Political and Economic Implications of Authoritarian Control of the Internet

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Chapter 1

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Abstract During the early days of the 2011 Egyptian Revolution, the Mubarak regime shut down all Egyptian Internet access with the exception of one service provider, Noor ADSL. Analysts have noted that President Mubarak, in attempting to restrict Internet access, suffered from the dictator's digital dilemma, and have speculated that Noor's exceptional treatment was due to its role as a telecommunications provider for the Egyptian Stock Exchange. This paper shows, through an analysis of events, that stock exchange connectivity could not have been the rationale for Noor's continued services and that transaction cost economics, as described by North's theory of the state, provides a more thorough explanation for Mubarak's selective intervention with regard to Internet service. Decisions made during this series of events have implications beyond the Arab Spring. Insights are drawn from the particular case of Noor's role in the Egyptian Revolution and, in the process, a model is developed for future examination of the general case of the potential for loss of critical Internet infrastructure service under authoritarian governments.

Keywords: Authoritarian regimes, Internet governance, Arab Spring, Egypt

1. Introduction

As defined in the United States and in many countries around the world, the infrastructure is critical to the extent that the economy and society depend on it. This is a public-oriented definition. However, if we use economic theory to interpret the decisions made by authoritarian regimes in the management of critical infrastructures, we may find more self-interested motives in play. Internet access is increasingly valuable to the economy and society; it is itself part of the critical communications infrastructure. National leaders are beginning to

see the benefits of manipulating the information technology (IT) infrastructure that controls the Internet.

All the regimes that have faced popular uprisings in the Middle East over the last three years have considered the role of the Internet when protesters challenged their legitimacy. Before the events of the Arab Spring, nations around the region, such as Iran, routinely blocked websites or portions of their networks. In recent years, smaller nations such as Myanmar [22] and Libya [9] have shut down the Internet, but they maintained central control of their telecommunications systems through state-run Internet service providers.

The Internet shutdown in Egypt is an interesting case for two reasons. For one, Egypt is a large country compared with the others in the region. It has one of the region's largest economies, built on a growing IT sector that the state had been cultivating since the late 1990s [7]. Egypt had more than 20 million Internet users in 2009, second only to Turkey in the Middle East, using over ten times as much bandwidth in 2005 [5, 26]. Secondly, the Egyptian IT sector fueled the development of a number of independent ISPs that were not subject to direct governmental control and that cultivated a number of powerful clients, including regional and international financial firms as well as government ministries. These conditions present powerful countervailing economic threats to any regime that considers shutting down Internet services.

This paper provides an analysis of the Mubarak regime's shutdown of Internet service during the Arab Spring. Several reasons have been posited. This paper compares the plausibility of the various hypotheses against political, economic and technical data that describe the events related to the Egyptian protests and the government response. The analysis highlights the potential for economic theories that describe self-interested actors in transaction cost contexts to explain the events of the time. Theories that promise to reveal the motives of authoritarian leaders in the management of critical infrastructures provide opportunities to reframe national and international contractual conditions for Internet governance in the interest of critical infrastructure protection for the public good.

2. Internet Shutdown

Protests in Egypt began on January 25, 2011 and quickly spread throughout the country. After more than three decades in office, President Hosni Mubarak came under significant pressure to step down. The exit of Zine El Abidine Ben Ali, the President of neighboring Tunisia earlier that month did not portend well for Mubarak, yet he refused to relinquish power to an angry opposition. In their desire to grow and sustain their movement, Egyptian protesters benefited from online communications networks that they used to organize, draw support from around the world, and gain attention and exposure to their cause. The protesters also relied heavily on computers and mobile phones to coordinate groups of activists, track government forces and promote pro-democracy sentiments, amongst numerous other informational uses. Mubarak's government and the Egyptian economy also depended on the Internet for communications

and to conduct business. If Mubarak decided to shut down the Internet, either by blocking selected websites or by completely blocking access, there would be costs for him as well. Nevertheless, on January 28, 2011, Mubarak made the move to shut down the Internet in Egypt.

