Political Instability as Financial Information:

Terrorism, Unrest, and Capital Markets in Tsarist Russia

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ABSTRACT

Good institutions are necessary to disseminate information to financial markets, but even in their absence, markets may still behave efficiently if information is costless. Tsarist Russia, known for weak political institutions but home to a vibrant financial sector, proves this point. Using a new database on political instability in Russia from 1788 to 1914 – supplemented with daily financial data surrounding major terrorist attacks - this paper shows that markets were consistently discriminating in their perceptions of terrorism, with at most a short-term effect in depressing Russian financial markets. However, there were sizable longer-term effects on financial volatility in capital markets.

Keywords: Information; Terrorism; Financial Volatility; Russia; Efficient Markets; Institutions

JEL Codes: G14; N23; D74; P48

1. Introduction

A consensus exists both theoretically and empirically that "good" institutions are necessary for financial development. Indeed, the key tenet of the "law and finance" literature (La Porta *et al.* 1998) is that countries with better institutions related to the financial sector – including creditor rights, contract enforcement, and legal institutions – are able to develop both banks and capital markets to drive investment. While there are counterfactuals from emerging markets on the necessity of formal legal institutions (Allen *et al*. 2005, Hartwell and Malinowska 2019), even these examples place an emphasis on institutional arrangements, outside of the financial sector itself, which may facilitate transactions and information dispersal within financial markets.

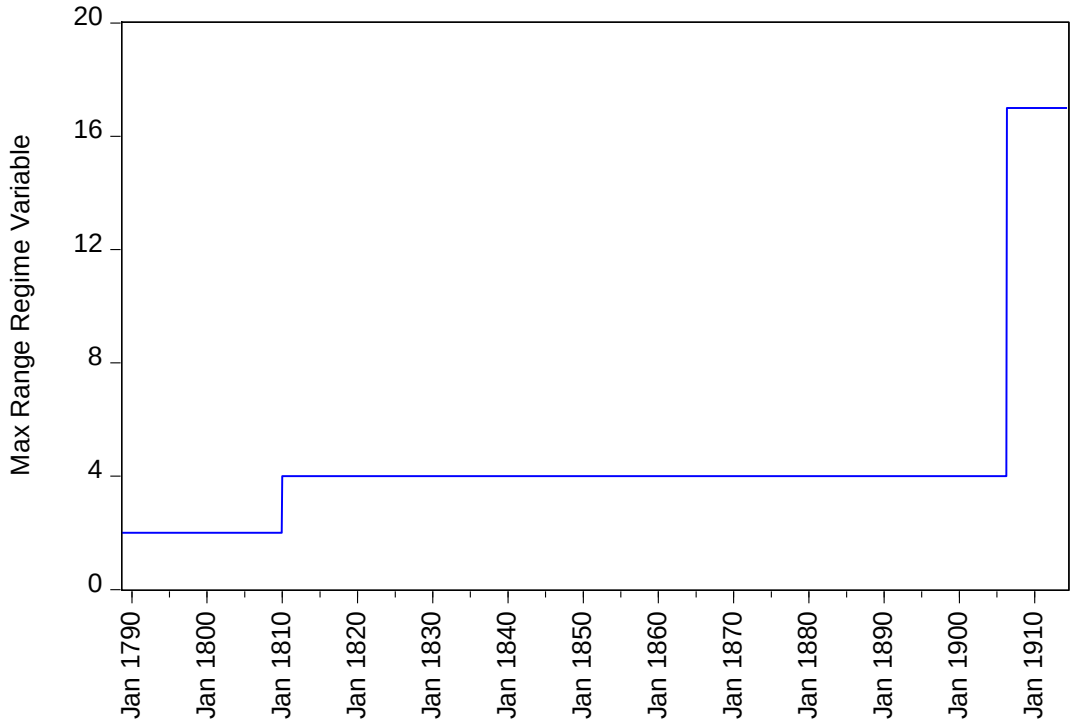
There is, however, no reason why financial markets which exist in an environment without the necessary external institutional prerequisites cannot also be efficient when presented with new information. That is, while information asymmetries may plague financial markets without the appropriate supporting institutions to disseminate information, when information is symmetrically available, markets should have the ability to adjust whether or not a supporting legal framework exists. In fact, this is the crux of the efficient markets hypothesis (EMH), in that changes in the prices of various assets are directly related to information flows. Even alternatives such as the adaptive markets hypothesis (Lo 2004) or behavioral finance (Barberis and Thaler 2003) build on these insights to show how information is assimilated in a capital market framework even in the absence of hyper-rationality or in a world of frictions. And recent evidence shows that it is not necessarily facilitating institutions which are a first-order necessity for the calibration of information, as they are second-order in ensuring that the information is received by the markets in the first place; rather, it is government barriers which are the first-order impediments to market efficiency (Barth *et al.* 2004, Cochrane 2011). Thus, in an environment where relevant market information is obtained at no cost or given exogenously, even where supporting institutions are absent, financial markets should still perform efficiently so long as they are (relatively) distortion-free in their internal institutional workings.[1]

Of course, the omnipresent difficulty is finding information which can be received frictionlessly, as all information requires a cost to obtain. Macroeconomic news can be thought of as exogenously given information, signaling information about government policies and future expected earnings but requiring little work from financial markets to obtain. Terrorism and political instability can also be considered as frictionless information, signaling to markets about possible upcoming political volatility and policies (Corbet *et al.* 2018). While terrorism itself may be a sign of a weak institutional order (Newman 2007) – especially related to financial markets (Karolyi 2015) – no institutional supports are necessary to disseminate the information contained in a terrorist act (apart from a press willing and able to report on such attacks). Indeed, all forms of informal political volatility, including unrest or uprisings, would contain information about possible changes in government policy which could affect firm profitability.

[1] Note that this does not imply that the structure of financial institutions themselves would be optimal, perfect, or at the highest level of efficiency. Additional issues – likely in an environment of low institutional quality – could manifest themselves within the financial sector itself, see Benhabib *et al.* (2016) and Section II below.

It is how prices react to this information which gives us clues as to the efficiency of financial markets, as political events or terrorism and rumors in low institutional quality environments can create large price swings and higher volatility (Morck *et al.* 2000). Moreover, environments of opacity can also impede information transmission, as information about firms are hidden from investors (Jin and Myers 2006). On the other hand, effective and efficient financial markets would absorb the information contained in political instability quickly and effectively, making a determination on the longer-term ramifications of each bout of instability. In the best-case scenario, markets could actually act as providers of information to other institutional actors on these ramifications (Hayek 1945, Bond *et al.* 2012), fulfilling a role that external institutions could not or would not provide.

Figure 1 – The Max Range Regime Variable for Russia, 1789-1914



Source: Max Range dataset, based on Rånge and Sandberg (2017). Lower numbers correspond with more autocracy, higher numbers with greater access to the political system.

To probe this relationship between institutions, instability, and information, this paper examines an environment of striking contrasts, namely Russia in the 19th century. On the one hand, Russia had a political system with a corrupt bureaucracy overseeing a largely illiterate and politically inactive population which was little touched by capitalist development. Executive constraints in the modern sense were non-existent, as effectively unlimited power was encapsulated in the personality of the Tsar. As Figure 1, using the "Max Range" political indicator (Rånge and Sandberg 2017) shows, Russia was either classified as an "absolute monarchy" or "parliamentary absolute monarchy" for much of its Tsarist history,

with very little civil society or even industrial constraints on the Tsar's room for maneuver. This translated into little protection of private commercial interests and policies which benefited business as long as they benefited the Tsar (Owen 1985).[2] And while Tsarist Russia began a move in the 19th century towards formal legislation and a concept of "legality" as a structure for society (Borisova 2012), the Tsar himself was unconstrained. As prominent Russian scholar Zhivov (2002:256) noted, the pretense of legality in Tsarist Russia was a "cultural fiction" demonstrating the weakness of the formal judiciary.

Despite these broader institutional failings, Russia's financial institutions were robust, with Ukhov (2003:1) noting that "Russia was a leader in using public capital markets and especially foreign markets and foreign intermediaries to finance her ambitions and development." From 1805 to 1807, the Tsar allowed for the creation of limited liability corporations and set three forms of corporate governance (full/limited partnerships and corporations), while the government began issuing domestic bonds in 1809-1810 to finance foreign wars. Moreover, the first stocks were traded on the St. Petersburg Stock Exchange in the 1830s, followed by a corporate law in 1836 which was meant "to encourage corporate capitalism in the style of Western Europe" (Goetzmann and Huang 2015:4). And for the most part, the Tsar did not intervene in Russian asset markets, making them free of many of the distortions seen today.

These parallel institutions were confronted in the late 19th century by successive waves of political violence. The forms changed – first, attempts to reform the archaic serfdom system sparked peasant uprisings, while, post-serfdom, ideologically-inspired attacks on the Tsarist order predominated. Covert networks of anarchists and socialists pioneered a recognizably modern form of terrorism that embraced political assassinations and bombings. By 1907, the "neo-populist and avowedly terrorist" Socialist Revolutionary Party numbered 45,000 members and 300,000 sympathizers (Naimark 1990:173). Estimates of the number killed in political violence early in the 20th century run into the tens of thousands (Geifman 1995).

How was such violence perceived by the Russian financial sector? In a weak institutional environment, with no property rights and little political freedom, were asset markets able to exploit the information given by terrorism and unrest to set expectations? To explore this question, I have amassed a new, comprehensive, and unique monthly database on finance and terrorist attacks by their type in Tsarist Russia from 1788 to 1914. Using an Asymmetric Component GARCH-in-Mean (ACGARCH-M) model on this data to tease out the short- and longer-term effects of terrorism, the results show that political violence was absorbed by markets in a discriminating matter, with effects differentiated by financial instrument and by the type of political instability. As seen in modern capital markets afflicted with terrorism (Brounen and Derwall 2010, Chesney *et al.* 2011, Kollias *et al.* 2011, Goel *et al.* 2017), Russian asset markets saw evanescent effects from various types of instability, with volatility effects also stratified by type of political

[2] The argument on "private property" in Tsarist Russia, taken to mean either ownership of land or property rights more broadly, is a bigger question that cannot be dealt with here. Weickhardt (1994) argues that there was at least a legislative framework for land ownership in Tsarist Russia, but Pipes (1998) counters that a) limited property rights for the gentry only intensified serfdom and b) private property in the modern sense was vilified by both conservatives and the intelligentsia alike throughout the 19th century.

volatility and financial instrument. In fact, financial markets in Russia appeared to be both efficient and discriminating when given new information, even as this information hinted at the longer-term lack of viability of the external institutional environment. Where the weak external environment likely manifested itself was in the volatility (rather than level) of prices, with (rational) reassessments of market value occurring more frequently as a function of shifting political winds and abrupt and erratic responses from the Russian government to instability.

Building on these results, I also use, for the first time in digitized form, daily price data from Russian bond and stock markets to test the effects of two separate bouts of political instability: the attempted assassination of the Tsar in April 1866 and the actual assassination of the Tsar in March 1881. Consistent with the broader monthly data, at a daily frequency, markets were discriminating in their perceptions of the effects of both incidents, with information absorbed quickly and dissipating within two weeks following the Tsar's assassination (by contrast, the attempted assassination did not move bond or stock markets at all).

The paper contributes to the literature on law and finance, information, and terrorism in several ways. First, I show conclusively that terrorism did have an effect on financial markets in 19th-century Russia, and that the impact on valuations, prices, and short- and long-run volatility varied across financial instruments. The results also show that different types of political violence – assassinations, other acts of terrorism, peasant uprisings, and war – were perceived differently by financial markets, depending upon their possible object of influence. Finally, in line with the hypothesis given above, this paper documents that Russian market behavior in the face of terrorism, in a weak overall institutional environment, still performed "efficiently" (in the informational sense) and in a manner similar to modern-day capital markets.

Despite these contributions, this paper also has some limitations. In the first instance, this examination cannot test directly for the ultimate "efficiency" of the Russian market (i.e. if arbitrage opportunities were left on the table or if markets over-reacted). However, I believe that we are able to infer attributes of Russian market efficiency based on the speed and nature of the responses to the information encapsulated in political volatility (as shown in Kothari and Warner [2007]) combined with what is known know *ex post* regarding the political regime. Similarly, I focus on political instability due to its highly visible nature, and with a dearth of information available on market conditions beyond returns, it is difficult to test for other impediments to market efficiency, such as capacity constraints or operational inefficiencies (Karolyi 2015). In the future, building on this research, I hope that finer gradations may be found in the data; for the purposes of this single-country study, however, it is also plausible that any additional market constraints would have been shared equally by most firms and thus would not be as important a determinant of responses to specific information (that is, trends would still be accurate even if precise magnitude would not).

With these caveats in mind, the rest of the paper proceeds as follows: Section II offers an overview of the finance and terrorism literature with reference to the institutional basis of information, while Section III surveys the landscape in Tsarist Russia and the state of both its political and financial institutions. Section

IV introduces the new database, while Section V describes the methodology and Section VI describes the results. Section VII offers some concluding thoughts and ways in which this work can be extended.

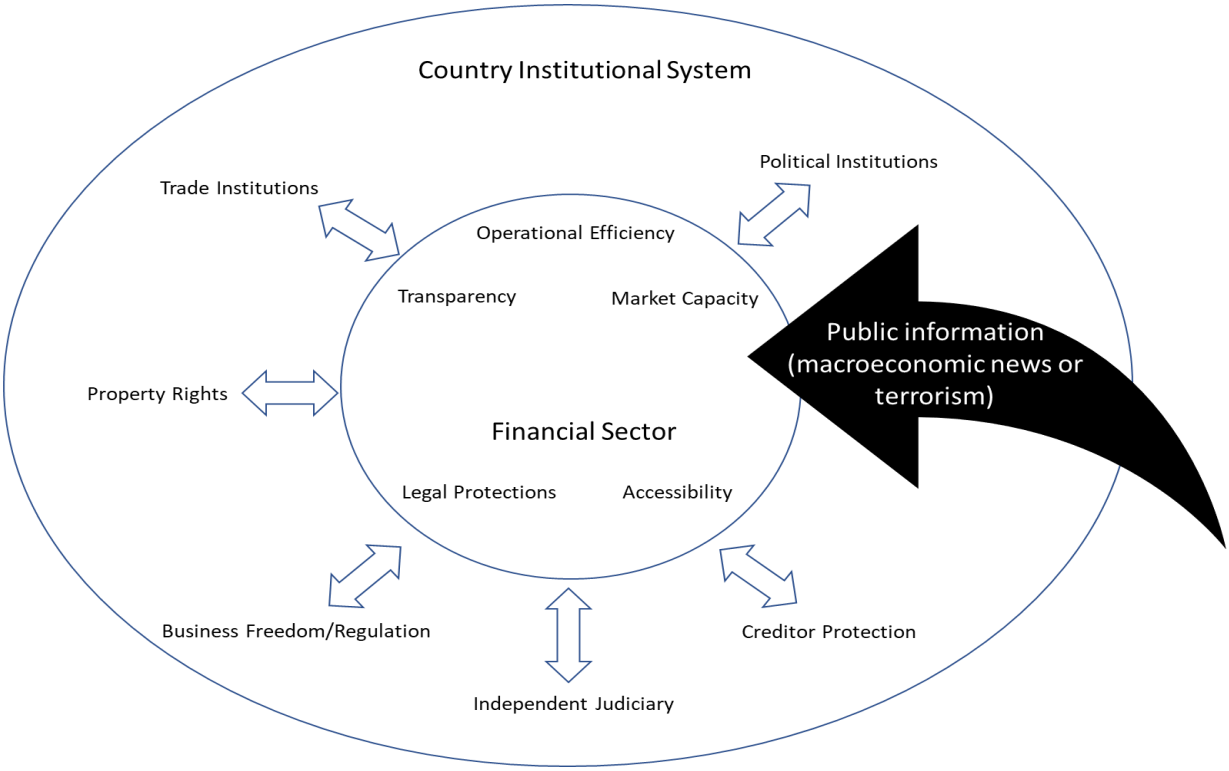
2. Information, Institutions, and Finance

2.1 From law and finance to efficient markets

The law and finance literature (exemplified in La Porta *et al.* 1998) posits that institutions such as property rights, contract viability and enforcement, and an independent judiciary are crucial for financial markets to develop, with financial institutions performing better if these attributes are in place. For example, Chen and Siems (2004) show that stronger institutional environments foster better financial sectors, meaning that liquidity is available to promote market stability, while Claessens and Laeven (2003) note that collateralization for finance is only available in a regime with secure property rights.

