A Methodology for Estimating the Impact of Partisan Competition on the Economy

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Abstract

This paper develops and applies a methodology designed to pinpoint the relation between government partisanship and national–level economic variables. In particular, we consider the British polity since the early 1980s and estimate the economic impact of the Conservative Party's dominance of government since 1983. Furthermore, we consider the counterfactual problem of assessing the economic consequences of a Labour win in any of the three most recent British elections.

The analysis conducted in the paper creates snapshots of government partisanship effects at each national election. Thus, the paper is able not only to determine if changes in the partisan nature of British government were reflected in economic variables but also is able to consider how the relation between the partisanship of the British government and the British economy has varied over time. The ability to allow for time–based fluctuations in this relation represents an advance within the existing empirical literature on the subject of government partisanship effects. Indeed, contemporary empirical research on government partisanship and its economic consequences is entirely silent on the possibility of temporal variation in the relation between the two.

The methodology employed in this paper is based on campaign–period movements of prices of publicly–traded financial and equity derivative securities. The dataset of such securities is exceedingly rich; compared to the extant literature on government partisanship and economics, the dataset in conjunction with the models developed here allow for greater precision in estimating the impact of partisan changes in government. Overall, the tools presented augment the scholarly understanding of the implications of government partisanship.

1 Introduction

This paper develops and applies a new methodology designed to estimate and characterize precisely the relation between government partisanship and its economic consequences. The literature that considers the connection between these two typically travels under the labels of political–business cycle theory or partisan macroeconomic theory (Hibbs 1994). This paper advances the methodology employed in this literature, and its substantive conclusions regarding the British polity augment the current level of understanding of the relation between government partisanship and economic outcomes. Furthermore, the paper's empirical results cast doubt on a central assumption exploited by the majority of scholars who have studied this relation. This latter finding suggests that commonly accepted beliefs concerning the nexus between government partisanship and its economic consequences may rest on tenuous grounds.

The paper proposes the use of a rich data set, previously untapped by political scientists, that can assist researchers in their task of identifying the economic impact wrought by partisan changes in government. In particular, this paper demonstrates how researchers can employ national election period prices of certain types of financial instruments to clarify the relation between government partisanship and its economic consequences. The methodology developed in this paper is applied to the three most recent British national elections, those held in 1983, 1987, and 1992, and the ensuing results affirm the value of harnessing financial market data as a tool for studying the economic impact of partisan government.

As explained in much detail later, the analysis in this study harnesses financial instruments that fall in the category known as derivative securities. Unlike the more common financial instruments such as stocks, derivative securities have prices that depend on the future values of other securities. In particular, two features of derivatives make these financial instruments extremely valuable tools for scrutinizing the economic impact of government partisanship. On a theoretical level, prices of derivatives are based on expectations of future economic conditions. This allows us to model *pre–election* derivative prices as functions of *post–election* events, in particular, as functions of the partisanship of national election winners. On the empirical side, the data set of derivative prices is sufficiently rich as to permit estimation of numerous parameters.

The political science and economics literatures examining the relation between government partisanship and its economic effects typically assumes that the connection between these two does not vary in time. For instance, the seminal paper by Hibbs (1977) and the recent Hibbs, Carlsen and Pedersen (1996) assume that the impact of political partisanship on the economy has not varied since the early 1950s. The methodology described in this paper relaxes this strong assumption. Given the richness of the data set

used in this paper, it is no longer necessary to assume that the influence of government partisanship on economic consequences is constant. Rather, each national election studied via the methodology described here may be treated as entirely idiosyncratic, and the relation between government partisanship and economics may fluctuate election by election. To the extent that assumptions in the literature are relaxed, conclusions regarding the positive relationship between government partisanship and economic conditions may be considered increasingly robust.

The majority of the literature on electoral cycles and economic consequences focuses on macroeconomic variables such as economic growth, unemployment, and inflation. This paper, though, considers short–term interest rates and aggregate stock market indices. As explained in subsequent sections of this paper, the selection of interest rates and stock market indices as variables of interest is a result of the paper's choice of methodology. In no way, though, does this paper's consideration of these two economic variables, rather than inflation and unemployment, impinge on the ability of the study's conclusions to engage the traditional literature on government partisanship.