After reviewing more than 600 unique incidents involving Internet censorship compiled by researchers at the University of Washington's Communication Department, we discovered that a complete network disconnection had never been attempted on a scale as large as that in Egypt. The precedents were either much smaller, such as Myanmar's decision to cut connections in 2007, or more limited, as in Iran's Internet slowdown during the disputed elections of 2009 [11]. Libya, while immersed in an internal conflict that would end in the downfall of Gaddafi, shut down the Internet in February 2011, but its networks were neither as large as Egypt's nor as important to the nation's economy and infrastructure.

The Mubarak regime had made the decision to cultivate a strong IT sector in the late 1990s. The creation of the Ministry of Information Technology and Communications in 1999 paved the way for the massive growth of Egypt's online population, technology sector and broadband capacity [7]. By the time the Arab Spring erupted, roughly 23 million people – more than one quarter of the Egyptian population – used the Internet on a regular basis [5]. Egypt, a member of the Arab League, set up an Internet exchange in 2004. The country connects to the Internet through three crucial Asia-Europe undersea cables, FLAG, SEA-ME-WE 3 and SEA-ME-WE 4, making the control over these assets an important issue. However, it is also notable that all the Internet exchange point switches (IXPs) were collocated in one facility, allowing the regime to shut them down together by gaining physical control of a central location [23].

In this light, Mubarak's decision to force the country's Internet service providers (ISPs) to stop providing international connections was unprecedented, but it was also incomplete. For a brief period of time, one ISP remained active. This last surviving ISP, Noor ADSL (hereafter referred to as Noor), was responsible for transmitting the country's financial transactions through the Egyptian Stock Exchange, and journalists and technical experts at the time speculated that its persistence lay in this connection [10]. Most have hypothesized that the regime wanted to keep the Egyptian exchange online and, as a result, stopped short of a complete Internet blackout [6]. However, it is not outside the realm of possibility that Noor stayed online to allow the regime to make its own international financial transactions.

3. Theories of Motivation

Analysts have offered several explanations for the activities in Egypt, most of which suggest that Mubarak faced the "dictator's digital dilemma" [11] – when he weighed the economic opportunity cost of shutting down the Internet against the political consequences of leaving it operating and the protesters using it to further their cause. By this account, Mubarak reacted to the Internet's use

for collective action and, by stopping access, acted to preserve his political authority. Perhaps Noor was left operating because, as Howard, *et al.* [11] observe, governmental efforts to organize, even for national security activities, can be crippled when communications networks are compromised.

The dictator's digital dilemma plays off an observation made by former U.S. Secretary of State George Shultz in the 1990s when the Soviet Union grappled with a nascent, but rapidly growing, democracy movement. In a 1985 article in *Foreign Affairs* [28], Shultz noted that the failing Eastern Bloc regimes were facing the same challenges as the Shah of Iran faced when technology fueled the Islamic Revolution in 1979: "Totalitarian societies face a dilemma: either they try to stifle these technologies and thereby fall further behind in the new industrial revolution, or else they permit these technologies and see their totalitarian control inevitably eroded. In fact, they do not have a choice, because they will never be able entirely to block the tide of technological advance."

Building on Shultz's notion, Kedzie [13] coined the term "dictator's dilemma" in the mid-1990s. With each iteration of the theory, the telecommunications networks that form the backbone of each country's command and control, financial and social networking systems (among others) evolve into more robust, strong and dynamic forms that authoritarian regimes find increasingly difficult to control.

While the dictator's digital dilemma may well explain the economic opportunity cost for rulers who, in order to maintain control over an angry public, contemplate shutting down Internet services, transaction cost economics can provide a better lens for viewing the activities in Egypt. When a transaction cost economic approach is taken to discern the motivations of actors, the underlying behavioral assumptions have actors subject to bounded rationality, acting in their self-interest, and doing so strategically, or perhaps even opportunistically and with guile [37]. Actors are not perfect planners and it cannot always be assumed that – when their preferences conflict with others – they will act in the interest of others. Instead, the actors can be assumed to adapt to changing or unfolding situations over time, and to do so to in a self-interested way, presumably for economic gain. Indeed, the economic gain may be personal gain, even when the actor represents an organization such as an authoritarian regime.

