our regulatory index measures, Reg1, Reg2, and Reg3.

We use Ordinary Least Squares in our estimation and include industry fixed effects to account for the fact that some industries may persistently have more startup births than others for reasons other than regulation, such as greater funding availability or naturally low barriers to entry.

To investigate the relationship between regulations and the likelihood of a startup closing, we use startup-level data from Crunchbase, which includes information on each startup's active versus closed status, year of founding, and total funding acquired. Our dependent variable is a binary variable equal to 1 when a startup closed and 0 if it remains active as of the data collection date.

We use Ordinary Least Squares in our estimation and control for total funding along with year of founding and industry fixed effects. We estimate all results individually for Canada and the United States.

Results

Startup births

Tables 3 and 4 summarize our results for Canada and the United States. For Canada, our regulatory indices Reg1 and Reg2 have negative coefficients and are approaching significance at the 10 percent level. Reg3 is significant at the 10 percent level and the results suggest a 1 percent increase in the regulatory index is associated with a statistically significant 5-percentage point reduction in startup birth rates.

For the United States, all three specifications generate negative coefficients and statistically significant results at the 5 or 1 percent level. Our specification using Reg1 suggests a 1 percent increase in the regulatory index is associated with a 1.82 percentage point reduction in startup birth rates. Our specification using Reg2 suggests a 1 percent increase in the regulatory index is associated with a 2.55 percentage point reduction in startup birth rates. Our specification including Reg3 suggests a 1 percent increase in the regulatory index is associated with a 2.45 percentage point reduction in startup birth rates.

All six coefficients on the relationship between regulation and startup births are negative, but there is greater statistical significance in the results for the United States than in those for Canada. Our findings support Hypothesis One that more regulated industries will exhibit fewer new technology startup entrants. However, it is important to note that there are fewer observations of new firm entries by industry in Canada, and thus the results in Canada should be interpreted with caution.

Startup closings

Tables 5 and 6 summarize our results for the relationship between regulation and startup exits in Canada and the United States. For Canada, all three specifications generate positive coefficients, and both Reg2 and Reg3 are statistically significant at the 10 percent level. Using the 5-year aver-

Table 3. Regulation and Annual Startup Birth Rate in Canada, 2012-2019

Dependent variable: Annual startup birth rate	(1)	(2)	(3)
ln(reg1)	-2.079		
	(1.279)	-2.955	
ln(reg2)		(1.923)	
			-5.044*
ln(reg3)			(2.733)
Pharma Med. Mfg.	0	0	0
	0	0	0
Soft. Pub. Industries	-7.304	-10.381	-17.265*
	(4.449)	(6.712)	(9.298)
Data Processing	-8.769	-12.439	-20.712*
	(5.311)	(8.011)	(11.131)
Info. Services	-4.364	-6.179	-10.033*
	(2.603)	(3.935)	(5.347)
Credit Interm.	-1.187*	-1.924	-3.346**
	(0.678)	(1.211)	(1.628)
Securities, CC, Invest.	-2.618	-3.731	-5.811*
	(1.579)	(2.393)	(3.099)
Insurance	-3.817	-5.405	-8.619*
	(2.297)	(3.464)	(4.607)
Amb. Healthcare	-5.941	-8.478	-13.562*
	(3.724)	(5.571)	(7.329)
Adjusted R2	-0.02	-0.02	0.18
Obs.	56	56	56

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Notes: Data are taken from RegData and Crunchbase. OLS with robust standard errors in parentheses. Startup annual birth rate is the percent of new startup entries for each year in the 2012-2019 period. Adjusted-R squared reported.

age regulatory index Reg2, the results suggest that a 10 percent increase in regulatory intensity is associated with a statistically significant 2 percent increase in the likelihood of a startup closing in Canada. With Reg3, the results suggest that a 10 percent increase in regulatory intensity is associated with a statistically significant 3.5 percent increase in the likelihood of a startup closing in Canada.

