ANALYZING THE EFFECT OF WORLD TRADE ORGANIZATION DISPUTES ON SPECIFIC MARKETS AND INDUSTRIES

by

SANDER CAPETZ

A dissertation accepted and approved in partial fulfillment of the
requirements for graduation with honors research distinction for the degree of
Bachelor of Science
in Economics

Dissertation Committee:
Dr. Ian Sheldon, Chair
Dr. Gabriel Mihalache, Core Member
Dr. Bruce Weinberg, Core Member

The Ohio State University
May 2024

DISSERTATION ABSTRACT

Sander Capetz

Bachelor of Science in Economics

Title: ANALYZING THE EFFECT OF WORLD TRADE ORGANIZATION DISPUTES ON SPECIFIC MARKETS AND INDUSTRIES

How effective are World Trade Organization (WTO) dispute settlements? This paper presupposes that the WTO, in its current form, is not effective enough to be regularly used when trade disputes occur between nations. For urgent matters, it is often more favorable for nations to implement sanctions or tariffs which promptly address trade disputes. Case in point is the use of U.S. tariffs imposed on China for dumping low-cost goods in the U.S. or how NATO countries are now dealing with Russia regarding gas exports. While the use of tariffs and sanctions have researched results, evaluating the impact of WTO dispute settlements measured using stock market price levels remains relatively unexplored. This paper uses an event study model to find that industry stock prices for both complainants (member countries who initialize a case) and respondents (member countries who are facing a judgment from WTO judges) do not receive any significant effects from WTO policy during the entire period that the dispute takes place. Moreover, these findings are reinforced after performing two variations of a Bayesian hierarchical model. The results will contribute to future research on the impact of trade tensions between nations and the challenges facing the WTO's dispute settlement system.

ACKNOWLEDGMENTS

First and foremost, I would like to express my sincere gratitude to my thesis advisors, Dr. Ian Sheldon and Dr. Gabriel Mihalache, whose expertise, guidance, and support have been beyond valuable in the completion of this undergraduate thesis. I would also like to thank Dr. Bruce Weinberg, Dr. Ryan Ruddy, and Dr. Yongyang Cai for their insightful comments, suggestions, and critical review of my work. Finally, I would like to extend my appreciation to my thesis committee members − Dr. Ian Sheldon, Dr. Gabriel Mihalache, and Dr. Bruce Weinberg − for giving your time, expertise, and feedback in helping me achieve this accomplishment.

For my parents, Chris and Jon

TABLE OF CONTENTS

Chapter Page

1. INTRODUCTION 5

2. DIFFUSING TRADE DISPUTES UNDER WTO TRADE RULES: AN EVOLVING LANDSCAPE 9

3. RELATED LITERATURE 10

4. DATA 12

5. EMPIRICAL METHODS 17

6. CASE DS548 AS AN EXAMPLE 22

7. RESULTS 25

8. CONCLUDING REMARKS 29

Bibliography 31

APPENDICES

A. SENSITIVITY ANALYSIS FIGURES 34

B. DISTRIBUTION GRAPHS 41

C. DATA SET INFORMATION 53

CHAPTER 1

INTRODUCTION

In a world economically intertwined through global trade, there exists a need to navigate the complexities and to manage the risks associated with the movement of goods and services among nations. The challenges of international trade gave rise to the creation of the WTO, a rules-based international body that regulates trade between nations. Established in 1995 to replace the General Agreement on Tariffs and Trade (GATT), the WTO serves as a forum for member countries to negotiate multilateral trade agreements and settle trade disputes between its 164 members. Assessing the effectiveness of the WTO's dispute settlement system is important to the future of international trade at a time of global uncertainty. The WTO addresses international trade disputes using a multi-prong approach to resolve trade tensions as outlined in the organization's Dispute Settlement Understanding (DSU). This involves a negotiation period between affected WTO member governments who, if no resolution can be reached, move the dispute to the WTO's Dispute Settlement Body – a group composed of all WTO members who form review panels and prepare panel decision reports that can be appealed under the WTO's Appellate Body (Lichtenbaum, 1998). According to the WTO, there were 621 disputes initiated between 1995-2023, of which only 290 resulted in a panel report followed by 191 dispute appeals (2023). However, such appeals have not been heard by the WTO's Appellate Body members since December 2019 due to the fact that the Appellate Body "lost its quorum of three members necessary for the Body to decide appeals of WTO dispute settlement panel decisions and issue final reports" (Hart and Murrill, 2021, p. 2). While the WTO dispute settlement system has always been the preferred venue for addressing trade disagreements, more recently its effectiveness has come into question. In particular, the current impasse in the WTO – triggered by America's blockage of member appointments to the WTO's Appellate Body – has led to calls for reform (Schneider-Petsinger, 2020). Weinberger and Van Kerckhoven (2022) argue that "the trend of moving away from the WTO dispute settlement towards bilateral, regional or selective regimes may be seen as one aspect of a development towards greater multipolarity in global economic governance. In such a case, the WTO might provide a last resort in addressing trade disputes" (p. 10). Still, other WTO member nations feel the organization offers the best foundation to enable and settle trade disputes. Chaudoin et al. (2016) assert the following: "Some observers even suggest that the success of the dispute settlement understanding may fill in where multilateral negotiations fall short" (Steinberg, 2009; Goldstein and Steinberg, 2008, as cited in Chaudoin

et al., 2016, p. 294). The realities of a constantly evolving global trade environment and rising trade tensions continue to challenge the WTO's dispute settlement system and its principle of non-discriminatory trade among all of its member countries under the Most-Favored-Nation (MFN) clause − a cornerstone of the multilateral trading system (Bagwell and Staiger, 2004).

There are a variety of ways to measure the effectiveness of WTO dispute settlements. This paper investigates the impact of WTO dispute settlements on closing stock prices before and after resolution of trade-related legal arguments between WTO member states. Building upon the Heckscher-Ohlin model, it can be assumed that contemporary firms enjoy unhindered access to free trade. Consequently, the value derived from a country's imports and exports surpasses that in autarky (Markusen et al., 1994). This scenario proves advantageous for companies engaged in both exporting and importing, thereby enhancing the well-being of their shareholders. In summary, stock prices align with the increased utility generated through the facilitation of imports and exports. Moreover, analyzing daily stock price information allows for a more specific investigation into how markets react to WTO policy decisions in a 24-hour period before and after they occur. This is important as it allows me to capture the most immediate market reaction. However, it should be noted that by looking at international stock information, I am limited to daily stock closing prices and cannot investigate hourly or by the minute. Although the stock market has recently been demonstrated to be an imperfect gauge of an economy's well-being, evidence suggests that for developing countries, the stock market continues to serve as a significant indicator of economic health (Aylward and Glen, 2000). Because my study involves dispute settlement cases that include countries such as Peru, Argentina, Chile, Brazil, Mexico, Indonesia, China, the Philippines, South Africa, Egypt, Thailand, and India (all developing countries), I use stock prices as an indicator of the economic health of a nation (GOV.UK, 2021).

Currently, there is limited available literature on this area of investigation. This study explores the potential correlation between complainant and respondent member nations in WTO Dispute Settlement (DS) cases. Its specific focus lies in observing how stock market prices of industries mentioned in corresponding cases for participating countries respond to key WTO policy days. The evaluation of these disputes involve assessing the price change in industry stocks in relation to the price change in index stocks. This comparison is conducted to determine the percentage change in prices. A noteworthy case involves the European Union's (EU) complaint against the U.S. (DS548) regarding the steel and aluminum tariffs during the Trump era (which is currently in a trade war truce) (Bounds,

2023). As a result of this dispute, United States Steel (X) shares reportedly experienced an 18.5 percent decline in August 2018, as indicated by data from S&P Global Market Intelligence (Chamaria, 2018).

Given these trade issues, I conduct an event study model to evaluate the impact of WTO disputes on stock prices. I collect stocks related to specific industries mentioned in each of the corresponding disputes for respondent and complainant countries as well as index stocks corresponding to these respondent and complainant countries. Time is integrated through 61 dummy variables representing the 30 days before policy takes place, the day when policy takes place, and 30 days after policy takes place. There are 62 total dispute settlement cases that I look at when investigating six key WTO policy days that occur in most of the disputes. The dependent variable captures the difference between the day-to-day percent change for industry stocks against the day-to-day percent change for index stocks. Moreover, I conduct two distinct Bayesian hierarchical models as supplementary analyses to determine if the findings from the event study model can be corroborated. These Bayesian hierarchical models are only supplied with information on the day-to-day percent change for industry stocks against the day-to-day percent change for index stocks and whether or not the involved member country is a respondent or complainant. There are three layers to each model. First, there is a normal distribution for the day-to-day percent change for industry stocks compared to that of index stocks. Second, this initial normal distribution is contingent upon a second normal distribution for the mean day-to-day percent change for industry stocks compared to index stocks. Lastly, this second normal distribution is dependent on a Beta distribution for the serial correlation of the mean day-to-day percent change for industry stocks compared to index stocks. Additionally, this second normal distribution is dependent on a Gamma distribution for the variance of the mean day-to-day percent change for industry stocks compared to index stocks. However, this Gamma distribution only applies to the first Bayesian hierarchical model.

After implementing the Benjamini & Yekutieli (2001) false discovery rate, the event study model indicates that WTO policy has no significant effect on industry stock prices for both complainants and respondents during the entire period that the dispute takes place. Moreover, these findings are reinforced after performing two variations of a Bayesian hierarchical model.

This paper makes a noteworthy contribution by analyzing the impact of WTO policy on industry stocks both before and after policy takes place. The insights derived from this study offer valuable information to governmental agencies, researchers, and law firms affiliated with the WTO, providing them with a deeper understanding of potential outcomes in member countries engaged in litigation through the dispute settlement system. This knowledge can be leveraged to facilitate more informed and constructive negotiations, ultimately minimizing the volatility in stock prices in response to such policies.

The remainder of this paper is organized as follows: Diffusing Trade Disputes Under WTO Trade Rules: An Evolving Landscape; Related Literature; Data; Empirical Methods; Case DS548 as an Example; Results; and Concluding Remarks.

CHAPTER 2

DIFFUSING TRADE DISPUTES UNDER WTO TRADE RULES: AN EVOLVING LANDSCAPE

WTO member countries settling cases in the organization's dispute settlement system impacts the trade of mentioned industries in each dispute settlement case. Bahri (2016) argues that "the engagement of affected industries during the management of trade disputes is a 'crucial enabling element' for any government action that is undertaken to safeguard or expand business interests" and that "coordination between government and industry, in most cases, is embedded in the nature of WTO dispute settlement proceedings" (p. 646). WTO member countries often employ these strategies as a means to safeguard their own interests, occasionally straining the established rules of the WTO. For example, when China joined the WTO in 2001, it was thought that the country would pursue economic reform. In a 2018 statement delivered by Dennis Shea, former U.S. Ambassador to the WTO, he argued that when China joined the WTO, it was hoped that the country would transform from a state-led to a market-oriented economy (Office of the United States Trade Representative, 2018). However, a 2018 WTO General Council report on China's economy states that the country "maintains a state-led, trade-disruptive economic model... that imposes substantial costs on and presents severe challenges to WTO members" (p. 2). Moreover, a rise in regional and bilateral preferential trade agreements (PTAs) reflects a dissatisfaction with the multilateral trading process. Yet such frustration does not necessarily diminish the significance of the WTO. Bagwell, Bown, and Staiger (2016) argue that the WTO's framework "is likely to encourage policy outcomes that are viewed as efficiency enhancing... This position is only strengthened when also taking into consideration the WTO's relatively successful track record of resolving bilateral frictions through its system of dispute settlement" (p. 1219). Amidst ongoing challenges and viewpoints, the sustainability and growth of the WTO hinge on the extent to which its members embrace the effectiveness of its dispute settlement system, especially at a time of increased trade protectionism.

CHAPTER 3

RELATED LITERATURE

Existing research comparing stock prices of countries involved in WTO dispute cases and the extent to which such cases affect specific markets and industries is limited. This study takes inspiration from related literature involving trade disputes and stock volatility between the U.S. and other WTO member countries. For instance, Jensen (2006) investigates how individual U.S. steel stock prices, when compared against U.S. index steel prices, are affected by the WTO ruling on the 2002 U.S. steel tariffs. For context, the Bush administration's special safeguard tariffs of 8 to 30 percent on steel imports in 2002 − a response to America's ailing steel industry − led the EU to file a complaint with the WTO Dispute Settlement Body that included several other WTO trading partners. The author's study utilizes an OLS regression with Newey-West standard errors to examine how on the day of the WTO's ruling, individual steel companies, as well as their indexes, had statistically significant negative results (Jensen, 2006).

In another related paper, Chen and Jeong (2020) examine U.S.-China trade disputes and related pre- and post-trade volatility in the U.S. and Chinese stock markets. The authors found that while both the U.S. and Chinese stock markets experienced volatility transitioning from the pre-trade to post-trade dispute period, the U.S. market experienced significantly greater fluctuations in price during the period following the U.S.'s decision to impose the first round of tariffs against China (Chen and Jeong, 2020). Their findings provide insight into how there may exist statistically significant lingering effects on stock prices either before or after trade policy takes place.

Furthermore, Chen and Pantelous (2022) investigate the impact of the U.S.-China trade disputes on the Chinese and U.S. stock markets at the industry level. The authors found that industries that export their goods, or require certain parts of a good to be imported, had significant negative effects on stock prices during the trade conflict period (Chen and Pantelous, 2022).

In addition, Jammalamadaka et al. (2019) study how stock prices are affected by information on Twitter through a multivariate Bayesian structural model. They find that positive news, such as good earnings reports, translated into "buying motivations and increasing in stock prices, while negative news" had the opposite effect (Jammalamadaka et al., 2019, p. 94).

Compared with existing related research, the contribution of this study involves the evaluation of the effect that WTO dispute settlement key ruling dates have on specific countries' stocks and the extent to which said disputes influence the industries mentioned in these corresponding cases.

CHAPTER 4

DATA

The data set contains WTO disputes that fall into two categories: the country at fault implements the chosen punishment recommended by the WTO (implementation notified by respondent), and cases where the countries involved (both respondent and complainant) come to a mutual agreement and decide to withdraw their dispute. As of 2022, there have been 123 disputes that ended with the respondent implementing the recommendation and 104 disputes that were withdrawn after coming to a mutual agreement (WTO, 2024). These cases typically involve six key dates: consultation requested, panel requested, panel established, panel composed, panel report circulated, and implementation. The WTO describes the key dispute settlement process as follows: consultation requested is when a member country of the WTO will go to the board to request that they seek charges against another member country; panel requested is when the WTO request a panel of judges to look at a dispute; panel established is when the WTO has successfully assigned a panel of judges to review a dispute; panel composed is when the panel has met; panel report circulated is when the panel has released their decision to the respondent and complainant member countries; and implementation is when the complainant and respondent countries have reached a decision to either implement the recommendations put forth by the WTO or come to a mutually agreed solution (WTO, n.d.).

Of these disputes, I do not consider any that fail to reveal information about what industry was discussed (i.e., dispute DS560 involving requested consultations by the U.S. with Mexico regarding increased duties on U.S. products, which were not specified). Moreover, I do not investigate any cases that ended before the year 2000 due to constraints in data accessibility. Additionally, I do not incorporate any cases that ended in 2023 as all data was collected before any cases were finalized during that year. Thus, I look at cases from 2000 to 2022. I use a variety of sources, such as Yahoo! Finance, MarketWatch, and Investing.com to discover stock price data three months before and after each key WTO policy day for both general indices and specific business related to the countries involved within each dispute. However, in my models I only investigate 60 days before and after each policy day takes place. I then construct parameters for 30 days before and after each policy day takes place and assign the remaining days, that are not given parameters, to the constant coefficient (days 31-60 before policy takes place and days 31-60 after policy takes place). If a country did not have both a general stock index and a specific business stock − a stock that was related to the industry discussed throughout the dispute − avail-

Table 4.1. Median IQR for the difference in stock price percent change

	Recommendation Implemented		Mutually Agreed Solution	
Timeframe	Complainant	Respondent	Complainant	Respondent
Market Days After Consultation Req				
Before	-0.01 (-1.06, 1.17)	-0.06 (-1.20, 1.18)	0.00 (-1.11, 1.07)	0.01 (-1.23, 1.24)
After	0.00 (-1.11, 1.14)	0.06 (-1.24, 1.42)	-0.09 (-1.09, 1.04)	0.08 (-1.26, 1.30)
Num Cases	32	32	30	30
Market Days After Panel Req				
Before	-0.02 (-1.00, 1.11)	0.03 (-1.21, 1.16)	-0.08 (-1.12, 0.93)	0.03 (-1.18, 1.06)
After	-0.08 (-1.04, 0.99)	-0.02 (-1.30, 1.19)	-0.10 (-1.35, 1.07)	0.03 (-1.17, 1.20)
Num Cases	32	32	17	17
Market Days After Panel Estb				
Before	-0.04 (-1.02, 1.05)	-0.12 (-1.30, 1.16)	-0.11 (-1.32, 1.12)	0.07 (-1.22, 1.26)
After	0.04 (-0.95, 1.10)	-0.04 (-1.27, 1.18)	0.00 (-1.22, 1.11)	0.05 (-1.06, 1.29)
Num Cases	32	32	12	12
Market Days After Panel Comp				
Before	0.05 (-0.97, 1.08)	0.03 (-1.11, 1.15)	0.02 (-0.80, 1.15)	-0.06 (-1.09, 1.11)
After	-0.09 (-1.04, 0.97)	0.06 (-1.14, 1.15)	-0.14 (-1.12, 1.04)	0.21 (-0.86, 1.69)
Num Cases	32	32	11	11
Market Days After Panel Rep Circ				
Before	0.02 (-0.86, 0.87)	-0.02 (-0.97, 0.91)	-0.19 (-1.17, 0.96)	-0.04 (-0.93, 1.06)
After	-0.03 (-0.89, 0.89)	-0.12 (-1.04, 1.00)	0.14 (-1.16, 1.23)	-0.08 (-1.01, 0.88)
Num Cases	32	32	11	11
Market Days After Implementation				
Before	-0.04 (-0.77, 0.77)	-0.11 (-1.14, 1.02)	-0.09 (-1.08, 1.12)	-0.05 (-1.23, 1.16)
After	-0.07 (-0.88, 0.79)	-0.11 (-1.17, 1.07)	-0.04 (-1.04, 1.00)	-0.14 (-1.36, 0.98)
Num Cases	32	32	30	30

able, then such disputes were excluded from the data set. After collecting this information via Python, or manually downloading csv files, I transform the data into a panel data set that is distinguished by case id and the dates of recorded stock prices. The full list of cases that I investigate is within the data set information section of the appendix.