These behavioral assumptions are made plain in Williamson's conception of the theory [35, 37] and, given applicability to the question of authoritarian action through a theory of the state, an exercise in the logic of self-interested ruling parties as described by North [20]. In North's theory, specialization and division of labor bring about economic growth as well as transaction costs. The costs of information, which play a significant role in holding back the economic growth of nations, are one form of transaction cost. As conceived by Williamson and furthered by North, all economic activity – even exchange between the state and the public – can be conceived to be contractual, economic exchange. Within their "contractual" arrangements, authoritarian rulers have a choice between acting in the public interest and acting in their personal interest. To act in

the public interest brings economic growth. However, economic growth also increases the incentive that rulers have to expropriate funds for their personal interest. Indeed, these two interests can be acted upon concurrently.

North hypothesized that technological change, even when it brings about economic growth, can cause economic instability and have a destabilizing effect on a country. Autocratic rulers find themselves in a conflict between their desire to build a system that seeks rent from their population versus one that maximizes economic output and efficiency through technological advances such as the Internet [20]. An important corollary to this hypothesis is that a reduction in the costs of information will lead to an alteration in an individual's ideology, because he can more easily discern that different, more personally beneficial systems – potential "contractual" relations – of exchange exist elsewhere. As North says, "the cost of maintaining ideological consensus is inversely related to the costs of information and directly related to the stability of relative prices" [20]. In this theory of the state, ideological consensus reduces the transaction cost of maintaining the state. The Internet lowers the cost of information and, thus, transaction costs for the public. Prices shift, economies are disrupted and more growth is made possible, but so is a diverse and dynamic pace of ideological change. When ideological consensus erodes, the transaction costs for the ruler to maintain the existing "contract" with the public rise, perhaps to extremes, as the perception of injustice or the illegitimacy of the ruling party threatens to become the core message in a new ideological consensus.

In this transaction cost conception of authoritarian rule, it is in the interest of the ruler to attempt to selectively intervene, in a calculated way, in the governance of the Internet. The perspective of the ruler may begin with a dilemma, but what results in the case of the critical infrastructure may be more reasonably described as a calculated act of selective intervention. The dictator's digital dilemma expresses the concern that a ruler may have for the impact that may result from the initial choice of whether or not to invest in the Internet, or whether or not to intervene in the provision of Internet services. When public services are shut down, the transaction costs shift abruptly from the ruler to the public. However, the calculated act occurs when Internet services that can serve the personal interests of the ruler are allowed to remain viable, while the services of value to the greater public are eliminated.

The next section examines events in Egypt during the Arab Spring for evidence to support or refute these positions.

4. Data Sources

We analyzed events using political, economic and technical data from several sources. We define a reputable source for political data as a news organization that has an established record for reporting; these sources include *The Guardian*, *The New York Times*, Al Jazeera, CNN, Reuters and Associated Press. Accuracy in reporting news is paramount in these organizations. Given that some of the sources are blogs published by news organizations, it is im-

portant to note that the Associated Press suggests that blogs may also be used as valid news sources [8].

Detailed economic data has been difficult to obtain, although we located sources that provide data about the Egyptian economy as a whole. The stock market is traditionally used as a measure of reactions to events – sometimes in business, sometimes in politics. It is common knowledge that stock markets are economic indicators for nations and regions. Resources such as Bloomberg and Google Finance were used to track the EGX 30 stock index, which offers a snapshot of Egypt's market economy. By monitoring the rise and fall of financial measures, we were able to discern trends related to the interaction between the events of 2011 and the Egyptian economy. Stock market closures also provided insights into the government's critical actions during moments of crisis.

However, after the Egyptian Stock Exchange was closed, the primary economic indicator for the country was no longer available. This made it necessary to assess economic trends in Egypt using data from outside Egypt. We concluded that our analysis would have to move a degree or two away from Egypt's central economy (or the CASE 30 index that measures it). Therefore, we used data sources that were invested in Egypt's economy without actually being a part of Egypt's economy.

We examined two sources. One source was the value of major currencies in relation to the Egyptian pound. Egypt may have been able to close its domestic banks, but it could not silence how other nations reacted to its political upheaval. Tracking the Egyptian pound to monetary heavy-hitters (such as the dollar, euro and British pound) provided insights into how these nations reacted to the crisis in Egypt – and, in fact, a glimpse into the world's perception at a macroeconomic scale. Bloomberg and Google Finance permit the mapping of multiple currencies on one graph using a predetermined time frame, allowing narrow currency comparisons that revealed reactions to individual events in the Egyptian crisis timeline.

