

Markets under Siege:

How Differences in Political Beliefs Can Move Financial Markets

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Abstract

Can differences in beliefs about politics, particularly the benefits of war and peace, move thick financial markets? During the Siege of Paris by the Prussian army (1870-71) and its aftermath, we document that the price of the French 3% sovereign bond (*rente*) differed persistently between the Bourse in Paris and elsewhere, despite being one of the most widely held and actively traded financial assets in continental Europe. Further, these differences were large, equivalent to almost 1% of French GDP in overall value. We show these differences manifested themselves during the period of limited arbitrage induced by the Siege and persisted until the terms of peace were revealed.

As long as French military resistance continued, the *rente* price was higher in Paris than the outside markets. However, when the parties ceased fire and started negotiating peace terms this pattern was reversed. Further, while the price responded more negatively (positively) to defeats (victories) in Paris, the price responded more to peace events elsewhere.

These specific patterns are difficult to reconcile with other potential mechanisms, including differential information sets, need for liquidity, or relative market thickness. Instead, we argue, these results are consistent with prices reflecting the updating of different prevailing political beliefs that existed in Paris and elsewhere about the benefits of war versus peace. JEL codes: N23, G12, F51.

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1 Introduction

Can differences in beliefs about politics, particularly the benefits of war and peace, move markets? More specifically, can changes in the beliefs of particular groups of investors change equilibrium prices, even for actively traded and liquid assets such as sovereign debt in advanced economies? Or will the actions of investors whose beliefs have not changed ensure that prices stay the same? Recent research establishes that political beliefs often shape *individual* investment choices. However, much less is known about how, if at all, political beliefs can shape real-world *equilibrium* prices in thick markets.

The question of whether differences in political beliefs can shape aggregate market outcomes has been thus far hard to answer arguably for the simple reason that we typically observe only one price for an asset. Even if we do observe prices in multiple markets, which might reflect the beliefs of different groups of investors, arbitrage usually leads prices to converge rapidly. At least since the introduction of the telegraph, thick financial markets have tended to be characterized by the “law of one price”.

Further, with that one price determined ultimately by the marginal investors in the market, it is very difficult to attribute the actual prices that are realized by that market to *changes in political beliefs* rather than changes in endowments or the information that those investors may possess. Political events, such as close elections, are often accompanied by changes in the market price for companies that may be expected to benefit from the policies of the new regime. However, a key open question remains about the extent to which these changes reflect differing political beliefs rather than jointly-shared, even if sometimes overshooting, changes in expectations of the future stream of profits of the firm in response to government policy, or other economic changes that accompany political events. To answer the question of whether differential political beliefs can shape equilibrium prices, therefore, an ideal setting would involve the same asset being traded by different marginal investors with different political beliefs with the possibility of different equilibrium prices. In this paper, we exploit a historical episode that is a very close approximation to that ideal.

In 1870, French financial markets, along with Paris itself, came under Siege. The besieging Prussian army cut the telegraph lines out of the City, leaving communications to be largely entrusted to carrier pigeons and hot air balloons.¹ Despite the Siege, both the main Bourse in beleaguered Paris and other French stock exchanges still connected to the rest of the world—particularly in Bordeaux and Lyon—continued to function. In particular, French

¹The carrier pigeons of Paris were fêted as heroes, honored in Paris by a monument unveiled in 1906 and melted by the Germans in 1944 (Hayhurst 1970). The balloon remains a symbol of the city.

sovereign debt, the most liquid three percent *rente*, continued to be actively traded.

Yet, stark differences between the political views prevailing among Parisians and elsewhere in France are long-standing in French history, and political attitudes during the Franco-Prussian war were no exception. These historical facts allow us to observe three time series of equilibrium prices for the same actively traded asset, and thus a unique opportunity to document if and to what extent equilibrium prices can be shaped by differing political views about war and peace.

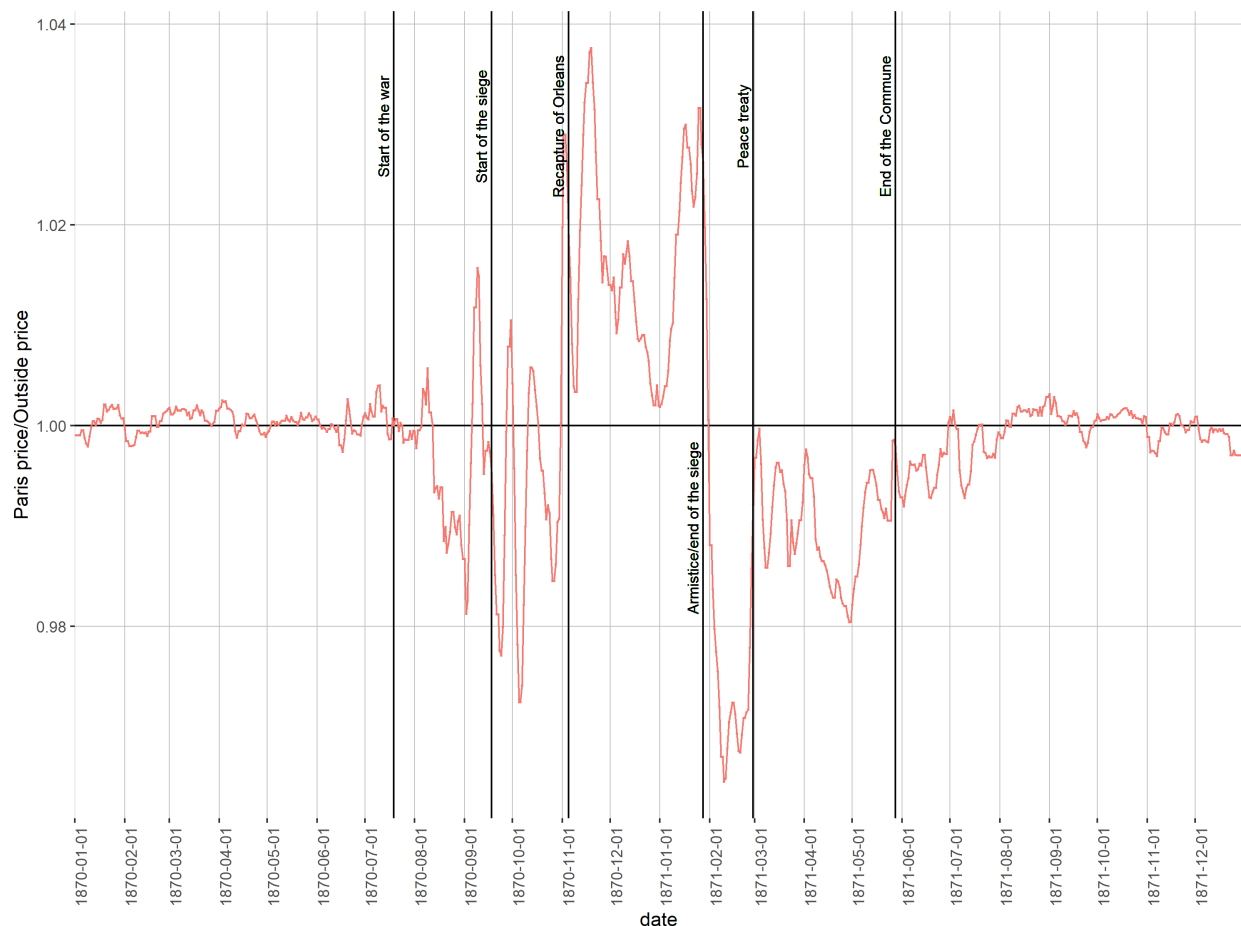
We first document that during the Siege of Paris, the price of the three percent *rente* differed persistently between markets in Paris and elsewhere in France, despite being one of the most widely held and actively traded financial assets in continental Europe. Figure 1 previews this result. From the start of the Siege on 19 September 1870 until the ceasefire on 28 January 1871, the *rente* price in Paris was on average 0.96% higher than in Lyon and Bordeaux.² In contrast, as soon as the ceasefire began, the Siege was lifted, and negotiators sought to hammer out the costs to France of securing peace, these patterns were reversed: between the Armistice and the signing of the peace treaty (on 26 February 1871), prices outside Paris were on average 2.51% higher. These differences are large, amounting to 0.31% and 0.86% of French GDP respectively.³ In contrast, despite underlying political differences, but consistent with the law of one price, *rente* price differences in the early phases of the war prior to the Siege and in peacetime more generally, were almost non-existent.

We next conduct a series of event studies, examining how the arrival of news of battles as well as peace negotiations impacted prices in these different markets. We show that the *rente* price in Paris during the Siege responded more to the arrival of news of the war and less to news about the peace than that of Bordeaux and Lyon. In particular, prices fell more in Paris in response to defeats, and rose more in response to one French victory. On average, the difference in responses to military events equals 0.87pp. In contrast, right after the news about peace was announced (the Armistice that ended the war), prices in the provinces rose by 5.01%, compared to a 1.08% price decrease in Paris. Finally, the revelation of the terms of the peace treaty one month after the armistice (which included the loss of Alsace-Lorraine

²This difference is larger (Paris was 1.87% higher) if we focus on the second part of the Siege when differences of opinion about the benefits of war and peace became more pronounced. See Figure 4 and Table 2.

³To calculate these numbers, we first estimate that these differences were equal to 0.52% (during the Siege) and 1.45% (during peace negotiations) of the nominal value of bonds. Second, we calculate that the French debt-to-GDP ratio in 1870 was 59.63% (Source for debt: *Annuaire Statistique de la France* 1966, source for GDP: Lévy-Leboyer and Bourguignon 1990). Third, we multiply these two numbers in order to compare the difference in prices to GDP.

Figure 1: Price ratio of the 3% sovereign bond (*rente*) between Paris and other French exchanges



This figure shows the ratio of the price of 3% *rente* in Paris divided by the average of the Bordeaux and Lyon prices for that same asset (7-day rolling average). Notice three patterns. First, consistent with the law of one price, the price was very similar in Paris and elsewhere (a ratio of 1) before the start of the war and after the defeat of the Paris Commune. Second, the Parisian price deviated and tended to be consistently higher throughout the Siege. Third, this pattern reversed, and the outside price was higher between the Armistice (end of the Siege and the announcement of the terms of the peace treaty).

and an indemnity equal to 25% of French GDP Dehdari and Gehring 2019; Occhino et al. 2008)⁴ reversed the outside price gains and led to a convergence to Paris prices. The outside reaction to the peace treaty was a 4.00% price drop, compared to a 1.08% drop in Paris (see tables 3 and 4).

We interpret these differences as being consistent with the different political beliefs of the marginal investors in Paris and the two outside stock markets, and specifically reflecting differing views on the gains from continuing the war versus suing for peace. As we discuss below, many in Paris considered continued resistance the key means to obtaining favorable peace terms.⁵ Therefore, we argue, the marginal investor in Paris responded more negatively to defeats (and more positively to the occasional French victory). Outside Paris, on the other hand, many thought that a quick end to the war would encourage the Prussians to offer favorable terms. Therefore, we argue, that these markets reacted positively to the surrender of the French armies, only to fall when the high cost of the peace terms was revealed.

To the best of our knowledge, this is the first paper to document the presence of persistent differences in market prices due to differences in political beliefs. We argue that the key source of disagreement that many in France faced was a dynamic trade-off common to many decision-makers facing the prospect of defeat in war-time: between continuing fighting today to secure a better peace in the future or suing for peace to avoid the costs of continued conflict.⁶

Beyond this, our results are arguably even more striking for a number of reasons. Wealth inequality was very high in 1870⁷, and though the rente was relatively widely held, market participation remained largely the preserve of the economic elite, both in Paris and elsewhere.

⁴Devereux and Smith 2007 describes this payment as “the largest transfer in history”. It is hard to overstate the size of the indemnity: it also 2.5 times the annual government budget (Devereux and Smith 2007) and around 1.67 times the size of annual French exports (Gavin 1992).

⁵Differences in political attitudes between Parisians and elsewhere in France, including major cities like Lyon and Bordeaux, are long-standing, being accentuated during the Revolution and the economic transformation and political upheaval that France experienced during the nineteenth century. The Franco-Prussian War showed continuity in these patterns. In particular, relatively more Parisians leaned to the left, were more likely to be Republican, and had greater optimism in the virtue and effectiveness of the citizen armies upon which France was forced to rely. In contrast, more of those outside Paris leaned to the right, supported the restoration of monarchical rule, and were skeptical of France’s prospects on the battlefield (Wawro 2003, p. 232). We confirm these differences using roll-call votes of representatives asked to ratify the treaty. In particular, Parisian representatives voted against the ratification of the peace treaty (6 in favor and 31 against, see table A.1). On the other hand, apart from one abstention, every representative from Bordeaux and Lyon voted in favor. The final result was 546 in favor and 107 against.

⁶For a broader discussion of dynamic trade-offs leading to war see Fearon 1996.

⁷In 1867, the richest 1% in Paris owned 53% of the wealth Piketty et al. 2006. Inequality was higher when we only take non-real estate assets into account: the top 1% of Parisians owned 59% of this wealth (we made this calculation with Piketty et al. 2006’s replication data.).

One might expect elites all over France to broadly share the same beliefs. Yet, we find that during the Siege, different political views in Paris and elsewhere, even if not initially shared by economic elites, began to be translated into substantially and persistently different equilibrium prices.

Further, we describe how these specific patterns are difficult to reconcile with other key potential mechanisms, including differential information sets, need for liquidity, or relative market thickness. First, we show that price differences cannot be explained by different information environments. The Siege limited communication between Paris and the rest of the world, but did not put a stop to the sharing of information. We track when Paris prices first appear in a business-oriented Bordeaux newspaper, *La Gironde* before and during the Siege. We find that though the Bordeaux price tended to respond to the Paris price in peacetime, Bordeaux prices did not converge when Paris prices arrived during the Siege. Neither did prices in Paris converge when news from outside entered the city, whether borne by carrier pigeon or Siege-running smuggler. Interestingly, the price divergence persisted even after more regular communications were partially restored following the Armistice but prior to the peace treaty. This was a time when Paris prices were once again printed daily in Bordeaux but arbitrage was still difficult due to delays in the transmission of information.

We next describe why our results are hard to explain by differences in liquidity. First, price differences were too persistent to reflect short-term liquidity shocks. Second, during the Siege, liquidity was arguably worse in Paris but prices were higher. During the Siege, and relative to Bordeaux and Lyon, the population in Paris faced grave hunger – Parisian restaurants put zoo animals on the menu – and, later on, bombardment as well. One might expect this to lead to overall market pessimism, with investors fire-selling securities to purchase food, or increased discounting of the future. Also, using weekly food prices during the Siege, we show that rente price differences are not related to food inflation. Third, we calculate price differences for another asset that was also double-listed and liquid: the Italian 5% bond. We find that there were no significant price difference between the Paris price and the Bordeaux price of the Italian bond during the Siege. During the peace negotiations, the Italian bond was *over*-valued (opposite of what happened with the rente). Since price differences are unrelated across assets, suggesting that market-wide differences in liquidity are not at play.

Our results are also unlikely to be explained by short-term fluctuations due to political beliefs moving thin markets in the regional exchanges. Paris had the deepest financial market in France, and one might expect belief shocks to have less of an effect there. We document

instead that during the Siege the opposite was true, however, with Paris responding more strongly to war news than elsewhere.

Our paper is closely related to a growing literature showing that political views affect people’s investment decisions, giving rise to heterogeneous beliefs in the market. Investors of different political leanings often disagree about which policies give them the largest economic benefits. For example, U.S. investors from Democrat- and Republican-leading ZIP codes appear to invest more in (risky) equities when their party is in power, suggesting investors think the market will do better when there are economic policies in place that are consistent with their own beliefs (Bonaparte et al. 2017 and Meeuwis et al. 2021).⁸ There is also a growing literature showing that political beliefs affect the actions of financial professionals, which in turn affect investor behavior (Hong and Kostovetsky 2012, Hutton et al. 2014, Kempf and Tsoutsoura 2018, and Goldman et al. 2020).⁹

At the same time, it is an open question whether such differences of beliefs have implications for market-wide pricing (and thereby aggregate investment decisions). In particular, the effects of beliefs on investment decisions found to be driven by a small sub-sample of investors who actively rebalance their portfolio, are economically small on average, and can take months to materialize (Meeuwis et al. 2021). Moreover, cooler (less-partisan) heads may prevail in equilibrium and might arbitrage away any partisan impact on prices such that, in equilibrium, asset prices are unbiased. As noted above, the share prices of companies that are politically affiliated or that may benefit from the policies of a new regime often do move with political events such as elections, but it is less clear whether this is the result of belief disagreement or instead reflects news that also affects future cash-flows (e.g. Addoum and Kumar 2016; Faccio 2006; Fisman 2001; Girardi 2020; Mattozzi 2008). Compared to this literature, by exploiting the existence of three concurrent price series for the same asset in locations with different prevailing political views, our paper provides evidence linking large and persistent equilibrium price-differences in a liquid and actively traded asset directly to differences in political beliefs.¹⁰

⁸Relatedly, Cookson et al. 2020 use an investor social media platform to show that Republican investors were less pessimistic during the Covid-19 pandemic, Bernstein et al. 2020 show that Republican-leaning voters are more likely to own houses exposed to sea level rises, and Laudenbach et al. 2020 show that investors in former East Germany, who have grown up with a Communist ideology, invest less in the stock market than investors in West Germany.

⁹Another literature establishes this for economic forecasts, but effects on individual consumption decisions are mixed (Conover et al. 1987, Gerber and Huber 2009, Gillitzer and Prasad 2018, and Mian et al. 2017).

¹⁰Further, the existing empirical evidence is predominantly based on the recent increase in U.S. political polarization. We show economically meaningful effects in a different setting in response to political

Our paper is also related to an established literature on the importance of difference of beliefs for investment decisions (see, among others, Miller 1977, Harrison and Kreps 1978, Jarrow 1980, Harris and Raviv 1993, Kandel and Pearson 1995, Hong, Scheinkman, et al. 2006, and Hong and Stein 2007). Recent empirical work suggests that differences in beliefs are significantly related to trading activity, but that economic effects are small (e.g. Ameriks et al. 2020, Giglio et al. 2021, and Cookson et al. 2020). Further, the evidence that differences of beliefs have aggregate (pricing) implications is limited. There are some exceptions. There is evidence from dual-listed shares that is at least consistent with differences of beliefs affecting equilibrium prices (Froot and Dabora 1999).¹¹ Compared to this literature, our paper provides direct evidence that differences of *political* beliefs can have economically important equilibrium pricing effects.

Our paper also relates to a literature examining from where differences in beliefs emerge. There is growing evidence that personal experience is important (E.g. Vissing-Jorgensen 2003, Greenwood and Nagel 2009, Choi et al. 2009, Malmendier and Nagel 2011, Malmendier and Nagel 2016 Koudijs and Voth 2016). There is also evidence that social networks and peer effects matter (E.g. Hong, Kubik, et al. 2004, Hong, Kubik, et al. 2005, Bursztyn et al. 2014, Bailey, Cao, et al. 2018 and Bailey, Dávila, et al. 2019). Burnside et al. 2016 provide a theoretical model in which investors can get ‘infected’ by others’ beliefs. In our setting, negative war experiences notwithstanding, many on the Parisian ‘street’ perceived continued French resistance as preferable for securing a better peace. Compared to this literature, our evidence suggests that these popular beliefs in Paris even infected the local economic elite (who likely set asset prices on the margin) such that their beliefs deviated from that of economic elites elsewhere.

Our paper also builds upon a literature that explores the relationship between war and financial markets (see Jha and Van Rensselaer 2021 for an overview). On the one hand, war and finance can be complements. Often seen as the ‘sinews of power’ in international relations (e.g. Brewer 2002), the ability for governments to access cheap finance has historically been crucial for supporting war in many settings. Financial markets can also allow individuals to

disagreement related to the costs and benefits of war and peace.

¹¹For example, Baker et al. 2012 show that price differences between dual-listed shares are correlated with differences in the principal components of a number of local sentiment proxies. Jia et al. 2017 show that dual-listed shares in Hong Kong and mainland China respond differently to analyst forecasts depending on where they are located. Moreover, firms that are covered by more analysts see a lower return correlation between the two share classes. In addition, Koudijs and Voth 2016 show that different experiences of margin-lenders during the Panic of 1773 differentially affected haircuts on future margin-loans in an over-the-counter setting with search frictions. This appears to have had implications for market-wide haircuts.

potentially profit from the fortunes of war as well.¹² At the same time, financial markets, by aggregating the beliefs of investors, can provide important information to political decision-makers.¹³ As conflict, and particular defeat and its aftermath, is economically destructive and can lead to increased risk and uncertainty (e.g. Barro 2006; Besley and Mueller 2012; Verdickt 2020; Wang and Young 2020), broad asset prices can drop substantially in the face of conflict (Jha and Van Rensselaer 2021; Rigobon and Sack 2005; Schneider and Troeger 2006; Zussman et al. 2008).¹⁴ The informative aspect of financial markets can be further reinforced when decisionmakers are themselves invested in broad financial assets, aligning their interests with the broader economy as well (Jha 2015; Jha, K. Mitchener, et al. 2020; Jha and Shayo 2019). Both of these effects can lead asset prices to moderate the political behavior of individuals, including elites. Our paper shows, however, that this potential moderating effect depends importantly on the political views of marginal investors. Our paper is uniquely available to show this, because we can observe the price for the same asset in two segmented markets.

We next provide some brief historical background on the Franco-Prussian war, the market microstructure for the French sovereign bond, and the politics of France useful for understanding our results. We next turn to a description of the novel data we have collected before presenting our main results. Finally, we discuss the implications of our findings and avenues for future research.