Simply put, the economic variables analyzed here ultimately address the impact of partisan government on national–level economics. The behavior of interest rates and stock market indices is an important signal about national economic health: interest rates provide information about future inflation and stock market indices about economic growth. In this sense, the paper maintains the tradition of examining the economic impact of electoral cycles. However, within the literature the specific variables used in this paper to effect the examination of the impact of government partisanship on the economy are to some extent unique.

The remainder of this paper is organized as follows. The next section briefly reviews and critiques the literature focusing on government partisanship and its impact on the economy. The paper then provides intuition and a mathematical formulation that allows derivative prices to be modeled as functions of government partisanship. We apply the model to the three most recent British elections and find strong evidence for the existence of political effects on the British economy. In particular, the paper concludes that Labour governments would have produced higher interest rates and in some cases diminished stock market growth than that witnessed under the past two decades of Conservative government. Furthermore, the paper's conclusions concerning the temporal variation in the relation between the Labour party and the British economy are consonant with the informal literature on British politics. The final section of the paper presents concluding remarks and proposes directions for future research.

2 Government Partisanship and Economic Outcomes

The pioneering empirical paper of Hibbs (1977) is generally credited with demonstrating that the political partisanship of governing parties in the United States (US) and the United Kingdom (UK) is reflected in unemployment and inflation figures. Hibbs has authored and co–authored numerous followup studies (Hibbs 1986; Hibbs 1977; Hibbs 1987; Hibbs 1994; Hibbs, Carlsen and Pedersen 1996), and other scholars have investigated the relationship between governing party and economic outcomes. Concerning the United States, Laney and Willett (1983) study the relation between government deficits, money supply, and government partisanship. Beck (1982) and Chappell and Keech (1988) conclude with Hibbs that unemployment is lower under Democratic as compared to Republican administrations but suggest that the partisan effects are less pronounced than those offered by Hibbs. Alesina and Sachs (1988) claim that growth during presidential administrations tends to follow partisan patterns: during the first two years of Republican administrations, growth attenuates; in the first half of Democratic administrations, the United States economy has above average growth. Alesina and Roubini (1992) study economic cycles and elections in European nations. The paper by Alesina, Londregan and Rosenthal (1993) and book authored by Keech (1995) summarize much of the literature on government partisanship and macroeconomic consequences.

Other analyses have concluded that stock markets react to national changes in government partisanship (Niederhoffer, Gibbs and Bullock 1970; Reilly and Drzycimski 1976; Riley and Luksetich 1980; Peel and Pope 1983; Thompson and Ioannidis 1987; Homaifar, Randolph, Helms and Haddad 1988; Bachman 1992; Hensel and Ziemba 1995), although very few studies have examined whether changes in interest rates covary with government partisanship (Quinn and Shapiro 1991). Recently, Gärtner and Wellershoff (1995) have provided evidence for the existence of electoral cycles in United States stock markets. Overall, it appears the evidence for the existence of government partisan effects on economic variables is strong, although there is disagreement over the magnitude of this influence.

There are two important assumptions that most of the above literature exploits when analyzing the impact of government partisanship on economics. First, as briefly broached in the introduction, it is generally presumed that with respect to a particular nation the impact of partisanship on the economy is *ceteris paribus* fixed in time. In particular, the literature contrasts economic variables, for example, unemployment statistics, under politically left governments with numbers generated under politically right governments. Because different governments cannot exist simultaneously in a single nation, this comparison is only valid under the assumption that the left–right party disparity concerning unemployment does not fluctuate in time. Yet, Beck's (1982) critique of Hibbs finds that of American Democratic parties,

only the Truman and Johnson Administrations behave as Democrats in the unemployment sense. "Looking at unemployment rates only, it would be quite hard to tell that Carter was a Democrat, and it would be equally difficult to guess the parties of Eisenhower, Kennedy, and Nixon" (Beck 1982, p. 91). Beck's critique is essentially that Democratic preferences may be circumstance and president dependent; this possibility, both plausible and important, has been ignored by much of the literature that has followed in Hibbs's footsteps.