Data pertaining to the fluctuating stock prices of multinational corporations based in Egypt was also used. In particular, we examined NYSE Arca: EGPT, which comprises companies that derive at least 50% of their revenues from Egyptian sources; this was deemed to be a worthwhile second-degree data source because it is traded on the NYSE. The EGPT companies trade in markets independent of Egypt's EGX 30, and their activities provide economic data during the period that the Mubarak regime shut down the stock market. This data provides a glimpse into the market decisions and motivations of Egyptian stock holders in America, which may be a more direct and independent indicator than the U.S. dollar to Egyptian pound exchange rate.

Our main source of technical data was Renesys, a company that tracks Internet usage around the world in real time. Renesys posts information in the public domain about the number of networks that each Egyptian ISP administers, when they went down and when they returned to operation. Renesys also provides trace-route information from computers within Egypt that allows mea-

surements of the speed, route and availability of connections with U.S.-based systems.

We also secured an account with Renesys Market Intelligence that enabled us to understand how Noor and other Egyptian ISPs connected financial markets to the Internet. We confirmed the data with other information provided in blogs as well as data drawn directly from regional Internet registries, primarily Reseaux IP Europeens Network Coordination Center (RIPE NCC), which coordinates routing tables for Europe and the Middle East. We also reviewed the number of Internet users within the country based on figures from the International Telecommunications Union [12]; this helped quantify the scale of the Internet shutdown in relation to the size of the protests and other political events.

5. Stakeholders

We selected several stakeholders to follow during the events of Egypt's Arab Spring based on their perceived political, economic and technical power or influence.

- **Hosni Mubarak:** Hosni Mubarak was Egypt's President for almost thirty years. The revolution began as a protest against Mubarak's repressive and corrupt regime, and the desire to change decades of one-party rule in Egypt [30]. At the time, Mubarak's financial holdings were estimated to be between $1 billion and $70 billion, largely amassed through illegal means [15].

- **Protesters:** The Egyptian protesters were tired of the intense repression and rampant corruption during Mubarak's one-party rule [30]. The protesters, not all of whom were members of political organizations, demanded regime change and imposed unrelenting pressure during the eighteen days of the revolution. The protesters organized massive rallies throughout the country, with Cairo's Tahrir Square as the focal point.

- **Noor:** Noor is a mid-sized ISP that serves a number of clients who are dependent or "critically dependent" on it for access to the Internet (critically dependent means that Noor provides a client its sole connection to the Internet). ISPs provide software, hardware and services, but they use fiber optic cables and other transmission resources owned and managed by telecommunications firms. Noor connects with international networks through two providers, Telecom Italia and Reliance Globalcom, an Indian telecommunications firm. Noor's clients include the Commercial International Bank of Egypt, the largest privately-held bank in Egypt; Allianz Financial, a German insurance company; AT Holding Corporation, a subsidiary of the Saudi conglomerate Dalla Al-Baraka; and a number of smaller financial and IT firms. A large portion of Noor's traffic also comes from a subsidiary provider, The Wayout Internet Solutions. At the

time, this company provided Internet connections for about one hundred networks.

- **Other ISPs:** The largest provider and the flagship government carrier is Telecom Egypt, which is also responsible for the country's telephone infrastructure [38]. Telecom Egypt provided Internet services to roughly 800 sub-networks at the time it was taken down. Other providers with access to the international Internet included two Egyptian IT companies, Link Egypt (roughly 740 networks), and Internet Egypt (100); Raya Holding Corporation (150), which is controlled by Vodafone; and Etisalat Misr (640), the Egyptian subsidary of Etisalat, an Abu Dhabi based multinational corporation [6].