2 Historical Background

2.1 The War

The Franco-Prussian War of 1870-71 was the greatest conflict to take place in Europe between the end of the Napoleonic Wars and the First World War (Clodfelter 2017). Though the war itself lasted less than half a year, it was a turning point in European history. In that

¹²See for example DellaVigna and La Ferrara 2010; Guidolin and La Ferrara 2010.

¹³For example, Willard et al. 1996 and Calomiris and Pritchett 2016 examine how currency and slave prices in the US Civil War responded to war events as means to gauge public opinion of the chances of Union victory. K. J. Mitchener et al. 2015 use bond prices to predict victories in civil wars. Frey and Kucher 2000 and Ferguson 2006 look at bond prices around WWII and WWI, respectively. We contribute to this literature by reinforcing the point that the ‘smart money’ may actively disagree and such responses can be importantly influenced by the changing beliefs of the marginal investor rather than necessarily reflecting a broader consensus.

¹⁴Jha and Van Rensselaer 2021 take a sample of all inter-state wars in which at least one participant had an active stock market with daily returns between 1900-2020. They find that on average there is a 2.5% fall in the three day cumulative abnormal returns when a war begins in the countries involved.

period, France would see the death of an empire and the birth of a republic, Germany would emerge as a unified state, and the stage was set for the more global conflicts to come (Horne 2012). In short, the Prussian prime minister, Otto von Bismarck, sought to provoke the French emperor Napoleon III to declare war in order to unite Germany.¹⁵ On July 13th, Bismarck issued press releases manipulating the language of a diplomatic communication, the so-called ‘Ems telegram’, omitting key phrases so that it seemed that the French had insulted the Prussian king, incensing German public opinion and seeking to provoke the French. Bismarck’s attempts proved successful, and on July 16th, 1870, the French imperial parliament, the *Corps Legislatif*, declared war.

The war was initially very popular on the Paris street and among representatives of the *Corps Legislatif*— with “war fever” among some (Wawro 2003 (pg.38)), combining with concerns about a rising Germany. The call to arms on July 14th was greeted by crowds in the streets of Paris shouting “*à Berlin!... à bas Bismarck!*” [To Berlin!... Down with Bismarck!]” Wawro 2003 (pg.38). In the *Corps Legislatif*, the call for 50 million francs (\$ 150 million) to pay for a punitive war against Prussia was greeted by shouts of “*vive la France! vive l’Empereur! Bravo! Bravo*”, with all but 16 representatives in the 260 person chamber rising in acclaim.¹⁶

Summarizing the debates in the legislature, Wawro writes: “*What actually transpired revealed just how far [Napoleon’s ministers] had drifted from sensible opinion in their rush to war* (pg. 38).”¹⁷ Importantly too, the French rente price did not reflect the war fever outside the Bourse, and the rente fell a dramatic 9.97% both in and outside Paris in the lead up to the war (see the time series of the rente price in Figure A.1).

And indeed, France’s diplomatic and military preparations also fell short. France failed to

¹⁵For example, on July 10th, 1870, Bismarck wrote that “*politically a French attack would be very beneficial to our situation.*” (cited in Ferguson 2000,pg.191). See also Dehdari and Gehring 2019. The six-week Austro-Prussian War four years earlier (in 1866) had culminated in the encirclement of the Austrian forces at the battle of Königgratz. This was accompanied by a large fall (of more than 10 per cent) in the French 3 per cent rente as well (see Figure A.3). Prussia’s dramatic success had removed its key rival to leadership in the German lands but had also left a set of very restive south German states that did not wish to cede autonomy to a German empire dominated by Prussia.

¹⁶Interestingly, the 16 opposed were “irreconcilable” Republicans, led by Leon Gambetta, who would be among the most pro-war with the declaration of the Republic. Gambetta argued: “we would be the first to stand for a *national* war in the defense of our homeland. We will not stand for an aggressive *dynastic* war!” (Wawro 2003(pg.39), his italics.)

¹⁷In the *Corps Legislatif* too, moderate voices spoke, not against war, *per se*, but its current timing. Adolphe Thiers, who after the Prussian victory against Austria four years earlier had declared “the way to save France is to declare war on Prussia *immediately*” (Wawro 2003 pg. 17), remarked in the debate: “No one desires reparation for the events of 1866 more than me, but *this* occasion is detestably badly chosen.” (pg.39, his italics).

secure commitments from key potential allies before going to war. The French imperial army was made up of a cadre of highly experienced (but also relatively old) professional soldiers - *les grognards* (the grumblers)- which gave it a short-term advantage. Prussia, in contrast, had instituted universal conscription, which allowed it to access younger and more literate soldiers. This meant that if the war endured, and the reservist troops were mobilized, they would have a large numerical advantage (Wawro 2003). Further, while Prussia had inferior firearms, they enjoyed far superior artillery.¹⁸

However, it was not obvious *ex ante* that France would lose the war. This changed with a series of missteps. French imperial forces squandered their early numerical advantages by failing to seize the initiative (Wawro 2003).¹⁹ Instead, French commanders preferred to wait for the Prussian forces to attack strongly defended strongpoints. This might have worked if the Prussian artillery had not effectively targeted the French emplacements. Prussian successes against the fortified emplacements in Wissenbourg and Spicheren- Wörth forced French armies to retreat, even as Prussian numerical advantages were building as reservists were called to arms.

Napoleon III also split his army, allowing the Prussians to surround them separately. Marshal Bazaine's army contested a major battle at Gravelotte before he withdrew to the fortress-city of Metz, where he was besieged.²⁰ The other major field force, which would include Emperor Napoleon III himself, withdrew towards Mars-la-Tour and ultimately Sedan, where it too was surrounded. After a disastrous battle there on the 1st September 1870, which led to around 122,031 French killed, wounded, or captured (Clodfelter 2017), the French Emperor rode alone through the Prussian lines to seek terms of surrender.

Ironically, the capture of the Emperor at Sedan by the Prussians proved to be a liability for Bismarck, as the capture of the Emperor delegitimized the remaining Imperial regime, and thus those who might have been able to negotiate with Prussia on behalf of all France.²¹

¹⁸The French army had developed the highly accurate *Chassepot* rifle and put their faith in a newly-developed precursor to the machine gun- the *mitrailleuse*. The Prussians deployed the Krupp gun, which greatly out-ranged their French counterparts, the *bronze Napoleons*, and thus could destroy French batteries from a distance, and with impunity, before turning against the infantry. This artillery imbalance would prove militarily crucial in a series of key battles (Wawro 2003).

¹⁹Reminiscent of the so-called 'Phony War' seventy years later, French forces did make a small foray of several companies into the Saarland, but they quickly withdrew.

²⁰Bazaine, a hero of the Mexican War and the most senior Marshal, may have felt slighted by the appointment of Imperial favorites over his head (Wawro 2003). He would be tried after the war for treason.

²¹As part of later negotiations, Prussia would repeatedly threaten to release the Emperor or set up Marshal Bazaine, then still in command at Metz, as an alternative dictator. This was potentially credible since many of the professional officer corps were Bonapartists (Wawro 2003). However, their influence would wane as the professional forces besieged at Metz began to starve and became increasingly degraded as a fighting force.

Shortly thereafter, a group of revolutionaries ascended the steps of the Hotel de Ville in Paris to declare the deposition of the emperor and the creation of the Third Republic. The birth of what would become France’s longest-lived republic was however not met with universal acclaim. Again, the rente price tumbled (Figure A.1).

2.2 The Siege and the Politics

“*The obstacle to peace is Paris*” - Emilio Visconti-Venosta, Italian Foreign Minister, 22 Oct 1870.²²

The new junta in control of the newly-established Republic in Paris had different views on the war. Among its leaders was Leon Gambetta, who believed that despite the defeat and capture of almost all of France’s (largely Bonapartist) professional army, continued hope both for the war and for the new Republic lay in the *levee en masse*- new conscription of citizen-soldiers like those who had saved the Great Revolution (Ferguson 2000). New conscript forces were raised around France, with clusters both in the North (around Amiens) and in the South (around Orleans). But with such limited time, both these forces lacked training and discipline. Paris itself retained an extremely strong set of fortifications, defended by a mainly- citizen force of 300,000 and rings of forts. To put pressure on the French authorities within to negotiate terms, Prussia laid Siege to Paris itself on September 19th, 1870.

Apart from the surrender of the professional forces still holding out in Metz, Strasbourg, Thionville, and other fortress towns, the key war events during the Siege of Paris largely centered around attempts to coordinate with French forces near Orleans. With its bridge across the Loire and rail connections, Orleans could promise resupply to the capital (Figure A.2). Orleans itself would change hands three times during the war.

However, coordination with breakout attempts from the city was hampered by the cutting of the telegraph lines and the Prussian forces who attempted to forestall news and letters from entering the city.²³ The French improvised, sending out carrier pigeons carried by hot air balloons and developing a new miniaturizing technology to maximise the information a pigeon could carry. These balloons could be sent from Paris, but once aloft, their trajectories were unpredictable and determined by the air currents, making it hard to return. One balloon carrying the key message to coordinate a breakout attempt with the forces in Orleans ended

²²UK Public Records Office (PRO): FO 425,98,89, Florence, 22 Oct. 1870

²³The one main exception was that the American Minister to France, Elihu Washburne, was allowed to receive a regular *Times of London* in his diplomatic pouch on condition that he did not share it. This, too was stopped when the Prussians suspected that some news had been leaked.

up in Norway (see Figure A.7).²⁴ Those flying low were pursued by Prussian cavalry (*Uhlans*) that scoured the countryside seeking their capture. Among those sent aloft to rally France in the name of the Republic was Gambetta himself, who ran a parallel administration from Tours and later Bordeaux.

After the Battle of Sedan, it was clear to almost everyone that France would have to come to terms if there was to be peace. However, the nature of those terms was much less clear. For the Republicans in Paris, the hope remained that the French conscript levies, along with the emergence of partisan forces—*les franc-tireurs*—behind the lines, could keep up a slow war of attrition. This approach might make the occupation costly enough for the Prussians that they would agree to leave without costing France its territorial integrity. Some also hoped for foreign pressure and involvement, particularly from Britain, Italy, Austria, and Russia. As the Siege continued, Paris itself faced increasing hunger and, beginning in January 1871, bombardment. In the countryside, the costs of war were also grave. The Prussians were charging the French for the occupation, looting by both French and Prussian soldiers was common, and reprisals against civilians for *franc-tireur* activity became widespread.²⁵

For many outside Paris’ walls, and indeed around the world, however, a common view was that the costs of war dominated the potential gains from continued resistance, and France should seek peace as soon as possible.²⁶ Ironically, despite claiming to be staunch republicans, the junta in Paris was aware that their pro-war view was a minority one for French voters in general, and they consistently delayed holding elections that would return a more pacifist government.²⁷ Eventually, with starvation in the offing, a breakdown of military discipline and the threat of revolution, Parisian authorities agreed to an Armistice and the calling of elections on January 28, 1871.²⁸

²⁴Two crews were also lost in the Atlantic Ocean.

²⁵Bismarck, whose own son was a early casualty of the war, expressed a similar sentiment to Sherman in his famous March to the sea a few years earlier. Institutional memory of the *franc-tireurs* would also shape German military attitudes towards civilian partisans in the great wars to come (Wawro 2003).

²⁶For example, on his account of the Siege, Horne writes: “From the very first, the war was markedly less popular in the provinces than in Paris.” (Horne 2012 p. 39).

²⁷The Italian foreign minister complained that ‘French politicians will not “accept certain conditions that the French *nation* might be disposed to accept” [e.g., Alsace-Lorraine] (Wawro 2003 pg 246, op cit. PRO FO 425,98,89, Florence 22 Oct. 1870). Similarly, Wawro 2003 pg 246 writes: “. . . many of the neutral powers had begun to resent the French provisional government’s intransigence and its unwillingness to hold national elections that, according to Italy’s foreign minister, ‘would return an assembly with a strong pacific current’”.

²⁸Even after months of hardship and hunger, however, the Armistice was unpopular in Paris. When Jules Favre, the minister for foreign affairs, sent a messenger to the Germans to start armistice negotiations, he asked for secrecy: “God only knows what the Parisian populace will do to us when we are compelled to tell them the truth” (Horne 2012, p. 239). Another contemporary observed: “There is a danger. And that is,

France elected representatives to a National Assembly on February 8th, 1871.²⁹ Consistent with our interpretation and with the views of contemporaries during the Siege, the elections resulted in a overwhelmingly conservative, rural, and pro-peace majority. Paris, on the other hand, elected mostly republican, pro-war, candidates.³⁰ On March 1th the Assembly voted to ratify the peace treaty. Table A.1 confirms that a majority of the representatives elected in Paris (Seine district) voted against ratification, while, apart from one abstention, all the representatives elected in Bordeaux (Gironde) and Lyon (Rhône) voted in favor.³¹

The political divide between left-wing Paris and the conservative rural France predated (and outlived) the Franco-Prussian war. Figure 2 shows the percentage of deputies in the National Assembly identified as leftist, republican, or liberal in Paris vs. in the rest of France. Paris consistently elected more left-wing representatives.

2.3 The Bourses

The Paris financial market was “the leading financial center in continental Europe throughout the nineteenth century (Hautcoeur and Riva 2012 pg. 3)” We compare asset prices in Paris to that of two regional exchanges, Lyon and Bordeaux, that were the longest-established stock exchanges in France after Paris.³² Unlike Paris, these exchanges, moreover, remained largely connected to the rest of the world, and thus can be considered to provide a reflection of the world price.

During normal times, there was real-time information sharing and active arbitrage via telegraph between Paris and the regional exchanges. Information delays were minimal and arbitrageurs could take opposite positions in different markets that would clear within the business day (e.g. buying in Lyon, selling in Paris). This was further facilitated by the

one doesn’t know whether, the capitulation having been signed, it will not be rejected by the virile portion of Paris.” (Horne 2012, p. 241).

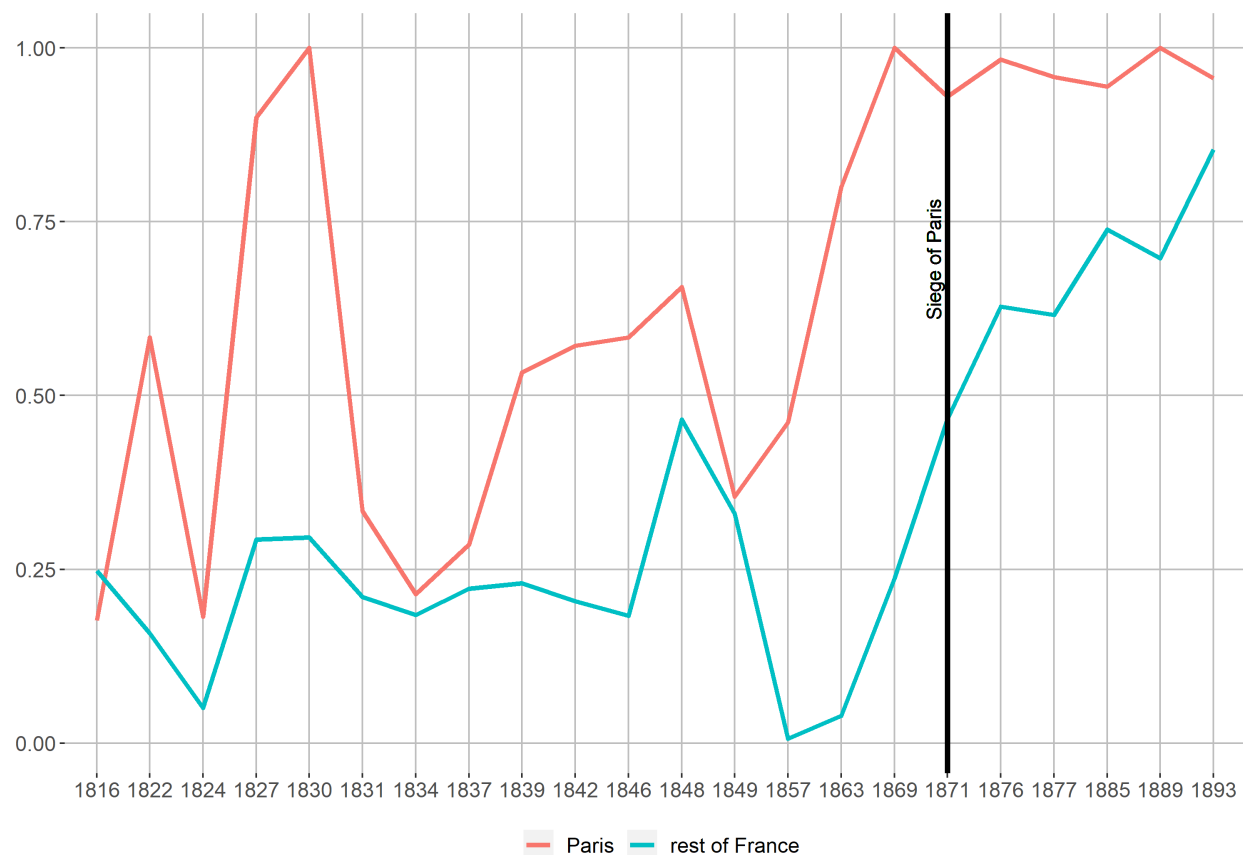
²⁹They used the electoral law of 1849, which provided for universal suffrage for males 21 and older.

³⁰Horne 2012 (p. 254) writes: “... the contenders fell into two principal groups, the ‘list for peace’ and the list for continuation of the war. If the latter comprised principally the left-wing firebrands of Paris, those standing on the ‘list for peace’ were essentially conservatives from rural France”. Included among the left-wing firebrands were the writer Victor Hugo, the Italian patriot Giuseppe Garibaldi, and the future prime minister Georges Clemenceau, who would make the recovery of Alsace-Lorraine a career goal (finally achieved in 1918).

³¹Sources: *La Gironde*, 1871-03-03 (roll-call), and *Journal Officiel*, 1871-02-14 and 19 (representatives and their districts).

³²The Lyon exchange was the first provincial exchange to gain the right to establish a trading floor (*parquet*) in 1845 (Ducros and Riva 2014,6-7). Bordeaux did so in 1846. Newer exchanges were founded in Marseilles, Toulouse, Lille and Nantes. See Ducros and Riva 2014. Using commissions as a measure of transactions volumes, Ducro and Riva suggest that the Lyon stock exchange had about 1/10 of the volume of trading of the exchange of Paris in 1870 (Ducros and Riva 2014, p.34)

Figure 2: Proportion of republican, liberal, or leftist deputies in the National Assembly from Paris and the rest of France.



This graph shows that Paris consistently elected more leftist deputies than the rest of France. Each observation corresponds to an election year (every post-revolutionary election of the XIXth century is included). The lines indicate the proportion of the delegation that was identified as “leftist”, “republican”, “socialist”, or “liberal”. The most common “non-leftist” identifications were: “right”, “dynastic”, “bonapartist”, and “conservative”. Source: *Assemblée nationale*, website.

presence of futures markets that obviated the need for arbitrageurs to take expensive spot positions. However, with the start of the Siege and the cutting of telegraph connections between Paris and the rest of the world, real-time information sharing disappeared. Instead news now depended upon hot air balloons, carrier pigeons (carrying micro-filmed messages) and smugglers crossing enemy lines.³³ After the Siege ended, telegraph connections were not reintroduced, though the Prussians did allow people in and out of the city. It would only be on May 28th, 1871, that the telegraph lines were repaired and restored.³⁴

Table 1: Information flows between Paris and the outside world, during the Siege

		Inverse frequency, in days		25 pc	Delay, in days	
		Mean	Max		Median	75 pc
Siege	Balloons	2.85	8			
	Paris price printed in Bordeaux	4.40	14	5	6	7
	Pigeons	3.20	14			
	Outside news printed in Paris	3.20	10	3	4	6
Peace negotiations	Paris price printed in Bordeaux	1.82	6	4	4	6
	Outside news printed in Paris	1.29	6	3	3	4

This table shows the (inverse) frequency and delay of information flows in and out of Paris. During the Siege, hot-air balloons left Paris with mail, official communications, and homing pigeons. Those pigeons were sent back to Paris with private mail and official communications. Both during the Siege and subsequent peace negotiations, a Bordeaux newspaper printed Paris prices, and a Parisian newspaper printed news from the outside. The mean (inverse) frequency measures how often news arrived through each medium. The maximum is the largest time interval without news from that source. ‘Delay’ measures how old were the prices and news observed at the time they arrived in Bordeaux and Paris respectively.

In Table 1, we show the amount of time that prevailed between instances in which news from outside the Prussian cordon were reported in Paris (and vice versa) during the Siege and during the subsequent peace negotiations. During the Siege, hot-air balloons landed outside Paris every 2.85 days on average. Starting in October, pigeons arrived in Paris every 3.2 days on average. We also report how often the Bordeaux newspaper *La Gironde* printed the prices of the Paris Bourse: every 4.4 days during the Siege, every 1.82 days during peace negotiations. Lastly, we report how often *Le Figaro*, a Parisian newspaper, printed news

³³Even for the Ferguson 2000 besieged in Paris, communications were extremely difficult, and they depended on the balloons as well, with significant delays. For example, on December 10, Alphonse de Rothschild received a letter dated October 21 (Ferguson 2000, pg 203). The Rothschild were only able to restore regular letter correspondence even between their constituent banking households on February 3, 1871 onward, when a hamper of food arrived in Paris sent from London.(Ferguson 2000, pg 203)

³⁴Private telegraphic communication between Paris and Bordeaux was restored on June 25th and between Paris and Lyon on June 23th (La Gironde, 1871/06/23-25, Le Salut Public 1871/06/23).

from the outside world: every 3.2 days during the Siege, falling to every 1.29 days during peace negotiations.