As seen from Table 4.1, all cases that end with the respondent implementing the recommendation have six key policy days. However, this cannot be said for cases that end with a mutually agreed solution. Only 11 out of the 30 captured cases that end with a mutually agreed solution have six key policy days. This is important to note when investigating the results. While all case types have a first (consultation requested) and last (implementation) policy day, after the consultation has been requested, cases can be termi-

nated at any point to arrive at a mutually agreed solution on the day of implementation. This is why disputes that end in a mutually agreed solution exhibit a decrease in the total amount of cases across key WTO policy days after the consultation was requested.

Table 4.1 shows the median IQR for the difference in stock price percent change for the period before policy takes place (30 days before policy takes place) and the period after policy takes place (30 days after policy takes place). The difference in stock price percent change is constructed as follows:

$$y_{i,t} = \frac{\text{stock\_price}_{i,t} - \text{stock\_price}_{i,t-1}}{\text{stock\_price}_{i,t-1}} - \frac{\text{index\_price}_{i,t} - \text{index\_price}_{i,t-1}}{\text{index\_price}_{i,t-1}}.$$

Some notable differences between the before and after periods for when policy takes place occur when the consultation was requested, when the panel was established, when the panel was composed, and when the panel report was circulated.

There exists a positive change between the before and after median difference in stock price percent change when the consultation was requested for both complainant and respondent countries whose cases ended in the recommendation being implemented. However, when consultation was requested for complainant countries that had their cases end in a mutually agreed solution, the median difference in stock price percent change exhibited a negative difference between the before and after periods.

Likewise, there exists a positive change between the before and after median difference in stock price percent change when the panel was established for both complainant and respondent countries whose cases ended in the recommendation being implemented. Yet, when the panel was established for respondent countries that had their cases end in a mutually agreed solution, the median difference in stock price percent change exhibited a negative difference between the before and after periods. This is not the case for complainant countries that had their cases end in a mutually agreed solution when the panel was established.

The largest positive difference between the median before period difference in stock price percent change value and the median after period difference in stock price percent change value occurs for complainant countries, whose cases end with a mutually agreed solution when the panel report is circulated. The second largest positive difference between the median before period difference in stock price percent change value and the median after period difference in stock price percent change value occurs for respondent countries, whose cases end in a mutually agreed solution when the panel was composed.

The largest negative difference between the median before period difference in stock price percent change value and the median after period difference in stock price percent change value occurs for complainant countries, whose cases end with a mutually agreed solution when the panel is composed.

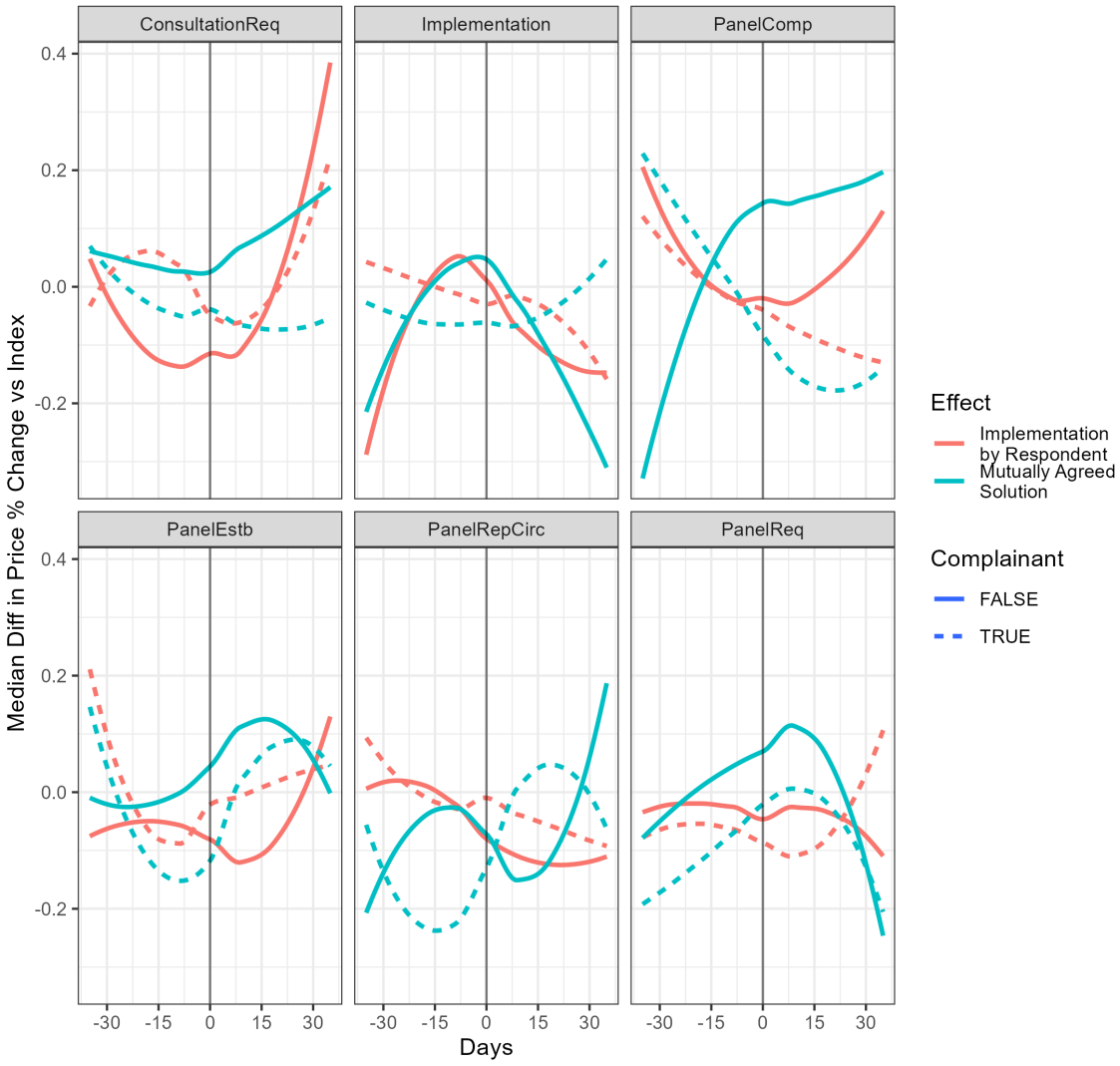

Figure 4.1. Checking for parallel trends across all six key policy days for respondents and complainants within their respective case types.

Figure 4.1 shows the absence of parallel trends between complainants and respondents for the two types of cases that I am analyzing (mutually agreed solution and respondent implements WTO recommendations). Therefore, when constructing my estimating equation, I will have to control for trends. To do this, I will add within fixed effects to my event study model.

CHAPTER 5

EMPIRICAL METHODS

I perform an event study regression to estimate the impact of WTO disputes on a stock's price. My main estimating equation is

$$\hat{y}_{i,t} = \beta_0 + \beta_{1-61}\boldsymbol{X}_t + \beta_{62-123}\text{Fixed effect}_i + e_{i,t}.$$

The dependent variable is constructed as

$$y_{i,t} = \frac{\text{stockprice}_{i,t} - \text{stock\_price}_{i,t-1}}{\text{stock\_price}_{i,t-1}} - \frac{\text{index\_price}_{i,t} - \text{index\_price}_{i,t-1}}{\text{index\_price}_{i,t-1}},$$

i.e., the daily price percent change for industry stocks against the daily price percent change for index stocks.

This equation closely follows the model given by Miller (2023),

$$y_{i,t} = \underbrace{\left(\sum_{j\in\{-m,\ldots,0,\ldots,n\}} \gamma_i \cdot D_{i,t-j}\right)}_{\text{Event Study Terms}} + \underbrace{\alpha_i + \delta_t}_{\text{Panel Study Terms}} + \underbrace{\beta \cdot X_{i,t}}_{\text{(Optimal) Control Variables}} + \epsilon_{i,t},$$

with the exception that I integrate the control variables (daily percent change in index stocks) into the dependent variable (daily percent change in industry stocks). I evaluate the daily price percent change for industry stocks against the daily price percent change for index stocks, as the daily price percent change for index stocks is acting as a control variable to reduce volatility.

In my estimating equation, $\boldsymbol{X}_t$ is a vector of dimensions 1 by 61. It represents dummy variables for 30 days before, on, and after each key WTO policy day (61 days total). I incorporate a within fixed effect variable (Fixed Effect$_i$) to address the absence of parallel trends, thereby enhancing control for endogeneity. The within fixed effect variable adds a dummy variable for every case id (there are 62 total cases, however one of the cases is assigned to the constant variable). In order for the constant not to take on a day dummy value from $\boldsymbol{X}_t$, I let the constant take on values 31-60 days before and after each key WTO policy day. This model is performed separately for complainants and respondents across all six key policy days. I expect complainant countries to have large significant positive

effects on $y_{i,t}$ after the panel report has been circulated. I propose this hypothesis based on my summary statistics, which indicate that the largest difference between the median before and after periods when policy takes place for the difference in stock price percent change occurs for complainants during this period.

I construct a Bayesian hierarchical model as an additional method to investigate the daily price percent change for industry stocks against the daily price percent change for index stocks. I chose this model specifically as it does not require any weights. For other models, i.e., synthetic control method or propensity scoring, appropriate weights would have to be chosen. However, it is not clear if using other stocks (index or industry) to simulate the chosen industry stocks that are related to the industries mentioned in each dispute (after policy takes place) would be a justified model. This is due to the fact that there is a scarcity of literature employing these techniques in this manner.

The Bayesian hierarchical model follows a three-tiered model as described by Chib and Greenberg (2008), where the priors for each tier are dependent on the previous tier's distribution. The y_i and μ variables that I formulate in the two distinct Bayesian hierarchical models that I perform are influenced by the approach used by Jammalamadaka et al. (2019) in constructing their variables for $Y = [\tilde{y}_1, \ldots, \tilde{y}_n]^T$ and $M = [\tilde{\mu}_1, \ldots, \tilde{\mu}_n]^T$.

In the first Bayesian hierarchical model, the first tier is constructed as follows:

$$y_i \sim \begin{cases} \mathcal{N}_{61}(\mu_C, \Sigma_{\text{error}}) & i \text{ represents a complainant} \\ \mathcal{N}_{61}(\mu_R, \Sigma_{\text{error}}) & i \text{ represents a respondent} \end{cases}.$$

Note, y_i is the same $y_{i,t}$ as in the event study model (the daily price percent change for industry stocks against the daily price percent change for index stocks). The variable y_i follows a multivariate normal distribution of 61 dimensions. Because of this, we do not need a time component within this model. The μ_C and μ_R variables are the vectors of average difference in daily percentage change between industry stock prices and index stock prices for complainants and respondents. Additionally, as y_i can take on a positive or negative real value, I normally distribute it. The Σ_{error} variable represents a covariance matrix.

The second tier is constructed as follows:

$$\mu_C \sim \mathcal{N}_{61}(\mathbf{0}, \Sigma_{\text{daily}}),$$
$$\mu_R \sim \mathcal{N}_{61}(\mathbf{0}, \Sigma_{\text{daily}}).$$

Here, μ_C and μ_R are the mean daily percentage price between industry and index stocks for complainants and respondents respectively. Since they can also take on positive or negative real values, I normally distribute them. Variable $\mathbf{0}$ is a vector of zeros with a length of 61. I include this zero-vector as I do not have reason for either μ_C or μ_R to be inherently positive or negative. The Σ_{daily} variable represents a covariance matrix.

The covariance matrices are constructed as follows:

$$\mathbf{\Sigma}_{\text{daily}} = \breve{\sigma}^2_{daily} \begin{pmatrix} 1 & \breve{\rho} & \breve{\rho}^2 & \dots & \breve{\rho}^{61} \\ \breve{\rho} & 1 & \dots & \dots & \dots \\ \breve{\rho}^2 & \dots & 1 & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \breve{\rho}^{61} & \dots & \dots & \dots & 1 \end{pmatrix},$$

$$\mathbf{\Sigma}_{\text{error}} = \sigma^2_{error} \begin{pmatrix} 1 & \rho & \rho^2 & \dots & \rho^{61} \\ \rho & 1 & \dots & \dots & \dots \\ \rho^2 & \dots & 1 & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \rho^{61} & \dots & \dots & \dots & 1 \end{pmatrix}.$$

The third tier is constructed as follows:

$$\begin{aligned} \breve{\rho}_{daily} &\sim 2 \cdot \text{Beta}(\alpha_{\text{daily}}, \beta_{\text{daily}}) - 1, \\ \rho_{error} &\sim 2 \cdot \text{Beta}(\alpha_{\text{error}}, \beta_{\text{error}}) - 1, \\ \breve{\sigma}^2_{daily} &\sim \text{Gamma}(a_{\text{daily}}, b_{\text{daily}}), \\ \sigma^2_{error} &\sim \text{Gamma}(a_{\text{error}}, b_{\text{error}}). \end{aligned}$$

The serial correlation for the mean difference in price percentage change is $\breve{\rho}_{daily}$. The same correlation parameter is used for both complainant and respondents, i.e., for defining the priors of μ_C and μ_R. The error terms have a counterpart, ρ_{error}, which defines the distribution of y. I utilize a modified Beta prior to account for values being between -1 and 1. The variance of each component of μ_C and μ_R is $\breve{\sigma}^2_{daily}$. The variance of each component of y is σ^2_{error}. Since the variances, $\breve{\sigma}^2_{daily}$ and σ^2_{error}, are always positive, I utilize a Gamma prior. Moreover, this assumes that the variance in percent change stock prices between industry and index stocks for complainants and respondents is the same for every day. The

second Bayesian hierarchical model does not assume this, i.e., the variance follows a non-informative prior.

I assign parameters $(\alpha, \beta) = (5, 2)$ for the Beta distributions corresponding to $\breve{\rho}_{daily}$ and ρ_{error}. I parameterize the prior distributions of the variances by choosing a mean of 5 and a standard deviation of 4 for the priors in order to determine the parameters (a, b) of the Gamma distribution. A sensitivity analysis for the choices of priors is shown in the appendix.

In the second Bayesian hierarchical model, I evaluate stock price percent changes relative to the policy dates.

The first and second tiers to the model are constructed in the same manner, i.e,

$$y_i \sim \begin{cases} \mathcal{N}_{61}(\mu_C, \Sigma_{\text{error}}) & i \text{ is complainant} \\ \mathcal{N}_{61}(\mu_R, \Sigma_{\text{error}}) & i \text{ is respondent} \end{cases},$$

$$\mu_C \sim \mathcal{N}_{61}(\mathbf{0}, \Sigma_{\text{daily}}),$$
$$\mu_R \sim \mathcal{N}_{61}(\mathbf{0}, \Sigma_{\text{daily}}).$$

However, the covariance matrices are constructed differently as I am no longer performing a Gamma distribution for $\breve{\sigma}^2_{daily}$ and σ^2_{error}. We would expect to see more variation in both y and μ the further we move from when policy takes place. As a result, I give $\breve{\sigma}^2_{daily}$ and σ^2_{error} a non-informative prior. The covariance matrices are constructed as follows:

$$\mathbf{\Sigma}_{\text{daily}} = \begin{pmatrix} \breve{\sigma}_1^2 & \breve{\sigma}_1\breve{\sigma}_2\breve{\rho} & \breve{\sigma}_1\breve{\sigma}_3\breve{\rho}^2 & \dots & \breve{\sigma}_1\breve{\sigma}_{61}\breve{\rho}^{60} \\ \breve{\sigma}_2\breve{\sigma}_1\breve{\rho} & \breve{\sigma}_2^2 & \dots & \dots & \dots \\ \breve{\sigma}_3\breve{\sigma}_1\breve{\rho}^2 & \dots & \dots & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \breve{\sigma}_{61}\breve{\sigma}_1\breve{\rho}^{60} & \dots & \dots & \dots & \breve{\sigma}_{61}^2 \end{pmatrix},$$

$$\mathbf{\Sigma}_{\text{error}} = \begin{pmatrix} \sigma_1^2 & \sigma_1\sigma_2\rho & \sigma_1\sigma_3\rho^2 & \dots & \sigma_1\sigma_{61}\rho^{60} \\ \sigma_2\sigma_1\rho & \sigma_2^2 & \dots & \dots & \dots \\ \sigma_3\sigma_1\rho^2 & \dots & \dots & \dots & \dots \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \sigma_{61}\sigma_1\rho^{60} & \dots & \dots & \dots & \sigma_{61}^2 \end{pmatrix}.$$

Here, σ_j is the standard deviation of the jth component of μ_C and μ_R, and $\breve{\sigma}_j$ is the standard deviation of the jth component of y conditional on μ_C or μ_R.

Now, the third tier only has a Beta distribution for $\breve{\rho}_{daily}$ and ρ_{error}, i.e.,

$$\breve{\rho}_{daily} \sim 2 \cdot \text{Beta}(\alpha_{\text{daily}}, \beta_{\text{daily}}) - 1,$$
$$\rho_{error} \sim 2 \cdot \text{Beta}(\alpha_{\text{error}}, \beta_{\text{error}}) - 1.$$

For all three models (the event study model and the two Bayesian hierarchical models), I estimate y after performing a Benjamini & Yekutieli (2001) false discovery rate. This is due to the fact that previous price information partially determines future price behavior (Fama, 1965).

CHAPTER 6

CASE DS548 AS AN EXAMPLE

Case DS548 was brought forward as a complaint by the EU regarding certain measures imposed by the U.S. to allegedly adjust imports of steel and aluminum into the U.S. (WTO, 2022). The case began on June 1, 2018 and was terminated (ending with a mutually agreed solution) on January 17, 2022. All key six WTO policy days (consultation requested, panel requested, panel established, panel composed, panel report circulated, and implementation) occurred within the duration of the dispute. The U.S. was listed as the respondent country and the EU was listed as the complainant.

To investigate how WTO policy might affect the steel and aluminum industries within the U.S. and EU, I analyze steel and aluminum companies in France and in the U.S. that make up a considerable share of their respective country's industries. I then compare the day-to-day percent change in stock prices for these companies against the day-to-day percent change in stock prices for index stocks within the U.S. and EU.

For the U.S., the industry stock I use for my research is Kaiser Aluminum Corp. (KALU), a Tennessee-based company that engages in aluminum manufacturing. The index stock I use for the U.S. is the S&P 500. Thus, y is constructed for the U.S. as,

$$y_{i,t} = \frac{\text{Kaiser\_Aluminum\_Corp}_{i,t} - \text{Kaiser\_Aluminum\_Corp}_{i,t-1}}{\text{Kaise\_Aluminum\_Corp}_{i,t-1}} - \frac{\text{S\&P\_500}_{i,t} - \text{S\&P\_500}_{i,t-1}}{\text{S\&P\_500}_{i,t-1}}.$$

For the EU, the industry stock I use for my research is Jacquet Metal Service (JCQ), a French-based company that engages in steel manufacturing. The index stock I use for the EU is the EU 50. Thus, y is constructed for the EU as,

$$y_{i,t} = \frac{\text{Jacquet\_Metal\_Service}_{i,t} - \text{Jacquet\_Metal\_Service}_{i,t-1}}{\text{Jacquet\_Metal\_Service}_{i,t-1}} - \frac{\text{EU\_50}_{i,t} - \text{EU\_50}_{i,t-1}}{\text{EU\_50}_{i,t-1}}.$$

I then perform my event study model regression as follows:

$$\hat{y}_{i,t} = \beta_0 + \beta_{1-61}\boldsymbol{X}_t + e_{i,t}.$$

Note, there are no within fixed effects added to the above model as I am regressing this estimation for only one case id (DS548). After performing each regression for the complainant and respondent separately, I also correct for any misleading p-values by utilizing a Benjamini & Yekutieli (2001) false discovery rate.