- **Egyptian Stock Exchange:** The Egyptian Stock Exchange is based in Cairo and Alexandria. Its EGX 30 index is the primary indicator of Egypt's economic performance. EGX 30 comprises 30 large Egyptian companies that have a free float (publicly-traded shares) of 15% or more. The Egyptian Stock Exchange is open Sunday through Thursday. When data from EGX 30 was unavailable, the Market Vectors Egypt Index (EGPT) served as an economic indicator. EGPT is an Egyptian exchange-traded fund that tracks publicly-traded companies listed on an Egyptian stock exchange. EGPT firms that are not traded on an Egyptian exchange must generate at least 50% of their revenues in Egypt. It is worth noting that the EGPT does not permit losses of more than 10% during a trading day [27].

- **Mubarak Family:** Gamal is the youngest son of Mubarak and the younger brother of Alaa. Gamal was one of the most powerful people in Egypt before the revolution. He was Deputy Secretary General of the then ruling National Democratic Party (NDP) and also led NDP's Policies Committee, which was largely responsible for setting the course of the government. He has a background in finance; he received an MBA degree from the University of Cairo and worked in investment banking for many years, notably with the Bank of America. Later, he founded Medinvest, a private equity firm based in London (from which he has been forced to disinvest). Gamal is thought to have millions of dollars of assets worldwide; the Egyptian newspaper *Al Ahram* uncovered evidence that he controlled bank accounts at the National Bank of Egypt valued at more than $275 million.

  Gamal's older brother Alaa is also very wealthy. They reportedly had an argument about whether their father should give his resignation speech. During the argument, Alaa accused Gamal of dragging the nation into corruption [2]. Gamal and Alaa, along with their wives, are now under investigation for money laundering and stock market manipulation.

- **Egyptian Army:** The Egyptian Army has for many decades commanded the respect and reverence of the Egyptian people [17]. At the

time of the revolution, the Army had considerable independent political power, including key government posts [17]. During the revolution, the Army made the decision to allow the protests. This decision was cheered by the protesters and gave standing to their cause. The Army gained complete control of the country after Mubarak stepped down.

- **Egyptian Financial Firms:** Four financial firms, Commercial International Bank, AT Holding Corporation, Beltone Financial and Allianz Financial, represent some of the largest businesses in Egypt. The Mubarak family is suspected of having substantial investments in these firms [1]. Some of these firms trade on the EGX 30 while others are traded externally. Noor provides Internet services to these firms and enabled them to continue their business activities after the Mubarak regime shut down the other Egyptian ISPs [38].

6. Principal Events

The events are described in chronological order as they occurred in 2011. When specific times are listed, they refer to the Eastern European Time Zone, which is observed by Egypt.

Event 1 (Tuesday, January 25): Protests Start
On January 25, 2011, massive numbers of Egyptians took to the streets to protest against decades of repression and corruption perpetrated by Mubarak's regime. The protests were called "A Day of Rage" and coincided with Police Day, an Egyptian holiday [21]. The Day of Rage was apparently inspired by the successful protests in Tunisia. An invitation to protest on January 25 was widely circulated on Facebook, where it received more than 95,000 positive responses [21]. The Twitter hashtag #Jan25 was used for social media communications and helped protesters coordinate their activities.

Economic data was particularly difficult to obtain during the downward spiral that followed. An Associated Press headline claimed that the Egyptian Stock Exchange closed immediately after falling 6% in fifteen minutes, but it was not possible to verify the headline with a full report.

The government appeared to start blocking Twitter almost immediately. Numerous sources, including Twitter itself, reported that it was no longer accessible from Egyptian IP addresses. The next day, Facebook also appeared to be blocked from inside Egypt, according to local reports and data from HerdictWeb, a project of Harvard University's Berkman Center for Internet and Society that tracks web blockages worldwide [4].

Event 2 (Thursday, January 27, 2:30 PM): Stock Market Closes
EGX 30 suffered significant losses. The day after the protests began, EGX 30 lost 4.6%. At the end of the trading week (Thursday, January 27) and just three days after the protests started, EGX 30 had fallen 15% (from 6,723 to 5,646 points). The Egyptian Stock Market closes on Thursday and reopens on Sunday, but after closing on Thursday, January 27, amid escalating protests, the

stock market did not reopen the following Sunday. The government announced that the market would remain closed [31]. In fact, the market did not open again until Wednesday, March 23, 2011.

