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Evaluating the Impact of the Chief Digital Officer on Firm Performance

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Does the Chief Digital Officer Matter?

Evaluating the Impact of Digitization on Firm Performance

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Abstract

Over the past several decades, digitization has rapidly transformed and disrupted every industry across the planet. As digital technology becomes integral to the success and survival of companies on a global scale, an executive role tasked with leading digital transformations has become increasingly employed – that of the Chief Digital Officer (“CDO”). Emerging from relative nonexistence in recent years, the CDO is now a key figure at the helm of many large organizations in the digital age. While the growing prevalence of the CDO is indisputable, there presently exists little empirical research on the impact of this officer. This led me to wonder: in the digital age, do firms with a CDO in place outperform those which do not? In an effort to assess the impact of the CDO, I conduct an exploratory study into the position. I first define the role and investigate its associated duties, expectations, and challenges, as well as survey its prominence across industries. I then illustrate the officer’s potential impact on firm performance through real-life example. I conduct empirical research into the financial performance for firms with a CDO and firms without to understand the significance of the role, uncovering Tobin’s q 0.230 ($p = .000$) higher on average for CDO firms after accounting for other variables. I conclude by acknowledging limitations to my research and further opportunities.

Keywords: Chief Digital Officer, CDO, digitization, digital transformation, digital innovation

Does the Chief Digital Officer Matter?

Evaluating the Impact of Digitization on Firm Performance

Over the past several decades, digitization has rapidly transformed and disrupted every industry across the planet. This change has unseated some of the world's most powerful companies, newly challenged by their digitally savvy counterparts. Not only are organizations challenged to digitize existing processes, but they are additionally expected to “[disrupt] the current competitive landscape with innovative digital services” (Stanton Chase, 2015). As digital technology becomes integral to the success and survival of companies on a global scale, an executive role tasked with leading digital transformations has become increasingly important – that of the Chief Digital Officer (“CDO”). Emerging from relative nonexistence in recent years, the CDO is now a key figure at the helm of many large organizations in the digital age. As of 2016, approximately nineteen percent of companies had a CDO or equivalent, up from six percent the year prior; approximately sixty percent of these officers had been appointed since 2015 (Peladeau, Herzog, & Acker, 2017). While the growing prevalence of the CDO is indisputable, there presently exists little empirical research on the impact of this officer. This led me to wonder: in the digital age, do firms with a CDO in place outperform those which do not? In an effort to better understand the CDO, I conduct an exploratory study into the position. I first define the role and investigate its associated duties, expectations, and challenges, as well as explore its prominence across industries. I then illustrate the officer's potential impact on firm performance through example. I conduct empirical research into the financial performance of firms with a CDO and firms without to evaluate the significance of the role, and conclude by summarizing limitations to my research and further opportunities.

What is a Chief Digital Officer?

As a nascent position, not yet precisely defined, the description of the CDO varies on a company-to-company basis. The particular background and skillset of each officer depends on a company's unique strategic objectives, existing executive team, level of digital development, and a wealth of other factors. For example, some CDOs might be hired specifically for the purpose of enhancing customers' digital experience, while others may have the task of overhauling many to all parts of the organization. For the former, specialization in marketing might be of unique value, while for the latter, the officer would likely need expertise in multiple areas and the ability to facilitate holistic organizational change¹.

Despite the variance in the functions of this position, in this paper I will define the overarching role of the CDO as driving digital transformation across an entire organization. The CDO is a "transformer in chief" with the uniquely challenging task of revolutionizing company structure in a constantly evolving digital landscape (Rickards, Smaje, & Sohoni, 2015). This officer does so to maximize business value from digital technologies. As a C-suite role, the CDO supports top management in the creation and execution of a dedicated digital transformation strategy (Singh & Hess, 2017). He or she may spread enthusiasm around digital possibilities, coordinate digital activities, rethink products and processes, and more. A successful CDO will not only facilitate top-line support for digital initiatives, but will be able to spread this throughout the organization and across all levels of hierarchy.

In understanding the CDO role, it is important to distinguish it from seemingly analogous C-suite positions. The most essential differentiation is with that of the Chief Information Officer (CIO), an organization's most senior information technology (IT) executive. The CDO plays no explicit role in the maintenance of the company's IT systems, giving this officer freedom to

¹ For case studies of CDOs across industries, see the Sing and Hess (2017) article "How Chief Digital Officers Promote the Digital Transformation of their Companies."

focus on broader strategy and digital innovation (Tumbas, Berente, & vom Brocke, 2017). Even if the CIO does have a more all-encompassing role, the CDO expands upon this by supporting cross-functional collaboration and actions to digitally transform the entire company (Singh & Hess, 2017). The CDO also differs from the Chief Data Officer in that it does not focus solely on the exploitation of data, and from the Chief Innovation and Chief Strategy Officers in that its innovation and strategy focuses are limited to digital. Through these slight differentiations, it is clear that many top management roles overlap with the CDO. This is an innate part of the position. Because digital has the ability to influence every aspect of a business, the CDO resembles a CEO in many ways. This officer must ensure that disparate business functions are acting in harmony to successfully implement the digital strategy.