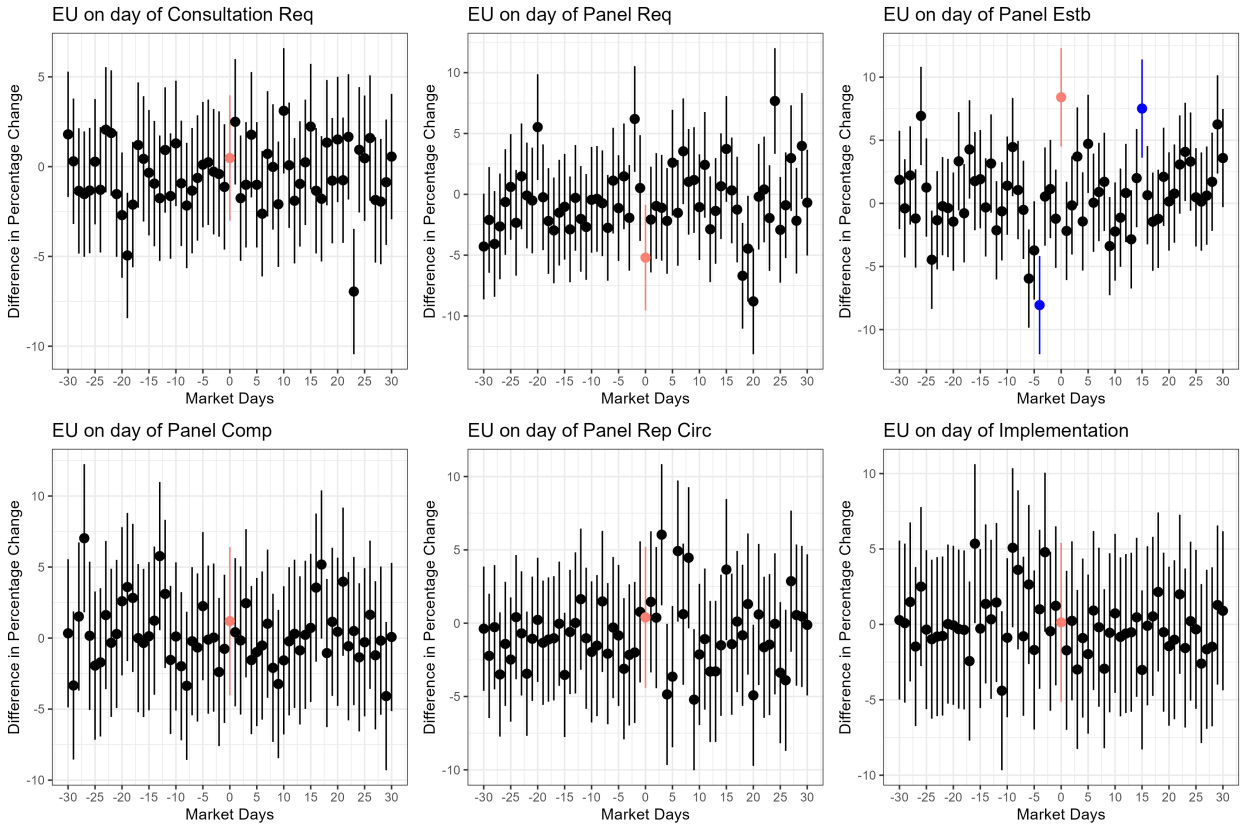

Figure 6.1. Event study model for the EU (complainant) across all six key policy days.

Figure 6.1 shows that four days before the panel was established, the EU suffered a significant percent change decrease of 8.06 while 15 days after the panel was established, it experienced a significant percent change increase of 7.51.

Figure 6.2 shows that 24 days before the panel was established, the U.S. suffered a significant percent change decrease of 9.62 while 16 days after the panel was established, it experienced a significant percent change increase of 4.69. Moreover, two days before the panel report was circulated, the U.S. suffered a significant percent change decrease of 13.60; one day after the panel report was circulated, it suffered a significant percent change decrease of 7.50; five days after the panel report was circulated, it suffered a significant percent change decrease of 8.14; nine days after the panel report was circulated, it suffered a significant percent change decrease of 7.64; and 20 days after the panel report was circulated, it suffered a significant percent change decrease of 8.32.

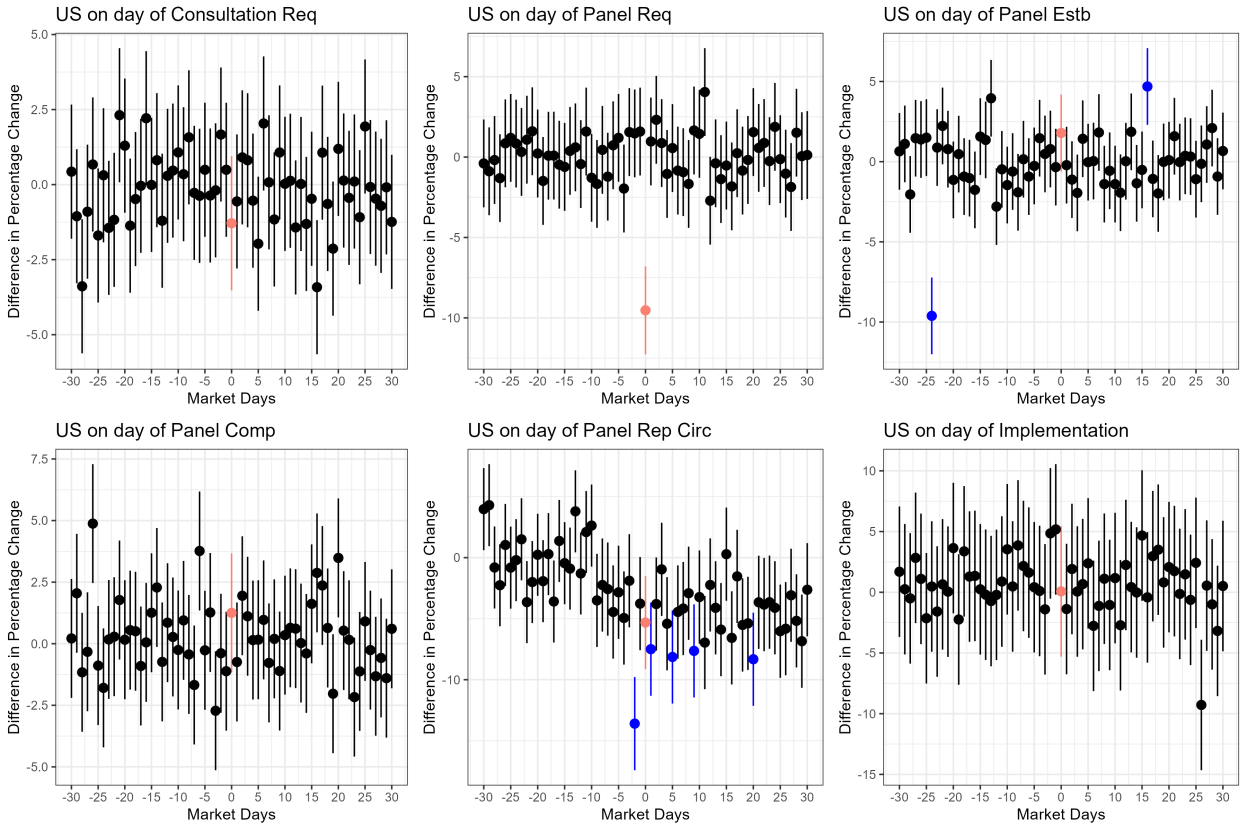

Figure 6.2. Event study model for the U.S. (respondent) across all six key policy days.

While these results appear significant, it is essential to acknowledge the volatility inherent in these findings. Consequently, I approach the significance of the results for these specific days with caution.

CHAPTER 7

RESULTS

After performing the event study model, Figure 7.1 shows that there exist no significant effects on specific stock prices from WTO policy across all six policy days for either respondents or complainants. This is due to a number of factors.

First, this could stem from the inherent volatility of stock prices. While I control for within effects, there exists a variety of other external influences that I do not take into account, i.e., the economy is experiencing a decrease in growth, regulation changes regarding subsidies, any speculation about the market, etc. As my investigation uses stock prices as the sole numerical variable, it is inherently difficult to determine the true effects.

Second, this could stem from the size of the data set. This data looks at 62 total cases that were finalized between the years 2000 to 2022. However, it is important to note that while there exist 62 cases that have a first (consultation requested) and last (implementation) policy day, there exist only 43 total cases that have all six key WTO policy days. This is due to the fact that cases can be terminated at any time after the consultation was requested. Thus, the results for policy days such as panel requested, panel established, panel composed, and panel report circulated are all less informative than the results for when the consultation was requested and when implementation occurred.

Third, this could stem from each complainant and respondent having been assigned one index stock and one industry stock. This means that I have only one vector of y observations for every country in each case. Despite my chosen industry stocks being leading companies within their respective industries, it cannot be said that one industry stock is representative of the entire industry within each country.

Fourth, the results could stem from an issue with the model. It is possible that the event study model might not accurately reflect reality. Perhaps there exists a better financial model that could be used.

After performing both Bayesian hierarchical models, the results of the event study model are reinforced. This is seen in Figures 7.2 and 7.3. These findings could be due to the large number of parameters that occur within these models, e.g., μ (dependent on ρ and σ^2) which has 61 values for either complainant or respondent across six policy days.

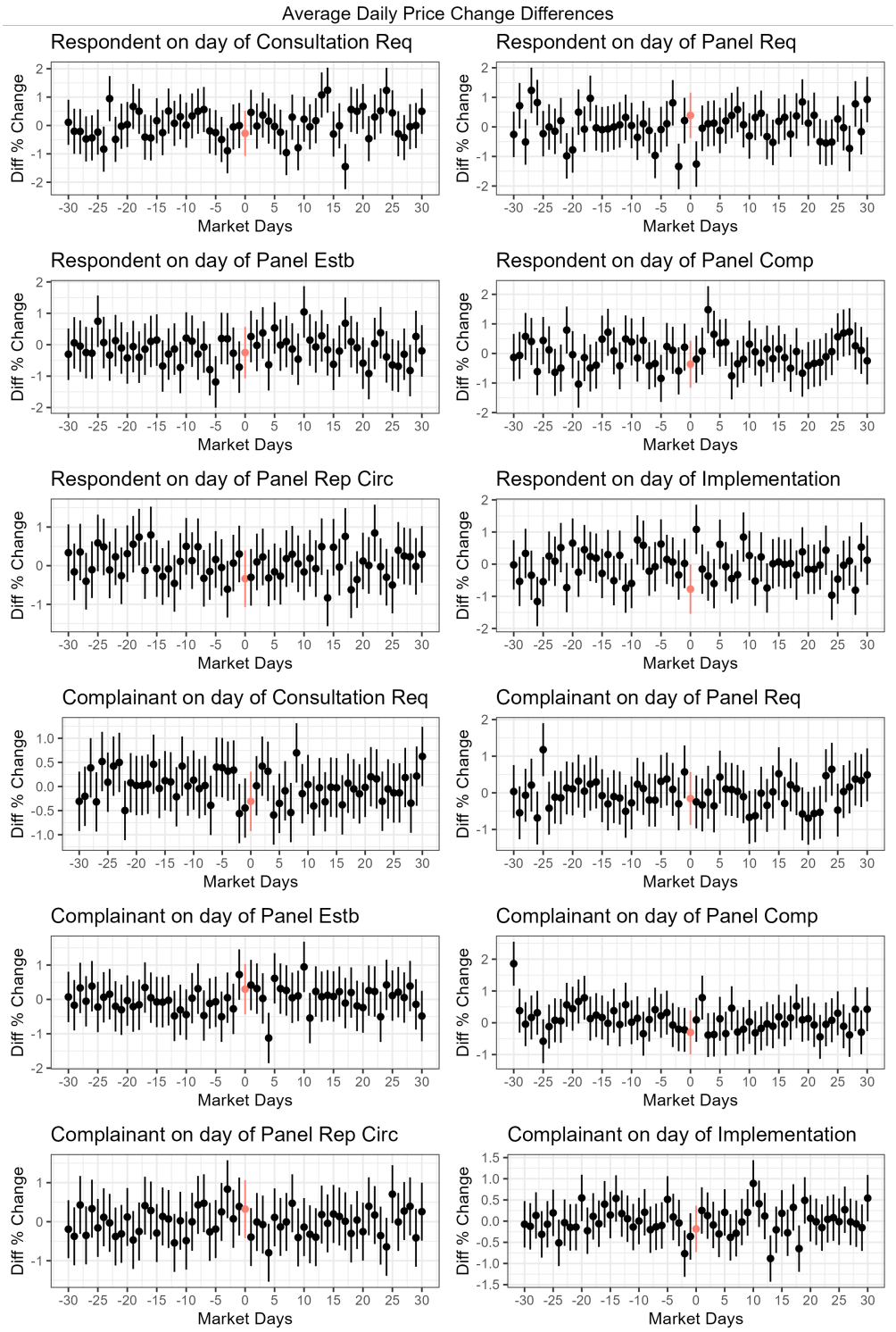

Figure 7.1. Event study model for both complainants and respondents across all six key policy days.

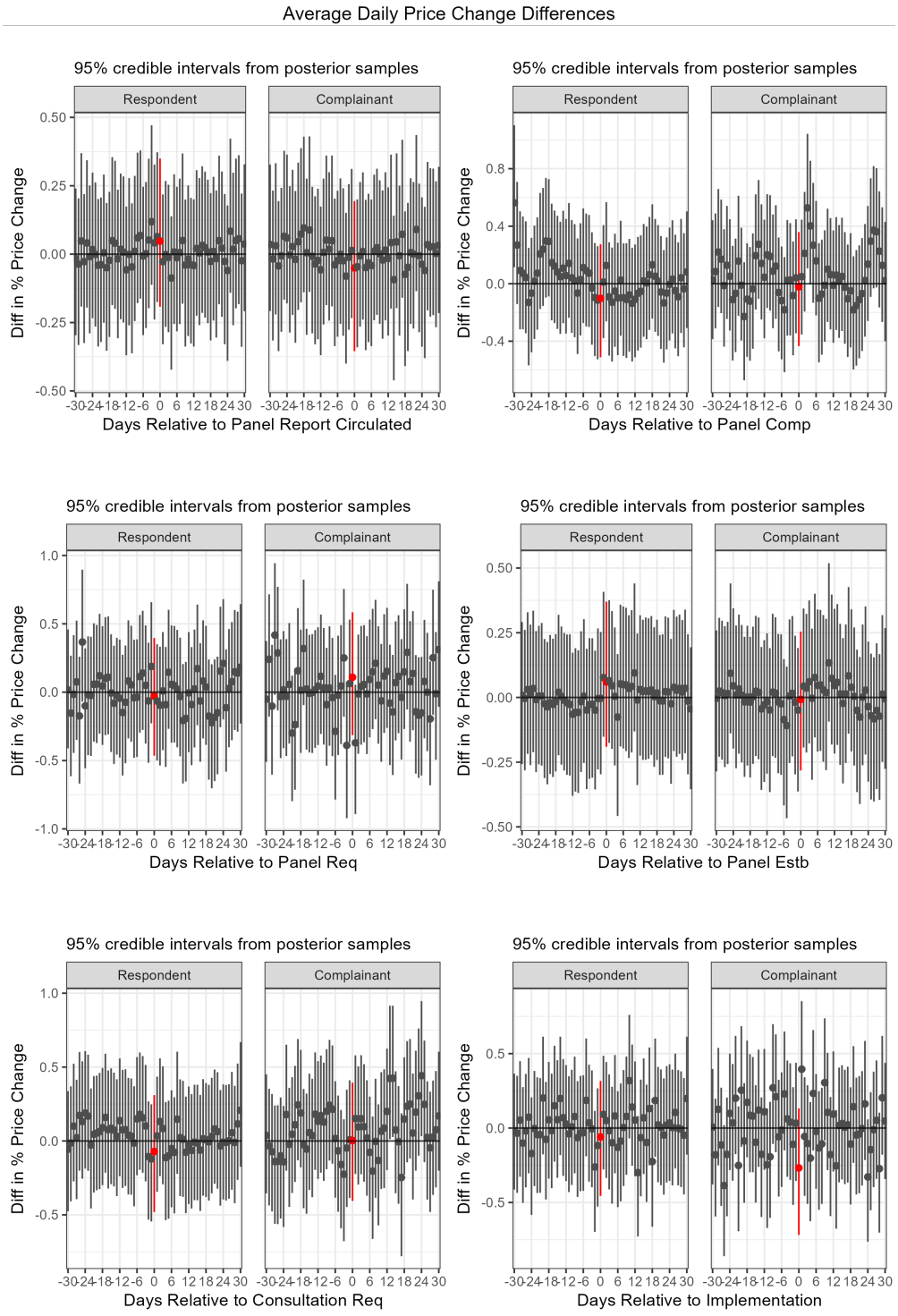

Figure 7.2. First Bayesian hierarchical model for both complainants and respondents across all six key policy days.