In the United States, all three specifications generate positive coefficients and are significant at the 5 or 1 percent level. With all three regulatory indices (Reg1, Reg2, or Reg3), the findings suggest that a 10 percent increase in the regulatory index is associated with an approximately 1-per-

Table 4. Regulation and Annual Startup Birth Rate in the U.S., 2012 to 2019

Dependent variable: Annual startup birth rate	(1)	(2)	(3)
ln(reg1)	-1.873**		
	(0.873)		
ln(reg2)		-2.558***	
		(0.826)	
ln(reg3)			-2.458***
			(0.462)
Pharma Med. Mfg.	0.000	0.000	0.000
	0.000	0.000	0.000
Soft. Pub. Industries	-9.332**	-12.762***	-12.371***
	(4.358)	(4.121)	(2.333)
Data Processing	-8.397**	-11.336***	-11.418***
	(3.912)	(3.675)	(2.172)
Info. Services	-5.347**	-7.323***	-6.815***
	(2.307)	(2.283)	(1.272)
Credit Interm.	-0.748*	-1.032***	-1.128***
	(0.402)	(0.362)	(0.249)
Securities, CC, Invest.	-2.249**	-3.069***	-3.083***
	(1.073)	(1.005)	(0.598)
Insurance	-3.276*	-4.781***	-4.806***
	(1.687)	(1.581)	(0.884)
Amb. Healthcare	-4.928**	-6.647***	-6.522***
	(2.260)	(2.128)	(1.222)
Adjusted R2	0.19	0.3	0.55
Obs.	40	56	56

* p<0.1; ** p<0.05; *** p<0.01

Notes: Data are taken from RegData and Crunchbase. OLS with robust standard errors in parentheses. Startup annual birth rate is the percnt of new startup entries for each year in the 2012-2019 period. Adjusted-R squared reported.

centage point increase in the likelihood of a startup closing in the United States.

Taken together, these findings provide some preliminary evidence that greater regulations may be associated with a greater likelihood of technology startups closing. Here, too, there is greater statistical significance in the results for the United States. There are fewer observations of startup closings by industry in Canada, and thus the results should be interpreted with caution.

Clearly the results for both startup births and startup closings are weaker in Canada than the United States. This could be because our data-

Table 5. Regulation and the Probability of Startup Closing in Canada

Dependent variable: Startup Closed	(1)	(2)	(3)
ln(reg1)	0.113		
	(0.113)		
ln(reg2)		0.210*	
		(0.105)	
ln(reg3)			0.358*
			(0.174)
fundtotusm	(0.262)	(0.263)	(0.252)
	(0.275)	(0.275)	(0.269)
2012	0.000	0.000	0.000
	0.000	0.000	0.000
2013	(0.011)	(0.016)	(0.014)
	(0.010)	(0.011)	(0.011)
2014	(0.010)	(0.017)	(0.018)
	(0.015)	(0.015)	(0.014)
2015	(0.054)	-0.056*	-0.061*
	(0.029)	(0.025)	(0.026)
2016	-0.062***	-0.072***	-0.078***
	(0.014)	(0.016)	(0.016)
2017	-0.065***	-0.075***	-0.084***
	(0.018)	(0.019)	(0.018)
2018	-0.072***	-0.081***	-0.100***
	(0.020)	(0.020)	(0.027)
2019	-0.070***	-0.081***	-0.100***
	(0.016)	(0.017)	(0.023)
Pharma Med. Mfg.	0.000	0.000	0.000
	0.000	0.000	0.000
Soft. Pub. Industries	0.408	0.744*	1.221*
	(0.387)	(0.360)	(0.583)
Data Processing	0.451	0.853*	1.431*
	(0.461)	(0.432)	(0.701)
Info. Services	0.255	0.451*	0.712*
	(0.222)	(0.207)	(0.329)
Credit Interm.	0.163*	0.240**	0.349**
	(0.084)	(0.080)	(0.132)
Securities, CC, Invest.	0.168	0.284**	0.421*
	(0.125)	(0.120)	(0.182)
Insurance	0.207	0.379*	0.593*
	(0.193)	(0.183)	(0.280)
Amb. Healthcare	0.310	0.580*	0.920*
	(0.312)	(0.290)	(0.447)
Adjusted R2	0	0	0
Obs.	543	543	543

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Notes: Data are taken from RegData and Crunchbase. OLS with robust standard errors clustered by NAICS industry in parentheses. Startup closed is a binary variable equal to one if the startup closed. Adjusted-R squared reported.

Table 6. Regulation and the Probability of Startup Closing in the U.S.