At the intersection of these various functions, often times CDOs will demonstrate expertise in a particular area, such as information technology or marketing. It is commonly believed that there are subsets of the CDO position. The three most notable seem to be brand and marketing specialists, technology experts, and transformation strategists (Deloitte Digital, 2016). Tumbas, Berente, and vom Brocke (2017) expand upon this line of thought by supporting the notion that there are three primary functions performed by the CDO, and consequently, three subsets: digital accelerators, marketers, and harmonizers. Their three focal points are digital innovation, data analytics, and customer engagement, respectively. The digital accelerator promotes innovation by relentlessly experimenting; a key principle of this role is to “reduce the cycle time required for different areas to consider and incorporate digital innovations.” The digital marketer CDO uses data analysis and other technologies to obtain an in-depth understanding of customers, and the digital harmonizer aggregates initiatives in various parts of the organization under a single umbrella (Tumbas, Berente, & vom Brocke, 2017). Once again, the CDO will ideally demonstrate the ability to perform each of these functions.

While each CDO differs from the next, there are several core competencies that tie them all together. Digital transformation leaders are unique from other officers in that they serve as “productive disruptors.” They don’t simply endeavor to disrupt their industries; they know what actions to take in order to productively do so. They are innovative, disruptive, socially adept, determined, and bold leaders (Russell Reynolds Associates, 2015). The strength of these attributes in each leader may vary, but all are present nonetheless. These personal qualities are matched by subject-area expertise and experience. The ideal CDO is “an executive with digital acumen, as well as a seasoned general manager capable of driving large-scale change” (Grossman & Rich, 2012).

With so many different responsibilities in so many areas, the CDO needs the ability to skillfully navigate a myriad of challenges. The most prominent of these include “ad hoc digital initiatives spread throughout a large organization, lacking central oversight; a traditional culture that resists change; a gap in the talent required; and legacy systems and structures that threaten to derail their ambitions” (Peladeau, Herzog, & Acker, 2017).

Hiring a CDO indicates that a company is digitally advanced enough to warrant a unified, comprehensive approach to digitization. There are two major factors promoting the establishment of this position: (1) external pressure from the market to advance digitally and (2) complexity in facilitating this change (Singh & Hess, 2017). Among the number of reasons why this transformation can be complex, some of the most prominent include the IT department’s lack of influence or its fixation on the maintenance of systems, the prominence of traditional marketing practices with no functioning relationship between IT and marketing, and digital innovations in disparate areas of the business, lacking overarching strategy (Tumbas, Berente, & vom Brocke, 2017). The prominence of the CDO varies from industry to industry, largely stemming from the scale with which digitization has upended it (see Figure 1). While B2C

companies such as those in consumer goods and media are more likely to have a CDO, B2B organizations such as those in mining and automotive tend to lag behind, as digitization has had less of an impact on these industries to date (Friedrich, Péladeau, & Mueller, 2015). In many of these comparatively unaffected industries, organizations have yet to see the need for a singular executive role to oversee digital strategy. Instead, these firms tend to manage their digital transformations at the function, business unit, and geographical market level, and hire individual employees to manage transformations within each (Newman, 2016). This isn't likely to remain the case for the foreseeable future, however. With the rise of transformative technologies such as the Internet of Things, digital penetration is inevitable in all industries.

Interestingly, technology companies tend to be some of the least likely to have a CDO. Inherently digital in nature, they instead have probably integrated digital into various executive positions and across all hierarchies in the organization. Rather than a centralized role, the various responsibilities are distributed among numerous positions. This finding highlights that, in digitally advanced companies, a single digital officer is not necessarily requisite. Although this role might not always be around, its duties will be. It is likely that “there will be a time where the word ‘digital’ added to a job title will be seen as superfluous” (Stanton Chase, 2015). Digital will be ingrained in every major organizational role. It seems that companies relatively young in their digital journeys can benefit the most from a centralized officer. Friedrich, Péladeau, and Mueller (2015) delineate the point in digitization at which organizations tend to benefit most from a CDO (see Figure 3) – not quite in digital infancy (“Discovery”), but also not quite at the point of full digital integration (“Transformation”).

Across all industries, the top performers in revenue growth and return on digital investment are far more likely to tie in digital with their corporate strategies. Among leading companies, nearly half invest more in digital than their counterparts. Even more importantly, they invest more in

every area of the business; their digital investments are larger in both scope and magnitude. Additionally holding true across all industries is that larger companies are more likely to see the need for a single leading digital officer to coordinate a strategy. Companies with more than 10,000 employees are roughly three times more likely to have a CDO (Bughin, LaBerge, & Mellbye, 2017). Given the complexity of these larger companies, it is believable that their digital transformations are distinctly more challenging and thus warrant a CDO.

A Tale of Two Companies

The true necessity and value of digitization is best understood through real-life example. In 2017, Domino's unseated Pizza Hut as the largest pizza chain in the U.S. So how did it accomplish this? In response to dismal sales and customer complaints in the early 2000s, Domino's set in place a strategy to revitalize its business. It transformed from a pizza company that sold online into an "e-commerce company that happens to sell pizza" (Wong, 2018). This makeover led to innovations that would revolutionize not only the organization, but also the pizza, fast food, and delivery industries.