Nations that held a significant amount of Egyptian debt saw their currency exchange rates slide after the protests began. In the week ending January 28, 2011, the Egyptian pound lost 0.9% against the U.S. dollar and euro. The following week, the Egyptian pound lost 1.4% against the British pound. The British pound and euro would continue to fall, reaching their lowest exchange rates in three years in April 2011, shortly after the Egyptian Stock Market resumed trading.

Event 3 (Friday, January 28, 12:30 AM): Internet is Shut Down
Just after midnight on January 28, three days after the protests began and on a Friday, a holy day in Islam and the beginning of the weekend in Egypt, the Egyptian ISPs, Telecom Egypt, Raya Holding Company, Etisalat Misr, Internet Egypt and Link, shut down all their connections to international networks [38]. By 12:35 AM, Noor was the only Egyptian ISP that provided access to the global Internet. Later that day, Vodafone Egypt, which also controls Raya, announced that it had been ordered by the government to take down its mobile services, saying that, under Egyptian law, it was obliged to comply with the order [32]. Vodafone was likely referring to Egypt's Telecommunication Regulation Law of 2003 [19] that requires every telecommunications service provider to have a plan it would implement in cases involving general mobilization and national security. Since the start of the protests, Egypt's Market Vector Index had lost more than 20% of its value and the Egyptian pound had fallen markedly against the dollar.

The day leading up to the overnight shutdown of the Internet saw continued protests. A call was made to have the largest protest yet on the following day (Friday, January 28); this was billed as "The Friday of Anger and Freedom." Given the potential scale of the Friday protest, the Internet shutdown was described by some media sources as an apparent attempt to keep the protesters from organizing demonstrations [6].

Event 4 (Saturday, January 29, 12:18 AM): Mubarak Announces the Government Will Resign and a New Government Will be Formed
Mubarak spoke on Egyptian state television at 12:18 AM on Saturday, January 29 [33]. This was the first time he addressed the nation since the protests began. Mubarak announced that he would force the government to resign and appoint a new government the following day. Mubarak stated that he would continue to protect the security of the nation and the people, and he made it clear that he would not step down. Mubarak also criticized the protestors for creating chaos and added that he would "not let this happen."

On the day of Mubarak's speech, the American-traded EGPT fund pulled out of its free-fall; it rose 10% within a week of the speech. The protesters did not response positively to Mubarak's speech [33]. Vigorous protests calling for him to step down continued.

Event 5 (Monday, January 31, 12:46 AM): Noor Shuts Down Internet Services

At about 12:46 AM in the early hours of January 31, Noor lost its connection to the Internet. The company had been administering roughly one hundred networks and none of them were reachable [38]. With the exception of a few phones with satellite connections [11], the entire country of Egypt was effectively offline.

The previous day of protests had brought more violence to the streets of Egypt. Protesters refused to leave Cairo's Tahrir Square in defiance of a curfew imposed by the Egyptian Army.

Event 6 (Tuesday, February 1, 10:57 PM): Mubarak Announces He Will Not Run for Re-Election But Will Not Step Down

Following intense pressure from the protesters, Mubarak announced on state-run television that he would not run for re-election. Despite this concession, he refused to step down. He appointed a new Vice President, Omar Suleman, who was tasked with conducting a dialogue with "all the political forces and factions" regarding democratic reform [29]. The protesters in Tahrir Square renewed their chants of "Leave, Leave" during Mubarak's live speech. It is worthwhile to note that Mubarak did not promise that his son, Gamal, would not run for election – one of the protesters' major demands [14].

Reports indicate that pressure from the Egyptian Army may have been a factor in this announcement by Mubarak. The Egyptian Army, as a major stakeholder, had increasingly condoned the efforts of the protesters, announcing support for the people's legitimate demands and that it would not use force against peaceful demonstrators.

Event 7 (Wednesday, February 2, 11:29 AM): Internet is Turned Back On

On February 2 at 11:29 AM, all the Egyptian ISPs except for Noor returned to service. Al Jazeera reported at the time that Internet services were at least partially restored in Cairo after a five-day blackout aimed at stymieing the protests. At 12:52 PM, Noor returned to service as well. The total number of networks was slightly smaller than before due to a process called re-aggregation, in which ISPs clear redundant routes that clients are no longer using. On the day the Internet was turned back on, the euro traded for 0.126 Egyptian pounds, a 0.7% increase from the day before. Exchange rates with other major currencies also improved, but more modestly.