More importantly, we can establish the average delay in information transmission from the Bordeaux and Paris newspapers. During the Siege, the median price printed in Bordeaux was 6.6 days old, with the 25th and 75th percentiles at 5 and 7 days. The median news from outside reported in Paris was 4 days old, with the 25th and 75th percentiles at 3 and 6 days. The delays were shorter during peace negotiations, with a median of 4 days for Paris prices in Bordeaux and 3 days for outside news in Paris.

Though Paris and the outside world continued sharing information, the presence of significant information delays did limit arbitrage between Paris and the regional markets.³⁵ Moreover, the physical clearing of accounts was likely restricted in the absence of reliable information channels. As a result, the price of an asset in Paris and elsewhere reflected the beliefs (and other conditions) of the marginal investor in those markets specifically and prices could diverge significantly.

2.4 The Rente

“[T]he French rente is a security which can always find buyers”

- Alphonse de Rothschild, August 22, 1870, quoted in Ferguson 2000.

We focus on the French 3 per cent sovereign bond, (henceforth, the *rente*).³⁶ The *rente* had a nominal value of 100 francs, and its interest was 3% annually, paid quarterly.³⁷ During the nineteenth century, the *rente* was the most liquid security in France (Mériclet 1858, pp. 63-66) and indeed, the most actively traded asset in continental Europe.³⁸ Further, the

³⁵Take a symmetric information delay of five days. An arbitrageur would have to use five-day-old information from the other market to take a position that he could only offload five days into the future. Such a “round-trip” of ten days was risky, especially during the Siege and its aftermath as prices were volatile. During the 18th century, when information travelled by sailing boats, similar delays led to substantial price difference between cross-listed assets (Koudijs 2015; Koudijs 2016).

³⁶The French government also had previously issued bonds at 4%, 4.5% and 5%, which continued to be traded. However, it could redeem these at will, and as Homer and Sylla 1996, pg 221 discuss, French investors “preferred discount issues with longer probable life and a greater chance of price appreciation”, favoring the 3 per cent.

³⁷Since interest coupons are not paid in the three cities on exactly the same day, for each day of payment we add 0.75 francs (3% of the nominal value of 100 split in four quarterly payments) to the price of all subsequent observations. Our sources always specify which coupons were included with the listed bond.

³⁸Rentes represented Fr 7,742,001,334 of the capitalization of the Paris Bourse in 1870 compared to Fr.5,028,424,050 for stocks (Viaene 2002). For an excellent overview on the French sovereign debt, see Hautcoeur 2007 and other volumes in that series.

rente was broadly held.³⁹ On the eve of the Franco-Prussian War, the number of primary subscriptions to the last-prewar rente issuance (of 1868) was 832,798 (having risen from 99,224 in 1854).⁴⁰

3 Data

We hand-collected daily prices for the 3% *rente* for the years 1870 and 1871 for three cities with longest established stock exchanges in France: Paris, Lyon and Bordeaux. Our original sources are the *Cours Authentique* (Paris), the *Cours Officiel* (Bordeaux), and the newspaper *La Salut Public* (Lyon) (please see figures A.4, A.5, and A.6 for an example.) We always use the first price of the day. All price differences are calculated as the Paris price minus the price in the other exchange on the same day.

In order to measure the reaction to events, we need to know when each city found out about each news event. Our main sources are the newspapers *Le Figaro* (Paris), *La Gironde* (Bordeaux), *Le Salut Public* and *Le Journal Des Dépêches* (both Lyon).⁴¹ We also transcribed the corpus of all 29,903 surviving private messages as well as official messages received in Paris via carrier pigeon (please see wordclouds in Figures A.10 and A.11) and used the journal of a Parisian stockbroker, Jacques-Henri Paradis 1872, who kept and published a detailed account of life in Paris and the markets during the Siege.

We include the most important military events during the Siege. We base our decision on importance based upon the extent of their coverage in Wawro 2003’s definitive history of the *Franco-Prussian War*.⁴² For robustness, we also include a set of events that were mentioned in Clodfelter 2017 or in Parisian newspapers, even though they were ultimately not as consequential (see Appendix A.1). For each battle, we follow Wawro in determin-

³⁹Hautcoeur 2007 points to the “democratization of the rente” over the 19th century (p.331), as successive governments reduced the minimum denomination that could be registered, from 50 Francs in 1831– putting it out of the reach of small savers– to merely 3 Francs according the Finance Law of July 1870.

⁴⁰Further, the number of separate registrations of rentes (inscriptions) in the General Ledger in 1870 was 1,254,040, reflecting a sum of 358,087,510 Francs (Hautcoeur 2007 p.333-34). Naturally, both these figures could, to some extent, reflect large investors making multiple subscriptions and registrations, and as Hautcoeur argues, the actual number of individual propriétaires is hard to know for sure. However, Leroy-Beaulieu suggests a ballpark of 550,000 or 600,000 individual investors before 1870. (Hautcoeur 2007, p.335).

⁴¹These newspapers were chosen because they were available in a digital format for the entire period.

⁴²In particular, we go through each page of Wawro’s book and classify major battles as those that he treats with separate chapters or sections with the battle name listed in capital letters in his book (the one exception is the Siege and Fall of Metz, which he describes in great detail.) *Minor* battles are those that are mentioned only once or in passing.

ing whether they were French victories (positive news for French arms) or French defeats (negative news). We end up with seven major military events (six defeats and one victory). We add two peace events, the armistice of January 28th and the peace treaty of February 26th. The Armistice marks the end of the military conflict, and contemporaries interpreted it as positive news (especially outside Paris). The peace treaty revealed the very high cost demanded by Prussia, and therefore we classify it as negative news for the prospects of enduring peace.⁴³ Figure A.2 provides the *rente* price time series inside and outside the Siege over these events.

We focus on two-day returns for the *rente*. Returns in day t are calculated as: $\frac{p_t - p_{t-2}}{p_{t-2}}$. We choose a two-day window because that is the smallest time frame within which one can time with certainty the arrival of a specific piece of news.⁴⁴

4 Results

4.1 Persistent Price Differences during the Siege

We now document our first main result: that prices for the *rente* were persistently higher in Paris during the war and higher elsewhere during peace negotiations. Figure 3 summarizes these basic patterns, showing the distributions of the differences between the *rente* price inside and outside Paris in three time periods in the years 1870 and 1871: during peacetime (in green), during the Siege (blue) and during the period of peace-negotiations that followed the Armistice. Table 2 shows the average daily differences.

Notice first that in peacetime, the distribution of differences between the *rente* prices inside and outside Paris is tight and centered almost perfectly around a zero mean. This is consistent with the law of one price. However, during the Siege, Parisian prices diverged and were higher, with a mean price difference of 0.52 Francs relative to outside Paris (se=0.11). During the second part of the Siege (when beliefs diverged) the price difference is more stark

⁴³Bismarck predicted that seizure of large parts of Alsace and Lorraine would humiliate France and lead to future war, but in this instance the generals, particularly von Moltke, largely prevailed (see Dehdari and Gehring 2019.) Indeed, as we examine in our companion work, France itself would very soon confront a civil war, with Communards in Paris refusing to accept the terms of peace.

⁴⁴For example, news of the fall of Orleans was printed in Le Figaro on Saturday, October 15th. The stock market traded for a couple of hours around noon (approximately 12 A.M. to 2 P.M., Monday to Saturday), and newspapers were distributed in the early morning. By choosing the two day time frame we incorporate the possibility that Thursday's news could have arrived between the printing of the Friday newspaper and the Friday stock market or after the Friday stock market. Since the response could be incorporated into prices on either Friday or Saturday, we compare the Saturday price to the Thursday price.

(0.98 francs, $se=0.088$).

Further, as Figure 4 suggests, the distribution of the price differences in peace-time, the Siege, and the negotiations are not only systematically different on average, they are also largely persistent over time. Notice that at the beginning of the Siege in September 1870, the *rente* price in and outside Paris remained quite similar, but by the beginning of November the prices diverged. From then on the *rente* had a persistently higher price in Paris than in other exchanges at almost all times over the nearly three months remaining of the Siege.

On January 28, 1871, the national government agreed to an Armistice with the Prussians, and negotiations over a peace settlement began. The price patterns however reverse: now Parisian traders undervalue the *rente* relative to those outside the Siege cordon. The difference in prices went from +1.025 on January 25th to -1.025 on February 1st, and it subsequently became even more negative. During this period, the average price difference was -1.45 francs ($se = 0.15$). This difference is equal to 2.6% of the Paris price.

The Treaty of Versailles was announced on February 28th. The conditions were onerous: the loss of Alsace-Lorraine and payment of a five billion francs indemnity. This sum was equal to 25% of France's GDP and 2.5 times its yearly government budget, to be paid over three years. Immediately after the conditions were known, prices dropped outside Paris. After the news about the peace treaty became public, the price of the *rente* in Bordeaux and Lyon was down -3.87% and -5.15%, respectively. The Paris price, on the other hand, barely moved with the announcement of the treaty terms. Figure 5 shows *rente* price frequencies (each observation is a daily price) for January (last month of the war), February (the month of negotiations, since it starts with the Armistice and it ends with the peace treaty), and March 1871. It shows that Parisians appear to have accurately priced the peace treaty. During January and February, Parisians accurately predicted post-treaty prices. The average difference between Parisian January and March prices is 0.10 francs ($p\text{-value} = 0.50$), and the difference between Parisian February and March prices is 0.08 francs ($p\text{-value} = 0.54$). Outside Paris, investors first undervalued the *rente* (the average difference between January and March outside prices was -1.41, $p\text{-value} = 0.00$), and then overvalued it (the average difference between February and March outside prices was 1.03, $p\text{-value} = 0.00$).

4.2 Differential Responses to War and Peace

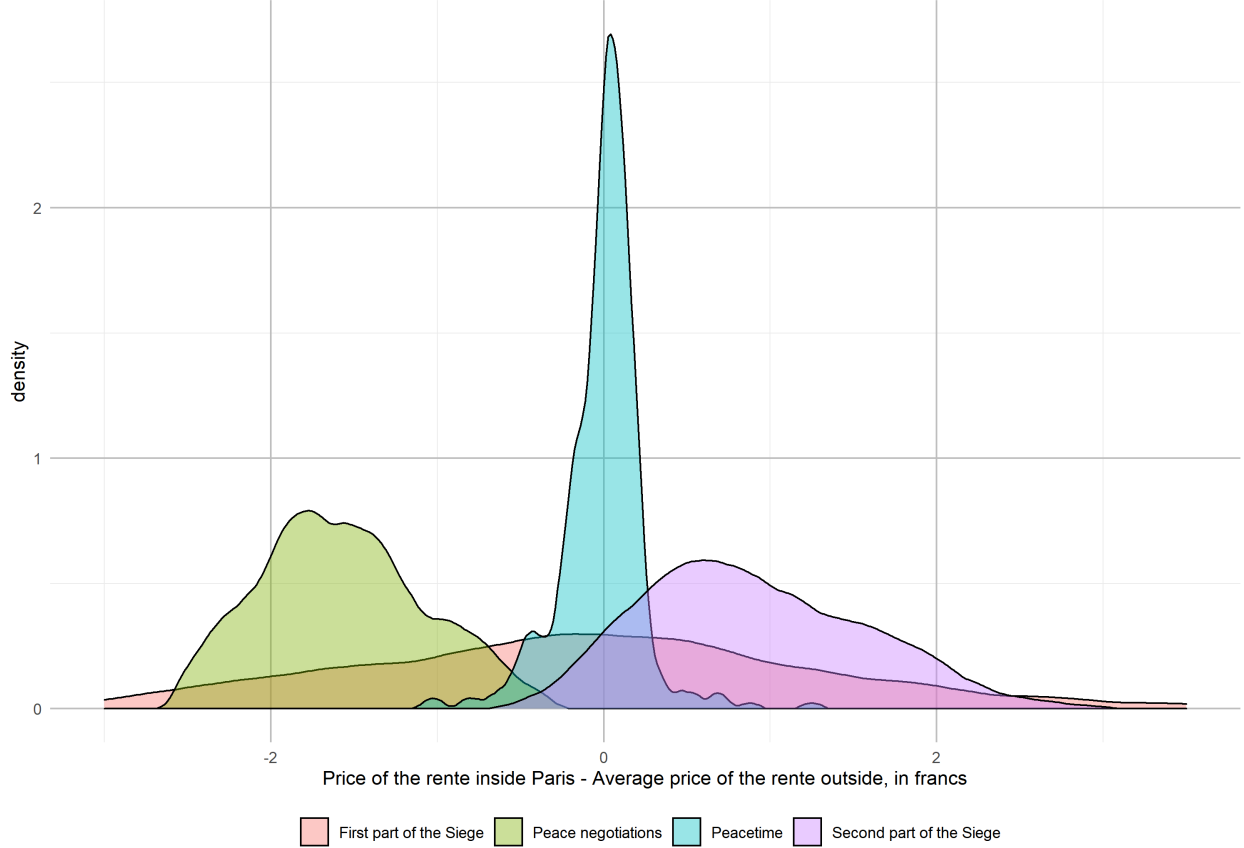
In the last section, we showed that investors inside Paris valued *rentes* more during the war, and investors outside Paris valued them more during peace negotiations. We know that the war was more popular in Paris from contemporary accounts, historical accounts,

Table 2: 3% *Rente* Price Differences between Paris and Elsewhere

	Paris - Elsewhere	Paris - Bordeaux	Paris - Lyon	Average Paris price
Entire Siege	0.511*** (0.111)	0.679*** (0.118)	0.325** (0.135)	55.33
Prob($t : \Delta = 0$)	[0.000]	[0.000]	[0.018]	
% price difference	0.92%	1.23%	0.59%	
Second half of the Siege	0.981*** (0.09)	0.803*** (0.12)	1.14*** (0.08)	55.31
Prob($t : \Delta = 0$)	[0.000]	[0.000]	[0.000]	
% price difference	1.77%	1.45%	2.06%	
Peace negotiations	-1.45*** (0.154)	-1.72*** (0.228)	-1.23*** (0.115)	54.4
Prob($t : \Delta = 0$)	[0.000]	[0.000]	[0.000]	
% price difference	-2.66%	-3.16%	-2.26%	
Peacetime	-0.010 (0.013)	-0.007 (0.015)	-0.018 (0.017)	67.18
Prob($t : \Delta = 0$)	[0.448]	[0.646]	[0.303]	
% price difference	-0.01%	-0.01%	-0.03%	

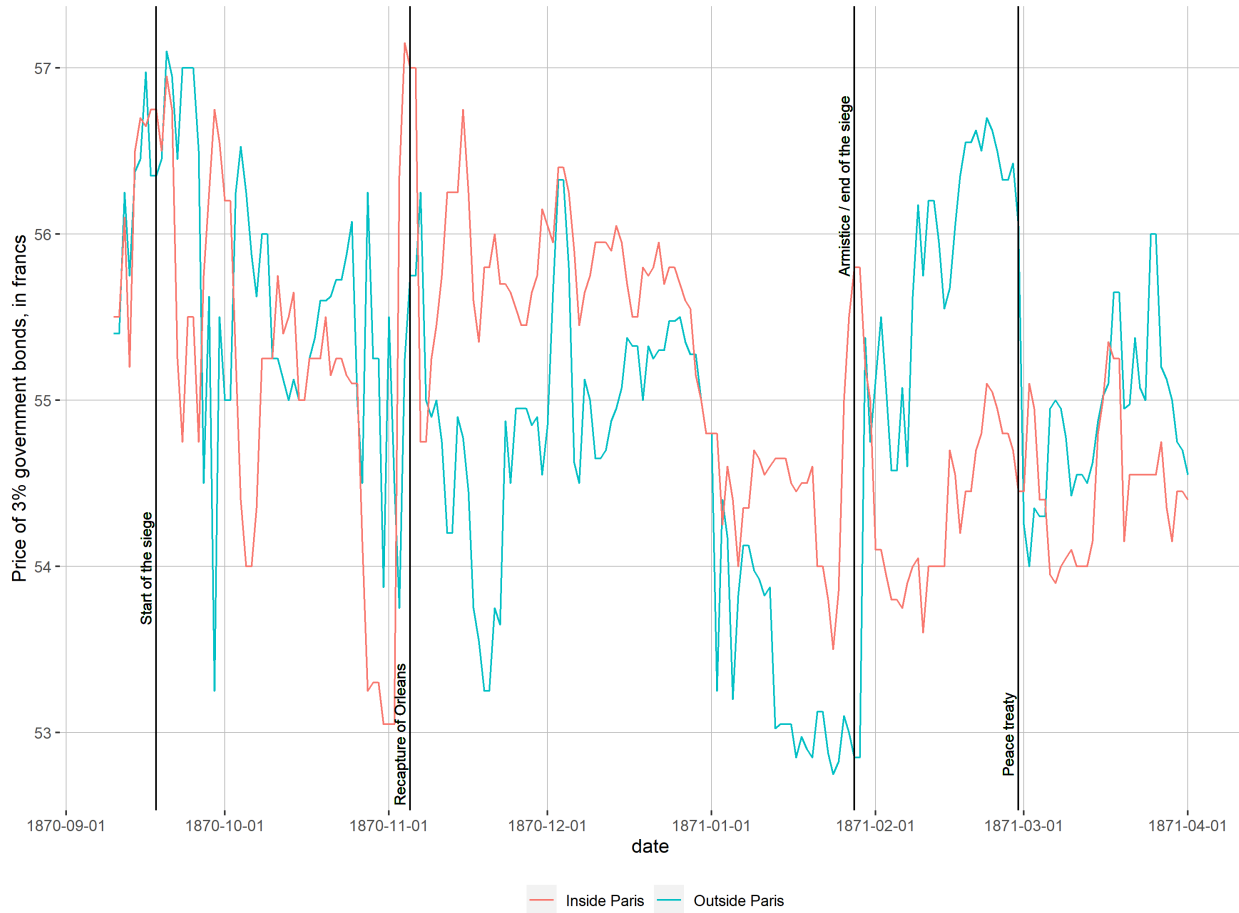
This table shows the average daily price difference between Paris, Bordeaux, and Lyon prices for three different periods. Elsewhere is calculated as the average between the Bordeaux and Lyon price. The standard errors (in parentheses) are the result of a one-sample t-test comparing the sample of daily differences to zero, p-values in brackets. The last row for each period reports the average difference as a percentage of the average Paris price (in the last column). The periods of analysis are: The entire Siege, from 1870-09-18 to 1871-01-28. The second half of the Siege starts after the French victory at Coulmiers (which led to the recapture of Orleans) on 1870-11-15. The peace negotiations went from the end of the Siege until 1871-03-02. Peacetime includes two periods: before the war (1870-01-01 to 1870-07-17), and after the pacification of Paris and restoration of the telegraph (1871-05-30 to 1871-12-31).

Figure 3: Density of price differences of the 3% *rente* between Paris and other French exchanges



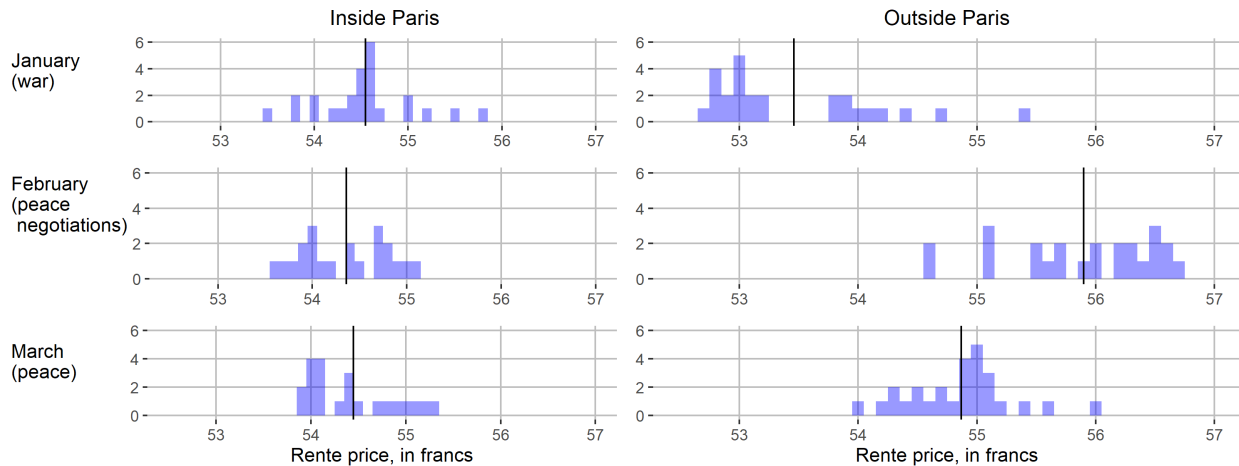
This graph shows the distributions of daily price differences between Paris and elsewhere for four periods: the first part of the Siege (September 18th to the French victory at Coulmiers in November 15th, 1870), the second stage of the Siege (November 15th, 1870 to January 28th, 1871), the peace negotiations (January 28th, 1871 to March 1st, 1871), and peacetime (January 1st, 1870 to July 15th 1870, and May 31st, 1871 to December 31st, 1871). The differences are calculated by subtracting the average between the Bordeaux and Lyon prices from the Paris price. As expected, differences are small and centered in zero during peacetime. The first part of the Siege shows wide variance centered around zero. Prices are higher in Paris during the second stage of the Siege and higher outside during piece negotiations. Epanechnikov kernel with Silverman rule-of-thumb bandwidth.

Figure 4: Prices of the 3% *rente* in Bordeaux, Lyon, and Paris



This graph shows the prices of the 3% French sovereign bond (the *rente*) inside and outside Paris between September 18th 1870 (the start of the Siege) and April 1st, 1871. The outside price is an average between Bordeaux and Lyon. The graph shows that Parisians were higher during the war, but the situation was reversed after the end of hostilities. Prices differences during the Siege were salient after during the later months of the conflict. Prices converged again when the terms of the peace treaty (and the cost of the war) became public.