Domino's appointed its first CDO, Dennis Maloney, in 2015. The company began prioritizing digital innovation before recognizing the need for a central officer, however. Prior to Maloney's hire, the company launched an online ordering portal, later incorporating a pizza designer and delivery tracker. It also introduced a smartphone app with the ability to save delivery addresses, payment methods, and favorite items (Kirk, 2015). Each improvement to Domino's digital technology was enacted with a desire to make the customer experience as seamless as possible. Maloney's entrance into the company elevated digital; many of the initiatives he led altered Domino's approach to delivery. In 2015, Domino's unveiled a delivery vehicle with a heating oven capable of storing eighty pizzas. While under two hundred of these cars exist, they add to the company's ethos as a technology leader, only furthered by its

experimentation with robot and drone delivery (Taylor, 2016). Most recently, Domino's announced over 150,000 delivery "Hotspots." Customers can now have pizza delivered practically anywhere, no longer limited to at-home delivery. Once again, this initiative was formulated with a unified customer experience in mind. It has never been easier to order Domino's; presently, it's as simple as texting a pizza emoji or shouting to Alexa. Before investing in digital technology, Domino's stock price hit an all-time low at \$3.00 a share in 2008 (Wong, 2018). Today, it hovers around \$250.00 a share.

Pizza Hut lagged behind as Domino's made these massive digital strides (see Figure 3), and it only began to regain market share when it enacted a similar strategy. Although Pizza Hut appointed its first CDO, Baron Concors, before Domino's in 2014, the company focused its efforts primarily on retail storefronts rather than technological innovation. Pizza Hut's parent company Yum! Brands committed \$130 million to the chain in 2017, a large portion of which will be used for an "aggressive investment in digital" to catch up to competitors (Kelso, 2018); namely, to catch up to Domino's. It will take Pizza Hut time to level the playing field. While Domino's generates approximately 60% of its sales through digital channels, Pizza Hut is in the realm of only 55% to 58% (Kelso, 2018).

In as saturated and competitive of markets as fast food and pizza, digital technology is an obvious way for companies to differentiate themselves. Not only is there ever-present competition from other major chains, but the rise of delivery services like Uber Eats and Postmates are adding pressure to enhance the digital experience. Through these mediums, companies like Domino's and Pizza Hut are faced with the threat of smaller restaurants. Food delivery services give customers the option to order from local restaurants with the ease and speed of a major chain, and new, innovative businesses such as Brenz continue their infiltration of the American fast food scene. While the pizza business will undoubtedly continue changing

rapidly, one thing is certain: digital will be a key driver of the evolution in this industry and many others.

Analytical Assessment of Whether the CDO Matters

Data

In my exploratory study into the CDO, I examine financial performance in companies with CDOs and those without through ordinary least squares regression. I control for various variables including Standard Industry Classification (“SIC”) industry, company size, and the officer’s length of time in the role. Tobin’s q is the metric I use to ascertain firm performance. Tobin’s q is the ratio of firm market value over the current replacement cost of its assets (Tobin, 1969). It measures the premium that the market is willing to pay above or below the firms’ assets’ replacement costs and captures above-normal returns. I used this capital market-based measure modeled after Germann, Ebbes, and Grewal (2015) research for a number of reasons: “(1) [it captures] both immediate and future firm performance; (2) [it is] organizational goal agnostic, permitting performance comparison across firms that pursue different performance goals (e.g., growth vs. profits); and (3) [it is] less affected by accounting conventions because they include the potential effect of accounting practice inconsistencies across industries when evaluating expected future revenue streams” (Germann, Ebbes, & Grewal, 2015).

In determining the companies of interest for my research, I was granted access to data collected for the Peladeau, Herzog, and Acker (2017) study², “The New Class of Digital Leaders,” which examined CDOs at the world’s largest 2,500 public companies³. I narrowed this list down to United States-based companies, excluding those in the Global Industry Classification Standard (“GICS”) electric utilities and capital markets industries. These firms

² Data access was granted to me with the exclusion of the names of Chief Digital Officers found in the study.

³ The Peladeau et al. study defined the 2,500 largest publicly traded companies by their market capitalization (from Bloomberg) on July 1, 2016.

operate in highly regulated markets, making their capital and risk requirements abnormal. From this, I selected only the firms with a CDO. For the purposes of my study, I define the CDO as any executive in a vice presidential or C-suite role with the word “digital” included in his or her title⁴. This definition serves to determine the impact that this officer can have when he or she is empowered at the highest levels of an organization, rather than in less influential positions (e.g. director)⁵.

In obtaining information on each company’s CDO(s), I primarily utilized LinkedIn. As an added layer of insurance, I searched for support of his or her role within the company through articles written about or by the executive, as well as information available on the company website. If I was unable to find supporting information, I excluded the executive and company from the list. For example, this next step led me to eliminate Ford. To be included as a “CDO” classified company, it needed a CDO in place at least once over the time period of my study, which assessed financial performance from the years 2013 to 2017. My approach to finding peer firms without a CDO followed a similar strategy. For the five year period in which I examined the companies, I used the aforementioned methods to ascertain if the company had an executive that fit my description of a CDO. If the company showed no sign of such an executive, they were a potential match. I paired each CDO firm with another in the same 2-digit historical SIC code, found via Compustat. A list of 2-digit SIC industries can be found in Table 1.

From my list of companies, I attempted to include only “corporate brands.” A corporate brand is described as having its corporate name “dominant in endorsing all or part of the firm’s product and service brands. At the least, the corporate name is an element of the product brand

⁴ This is a narrower scope than that of Peladeau, Herzog, and Acker (2017), who define a Chief Digital Officer as “an executive, no matter of the title, who has been given the task of putting into practice the digital mission of his or her company or business unit.”