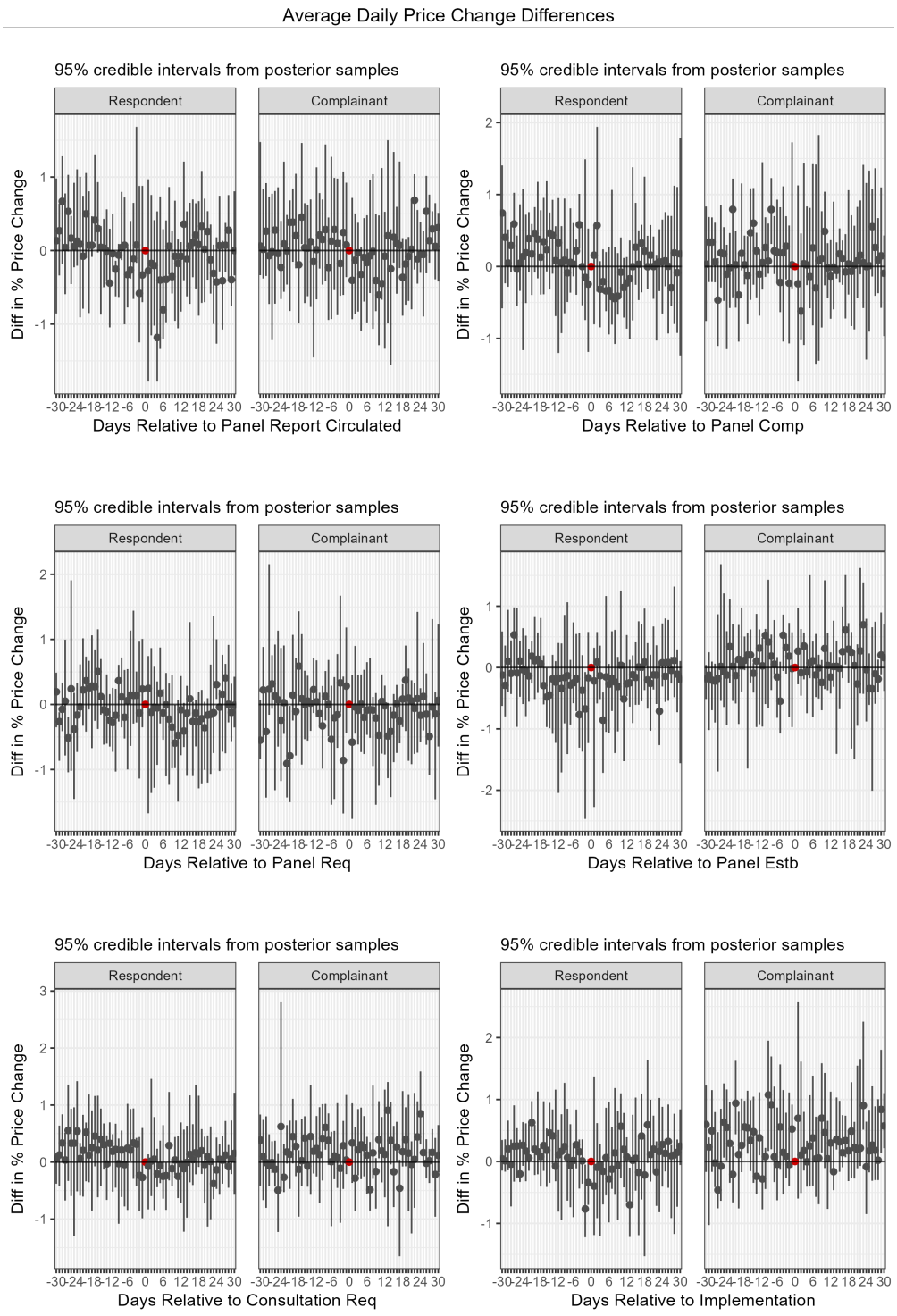

Figure 7.3. Second Bayesian hierarchical model for both complainants and respondents across all six key policy days.

CHAPTER 8

CONCLUDING REMARKS

The analysis indicates the absence of significant effects from WTO policy on complainant or respondent stocks during all six key policy days. This is shown not only in the event study model, but also is reinforced in both Bayesian hierarchical models. While no significant effects are shown, this does not necessarily mean that WTO policy has no effect on industry stocks. There could exist significant findings that cannot be shown within the framework of my investigation due to the following: the inherent nature of stock volatility; working with a small data set; having only one set of y observations for every involved country within each case; non-apparent issues with the models; or constructing a large number of parameters.

This study faces certain limitations, notably the absence of parallel trends and the relatively small size of the data set. This lack of parallel trends suggests the presence of undisclosed trends in the stock market (e.g., market size) or time-varying factors (e.g., recessions), both of which show differences in prices for industry stocks and index stocks.

Further, the data set size is relatively small. By excluding cases that concluded before 2000, the study is left with 62 disputes, each involving a minimum of four stocks (one industry and one index stock for each involved nation). Working with this restricted data set might introduce higher variability in the dependent variable, y, as the susceptibility to outliers increases with a smaller sample size.

On the positive side, this study leverages several strengths, notably the attempt to address the parallel trends issue through the incorporation of within fixed effects. These incorporated fixed effects play a crucial role in accounting for differences in the dependent variable across each of the 62 cases, thereby offering a clearer understanding of how observed changes in the dependent variables can be attributed to the industry stock prices.

In addition, by capturing a broad time interval of stock price information, the study investigates the potential leakage of information about the outcomes of WTO disputes. The findings indicate no such phenomenon occurs, lending greater validity to the WTO's dispute resolution process. This extensive time coverage also allows for the identification of any specific days when industry stock prices are affected, revealing there does not exist any lagged effect in changes to industry stock prices following the usage of WTO policy.

Moreover, the addition of a Bayesian hierarchical model is crucial to addressing whether or not there exists hidden significant values. This additional insight helps to reinforce the findings of the event study model, and shows that there does not exist any hidden significant effects.

Looking ahead, my model has the potential for extension across various dimensions. Exploring the difference in daily stock price percent change at a finer level, such as by the minute or even second, could provide intriguing insights. Investigating specific companies most affected by WTO disputes and the nature of the goods they produce is also crucial for a comprehensive understanding. Furthermore, an extension could delve into how measurements beyond stock prices, such as revenue and profit, impact individual firms engaged in WTO cases.

The policy implications of this paper hold relevance for WTO policies. A feasible policy approach involves acknowledging suitable procedures to mitigate stock price volatility within the industries implicated in dispute settlements. The WTO should particularly highlight the potential impact of its rulings on specific businesses. By optimizing recommendations made by WTO judges that make an effort to reduce stock price volatility, adverse effects on local unemployment rates and company payrolls in countries listed as complainants or respondents to dispute settlement cases may be minimized (Chodorow-Reich et al., 2021).

BIBLIOGRAPHY

Aylward, A., & Glen, J. (2000). Some international evidence on stock prices as leading indicators of economic activity. *Applied Financial Economics*, 10(1), 1–14. https://doi.org/10.1080/096031000331879

Bagwell, K., Bown, C. P., & Staiger, R. W. (2016). Is the WTO Passe? *Journal of Economic Literature,* 54(4), 1125-1231. https://www.jstor.org/stable/26303159

Bagwell, K., & Staiger, R. W. (2004). Multilateral Trade Negotiations, Bilateral Opportunism and the Rules of GATT/WTO. *Journal of International Economics*, 63(1), 1-29. https://doi.org/10.1016/S0022-1996(03)00054-0

Bahri, A. (2016). Handling WTO disputes with the private sector: the triumphant Brazilian experience. *Journal of World Trade* 50(4), 641-674. http://eprints.lse.ac.uk/68276/

Benjamini, Y., & Yekutieli, D. (2001). The control of the false discovery rate in multiple testing under dependency. *The Annals of Statistics*, 1165-1188. https://www.jstor.org/stable/2674075

Bounds, A. (2023, December 14). EU to extend truce with US until after presidential election. *Financial Times*. https://www.ft.com/content/07c68a2f-3b22-4029-ac08-ac1e36edf2a2

Chamaria, N. (2018, September 9). Why United States Steel Stock Plunged 18.5% in August. *The Motley Fool*. https://www.fool.com/investing/2018/09/09/why-united-states-steel-corporation-shares-crashed.aspx

Chaudoin, S., Kucik, J., & Pelc, K. (2016). Do WTO Disputes Actually Increase Trade? *International Studies Quarterly* 60(2), 294-306. https:// www.jstor.org/stable/43869073

Chen, S., & Jeong, J. (2020). *The Effects of the US-China Trade Dispute on the Asymmetric Volatility in the Stock Market: An Investigation of EGARCH Model Analysis*. 2020 2nd International Conference on Economic Management and Model Engineering (ICEMME), Chongqing, China, 343-351. doi: 10.1109/ICEMME51517.2020.00073

Chen, Y., & Pantelous, A. A. (2022). The U.S.-China trade conflict impacts on the Chinese and U.S. stock markets: a network-based approach. *Finance Research Letters*, 46(Part B), [102486]. https://doi.org/10.1016/j.frl.2021.102486

Chib, S., & Greenberg, E. (2008). Hierarchical Bayes Models. *The New Palgrave Dictionary of Economics*, 1-9. Palgrave Macmillan. doi: 10.1057/978-1-349-95121-5_2230-1

Chodorow-Reich, G., Nenov, P. T., & Simsek, A. (2021). Stock Market Wealth and the Real Economy: A Local Labor Market Approach. *American Economic Review*, 111 (5), 1613-57. doi: 10.1257/aer.20200208

Fama, E. F. (1965). The Behavior of Stock-Market Prices. *The Journal of Business*, 38(1), 34–105. http://www.jstor.org/stable/2350752

Goldstein, J., & Steinberg, R. H. (2008). Negotiate or Litigate? Effects of WTO Judicial Delegation on U.S. Trade Politics. *Law and Contemporary Problems*, 71(1), 257-282. https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1459&context=lcp

GOV.UK. (2021, April 26). *Countries defined as developing by the OECD* https://www.gov.uk/government/publications/countries-defined-as-developing-by-the-oecd

Hart, N. M., & Murrill, B. J. Congressional Research Service. (2121, July 22). *The World Trade Organization's (WTO's) Appellate Body: Key Disputes and Controversies*, R46852. https://crsreports.congress.gov/product/pdf/R/R46852

Investing.com (n.d.). https://www.investing.com

Jammalamadaka, S. R., Qiu, J., & Ning, N. (2019). Predicting a Stock Portfolio with the Multivariate Bayesian Structural Time Series Model: Do News or Emotions Matter? *International journal of artificial intelligence, 17*, 81-104. https://www.semanticscholar.org/paper/Predicting-a-Stock-Portfolio-with-the-Multivariate-Jammalamadaka-Qiu/000f3f80dfd3ccbf699fccbd451e11720e31ba60

Jensen, N. M. (2006). International Institutions and Market Expectations: Stock Price Responses to the WTO Ruling on the 2002 U.S. Steel Tariffs. *SSRN Electronic Journal*. https://ssrn.com/abstract=869491 or http://dx.doi.org/10.2139/ssrn.869491

Lichtenbaum, P. (1998). Procedural Issues in WTO Dispute Resolutions. *Michigan Journal of International Law*, 19(4), 1195-1274. https://repository.law.umich.edu/mjil/vol19/iss4/6

MarketWatch. (n.d.). https://www.marketwatch.com/

Markusen, J. R., Melvin, J. R., Maskus, K. E., & Kaempfer, W. H. (1994). International Trade: Theory and Evidence. New York: McGraw-Hill/Irwin.

Miller, D. L. (2023). An Introductory Guide to Event Study Models. *Journal of Economic Perspectives*, 37(2), 203-230. doi: 10.1257/jep.37.2.203

Office of the United States Trade Representative. (2018, December 17). *Statement of the United States by Ambassador Dennis Shea at the 14th WTO Trade Policy Review of the United States of America*. https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/december/statement-united-states-ambassador

Schneider-Petsinger, M. (2020). Reforming the World Trade Organization: Prospects for transatlantic cooperation and the global trade system. *Chatham House*. https://www.chathamhouse.org/sites/default/files/publications/research/2020-09-11-reforming-wto-schneider-petsinger.pdf

Steinberg, R. (2009, February 23). Future of the WTO. *Chicago Law School Faculty Blog*. http://uchicagolaw.typepad.com/faculty/2009/02/future-of-the-wto.html

Weinberger, J. & Van Kerckhoven, S. (2022). The EU's Trade Dispute Settlement Mechanism: An Alternative to the WTO DSU? (October 20, 2022). *SSRN Electronic Journal*. https://ssrn.com/abstract=4253946 or http://dx.doi.org/10.2139/ssrn.4253946

WTO. (2018, July 16). *China's trade-disruptive economic model: Communication from the United States*. General Council, WT/GC/W/745. https://docs.wto.org/dol2fe/Pages/FE_Search/FE_S_S009-Html.aspx?Id=246786&BoxNumber=3&DocumentPartNumber=1&Language=E&HasEnglishRecord=True&HasFrenchRecord=True&HasSpanishRecord=True&Window=L&PreviewContext=DP&FullTextHash=371857150

WTO. (2022, January 1).*Dispute settlement - DS548: United States – certain measures on steel and aluminium products*. https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds548_e.htm

WTO. (2023). *Dispute settlement activity– some figures*. https://www.wto.org/english/tratop_e/dispu_e/dispustats_e.htm

WTO. (2024) *Current status of disputes*. https://www.wto.org/english/tratop_e/dispu_e/dispu_current_status_e.htm

WTO. (n.d.) *The panel process*. https://www.wto.org/english/thewto_e/whatis_e/tif_e/disp2_e.htm

Yahoo! Finance (n.d.). https://finance.yahoo.com/

APPENDIX A

SENSITIVITY ANALYSIS FIGURES

I assign parameters $(\alpha, \beta) = (5, 2)$ for the Beta distributions corresponding to $\breve{\rho}_{daily}$ and ρ_{error}. I expect that adjacent days would have a positive correlation to stock price, i.e., the serial correlation for the difference in price percentage change will be positive. I parameterize the prior distributions of the variances by choosing a mean of 5 and a standard deviation of 4 to determine the parameters (a, b). This is denoted by A in the table below. The other prior choices represent my sensitivity analysis. I graph distributions of these prior choices across all six key policy days for $\breve{\rho}_{daily}$, ρ_{error}, $\breve{\sigma}^2_{daily}$, and σ^2_{error}.

Table A.1. Details of prior specifications for sensitivity analysis

Prior Choice	$\rho \sim 2 \cdot \text{Beta}(\alpha, \beta) - 1$	$\sigma^2 \sim \text{Gamma}(a, b)$
A	$(\alpha, \beta) = (5, 2)$	$\text{E}(\sigma^2) = 5,\ \text{SD}(\sigma^2) = 4$
B	$(\alpha, \beta) = (1, 1)$	$\text{E}(\sigma^2) = 1,\ \text{SD}(\sigma^2) = 1$
C	$(\alpha, \beta) = (2, 1)$	$\text{E}(\sigma^2) = 2,\ \text{SD}(\sigma^2) = 1$
D	$(\alpha, \beta) = (2.5, 2)$	$\text{E}(\sigma^2) = 5,\ \text{SD}(\sigma^2) = 2$
E	$(\alpha, \beta) = (5, 4)$	$\text{E}(\sigma^2) = 7,\ \text{SD}(\sigma^2) = 4$

I use the rectangular distribution (1, 1), for ρ as it is a uniform distribution and thus non-informative. I use the triangular distribution (2, 1) for ρ, as it is the simplest distribution that places more mass on the positive correlations. I use distributions (2.5, 2) and (5, 4) for ρ, as they result from similar intuition from how the original (5, 2) distribution was chosen, but the (2.5, 2) distribution is more weakly informative and the (5, 4) distribution is more strongly informative.

I consider a variety of priors for σ^2, some of which are more strongly informed than others, which assign a variety of a priori expectations for σ^2.

For a majority of the key policy days, it is seen that the correlation (ρ) and variance (σ^2) of μ are robust to moderate changes in the prior specification. Moreover, these variables are volatile to large changes in the prior specification. However, when the panel was established and when the panel report was circulated, the posterior distribution of the variance and correlation with respect to μ are volatile to any changes in the prior specification. This indicates that the data carried little information about μ.

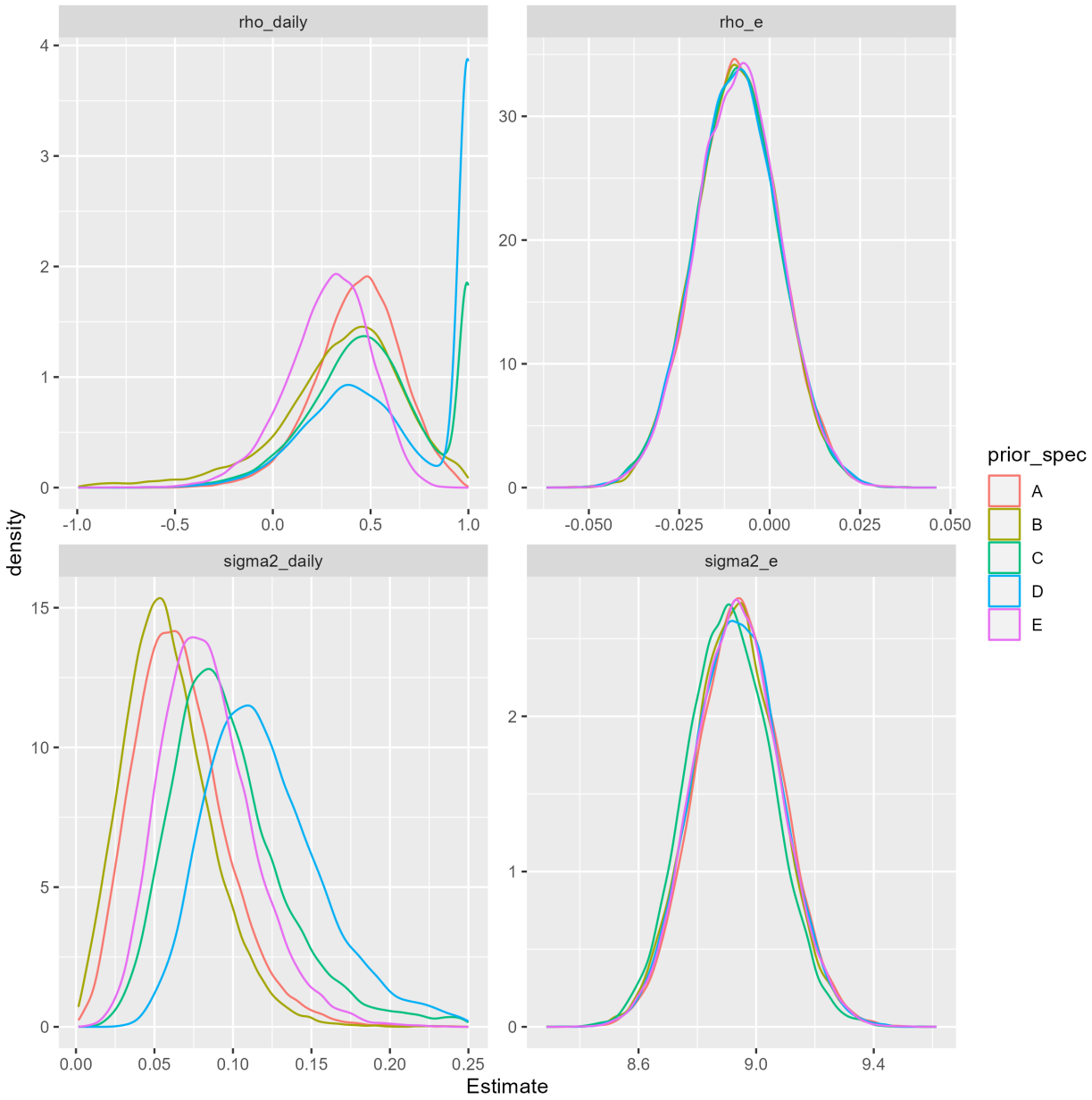

Figure A.1. Effect of prior choice on posterior distributions for the serial correlation, ρ and variance, σ^2, of daily means and error terms for difference in percent price change surrounding the days when consultation was requested.