Dependent variable: Startup Closed	(1)	(2)	(3)
ln(reg1)	0.095***		
	(0.024)		
ln(reg2)		0.116**	
		(0.042)	
ln(reg3)			0.089**
			(0.035)
fundtotusm	-0.325**	-0.324**	-0.323**
	(0.095)	(0.095)	(0.095)
2012	0.000	0.000	0.000
	0.000	0.000	0.000
2013	(0.007)	-0.016*	(0.016)
	(0.010)	(0.008)	(0.010)
2014	-0.047***	-0.062***	-0.060***
	(0.009)	(0.009)	(0.011)
2015	-0.092***	-0.108***	-0.113***
	(0.012)	(0.009)	(0.017)
2016	-0.135***	-0.150***	-0.161***
	(0.010)	(0.010)	(0.018)
2017	-0.139***	-0.154***	-0.166***
	(0.007)	(0.011)	(0.020)
2018		-0.167***	-0.178***
		(0.011)	(0.021)
2019		-0.179***	-0.189***
		(0.009)	(0.019)
Pharma Med. Mfg.	0.000	0.000	0.000
	0.000	0.000	0.000
Soft. Pub. Industries	0.489***	0.591**	0.460**
	(0.117)	(0.208)	(0.179)
Data Processing	0.423***	0.513**	0.409**
	(0.108)	(0.190)	(0.170)
Info. Services	0.292***	0.340**	0.261**
	(0.065)	(0.112)	(0.092)
Credit Interm.	0.154***	0.153***	0.147***
	(0.009)	(0.018)	(0.019)
Securities, CC, Invest.	0.145***	0.168**	0.140**
	(0.028)	(0.051)	(0.046)
Insurance	0.186***	0.225**	0.180*
	(0.046)	(0.085)	(0.077)
Amb. Healthcare	0.210**	0.258**	0.192*
	(0.061)	(0.108)	(0.094)
Adjusted R2	0.04	0.04	0.04
Obs.	5,232	5,579	5,579

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Notes: Data are taken from RegData and Crunchbase. OLS with robust standard errors clustered by NAICS industry in parentheses. Startup closed is a binary variable equal to one if the startup closed. Adjusted-R squared reported.

set has many more US-based than Canadian-based startups. It may also be that the regulatory and/or market environments differ in the US and Canada such that the impact of regulation differs. For instance, the Canadian regulations may be less relevant for Canadian-based startups to the relatively larger US market if the goal is to expand.

Discussion and Implications

Findings on startup births and closings

Our findings are consistent with Bailey and Thomas (2017), who similarly used the Mercatus Center's RegData, and found "a 10 percent increase in the intensity of regulation as measured by the RegData index leads to a statistically significant 0.47 percent decrease in overall firm births." While our findings also suggest a statistically significant negative relationship, our magnitudes were greater.[9]

In terms of startup "deaths" or "exits," Bailey and Thomas (2017) find that regulation has no statistically significant effect on firm deaths. They conclude that it supports their hypothesis that regulations benefit incumbent companies and thus do not put existing firms out of business. In fact, Bailey and Thomas do find some evidence that deaths among large firms actually decrease: a 10 percent increase in regulation is associated with a 0.9 percent decrease in the deaths of large firms. Our findings may be consistent and complementary with Bailey and Thomas because our sample weeds out the incumbents since we only include startups that were founded after 2012. In this way, we maintain only the young firms in our sample, and do find that higher regulations are associated with more young startups exiting the industry. This finding is likewise consistent with Chambers et al. (2018). Using RegData, Chambers et al. (2018) also find that a 10 percent growth in regulatory restrictions is associated with a reduction in the total number of small firms within that industry, while simultaneously having no statistically significant association with the number of large firms in that industry.

[9] Perhaps our magnitudes are greater because our dataset consists of young, small startups and the regulatory burden may be more consequential for this group. Bailey and Thomas's (2017) dataset includes both small and large businesses.

Regulations and venture capital funding

Why would regulation lead to more startups closing? Existing studies have found that factors such as higher costs of regulatory compliance burden small companies more than larger and incumbent companies. While compliance cost is one important mechanism, another potential mechanism relevant for young technology startups is the amount of venture capital funding.

Venture capital funding is important for technology startups because almost all technology startups rely on venture capital funding to enable them to grow from early to late stages, and eventually to acquisitions or IPOs as an exit strategy, and eventually to acquisitions or IPOs as an exit strategy (Gompers and Lerner 2004) . A lack of funding (or running out of money) is often cited as one of the main reasons why startups fail (CB Insights, 2019).