Figure 5: Rente price frequencies in Paris and outside right before, during, and right after the peace negotiations



This figure shows rente price frequencies in Paris and outside for January, February, and March 1871. Therefore, it includes the month of peace negotiations (February) and a month before and after. It shows that Parisians accurately priced the costs of peace. Outside investors, on the other hand, experienced high volatility, under-pricing rentes before the end of the war, and overpricing them during peace negotiations.

and election results (Horne 2012, Wawro 2003). We hypothesize that Parisians believed that continuing the war effort would bring more favorable peace terms. The prevailing view elsewhere, on the other hand, was that a quick ceasefire and start of peace negotiations would yield better outcomes for France. We now test this hypothesis by showing how the three markets responded to war and peace events. We find that the Parisian market reacted more strongly to war news, and reacted less to news about peace.

As we have discussed, arbitrage between Paris and markets elsewhere was interrupted as early as September 19th, 1870. After the battles of Spicheren (Wörth), Gravelotte, and Sedan in early August and early September 1870 the price of the *rente* had fallen dramatically from 66 to 52 Francs (Figure A.1). However, persistent price differences between markets inside and outside Paris only appear in November 1870 (Figure 4). With Paris under Siege and most of the professional army having surrendered, it was already clear to most that France had lost the war. As we have described above, to the extent that this reflects political disagreement, therefore, it was most likely about whether continued fighting in a war of attrition was worth the costs of war in affecting the ultimate terms of the peace.⁴⁵

⁴⁵That there were differences in political beliefs that might have driven the markets was also not alien to contemporary observers. After the ceasefire, an anonymous financial analyst for *The Times* of London wrote:

To test the hypothesis that the persistent price differences we observe are due to differences in political beliefs, we examine how these prices update in response to new information. Our logic is as follows. If investors in Paris had different beliefs about the potential success of the war efforts in securing a better peace, we would expect them to respond more strongly to war-related news. In the case of French military defeats, the price should fall more in Paris than elsewhere since this would lower Parisian investors' hopes for better peace terms. In contrast, if investors elsewhere were more skeptical of the gains of war and more cognizant of the costs, then they would react in a more muted way to military defeats that would both weaken France's bargaining position but could also expedite the end of the war. In the case of (the few) French military victories, we expect Parisians to update more positively as they expected more favorable peace terms as a function of French military success. Moreover, a French victory increased the probability of extending the war of attrition against Prussia.

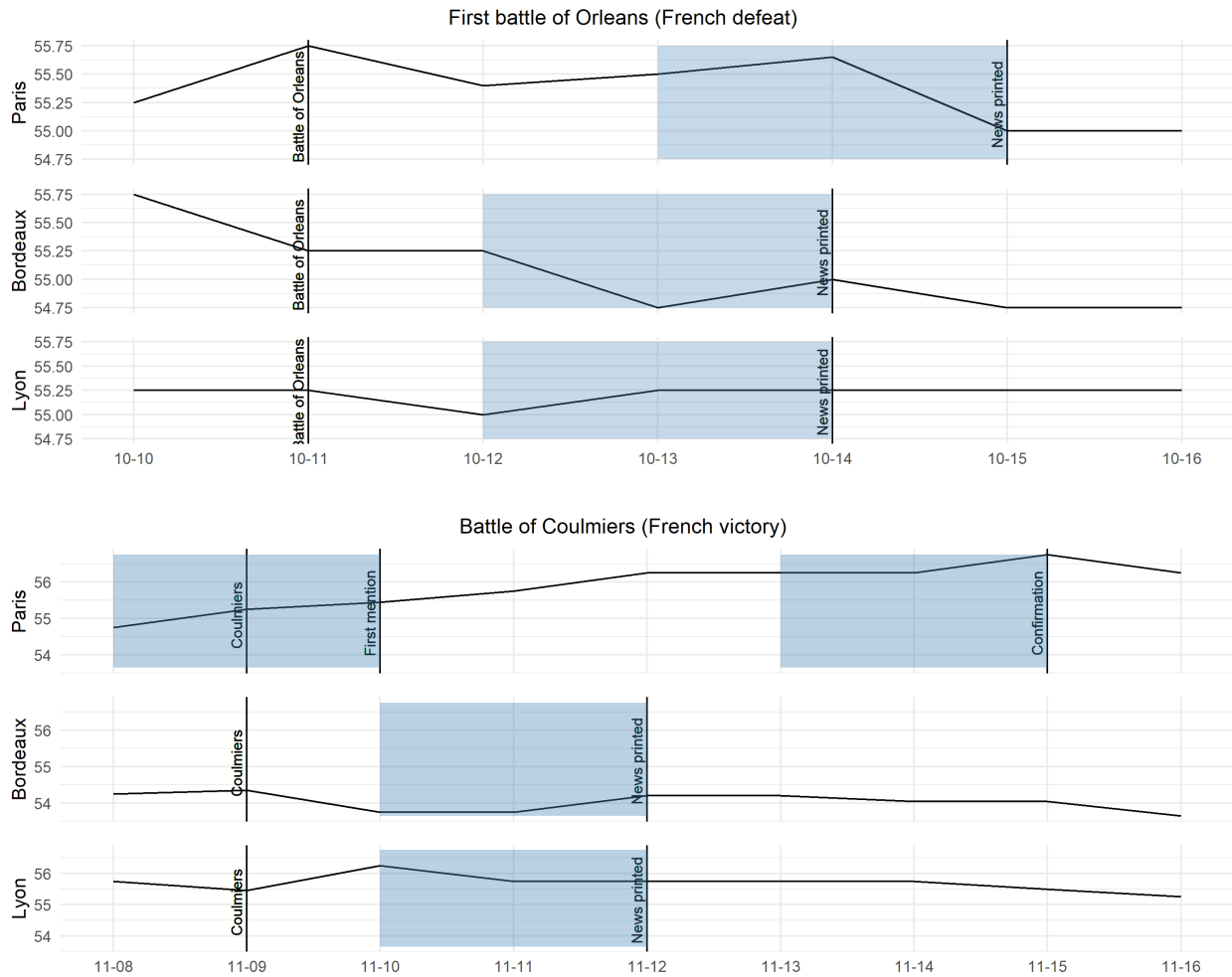
Along the same lines, if investors outside Paris thought that a quick end to war would improve the outcome of the peace negotiations, we would expect the outside price to respond more positively to news about the ceasefire. The ceasefire was instigated by the Paris government under duress, not by the Prussians trying to end the conflict in the fear of French military success. We therefore expect Parisian investors to have been more skeptical about the final peace terms than investors outside Paris who believed that a quick surrender was the way to get better peace terms. Given that the final peace terms were very harsh for France, we expect the price elsewhere to respond more negatively to the announcement than in Paris.⁴⁶

Figure 6 illustrates the steps in our methodology. It shows the *rente* prices in the three cities during developments in the crucial battles of Orleans and Coulmiers. Recall that, with its bridge and rail networks, Orleans represented the French Republic's best hope of relieving Paris. Three battles were fought there that led to the fall, recapture and subsequent fall of

"It is worth noting that during the time Paris was invested [surrounded], prices ruled higher in the principal provincial bourses... This was probably owing to the conviction being entertained by Parisians that armies from the provinces would relieve them, whereas outside that was known to be a delusion. But since the capitulation the Bordeaux prices have been better than those of Paris... The explanation no doubt is that at Bordeaux the armistice was considered morally certain to lead to peace, whereas in the capital that was not clear." (*The Times*, February 15, 1871).

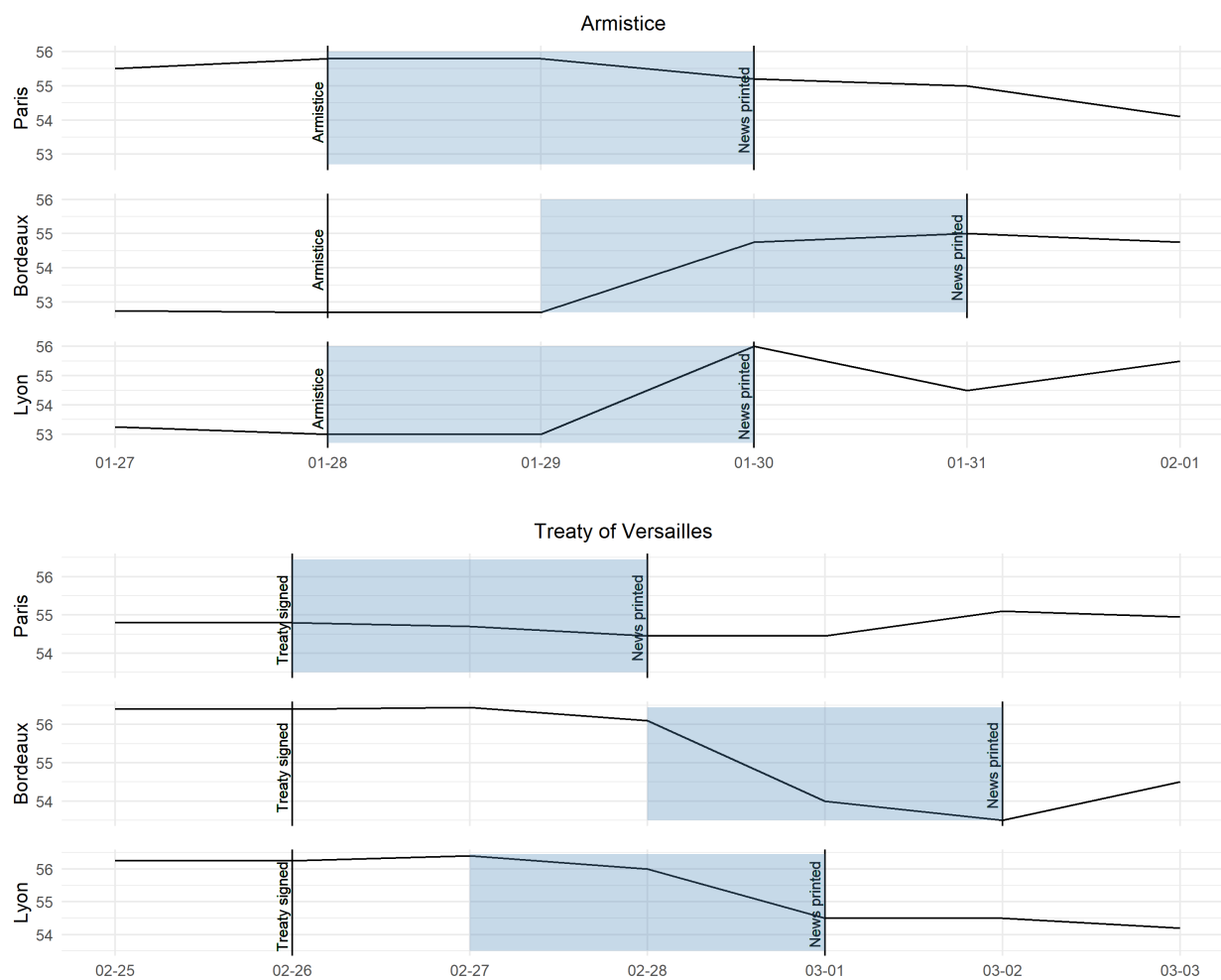
⁴⁶France ultimately managed to pay the enormous war indemnity ahead of schedule without defaulting on its debts. However, contemporaries did not expect this. An analysis by *The Economist* (February 11, 1871), considered France unable to pay interest on the debt required to cover a 2.5 billion franc indemnity (half as big as the one announced three weeks later) (cited by Gavin 1992).

Figure 6: Price of *rentes* (in francs) around the Struggle for Orleans



This figure shows *rente* prices in three markets around the Struggle for Orleans that was the main hope for the relief of Paris. Note that prices fall more in Paris in defeat (graph 1) and rise more in victory (graph 2). The shaded area covers the two-day period when news could have arrived.

Figure 7: Price of *rentes* (in francs) around peace events



This figure shows *rente* prices in three markets around peace events. As expected, prices rise more outside Paris after the armistice (graph 1) and fall more when the terms of the peace treaty are revealed. The shaded area covers the period when news could have arrived.

Orleans.⁴⁷

For each event, we note the date of the event, but also the first date or a rumor about the event is reported in local newspapers. With Paris under Siege, rumors (often inaccurate) would arrive quickly but the confirmation of news would arrive considerably later than in Bordeaux and Lyon. As described above, we allow a two day window for news to be reflected in the reported end of day rente price.

Notice that during the period that the news was reported in each city, the responses in Paris versus Bordeaux and Lyon tended to differ. In Paris the news of the first fall of Orleans to the Prussians was met by a fall in the rente price of 0.90%, whereas in Bordeaux the response was a more muted 0.45% fall, and Lyon the price actually increased by 0.45%. The French victory at Coulmiers raised the Paris price by 0.89%, whereas the price in Bordeaux rose by 0.84% and the price in Lyon actually fell by 0.90%.⁴⁸

Figure 7 does the same exercise for the two main peace negotiation events- the Armistice, and disclosure of the terms of the peace treaty. The response in Paris rose with rumors of the Armistice before falling when the rumors were confirmed, leaving a 1.73% overall gain (our measure adds up the returns of both days, though as we show below our main estimates are not sensitive to this.) The gains in Bordeaux and Lyon, in contrast, were much higher (4.36% and 5.74%). When the onerous terms of the treaty were revealed, the marginal Parisian investor did not seem terribly surprised, and the price fell only slightly (by 0.64%) compared to dramatic falls elsewhere (of 4.63% in Bordeaux and 3.41% in Lyon). Figure 5 depicts the price frequencies inside and outside Paris around the peace negotiations, showing that Lyon and Bordeaux experienced higher volatility and that Parisians accurately predicted the high costs of peace at the time of the Armistice.

Table 3 displays these comparisons for all major war and peace news events during the Siege. For each event and market, it reports the two-day return for *rentes* on the day in which news were printed in the city. In bold it presents effect patterns which are consistent with our hypotheses: that Paris should experience larger absolute returns for war events (positive for victories and negative for defeats), and that outside markets should react more

⁴⁷Orleans was first captured by the Prussians on October 11. A month later, a rare French victory- at Coulmiers- led to the Prussian evacuation of Orleans. The French attempt to relieve Paris was however checked at Beaune-La-Roland when 80,000 French conscripts encountered 9000 German regulars along with artillery, and they were forced to retreat. The Battle of Loigny then led to the French evacuating Orleans once more.

⁴⁸The difference between Paris and Bordeaux is starker if we take into account that the news were first reported as a rumor and later confirmed, see figure 6. The arrival of news of the final time Orleans exchanged hands led to falls in all stock exchanges, with the fall in Paris being smaller than in Lyon (1.42% vs. 2.24%), but bigger than in Bordeaux (1.07%).

Table 3: Events and *rente* returns in three cities

			Two-day returns to rentes		
War events	Date	Positive news for France?	Paris	Bordeaux	Lyon
First battle of Orleans	1870/10/11	No	-0.90%	-0.45%	0.45%
Chateaudun	1870/10/18	No	-3.36%	-0.80%	0.00%
Metz	1870/10/27	No	-0.47%	1.91%	0.45%
Coulmiers	1870/11/09	Yes	0.89%	0.84%	-0.89%
Beaune-la-Rolande	1870/11/28	No	-0.80%	0.00%	-0.54%
Loigny	1870/11/28	No	-1.42%	-1.07%	-2.24%
Le Mans	1871/01/12	No	-0.92%	-2.57%	-0.47%
Average (signed)			1.25%	0.55%	0.21%
Peace events			Paris	Bordeaux	Lyon
Armistice	1871/01/28	Yes	-1.08%	4.36%	5.66%
Treaty of Versailles	1871/02/26	No	-0.64%	-4.63%	-3.37%
Average (signed)			0.86%	4.49%	4.51%

This table shows the two-day returns in the three markets to war and peace events. Returns are calculated as: $\frac{p_t - p_{t-2}}{p_{t-2}}$, for news printed on day t . Since news arrived on different days to each market, they do not necessarily correspond to the same calendar date. In bold, the events for which our hypothesis holds: bigger responses for war events in Paris, and bigger responses for peace events outside Paris. To calculate the averages we multiply the returns to defeats and the negative peace event by -1.

strongly to news about peace. Notice that the patterns hold for 7 out of the 9 major news events.

Table 4 reports the results of two-tailed t-tests on the average difference in price responses. The null hypothesis is that the differences are equal to zero on average. We show comparisons between Paris and Bordeaux, Paris and Lyon, and Paris and the outside (i.e., the average between Bordeaux and Lyon). We always compute differences in the direction our hypothesis predicts.⁴⁹ For our baseline model, we obtain that the average difference between Paris and the provinces (over 9 events) was 1.73 percentage points. We also report the same result including only including war events, and we find a positive (but somewhat smaller) significant result (0.875 pp.) These results are also robust to including minor battles and draws.⁵⁰

4.3 Robustness and Alternative Mechanisms

So far we have argued that these patterns are consistent with the different political beliefs between Paris and elsewhere on the trade-offs between continuing the war or suing for peace. We now consider the robustness of our findings and alternative explanations for the patterns we observe.

4.3.1 Rejecting null hypothesis 1: markets are responding to different, unrelated events

What if each market is actually responding to something else, not included in our event list? In this case, prices changes in one market would be unrelated to price changes in the other two. In this section, we explicitly model this possibility, and test it as a null hypothesis we need to reject.

Out of our nine events, seven are objectively negative and two are objectively positive. That is, we expect negative returns after seven of them (six defeats and the peace treaty) and positive returns after two of them (one victory and the Armistice). Therefore, in order to reject this null, we compare the average differences reported in Table 4 to average differences of nine random “negative news days” and two “positive news days”, during war and the peace

⁴⁹For example, we expect prices to decrease more in Paris when news of the first battle of Orleans (a French defeat) arrive. Therefore, we predict $R_{outside} > R_{paris}$. We calculate that $R_{outside} - R_{paris}$ is in fact bigger than zero (0.90 percentage points). On the other hand, we expect prices in Paris to increase more when news about the battle of Coulmiers (the French recapture of Orleans) arrives. Therefore, we predict $R_{paris} > R_{outside}$. We likewise calculate that $R_{paris} - R_{outside}$ is in fact bigger than zero (0.90 percentage points).

⁵⁰We classify draws as French defeats, since they came late in the war when the French were desperate for a victory.

Table 4: Differences between Paris and the outside in responses to events

	Differences in two-day returns to rentes, in percentage points			N
	Paris v Outside	Paris v Bordeaux	Paris v Lyon	
Baseline	1.73** (0.70)	1.60* (0.73)	1.86** (0.74)	9
Only war events	0.87* (0.45)	0.70 (0.54)	1.04* (0.50)	7
Baseline + minor battles	1.13** (0.47)	0.85 (0.53)	1.42*** (0.48)	18
Baseline + minor battles and draws	0.96** (0.44)	0.67 (0.49)	1.25** (0.45)	20
Placebo (pre- Siege battles)	-0.68 (0.50)	-0.74 (0.66)	-0.61 (0.48)	8

This table shows that differences in responses to events between Paris and the outside are statistically significant. Each coefficient represents a one-sample t-test. We set up differences in the direction our hypothesis predicts, so positive differences are evidence in our favor (in bold). We compute returns as: $R = \frac{p_t - p_{t-2}}{p_{t-2}}$, for news printed on day t . We show the robustness of our estimates to restricting the sample to only war events.

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

negotiations: September 18th, 1870 to March 15th, 1871. We implement this comparison with a Monte Carlo procedure, drawing 10,000 samples of eleven prices per city. More specifically, we do the following in each iteration of the Monte Carlo: First, we draw two observations with price increases and seven with price decreases for each city (note that they may be on different dates). Second, we designate seven of these events to be war events and two to be peace events. Third, for each event, we compute $R_{\text{paris}} - R_{\text{outside}}$ for positive war events and for negative peace events, and $R_{\text{outside}} - R_{\text{paris}}$ for negative war events and positive peace events. Lastly, we compute the mean difference for the nine placebo events.

The first row of Table 5 displays the mean differences in our event sample (already reported in Table 4, first row). The second row shows the average over the 10,000 Monte Carlo iterations of the computed mean differences. The numbers are close to zero, far from the large return differential we found. The third row shows the 95% percentile of mean differences in the placebo samples. They are all smaller than the mean difference in our event sample (1.73 pp.). The last row further shows that the value of the cumulative distribution function at 1.73 is close to a 100%. In other words, almost none of the iterations yield a

higher average. In summary, it is extremely unlikely to observe the price patterns we observe if each city was reacting to different events.

Table 5: Comparison to placebo samples where markets react to different events

	$R_{paris} \vee R_{bord}$	$R_{paris} \vee R_{lyon}$	$R_{paris} \vee R_{outside}$
Mean difference for 9 events	1.60 pp.	1.86 pp.	1.73 pp.
Average over 10,000 samples of mean differences for 9 placebo events	-0.042 pp.	-0.102 pp	-0.072 pp.
95% percentile of mean differences in placebo samples	0.784 pp.	0.689 pp.	0.642 pp.
P(placebo mean difference < mean difference for 9 events)	99.89%	99.99%	99.98%

This table shows that the differences in responses we observe that we observe to the 9 events are very unlikely to occur due to pure chance. The first row reports the mean (directed) return difference ($R_{paris} - R_{outside}$ for military victories and negative peace events, and $R_{outside} - R_{paris}$ for military defeats and positive peace events). For each sample of placebo events, we draw 7 days with negative returns and 2 days with positive returns (different days for each city). Row 2 reports the average of the mean of (directed) return differences in the placebo samples. Row 3 reports the 95% of the mean (directed) return differences. Row 4 reports the probability than the mean difference for actual events (the number in row 1).