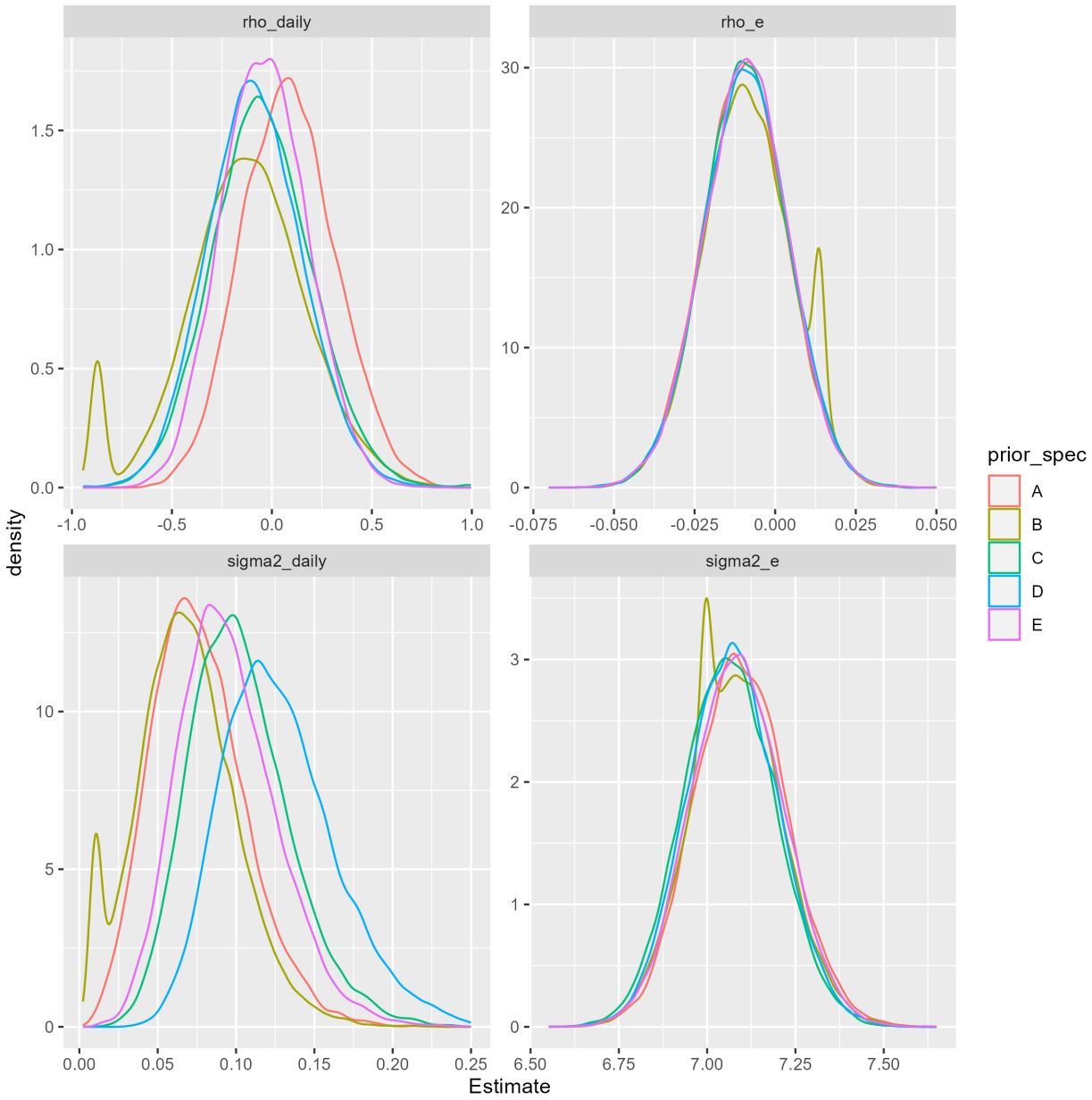

Figure A.2. Effect of prior choice on posterior distributions for the serial correlation, ρ and variance, σ^2, of daily means and error terms for difference in percent price change surrounding the days when the panel was requested.

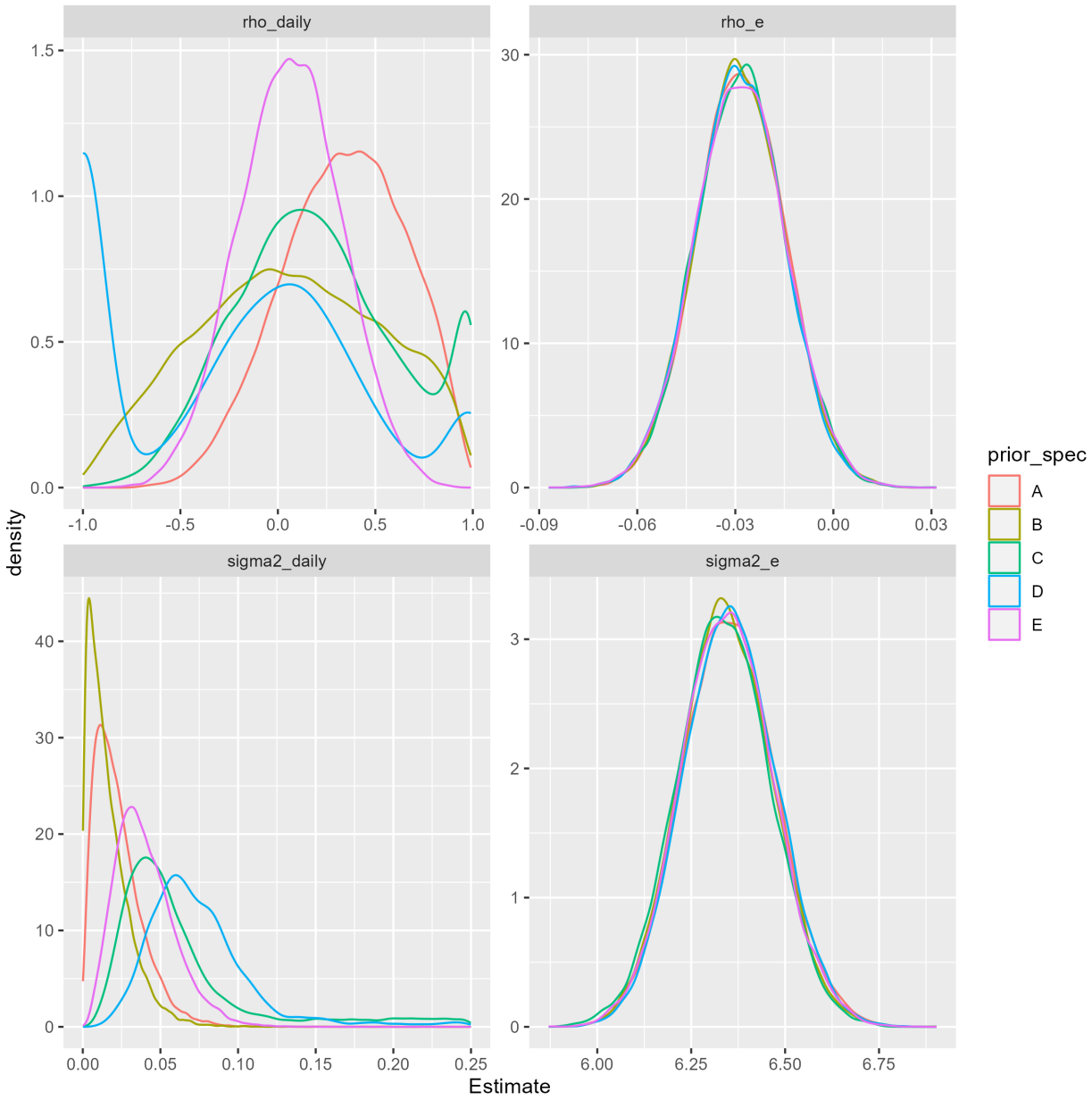

Figure A.3. Effect of prior choice on posterior distributions for the serial correlation, ρ and variance, σ^2, of daily means and error terms for difference in percent price change surrounding the days when the panel was established.

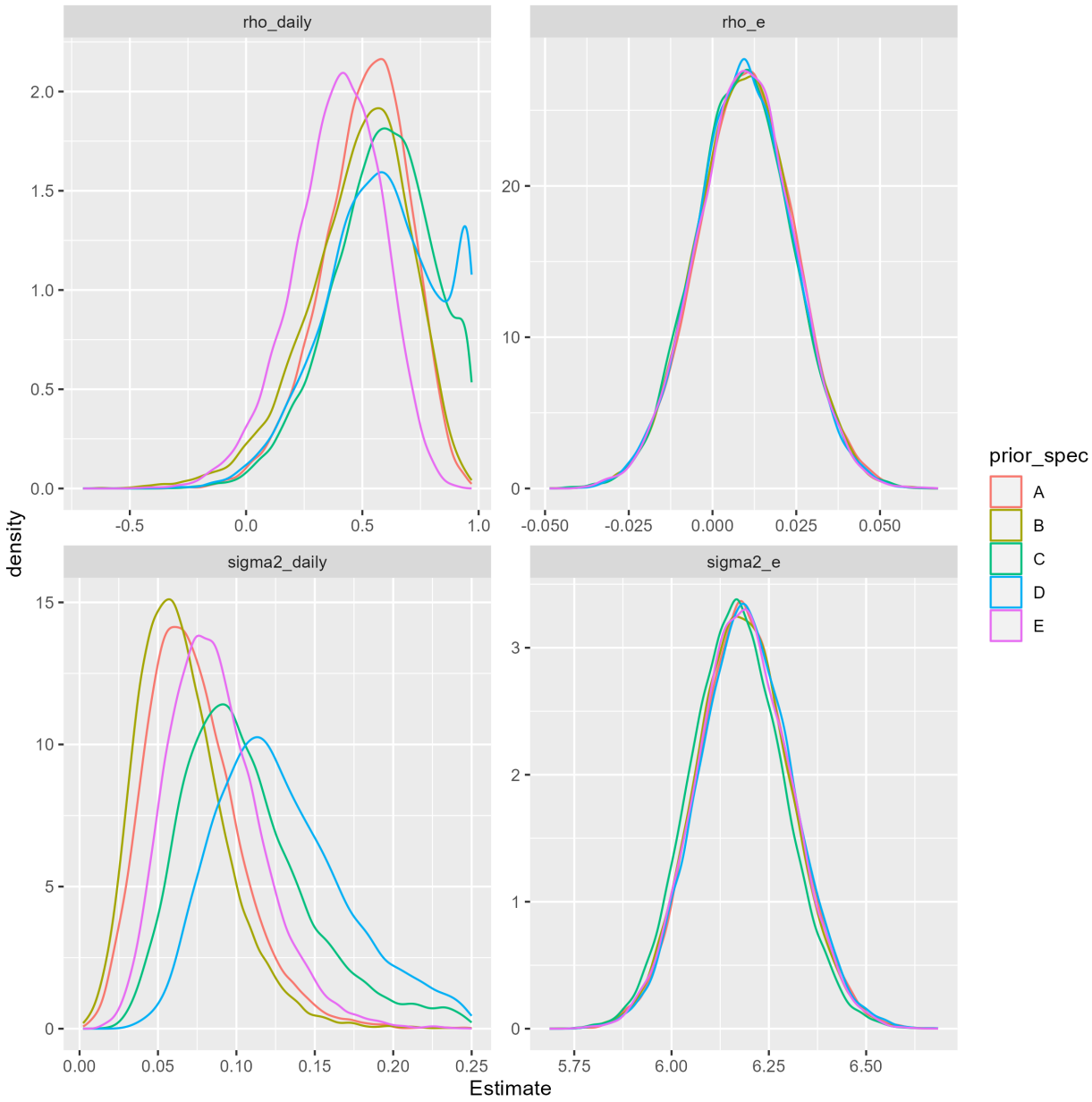

Figure A.4. Effect of prior choice on posterior distributions for the serial correlation, ρ and variance, σ^2, of daily means and error terms for difference in percent price change surrounding the days when the panel was composed.

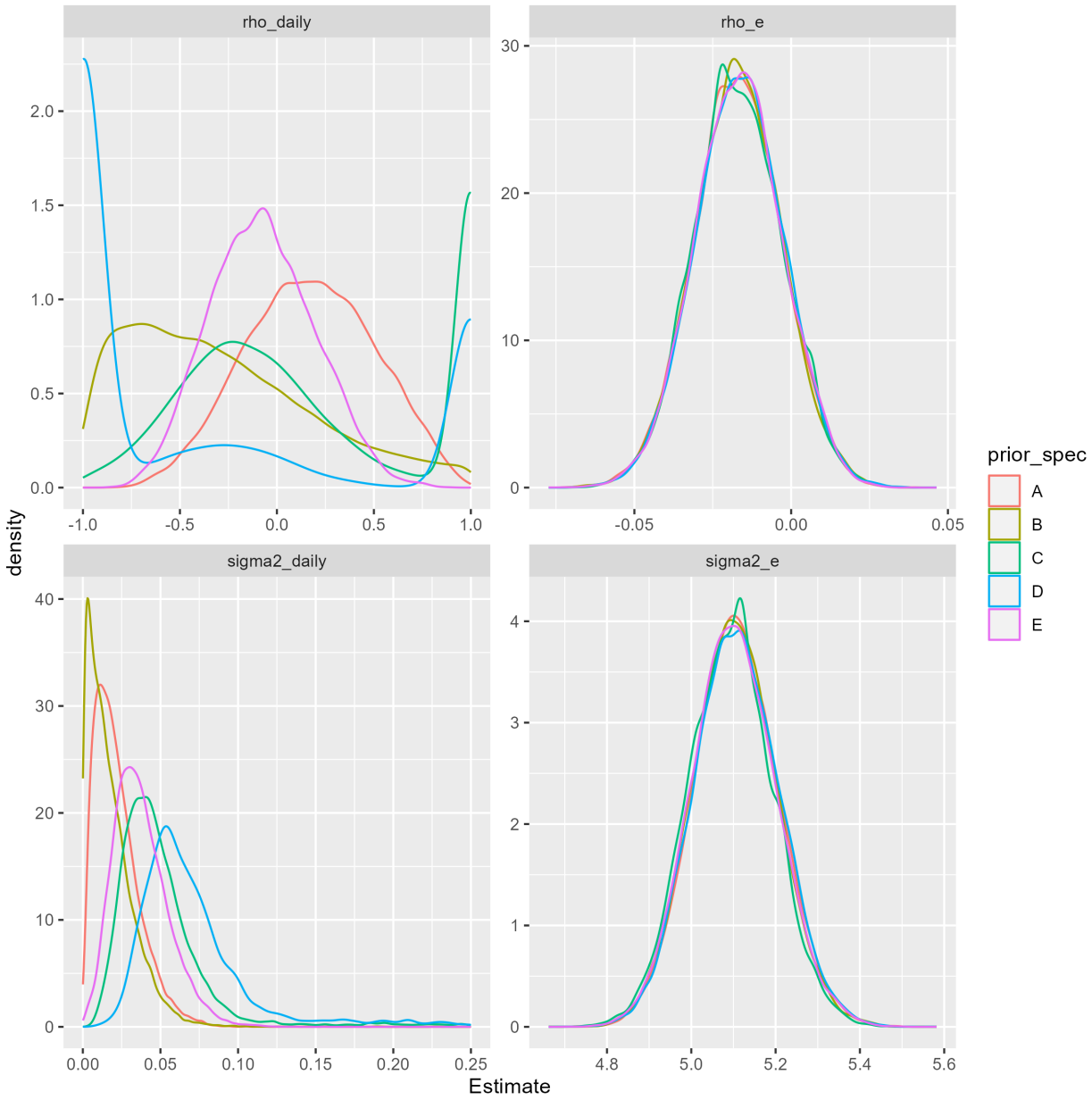

Figure A.5. Effect of prior choice on posterior distributions for the serial correlation, ρ and variance, σ^2, of daily means and error terms for difference in percent price change surrounding the days when the panel report was circulated.

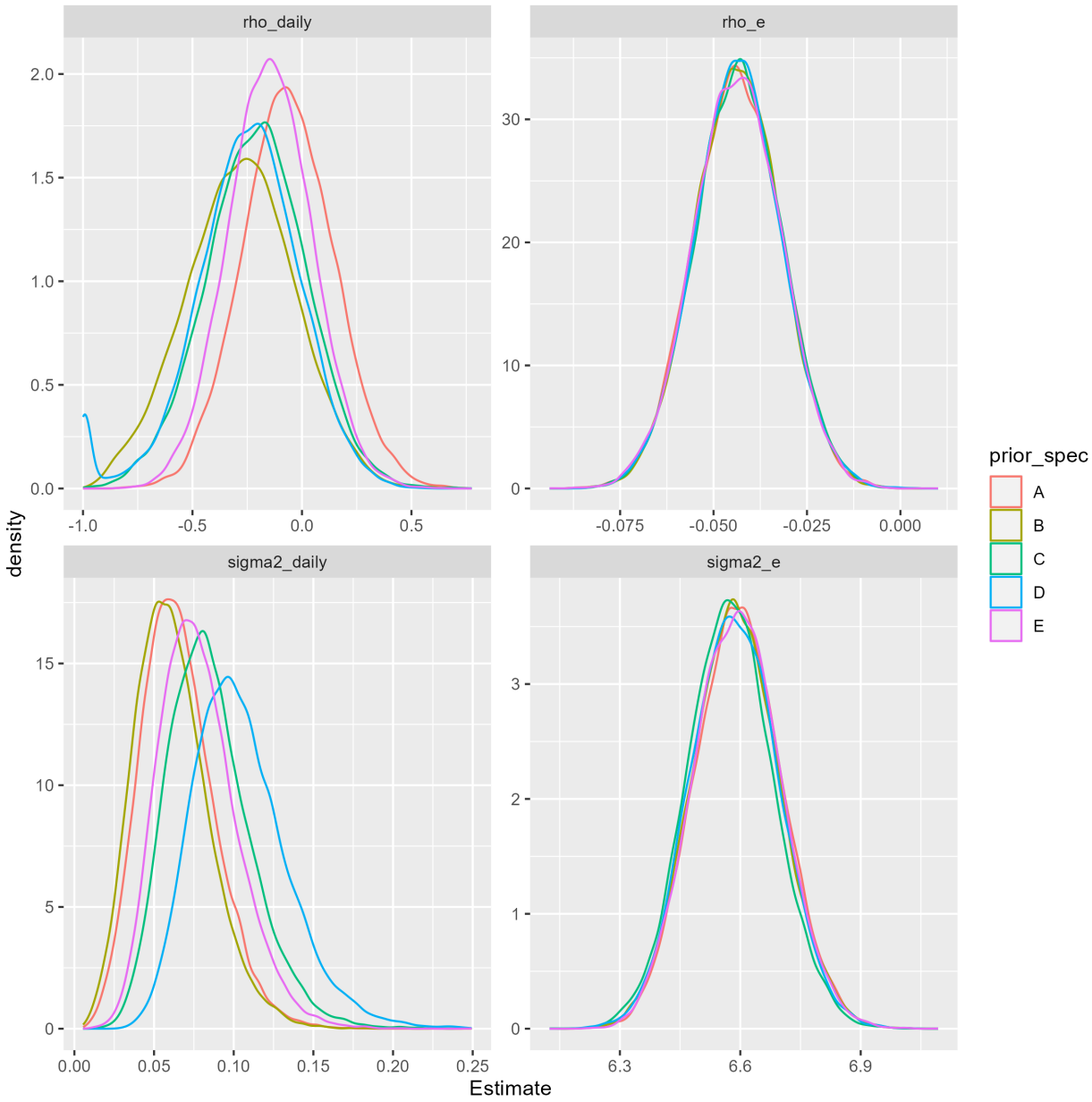

Figure A.6. Effect of prior choice on posterior distributions for the serial correlation, ρ and variance, σ^2, of daily means and error terms for difference in percent price change surrounding the days when implementation occurred.