⁵ My definition resembles that of Germann, Ebbes, and Grewal (2015) in their study on the Chief Marketing Officer (CMO). They similarly define a CMO as “an executive listed in the TMT with the term ‘marketing’ in his or her title.”

names. This holds throughout all its subsidiaries and at all company levels” (Laforet & Saunders, 1994). Examples of corporate brands include Apple, Nike, and AT&T. Corporate branding strategy is believed to positively impact Tobin’s q (Rao, Agarwal, & Dahlhoff, 2004)⁶. To avoid bias in my estimation of Tobin’s q , narrowing my scope to companies with a corporate branding strategy was necessary. I did my best to follow the approach used by Rao, Agarwal, and Dalhoff (2004) to ascertain corporate brands⁷. After completing my list of CDO and matched non-CDO firms ($n = 98$), I created a dataset with company financial information for 2013 – 2017 using Compustat. A complete list of firms in my study can be found in Table 2.

Independent variables used in my linear model include 2-digit SIC code, number of employees, the presence of a CDO (or lack thereof), and the officer’s length of time in the role. SIC was coded as a dummy variable (x_1 through x_{21}), resulting in $x_n = 1$ if the firm was in said industry and $x_n = 0$ if not. I coded firm size as the number of employees (in millions) as a continuous independent variable (x_{22}). If the company was one of the forty-nine classified as having a CDO at some point during the five year period, it was coded $x_{23} = 1$. It was coded $x_{23} = 0$ if not. My final variable looked at the length of time the CDO had been in his or her position, listed in number of months (x_{24}). In all non-CDO firms, this column was given a zero.

Methodology

I conducted ordinary least squares regression using R, fitting a linear model between Tobin’s q and independent variables. Tobin’s q did not have a normal distribution, and consequently, I used the logarithm of this number in my linear model. Figure 4 (a) shows the non-normal distribution, and (b) shows the more normal histogram after taking a log of the number.

⁶ For more information regarding the potential impact of branding on Tobin’s q , see Rao, Agarwal, & Dahlhoff’s 2004 paper, “How Is Manifest Branding Strategy Related to the Intangible Value of a Corporation?”

⁷ In the Rao, Agarwal, & Dalhoff (2004) study, the degree of consistency between two students classifying companies as corporate brands was roughly 86.7%.

Hierarchical linear regression results are shown in Table 3. Model I shows that SIC alone is fairly predictive of Tobin's q , explaining 47.07% of the variance in the data. Model II reveals that the size of the company, quantified in terms of the number of employees, is additionally significant in predicting Tobin's q . This model leads to a jump in R^2 and adjusted R^2 (47.07% to 48.21% and 44.65% to 45.72%, respectively). Evaluating the additional sum of squares, Model II performs better than Model I ($F = 10.10$; p -value = 0.002). Furthermore, when we include CDO presence ($x_{25} = 1$ if firm had a CDO at any point during the time of the study, $x_{25} = 0$ if not) in Model III, we can see additional improvements in the model. CDO presence leads to a jump in R^2 and adjusted R^2 (48.21% to 50.58% and 45.72% to 47.99%, respectively). Evaluating the additional sum of squares, Model III performs better than Model II ($F = 21.65$; p -value = 0.000). This finding suggests that CDO presence is a significant predictor of Tobin's q . In Model IV, I examined the CDO's length of time in his or her role (in months) to assess its significance. While the model improves R^2 and adjusted R^2 slightly (50.58% to 50.67% and 47.99% to 48.08%, respectively), when we evaluate the additional sum of squares, Model IV does not perform better than Model III ($F = 1.14$; p -value = 0.287). Thus, the officer's length of time in the role does not significantly contribute to model fit. Referring back to Table 3, looking at Model IV, we see that the coefficient for CDO presence (β_{25}) equals 0.207. Holding 2-digit SIC code and firm size constant, the logarithm of Tobin's q is 0.207 higher for CDO firms than for their peer firms. To evaluate the impact of CDO presence on Tobin's q , rather than its logarithm, we must interpret this coefficient. After doing so, the results show that after holding 2-digit SIC code and firm size constant, CDO presence is expected to result in a Tobin's q is 0.230 higher than without. With an average value of Tobin's q of 2.289 for all non-CDO companies over the five-year span, this 0.230 difference is approximately 10.05% higher.

Limitations, Future Research Directions, and Conclusions

There are a number of limitations imposed on my research that, time and resources notwithstanding, I feel would have enhanced my inquiry into the CDO. Ideally, I would have closely modeled my study after the Germann, Ebbes, and Grewal (2015) paper, “The Chief Marketing Officer Matters!” This paper takes an incredibly thorough approach to determining the Chief Marketing Officer’s impact on firm performance, and it was able to uncover the positive impact of the CMO in doing so, contrary to earlier studies. While I did utilize parts of this research in my CDO study, there were many components that I had neither the time nor know-how to implement. In a master’s or doctoral-level thesis, I would have taken the effort to understand and employ the methods of observation utilized by Germann, Ebbes, and Grewal (2015). Their study looked at Tobin’s q , as well as sales growth, excess stock return, and firm systematic and idiosyncratic risk. The models used in this research include (1) rich data models, (2) unobserved effects models, (3) IV models, and (4) panel internal instruments models.

It was additionally a challenge to precisely define companies with and without a CDO. Many organizations report that the Chief Information Officer and other high-level roles perform the same duties as a CDO. In Peladeau, Herzog, and Acker’s (2017) “Chief Digital Officer study,” they accounted for this by defining the CDO as “that executive, no matter of the title, who has been given the task of putting into practice the digital mission of his or her company or business unit.” Given more time, I would reach out to these organizations and learn first-hand if they have or have had an officer in place with duties aligning with a CDO. I feel this would cultivate a larger and more defined sample, strengthening the results of my research.