4.3.2 Rejecting null hypothesis 2: markets have the same reaction, but differences in magnitude are due to noise

Our second null hypothesis is the opposite of the first one: markets are reacting to the same event, but the differences in the magnitude of their responses are purely due to random noise. If this were true, the fact that we usually observe Paris on the predicted side of the inequality is purely due to chance. We explicitly model this possibility taking advantage of the fact that, during the period without limits to arbitrage, the three markets reacted to the same set of events on each day.

In particular, we compare responses to our nine events to random sets of nine days chosen from the period before September 15th, 1870 and after May 31st, 1871. For each iteration of the Monte Carlo procedure we do the following: Since we have seven negative events and two positive events, we first select seven trading days when Paris had a price decrease and

three days when Paris had a price decrease. Second, we designate nine of these events to be war events and two to be peace events. Third, for each event, we compute $R_{paris} - R_{outside}$ for positive war events and for negative peace events, and $R_{outside} - R_{paris}$ for negative war events and positive peace events. Lastly, we compute the mean difference for the eleven placebo events.

Table 6: Comparison to placebo samples where markets react to the same event but the magnitude is noise

	$R_{paris} - R_{bord}$	$R_{paris} - R_{lyon}$	$R_{paris} - R_{outside}$
Mean difference for 9 events	1.60 pp.	1.86 pp.	1.73 pp.
Average over 10,000 samples of mean differences for 9 placebo events	0.01 pp.	0.03 pp.	0.02 pp.
95% percentile of mean differences in placebo samples	0.41 pp.	0.56 pp.	0.39 pp.
P(placebo mean difference < mean difference for 9 events)	100%	100%	100%

This table shows that the difference we observe in responses to the 9 events is very unlikely to occur due to pure chance. The first row reports the mean (directed) return difference ($R_{paris} - R_{outside}$ for military victories and bad peace events, and $R_{outside} - R_{paris}$ for military defeats and positive peace events). For each sample of placebo events, we draw prices from the three cities for 9 days during the period with arbitrage (same day for all three cities). Row 2 reports the average of the mean of (directed) return differences in the placebo samples. Row 3 reports the 95% of the mean (directed) return differences. Row 4 reports the probability that a placebo mean difference is higher than the mean difference for actual events (the number in row 1).

The first row of Table 6 displays the mean differences in our event sample (already reported in Table 4). The second row shows the average over the 10,000 Monte Carlo iterations of the computed mean differences. The numbers are close to zero, far from the large return differential we found. The third row shows the 95% percentile of mean differences in the placebo samples. They are all smaller than the mean difference in our event sample (1.73 pp.). The last row shows that the value of the CDF at 1.73 is 100%. In other words, none of the iterations yield a higher average.

4.4 Different information sets

When the Siege of Paris started, the Germans cut off information flows in and out of Paris. The telegraph lines were cut, and neither people nor goods were allowed to pass through Siege lines. However, Parisians successfully managed to smuggle information into and out of the city. The principal way to get news out of the city was hot air balloons, and the main way to get them in were carrier pigeons (Horne 2012, ch. 8). These two were sometimes supplanted with runners who dared to dodge the Prussians, and diplomatic mail. Given that these means of communications are unreliable and slow, a remaining concern is that the difference in prices we observe is due to different information sets. In other words, Parisians or those outside its walls may have been ignorant about facts that influenced the price of the *rentes*.

We argue that price differences are explained by political beliefs and not purely by information. That is, even when investors inside and outside Paris were in possession of the same facts about the world, they agreed to disagree. We have three pieces of evidence to support this claim.

First, Parisians and those elsewhere had full knowledge that their prices were systematically different. In Bordeaux, Paris prices were printed often (see below). In Paris too, a financial analyst noted with worry how much lower the prices were in Bordeaux and Lyon (*Le Figaro*, November 6 1870).⁵¹

Second, the differences are even more stable in the period of peace negotiations, despite more regular information flows. After the Armistice, telegraph service was still not restored and mail was slow and unreliable due to backlog and Prussian restrictions.⁵² However, Prussians allowed people to leave and enter the city (and more importantly for Parisians, they allowed food in). During this period, four day old Paris prices were printed daily in Bordeaux, but prices failed to converge until peace terms were announced.

Third, we show below that information flows between Paris and the outside did not drive prices closer to each other. Bordeaux prices did not converge to Paris prices when the latter were printed in *La Gironde*. In turn, Paris prices did not converge to external prices when news from the outside were printed in *Le Figaro*. Also, Paris did not experience abnormal returns on days with incoming news— as measured by pigeon arrivals or news from outside reported by *Le Figaro*.⁵³

⁵¹An analyst from the *The Times* (quoted above) also noted the difference.

⁵²*Le Figaro*: 1871-01-31, p. 4; 1871-02-07, p. 4; 1871-02-13, p.4; 1871-02-18, p.5, among others.

⁵³We analyze the pigeon messages themselves: as Figure A.11 shows, the word *rente* appears only 28 times in 29,903 messages.

4.4.1 The External Exchanges do not converge to the Paris price

In this section, we show that even when a Bordeaux newspaper printed the price of the *rente* in Paris, the price did not converge. Before the Siege, the Bordeaux newspaper *La Gironde* printed daily prices of a few securities in the Paris and Bordeaux markets. During the Siege, Paris prices were printed less regularly. Between September 19th, 1870, and January 28th, 1871, Paris prices were printed 30 times (an average of one every 4.4 days). The information was also lagged, the median Paris price during the Siege was reported 6 days later (see Table 1 for more details about information transmission).

We measure the Bordeaux market response to these printed prices. We once again focus on two-day changes in prices.⁵⁴ We calculate the changes in price difference for each instance of a printed price as:

$$\Delta \text{price difference}_t = |p_t^B - p_{\text{print},t}^P| - |p_{t-2}^B - p_{\text{print},t}^P|$$

Where p denotes the *rente* price, the superscripts P and B denote Paris and Bordeaux, and the subscript print, t denotes that the Paris price was *printed* in Bordeaux on day t (but it was on average five days old). The first term captures the difference before and after the price was reported, and the first term the difference before. If Bordeaux moved closer to the reported Paris price after receiving news, the change in price difference should be negative, since the prices would be moving closer to each other. We find 48 instances of Paris prices printed in Bordeaux during the Siege and the peace negotiations.

Panel a of Table 7 reports the results. The average $\Delta \text{price difference}_t$ equals is -0.028 francs, a very slight convergence. However, it is not statistically significant (p-value = 0.76). The lower bound of the 95% CI (an upper bound for convergence) is -0.215 francs, which is only 18% of the average distance between the Bordeaux and Paris prices during the Siege. Table 7 also reports separate results for the Siege and peace negotiations periods. In neither of these do we find convergence.

4.4.2 The Paris price does not converge to the external exchanges

We were not able to find outside prices printed in Paris. However, we can show more indirect evidence that suggests that Paris prices were not significantly affected by outside prices either. In this section, we show that when Paris got news from the outside world,

⁵⁴For a price printed on a newspaper in day t , we know that it arrived before the market opened in t , since trading hours started at noon. However, we do not know whether it arrived before or after trading on $t - 1$. Therefore, we compare prices in t to prices in $t - 2$.

Table 7: Absence of price convergence after incoming information to Paris and Bordeaux

	Panel A			Panel B		
	Bordeaux prices after receiving the Paris price			Paris prices after receiving news from outside		
	Siege	Peace negotiations	All	Siege	Peace negotiations	All
Mean absolute price difference	1.05	1.73	1.18	1.06	1.70	1.17
Δ price difference	-0.113 (0.129)	0.114 (0.120)	-0.028 (0.093)	0.084 (0.099)	-0.107 (0.115)	0.033 (0.079)
Lower bound 95% CI	-0.377	-0.139	-0.215	-0.118	-0.356	-0.127
Observations	30	18	48	38	14	52
Median delay	6 days	4 days	5 days	4 days	3 days	4.5 days

This table shows the absence of convergence after incoming news. In panel A, we study whether the price difference between Bordeaux and Paris decreased after the Bordeaux newspaper *La Gironde* printed Paris prices. In panel B, we study whether the price difference between markets inside and outside Paris decreased after the Parisian newspaper *Le Figaro* printed news from the outside. Standard errors are calculated from a t-test that compares the sample of changes in price differences to zero. We also report the lower bound of the 95% CI (an upper bound for convergence). The upper bound for convergence is never more than 36% of the mean absolute price difference.

prices did not converge. To compile this information, we collected every piece of news from the outside printed in *Le Figaro* during the Siege and the peace negotiations. In order to identify the days with new information, we classify a day as a “day with news” if the events reported by *Le Figaro* were more recent than any event reported before. We find that 53 days had information more recent than anything previously reported. We measure the Paris market response to the incoming news. In particular, we test whether prices converged to the average price between Bordeaux and Lyon. We perform the same test as in the previous section.

Panel b of Table 7 reports the results. The average Δ price difference_t equals 0.033 francs, meaning that on average prices slightly *diverged*. However, it is not statistically significant (p-value = 0.68). The lower bound of the 95% CI is -0.13 francs, which is only 11% of the average distance between inside and outside Paris. Table 7 also reports separate results for the Siege and peace negotiations periods, in neither of which we find convergence.

4.4.3 There are no abnormal returns on days with incoming information flows

We also show that the *rente* did not experience abnormal returns on days with incoming news. In Paris, the absolute value of the two-day *rente* return was not higher on days when a carrier pigeon arrived, nor when *Le Figaro* printed news from the outside. In Bordeaux, there were no abnormal returns on days when the Paris *rente* price was printed in *La Gironde*, or when a hot-air balloon with Paris mail landed.

Table 8 shows the effect of different measures of incoming information on abnormal *rente* returns. As in the rest of the paper, we calculate two-day rent returns, but since we are interested in a measure of volatility, without an expectation of direction, we take the absolute value. Therefore, returns on day t are calculated as $|\frac{p_t - p_{t-2}}{p_{t-2}}|$, where p_t is the Paris or Bordeaux price on day t . In table 8 we present four measures of incoming information. First, we use a dummy that equals one if *Le Figaro* reported a pigeon arrival on that day. Second, a dummy that equals one if news from the outside were printed in *Le Figaro* (using the same definition as in the previous section). Third, a dummy that equals one if the Paris price was printed in *La Gironde*. Fourth, a dummy that equals one if there was a balloon landing on that day.⁵⁵

We account for the fact that information flows are not necessarily uniform during the Siege by adding week fixed effects. For example, the early days of the Siege were a period of high price volatility, but there are no pigeon arrivals because the service had not been yet established. We do not find any evidence of increased volatility. The coefficients are largely indistinguishable from zero.

In summary, we do not find that the *rente* had increased volatility when news arrived. Therefore, we can rule out the possibility that the differences in prices were fully explained by some investors knowing facts that others ignore. As figures 6, 7, A.8, and A.9 show, Parisians often knew about the most important events at the same time or a few days later than people outside. Maybe the most clear example are the “peace events” in Figure 7: everyone learned about them at (approximately) the same time, but the reactions are wildly different. Moreover, figures A.12, A.13, A.14, and A.15 show graphically that there is no correlation between periods with more information flows and the price difference.

⁵⁵Our results are robust to using a dummy that equals one if there was a pigeon arrival documented by a historian (Hayhurst 1970) instead of *Le Figaro*, and to use the number of news reported by *Le Figaro* instead of the dummy (table A.5).

Table 8: Incoming information and abnormal returns in Paris and Bordeaux

	Absolute value of two-day <i>rente</i> returns, in percentage points			
	Panel (a): Paris		Panel (b): Bordeaux	
	(1)	(2)	(3)	(4)
Pigeon arrival in Paris	0.022 (0.211)			
Outside news printed in Paris		-0.188 (0.184)		
Paris prices printed in Bordeaux			-0.180 (0.223)	
Balloon landing				-0.003 (0.194)
Fixed effects	Week	Week	Week	Week
Mean DV	1.006	1.006	1.006	1.006
Observations	133	165	133	133

This table shows the relationship between incoming information and abnormal returns in Paris and Bordeaux. The dependent variable is the absolute value of the two-day *rente* return in Paris: $\left| \frac{p_t - p_{t-2}}{p_{t-2}} \right|$. The independent variables are: a dummy that equals one if *Le Figaro* reported a pigeon arrival, a dummy that equals one if *Le Figaro* printed news from the outside, and the number of outside news reported by *Le Figaro*. Robust standard errors in parenthesis. *p<0.1; **p<0.05; ***p<0.01.

4.5 Liquidity shocks

The purpose of this section is to show that price differences between Paris and the outside were not driven by liquidity shocks. During the period we study, money could not move freely between Paris and the outside. The demand and supply of money (francs) could have affected the demand and supply of traded securities. If the patterns we described for *rentes* in section 3 were driven by liquidity shocks, other publicly traded assets should display the same behavior. We also show that the price patterns we observe for the *rente* are not related to food inflation in Paris, and are therefore not a product of siege-induced scarcity.

In this section we study the price dynamics of a different asset: Italian government debt. As a foreign bond, we do not expect political disagreements between Paris and the outside to drive price differences. The Italian 5% bond was the only foreign asset traded regularly in both Paris and Bordeaux during the Siege.⁵⁶

We replicate the method we used to analyze the *rente*, but find a very different price pattern for the Italian bond. As a reminder, we showed that the *rente* was overvalued in Paris during the Siege and overvalued in the outside during peace negotiations. Figure 8 shows the equivalent of Figure 4, but for the Italian bond. We can see no persistent price differences between Paris and Bordeaux prices during the Siege. The average difference was +0.20 francs ($se = 0.26$), equivalent to 0.35% of the average Paris price. Unlike the *rente*, however, the Italian bond was overvalued in Paris during the peace negotiations. The average difference was +1.76 francs ($se = 0.22$), equivalent to 2.91% of the average Paris price.

In summary, the price dynamics of the Italian bond are different from the *rente*'s, ruling out the possibility that liquidity shocks are driving our results. Figure A.18 shows that the Midi railroad's bond and stock prices (the most liquid double-listed French assets other than *rente*) does not present the same price difference pattern as the *rente* either.

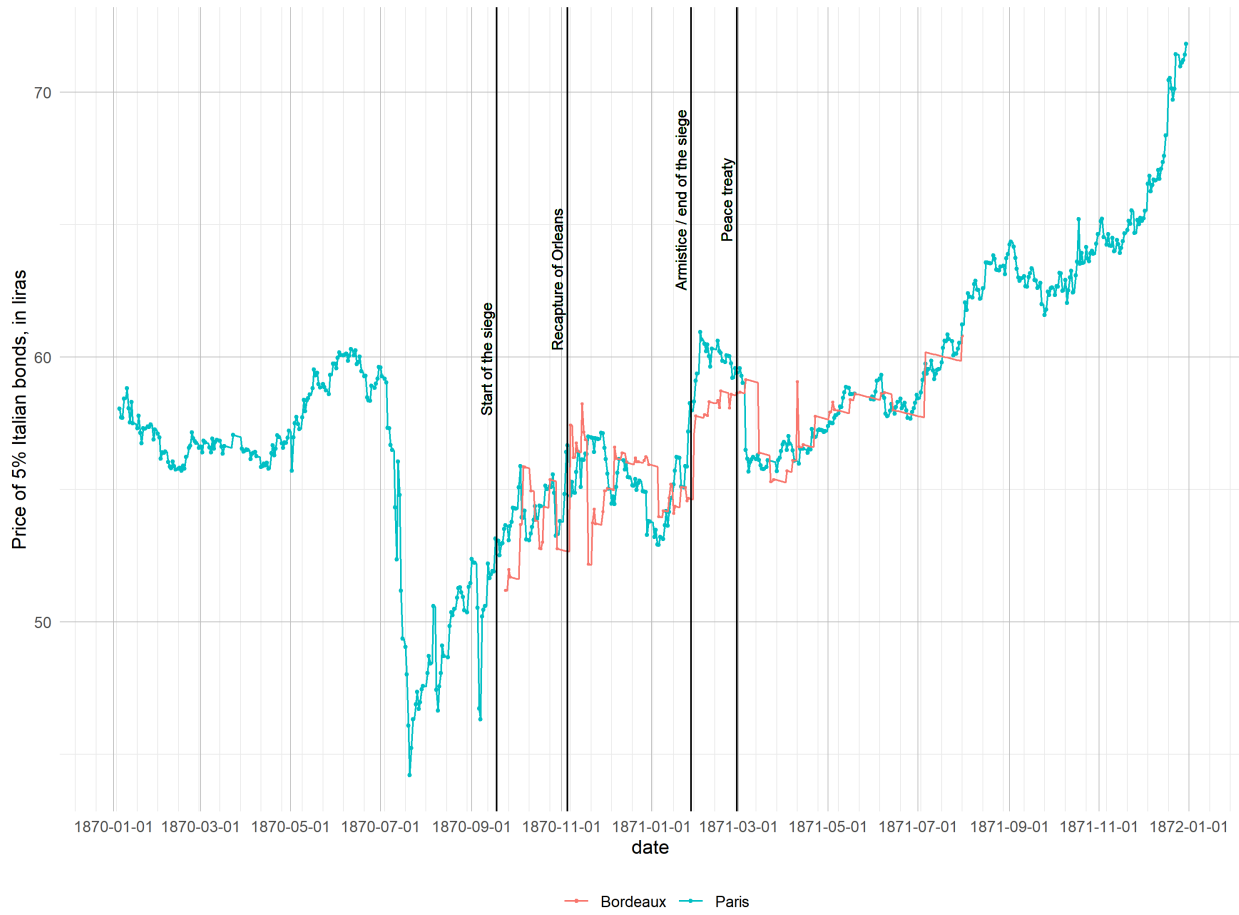
In Figure 9, we show that the differences in *rente* price between Paris and elsewhere bear no relation to food inflation in Paris (Figure A.17 shows more food items). Since the city was under Siege, with a limited supply of food, prices increased dramatically over time as the population grew within the population.⁵⁷ The steady increase is qualitatively different from *rente* price dynamics.⁵⁸ However, food prices do tell us something about beliefs about

⁵⁶We only include Bordeaux because we only have data on *rente* prices for Lyon.

⁵⁷Our source is the journal of Nathan Sheppard, who recorded prices of many food items with weekly frequency, we graph the items with the most observations (other items, such as beef, disappeared completely after a few weeks of the siege).

⁵⁸The correlation over time of butter price and the *rente* price difference is 0.012 ($p\text{-value}=0.96$), see table A.6 for correlations between food prices and the *rente* price difference.

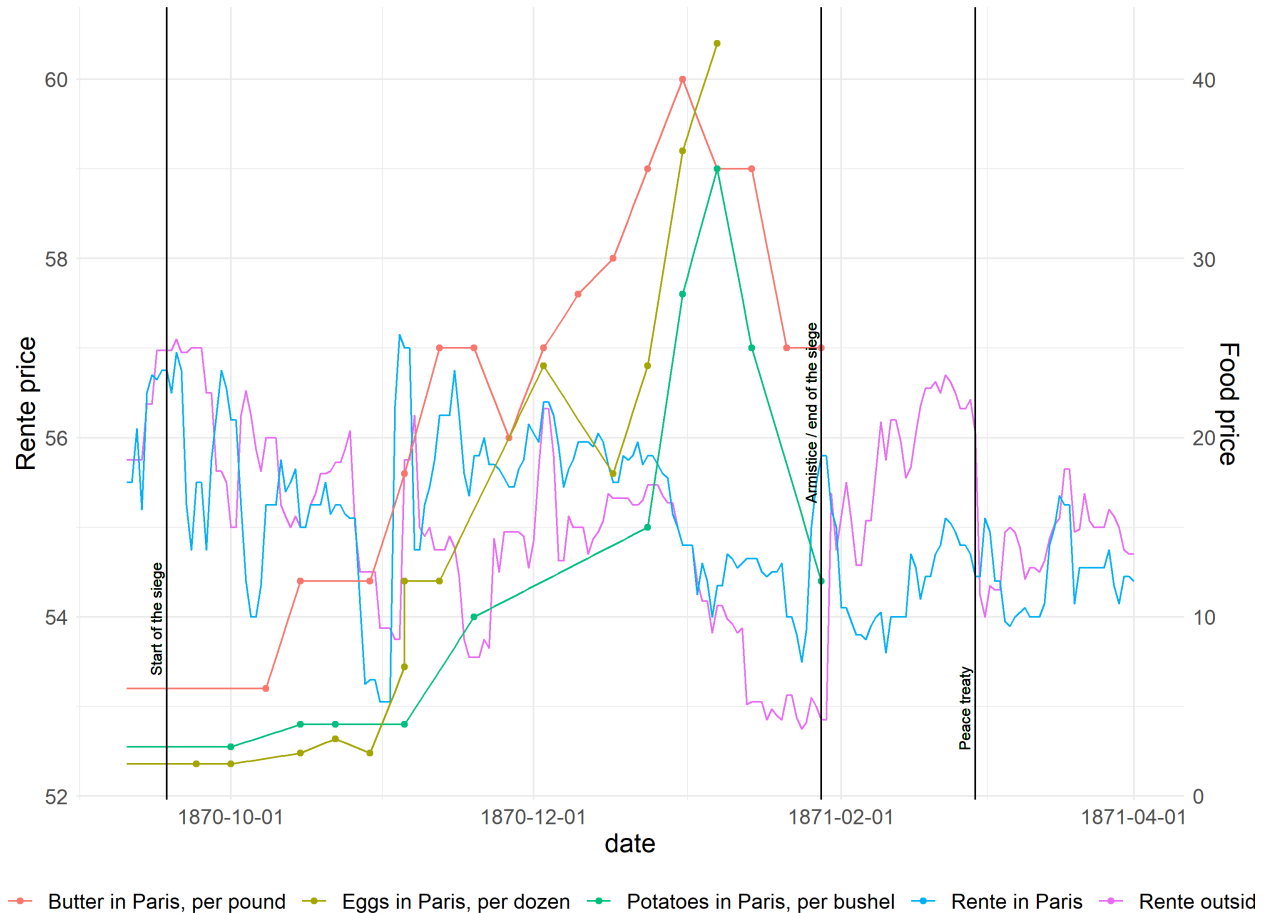
Figure 8: Italian bond prices in Paris and Bordeaux



This figure shows the prices of the Italian 5% bond in Bordeaux and in Paris. This graph suggests that the patterns discovered for *rentes* were not common to every security. The Italian bond price in Bordeaux was comparable to the Paris price during the Siege, and the bond was overvalued in Paris during peace negotiations. In summary, the patterns we observe on *rente* prices are not present for the Italian bond.

the war in Paris. In particular, prices started to decrease around mid-January, as Parisians anticipated the surrender and hoarders increased supply (Sheppard 1874, pg. 229). Around the same time, rente prices decreased in Paris, suggesting that Parisians were pessimistic about peace.