Angel investors (typically early investors of a startup) and institutional investors such as venture capitalists provide funding for technology startups in exchange for equity in the startup. Venture capitalists are especially important once a startup has established its concept and is ready for the growth stage. Venture capitalists seek to invest in startups in order to get significant returns and as quickly as possible (Galbooni and Rouzles, 2010; Hargadon and Kenney, 2011; Kousari, 2011). More specifically, the goal of venture funds is to achieve returns in the order of 20 percent or more per year within a 10-year period (Hargadon and Kenney, 2011; Niles, forthcoming). Because of this, they are more willing to finance companies that have shorter time horizons and greater capital efficiency. Since heavier regulations add a layer of bureaucracy, increase capital requirements, and lengthen the time horizon of investment returns, startups in more regulated industries could attract less venture capital funding.

There is some preliminary evidence suggesting that some venture capital investors are deterred from investing in startups in more regulated industries. In a set of fieldwork interviews conducted by one of the authors between May 2017 and December 2017 in the United States, 12 out of 12 venture capital investors indicated that regulations influenced their investment decisions—often causing them to stay away from companies with regulatory risk or industries that are highly regulated.[10] For example, a founder and managing partner of a venture capital firm in Austin said:

[10] Most of the venture capital firms interviewed were investing in early-stage startups (or seed and early stage). We conducted interviews with partners or managing partners of the venture capital firm. The venture capital firms interviewed were in Austin, Boston, Denver, Los Angeles, New York City, and Silicon Valley. For a discussion of the methodology, see Palagashvili (2020).

"We stay away from things that will be highly regulated" and a managing director of a venture capital firm in Denver said: "We are not interested in investing in any business that requires regulatory approval" (Palagashvili, 2020). Both of these venture capitalists provided in-depth reasons why they stay away from startups in regulated industries. However, not all venture capital investors significantly emphasized the extent to which they stay away from highly regulated industries. Some merely mentioned that it has an influence, but indicated their willingness to invest anyway—or added caveats that included, from a founder and managing partner in Los Angeles, "willing to invest in a regulated industry, but that's different than companies that have regulatory risk." Many of these investors listed Med-Tech or BioTech industries as the ones they avoid.

When we asked venture capitalists follow-up questions on why they stay away from regulated industries, some of the reasons they gave include:

> "It takes forever to take a product to market that gets lots of regulatory hurdles; lots of clinical trials… We stay away from those industries."
> —Founder and managing partner, Los Angeles

> "More regulations correlate to longer time horizons."
> —Founder and managing partner, Austin

> *"Our policy: no health that has blood. AI yes. Non-blood health care companies, maybe. But no blood...* [When asked for a reason] *Massive repercussions… big lawsuits we're afraid of."*
> —Partner, Silicon Valley

Moreover, some venture capitalists commented that they are unfamiliar with the complex regulations in highly regulated industries and for that reason they choose to stay away from startups in those industries.[11]

Thus, further empirical work is needed to explore different types of potential mechanisms for startup failures. However, there are challenges

[11] It is important to note that interviewees drew a distinction between startups in highly regulated industries and startups in regulatory gray areas that may be prone to disruption. While they indicated they stay away from the former, many believed the latter could be a "good investment opportunity." Furthermore, the measure for regulation that we use in our paper (RegData) does not capture enforcement or regulatory gray areas. Regulatory gray areas can consist of situations where there is insufficient clarity about which regulations apply to an industry or type of startup, which industry a startup falls under, or which agencies regulate that startup.

with accurately measuring and analyzing these mechanisms with aggregate empirical studies. Because regulations can increase the amount of capital necessary to enter an industry, it means that startups in more regulated industries may need more initial capital in their early stages. One prediction is that early-stage startups will need more seed or initial funding in more heavily regulated industries than in lightly regulated industries.[12] However, it may be difficult to disentangle in the data whether there is less venture capital money flowing to startups in more regulated industries since more regulated industries require startups with greater initial capital. Thus, results based on aggregate measures of funding, even within each funding stage, would render inadequate results.

[12] Our empirical approach does not yield causal estimates and thus does not distinguish between potential mechanisms, which is beyond the scope of our paper.

Conclusion

There are, of course, many challenges to capturing the true relationship between startups and regulation. First, the measure of regulation by industry (RegData) that our paper uses only tracks federal regulations. Thus, we did not measure and track local and state regulations that have relevance for startups. Uber and AirBnb both faced regulatory battles over ride-sharing and home-sharing with *local* authorities in their startups days. Second, our procedure to match NAICS codes to the Crunchbase database on startups automated the use of category descriptions of startups and thus could have had some matching errors. Last, in the process of matching NAICS codes to technology startups, there were challenges in using NAICS industry codes that could not be easily matched to the new industries and markets that exist today. Moving forward, it might be more appropriate to develop a regulatory index that better captures the relevant industries among technology startups.