An additional attribute of strong institutions is their ability to channel information to financial markets. Indeed, the lifeblood of capital markets – and in particular accurate pricing – is information, and in many ways, the relationship between institutions and capital markets is a tale of how institutions both disseminate and allow for the utilization of information. However, the law and finance literature appears to have concentrated almost exclusively on the ability of an "outer ring" of enabling institutions (depicted in Figure 2) which provide information and structure to financial markets, while how financial markets use information has been relegated to another tier of theory, namely those regarding the efficiency of markets (and in particular the efficient markets hypothesis, or EMH). EMH in its weakest form asserts that news is absorbed and that prices change in response to information, and, while it has been challenged by behavioral finance on the grounds of constrained arbitrageurs and bounded rationality, the heart of the theory regarding information remains difficult to disprove. Indeed, advances in alternatives to the EMH, especially the adaptive markets hypothesis, show how frictions and irrationality need not be barriers to information assimilation: as Lo (2004:23) notes, "prices reflect as much information as dictated by the combination of environmental conditions and the number and nature of 'species' in the economy… [and b]y species, I mean distinct groups of market participants, each behaving in a common manner." Thus, information dissemination is a function of the institutions of the financial sector and not necessarily of the outer ring of broader economic and political institutions.

Figure 2 – Institutions, Financial Markets, and Public Information



Information dispersal mechanisms within the financial sector have also been compartmentalized in their own literature on market microstructure (see Madhavan 2000) but with little linkages to the impact of institutions external to the financial sector. Noteworthy attempts to examine this connection have rested on many of the same theoretical precepts explaining the effects of the broader institutional environment on information. Morck *et al.* (2000:217) were the pioneers in this regard, noting that "the degree to which a country protects private property rights affects both the extent to which information is capitalized into stock prices and the sort of information that is capitalized." Looking at the same issue from a different viewpoint, Jin and Myers (2006) show that corporate opacity leads to higher volatility, as thresholds for bad news are smaller than in information-rich environments. The results of better institutions would thus be less synchronicity in price movements (i.e. differentiation across stocks, as shown in Morck *et al.* [2000] and Durnev *et al.* [2004]), owing simply to better diffusion of information and knowledge that this information could be used. By contrast, "stock markets in poorly governed countries [would be] characterized by higher volatility and more negative return asymmetry" (Lehnert 2019:4).

2.2 Terrorism as Information

However, it is possible for information to be given freely and with a minimum of frictions and yet be very valuable about the future prices of equity, company expected earnings, or the overall macroeconomic climate. Information in this vein can include earnings reports and macroeconomic news, which are

communicated directly to markets and cause changes in price based on their firm-specific, sectoral, or market-wide effects. In this instance, the weaker outer ring of institutions may be bypassed, leaving only financial institutional weaknesses as impediments to market efficiency. In fact, if information is obtained at no cost, the set of institutions necessary to process such information in financial markets narrows considerably: in reality, it would require enough market participants to make arbitrage effective (capacity), with supporting attributes including an ability to access markets, transparency of corporate governance, and market-specific (rather than broad) legal protection (Karolyi 2015).

Terrorism or political instability, while affecting the outer ring of institutions, should have an immediate informational effect within financial markets akin to macroeconomic news. This is not a new or novel point (see Abadie and Gardeazabal 2003), as the mere fact that markets react to terrorism means that there must be some informational component (a point shown empirically by Eldor and Melnick 2004). Indeed, in the words of Johnston and Nedelescu (2006:9) when discussing the terrorist attacks of September 11th, financial markets are well-built for "digesting the information on the economic and financial impact of the terrorist attacks after an initial shock and efficiently incorporating the information into asset prices so that it could be integrated into decisions about the future." Coleman (2012) proves this point in an examination of recent terrorist attacks, concluding that modern capital markets are semi-strong efficient in absorbing the information from terrorism.

But what exactly is the information which is encapsulated in a terrorist attack? Here the literature is conspicuously silent. From a purely financial point of view, the informational content of a terrorist attack should be rapidly absorbed, in the long run basically irrelevant to a firm's financial calculations, unless there are specific circumstances surrounding the event. These would include:

- industry- or sector-specific characteristics related to the terrorist attack, e.g. Boeing after September 11th, 2001, as shown in Drakos (2004);
- the geographic/spatial aspects of the attack, i.e. whether the attack occurs close or far away from financial markets or whether the attack targeted strategically or economically important centers (Sandler and Enders 2008); and
- the precise type of methods used, e.g. suicide bombing versus remote detonation (Jain and Mukand 2004).

Beyond the financial aspects, and perhaps much more important, is the fact that terrorism and other forms of political instability offer financial markets important information about the long run, and in particular the environment in which firms are operating: specifically, terrorism or instability can offer information on *institutions themselves*. While economic institutions are thought of as crucial for the functioning of markets, political ones (and especially their stability) are also crucial, especially since "political institutions determine the distribution of de jure political power, which in turn affects the choice of economic institutions" (Acemoglu *et al.* 2005:391). Political instability thus offers clues about the future composition of political institutions and has direct fiscal implications (i.e. for government borrowing and

spending policies), which then in turn can affect the economic landscape.[3] Terrorism in particular can reveal how susceptible political institutions are to political violence: are the rules of the game about change? Seen in this light, the current state of this outer ring of institutions can color market judgments about the effects of terrorism/instability, providing different information depending upon the existing institutional matrix.

For "stronger" institutional systems, the effects of terrorism or instability would seem to be less jarring in their impact. In the first instance, Sandler and Enders (2008) note that countries with stronger governance institutions are more likely to have the monetary and fiscal tools to mediate the effects of terrorism and restore confidence in markets. However, "strong" institutional environments have their own drawbacks in dealing with the aftermath of a terrorist attack. In the first instance, strong institutional environments have much more to target and correspondingly larger damage that can be done economically (Karolyi and Martell 2010). As Johnston and Nedelescu (2006) show, the September 11th attacks in the United States created economic damages small relative to the size of the US economy, but the majority of these damages were borne by the private sector (using numbers from Brück and Wickström [2004], they note that the private sector sustained losses of US$14 billion versus all federal, state, and local rescue and clean-up of approximately US$13.2 billion). The appearance of stability in an institutional system that is perceived as strong also leads firms to underestimate terrorism risk in daily operations, then, once an event does occur, to wildly overestimate the likelihood of terrorism (Willis 2007). Such uncertainty can lead to volatility in firm valuation as well as in investment allocation, draining resources from productive use towards security (Koh 2007).

Seen from the other side, weak institutional environments may actually be well-poised to absorb political instability. Terrorism by definition also has an element of surprise, creating uncertainty, but in an environment where firms are continuously responding to uncertain conditions, markets may be more resilient to bad news and terrorism than markets which are used to stability (Branzei and Abdelnour 2010). Aksoy and Demiralay (2017) show that, during bouts of terrorism in Turkey, Turkish investors received the information efficiently and with a shrug, while foreign investors (perhaps not as attuned to the information being provided) were hardest hit.

This does not mean that weak institutional environments can weather all forms of terrorism or political instability. In a country with strong institutions, a terrorist attack could be perceived as a one-off and highly idiosyncratic event (or the implications could be limited to specific firms or assets), but in a weak institutional environment, repeated bouts of terrorism may create regime or institutional uncertainty (even as each individual event may be perceived as unusual but not long-lasting, see Chesney *et al.* 2011). Terrorism in a weak institutional environment may thus not just be a one-off event but a harbinger of change in the institutional system itself. Even if the government survives, in countries where the rule of law is already tenuous, the response to terrorism may be over-vigorous. A retaliation which is based on restrictions, military action, and curtailing of civil liberties rather than confidence-building (Gupta *et al.* 2004) could thus increase transaction costs to firms (Brück and Wickström 2004), as may simply increasing

[3] Thanks to Steven Nafziger for suggesting this and other points in this section.

regulations regarding financial transactions (Aggarwal 2006). Political instability could then be perceived as a change in the environment which could directly affect a firm's future cash flows. In either event, the political instability itself communicates information which can be digested by markets and priced accordingly.

3. Nineteenth Century Russia: A Study in Contrasts

3.1 Political Weakness

Historians depict 19th-century Russia as a country with over-centralized and ineffective political institutions, albeit capable of economic success (Davidheiser 1992). The Tsar's personification of absolute power is seen as comparable to that in pre-revolution France (Neumann 2008), while the bureaucracy is often portrayed as isolated, unresponsive, and poorly supervised, with little interest in the empire's periphery (Yaney 1973, LeDonne 2014, Pearson 1989, Wcislo 2014). Even attempted reforms, such as the creation of small institutions of self-governance (the *zemstvo*), had very little ability to influence policy beyond small local matters (Nafziger 2011). Coupled with these formal institutional failings, civil society was underdeveloped, and the few voluntary associations that sprang up from the 1860s tended to reinforce nationalism and attachment to the Russian state rather than counter it (Bradley 2002). In sum, and despite the reforms of Catherine the Great at the end of the 1700s, Russia remained a mélange of social classes and interests (Freeze 1986) held in place not by a disinterested governance apparatus but by the extreme centralization and a small apparatus designed to implement the Tsar's will.

In this setting, political violence became a regular form of interaction between Russian individuals and the state. Frustrations with the antiquated system of serfdom led to peasant rebellions across Russia (Vucinich and Curtiss 1968, Moon 1992); ironically, attempts to reform and ultimately abolish serfdom also sparked revolt (Finkel *et al.* 2015). The state's response – as in the case of nationalist uprisings in Poland in 1830 and 1863 and throughout the Caucasus – was to send in the army. The 1860s saw a first major wave of political violence, combining peasant unrest associated with emancipation, student demonstrations and riots against the perceived inadequacy of the "Great Reforms," and the Polish uprising (Naimark 1990: 175-9). Despite the success of the military in every instance of rebellion, the fact that these events kept occurring signaled that the political institutional system was, at a basic level, failing the populace.

After the end of serfdom and the beginning of an important wave of industrialization in the 1870s, violence shifted from the Russian countryside into the cities, with a focus on the assassination of political officials (Siljak 2009). Indeed, Russia is credited as the birthplace of terrorism in its modern form, identified with lone-wolf attacks or shadowy revolutionary groups (Geifman 1995, Ulam 1977, Crenshaw 2010). The first phase of populist terrorism climaxed in 1876-81, the heyday of the People's Will (*Narodnaya Volya*), which assassinated Tsar Alexander II in 1881, in the first recorded use of a suicide bomber (Lewis 2013). An even bloodier wave broke out in the early 20th century, with casualty figures which were unprecedented. According to Geifman (1995), between 1900 and 1916, over 17,000 people were murdered in Russia as a consequence of political violence. In 1907 alone, according to Strakhovsky

(1959:357), "no fewer than 1,231 officials and 1,768 private persons were killed, and 1,284 officials and 1,734 private persons were wounded."

Such violence did not replace but rather coincided with large-scale demonstrations. Labor unrest grew as Russia industrialized, with the number of factory workers increasing by approximately 79% between 1887 and 1897 (Friedgut 1987, Rimlinger 1960a). Government responses to such unrest – again, typically military in nature – probably exacerbated the problem.[4] Thus, political violence in the form of industrial unrest, aided and abetted by the weak political system, often went hand-in-hand with revolutionary violence at the individual level.

3.2 …And Strong Markets

Russia's centralized, arbitrary, and repressive political system contrasted oddly with the country's relatively effective financial system. Crisp (1967:183) noted that, from 1856 onward, Russia saw "the creation of a fairly advanced and flexible credit system, and a moderately wide money market."

This development came across all asset classes. In terms of external finance, the Russian government was long a player on markets in the Netherlands before branching out to London and Paris, while the government also began issuing domestic bonds in 1809-1810 to finance its foreign wars. Despite the Tsar's image as a despot, international bondholders snapped up Russia's sovereign debt, with Russian bonds making up a full quarter of all French government securities holdings pre-World War I (Fishlow 1985). In part, this reflected active and expert Russian management of international obligations, including buying back less successful shares and switching in 1893 to paying interest on bonds in foreign currency (Sinyagina-Woodruff 2003). Whereas the Tsar was not particularly worried about building a modern administrative state, his advisors understood the need for maintaining international economic relations and consistently offered their bondholders (almost half of whom were foreigners, as shown in Ukhov [2003] and below in Table 1) more than other sovereigns.

Russia's financial modernity was not limited to government bonds. Even before Napoleon's invasion, the authorities had established rules for limited liability corporations (from 1805 to 1807), along with full and limited partnerships. The first stocks traded on the St. Petersburg Stock Exchange in the 1830s, followed by a corporate law in 1836 which intended "to encourage corporate capitalism in the style of Western Europe" (Goetzmann and Huang 2018:580-581) and placed great power in stockholder hands. The Russian state remained involved in the banking sector (Gatrell 1986) and even private banks were affiliated with quasi-state-owned industrial cartels (Buck 2003). Yet, capital markets were mostly left alone and governed by the laws of 1836 (Goetzmann and Huang 2018). It is not entirely clear why successive Tsars adopted such a laissez-faire attitude towards the new financier class. Late in the century, it likely reflected the

[4] As Rimlinger (1960b:69) notes, "the 'protective' arm of the Tsar usually was felt only when conditions became so bad that they threatened revolt. What was to become the government's basic approach to the 'settlement' of industrial disputes was foreshadowed by its forceful military repressions of the earliest instances of collective worker resistance – those in the Ural mining and iron centers in the late eighteenth century."

recognized need for rapid industrialization, which required mobilizing internal and external sources of finance to fund new enterprises (Mavor 1925) as well as government projects such as the Trans-Siberian railroad (Barkai 1973). Owen (1985) also documents the rise of industrial societies, which had some minor successes in pushing Tsarist economic policy to be more pro-business, especially in relation to foreign investment.

Regardless of the reasoning, the benefits were apparent. The "concession system" introduced by the Law of 1836 (whereby the Tsar signed off on corporate charters) conveyed the court's implicit backing for commerce (even though it was not a general incorporation) and encouraged investors to enter the stock market (Owen 2002). While stock market capitalization in Russia remained somewhat low – in 1913, the ratio of stock market value to GDP was 0.18, slightly higher than Argentina, Chile, Italy, and Norway and far below that of the Netherlands (0.56) – equity issues were more important in Russia for fixed capital formation than they were in the United States, France, or the United Kingdom (Rajan and Zingales 2003). Additional reforming legislation in 1893 helped to push the development of capital markets, as the repeal of the ban on futures from the Law of 1836 increased liquidity, spurred the creation of new investment banks to handle initial public offerings (Salomatina 2014), and (despite unleashing a wave of speculation which brought less-informed investors into the market) did not destabilize the market (Goetzmann and Huang 2018).[5]

TABLE 1 HERE

All of these advantages meant that, "despite… limitations, Russian corporations possessed considerable flexibility regarding their selection of organizational structures and financial strategies and exercised these choices in ways that echo modern theories of corporate governance and finance" (Gregg and Nafziger 2018). Perhaps more importantly, Russians themselves were the key beneficiaries of the development of the financial sector: as Table 1 shows, Russians were the majority of investors across every asset class in the latter half of the 19th century, making up 50.3% of government bondholders on the eve of World War I (and holding over 90% of the mortgage-backed bond market). In equity markets, the Russian presence was even stronger, with Russians holding 72% of all debt and equity issues of Russian companies in 1913 and 75% of all stock offerings in the same year. Across the board, Russian investors outnumbered their foreign counterparts after the reforms of 1893.[6]

In terms of information, as well, Russian markets had access to up-to-date financial news via the major international wire services, while a nascent but growing financial press in the country accompanied the

[5] In particular, Goetzmann and Huang (2018) note that there is no evidence of momentum-induced crashes post-1893 and momentum returns performed similarly across all states of the economy.