Figure 9: *Rente* and food prices in Paris



This figure compares food prices (see Figure A.17 for more other food items) in Paris to the price of the *rente* in Paris and outside (average of Bordeaux and Lyon). It shows that the differences we observe in the price of government bonds are not related to food inflation in Paris. The correlation over time of butter price and the rente price difference is 0.012 (p-value=0.96), see table A.6.

5 Discussion

To the best of our knowledge, this is the first paper to document that the presence of persistent differences in equilibrium market prices can arise due to differences in political

beliefs, and can do so even for one of the most actively traded assets in history. With increasing political polarization and the emergence of echo chambers in news provision and social interactions (e.g. Flaxman et al. 2016; Gentzkow and Shapiro 2010), market prices have the potential to provide much-needed non-partisan metrics of the effects of political decisions on the economy. Our results point to both the possibilities but also the limitations of this approach. When the French declared war on Prussia, there was much support, both on the street and among political elites. Nevertheless, the price of the French *rente* fell, consistent with the *smart money*, both in Paris and around the world, providing a corrective to “war fever”.⁵⁹

Yet, our results suggest that, as Paris was isolated by the Siege, the marginal trader began to see war news through the political perspective of those around her. Thus the corrective effect of the market price on potentially biased political perceptions seems to have weakened with their separation from world markets. This suggests an under-explored but potentially important social value to the dual listing of financial assets for companies across borders. This may be particularly relevant for aligning expectations among economic and political decisionmakers in countries perceived to be in great power competition. A focal contemporary example is that of the United States, where like, France and Germany in 1870, many are concerned about a rising China.⁶⁰ As contemporary political pressure is mounting to de-list one another’s financial assets, there is a risk of a further decoupling of beliefs, especially regarding the costs and benefits of military conflict. Though it caused the deaths of more than 180,000 soldiers, contributed to the deaths of more than 250,000 civilians, and created lasting animosities that would make the great conflicts of the twentieth century more likely, the Franco-Prussian War may still have lessons to teach us that might help support peace.⁶¹

⁵⁹On how social diversity may make asset markets less prone to bubbles in on-line lab experiments, see also Levine et al. 2014.

⁶⁰The ‘trap’ where incumbent powers may engage in pre-emptive war to check the rise of others perceived be in competition is a common phenomenon in international relations, noted as least as early as Thucydides (431), who argued the Peloponnesian War resulted from the fears of Sparta in the face of a rising Athens.

⁶¹Both stock prices and bond prices in France fell by around 30 per cent in real terms as a result of the Franco-Prussian War and the terms of the treaty (Le Bris 2012). The new French Republic would also face a vicious civil war in the streets of Paris, a topic of our companion research. But the recovery was rapid, and increasing integration of financial markets that followed in France also was accompanied by educational and other reforms that, in the classic words of Eugen Weber, made “Peasants into Frenchmen”.

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A Appendix

Table A.1: Votes for the ratification of the peace treaty

	Paris	Bordeaux	Lyon	Total
Yes	6	14	12	546
No	31	0	0	107
Did not vote	6	0	1	23

This table shows the number of deputies in the National Assembly voting for and against the ratification of the peace treaty on March 4th, 1871. The treaty was ratified with the votes of the conservative, rural, and provincial majority. The Parisian republican left opposed it.

Table A.2: Other events and *rente* returns in three cities

		Two-day returns to rentes		
		Paris	Bordeaux	Lyon
Minor battles	Positive news for France?			
Strasbourg	No	-2.30%	-0.94%	0.88%
Chevilly	No	-2.30%	1.84%	0.88%
Bellevue	No	2.31%	-0.89%	1.35%
Buzenval	No	0%	-1.34%	1.81%
Thionville	No	-1.42%	0%	-0.27%
Amiens	No	0.54%	0%	3.32%
Le Bourget	No	0.54%	1.09%	-0.54%
Villiers	No	0.54%	-1.33%	-0.54%
Beaugency	No	0.45%	0.91%	0.18%
Draws		Paris	Bordeaux	Lyon
Hallue River	No	0.64%	-0.27%	-0.18%
Bapaume	No	-0.27%	-1.27%	0%
Pre-Siege battles		Paris	Bordeaux	Lyon
Saarbrucken	Yes	0%	0.70%	0%
Weissenburg	No	-2.55%	-0.15%	-0.51%
Froschwiller/Worth/Spicheren	No	-2.68%	-3.65%	-2.78%
Borny (Colombey)	No	-2.11%	-1.79%	-3.89%
Vionville-Mars-la-Tour	No	-0.31%	0.84%	2.25%
Gravelotte-St. Privat	No	-3.14%	-4.30%	-3.71%
Noisseville	No	1.81%	1.46%	0.81%
Sedan/Beaumont	No	-7.24%	-11.60%	-8.15%

This table extends table 3 by shows the two-day returns in the three markets to war events not including in our main specification (due to being minor, draws, or happening before the Siege started). Returns are calculated as: $\frac{p_t - p_{t-2}}{p_{t-2}}$, for news printed on day t . Since news arrived on different days to each market, they do not necessarily correspond to the same calendar date. In bold, the events for which our hypothesis holds: bigger responses for war events in Paris.

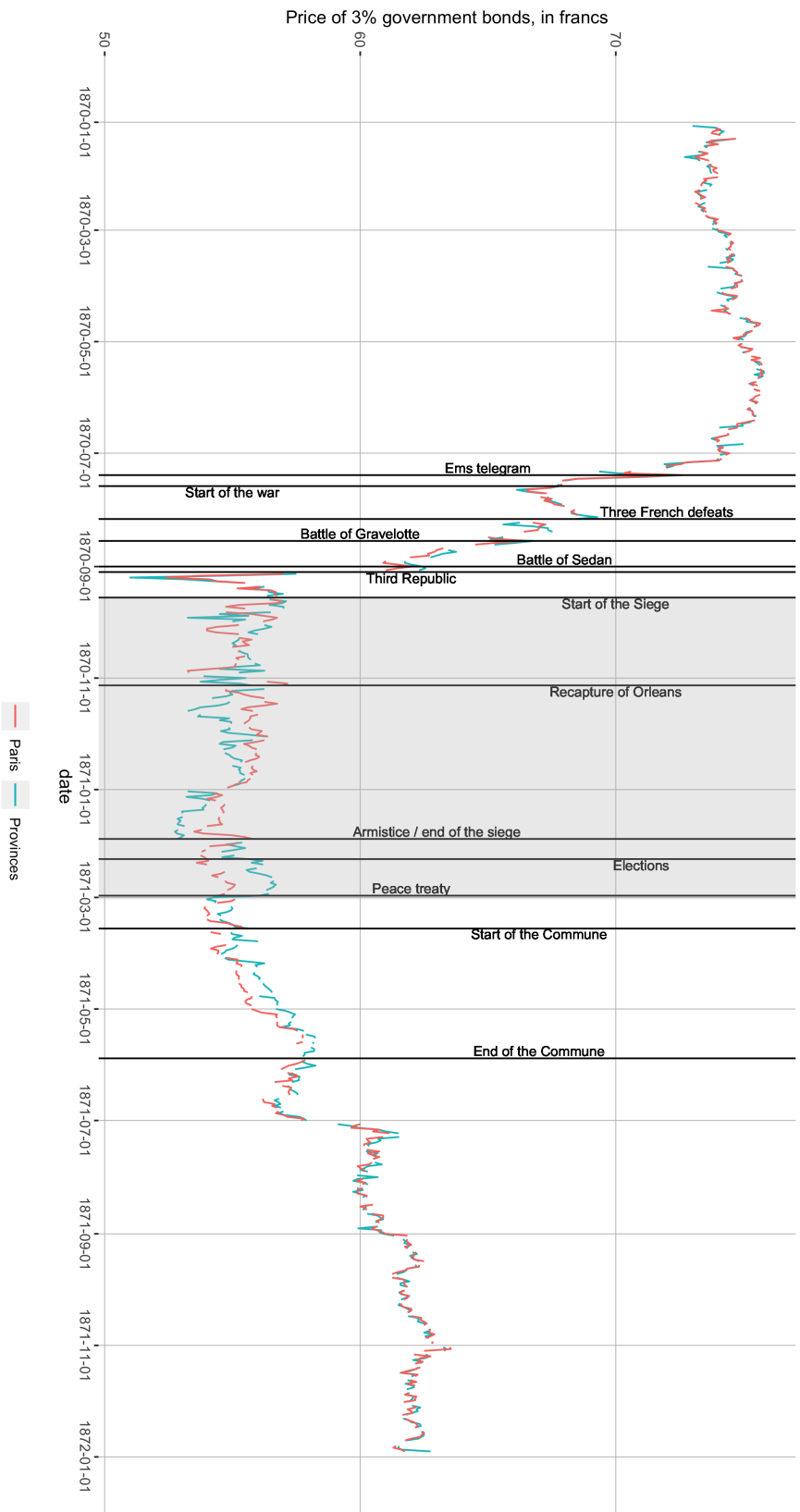
Table A.3: Main events, date, and delay for news to reach each city

Event	Date	How many days later news arrived at...		
		Paris	Bordeaux	Lyon
1 st defeat at Orleans	1870/10/11	4	3	3
Defeat at Chateadun	1870/10/18	10	3	3
Defeat at Metz	1870/10/27	4	5	5
Coulmiers, victory at Orleans (rumor)	1870/11/09	1		
Coulmiers, victory at Orleans	1870/11/09	6	3	3
Defeat at Beaune La Roland	1870/11/28	19	2	6
Loigny, 2 nd defeat at Orleans	c	5	5	5
Defeat at Le Mans	1871/01/12	9	1	2
Armistice	1871/01/28	2	3	2
Treaty of Versailles	1871/02/26	2	4	3

Table A.4: Other events, date, and delay for news to reach each city

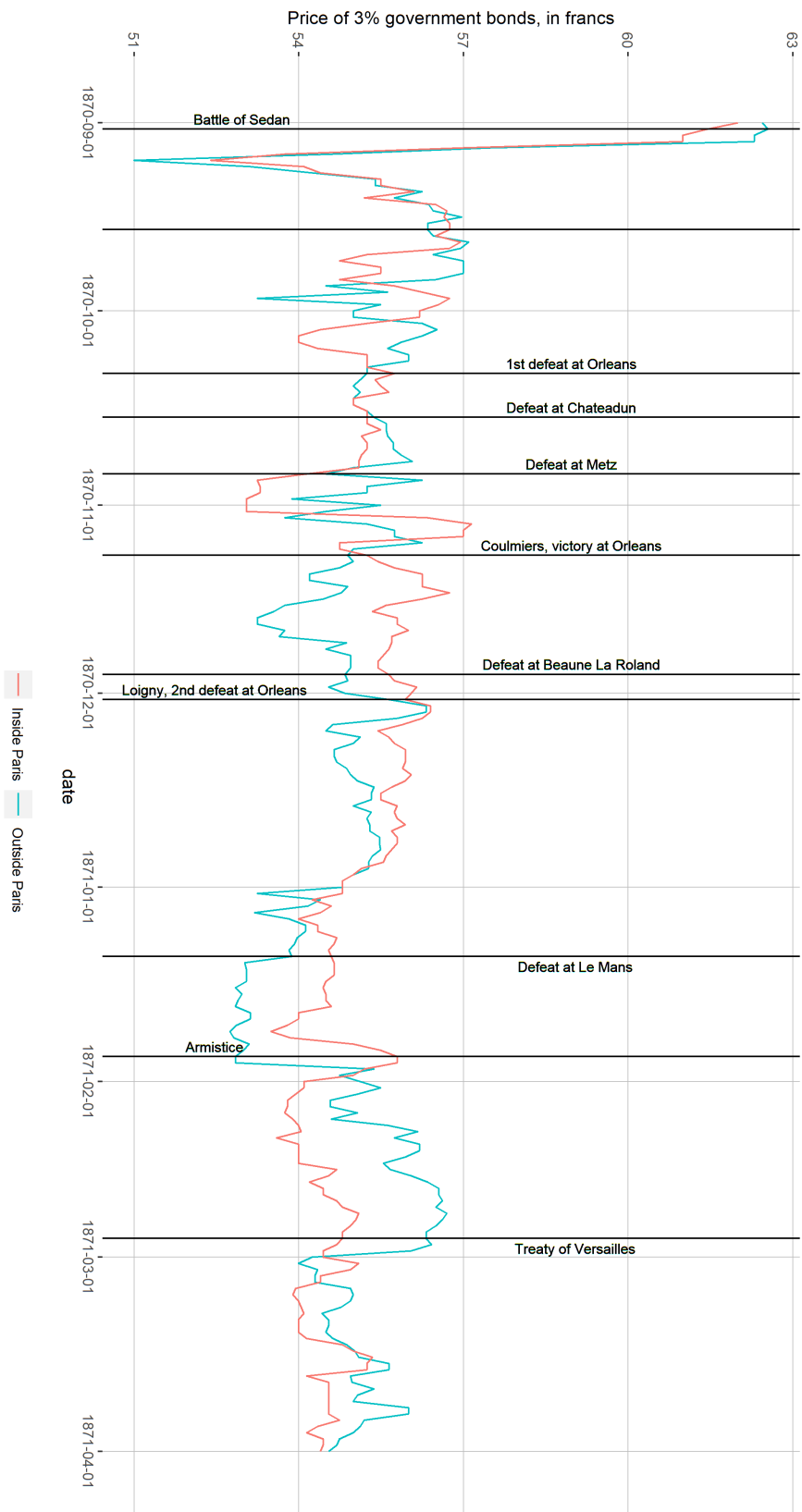
Event	Date	How many days later news arrived at...			Why not a main event?
		Paris	Bordeaux	Lyon	
Saarbrücken	1870-08-02	1	2	1	Pre-Siege
Weissenburg	1870-08-04	3	2	2	Pre-Siege
Froschwiller/Worth/Spicheren	1870-08-06	3	2	2	Pre-Siege
Borny (Colombey)	1870-08-14	2	2	2	Pre-Siege
Vionville-Mars-la-Tour	1870-08-16	3	3	3	Pre-Siege
Gravelotte-St. Privat	1870-08-18	3	3	3	Pre-Siege
Noisseville	1870-08-31	1	1	1	Pre-Siege
Sedan/Beaumont	1870-09-01	3	3	3	Pre-Siege
Hallue River	1870-12-24	16	2	3	Draw
Bapaume	1871-01-03	12	3	3	Draw
Lisaine River	1871-01-17	9	3	3	Minor
St Quentin	1871-01-19	7	2	6	Minor
Belfort	1871-02-15	5	2	3	Minor
Strasbourg	1870-09-28	4	3	3	Minor
Chevilly	1870-09-30	2	2	2	Minor
Bellevue	1870-10-07	1	1	1	Minor
Thionville	1870-11-24	13	6	4	Minor
Amiens	1870-11-27	7	3	5	Minor
Le Bourget	1870-10-30	35	35	35	Minor
Villiers	1870-12-02	2	3	3	Minor
Beaugency	1870-12-10	10	4	3	Minor
Buzenval	1871-01-19	4	3	3	Minor

Figure A.1: Prices of 3% government bonds in Bordeaux, Lyon, and Paris



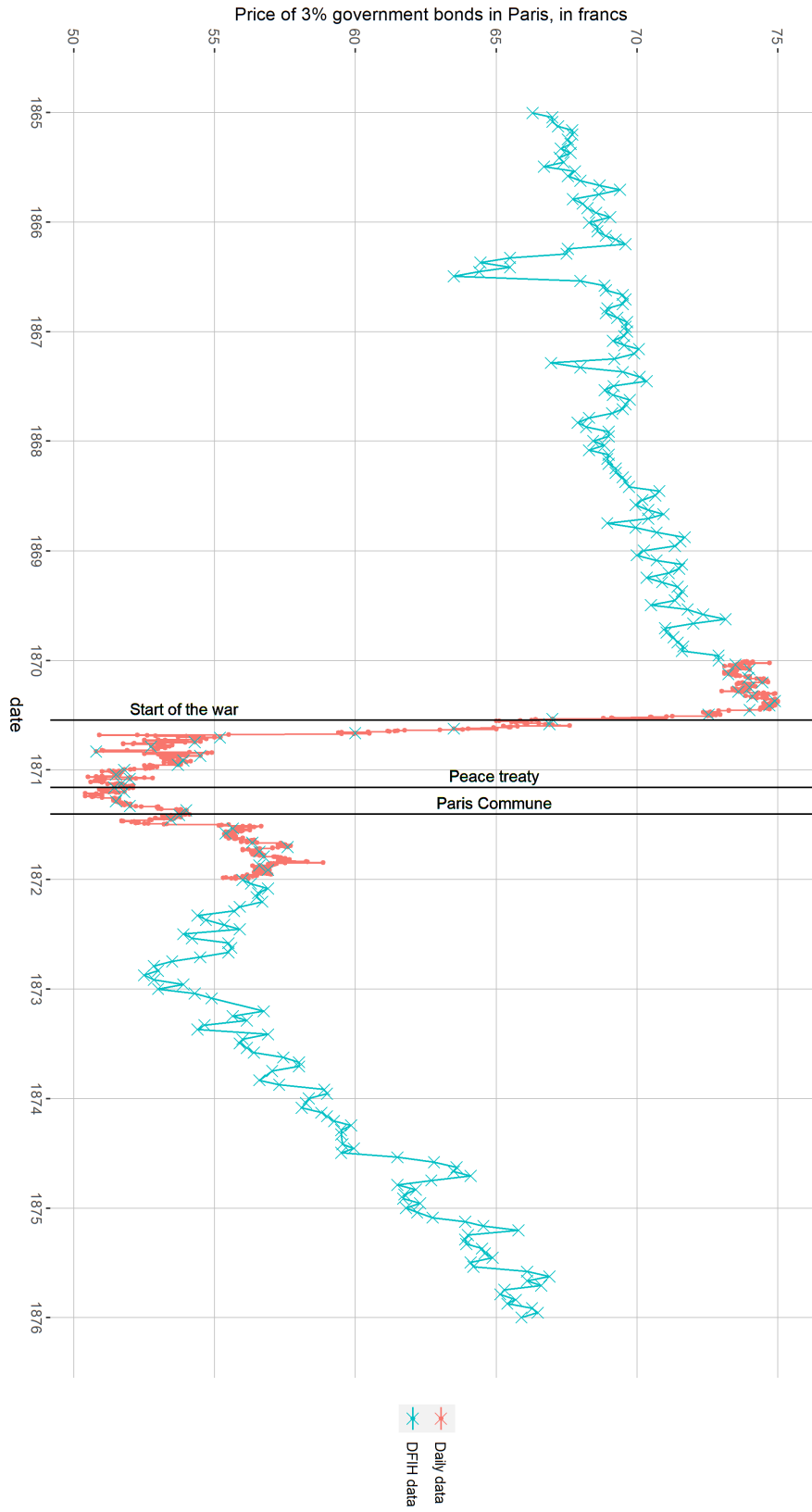
This graph shows the prices of 3% French government bonds inside and outside Paris between 1870-01-01 and 1871-12-31. The outside prices are an average between Lyon and Bordeaux. The shaded area corresponds to the period we analyze (zoomed in in Figure A.2). The events depicted are, on chronological order: the Ems telegram (a diplomatic incident), the start of the war (the French declaration of war), three French defeats that happened within three days (Wörth, Spicheren, and Wissembourg), the inconclusive Battle of Gravelotte, the Battle of Sedan (where Napoleon III got captured), the declaration of the Third Republic in Paris (and the accession of the Government of National Defense), the start of the Siege of Paris, the French surrender with the signature of the Armistice (and end of the Siege), the February elections to the National Assembly, the signature of the Treaty of Versailles (which was ratified four days later), and the beginning and end of the Paris Commune.

Figure A.2: Prices of 3% government bonds in Bordeaux, Lyon, and Paris



This graph shows the prices of 3% French government bonds inside and outside Paris between 1870-09-01 and 1871-12-31. Outside prices are an average between Lyon and Bordeaux. All the events we use in we use in section 4 are depicted here.

Figure A.3: Prices of 3% government bonds in Paris over 10 years



This graph shows the prices of 3% French government bonds in Paris between 1865 and 1876. In blue, bimonthly prices from DFTH. In red, daily prices collected by us (for 1870 and 1871). The purpose of this graph is to display *rente* prices over a longer time period, and to show that our independently collected data matches DFTH's.