After reaching out to companies to develop a precise list of CDOs, I would have examined characteristics of these individuals, such as education, background, gender, age, and major initiatives put into their place during their time in the role. I believe that simply having a

CDO in place alone will not have an impact on firm performance; he or she must be effective in the role and facilitate a culture of digital throughout the organization. As mentioned earlier in my paper, the ideal CDO is “an executive with digital acumen, as well as a seasoned general manager capable of driving large-scale change” (Grossman & Rich, 2012). I believe my results could benefit by uncovering the officers who most accurately align with this definition; I hypothesize that Tobin’s q for these firms would be higher than their counterparts.

I feel I could have assessed financial performance over more than a five-year span were I not limited by a two-semester time period. As a nascent role, the CDO at many companies has generally been in place for under one or two years. By extending my study several years into the future, I believe my analysis would uncover greater divergences in performance between companies with and without this officer. Along with this broader time period, I would examine the impact and prevalence of CDOs on a country-to-country basis. Peladeau, Herzog, and Acker’s (2017) state that 38% of companies based in Europe, Middle East, and Africa have a CDO in place, while North America and Asia-Pacific have 23% and 7%, respectively. Differences in the prevalence of this position suggest that the implications of the CDO might vary between countries or regions.

Despite the aforementioned challenges I faced due to a short research time-period and limited expertise as an undergraduate student, I feel that the results of my research are promising. With a Tobin’s q approximately 0.230 higher for firms with a CDO than those without, my exploratory research suggests that the impact of a singular executive overseeing a firm’s digital transformation has the ability to significantly impact firm performance. As digital continues to upend companies and industries on a global scale, I believe that these findings will only strengthen with time. Future research can benefit by expanding the scope and time period of my

research, employing alternate methods of analysis, and examining the characteristics of each CDO.

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Tables

Table 1

List of 2-Digit Standard Industry Classification (SIC) Codes

2-Digit SIC Code	Industry Name
20	FOOD AND KINDRED PRODUCTS
23	APPAREL AND OTHER FINISHED PRODUCTS MADE FROM FABRICS AND SIMILAR MATERIALS
26	PAPER AND ALLIED PRODUCTS
28	CHEMICALS AND ALLIED PRODUCTS
30	RUBBER & MISCELLANEOUS PLASTICS PRODUCTS
35	INDUSTRIAL AND COMMERCIAL MACHINERY AND COMPUTER EQUIPMENT
36	ELECTRONIC/OTHER ELECTRICAL EQUIPMENT AND COMPONENTS, EXCEPT COMPUTER EQUIPMENT
38	INSTRUMENTS & RELATED PRODUCTS
45	TRANSPORTATION BY AIR
48	PIPELINES, EXCEPT NATURAL GAS
51	WHOLESALE TRADE-NONDURABLE GOODS
52	BUILDING MATERIALS, HARDWARE, GARDEN SUPPLY, AND MOBILE HOME DEALERS
53	GENERAL MERCHANDISE STORES
54	FOOD STORES
56	APPAREL AND ACCESSORY STORES
57	HOME FURNITURE, FURNISHINGS, AND EQUIPMENT STORES
58	EATING AND DRINKING PLACES
59	MISCELLANEOUS RETAIL
60	DEPOSITORY INSTITUTIONS
61	NON-DEPOSITORY CREDIT INSTITUTIONS
63	INSURANCE CARRIERS
73	BUSINESS SERVICES

Table 2

List of Firms Included in Study

With CDO		Without CDO	
3M CO	KIMBERLY-CLARK CORP	AFLAC INC	NORTHERN TRUST CORP
AETNA INC	KOHL'S CORP	ALASKA AIR GROUP INC	PANDORA MEDIA INC
AMERICAN AIRLINES GROUP INC	KROGER CO	AMETEK INC	PILGRIM'S PRIDE CORP
AMERICAN EXPRESS CO	ESTEE LAUDER COS INC	ARAMARK	PPG INDUSTRIES INC
AMERICAN INTERNATIONAL GROUP	LOWE'S COMPANIES INC	AVERY DENNISON CORP	PROGRESSIVE CORP-OHIO
AT&T INC	MASTERCARD INC	BED BATH & BEYOND INC	QUALCOMM INC
BEST BUY CO INC	MCDONALD'S CORP	BRISTOL-MYERS SQUIBB CO	REGIONS FINANCIAL CORP
CAMPBELL SOUP CO	METLIFE INC	CASEYS GENERAL STORES INC	RITE AID CORP
CAPITAL ONE FINANCIAL CORP	MICROSOFT CORP	CHEESECAKE FACTORY INC	ROSS STORES INC
CBS CORP	NIKE INC	CINTAS CORP	SHERWIN-WILLIAMS CO
CISCO SYSTEMS INC	ORACLE CORP	COLUMBIA SPORTSWEAR CO	SINCLAIR BROADCAST GP - CL A
COCA-COLA CO	PFIZER INC	COSTCO WHOLESALE CORP	SMUCKER (JM) CO
CVS HEALTH CORP	PRUDENTIAL FINANCIAL INC	CRACKER BARREL OLD CTRY STOR	SYSCO CORP
DELTA AIR LINES INC	RALPH LAUREN CORP	DICKS SPORTING GOODS INC	TABLEAU SOFTWARE INC
DOMINO'S PIZZA INC	STAPLES INC	DOLLAR TREE INC	TELEPHONE & DATA SYSTEMS INC
DUNKIN' BRANDS GROUP INC	STARBUCKS CORP	ENCORE CAPITAL GROUP INC	TORCHMARK CORP
ELECTRONIC ARTS INC	TARGET CORP	FEDEX CORP	TRAVELERS COS INC
GAP INC	TIME WARNER CABLE INC	HOME DEPOT INC	TUPPERWARE BRANDS CORP
GENERAL ELECTRIC CO	TIME WARNER INC	INTEL CORP	TYSON FOODS INC -CL A
HERSHEY CO	UNDER ARMOUR INC	INTL PAPER CO	US CELLULAR CORP
HONEYWELL INTERNATIONAL INC	UNITEDHEALTH GROUP INC	LIBERTY MEDIA SIRIUSXM GROUP	WENDY'S CO
HP INC	VISA INC	LINCOLN ELECTRIC HLDGS INC	WORKDAY INC
INTL BUSINESS MACHINES CORP	WALGREENS BOOTS ALLIANCE INC	MARKEL CORP	XEROX CORP