[6] Thanks to Arnold Lutz and Daniel Treisman for suggesting that who held Russian securities may be of some importance. Data pre-1893 is more difficult to obtain, but it can be surmised that, given the transactional difficulties encountered in dealing with an "emerging market" like Russia, it is likely that foreign participation was even lower pre-1893.

expansion of the stock market (in stark contrast to the prevalence of censorship from the Tsar's officials for other publications). As Borodkin and Perelman (2011:103) stated, financial information was even "included in the official statistical compilation published by the Ministry of Finance, the *Ezhegodnik* (Yearbook), starting in 1865." In fact, recognizing the value of financial information, Tsarist authorities attempted to manipulate the French press from 1904-06 to assure investors that Russian bonds were still worth buying (Long 1972). Accompanying the dissemination of financial information was the concurrent development of what would today be known as "investigative reporters," a dedicated cadre of newspaper employees who "enhanced the concept of supplying news as a public service" (McReynolds 1990:284). While by no means a perfect conduit for all information, Tsarist financial markets did in fact have excellent access to news and a somewhat competitive market to help filter rumors from facts.

4. Measuring the Effects of Political Instability in Tsarist Russia: An Empirical Strategy

4.1 The Data

The contrast between Russia's relatively deep financial markets – which financed the same rapid industrialization that brought about the waves of political unrest already noted – and the reactionary responses that the violence prompted gave late imperial Russia its distinctive character. For our purposes, the combination of liquid, relatively advanced, and well-documented financial markets with high levels of terrorist and other political violence offers the opportunity to examine the interaction of these two phenomena in a new context.

To perform this examination, I have compiled a unique and new monthly database of financial movements and various types of political instability across the Russian empire from 1788 to 1914. Given the relative sophistication of Russian markets across many asset classes, I use three separate financial indicators as proxies for Russia's financial markets: first, data on Russian government long-term bond yields are an excellent measure to understand the market's perception of both political risk and the economic prospects of Russia, especially with relation to terrorism (see Procasky and Ujah [2016] on the relationship between terrorism and debt pricing). While bond prices tend to move slowly in response to political events in the 20th and 21st century (Duyvesteyn *et al.* 2016), Ferguson (2006) shows how important political events were to Russian sovereign yields from 1843 to 1880, and, even though he presents evidences that yields were less influenced by politics and more by economic fundamentals from 1880 to 1914, Ferguson's evidence also shows that bond yields in Russia during this latter period rose more than other countries and in direct response to political events. Thus, we can be confident in using bond yields as a proxy for financial market perceptions on the viability of the Russian state, both economically and politically. Data on Russia bond yields are available on a monthly basis back to 1788 and are obtained from the Global Financial Database.

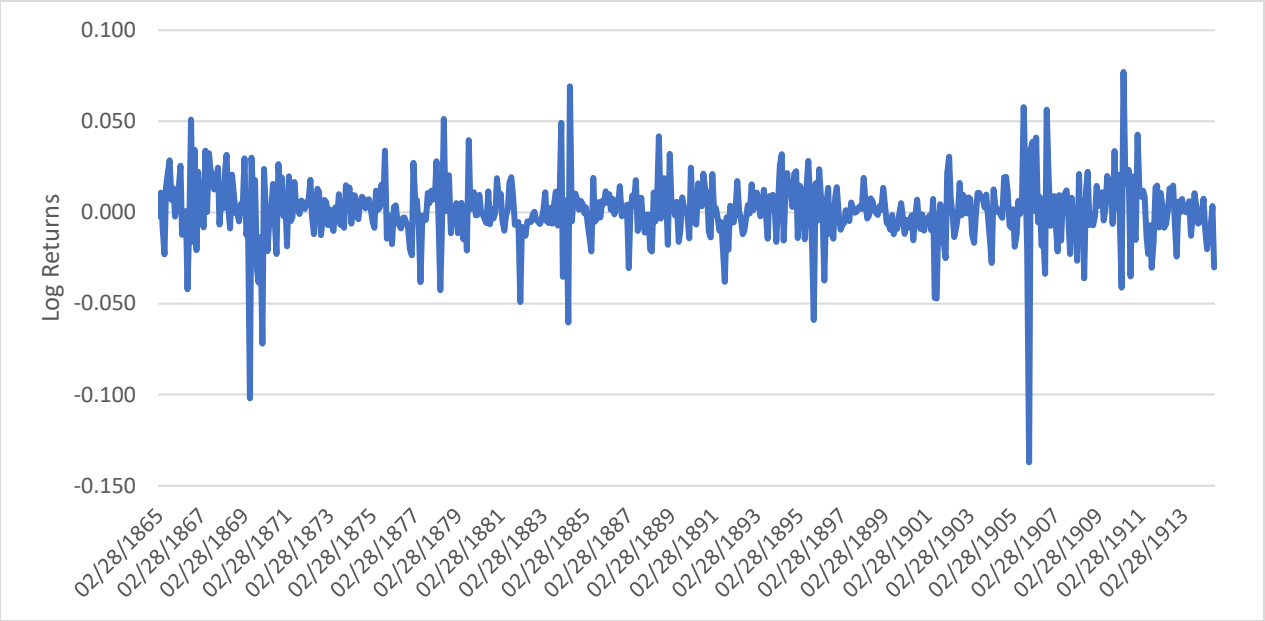
In addition to bond yields, I include information from the St. Petersburg stock exchange (SPSE), which has monthly data back to 1865; the SPSE data come from the excellent work of the St. Petersburg Stock

Exchange Project at Yale (see Goetzmann and Huang 2018).[7] As is standard in the financial literature, broad market index returns are taken as a proxy for financial responses, with monthly returns calculated as:

$$R_t = \log\left(\frac{P_t}{P_{t-1}}\right) \qquad (1)$$

Figure 3 gives a sense of the scale of monthly returns of the SPSE from February 1865 to July 1914. The SPSE's returns appear to be clustered in the -5% to 5% range over the entire half-century examined here with the exception of major losses occurring during May 1869 (when the stock market dropped approximately 10%) and the largest drop of all (13.7%) in November 1905, at the height of the unrest surrounding the revolution of 1905. Over the entire period surveyed here, the average return from the SPSE compared favorably with the New York Stock Exchange (NYSE), with an average of 0.10% for SPSE versus 0.04% for NYSE, and even the worst losses on the SPSE were less than seen in the NYSE in the 19th and 20th centuries (Schwert 1990).

Figure 3 – Monthly Log Returns in the St. Petersburg Stock Exchange



Source: Author's calculations from Goetzmann and Huang (2018) data.

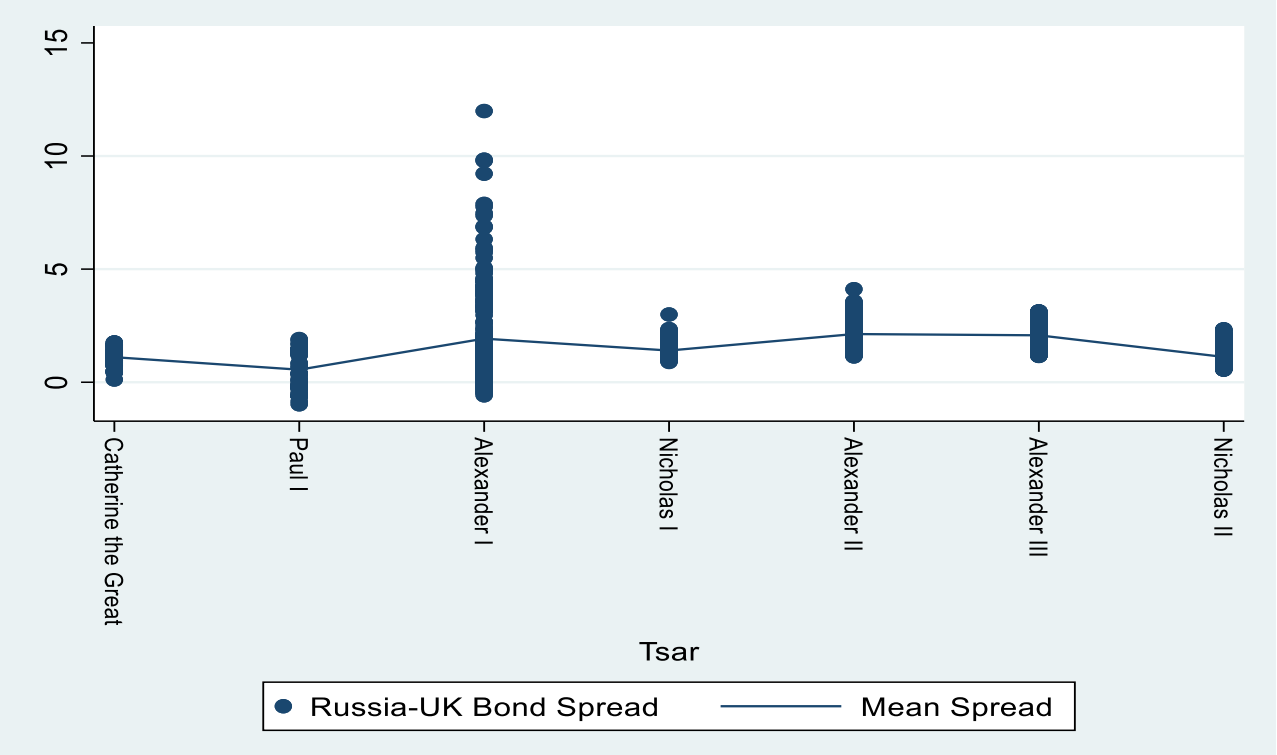
Finally, I also construct a country risk indicator to understand if political instability in Russia penalized Russian markets relative to other financial alternatives (that is, was political instability seen as a Russia-only idiosyncrasy). This risk indicator is structured as the risk premium of Russian bond yields over UK bonds, chosen to represent the "risk-free" rate; it is assumed that this spread will rise with domestic instances of terrorism in Russia (as no corresponding political disturbance would plausibly have occurred

[7] Similar time-series are available for global indices, as will be explored below.

in the United Kingdom at the same time). As can be seen in Figure 4, the average spread between Russian and UK bonds was remarkably stable under over the entire period surveyed here, with the dispersion increasing markedly during the reign of Alexander I (corresponding with the Napoleonic wars) but otherwise averaging approximately 2.5 points from 1788 to 1914. As with the underlying bond yield series, the data for UK bonds also stretches back monthly to 1788 and comes from the Global Financial Database.

The true innovation in the paper comes, however, not from the financial data, but from the data on political volatility in Russia in the 19th century. The taxonomy of volatility is shown in Table 2 and forms the basis for exploring the effects of terrorism on the financial variables of interest throughout this paper. Using several Russian- and English-language sources (see Data Appendix), I have hand-coded instability in the country according to their modality, target, and where they occurred geographically to create a brand-new monthly database. In particular, the demarcation by place is done to both capture possible spatial effects of terrorism and to capture the peculiarities of the Imperial Russian financial press; as noted in Rantanen (1997:613), "news bulletins provided by Russian agencies did not carry headlines and appeared in random order, separated only by an indication of the transmission place (not country) and date… as a result, the place and date became the most important distinctive feature of each news telegram." Thus, the place where instability occurred could be important for how firms *should* react, but it is also important for how the news is assimilated.

Figure 4 – Bond Spreads by Russian Tsar



Source: Author's calculations based on Global Financial Database data

In addition to utilizing dummies for terrorist events in Russia, and noting that political instability tends to cluster in waves, I also construct cumulative measures of terrorism, coded from 0 to 12, of the number of months in which a terrorist attack occurred within the previous 12 months. For example, if – as during the height of the socialist revolutionary campaign against the Tsar – there were assassinations in each of the preceding 10 months, a month would be coded as 10 in the database. In this manner, I can test econometrically if it was not just an isolated incident of terrorism but rather a pattern of instability which led to different financial market responses (as shown in Kutan and Yaya [2016]).

TABLE 2 HERE

4.2 The Model

The preferred approach for examining the effects of various forms of terrorism on financial markets in Tsarist Russia is based on a standard GARCH volatility model. However, given the exigencies of the Russian financial markets, the probability of differential effects over the short- and long-term, and the reality that volatility in one period likely influenced returns in subsequent periods, an Asymmetric Component GARCH-in-Mean (ACGARCH-M) model is used to capture not only the effect of terrorism on the three financial metrics but also on the long-term and short-term volatility of these instruments.[8] The model is structured as:

$$Y_t = \mu + \gamma Y_{t-1} + \pi x_t + \rho M'_{t-1} + \delta \sigma_t^2 + \varepsilon_t \qquad (2)$$

Where Y_t is one of three separate financial indicators to proxy for the Russian financial market as noted above, Y_{t-1} is the indicator lagged one period to alleviate autocorrelation concerns, and the X variable is the chosen proxy for terrorism within this particular model. Given the aggregated monthly nature of the data, and the fact that the market effects of an attack may dissipate quickly, the terrorist attack is examined contemporaneously with the aggregate monthly financial market indicator rather than lagging it (which could be done if daily data were available). On the other hand, in Equation 2, M is a vector of macroeconomic and global financial controls lagged one month, on the supposition that the macroeconomic and global conditions will take longer to filter through to financial markets; put another

[8] It is common in the literature to utilize a jump-diffusion model in the presence of macroeconomic and other news, if the introduction of such news leads to a discontinuous returns process. However, these jumps are often detected only in high-frequency data and in aggregated data such as the monthly data used here, the jumps are "washed out" in the aggregation. As Wilmot and Mason (2013:45) note, "For monthly observation… allowing for time-varying volatility is paramount, while the addition of jumps to the time-varying process appears inconsequential." Thus, one can be confident that a GARCH process can capture the underlying volatility and returns processes.

way, the political volatility metrics measure the arrival of information while the macroeconomic and global controls measure conditions, and thus information should have a more immediate effect.

Given data limitations on Russia's economy in the 18th and 19th centuries (and also the difficulties in having GARCH models converge with an unwieldy set of explanators), I use a necessarily parsimonious set of plausible covariates:

- *Price of gold*: a proxy for global economic conditions;
- *Ruble/Dutch Guilder exchange rates*: a proxy for Russian economic conditions; and
- *Tsar transition*: a dummy for the month in which a Tsar died and a new one ascended the throne, as a proxy for overall political volatility.

Additionally, the volatility term is included in the level equation (making it an ARCH-in-Mean specification) here as σ^2, but this is a placeholder in the baseline as the exact composition of the volatility term will be determined by comparison of models by distribution, optimization, and step method; thus, the model could retain the GARCH-modeled volatility as shown in Equation 2 or could use another transformation such as $\ln(\sigma^2)$ or $\sqrt{\sigma^2}$ if these models prove superior according to commonly-used information criteria (i.e. Akaike or Schwarz).

The long-term volatility relationship is modeled as:

$$q_t = \omega + \alpha(q_{t-1} - \omega) + \gamma(\varepsilon_{t-1}^2 - \sigma_{t-1}^2) + \theta_1 Z_{1t} \qquad (3)$$

Where $q_t$is the time-varying long run volatility of the underlying financial instrument. Equation 3 reflects the shock from terrorism and effects stemming from the controls of vector *M* shown in Equation 2, but which also converges to the time-invariant volatility level ω at a speed of γ (that is, the closer the estimated value of γ is to unity, the slower that the modeled long-term volatility reverts to the mean). In this manner, we can capture the persistence of volatility in response to shocks to the system. Equation 3 includes vector *Z,* a set of exogenous variables which influence volatility: in the model, this is represented by political volatility, both informal (terrorism) and formal (change of ruler).

Finally, the short-term conditional volatility is modeled as:

$$\sigma_t^2 - q_t = \beta_0(\varepsilon_{t-1}^2 - q_{t-1}) + \beta_1(\varepsilon_{t-1}^2 - q_{t-1})d_{t-1} + \beta_2(\sigma_{t-1}^2 - q_{t-1}) + \theta_2 Z_{2t} \qquad (4)$$

Representing the transitory component of shocks. In Equation 3, *d* is included to capture asymmetric effects, a dummy variable indicating if a negative shock is present. If $\beta_1 > 0$, there is a leverage effect present in the model, whereby negative news (in this case, terrorism) impacts the short-term conditional variance more than positive news (emanating from, for example, positive macroeconomic conditions). As with the long-term volatility, the *Z* vector in Equation 4 also captures the effects of political instability, most prominently the impact of terrorism. Given the exigencies of the dataset, the data is modeled using the Student's T distribution (although, in some rare instances, the generalized error distribution (GED) returned a better model as measured by information criteria).