[illegible]

COMPAGNIE		BOURSE DE BORDEAUX		COURS OFFICIEL	
DES		de 10 h 1/2 à 11 h. 1/2.		Jeudi 1 Decembre 1870	
AGENTS DE CHANGE					
Cours de Paris		en LIQUIDATION		LIQUIDATION du 31 xbre	
Fonds Français.		en LIQUIDATION		LIQUIDATION du 15 xbre	
3 % Jouiss. 1er Octobre 1870.	52 70 85 90	52 70 75	52 50 40 hier 52 40		
petite coupure.					
au porteur.	d.	Au			
Emprunt 1870 jouissance octobre obligations 6 %	53 25 40 50				
Répart. mexic. bull. négociable.					
do Prom de Rente.					
4 1/2 % Jouiss. 22 sept. 1870.					
petite coupure.					
au porteur.					
OBLIGATIONS DU TRÉSOR					
BANQUE DE FRANCE. Jouiss. 1er 1870					
CREDIT FONCIER de FRANCE estampille.	112 50 115				
SOCIÉTÉ GEN. DU CRÉD. MOBILIER.					
1. janv. 1866. Act. de 500f					

Table A.5: Incoming information and abnormal returns in Paris

	Absolute value of two-day <i>rente</i> return	
	(1)	(2)
Pigeon arrival in historical source	-0.028 (0.257)	
Number of outside news		0.005 (0.016)
Fixed effects	Week	Week
Mean DV	1.006	1.006
Observations	133	165

This table shows the relationship between incoming information and abnormal returns in Paris, as a robustness check of table 8. The dependent variable is the absolute value of the two-day *rente* return in Paris: $|\frac{p_t - p_{t-2}}{p_{t-2}}|$. The independent variables are: a dummy that equal one if a historical source documented a pigeon arrival (from Hayhurst 1970) and the number of outside news reported by *Le Figaro*. Robust standard errors in parenthesis. Models 3 and 4 include both the Siege and the peace negotiations. Models 1 and 2 only include the Siege (because there were no pigeon arrivals after the Siege ended). *p<0.1; **p<0.05; ***p<0.01.

Table A.6: Absence of correlation between food prices and price differences

	Paris price - Outside price
Butter	0.012 (0.26) [0.96]
Potatoes	-0.42 (0.30) [0.19]
Eggs	-0.17 (0.30) [0.57]
Rabbit	-0.23 (0.32) [0.50]
Fowl	-0.002 (0.35) [0.99]

This table shows the absence of a correlation between food prices in Paris and the difference between rente prices in Paris and outside. Coefficients are correlation coefficients. Standard errors in parentheses and p-values in brackets.

Figure A.6: Original Source: the published Paris *rente* price in the daily newspaper *Le Salut Public*, Dec 1st, 1870.

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du matin. En conséquence, toutes les personnes qui désiraient enchérir pourrnt prendre connaissance, jusqu'au jour de la vente, du cahier des charges dressé par ledit Me Achard, pour parvenir à l'adjudication.

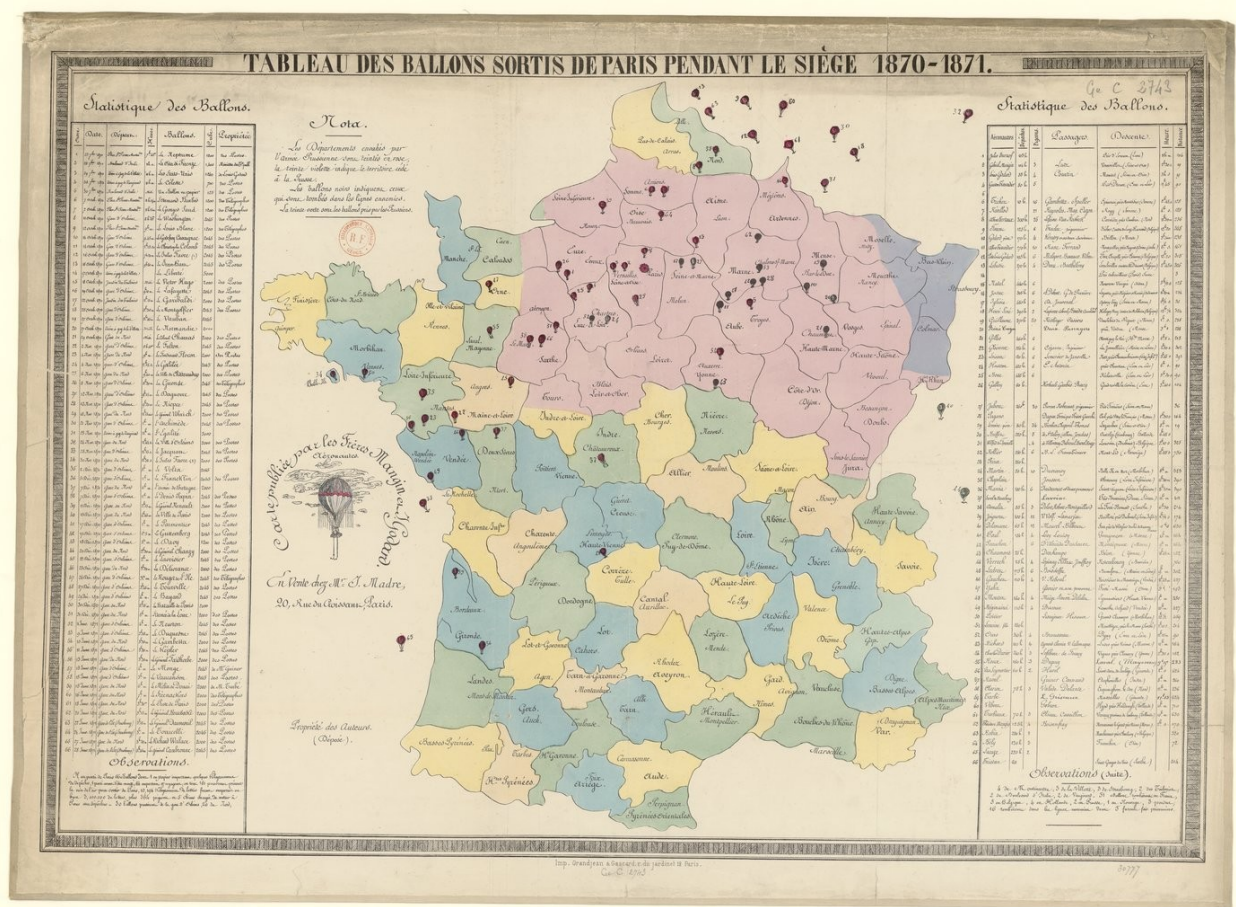
A CÉDER APRÈS FORTUNE FAITE
 Dans une jolie ville de province de 20,000 habitants
UN MAGASIN D'ARTICLES DE PARIS
 Belle clientèle — Affaires certaines. — Facilités pour le paiement
 26 d. S'adresser au bureau du journal. (0000)

SERRISON PARFAIT
 des
Maladies Secrètes
 Régénération des Organes & Vices du Sang, par le
ROB-SAVARESI, DÉPURATO-TONIQUE
 PERFECTIONNÉ
 S'adresser à M. TOUSSAINT, chimiste
 Pharmacien de première classe
 Rue Pizay, 42, 1er étage, Lyon
 Allée de travers, rue Arbre-Sec, 9

BOURSE DE LYON DU 1^{er} DÉC. (De 10 heures à midi 1/2.)

Dern. cours de Paris	FONDS D'ÉTAT FRANÇAIS.	AU COMPTANT	LIQ. DU 30 NOV.	LIQ. DU 31 DÉC.	OBLIGATIONS.	PR. PRAC.	COURS DU JOUR
56 75	7 0/0 Français.	56 67	56 69 56 57	56 92 56 97 57	Ville de Lyon 1867	480	484
	3. oct. 1871.		56 62 16 65		Ville de Lyon 1870	415	415
	— Coup.		d. 10	d. 50: 57 15	Départem. du Rhône	210	13 7
91 90	5 0/0 empr. 1871		91 71 91 70 91 72	92 05 92 15 92 10	Ville de Lyon 1865	"	470
	— coup...	91 85	d. 10:		De la Loire	"	100
	4 1/2 Français.		d. 2:	d. 50: 93 92 90	— 4 1/2	"	240
	O. Trésor 8 0/0	56 25 505			Rhône-et-Loire 3 0/0	"	365
					Paris-Lyon-Méditerranée	"	18
					— 1865	"	280 10 280 15
					Saône-et-Loire	"	205

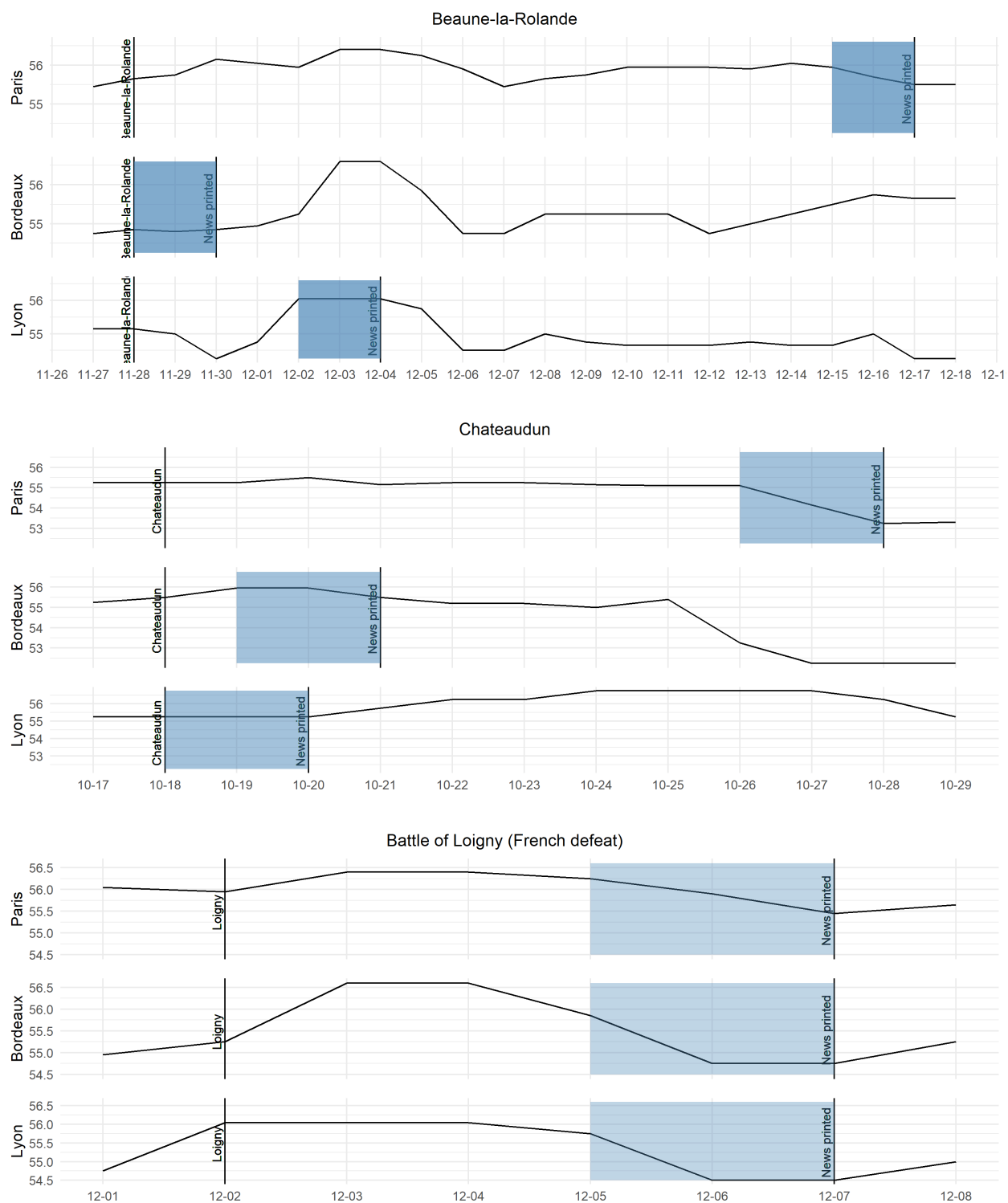
Figure A.7: Original Source: “Table of Balloons Leaving Paris during the Siege, 1870-1871”



Source gallica.bnf.fr / Bibliothèque nationale de France

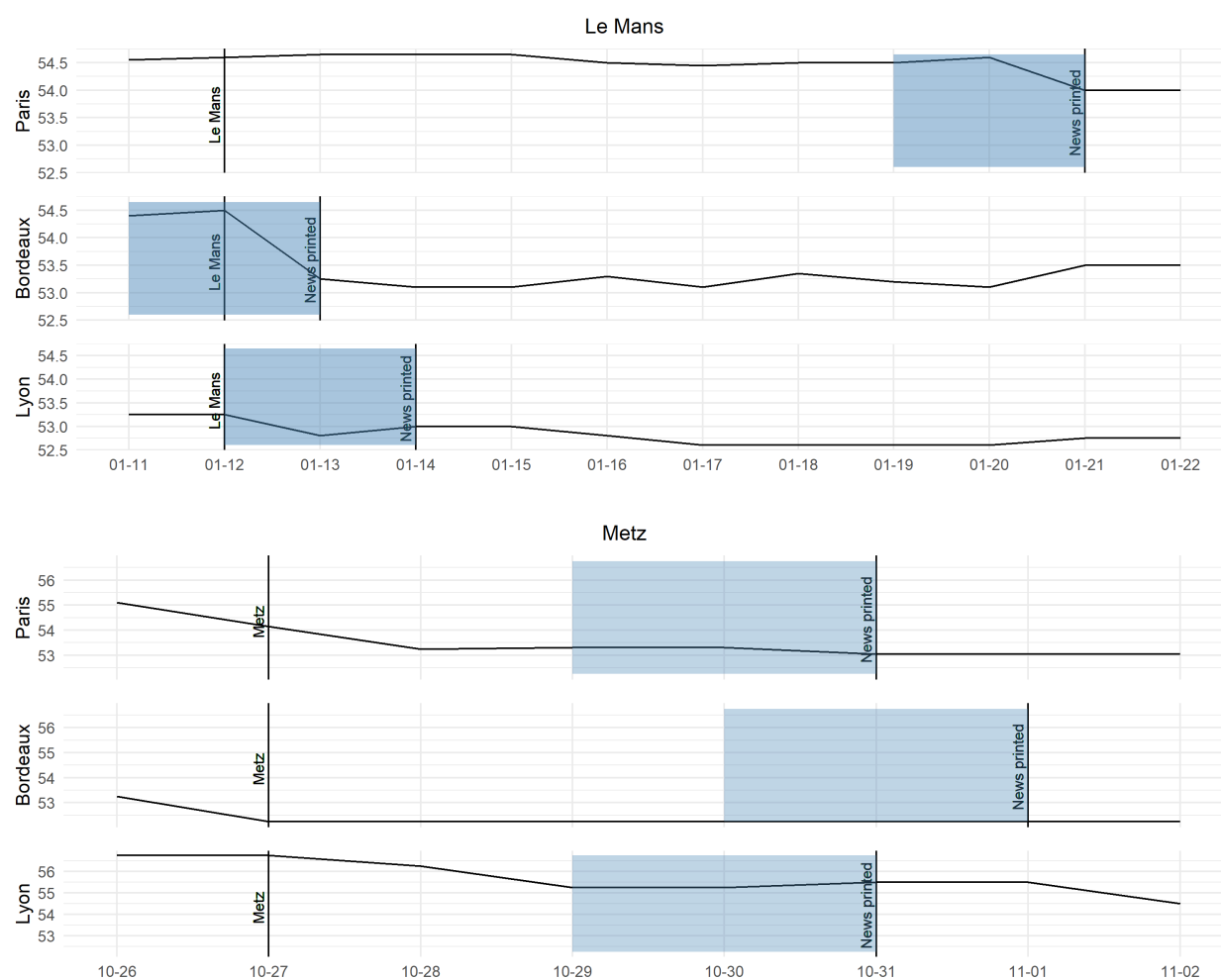
Source: Freres Mangin et Goddard, *Bibliothèque nationale de France*: Ge C 2743.

Figure A.8: Price of *rentes* (in francs) around other major war events



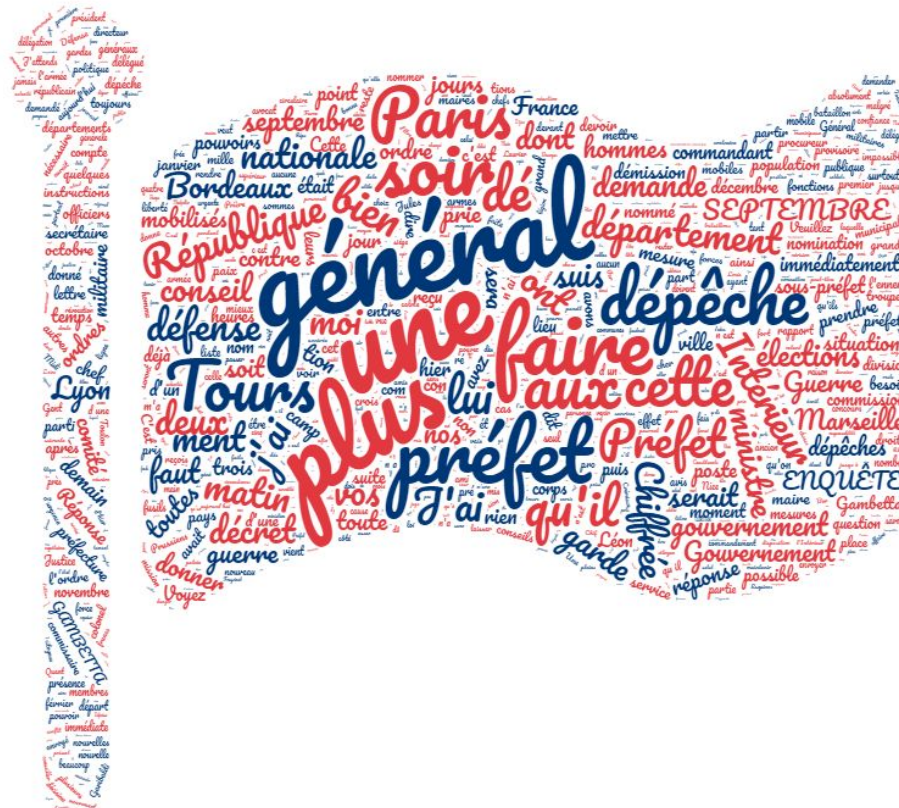
This figure shows *rente* prices in three markets around war events. The shaded area covers the two-day period when news may have arrived. Therefore, response to the event happened within the shaded area.

Figure A.9: Price of *rentes* (in francs) around other major war events (cont.d)



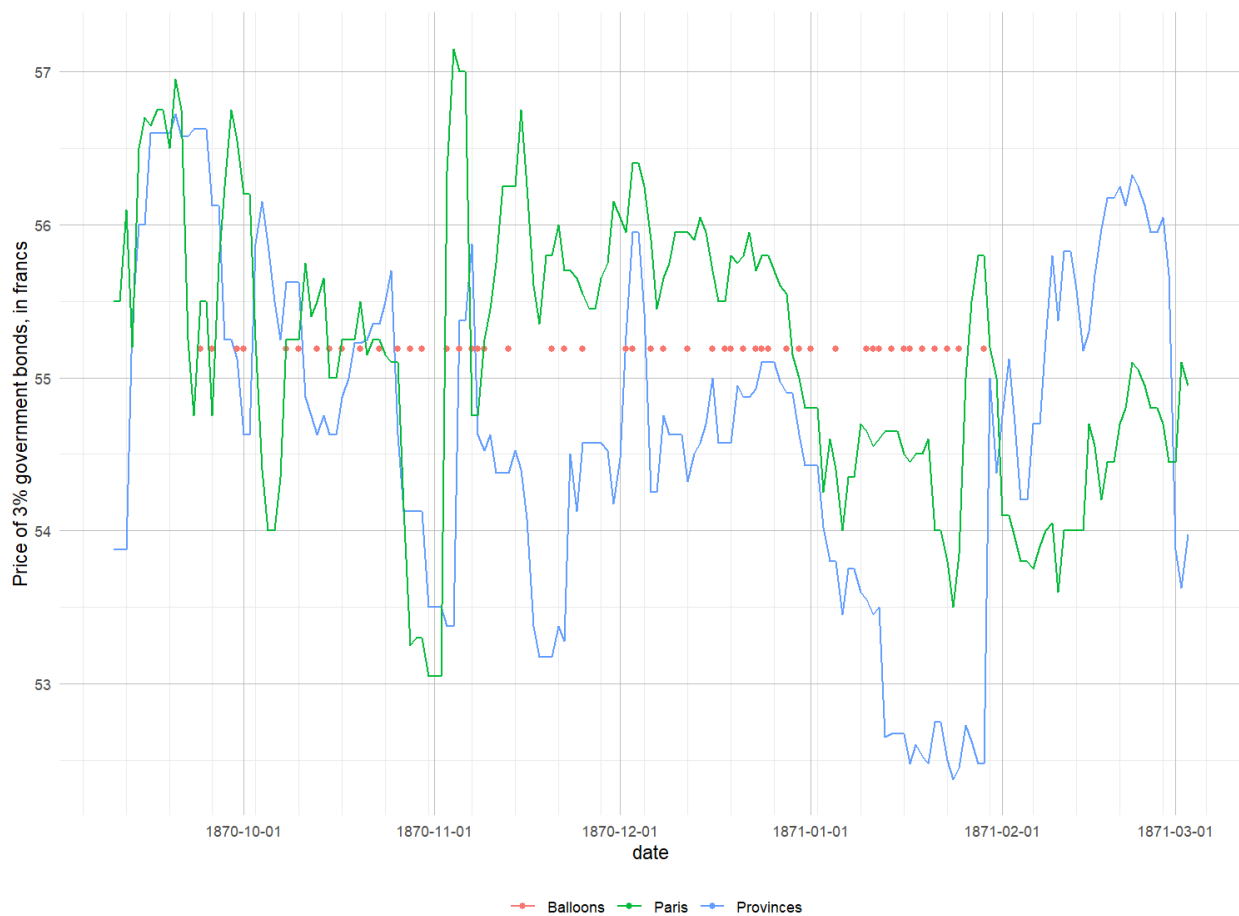
This figure shows *rente* prices in three markets around war events. The shaded area covers the two-day period when news may have arrived. Therefore, response to the event happened within the shaded area.