Nonetheless, our paper provided a first attempt to investigate on aggregate the relationship between industry regulations and startup birth rates (entries) and startup death rates (closings) in the United States and Canada from 2012 to 2019. We used Mercatus Center's RegData to capture the intensity of national-level regulations across industries in the United States and Canada. Our preliminary evidence suggests that more regulated industries may exhibit lower rates of entry and that more regulated industries are associated with a greater likelihood of a startup closing. Our paper also discussed startup funding as a potential avenue for how regulation may affect startup failures. Our paper leaves much room for future research. It will be important to identify the causal impact of regulation on startup entry and exit, as well as the channels by which regulation affects startup entry and exit..

Appendix A: Matching NAICS industries and Startup Descriptions

Industry Code	Categories
325 Chem. Mfg.	Biopharma, Cannabis, Chemical, Chemical Engineering, Dietary Supplements, Pharmaceutical
339 Misc. Mfg.	Assistive Technology, Medical Device
621 Amb. HC Svcs.	Cosmetic Surgery, Emergency Medicine, Health Diagnostics, Home Health Care, Outpatient Care
Unclassified Med	Bioinformatics, Biotechnology, Dental, Diabetes, Fertility, First Aid, Genetics, Health Care, Life Science, Medical, Neuroscience, Nutraceutical, Nutrition, Psychology, Quantified Self, Rehabilitation, Therapeutics, Wellness
511 Pub. Industries	Android, App Discovery, Application Performance Management, Apps, Augmented Reality, Biometrics, Browser Extensions, Business Information Systems, CAD, CMS, Computer Vision, Consumer Applications, Consumer Software, Contact Management, Developer APIs, Developer Platform, Developer Tools, Drone Management, EBooks, Electronic Design Automation (EDA), Embedded Software, Embedded Systems, Enterprise Applications, Enterprise Resource Planning (ERP), Enterprise Software, Facial Recognition, Image Recognition, Industrial Automation, Intelligent Systems, iOS, Linux, macOS, Management Information Systems, Marketing Automation, Meeting Software, Mobile Apps, Natural Language Processing, Operating Systems, Presentation Software, Productivity Tools, QR Codes, Reading Apps, Sales Automation, Simulation, Software, Software Engineering, Speech Recognition, Virtual Reality, Web Apps, Web Browsers
518 Data Processing	Cloud Computing, Cloud Data Services, Cloud Infrastructure, Cloud Management, Cloud Security, Cloud Storage, Data Center, Data Mining, Email, File Sharing, IaaS, IT Infrastructure, IT Management, Messaging, MOOC, Music Streaming, PaaS, Podcast, Private Cloud, SNS, Unified Communications, Video Chat, Video Conferencing, Video on Demand, Video Streaming, Virtual Desktop, Virtual Goods, Web Hosting
519 Other Info Svcs.	Blogging Platforms, Content, Content Creators, Content Delivery Network, Content Discovery, Content Syndication, Facebook, Google, Internet Radio, Online Forums, Online Portals, Product Search, Quantum Computing, Search Engine, Social Media, Social Network, Social News, Twitter, Vertical Search, Visual Search, Web Development
Unclassified Info	Broadcasting, Creative Agency, CRM, Data Center Automation, Data Integration, Data Storage, Data Visualization, Database, Digital Entertainment, Digital Media, Document Management, EdTech, Electronic Health Record (EHR), Independent Music, Information and Communications Technology (ICT), Information Services, Information Technology, Internet, Internet of Things, Journalism, mHealth, News, Open Source, Photo Sharing, Predictive Analytics, Publishing, SaaS, Social CRM, Social Media Management, Virtual Assistant, Virtual World, Virtualization
522 Credit Int.	Commercial Lending, Consumer Lending, Credit, Credit Bureau, Credit Cards, Debit Cards, Leasing, Lending, Micro Lending, Mobile Payments, Transaction Processing
523 Securities, CCs, Investments	Angel Investment, Asset Management, Financial Exchanges, Hedge Funds, Impact Investing, Incubators, Real Estate Investment, Stock Exchanges, Trading Platform, Venture Capital, Virtual Currency, Wealth Management
524 Insurance	Auto Insurance, Commercial Insurance, Health Insurance, Insurance, InsurTech, Life Insurance, Property Insurance
525 Funds, Trusts, etc.	(none)
Unclassified Fin	Banking, Bitcoin, Cryptocurrency, Finance, Financial Services, FinTech, Funding Platform, Payments, Personal Finance

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