APPENDIX B

DISTRIBUTION GRAPHS

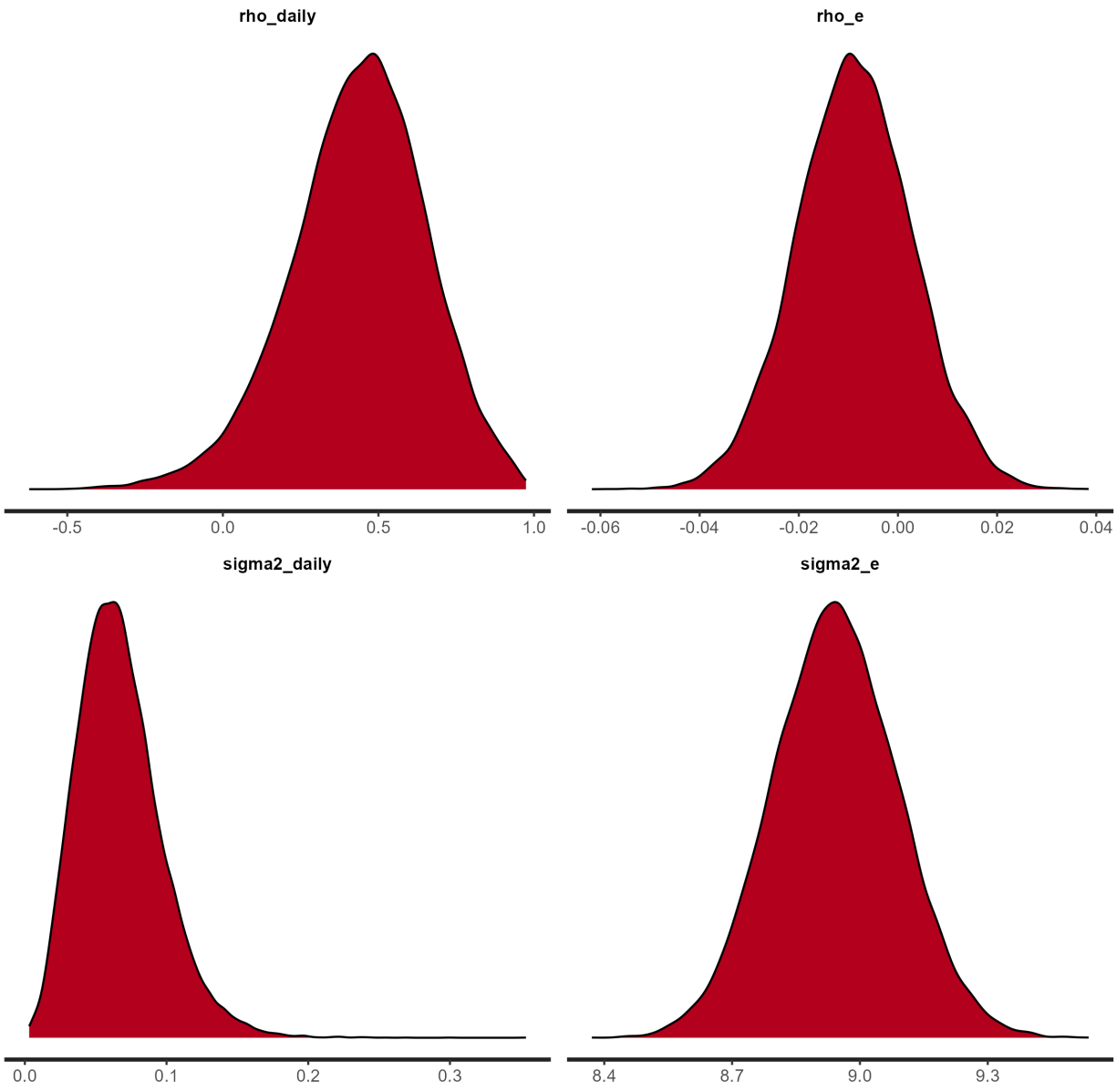

Figure B.1. Distribution plot for ρ and σ^2 for the 30 days before and after consultation was requested.

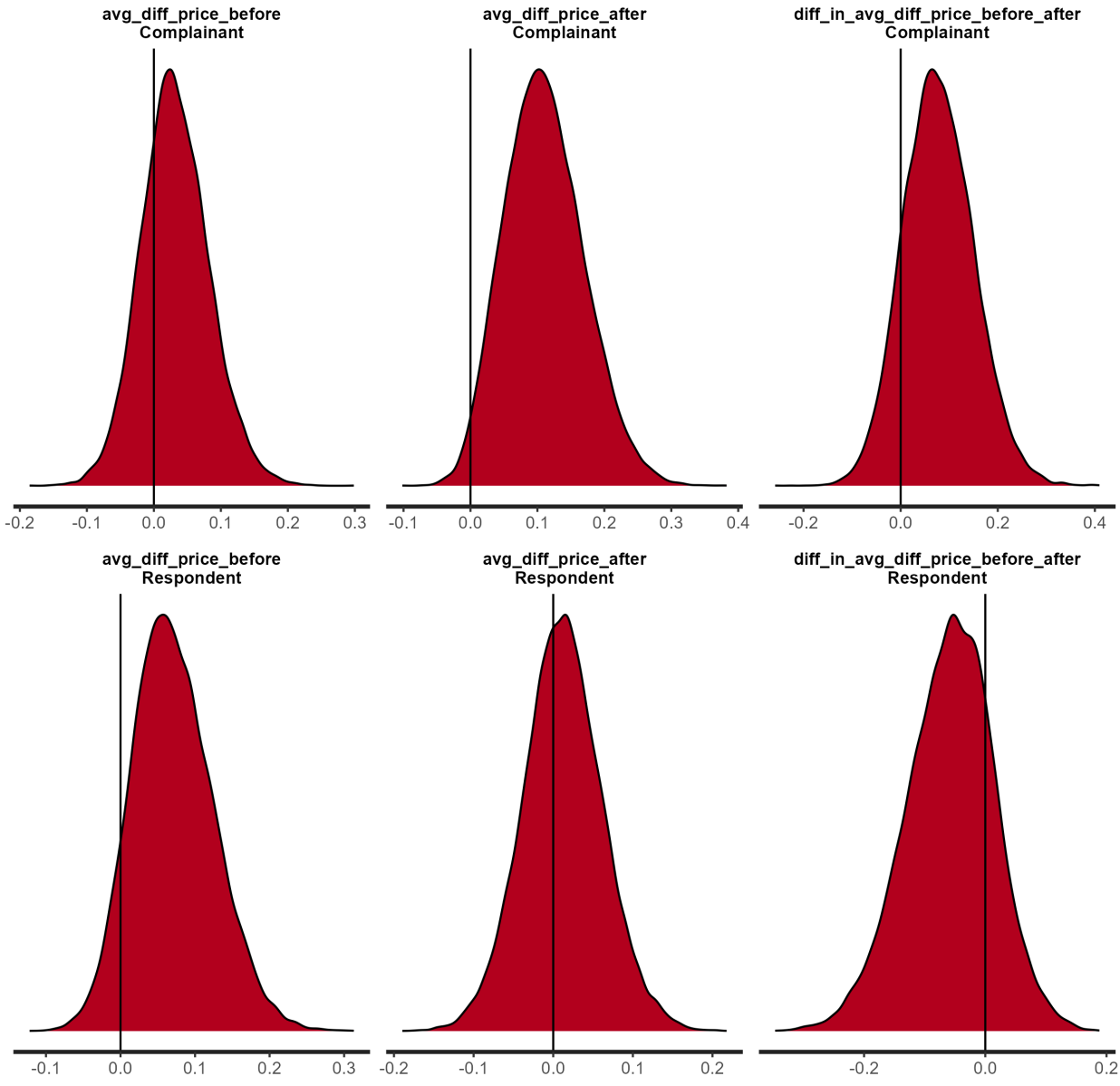

Figure B.2. Distribution plot for the mean of μ 30 days before consultation was requested, 30 days after consultation was requested, and the difference between these two time periods for complainant and respondent groups.

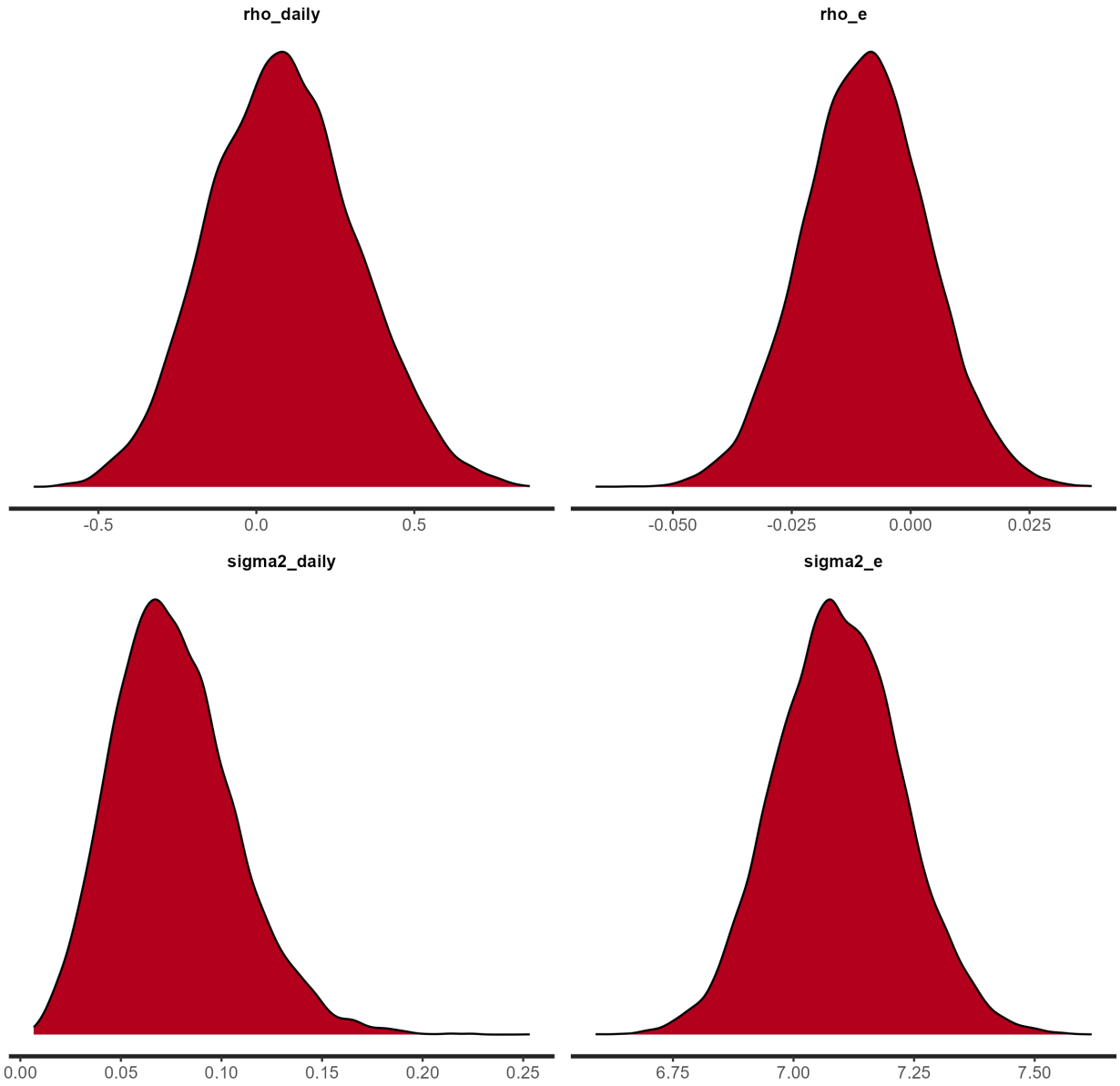

Figure B.3. Distribution plot for ρ and σ^2 for the 30 days before and after the panel was requested.

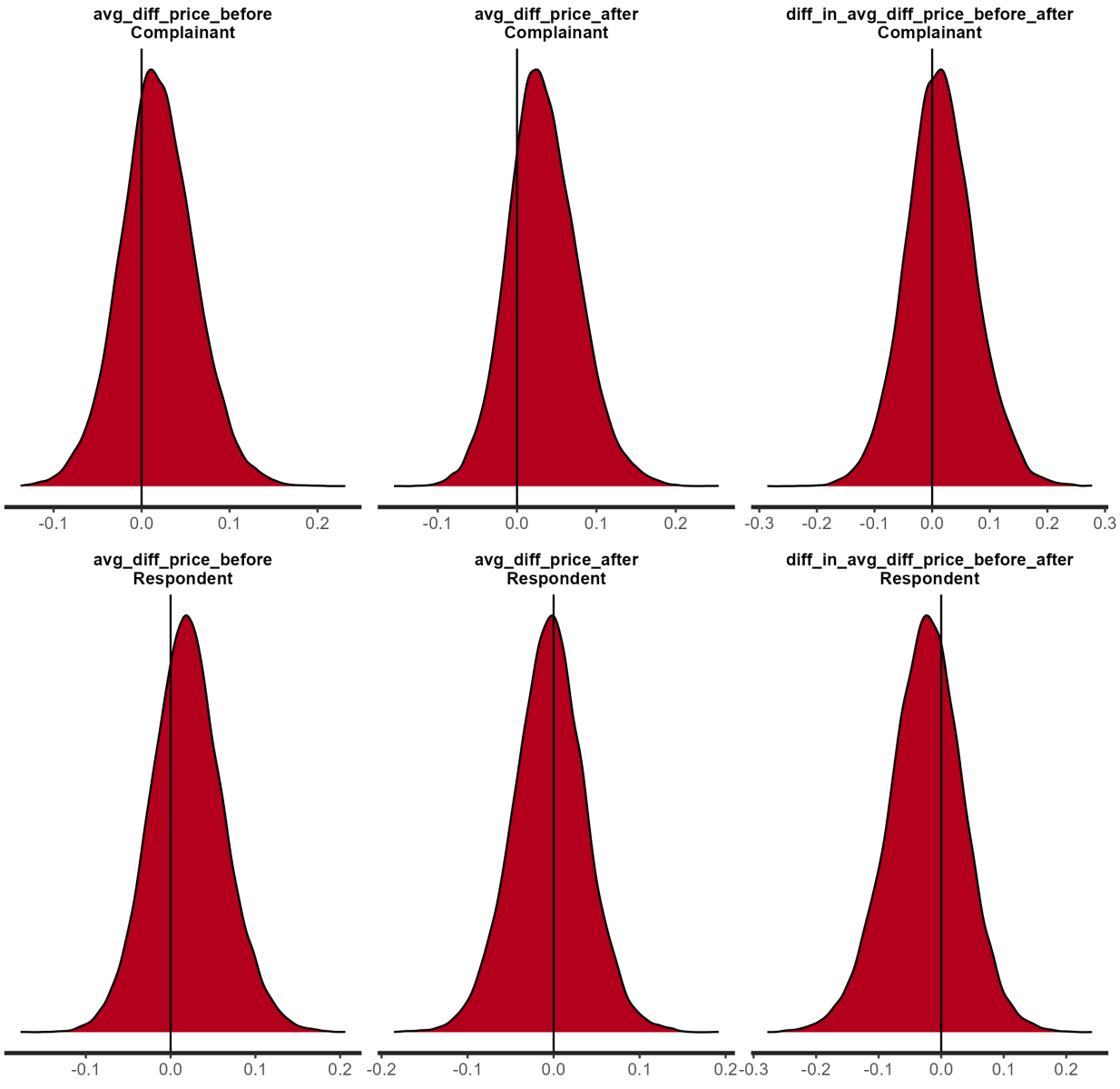

Figure B.4. Distribution plot for the mean of μ 30 days before the panel was requested, 30 days after the panel was requested, and the difference between these two time periods for complainant and respondent groups.

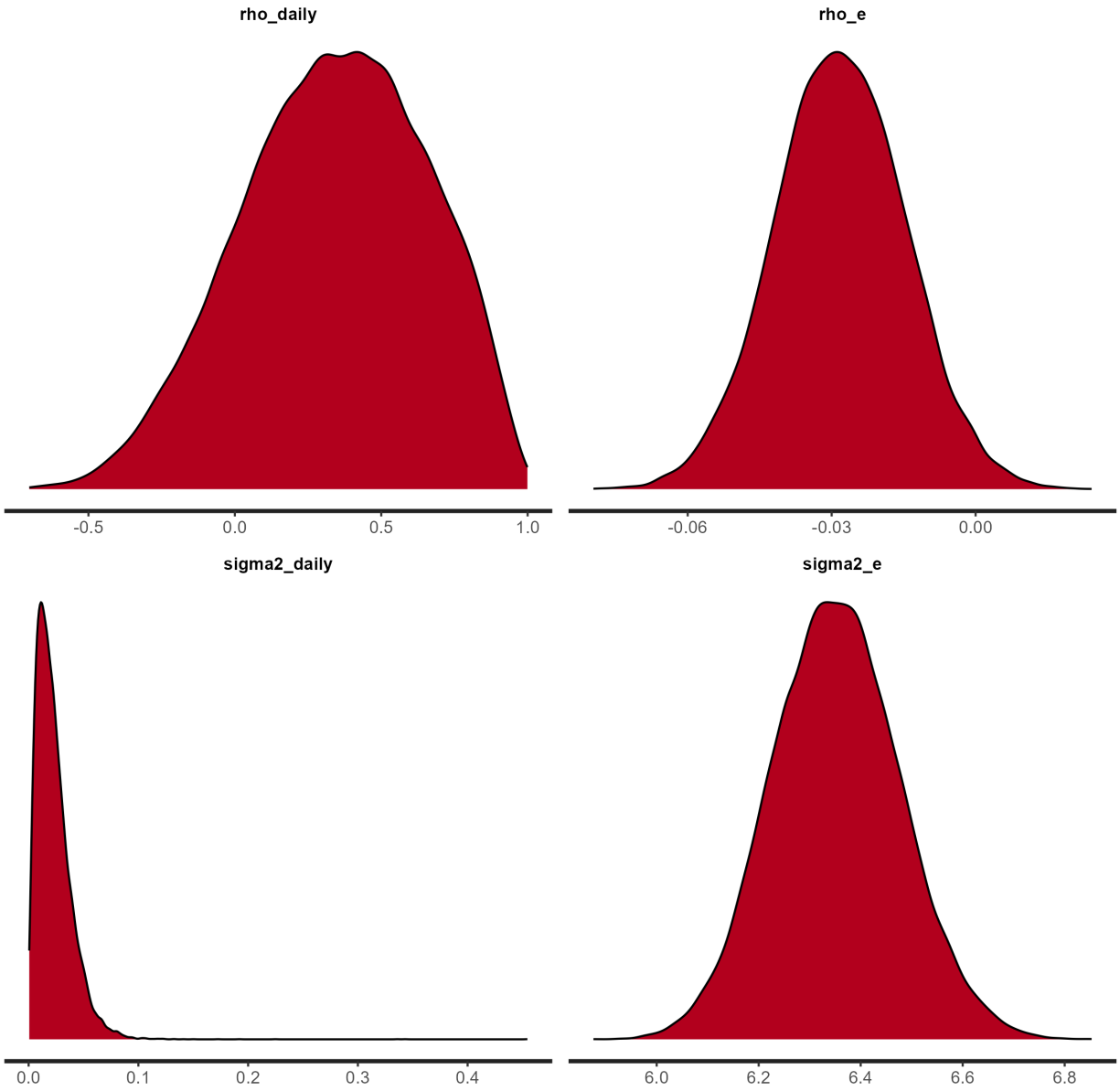

Figure B.5. Distribution plot for ρ and σ^2 for the 30 days before and after the panel was established.