5. Results

5.1 Single attacks

The results of the ACGARCH-M models are shown in Tables 3 through 5, broken out by type of political volatility.[9] Moving through each financial indicator, we start first with the Russia/UK bond spread and the effects of different types of terrorism on this risk indicator. As shown in Table 3, there is a positive correlation between political volatility and higher bond spreads, but only at the extremes: that is, attempted assassinations are more likely than actual assassinations to create an atmosphere of perceived risk. This oddly inverted finding could be because assassination has a finality to it (i.e. the target was eliminated), while attempted assassinations convey different information, e.g. more violence is coming and thus Russia is becoming relatively riskier. Beyond the individual-level political volatility, unrest in the Empire and all-out war also increase Russia's financial risk (and unrest in Russia proper remains paradoxically insignificant). The effects on volatility are for the most part muted, although in the full model including the Tsar's transition, successful assassinations in Russia appear to create higher volatility in bond spreads over the long run (Column 3). Similarly, unrest in Russia may not have a direct effect on bond spreads, but its impact on volatility in both the short and long run is sizeable (Column 6). Indeed, the volatility generated by the full model (including the Tsar transition variable and with unrest as the political volatility metric of interest) is shown in Figure 5 with obvious spikes occurring in 1848 and 1877 and a smaller one in 1906-07. While these are generally uncorrelated with terrorist activity in the early decades (and only slightly correlated with the terrorist waves of 1905 onward), the largest spikes coincide with external conflict and internal strife, as with the revolutions of 1848 and the Russo-Turkish War.

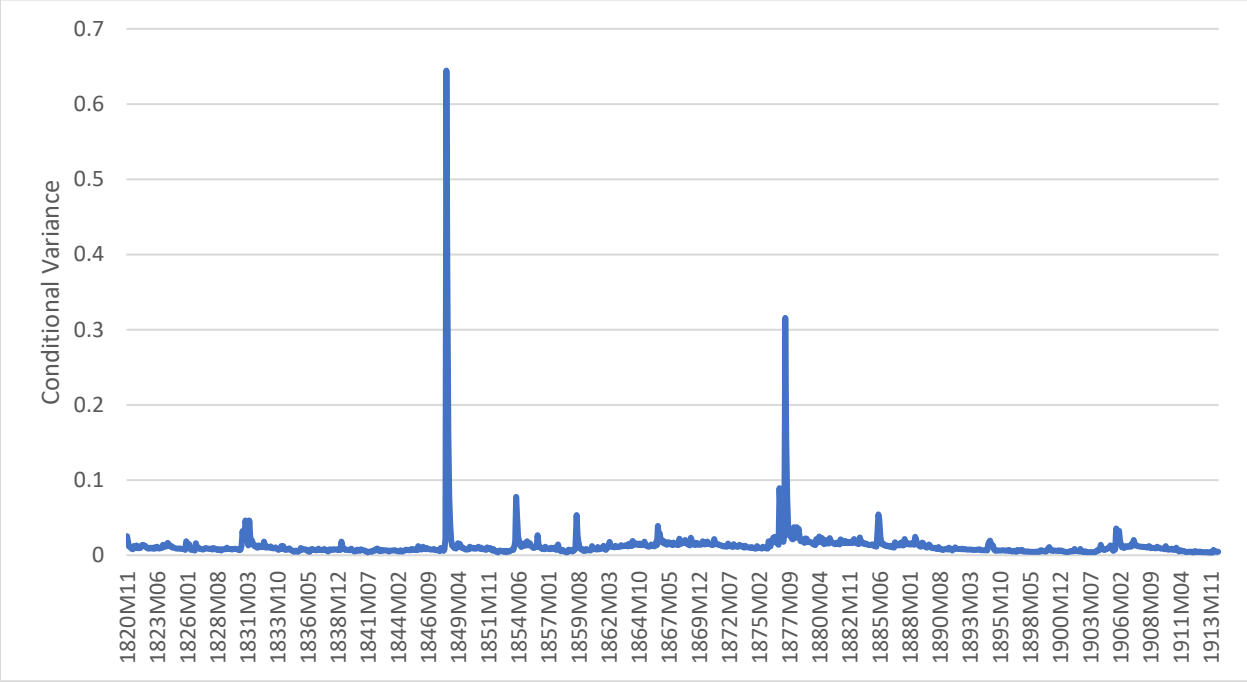
TABLES 3 THROUGH 5 HERE

Turning to Russian bond yields themselves (Table 4), there is a much clearer association between larger-scale political volatility, namely unrest, and higher bond yields. Across the stepwise models, attempted and successful assassinations in Russia have little relation to Russian government bond yields, but attempted and successful assassinations in the Empire serve to increase yields significantly (perhaps as they signify a greater investment needed by Russia in pacification). In a similar vein, unrest in the Empire is also significantly and positively correlated with higher bond yields, as is unrest in Russia proper. Somewhat surprisingly, external conflict appears to not feed into Russian bond yield calculations, although

[9] Given that the data series for the ruble/guilder exchange rate is not available monthly until 1820 (annually before that to 1788), a stepwise regression is built where covariates are added until the full model is reached; this approach allows for having a fuller set of observations pre-1820 in the case of bond yields and risk spread, but also fashions a more comprehensive model during the years of the most terrorism (i.e. from the mid-1800s onward). Shown in Tables 3 through 5 are only the regressions with the full set of controls; the stepwise regressions are available in the full tables in the online appendix.

this may be due to the fact that markets price in the possibility of external conflict well ahead of time. With regard to volatility, unrest in both Russia and the Empire also increases the long-term volatility of bond yields substantially, although unrest had little effect on volatility in the short-term (perhaps because yields were only going in one direction, i.e. up, or because the effects of unrest can only be ascertained in the medium-term). For other political volatility metrics, the influence on bond yield volatility was much less pronounced, with only successful assassinations in Russia having a (negative) effect on volatility in the long run.

Figure 5 – Implied Russia-UK Risk Volatility, Full Model of Unrest



Source: Generated from ACGARCH model, author's calculations

Finally, in reference to the effects of political volatility on Russian stock markets (Table 5), across models, terrorism, unrest, and war are uniformly negative for Russian financial institutions. There is a pronounced negative effect on stock returns across each metric, with the largest effect coming from attempted assassinations in the Empire, with each assassination corresponding to a 4% drop in returns in the St. Petersburg stock market. Other strong effects are found with successful assassinations in the Empire (a drop of 3%) and then unrest in Russia and in the Empire and external conflict (decreases of 2% in each instance).[10] Long-term volatility also increases in the cases of attempted and successful assassinations in Russia, as well as with unrest in Russia, in the Empire, and with external conflict. Importantly, these results

[10] This is not inconsistent with evidence such as Opitz (2017), who finds that war-related events had little influence on the SPSE. Given that this paper utilizes monthly data for this examination, it is more accurate to say that the cumulative effect of external conflict is, on average, negative for the Russian stock market.

are robust to the inclusion of the Tsar dummy, which for the most part has little effect on stock markets (full tables available in the Appendix). In this instance, it appears that informal political volatility, rather than formal political change, had the upper hand in moving markets.

A summary of the effects of terrorism on financial markets across all of the regressions can be seen in the heatmap of Figure 6

5.2 Evidence from Daily Data: Shooting for the Tsars

In addition to these aggregated monthly terrorist and financial indicators, it is perhaps instructive to focus in on a single event at a daily frequency, in order to capture more time-sensitive information being processed by financial markets. In this section, I examine two specific events of political instability: the attempted assassination of the Tsar in St. Petersburg in April 1866, and the actual assassination of the Tsar in the same city in March 1881. These two events share a modality (assassination), a geographic location (the capital, where the news was sure to be widely reported), and a potential impact (death of a sovereign), and thus can make an interesting study on the impact of political volatility on financial markets.

In order to more formally test the effects of these discrete bouts of political violence, I fashion an event study around the date of the attempted/assassination, using the technique of Fama *et al.* (1969) and as refined by Bessembinder *et al.* (2008) in the context of bond prices. The event study framework is defined by an event window, then a determination of actual returns and "abnormal" returns (in comparison with a baseline), and finally a test statistically for significance of the abnormal returns (MacKinlay 1997). For this exercise, I use four event windows to determine the effect of the political instability, namely +/- 1 day, 3 days, 5 days, and 10 days around April 4, 1866 (for the attempted assassination) and March 13, 1881 (for the actual assassination).

Daily data from this era is difficult to find, so I have digitized, for the first time, daily Russian government bond data from the 19th century. Given that the Russian government had been issuing bonds as far back as 1798, we can assume that bonds which had been in circulation for some time were likely to be seen as relatively safe; on the other hand, recently issued bonds may have run into some difficulty if something were to happen to the government, to the country, or to the sovereign's ability to pay. For this reason, I use the Russian bonds issued in 1860, 4.5% bonds issued for Russia by Hope and Company in London.[11] Bond returns are calculated in the same way as stock returns, as shown in Equation 1.

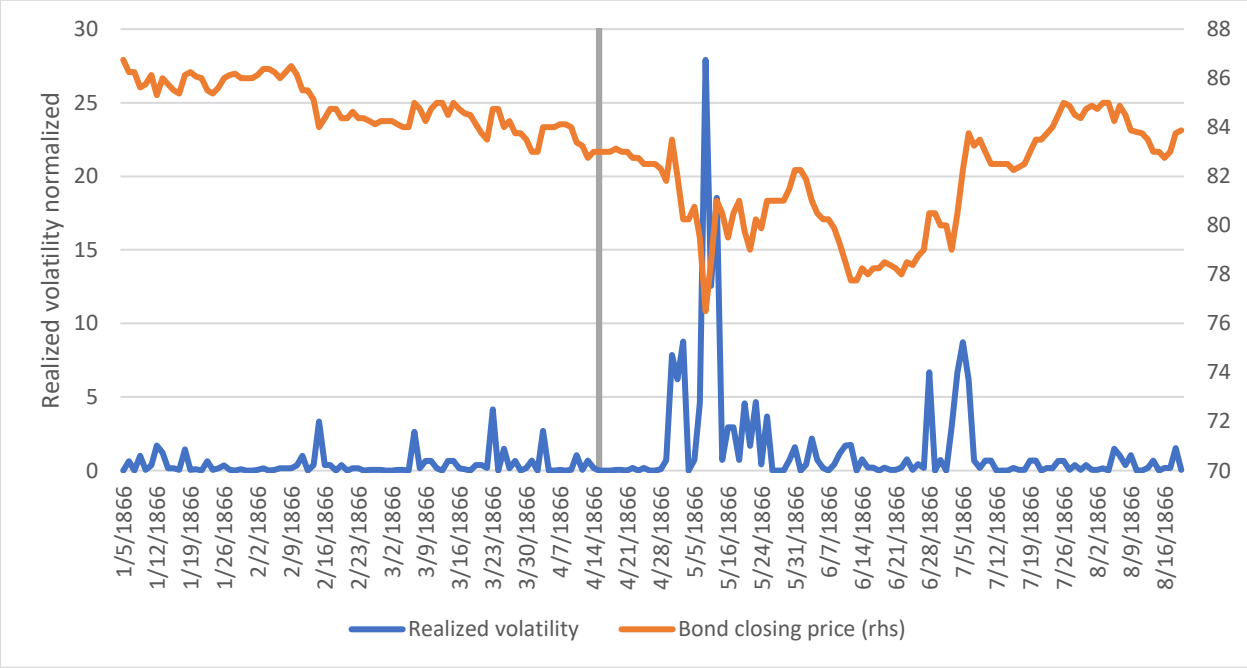
In addition, given the importance of volatility to financial markets, I also calculate two metrics of volatility, mainly day to day realized volatility and Brownian intraday volatility. Realized volatility is calculated as log of daily returns squared, while Brownian intraday volatility is calculated as in Parkinson (1980) and

[11] Raw data was obtained from individual editions of the *Amsterdamsch Effectenblad,* a Dutch broadsheet published three times a week from 1843 to 1869, with each issue carrying at least three days' worth of information on bond prices globally.

Alizadeh *et al.* (2002) as a range-based volatility estimator; this approach is used to correct for inflated bias in periods of high volatility where market microstructure noise may be especially pronounced. In terms of computation, intraday volatility is calculated here as the square of intraday returns multiplied by a variance estimator of 0.361 (as shown in Parkinson 1980).

Finally, to determine the baseline for comparison, I use the historical mean model (HMM), computing the mean returns over a window from the first of the year (either 1866 or 1881) to either 30 days or 20 days prior to the event; for foreseen events, a window closing further away from the event date is preferred, as it avoids potentially contaminating information (i.e. pricing as a result of expectations). For these events, however, given that they were entirely unforeseen for the day it occurs, a longer window ending 20 days prior allows for the incorporation of more information.

Figure 7 – Volatility and Bond Price Data surrounding the Attempted Assassination of the Tsar, 1866



Source: Bond prices from various issues of *Amsterdamsch Effectenblad.* Realized volatility calculated by author as noted in the text. Grey vertical line is the date of the assassination attempt.

The first application of the event study methodology is based on the attempt on the life of Tsar Alexander II in 1866 by Dmitry Karakozov, a revolutionary who believed the Tsar to be the source of all of Russia's ills (Verhoeven 2009). Saved by a bystander who jostled Karakozov as he attempted to fire, the Tsar had the would-be assassin executed and co-conspirators were swiftly rounded up. The attempt on the Tsar, however, was the first such act of its kind in Russia and gave birth to the violence that was to come in the late 19th century; such a novel and unexpected threat to the monarchy, with the promise of possibly more violence, could have substantially rattled financial markets.

Figure 7 shows the evolution of bond prices before and after the attempt, and as can be seen, Russian bonds were drifting downward pre-assassination attempt and remained fairly stable for several days afterwards before dropping in May and with a corresponding spike in realized volatility. Thus, by visual inspection of the data alone it appears that bond markets took the attempted assassination in stride. The results of the formal event study (Table 6) confirm this conclusion, as returns on bonds showed a slightly statistically significant *increase* in the day following the events and were slightly higher for 10 days out (but not significantly so). In terms of volatility, both realized and Brownian intraday volatility were actually slightly lower following the assassination attempt, rising 10 days past the event, but in no case was there statistical significance. In fact, the rise in volatility can be better explained by the oncoming bank panic in the United Kingdom of May 11, 1866, shown as a counterfactual in Table 6: with the collapse of Overend, Gurney and Company in London setting off a global downturn, Russian bonds suddenly became highly risky and volatility increased concurrently. This stands in marked contrast to the bond market's response to the attempted assassination.

TABLE 6 HERE

However, the aggregated examination in the previous section showed that it was the stock market which reacted more to attempted and actual assassinations rather than the bond market, so perhaps where bond markets saw no troubles ahead, the situation was different in capital markets. To run a similar event study required hand-collecting data on individual stocks listed on the St. Petersburg Stock Exchange, another feat never before attempted in the finance literature. Using various individual issues of *Биржевыя Вѣдомости* (Stock Exchange News), published in St. Petersburg six times a week, I was able to compile a complete series of stock prices for various companies.[12] While many firms on the SPSE did not have great variation in their valuation over this time period, one firm was highly sensitive to political news: *Общество "Кавказ и Меркурий"* (Company "Caucasus and Mercury," hereafter OKiM), one of Russia's largest joint stock companies, founded in 1859 as a merger of two other firms and with a Board located in St. Petersburg but operating throughout the Empire. As a massive transportation and logistics firm and one which was reliant on certain concessions from the government (including carrying mail and military cargo, see Zonn *et al.* [2010]), OKiM would certainly be affected by political volatility and instability, and this should have been reflected in their share prices and returns (calculated as in Equation 1).