Table 3

List of 2-Digit Standard Industry Classification (SIC) Codes

Variables	Model I	Model II	Model III	Model IV
(x1) SIC Code 20 (SIC_20)	-0.378*** (.000)	-0.399*** (.000)	-0.382*** (.000)	-0.431*** (.000)
(x2) SIC Code 23 (SIC_23)	-0.229* (.042)	-0.273* (.015)	-0.296** (.008)	-0.310** (.005)
(x3) SIC Code 26 (SIC_26)	-0.295** (.009)	-0.314** (.005)	-0.321** (.004)	-0.339** (.002)
(x4) SIC Code 28 (SIC_28)	-0.152 (.126)	-0.166 (.092)	-0.186 (.056)	-0.169 (.080)
(x5) SIC Code 30 (SIC_30)	0.064 (.661)	0.034 (.811)	0.008 (.955)	0.003 (.985)
(x6) SIC Code 35 (SIC_35)	-0.684*** (.000)	-0.674*** (.000)	-0.686*** (.000)	-0.675*** (.000)
(x7) SIC Code 36 (SIC_36)	-0.640*** (.000)	-0.617*** (.000)	-0.612*** (.000)	-0.593*** (.000)
(x8) SIC Code 38 (SIC_38)	-0.361* (.013)	-0.368* (.011)	-0.355* (.013)	-0.388** (.006)
(x9) SIC Code 45 (SIC_45)	-0.759*** (.000)	-0.715*** (.000)	-0.714*** (.000)	-0.700*** (.000)
(x10) SIC Code 48 (SIC_48)	-0.970*** (.000)	-1.009*** (.000)	-1.039*** (.000)	-1.025*** (.000)
(x11) SIC Code 51 (SIC_51)	-0.685*** (.000)	-0.697*** (.000)	-0.724*** (.000)	-0.700*** (.000)
(x12) SIC Code 52 (SIC_52)	0.016 (.913)	0.192 (.213)	0.227 (.137)	0.312* (.042)
(x13) SIC Code 53 (SIC_53)	-0.558*** (.000)	-0.470*** (.000)	-0.461*** (.000)	-0.427*** (.000)
(x14) SIC Code 54 (SIC_54)	-0.643*** (.000)	-0.542*** (.000)	-0.504*** (.001)	-0.497*** (.001)
(x15) SIC Code 56 (SIC_56)	-0.012 (.936)	0.005 (0.970)	0.043 (.765)	-0.003 (.983)
(x16) SIC Code 57 (SIC_57)	-0.719*** (.000)	-0.710*** (.000)	-0.692*** (.000)	-0.723*** (.000)
(x17) SIC Code 58 (SIC_58)	-0.066 (.470)	-0.035 (.705)	-0.034 (.703)	-0.024 (.787)
(x18) SIC Code 59 (SIC_59)	-0.674*** (.000)	-0.614*** (.000)	-0.608*** (.000)	0.588*** (.000)
(x19) SIC Code 60 (SIC_60)	-0.376*** (.001)	-0.423*** (.000)	-0.463*** (.000)	-0.461*** (.000)
(x20) SIC Code 61 (SIC_61)	-1.122*** (.000)	-1.159*** (.000)	-1.188*** (.000)	-1.189*** (.000)
(x21) SIC Code 63 (SIC_638)	-1.064*** (.000)	-1.086*** (.000)	-1.095*** (.000)	-1.113*** (.000)
(x22) Employees		-0.007** (.002)	-0.001*** (.000)	-0.001*** (.000)
(x23) CDO Company vs. Peer Firm (CDOCompany)			0.154*** (.000)	0.207*** (.000)
(x24) TimeInPosition				-0.001 (.287)
R^2	0.4707	0.4821	0.5058	0.5067
Adjusted R^2	0.4465	0.4572	0.4799	0.4808

Unstandardized Coefficients are reported with p-values in parentheses.

* p<.10; ** p<.05; *** p<.01.

The significant coefficients are bold-faced for easy reference.