Event 8 (Saturday, February 5, 5:36 PM): Ruling Party Leadership Resigns

The leadership of Egypt's ruling party, including Mubarak's son Gamal, resigned. One of the protesters' principal demands was that Gamal would not succeed his father [2]; this demand was finally met. With the Egyptian Stock Market closed indefinitely and American and European markets closed on the weekend, it was not possible to gauge the economic significance of this event.

Event 9 (Sunday, February 6, 10:00 AM): Banks Officially Reopen for 3.5 Hours
After a week of protests, Egyptian banks reopened for a shortened work day, allowing Egyptians their first access to cash since the protests began. From 10:00 AM to 1:30 PM, banks saw long lines of citizens who wanted to withdraw as much cash as possible, sometimes up to a full pension in one transaction [34].

Event 10 (Friday, February 11, 6:03 PM): Mubarak Resigns
Following eighteen days of intense protests, Mubarak's reign finally ended. The Vice President announced on state-run television: "My fellow citizens, in the difficult circumstances our country is experiencing, President Muhammad Hosni Mubarak has decided to give up the Office of the President of the Republic and instructed the Supreme Council of the Armed Forces to manage the affairs of the country" [18]. Protesters in Tahrir Square celebrated, chanting "We have brought down the regime! We have brought down the regime!" [18]. There was jubilation all over Egypt.

The previous day, Mubarak had announced the delegation of authority to the Vice President, but the protesters, as well as the Army, were deeply disappointed that Mubarak had refused to resign. The resulting protests were the most intense to date and precipitated Mubarak's resignation. The week following the resignation, the EGPT fund closed at 18.73, its highest closing price since the protests began in January 2011 and a price that has not been exceeded at the time of this writing.

Event 11 (Wednesday, March 23, 10:30 AM): Stock Market Reopens and Continued Effects
When trading resumed on March 23, 2011, EGX 30 fell 8.9%, losing 504 points to close at 5,142. During the eight weeks of closure, the EGPT fund lost 4.7%, dropping from 16.22 to 15.45. EGX 30 continued to tumble, reaching its lowest value of 3,632 in December 2011, around the time that Egypt held preliminary democratic elections. This low water mark was duplicated by the EGPT fund, which closed under 10 points in late December 2011 before making a minor turnaround. As of this writing, EGX 30 has not matched its closing market value on January 24, 2011, the last day before its temporary closure and the beginning of the Egyptian Revolution. The Organization for Economic Cooperation and Development (OECD) [25] has estimated that the Egyptian telecommunications and Internet services sector alone lost $90 million during the revolution. The losses in the other dependent sectors were also significant.

7. Analysis

At its most basic level, a revolution is a transaction between a populace and its political authorities. Events in Tunisia, coupled with the lower transaction cost of collective action brought about by widespread communications via the Internet and mobile services, allowed the rapid and effective formation of protests in Egypt. Yet, revolution must be motivated by more than just low transaction costs. In transaction cost terms, it is reasonable to view the seeds

of public discontent as *ex ante* misalignment between the Egyptian people and Mubarak, blossoming into *ex post* mal-adaptation over his nearly thirty-year reign. If the transaction cost of obtaining a better bargain with ruling authorities is lowered by communication technologies, then the populace may begin to perceive the potential benefits of revolution, and to organize in an attempt to obtain the better bargain.

The idea that authoritarian rulers face a choice when such events unfold is captured in the idea of the dictator's dilemma and, specific to the decision to shut down Internet service, the choice suggested by the dictator's digital dilemma. The dictator's dilemma is founded on the idea that dictators desire to stay in power. Economic theories spell out a more direct personal motive for action. This idea is described in North's theory of the state [20], in which rulers of the state are analogous to monopolists who are tempted to and may actually sequester quasi-rents for their personal use regardless of the public interest.