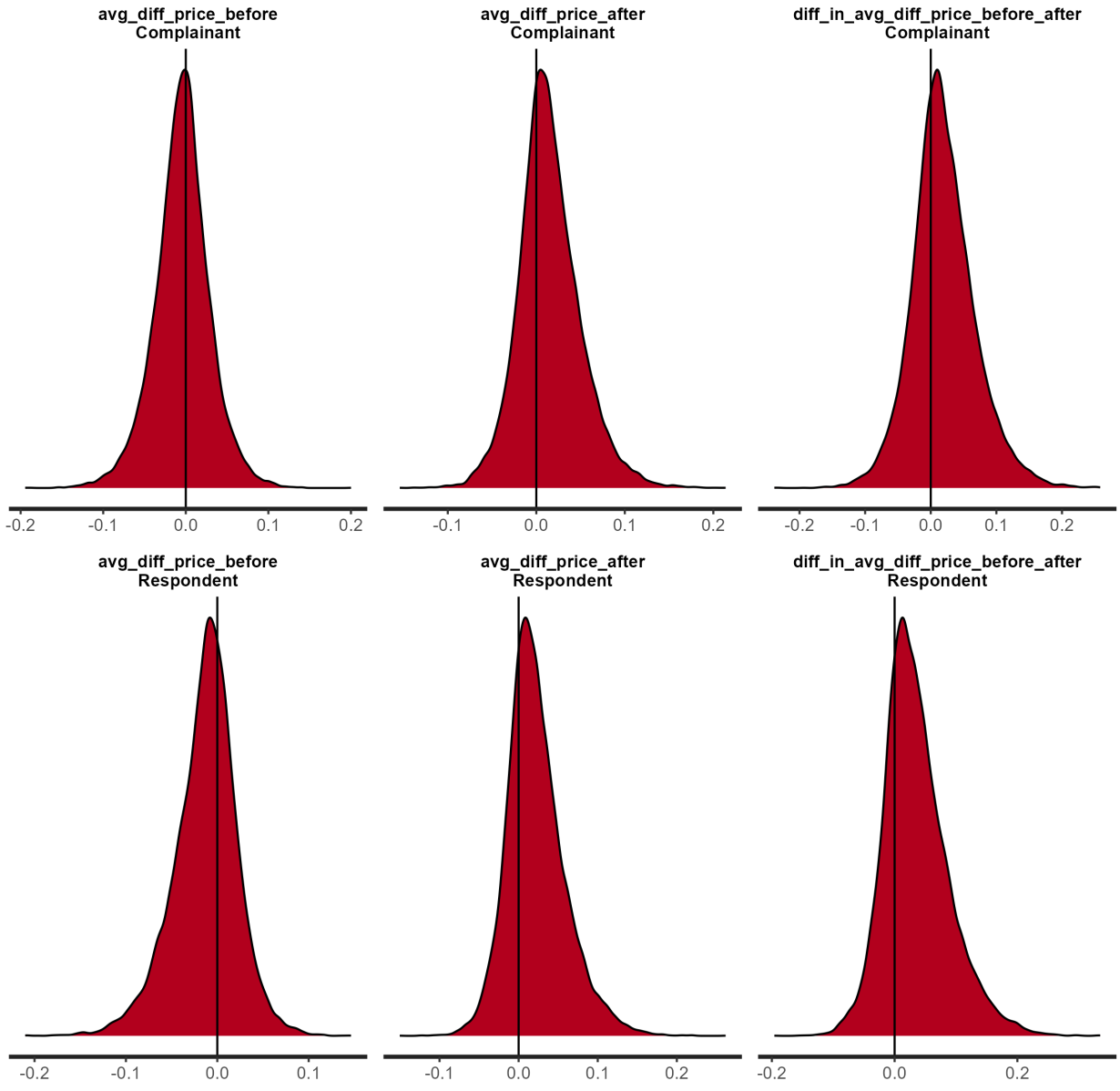

Figure B.6. Distribution plot for the mean of μ 30 days before the panel was established, 30 days after the panel was established, and the difference between these two time periods for complainant and respondent groups.

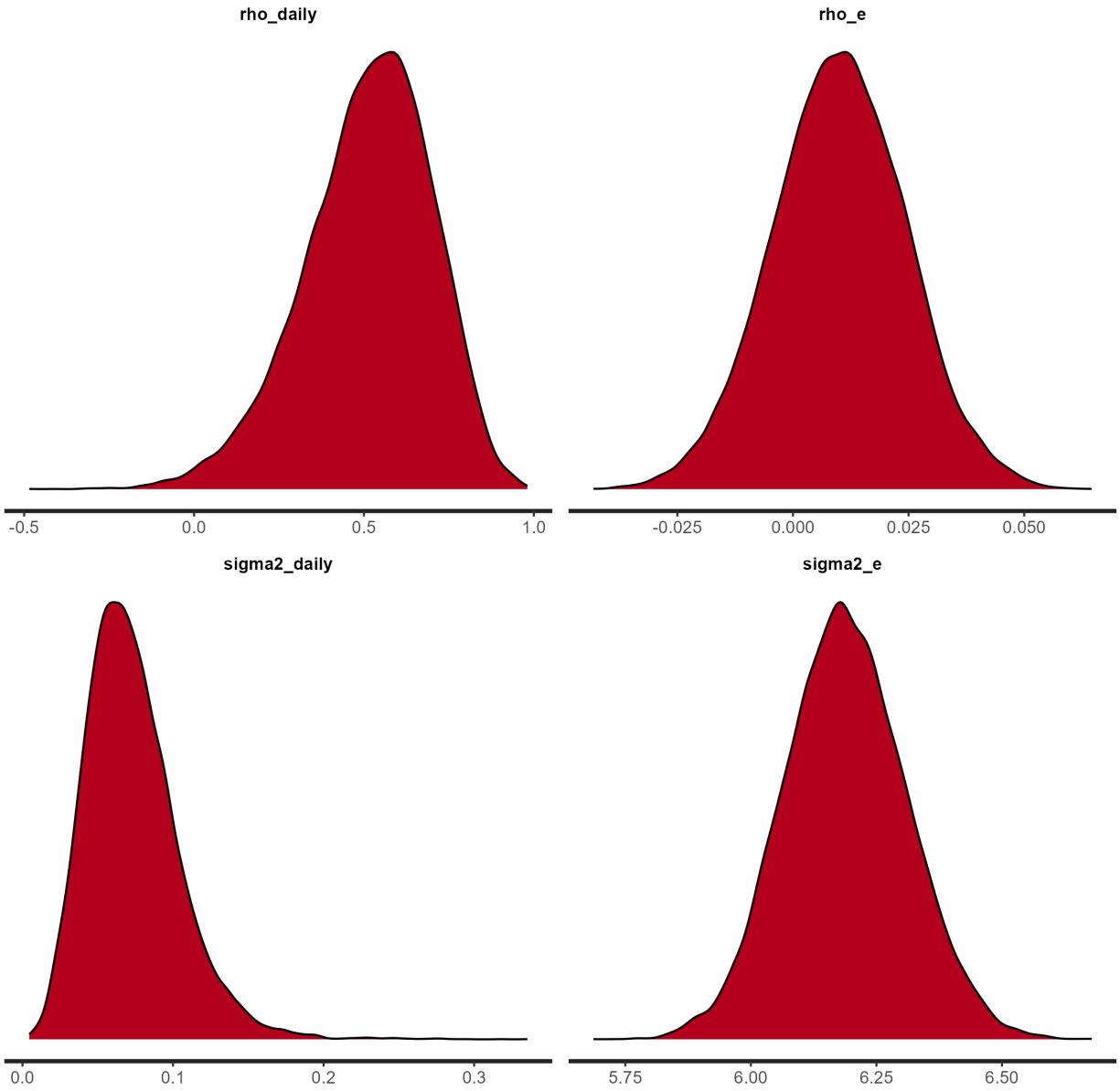

Figure B.7. Distribution plot for ρ and σ^2 for the 30 days before and after the panel was composed.

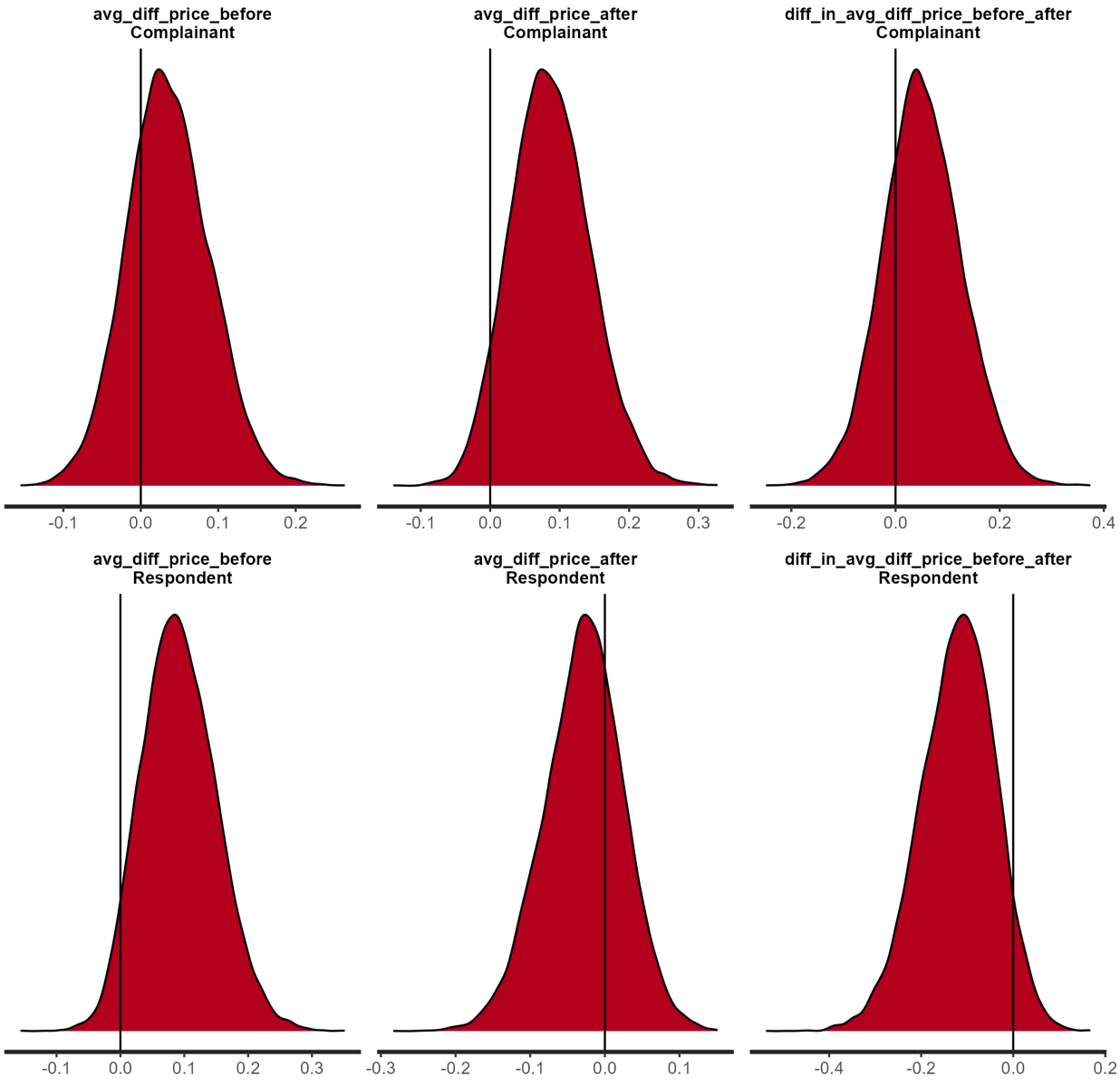

Figure B.8. Distribution plot for the mean of μ 30 days before the panel was composed, 30 days after the panel was composed, and the difference between these two time periods for complainant and respondent groups.

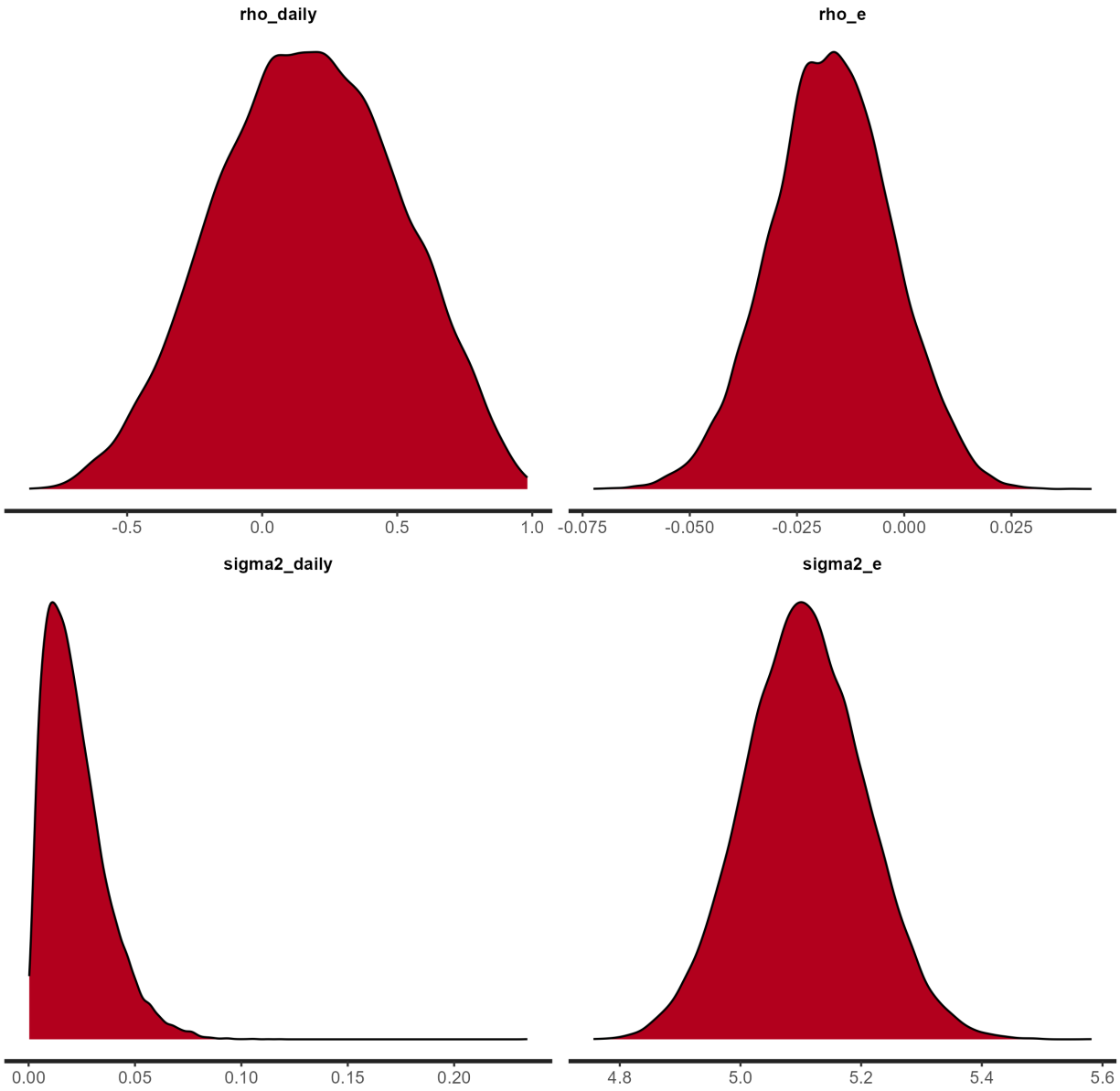

Figure B.9. Distribution plot for ρ and σ^2 for the 30 days before and after the panel report was circulated.