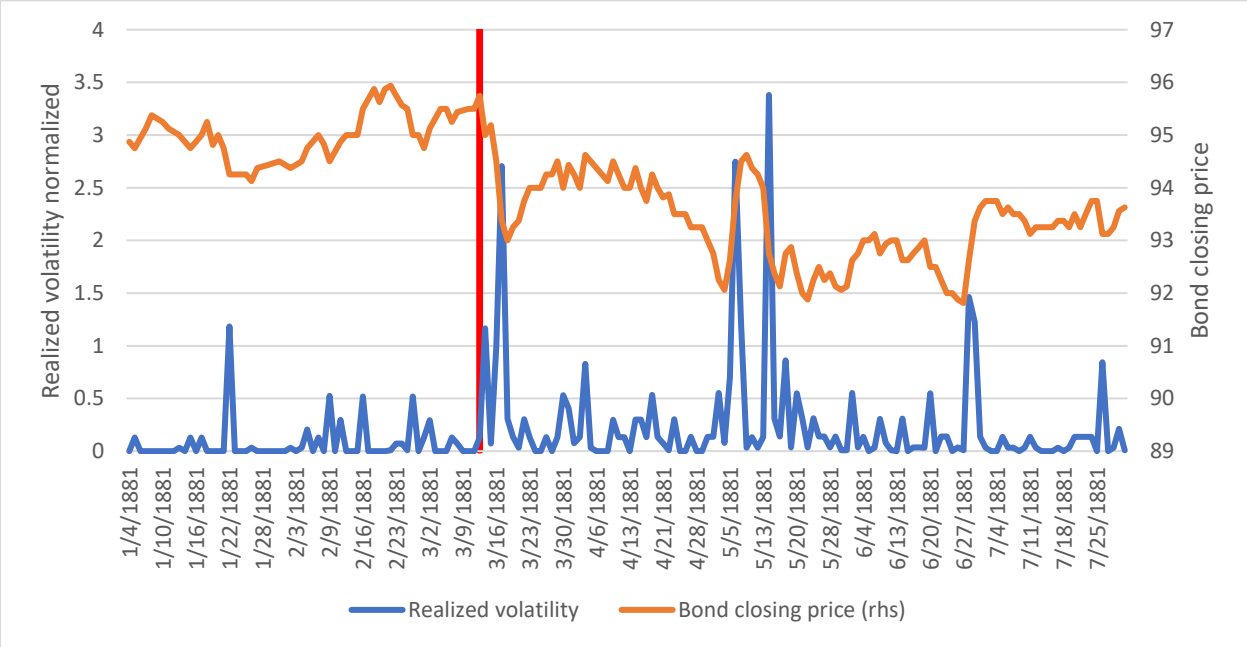
TABLE 7 HERE

[12] Massive thanks are due to Timur Nakhtov for his assistance in procuring this archival material.

The stock market event study (Table 7) shows similar results to that of the bond market, although stock returns for OKiM were down over each timeframe studied but only significantly so at the 10-day mark. Unlike the bond market, volatility was on the decline, but it was only after 10 days that changes in intraday volatility became significant. Thus, even for a firm which should have been most sensitive to political volatility, the attempted assassination of the Tsar made little difference to its projected cash flows.[13]

Across the board, the unsuccessful assassination attempt registered as a non-event for markets, but what would have happened to the markets if Karakozov had succeeded? Such an event was to occur a mere 15 years later, in March 1881, as Alexander II was killed in St. Petersburg by revolutionaries from the "People's Will." The successful assassination of the Tsar, more so than any other terrorist event in Tsarist Russia, might have had the largest effect on the country's political system, and thus on the business environment and the prospects for Russian business going forward. As a wholly unanticipated event (at least on that date and at that time), financial markets were likely to be surprised; moreover, given the size of the impact which potentially could have followed from the event, it should be expected that financial markets would have moved substantially.

Figure 8 – Volatility and Bond Price Data surrounding the Assassination of the Tsar



Source: Bond prices from various issues of *Nieuw Algemeen Effectenblad*, January to July 1881. Realized volatility calculated by author as noted in the text. Red vertical line is the date of the assassination.

[13] Interestingly, an event study was also done (not presented here for reasons of space) on OKiM during the Panic of 1866, and while returns were much lower even 10 days out (reaching a decline of 14%), they were not statistically significant.

As in the previous event study, I used bond prices with a large window from three months prior to the assassination to four months afterwards (i.e. from January to July 1881) to illustrate the movement of financial markets in response to the assassination (Figure 8.[14] Also as in the previous study, given that more recent bonds may create more uncertainty in the market, I use as a benchmark the bonds issued by the Russian government in 1877 in order to finance the Russo-Turkish War. These bonds represented a massive new influx of debt (according to Ukhov [2003], a total of 15 million pounds sterling) and a substantial obligation for the government.[15]

As can be seen in Figure 8, bond prices were on a slight upward trend pre-assassination, plummeting in the immediate aftermath of the assassination (from 95.5 the day preceding the assassination to a low of 92.0625 on March 21st and a further fall to 91.8125 in June). Figure 8 also plots the realized volatility in the bond market, calculated as log of daily returns squared. In tandem with the drop in bond prices, volatility spiked immediately following the assassination and again at the beginning of May 1881, peaking on May 14th in the immediate aftermath of the promulgation by Alexander III of the "Manifesto on Unshakable Autocracy" (*Манифест о незыблемости самодержавия*). Interestingly, it appears that the volatility surrounding the assassination was higher in reaction to the government's response than to the event itself.

The results of the formal event study for the assassination are shown in Table 8, and the results are conclusive across the board. In the first instance, no matter which HMM window is utilized (20 or 30 days prior to the assassination), the abnormal returns on Russian government bonds are significantly negative post-assassination, with the effects building from one day until hitting their largest effects at the 5-day window (conversely, effects have dissipated by 10 days out). However, the magnitude of even the highest effect on returns (a drop of 2.6% in bond returns on the 5th day following the assassination) is in line with the percentage changes in spectacular modern terrorist events; for example, US Treasury returns dropped 4.5% on the first day after the September 11th attacks. On the other hand, day to day volatility remains significantly elevated even 10 days after the assassination in both HMM windows, with volatility actually increasing as time passes (calculated but not shown here, day to day volatility actually remained abnormally high up to 40 days after the assassination). Again, the size of the volatility changes is in line with modern capital markets, as Gulley and Sultan (2009) report the average increase in bond volatility from 1983 to 2005 in France and Germany after terrorism at precisely 0.005 (i.e. the highest volatility hit in the Russian case). Finally, intraday volatility in Russia shows perhaps the most interesting effect, with both HMM windows showing higher-than-historical-average levels of intraday volatility at the 3-day window but not at the 5-day window (perhaps as markets waited to see what the government response would be). However, the additional information encapsulated in the 20-day prior closing window leads to

[14] The data is taken from daily individual editions of *Nieuw Algemeen Effectenblad*, the successor to the *Amsterdamsch Effectenblad* from 1870 and a similar price sheet for sovereign bonds.

[15] As a robustness test, not shown here, older debt issued by the Russian government in 1798 was also tested for its reactions to the assassinations. Like the results shown below, bond prices dropped by approximately 2% following the assassination but, unlike the newer debt, volatility increases were insignificant. I attribute this specifically to the fact that the debt was older, and thus had a longer pedigree of successful payments from the Russian government.

a result of statistically significant higher intraday volatility at 10 days out from the assassination, a result which may signal some chaotic behavior in the markets as the government came to grips with what had happened. In any case, bond markets definitely did respond to the assassination of the Tsar, although the immediate reactions disappeared rather quickly.[16]

TABLE 8 HERE

5.3 Cumulative Terrorism: Did it make more of a difference?

As noted above, I have also constructed cumulative terrorism indicators, broken out by the same taxonomy, to capture the effects of persistent terrorism on financial markets in Tsarist Russia. The results of these additional regressions, using the same ACGARCH model as shown in Equations 2 through 4 and using the full model including Tsarist transitions is shown in Tables 9 through 11 (with a corresponding summary in heatmap form as shown in Figure 11). A caveat is in order: while the cumulative metric may capture entirely the market response to multiple instances of instability, it may also inadvertently capture government responses to prior acts of terror, i.e. if the Tsarist government created an environment which was unfavorable for business. While this analysis cannot thus pinpoint the exact magnitude of the effect of cumulative instability, in some sense it does not matter, because financial markets should also react to the possible cumulative effects of terrorism and response and not just to the act itself.

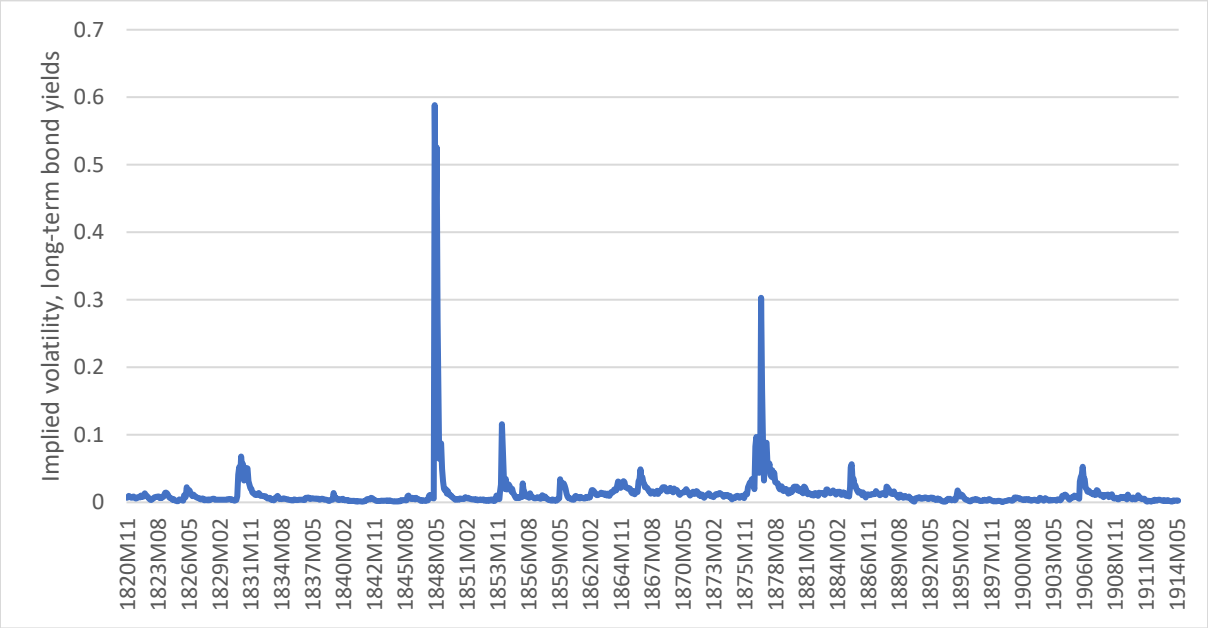
With regard to the Russia/UK bond spread (Table 9), over every metric except for assassinations there is a statistically significant increase in the level of the bond spread in response to repeated assassination attempts, unrest, or prolonged war. There is also near uniformity in a lack of volatility responses in the full model, apart from cumulative unrest in the Empire (and even then, only in a marginally significant effect on long-term volatility). In the same vein, all forms of cumulative political volatility have similar effects to single events (Table 10), with attempted assassinations in the Empire, assassinations in Russia, unrest in the Empire, and external conflict resulting in elevated bond yields. Unrest, whether in the Empire or in Russia proper, and external conflict also result in higher long-term volatility for Russian bonds. The small scale of the response to terrorism, however, may rely on a rational interpretation of political volatility: that is, even cumulative acts of terrorism may increase the perception of risk in Russia but ultimately they were perceived as not threatening the sovereign's ability to pay. The conditional volatility from the ACGARCH model confirms this (Figure 9): using the cumulative unrest model to generate the volatility series, we see that bond volatility – much as with the bond spread – spiked around international events (the revolutions of 1848, the Russo-Turkish War) and only began to be impacted by terrorism around the 1905 revolution (consistent with Opitz 2017).

[16] Data for OKiM and other stocks at a daily frequency was not immediately available for this time period, and work is underway as part of a follow-on to this paper to gather and digitize that data.

Finally, as with the individual attacks, the effects of terrorism on the stock markets (Table 11) were much more pronounced and translated into lower returns and higher volatility in the long run (for assassinations in Russia and unrest in the Empire). Cumulative assassinations in Russia had the most pronounced effect in depressing returns, a difference from the single attacks, while unrest in the Empire also had a substantial impact on returns; according to my calculations, each additional uprising or piece of unrest outside of Russia would have resulted in stock market losses of approximately 0.4%. The conditional volatility generated by the ACGARCH model for cumulative assassinations is shown in Figure 10, and, unlike bond yields or spreads, the effects of terrorism are much more discernible, with long-term volatility seeing peaks after the assassination of the Tsar and the waves of terrorism in the 1890s and a massive spike in the run-up to the revolution of 1905.

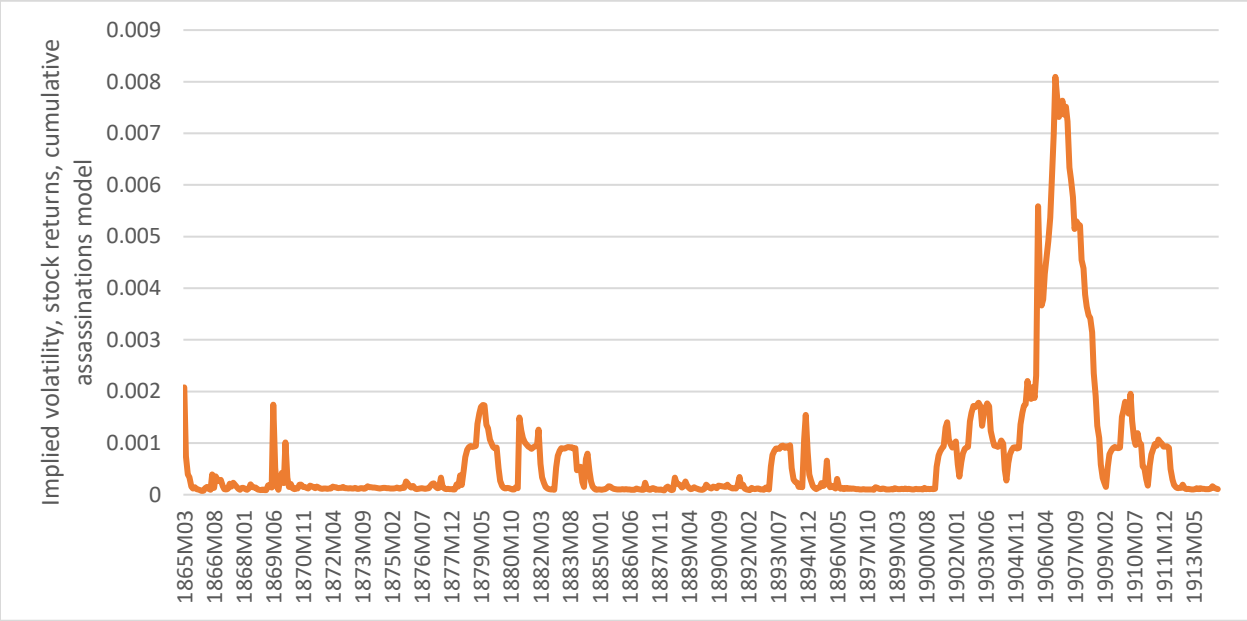
TABLES 9 THROUGH 11 HERE

Figure 9 – Implied Volatility of Long-term Bond Yields, Cumulative Unrest Model



Source: Generated from ACGARCH model, author's calculations

Figure 10 – Implied Volatility of Stock Returns, Long Term Component, Cumulative Assassinations Model



Source: Generated from ACGARCH model, author's calculations

6. Conclusions

This paper has taken an extensive look at the financial effects of terrorism and other forms of political instability in 19th-century Russia. Building on a unique database of terrorist activity and political unrest, the results of the econometric analysis showed that Russian financial markets had highly nuanced responses to terrorism based on the modality of terrorism and based on which particular financial instrument was examined. In particular, bond spreads and bond yields increased the most with larger and more persistent forms of political volatility, namely unrest, uprisings, and outright war between Russia and other states. On the other hand, stock markets were the most sensitive to nearly every form of political volatility, seeing across-the-board declines in returns and generally higher volatility, which again was stronger the more terrorist attacks that occurred: in the words of Eldor and Melnick (2004:367), "markets did not become desensitized to terror."