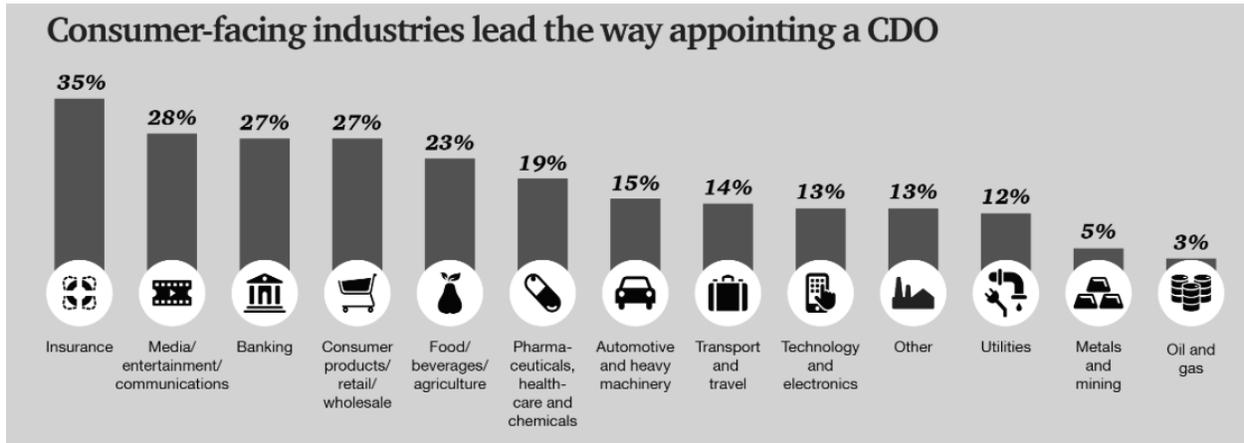


Figure 1. Chief Digital Officer prevalence by industry. This figure illustrates the percentage of companies out of the 2,500 largest global companies that had a Chief Digital Officer in position as of 2016. Reprinted from Peladeau, Herzog, and Acker (2017).

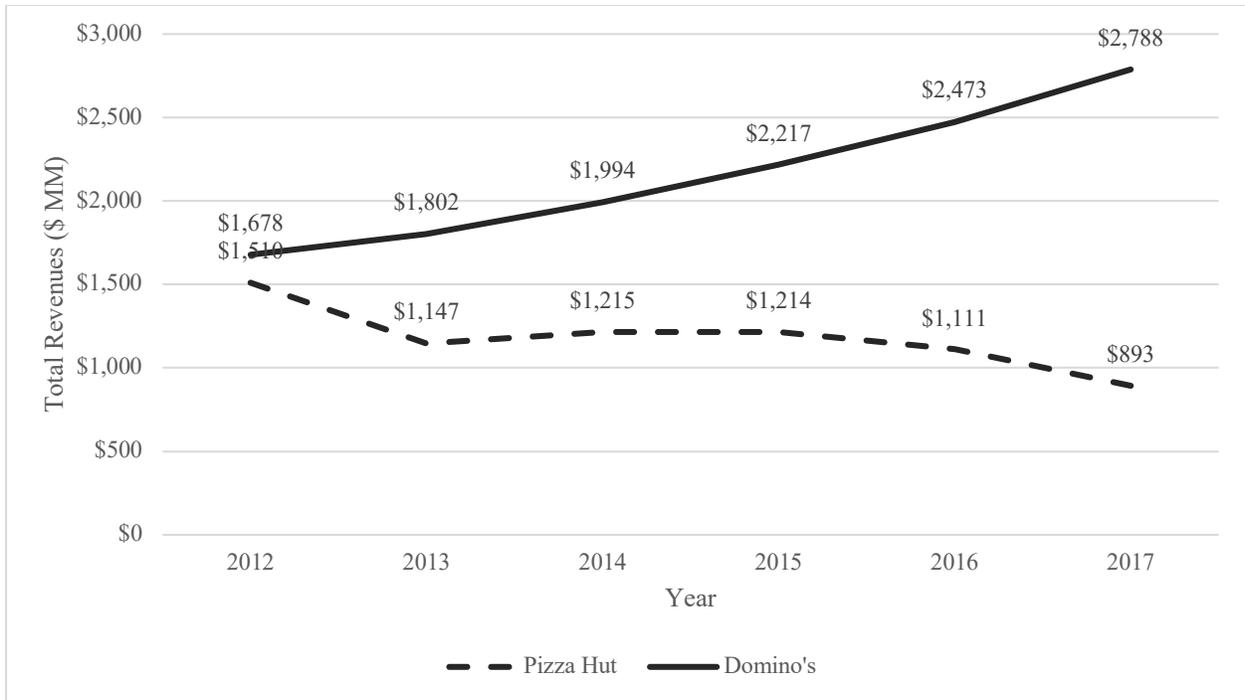


Figure 2. Domino's and Pizza Hut Annual Revenues, 2012 – 2017. As a subsidiary of Yum! Brands, Pizza Hut revenues alone were merged with other financials until the year 2012, making comparisons up to this date impossible. However, we can see the divergence in financial performance begin at some point around the year 2012. Data retrieved from Domino's Pizza, Inc. (2018) and Yum! Brands, Inc. (2018).