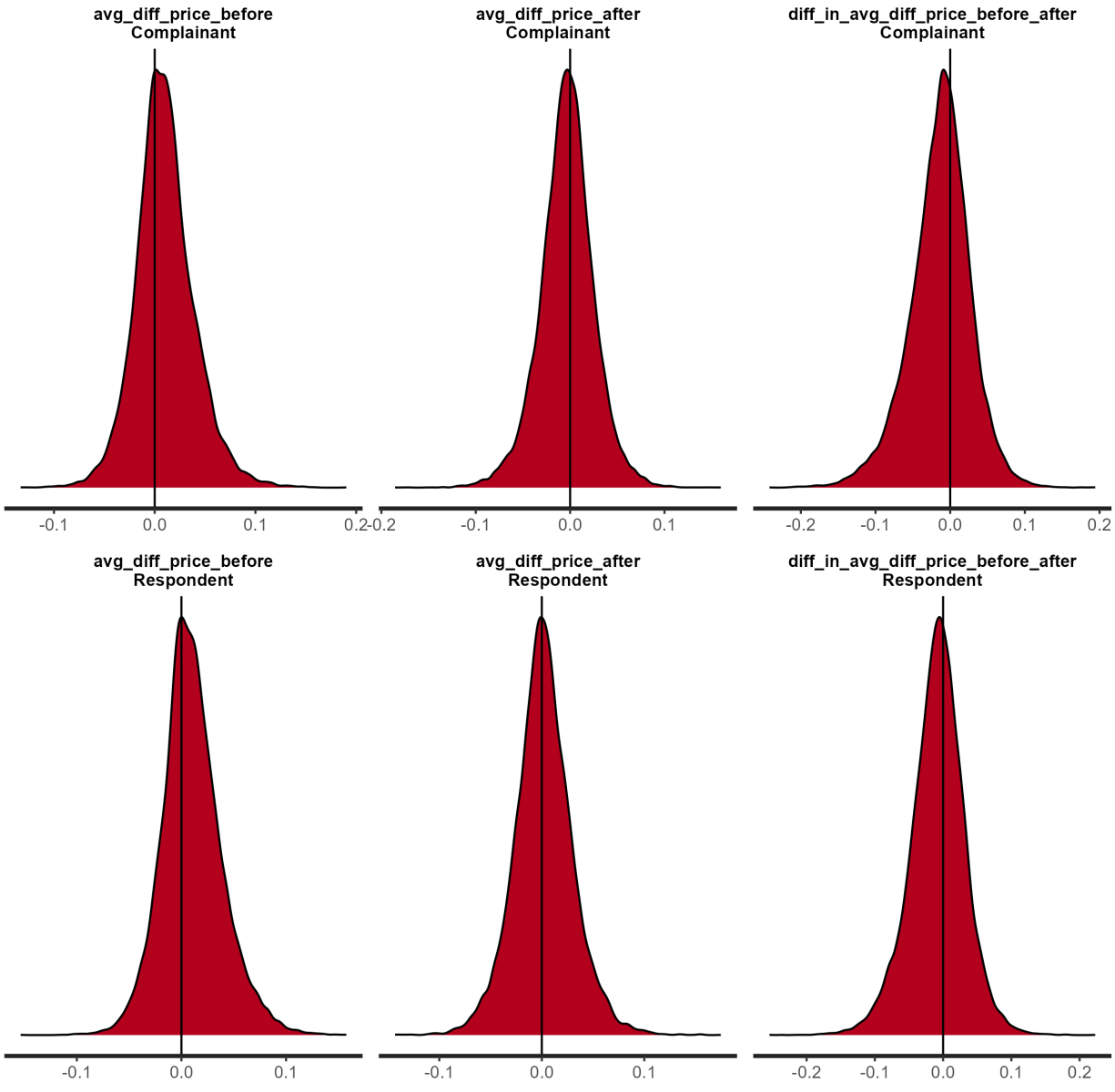

Figure B.10. Distribution plot for the mean of μ 30 days before the panel report was circulated, 30 days after the panel report was circulated, and the difference between these two time periods for complainant and respondent groups.

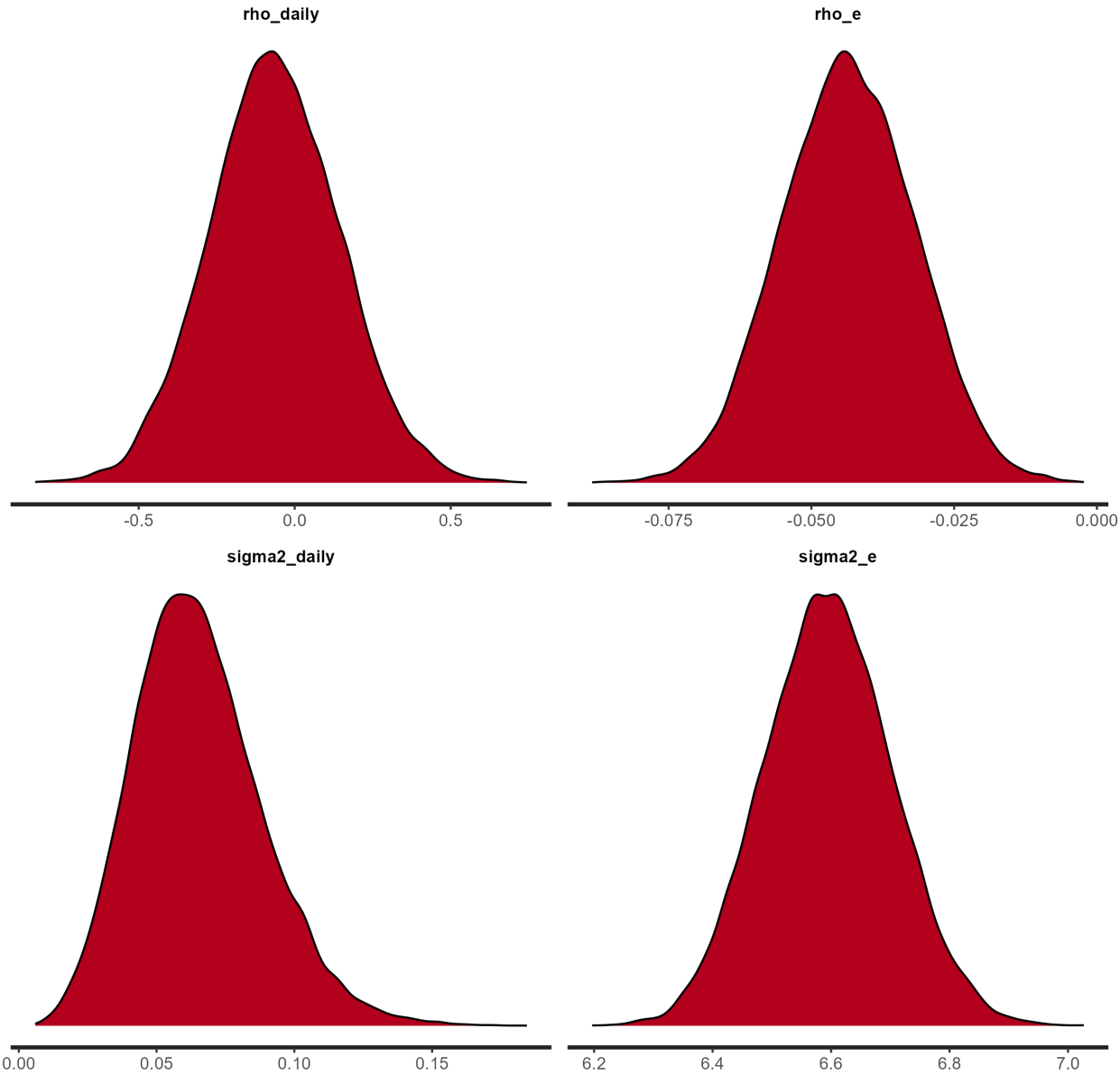

Figure B.11. Distribution plot for ρ and σ^2 for the 30 days before and after implementation occurred.

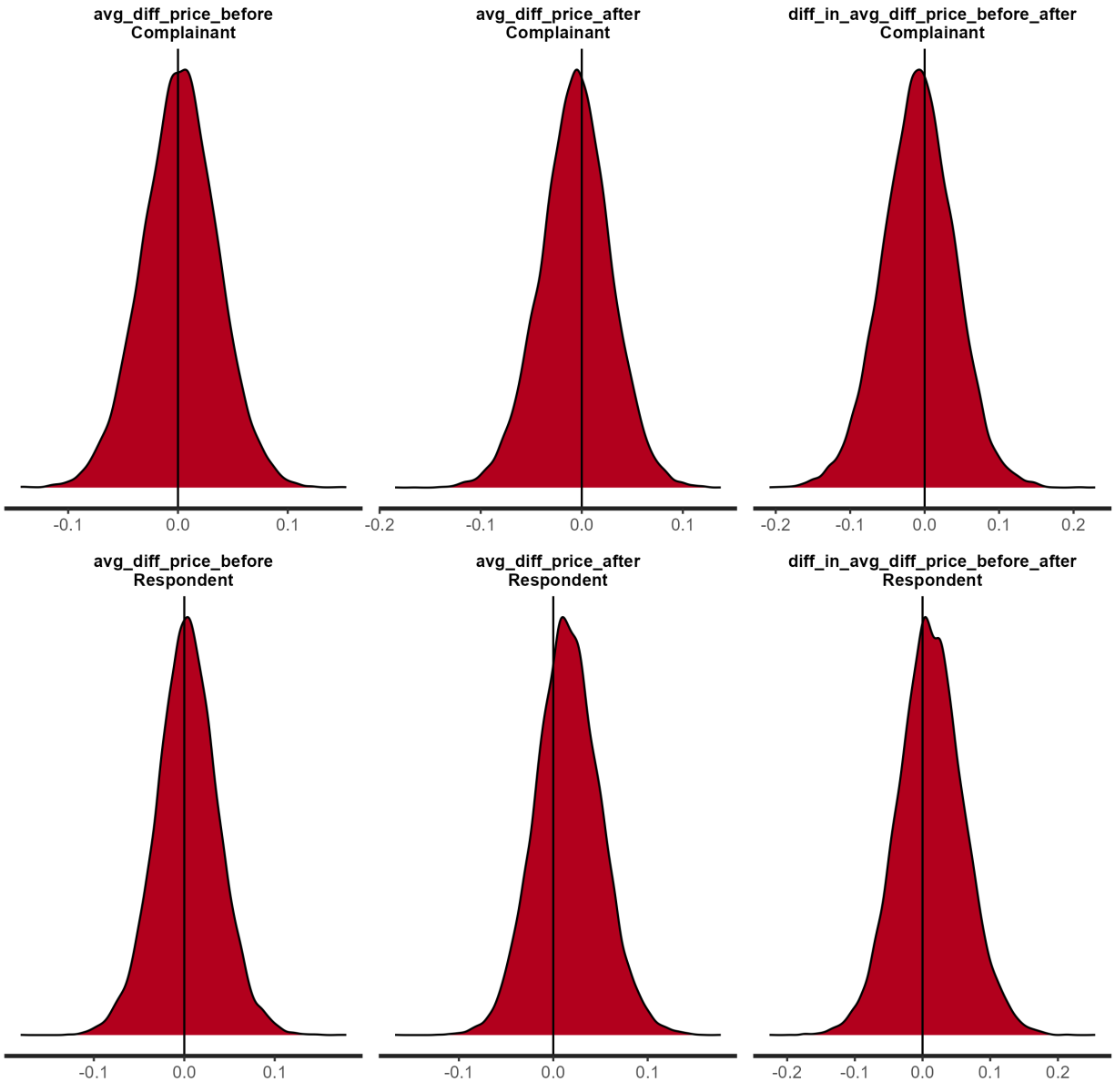

Figure B.12. Distribution plot for the mean of μ 30 days before implementation occurred, 30 days after implementation occurred, and the difference between these two time periods for complainant and respondent groups.

APPENDIX C

DATA SET INFORMATION

Table C.1. Mutually agreed solution cases

Case count	Case ID	Country	Role	Industry stock	Index stock	Total policy days count
1	DS548	U.S.	respondent	KALU	SPX	6
	DS548	EU	complainant	JCQ.PA	EU50	6
2	DS551	U.S.	respondent	AA	SPX	6
	DS551	Mexico	complainant	SIMECB.MX	MXX	6
3	DS550	U.S.	respondent	AA	SPX	6
	DS550	Canada	complainant	RUS.TO	GSPTSE	6
4	DS537	Canada	respondent	ADW-B	GSPTSE	6
	DS537	Australia	complainant	TWE	AXJO	6
5	DS492	EU	respondent	LOUP.PA	EU50	6
	DS492	China	complainant	300498.SZ	000001.SS	6
6	DS481	Indonesia	respondent	GGRM.JK	JKSE	2
	DS481	EU	complainant	BTI	EU50	2
7	DS391	Korea	respondent	KR XKRX	KS11	6
	DS391	Canada	complainant	MFI.TO	GSPTSE	6
8	DS382	U.S.	respondent	PEP	SPX	6
	DS382	Brazil	complainant	LOUP.PA	BVSP	6
9	DS378	China	respondent	0309.HK	000001.SS	2
	DS378	Canada	complainant	TRI.TO	GSPTSE	2
10	DS374	Indonesia	respondent	SAP	SA40	2
	DS374	South Africa	complainant	INKP	JKSE	2
11	DS373	China	respondent	0309.HK	000001.SS	2
	DS373	U.S.	complainant	WBD	SPX	2
12	DS372	China	respondent	0309.HK	000001.SS	2
	DS372	EU	complainant	PUB.PA	EU50	2
13	DS369	EU	respondent	PVA.MC	EU50	4
	DS369	Canada	complainant	HLF.TO	GSPTSE	4
14	DS354	Canada	respondent	TPX	GSPTSE	2
	DS354	EU	complainant	HEIA	EU50	2
15	DS344	U.S.	respondent	CENX	SPX	6
	DS344	Mexico	complainant	SIMECB	MXX	6
16	DS326	EU	respondent	PVA.MC	EU50	2
	DS326	Chile	complainant	DUNCANFOX	IGPA.SN	2
17	DS323	Korea	respondent	006040.KS	KS11	6
	DS323	Japan	complainant	1332.T	N225	6
18	DS313	EU	respondent	MT	EU50	2
	DS313	India	complainant	JSWSTEEL.NS	BSESN	2
19	DS311	U.S.	respondent	UFPI	SPX	2
	DS311	Canada	complainant	CFP.TO	GSPTSE	2
20	DS309	China	respondent	600345.SS	000001.SS	2
	DS309	U.S.	complainant	IBM	SPX	2
21	DS305	Egypt	respondent	Kabo	EGX 30	2
	DS305	U.S.	complainant	NKE	SPX	2
22	DS293	EU	respondent	GMAB.CO	EU50	6
	DS293	Argentina	complainant	ROSE.BA	MERV	6
23	DS292	EU	respondent	GMAB.CO	EU50	6
	DS292	Canada	complainant	TH.TO	GSPTSE	6
24	DS287	Australia	respondent	AAC.AX	AXJO	3
	DS287	EU	complainant	FARM	EU50	3
25	DS281	U.S.	respondent	VMC	SPX	3
	DS281	Mexico	complainant	CX	MXX	3
26	DS255	Peru	respondent	CASAGRC1	SPBLPGPT	3
	DS255	Chile	complainant	BLUMAR	IGPA	3
27	DS250	U.S.	respondent	PEP	SPX	3
	DS250	Brazil	complainant	LOUP.PA	BVSP	3
28	DS247	U.S.	respondent	UFPI	SPX	2
	DS247	Canada	complainant	CFP	GSPTSE	2
29	DS196	Argentina	respondent	ROSE.BAV	MERV	2
	DS196	U.S.	complainant	GILD	SPX	2
30	DS193	Chile	respondent	NUTRAVALOR	IGPA	3
	DS193	EU	complainant	PVA.MC	EU50	3

* Note, when looking at these cases, if only a consultation requested day and implementation day occur, then the total policy days count is two. Moreover, the policy days occur sequentially, i.e., there could never exist a scenario where the panel report was circulated before the panel was composed.

Table C.2. Implementation by respondent cases

Case count	Case ID	Country	Role	Industry stock	Index stock	Total policy days count
1	DS483	China	respondent	000069.SZ	000001.SS	6
	DS483	Canada	complainant	ADN.TO	GSPTSE	6
2	DS433	China	respondent	600111.SS	000001.ss	6
	DS433	Japan	complainant	1515.T	N225	6
3	DS432	China	respondent	600111.SS	000001.SS	6
	DS432	EU	complainant	AAL.L	EU50	6
4	DS431	China	respondent	600111.SS	000001.SS	6
	DS431	U.S.	complainant	NEM	SPX	6
5	DS426	Canada	respondent	BEP	GSPTSE	6
	DS426	EU	complainant	TTE	EU50	6
6	DS422	U.S.	respondent	SYY	SPX	6
	DS422	China	complainant	CMFO	000001.SS	6
7	DS413	China	respondent	TCEHY	000001.SS	6
	DS413	U.S.	complainant	AXP	SPX	6
8	DS412	Canada	respondent	AQN	GSPTSE	6
	DS412	Japan	complainant	ITOCY	N225	6
9	DS405	EU	respondent	ADDYY	EU50	6
	DS405	China	complainant	LNNGF	000001.SS	6
10	DS403	Philippines	respondent	GSMI	PSEI.PS	6
	DS403	U.S.	complainant	BF-B	SPX	6
11	DS402	U.S.	respondent	CLF	SPX	6
	DS402	Korea	complainant	005490.KS	KS11	6
12	DS398	China	respondent	0600711.SS	000001.SS	6
	DS398	Mexico	complainant	PE&OLES.MX	MXX	6
13	DS396	Philippines	respondent	GSMI	PSEI.PS	6
	DS396	EU	complainant	HEIA.AS	EU50	6
14	DS395	China	respondent	0358.HK	000001.SS	6
	DS395	EU	complainant	AAL.L	EU50	6
15	DS394	China	respondent	0358.HK	000001.SS	6
	DS394	U.S.	complainant	AA	SPX	6
16	DS383	Thailand	respondent	XBKK.AJ	SET.BK	6
	DS383	U.S.	complainant	XOM	SPX	6
17	DS379	U.S.	respondent	GT	SPX	6
	DS379	China	complainant	000589.SZ	000001.SS	6
18	DS376	EU	respondent	NOK	EU50	6
	DS376	Japan	complainant	6588.T	N225	6
19	DS375	EU	respondent	NOK	EU50	6
	DS375	U.S.	complainant	MSFT	SPX	6
20	DS367	Australia	respondent	SHV.AX	AXJO	6
	DS367	New Zealand	complainant	TGG.NZ	NZ50	6
21	DS363	China	respondent	0700.HK	000001.SS	6
	DS363	U.S.	complainant	WBD	SPX	6
22	DS362	China	respondent	BIDU	000001.SS	6
	DS362	U.S.	complainant	GOOG	SPX	6
23	DS345	U.S.	respondent	GSFD	SPX	6
	DS345	India	complainant	BKV.BO	BSESN	6
24	DS343	U.S.	respondent	SYY	SPX	6
	DS343	Thailand	complainant	CFRESH.BK	SET.BK	6
25	DS308	Mexico	respondent	FMX	MXX	6
	DS308	U.S.	complainant	PEP	SPX	6
26	DS296	U.S.	respondent	IBM	SPX	6
	DS296	Korea	complainant	SMSN.IL	KS11	6
27	DS299	EU	respondent	IFX.DE	EU50	6
	DS299	Korea	complainant	SMSN.IL	KS11	6
28	DS286	EU	respondent	LOUP.PA	EU50	6
	DS286	Thailand	complainant	CPF.BK	SET.BK	6
29	DS269	Brazil	respondent	BRFS	BVSP	6
	DS269	EU	complainant	LOUP.PA	EU50	6
30	DS219	Brazil	respondent	GGBR3.SA	BVSP	6
	DS219	EU	complainant	ACX.MC	EU50	6
31	DS276	Canada	respondent	ADM	GSPTSE	6
	DS276	U.S.	complainant	ANDE	SPX	6
32	DS204	Mexico	respondent	TV	MXX	6
	DS204	U.S.	complainant	VZ	SPX	6

* Note, all six key policy dates occur in cases that end with the respondent implementing WTO judges' recommendations.