However, more importantly, these results suggest that financial markets in Tsarist Russia were efficient in their assessment of the effects of informal political volatility, being able to separate political violence from threats to specific financial instruments. In fact, persistent terrorism may have created more doubts about the regime's viability and increased longer-term volatility about short-term reactions, but without threatening the basis for the profitability of firms. In this sense, Russian financial markets reacted just as modern markets have in the face of unexpected political volatility, absorbing the information in an efficient – or at least adaptive – manner. While the aggregated nature of the monthly data used here cannot test for the ultimate efficiency of the market, extensions using daily data also illustrate market efficiency even in the face of the most spectacular instability. Indeed, the takeaway from the daily bond data is that, in line with Brück and Wickström (2004), the government response to terrorism (and the

ensuing political uncertainty) may be worse than the disease. It appears to be only here that weak supporting institutions had a direct negative effect on financial markets.

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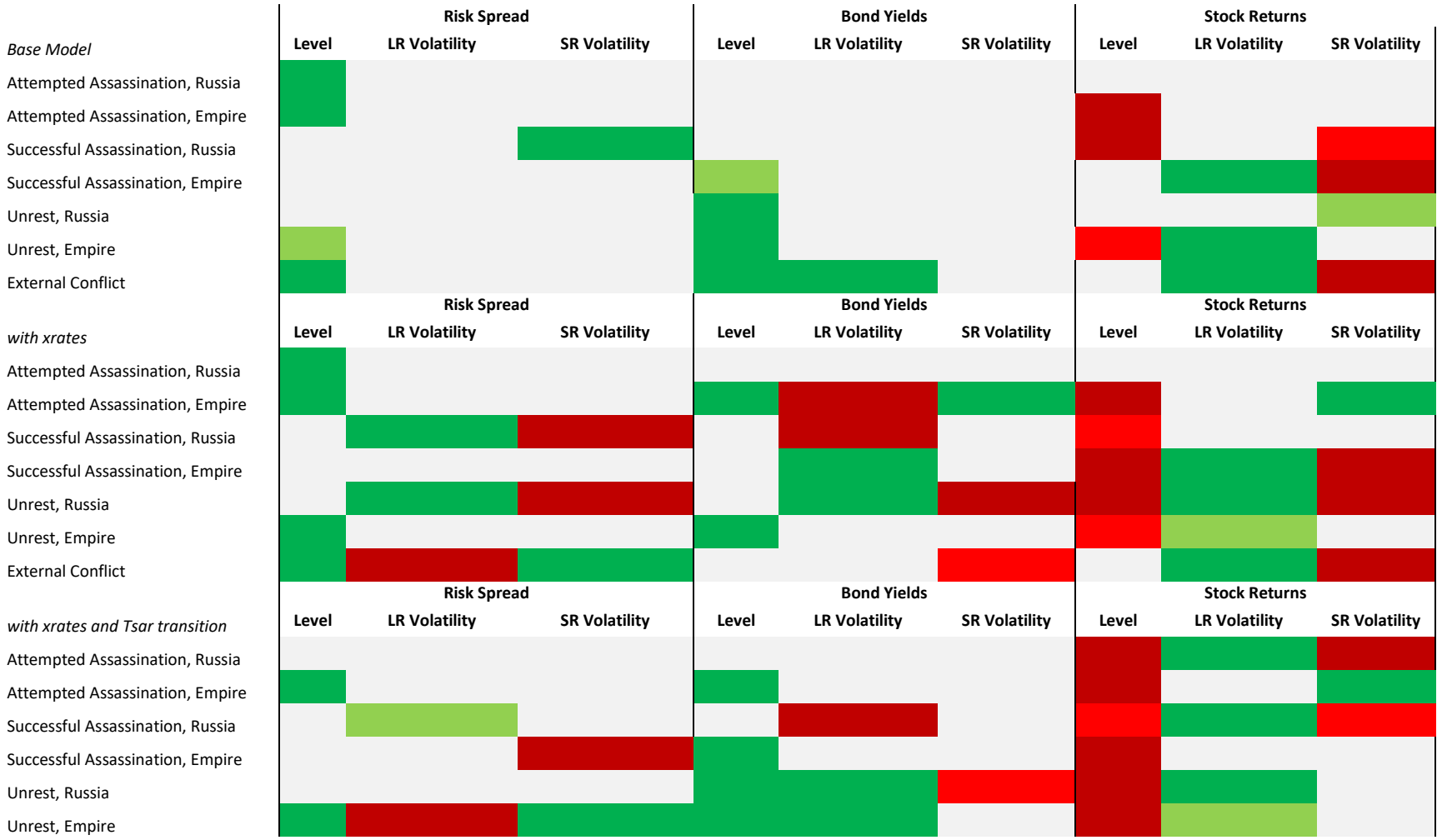
Figure 6 – Heatmap Summary of Results, Terrorism v. Financial Markets



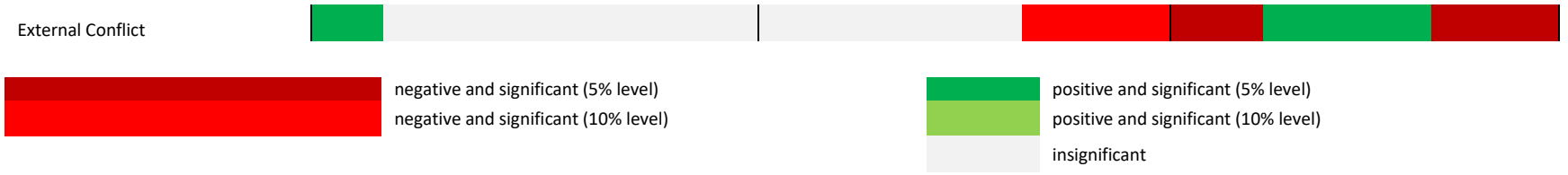


Figure 11 – Heatmap Summary of Results, Cumulative Terrorism v. Financial Markets

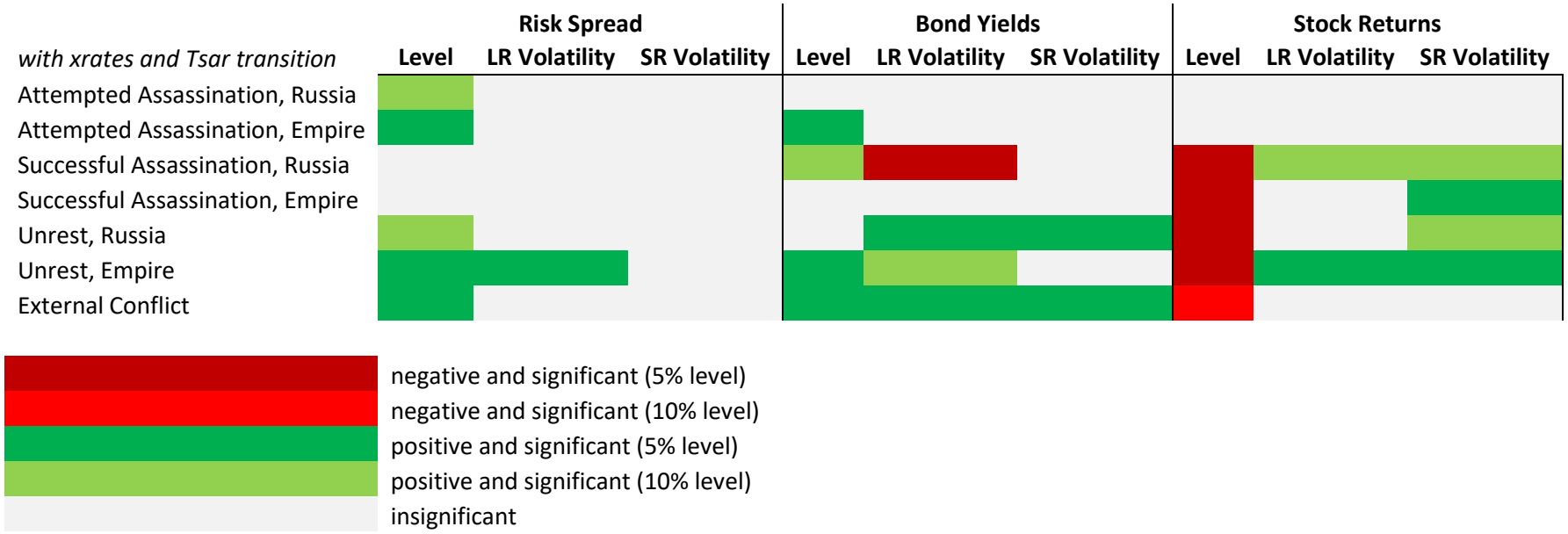


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Table 1 – Investors in Russian Capital Markets, Millions of Rubles as of January 1

Year	Government Bonds, Mortgage-Backed Bonds by Nobility Land Bank and Peasant Land Bank				Stocks and Bonds of Russian Public Companies			
	Government Bonds	Mortgaged-Backed	Total	Percentage of Total	Stocks	Bonds	Total	Percentage of Total
Russian Securities Held in Russia								
1893	2,712	209	2,921	58.29%	739	43	782	84.00%
1900	2,917	459	3,376	49.63%	1,640	67	1,707	75.77%
1908	4,072	1,069	5,141	52.04%	1,637	158	1,795	69.49%
1913	4,463	1,839	6,302	57.83%	3,433	219	3,652	72.19%
Russian Securities Held Outside of Russia								
1893	2,090		2,090	41.71%		35	149	16.00%
1900	3,325	102	3,427	50.37%		149	546	24.23%
1908	4,642	96	4,738	47.96%		198	788	30.51%
1913	4,410	186	4,596	42.17%		259	1,407	27.81%
Totals								
1893	4,802	209	5,011		853	78	931	
1900	6,242	561	6,803		2,037	216	2,253	
1908	8,714	1,165	9,879		2,227	356	2,583	
1913	8,873	2,025	10,898		4,581	478	5,059	

Source: Author's calculations based on data from Ukhov (2013) and Bovykin (1984).

Table 2 – Classification of Informal Political Volatility in Tsarist Russia

type of volatility	definition
Attempted Assassinations Russia	An attack (bombing, mass shooting) which resulted in fatalities but was unsuccessful in assassinating the main target (Russian territory only, excluding the Caucasus, Poland, Ukraine, and Central Asia)
Attempted Assassinations Empire	An attack (bombing, mass shooting) which resulted in fatalities but was unsuccessful in assassinating the main target (Russian Empire only, including the Caucasus, Poland, Ukraine, and Central Asia)
Assassinations Russia	A major public figure was assassinated on the territory of Russia; if shot in one month and died in another, month is coded 1 from the attack itself
Assassinations Empire	A major public figure was assassinated on the territory of the Russian Empire, including the Caucasus, Poland, Ukraine, and Central Asia. Same coding as above
Unrest Russia	Strikes, peasant uprisings, or other mass movements which resulted in fatalities or the use of state force to suppress; territory of Russia only
Unrest Empire	Same as unrest but only in Caucasus, Poland, Ukraine, and Central Asia and excluding Russia proper
External Conflict	Russia's involvement in external conflict, wars, or interventions abroad

Table 3 – ACGARCH-M Regressions, Russia/UK Bond Spread

	Dependent Variable: Russia/UK Bond Spread						
	1	2	3	4	5	6	7
Political volatility							
Attempted assassinations Russia	0.03						
	0.66						
Attempted assassinations Empire		0.05					
		*1.99***					
Assassinations Russia			0.004				
			0.17				
Assassinations Empire				-0.01			
				0.43			
Unrest Russia					0.001		
					0.20		
Unrest Empire						0.02	
						*1.92***	
External Conflict							0.02
							*2.06***
GARCH attributes							
Long-term volatility, political events	0.005	0.001	0.03	0.006	0.0001	23.45	-0.00002
	0.96	*0.40*	*1.70**	*1.18*	*0.10*	*4.13****	*0.02*
Short-term volatility, political events	-0.01	0.004	-0.03	-0.01	-0.0009	-23.44	0.0004
	1.42	*0.63*	*1.59*	*5.13****	*0.60*	*4.13****	*0.09*
GARCH-in-Mean	-1.00	-	-0.04	-	-0.55	-0.04	-0.10
	*1.83**	-	*3.09****	-	*1.77**	*2.78****	*1.20*
Full Control Set	YES	YES	YES	YES	YES	YES	YES
AIC	-1.90	-1.90	-1.88	-1.89	-1.89	-1.87	-1.89
n	1125	1125	1125	1125	1125	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 4 – ACGARCH-M Regressions, Bond Yields

	Dependent Variable: Russian Bond Yields						
	1	2	3	4	5	6	7
Political volatility							
Attempted assassinations Russia	0.02						
	0.52						
Attempted assassinations Empire		0.04					
		*2.07***					
Assassinations Russia			0.004				
			0.55				
Assassinations Empire				0.03			
				*10.50****			
Unrest Russia					0.005		
					*3.14****		
Unrest Empire						0.008	
						*4.87****	
External Conflict							0.002
							1.05
GARCH attributes							
Long-term volatility, political events	0.15	-0.002	-0.0002	0.002	0.05	0.0004	0.0001
	0.65	*0.87*	*2.60****	*0.25*	*1.96***	*5.69****	*0.73*
Short-term volatility, political events	-0.15	0.005	-0.0002	-0.004	-0.05	0.0003	-0.0005
	0.63	*1.12*	*0.17*	*0.64*	*1.95**	*0.70*	*1.83**
GARCH-in-Mean	-	-0.02	-0.08	-	-0.06	-0.006	-0.006
	-	*4.63****	*2.03***	-	*1.45*	*7.20****	*4.62****
Full Control Set	YES	YES	YES	YES	YES	YES	YES
AIC	-1.98	-2.04	-2.11	-2.06	-2.07	-2.09	-2.11
n	1125	1125	1125	1125	1125	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 5 – ACGARCH-M Regressions, Stock Returns

	Dependent Variable: Stock Market Returns						
	1	2	3	4	5	6	7
Political volatility							
Attempted assassinations Russia	-0.01						
	*3.24****						
Attempted assassinations Empire		-0.04					
		*3.55***					
Assassinations Russia			-0.005				
			*1.80**				
Assassinations Empire				-0.03			
				*2.02***			
Unrest Russia					-0.02		
					*2.20***		
Unrest Empire						-0.02	
						*6.13****	
External Conflict							-0.02
							*7.28****
GARCH attributes							
Long-term volatility, political events	0.001	0.0002	0.0008	0.01	0.0001	0.001	0.0006
	*2.90****	*1.01*	*2.16***	*1.42*	*2.15***	*1.79**	*7.11****
Short-term volatility, political events	-0.001	0.0007	-0.00005	-0.01	-0.0006	-0.001	-0.0008
	*3.25****	*2.16***	*1.87**	*1.33*	*1.15*	*1.44*	*8.81****
GARCH-in-Mean	0.02	0.02	0.007	2.16	1.05	0.006	1.28
	*174.48****	*3.99****	*16.24****	*3.09****	*9.99****	*73.24****	*23.32****
Full Control Set	YES	YES	YES	YES	YES	YES	YES
AIC	-5.45	-5.59	-5.63	-5.49	-5.59	-5.60	-5.60
n	593	593	593	593	593	593	593

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 6 – Results of the Event Study on Bond Prices, Attempted Assassination of the Tsar in 1866