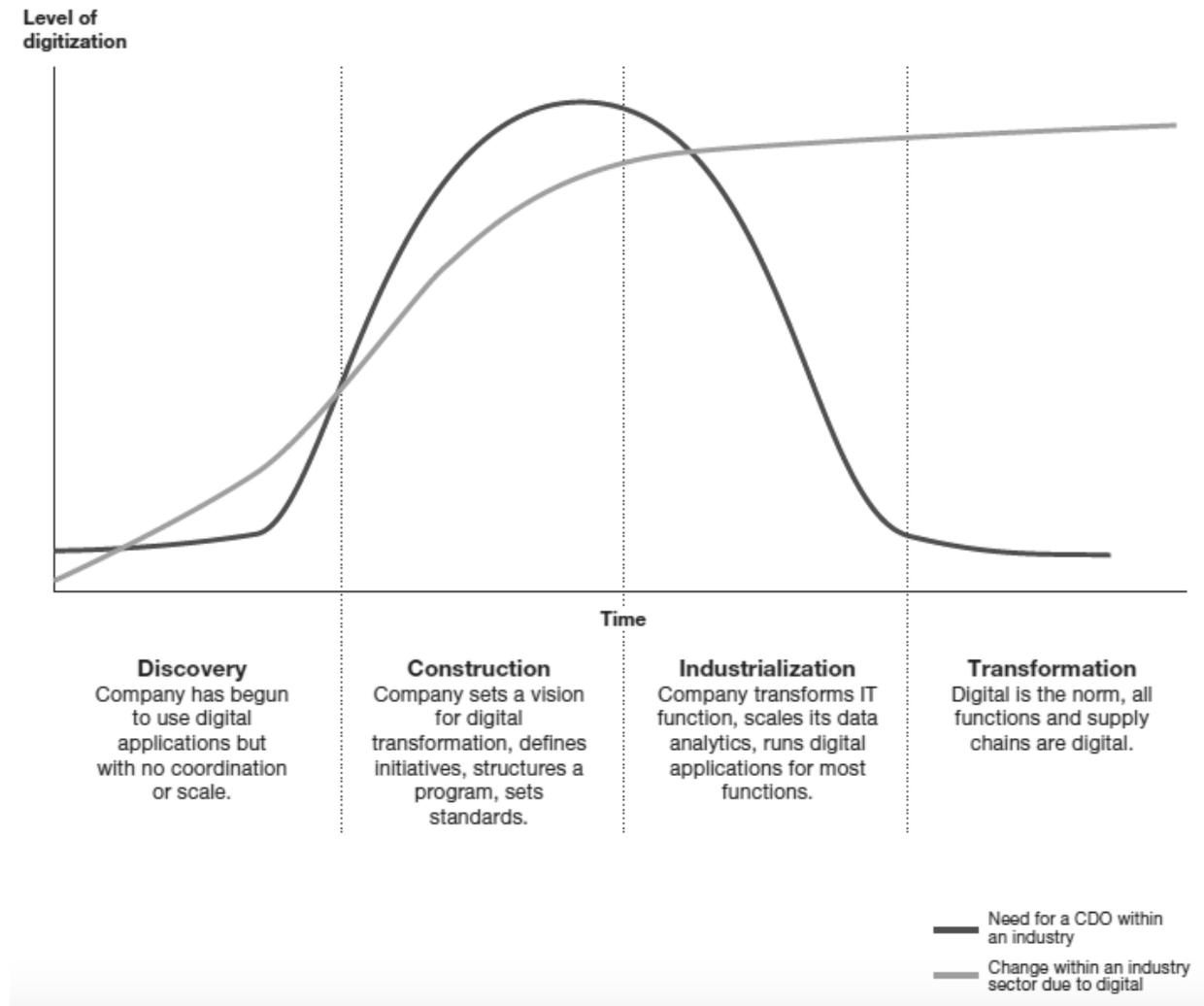


Figure 3. Chief Digital Officer need across four levels of digitization. Reprinted from Friedrich, Péladeau, and Mueller (2015).

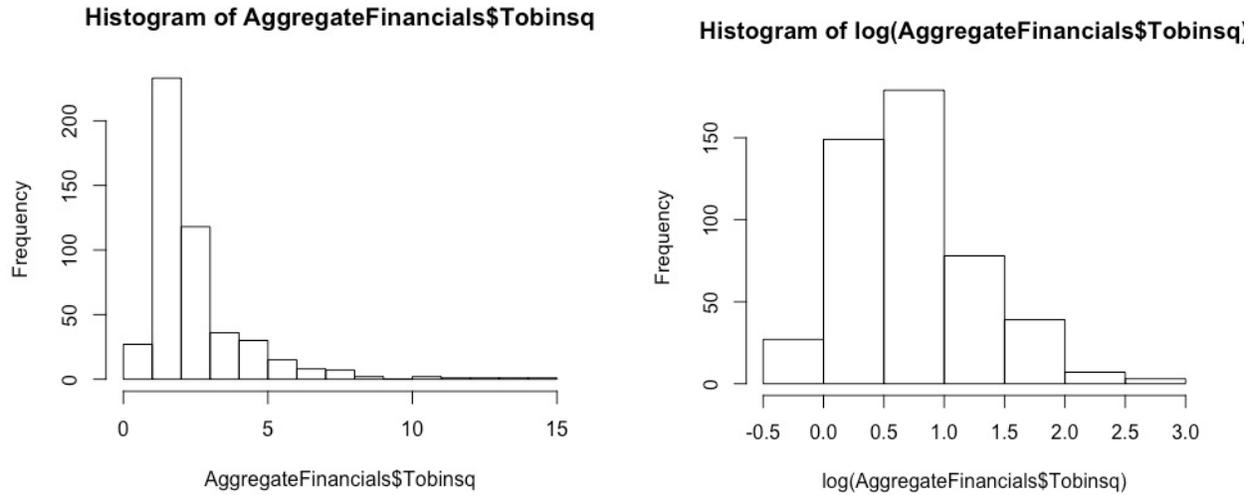


Figure 4. Histogram of Tobin's q before and after logarithmic transformation. We can see in (a) that this number is not normally distributed, and it is relatively normalized in (b) by taking a log. Because of this, I looked at the logarithm of Tobin's q in my linear model.