Figure A.10: Word Cloud Based upon Official Pigeon Correspondence



The *rente* was not mentioned in government to government Pigeon communications during the Siege.

Figure A.12: Balloon arrival dates and Prices



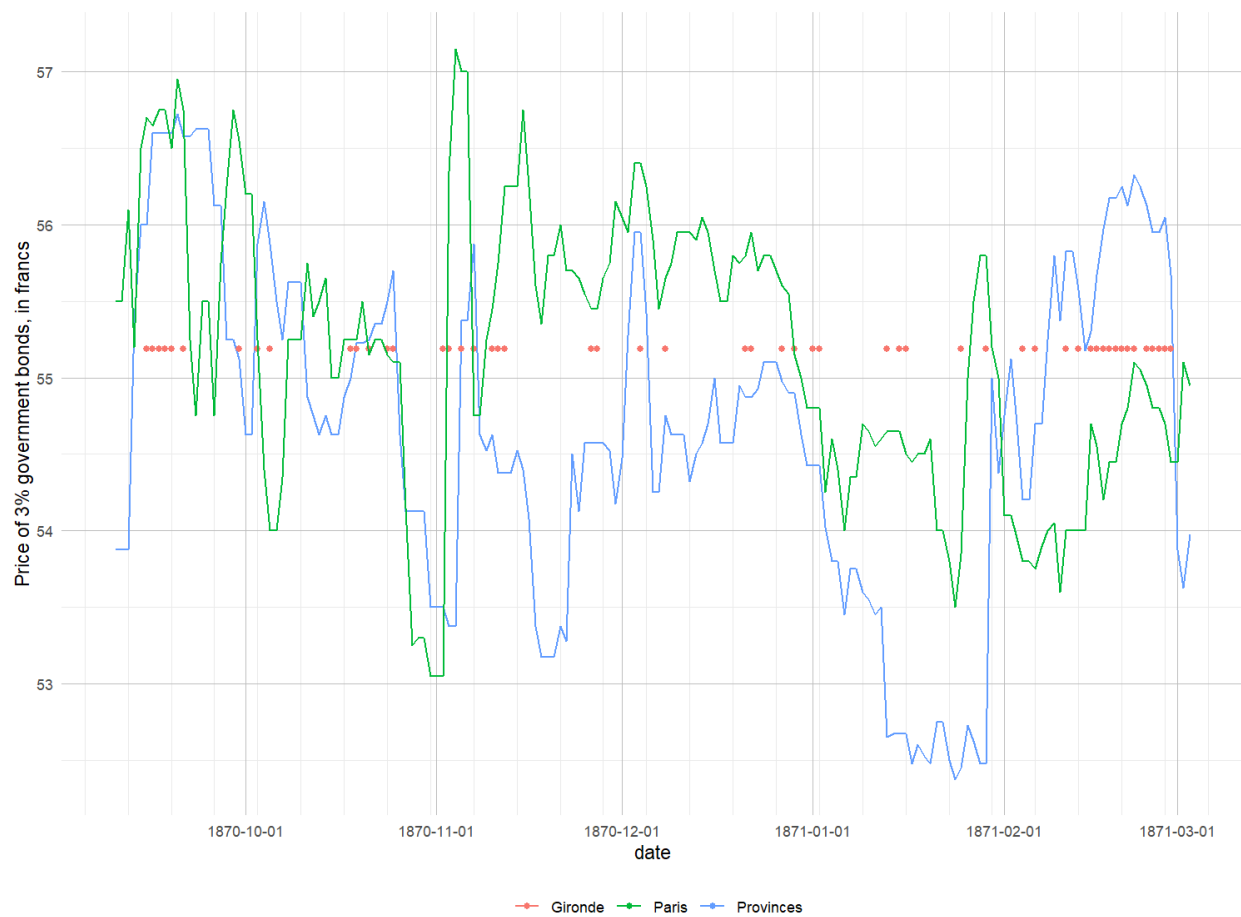
This figure shows the price of the *rente* inside and outside Paris during the Siege. Hot-air balloons travelled from Paris to the outside with official correspondence and private mail, the dots represent days with balloon landings.

Figure A.13: Pigeon arrival dates and Prices



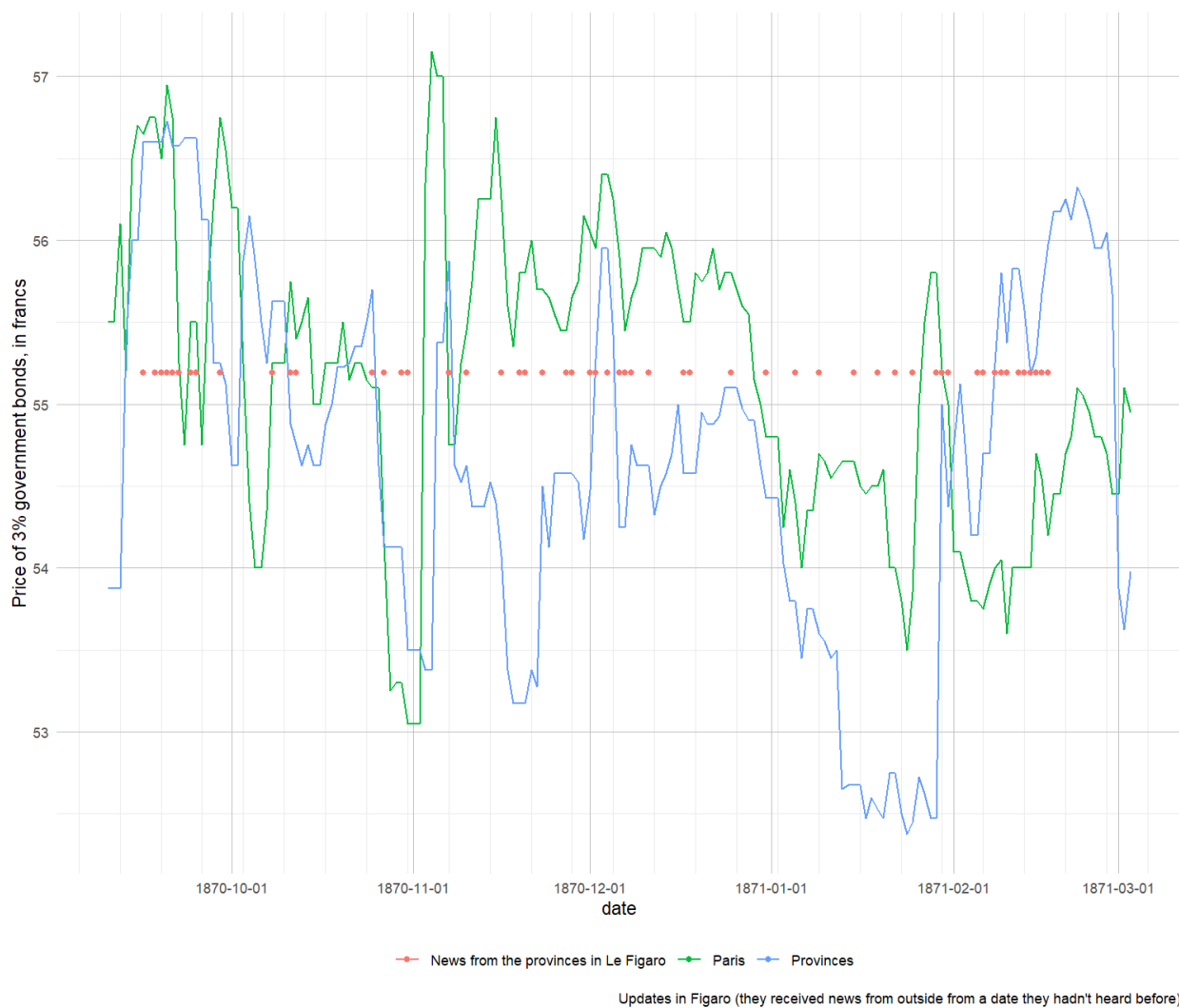
This figure shows the price of the *rente* inside and outside Paris during the Siege. Carrier pigeons travelled from the outside to Paris with both with official correspondence and private mail, the dots represent days with pigeon landings.

Figure A.14: Days with Paris prices printed in Bordeaux and Prices



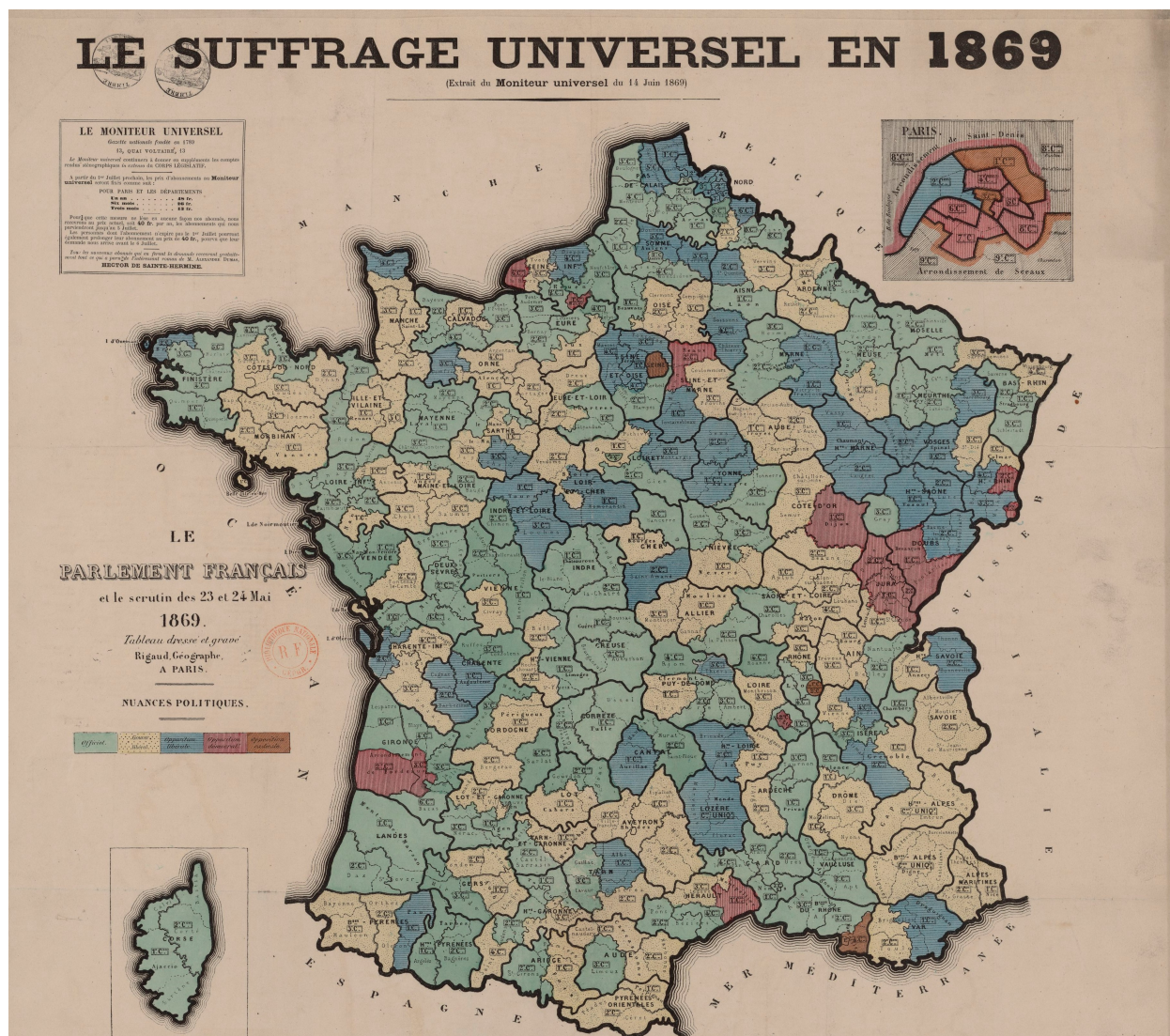
This figure shows the price of the *rente* inside and outside Paris during the Siege. The dots denote the days when the Bordeaux newspaper *La Gironde* printed the Paris prices.

Figure A.15: Days with news from the outside in Paris and Prices



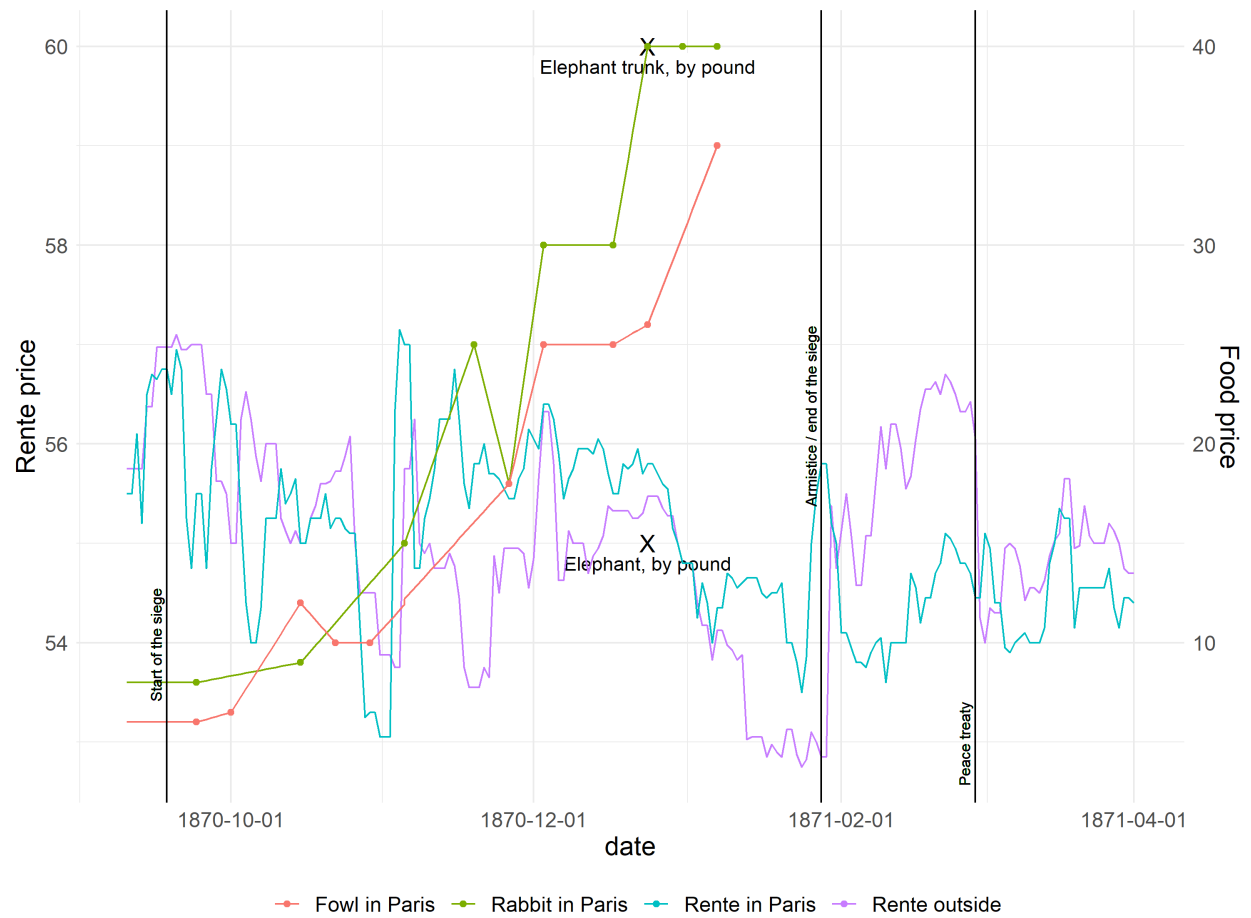
This figure shows the price of the *rente* inside and outside Paris during the Siege. The Parisian newspaper *Le Figaro* often printed news from outside. The dots represent the “day with news”, i.e. days when the events reported by *Le Figaro* were more recent than any event reported before.

Figure A.16: Elections results in the 1869 national elections



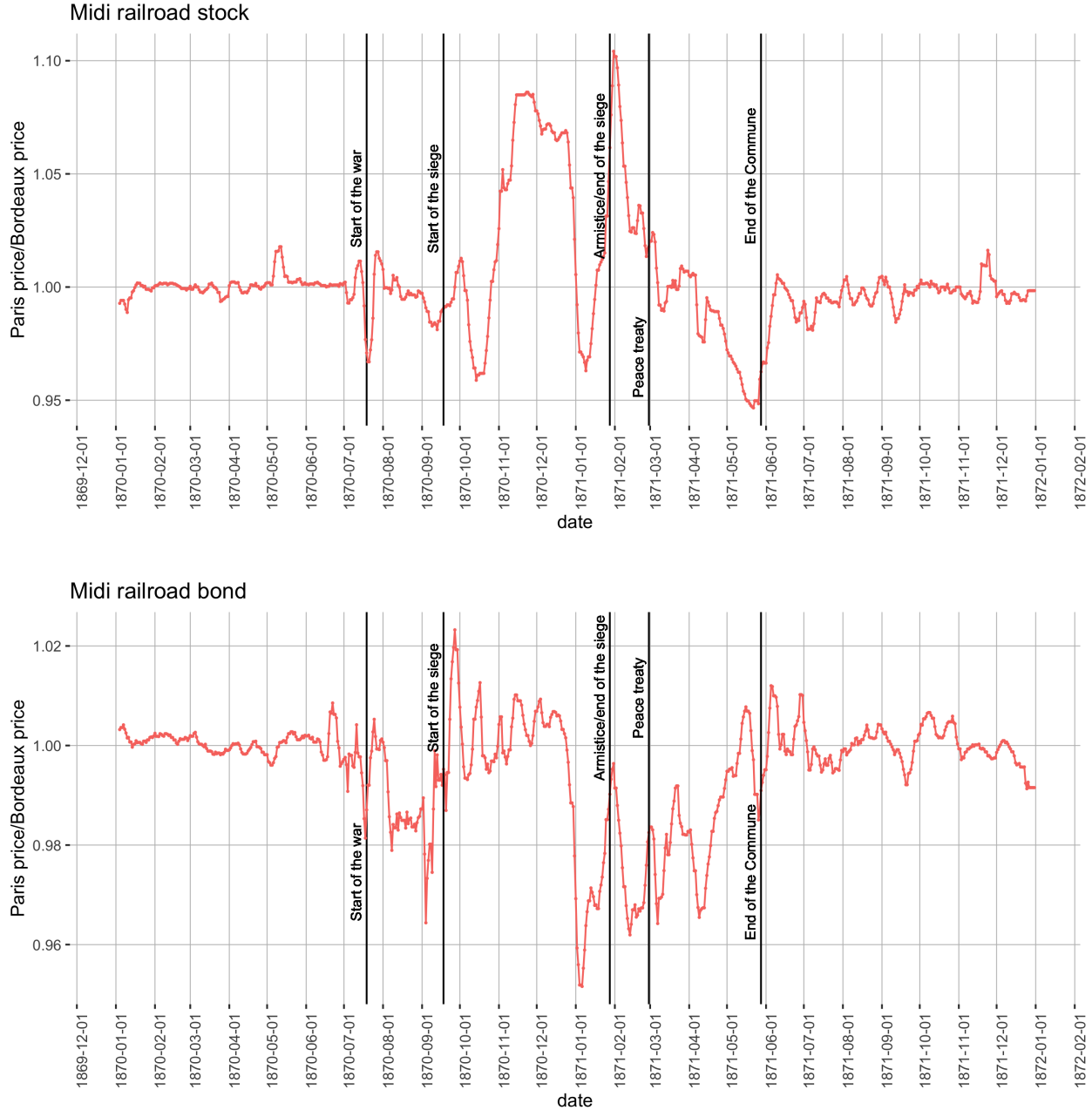
The colors denote the party or faction of the majority of deputies elected by each department. From more to less bonapartist (or from right to left): Green - government, white with dots - government liberal, blue with horizontal stripes - liberal opposition, red with vertical stripes - democratic opposition, orange with diagonal stripes - radical opposition. Parisians (zoomed in in the upper left) were way more likely to vote for the left.

Figure A.17: *Rente* and more food prices in Paris



This figure compares more food prices (as a complement to Figure 9) in Paris to the price of the *rente* in Paris and outside (average of Bordeaux and Lyon). It shows that the differences we observe in the price of government bonds are not related to food inflation in Paris.

Figure A.18: Price ratio of *Midi* railroad bonds and stock between Paris and Bordeaux



These graphs show the price ratio of two assets: *Midi* railroad stock and bond in Paris and Bordeaux. We divide the price in Paris by the price in Bordeaux. These graphs suggest that the patterns discovered for *rentes* were not common to every security. The stock was overvalued in Paris during most of the war and during peace negotiations. The bond ratio was volatile around one during most of the war. During the last month of the war and during peace negotiations, it was overvalued in Bordeaux. In summary, the patterns we observe on *rente* prices are not present for these two assets.