	[-1,1]		[-3,3]		[-5,5]		[-10,10]
historical average window closed at t=-30							
Returns on Bonds (%)	1.40		0.92		0.45		0.53
p-value	*0.0663**		*0.446*		*0.774*		*0.822*
Volatility	0.002		0.001		0.001		0.005
p-value	*0.124*		*0.494*		*0.820*		*0.138*
Brownian intraday volatility	-0.06		-0.28		-0.01		0.14
p-value	*0.560*		*0.078**		*0.947*		*0.656*
historical average window closed at t=-20							
Returns on Bonds (%)	1.32		0.74		0.17		-0.01
p-value	*0.0894**		*0.546*		*0.915*		*0.997*
Volatility	0.002		0.001		0.0004		0.005
p-value	*0.160*		*0.550*		*0.881*		*0.175*
Brownian intraday volatility	-0.06		-0.28		-0.02		0.12
p-value	*0.545*		*0.07**		*0.918*		*0.679*
Counterfactual: The Panic of 1866 (11 May)							
historical average window closed at t=-20							
Returns on Bonds (%)	-2.67		0.68		-3.08		-2.13
p-value	*0.001****		*0.597*		*0.06**		*0.373*
Volatility	0.04		0.06		0.08		0.10
p-value	*0.000****		*0.000****		*0.000****		*0.000****
Brownian intraday volatility	0.98		2.68		3.57		4.61
p-value	*0.000****		*0.000****		*0.000****		*0.000****

*Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 7 – Results of the Event Study on Stock Prices, Attempted Assassination of the Tsar in 1866

	[-1,1]		[-3,3]		[-5,5]		[-10,10]
historical average window closed at t=-30							
Returns on Stock (%)	-5.97		-13.92		-19.14		-33.77
p-value	*0.302*		*0.144*		*0.134*		*0.10**
Volatility	0.04		-0.06		-0.15		-0.35
p-value	*0.781*		*0.759*		*0.593*		*0.438*
Brownian intraday volatility	-1.07		-3.14		-4.71		-9.50
p-value	*0.509*		*0.239*		*0.186*		*0.09**
historical average window closed at t=-20							
Returns on Stock (%)	-3.80		-8.88		-11.21		-18.62
p-value	*0.569*		*0.411*		*0.431*		*0.395*
Volatility	0.03		-0.08		-0.18		-0.41
p-value	*0.806*		*0.632*		*0.435*		*0.257*
Brownian intraday volatility	-0.77		-2.44		-3.62		-7.43
p-value	*0.599*		*0.303*		*0.246*		*0.121*

*Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 8 – Results of the Event Study on Bond Prices, Assassination of the Tsar, 1881

	[-1,1]		[-3,3]		[-5,5]		[-10,10]
historical average window closed at t=-30							
Returns on Bonds (%)	-0.52		-0.99		-2.39		-0.79
p-value	*0.07***		*0.06***		*0.0009****		*0.4806*
Volatility	0.001		0.002		0.0049		0.0053
p-value	*0.0001****		*0.0002****		*0.000****		*0.0000****
Brownian intraday volatility	0.19		0.31		0.20		0.49
p-value	*0.017***		*0.0323***		*0.3182*		*0.1095*
historical average window closed at t=-20							
Returns on Bonds (%)	-0.57		-1.11		-2.59		-1.20
p-value	*0.07***		*0.0521***		*0.0007****		*0.3072*
Volatility	0.001		0.002		0.0047		0.0050
p-value	*0.0001****		*0.0004****		*0.000****		*0.0000****
Brownian intraday volatility	0.20		0.34		0.24		0.59
p-value	*0.009****		*0.0143***		*0.1921*		*0.0411***

*Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 9 – ACGARCH-M Regressions, Russia/UK Bond Spread, Cumulative Political Volatility

	Russia-UK Bond Spread						
	1	2	3	4	5	6	7
Political volatility							
Attempted assassinations Russia	0.02						
	*1.76**						
Attempted assassinations Empire		0.02					
		*2.54***					
Assassinations Russia			0.002				
			0.99				
Assassinations Empire				0.01			
				1.46			
Unrest Russia					0.002		
					*1.65**		
Unrest Empire						0.003	
						*2.04***	
External Conflict							0.002
							*2.19***
GARCH attributes							
Long-term volatility, political events	0.50	-0.0003	-0.0001	0.001	-0.0001	0.0002	0.00002
	1.44	*0.07*	*0.19*	*0.95*	*0.67*	*1.76**	*0.18*
Short-term volatility, political events	-0.50	0.001	0.001	-0.0002	0.0004	-0.0002	-0.0001
	1.43	*0.22*	*0.06*	*0.26*	*0.63*	*0.62*	*0.12*
GARCH-in-Mean	-0.02	-1.03	-	-0.93	-	-1.01	-0.82
	*6.18****	*26.69****	-	*1.97***	-	*2.29***	*1.92**
Full Control Set	YES	YES	YES	YES	YES	YES	YES
AIC	-1.87	-1.88	-1.89	-1.89	-1.89	-1.90	-1.89
n	1125	1125	1125	1125	1125	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 10 – ACGARCH-M Regressions, Bond Yield, Cumulative Political Volatility

	Long-term Bond Yields						
	1	2	3	4	5	6	7
Political volatility							
Attempted assassinations Russia	0.007						
	1.29						
Attempted assassinations Empire		0.009					
		*2.00***					
Assassinations Russia			0.002				
			*1.74**				
Assassinations Empire				0.003			
				1.07			
Unrest Russia					-0.0001		
					0.49		
Unrest Empire						0.001	
						*2.96****	
External Conflict							0.009
							*4.47****
GARCH attributes							
Long-term volatility, political events	0.003	0.001	-0.00004	-0.001	0.002	0.0002	0.03
	0.42	*0.21*	*8.97****	*1.58*	*3.33****	*1.85**	*5.01****
Short-term volatility, political events	-0.003	-0.008	0.0001	0.005	-0.003	0.001	-0.03
	0.37	*0.16*	*0.72*	*1.11*	*3.29****	*0.13*	*5.31****
GARCH-in-Mean	-0.005	-0.15	-0.003	-0.004	-0.07	-0.11	-0.10
	*18.12****	*2.32***	*15.25****	*3.67****	*4.00****	*5.61****	*5.63****
Full Control Set	YES	YES	YES	YES	YES	YES	YES
AIC	-2.06	-2.06	-2.10	-2.09	-2.04	-2.08	-1.87
n	1125	1125	1125	1125	1125	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 11 – ACGARCH-M Regressions, Stock Returns, Cumulative Political Volatility

	Stock Returns						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Political volatility							
Attempted assassinations Russia	0.00001						
	1.00						
Attempted assassinations Empire		-0.002					
		1.30					
Assassinations Russia			-0.002				
			*3.06****				
Assassinations Empire				-0.006			
				*2.56****			
Unrest Russia					-0.002		
					*2.74****		
Unrest Empire						*-0.004*	
						*7.82****	
External Conflict							-0.001
							*1.94**
GARCH attributes							
Long-term volatility, political events	0.00002	0.000001	0.0004	-0.0005	-0.0002	0.0001	0.0001
	0.88	*0.05*	*1.68**	*1.57*	*1.03*	*3.54****	*1.10*
Short-term volatility, political events	-0.00006	0.0001	-0.0005	0.0008	0.0008	-0.00014	0.000002
	1.00	*1.21*	*1.86**	*2.20***	*1.82**	*3.13****	*0.07*
GARCH-in-Mean	1.62	0.009	0.008	1.13	0.009	0.01	1.73
	*23.01****	*4.64****	*3.77****	*4.03****	*62.91****	*247.62****	*44.27****
Full Control Set	YES	YES	YES	YES	YES	YES	YES
AIC	-5.61	-5.63	-5.61	-5.60	-5.46	-5.61	-5.59
n	593	593	593	593	593	593	593

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

DATA APPENDIX

Terrorism and Political Instability

A number of sources were consulted for creating the database on political volatility in Russia during the Tsarist era. Where necessary, they are noted in the text, but a complete list of scholarly literature and compilations from which the dating was taken appears below:

Ascher, A. (2002). *P. A. Stolypin: The Search for Stability in Late Imperial Russia*. Palo Alto: Stanford University Press.

Crenshaw, M. (2010). *Terrorism in Context*. State College: Pennsylvania State University Press.

Donnorummo, R. P. (1987). *The peasants of Central Russia: reactions to emancipation and the market, 1850-1900*. New York: Garland.

Friedgut, T. H. (1987). Labor violence and regime brutality in tsarist Russia: The Iuzovka Cholera Riots of 1892. *Slavic Review*, 46(2), 245-265.

Haberer, E. (2004). *Jews and Revolution in Nineteenth Century Russia*. Cambridge: Cambridge University Press.

Klibanov, A. (1984). Problems of the Ideology of Peasant Movements (1850s-1860s). *Russian History*, 11(2/3), 168-208.

Kolchin, P. (2009). *Unfree Labor*. Cambridge, MA: Harvard University Press.

Laqueur, W. (2001). *A History of Terrorism*. New York: Transaction Books.

Lauchlan, I. (2001). The accidental terrorist: Okhrana connections to the extreme-right and the attempt to assassinate Sergei Witte in 1907. *Revolutionary Russia*, 14(2), pp.1-32.

Longley, D. (2014). *Longman Companion to Imperial Russia*, 1689-1917. New York: Routledge.

Mavor, J. (1914/1925). *An Economic History of Russia (Vol. 2).* London: JM Dent & Sons, limited.

Moon, D. (1992). *Russian Peasants and Tsarist Legislation on the Eve of Reform: Interaction between Peasants and Officialdom, 1825–1855*. Berlin: Springer.

Owen, R. (1977). Demonstrations in Russia 1876–1976. *Index on Censorship*, 6(1), pp.41-46.

Perris, G.H, (1905). *Russia in Revolution*. New York: Chapman & Hall

Ruud, C.A., and Stepanov, S. (1999). *Fontanka 16: The Tsars' Secret Police*. Toronto: McGill-Queen's Press.

Siljak, A. (2009). *Angel of Vengeance: The Girl Who Shot the Governor of St. Petersburg and Sparked the Age of Assassination*. London: St. Martin's Press.

Ulam, A.B. (1977). *Prophets and Conspirators in Pre-Revolutionary Russia*. New York: Transaction Publishers.

Valk, S.N. (1961a). *Krest'ianskoe dvizhenie v Rossii v 1796-1825 gg.: sbornik dokumentov*. Moscow: Akademia Nauk USSR.

(1961b) *Krest'ianskoe dvizhenie v Rossii v 1826-1849 gg.: sbornik dokumentov.* Moscow: Akademia Nauk USSR.

Vucinich, W.S., and Curtiss, J.S. (1968). *The Peasant in Nineteenth-century Russia*. Palo Alto: Stanford University Press.

In addition to these published works, a number of international newspapers were consulted to double-check dates and ensure that consistency was kept with new-style dating as opposed to the old-style dating used during the 19th century. These newspaper accounts were also used to verify that these events were reported widely, with no discernible lag, so that the event actually became a source of information for financial markets. For example, the assassination of the Governor-General of Finland, Nikolai Bobikov, in June 1904 was reported on the same day of its occurrence by the *Press Democrat*, a small Northern Californian (Santa Rosa) paper with a modern-day circulation of 54,000 and which, as a local paper, had no real business publishing such an event half a world away. Publication of these events around the globe confirms that news of this political volatility was widespread.

The full list of attempted assassinations, assassinations, unrest, and external conflict are available as an on-line appendix so that other researchers may make use of it, as this database in and of itself represents a contribution to the literature on political volatility in Russia throughout the 19th century.

Bond and Stocks Data

For the monthly data, a hearty thanks is due to the St. Petersburg Stock Exchange Project at Yale University, whose researchers have created a monthly stock index for the SPSE. As noted in the text, monthly bond data for both Russia and the United Kingdom was obtained via the Global Financial Database and returns were calculated as in the text.

The daily bond data was available only in scanned form from individual copies of *Amsterdamsch Effectenblad* for 1866 and its successor, *Nieuw Algemeen Effectenblad*, for 1881. The data is available after registration from the website http://prijscouranten-capitalamsterdam.nl/cgi-bin/vvde?refr=1. As noted, only scans of the original sheets are available, and so all price data was entered manually.

Daily stock data for 1866 was collected from original copies of *Биржевыя Вѣдомости* (Stock Exchange News), the St. Petersburg stock broadsheet. Originals were only available at the archives in the Russian

National Library in St. Petersburg, and a photo was taken of each day, then the prices were entered manually. Unfortunately, data for 1881 was not available at this time.

FULL REGRESSION RESULTS FOR ON-LINE APPENDIX

Table 3 – ACGARCH-M Regressions, Russia/UK Bond Spread (FULL)

	Dependent variable: Russia/UK Bond Spread																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Political volatility																					
Attempted assassinations Russia	0.02	0.02	0.03																		
	*8.31 ***	*2.83** **	*0.66*																		
Attempted assassinations Empire				0.04	0.05	0.05															
				*2.25***	*2.85*** *	*1.99***															
Assassinations Russia							-0.02	-0.002	0.004												
							1.44	*0.10*	*0.17*												
Assassinations Empire										-0.007	-0.01	-0.01									
										0.21	*0.26*	*0.43*									
Unrest Russia													0.003	0.007	0.001						
													0.58	*1.08*	*0.20*						
Unrest Empire																0.001	0.02	0.02			
																*1.80**	*2.02** *	*1.92** *			
External Conflict																			0.01	0.03	0.02
																			*2.16***	*2.72*** *	*2.06***
Control variables																					
Lagged Bond Spread	0.98	0.98	0.99	0.97	0.97	0.98	0.97	1.03	1.01	0.97	0.97	0.98	0.97	0.98	0.99	0.98	1.02	1.00	0.97	1.00	0.99

	*238.91***	*222.89****	*150.36****	*363.37****	*222.15****	*392.21****	*237.54****	*771.36****	*102.95****	*775.98****	*166.07****	*217.08****	*348.06****	*146.36****	*406.42****	*239.58****	*95.03****	*104.98*	*372.28****	*180.78****	*648.34****
Price of gold	0.001	0.0008	0.001	0.0004	0.0006	0.001	0.001	0.002	0.002	0.0008	0.002	0.001	0.001	0.001	0.001	0.0004	0.0001	0.001	0.002	0.0006	0.001
	*5.33****	*0.78*	*1.18*	*1.45*	*0.71*	*0.97*	*1.46*	*1.79**	*1.61*	*1.04*	*2.65***	*1.12*	*1.58*	*0.85*	*3.03***	*0.47*	*0.12*	*1.16*	*4.77***	*0.72*	*1.29*
Ruble/Guilder Exchange Rate		0.005	0.002		0.009	0.006		0.003	0.001		0.009	0.005		-0.003	0.002		-0.005	0.006		0.002	0.0007
		0.68	*0.29*		*2.99****	*0.73*		*0.37*	*0.10*		*1.20*	*0.62*		*0.29*	*0.47*		*0.62*	*0.49*		*0.19*	*0.09*
Tsar Transition			0.08			0.12			0.06			0.09			0.10			0.11			0.11
			*3.38****			*3.55****			*1.50*			*3.81****			*2.69****			*1.33*			*6.05****
GARCH attributes																					
Long-term volatility, political events	0.004	0.01	0.005	0.003	0.002	0.001	0.0002	0.05	0.03	0.002	0.0001	0.006	-0.0005	0.06	0.0001	0.0005	0.0009	23.45	0.001	-0.02	-0.00002
	0.69	*1.04*	*0.96*	*0.70*	*1.34*	*0.40*	*0.12*	*3.08****	*1.70**	*0.33*	*0.04*	*1.18*	*0.80*	*2.49***	*0.10*	*1.01*	*1.08*	*4.13****	*1.06*	*4.13****	*0.02*
Short-term volatility, political events	-0.004	-0.01	-0.01	-0.003	-0.003	0.004	-0.004	-0.05	-0.03	0.0007	0.006	-0.01	-0.0002	-0.06	-0.0009	0.0005	0.0007	-23.44	-0.0009	0.02	0.0004
	0.46	*1.59*	*1.42*	*0.54*	*0.93*	*0.63*	*2.56****	*3.17****	*1.59*	*0.08*	*0.55*	*5.13****	*0.20*	*2.58****	*0.60*	*0.37*	*0.26*	*4.13****	*0.60*	*4.62****	*0.09*
GARCH-in-Mean	-	-	-1.00	0.01	0.01	-	0.009	-1.12	-0.04	0.01	0.01	-	0.01	0.18	-0.55	-0.21	-0.03	-0.04	0.008	-0.02	-0.10
	-	-	*1.83**	*6.23****	*6.80****	-	*3.07****	*16.64*****	*3.09****	*3.15****	*2.51***	-	*4.24****	*1.43*	*1.77**	*2.50***	*3.01*****	*2.78****	*5.49****	*12.19*****	*1.20*
AIC	-1.44	-1.89	-1.90	-1.44	-1.90	-1.90	-1.43	-1.75	-1.88	-1.44	-1.89	-1.89	-1.44	-1.89	-1.89	-1.44	-1.87	-1.87	-1.44	-1.88	-1.89
n	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 4 – ACGARCH-M Regressions, Bond Yields (FULL)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Political volatility																					
Attempted assassinations Russia	0.02	0.01	0.02																		
	0.93	*0.51*	*0.52*																		
Attempted assassinations Empire				0.02	0.04	0.04															
				0.69	*2.15**	*2.07***															
Assassinations Russia							-0.0001	0.004	0.004												
							0.05	*0.55*	*0.55*												
Assassinations Empire										0.01	0.02	0.03									
										*1.86**	*0.45*	*10.50****									
Unrest Russia													0.006	0.003	0.005						
													*2.54***	*0.72*	*3.14***						
Unrest Empire																0.01	0.01	0.008			
																*2.19**	*2.15**	*4.87***			
External Conflict																			0.006	-0.003	0.002