At a purely intuitive level, the assumed constancy of the disparity in partisan preferences seems untenable. For instance, with respect to the US the presumption leads to the assertion that the Carter–Reagan disparity over unemployment in the early 1980s was equivalent to the Clinton–Bush tradeoff over unemployment in early 1990s. There are two reasons to be skeptical about this claim. First, conventional wisdom suggests that Reagan was more conservative than Bush, and Carter was considered more liberal than Clinton. Thus, *prima facie* one would think that *vis–a–vis* unemployment the Carter–Reagan disparity was greater than the Clinton–Bush difference.

Second, economic conditions in 1980 were quite different than those faced in 1992. Inflation was high in 1980, yet in 1992 the economy was growing in real terms at a reasonable pace. If political parties adjust their policy platforms to conform with contemporary economic realities, and most models and theories of party movement allow for exactly this possibility, then we should expect that the disparity in party preferences is not fixed.

In the UK, the assumption of constant party disparity mandates that the difference between the Labour party under Michael Foot and the Conservatives under Margaret Thatcher in the early 1980s was identical to the Neil Kinnock versus John Major gap in 1992. This is almost certainly false as Labour under Foot was considered more left–wing than Labour under Kinnock, and Thatcher's Conservative Party was perceived as more right–wing than the Major–led party.

Of course, these examples are informal and do not establish that the link between government partisanship and economic outcomes has a meaningful temporal dimension. Yet, with Beck's (1982) result and the intuition adduced above, it is clear that the researchers should initiate their investigations of the relation between government partisanship and economics with the assumption that the disparity in partisan preferences is not necessarily stable over time.

The second key assumption made explicitly or implicitly in the government partisanship literature involves the stationarity of the processes generating economic variables of interest. For example, when researchers study inflation figures over time, they typically assume that inflation follows a stationary

stochastic process with non–varying coefficients. This assumption is quite strong. Many macroeconomic variables appear to follow integrated time series and hence are non–stationary. Moreover, the assumption of a fixed generating process, stationary or not, is strong.

For researchers interested in analyzing the influence of electoral cycles on post–World War II trends in UK inflation or interest rates, for instance, increasing European integration and the advent of the European Monetary System with its accompanying exchange rate strictures undoubtedly induced changes in the process that drove inflation in the UK. Consequently, comparing inflation during the recent Conservative government of John Major with the inflation figures observed during British Labour governments in the 1960s is inherently problematic. It would necessitate controlling for the growth of European integration; how to accomplish such a feat is unclear at best.

To make these critiques more concrete, consider the following example characterizing, admittedly loosely, the existing literature on government partisanship and economic effects. Suppose that a researcher were interested in understanding the magnitude of partisan influence on short–term interest rates in the UK. Since the Conservative Party has been the governing party since 1979, the behavior of interest rates under a Labour government has not recently been observed. The researcher in question might estimate a linear regression where the response was short–term interest rates and the predictors included auto–regressive terms, perhaps inflation (instrumented appropriately), and some indicator variables representing government partisanship. Whether interest rates varied with government partisanship would be assessed by considering the estimated regression coefficients associated with government indicator variables.

If the researcher in question subsequently desired to understand how short–term interest rates would have fared in 1992 under a Labour government, 1992 data in conjunction with the estimated regression coefficients would be used to predict short–term interest rates under Labour. Note that since Labour was last a majority party in 1979, this analysis necessitates assuming that the Labour–Conservative disparity over interest rates from 1974 to 1979 was *identical* to the disparity in 1992. Furthermore, it is necessary to assume that the fundamental process generating interest rates did not change in this period.

This simple example illustrates the importance of the two assumptions made by most research that examines the effect of government partisanship on economic variables. Without the presupposition that partisan effects are constant, it would not be possible to use in a straightforward manner 1974 interest rate data to craft 1992–based estimates.

Ideally a researcher seeking to understand the effects of government partisanship on short–term interest rate would be able to effect the following scenario. Taking note of the state of the UK, the researcher

would observe interest rates under the government at the time, say, a Conservative administration. After observing the Conservative party for perhaps a year, the researcher would "insert" a Labour government, reset the state of the UK to that which characterized the inception of the previous Conservative government, and subsequently observe short–term interest rates under Labour. With this strategy, a student of government partisanship would not need to assume that the process generating interest rates was stationary over the entire postwar period and furthermore would be relieved of the assumption that the disparity in Labour–Conservative preferences was fixed over decades. Some stationarity assumptions would be still necessary, of course, but the severity of the assumptions would be much less constraining that that imposed by the vast majority of the literature on the economic effects of government partisanship.