At the time of the revolution, observers suggested that Noor remained online in order to keep the Egyptian Stock Exchange connected to the world. However, the stock exchange was closed before the Internet shutdown and remained closed during the time that Noor was the sole operating ISP in Egypt. In addition to the connectivity provided to the stock exchange, Noor connected Egypt with major European and Middle Eastern financial firms such as Allianz and Dalla Al-Baraka. The Mubarak family controlled a large portion of the economy and had millions of dollars in domestic bank accounts and in firms that relied on Noor's network. The Mubarak family may have intended to use Noor's network to transfer their monies out of the country.

When compared with the dictator's digital dilemma, this idea is more closely in tune with North's conception of inefficiencies of the state. It also supports the notion that Mubarak may have perceived that the duration of his transaction with the Egyptian people was at risk and could soon end. On June 4, 2012, Gamal and his brother Alaa were charged with money laundering and insider trading on the stock market. Egypt's Illicit Gains Authority, which is investigating the financial crimes perpetrated by the Mubarak regime, estimates that the Mubarak family controls more than $500 million in assets worldwide.

We posit that Noor's continued operation during the protests was because it advanced the Mubarak regime's personal financial interests. If indeed Mubarak faced – in the *ex ante* moments of the decision to shut down Internet access – the dictator's digital dilemma, then the opportunity costs of doing so may have been strategically lessened by his ability to gain control of ISPs in a calculated and selective way. Noor served the Commercial International Bank of Egypt (a joint venture of the National Bank of Egypt and Chase Manhattan Bank), and several other financial interests that were useful to the Mubarak regime. The Commercial International Bank was, according to Renesys, critically dependent on Noor for Internet service, meaning that Noor provided the firm's only access to the Internet. In contrast, the majority of the Egyptian populace used Telecom Egypt for Internet access.

Although investigations of the financial irregularities of the Mubarak regime are ongoing and the forensic analysis necessary to confirm our claim is beyond the scope of this paper, the fact that Noor, with its potential to serve Mubarak's personal interests, remained online while the services of most importance to the general public were taken offline, lends support to a transaction cost economic interpretation of events. Transaction cost economists call this selective intervention. It did not last *ex post*, because the transaction did indeed reach an end with both the complete shutdown of the Internet and the resignation of Mubarak. The temporary selection of Noor for exceptional treatment, however, provides insights into the critical importance of determining the motives in play during the high-stakes game of political bargaining that occurred during the Egyptian Revolution of 2011.

8. Conclusions

Conflicts between stakeholders intensify as the fight over control of the Internet moves from domestic to international forums. The 2012 World Conference on International Telecommunications (WCIT) held in Dubai became the latest battleground in the debate over the control of Internet infrastructure as governments confronted the challenges under the auspices of the International Telecommunications Union (ITU). The ITU is a UN-supported organization that has traditionally mandated the rules of the road for long distance telephony, but has more recently begun to examine its role with regard to regulating the Internet. At the Dubai conference, a number of mostly Middle Eastern authoritarian states led by China pushed a proposal to mandate greater government controls over domestic ISPs. Interestingly, Egypt was named as an author of some of the earlier drafts that were leaked; although Egypt later denied that it was involved in the process [16]. Language from these drafts was integrated into the final Acts of the WCIT [12], which eventually gained the support of the majority of nations present, including Egypt, but was opposed by the U.S. and European Union.

Repressive governments are well aware of the power that the Internet provides citizens and have attempted to maintain control through censorship. The events of Egypt point to more turmoil in repressive countries and authoritarian countries recognize this trend. During the Egyptian Revolution, China blocked the word "Egypt" from the country's popular Twitter-like services in an attempt to restrict coverage of the events in Egypt [24].

Future work should extend this research on the effects of the Egyptian Revolution of 2011 to other authoritarian regimes, and seek out cases with the potential to validate or refute the hypotheses presented in this paper. The work could employ a similar transaction cost analysis to determine the economic effects – to the public and the personal leadership of nations – of Internet outages in countries such as Iran and Libya. The research could also project the costs and benefits of partial or complete shutdowns in the case of ongoing conflicts as in Syria. Research could also comparatively examine the contractual arrangements between ruling parties and ISPs from nation to nation, along

with evidence of or opportunity for rent-seeking behavior on the part of ruling parties. If the theory holds, rent-seeking behavior on the part of ruling parties could become a rationale for contractual hazards in the governance of the critical Internet infrastructure.

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