																			*3.41***	*0.98*	*1.05*
Control variables																					
Lagged Bond Yield	1.00	0.99	0.99	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	*22083.02****	*305.60****	*8108.91****	*905.70****	*292.63****	*14031.29****	*14607.00****	*87220.25****	*411.28****	*116460.10****	*891.42****	*1989.54****	*3941.68****	*390.84****	*2016.13****	*1318.32****	*1037.28****	*2578.88****	*9496.70****	*890.13****	*62075.02****
Price of gold	-0.0008	0.001	0.0009	-0.0003	0.002	0.001	-0.0007	-0.0002	-0.0004	-0.0008	0.0007	0.001	-0.002	0.001	-0.0001	-0.0002	0.001	0.002	0.0002	-0.0004	0.0001
	*49.27****	*1.06*	*1.11*	*4.35****	*1.78**	*1.97***	*3.15****	*0.43*	*0.74*	*3.35****	*0.97*	*6.05****	*6.05****	*2.84****	*30.74*****	*0.430*	*4.44****	*31.90*****	*5.47****	*0.660*	*0.140*
Ruble/ Guilder Exchange Rate		0.001	0.008		-0.002	-0.01		-0.002	-0.005		0.003	0.01		-0.005	-0.005		-0.01	-0.01		-0.01	-0.02
		1.47	*2.09***		*0.28*	*1.35*		*0.84*	*1.16*		*0.38*	*4.61****		*2.10***	*1.41*		*5.24****	*3.21****		*6.38****	*5.96*****
Tsar Transition			0.10			0.05			0.07			0.07			0.05			0.08			0.070
			*2.09***			*1.23*			*2.61****			*4.53****			*2.28***			*4.47****			*3.27*****
GARCH attributes																					
Long-term volatility, political events	0.03	0.006	0.15	0.002	-0.15	-0.002	0.0004	-0.0002	-0.0002	-0.0006	0.05	0.002	0.001	0.01	0.05	0.0008	-0.007	0.0004	0.008	-0.0004	0.0001
	1.34	*0.99*	*0.65*	*0.39*	*2.57****	*0.87*	*0.15*	*1.89**	*2.60****	*0.32*	*1.94**	*0.25*	*0.22*	*4.61****	*1.96***	*1.45*	*1.45*	*5.69****	*2.60****	*1.49*	*0.73*
Short-term volatility,	-0.02	-0.007	-0.15	0.01	0.14	0.005	0.008	0.0001	-0.0002	0.0004	-0.05	-0.004	0.001	-0.01	-0.05	-0.0001	0.007	0.0003	0.004	-0.002	-0.0005

political events																				
	0.60	*0.75*	*0.63*	*0.65*	*2.59***	*1.12*	*0.98*	*0.06*	*0.17*	*0.04*	*1.63*	*0.64*	*0.70*	*4.65***	*1.95**	*0.05*	*1.57*	*0.70*	*0.46*	*1.75**	*1.83**
GARCH-in-Mean	-	-	-	-0.004	-0.22	-0.02	-	-0.11	-0.08	-0.005	-1.07	-	-0.10	-0.13	-0.06	-0.19	-0.23	-0.006	-0.08	-0.004	-0.006
	-	-	-	*2.96***	*2.82***	*4.63****	-	*4.53****	*2.03**	*32.41***	*2.55**	-	*3.74***	*4.47***	*1.45*	*6.24***	*25.66****	*7.20***	*7.54***	*4.64***	*4.62****
AIC	-1.99	-2.07	-1.98	-1.93	-2.04	-2.04	-2.00	-2.10	-2.11	-1.97	-1.85	-2.06	-1.91	-2.05	-2.07	-1.87	-2.05	-2.09	-1.89	-2.09	-2.11
n	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125	1510	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 5 – ACGARCH-M Regressions, Stock Returns (FULL)

	Dependent variable: Stock Market Returns																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Political volatility																					
Attempted assassinations Russia	0.001	0.001	-0.01																		
	0.35	*0.23*	*3.24***																		
Attempted assassinations Empire				-0.02	-0.03	-0.04															
				*2.73***	*3.13***	*3.55**															
Assassinations Russia							-0.002	-0.01	-0.005												
							*2.47***	*1.88**	*1.80**												
Assassinations Empire										0.002	-0.04	-0.03									
										1.04	*2.49**	*2.02**									
Unrest Russia													-0.007	-0.01	-0.02						
													1.62	*13.46****	*2.20**						
Unrest Empire																-0.006	-0.007	-0.02			
																*1.72**	*1.70**	*6.13****			
External Conflict																			0.001	-0.005	-0.02
																			0.48	*0.98*	*7.28****
Control variables																					
Lagged Returns	0.09	0.09	0.18	0.11	0.12	0.15	0.09	0.26	0.09	0.16	0.07	0.13	0.10	0.15	0.15	0.11	0.11	0.12	0.08	0.18	0.19

	*2.31**	*3.38**	*3.77***	*3.26**	*1.93**	*1.92**	*2.48**	*3.56**	*2.16**	*4.02***	*0.98*	*1.91**	*2.26**	*3.00**	*3.78**	*2.62**	*2.65**	*2.67**	*1.79**	*3.85***	*3.37**
Price of gold	0.0005	0.0005	-0.0001	0.0004	-0.0001	0.0005	0.0005	0.0002	-0.0004	0.0005	0.0004	-0.0002	0.0004	-0.0005	-0.0006	0.0005	0.0003	-0.0006	0.0006	-0.0006	-0.0005
	*6.62***	*3.78**	*3.44***	*8.14**	*0.25*	*0.08*	*2.24**	*0.34*	*3.07***	*184.97****	*0.89*	*2.35**	*13.51****	*2.50**	*9.03***	*2.57**	*1.01*	*1.02*	*3.16***	*8.85***	*10.63****
Ruble/Guilder Exchange Rate		-0.002	0.003		0.01	0.0004		0.004	0.008		-0.0008	0.01		0.02	0.02		0.003	0.01		0.01	0.02
		*3.01***	*4.49***		*1.16*	*0.03*		*0.34*	*12.27****		*0.09*	*6.74***		*20.32****	*16.06****		*0.91*	*15.81****		*11.48***	*5.07***
Tsar Transition			0.01			0.02			0.02			0.001			0.01			0.01			0.01
			1.64			*0.59*			*0.67*			*0.05*			*0.40*			*0.59*			*2.01**
GARCH attributes																					
Long-term volatility, political events	0.0002	0.0002	0.001	0.0003	0.0001	0.0002	0.0002	-0.0002	0.0008	0.0001	0.02	0.01	0.0001	0.01	0.0001	0.0004	0.0003	0.001	0.0001	0.0001	0.0006
	1.19	*1.05*	*2.90****	*1.45*	*0.48*	*1.01*	*1.24*	*0.77*	*2.16**	*1.96***	*2.40**	*1.42*	*0.28*	*56.09****	*2.15**	*2.06**	*1.78**	*1.79**	*2.16**	*2.35***	*7.11****
Short-term volatility, political events	-0.0003	-0.0002	0.00	0.0008	0.0008	0.0007	-0.0003	0.0004	-0.00005	-0.0003	-0.01	-0.01	0.0003	-0.01	-0.0006	-0.0003	-0.0002	-0.001	-0.0004	-0.0002	-0.0008
	1.16	*1.02*	*3.25****	*1.57*	*1.96**	*2.16**	*1.80**	*1.45*	*1.87**	*3.41****	*2.40**	*1.33*	*1.67**	*88.19****	*1.15*	*1.37*	*1.17*	*1.44*	*5.53****	*2.06***	*8.81****
GARCH-in-Mean	-	-	0.02	0.68	0.01	0.02	-	1.50	0.007	-	0.02	2.16	0.32	*1.31*	1.05	0.003	0.48	0.006	0.004	0.02	1.28
	-	-	*174.48****	*8.19***	*4.01***	*3.99***	-	*3.65***	*16.24****	-	*65.95****	*3.09***	*6.74***	*10.19****	*9.99***	*2.44**	*3.15***	*73.24****	*3.28***	*105.22****	*23.32****
AIC	-5.65	-5.65	-5.45	-5.63	-5.61	-5.59	-5.66	-5.59	-5.63	-5.64	-5.47	-5.49	-5.67	-5.53	-5.59	-5.63	-5.65	-5.60	-5.67	-5.61	-5.60
n	593	593	593	593	593	593	593	593	593	593	593	593	593	*593*	593	593	593	593	593	593	593

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 9 – ACGARCH-M Regressions, Russia/UK Bond Spread, Cumulative Political Volatility (FULL)

	Russia-UK Bond Spread						
	1	2	3	4	5	6	7
Political volatility							
Attempted assassinations Russia	0.02						
	*1.76**						
Attempted assassinations Empire		0.02					
		*2.54***					
Assassinations Russia			0.002				
			0.99				
Assassinations Empire				0.01			
				1.46			
Unrest Russia					0.002		
					*1.65**		
Unrest Empire						0.003	
						*2.04***	
External Conflict							0.002
							*2.19***
Control variables							
Lagged Bond Spread	1.00	1.03	0.98	0.99	0.98	0.99	0.99
	*203.57***	*442.55***	*338.69***	*192.34***	*371.02***	*293.32***	*206.56***
Price of gold	0.002	0.001	0.001	0.002	0.001	0.001	0.002
	*2.01***	*1.08*	*1.24*	*1.68**	*2.47***	*0.99*	*1.44*
Ruble/Guilder Exchange Rate	0.01	0.006	0.007	0.007	-0.003	-0.002	-0.001
	1.08	*0.52*	*0.84*	*0.92*	*0.35*	*0.23*	*0.39*
Tsar Transition	0.08	0.13	0.11	0.09	0.11	0.11	0.10
	*1.80***	*1.85**	*3.57****	*2.55***	*4.12****	*9.15****	*3.30****
GARCH attributes							
Long-term volatility, political events	0.50	-0.0003	-0.0001	0.001	-0.0001	0.0002	0.00002
	1.44	*0.07*	*0.19*	*0.95*	*0.67*	*1.76**	*0.18*
Short-term volatility, political events	-0.50	0.001	0.001	-0.0002	0.0004	-0.0002	-0.0001
	1.43	*0.22*	*0.06*	*0.26*	*0.63*	*0.62*	*0.12*
GARCH-in-Mean	-0.02	-1.03	-	-0.93	-	-1.01	-0.82
	*6.18****	*26.69****	-	*1.97***	-	*2.29***	*1.92**
AIC	-1.87	-1.88	-1.89	-1.89	-1.89	-1.90	-1.89
n	1125	1125	1125	1125	1125	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 10 – ACGARCH-M Regressions, Bond Yield, Cumulative Political Volatility (FULL)

	Long-term Bond Yields						
	1	2	3	4	5	6	7
Political volatility							
Attempted assassinations Russia	0.007						
	1.29						
Attempted assassinations Empire		0.009					
		*2.00***					
Assassinations Russia			0.002				
			*1.74**				
Assassinations Empire				0.003			
				1.07			
Unrest Russia					-0.0001		
					0.49		
Unrest Empire						*0.001*	
						*2.96****	
External Conflict							0.009
							*4.47****
Control variables							
Lagged Bond Yield	0.99	0.99	1.00	0.99	0.99	1.00	0.99
	*1870.99 ****	*2175.76 ****	*3927.69 ****	*5139.44 ****	*630.14 **	*1022.62 ****	*3325.66 ****
Price of gold	0.002	0.008	0.001	0.001	0.002	0.002	0.001
	*10.84 ***	*0.91*	*27.93 ***	*4.33****	*39.03 ***	*8.01****	*1.23*
Ruble/Guilder Exchange Rate	0.002	0.004	-0.001	0.003	0.006	-0.003	0.009
	*9.17****	*0.52*	*1.22*	*0.93*	*1.33*	*0.97*	*0.75*
Tsar Transition	0.10	0.10	0.07	0.08	0.08	0.07	0.13
	*2.91****	*1.92**	*2.43***	*4.92****	*2.30***	*2.30***	*1.42*
GARCH attributes							
Long-term volatility, political events	0.003	0.001	-0.00004	-0.001	0.002	0.0002	0.03
	0.42	*0.21*	*8.97****	*1.58*	*3.33****	*1.85**	*5.01****
Short-term volatility, political events	-0.003	-0.008	0.0001	0.005	-0.003	0.001	-0.03
	0.37	*0.16*	*0.72*	*1.11*	*3.29****	*0.13*	*5.31****
GARCH-in-Mean	-0.005	-0.15	-0.003	-0.004	-0.07	-0.11	-0.10
	*18.12 ***	*2.32***	*15.25 ***	*3.67****	*4.00****	*5.61****	*5.63****
AIC	-2.06	-2.06	-2.10	-2.09	-2.04	-2.08	-1.87
n	1125	1125	1125	1125	1125	1125	1125

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.

Table 11 – ACGARCH-M Regressions, Stock Returns, Cumulative Political Volatility (FULL)

	Stock Returns						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Political volatility							
Attempted assassinations Russia	0.00001						
	1.00						
Attempted assassinations Empire		-0.002					
		1.30					
Assassinations Russia			-0.002				
			*3.06****				
Assassinations Empire				-0.006			
				*2.56****			
Unrest Russia					-0.002		
					*2.74****		
Unrest Empire						*-0.004*	
						*7.82****	
External Conflict							-0.001
							*1.94**
Control variables							
Lagged Returns	0.22	0.10	0.12	-0.16	0.13	0.23	0.22
	*3.05****	*1.93**	*2.34***	*3.12****	*2.56****	*6.68****	*4.95****
Price of gold	-0.0001	-0.0003	-0.001	-0.0004	-0.0003	0.0004	-0.002
	0.46	*0.95*	*0.29*	*0.78*	*5.64****	*0.24*	*12.64****
Ruble/Guilder Exchange Rate	0.01	0.01	0.01	0.01	0.01	0.01	0.04
	*22.17****	*85.28****	*1.69**	*1.63*	*14.67****	*4.78****	*21.81****
Tsar Transition	0.02	0.03	0.02	0.01	0.02	0.01	0.01

	1.42	*42.24****	*2.36***	*0.39*	*0.89*	*0.73*	*0.74*
GARCH attributes							
Long-term volatility, political events	0.00002	0.000001	0.0004	-0.0005	-0.0002	0.0001	0.0001
	0.88	*0.05*	*1.68**	*1.57*	*1.03*	*3.54****	*1.10*
Short-term volatility, political events	-0.00006	0.0001	-0.0005	0.0008	0.0008	-0.00014	0.000002
	1.00	*1.21*	*1.86**	*2.20***	*1.82**	*3.13****	*0.07*
GARCH-in-Mean	1.62	0.009	0.008	1.13	0.009	0.01	1.73
	*23.01****	*4.64****	*3.77****	*4.03****	*62.91****	*247.62****	*44.27****
AIC	-5.61	-5.63	-5.61	-5.60	-5.46	-5.61	-5.59
n	593	593	593	593	593	593	593

*Note: absolute value of t-statistics under coefficients. ***, **, and * denote significance at the 1%, 5%, and 10% levels respectively*.