This example is intentionally crude and, obviously, completely infeasible. Social scientists are unable to create the experimental environment necessary to carry out the above scenario. However, the example highlights one important feature of electoral cycles, namely that only one party governs the UK at each instant of time.[1] This seemingly trivial observation is adduced in order to support this paper's contention that the campaign periods preceding national elections are special times that can be harnessed by scholars interested in understanding the relation between government partisanship and economics. The key intuition concerning the importance of campaigns is as follows.

Although only a single government can be in office at each period, the few weeks before a British national election exemplify an instance in which the nature of the future government is uncertain. This uncertainty is unique to the campaign period, as once the election concludes the outcome is fixed. In the 1992 UK election, for example, in between the election's being called on March 11, 1992 and the voting day, April 9, 1992, there was uncertainty over who would win the election. As of April 10, the uncertainty over the election winner was completely resolved. However, even though Labour eventually lost the 1992 contest, the fact that it might win suffused the entire campaign period.

In terms of the contrived government–swapping thought experiment presented above, the campaign period provides a close approximation to the environment researchers could engender if they had the power to decide the nature, Conservative versus Labour, of the UK government at each instant. While election campaigns do not feature multiple governments in place simultaneously, they do constitute time periods in which the possibility of different governments is considered.

This suggests that if we are interested in understanding the economic consequences of government partisanship, campaign periods should be of special interest. In this vein, during the three more recent election campaigns there were numerous publicly traded financial derivatives period whose values depended

[1] We are ignoring government coalitions at this time. This issue is discussed later in the paper.

on economic conditions after the election outcome was to have been known. The relation between the prices of derivatives and government partisanship will be made precise in the next section of the paper; for now, it suffices to recognize that *campaign–period* prices of derivative securities whose values depended on *post–election* economic conditions contain information about (unobservable) economic conditions that were expected to have come into existence conditional on all possible election outcomes. For the few weeks of campaign–period uncertainty, we can use selected derivative prices to clarify the post–election economic conditions that would have characterized a Labour victory in the British elections of 1983, 1987, and 1992.

Before delving into the relation between derivative prices and UK elections, it is worth noting that the literature that employs financial instruments in the study of politics is small but growing. This literature is grounded in the intuition that prices of financial assets reflect underlying political and economic variables. Hence, price data can be used to infer political variables. As will be made clear, this intuition is also at the heart of the present study of the three most recent British elections.

For instance, Herron, Lavin, Silver and Cram (1995) and Roberts (1994) employ stock prices to analyze the three candidates in the 1992 United States election. Shum (1995) considers short–term interest rates in the context of the 1992 Canadian constitutional referendum. Other analyses have focused on the UK: see Gemmill (1992), Gemmill (1995), and Manning (1989). Bueno De Mesquita (1990) considers European interest rates around the period of the 1866 Seven Weeks War, and Willard, Guinnane and Rosen (1995) use exchange rates between gold and a Civil War era currency called the Greenback to assess important events in the American Civil War; also see Mccandless (1996) on the Civil War. Roberts (1990*a*) studies the value of Senate seniority though stock price movement immediately following the death of a prominent senator. Similarly, Roberts (1990*b*) uses defense stock prices to analyze the importance of executive–legislative separation of powers in the 1980 United States presidential election. Brander (1991) analyzes movement in the Toronto Stock Exchange during the 1988 Canadian general election, and Mirus (1991) studies exchange rates in this same period. Finally, Gilligan and Krehbiel (1988) employ stock prices to test a formal theory of legislative behavior.

3 Derivative Prices and UK Elections

The key insight of the previous section of this paper is that campaign periods preceding UK national elections consist of stretches of time in which both alternative election outcomes, Labour or Conservative,

were ostensibly feasible.[2] As noted, this can be contrasted with the period immediately following the elections: once votes are tallied and the Conservative Party victorious, as it was in 1983, 1987, and 1992, the uncertainty over the future government of the UK was resolved, at least in the short run, and there was no probability that Labour would win the race.

Admittedly, there are political parties in the UK other than the Conservatives and Labour; furthermore, as a parliamentary democracy, the government in the UK can consist of a coalition of multiple parties. However, electoral contests in the recent two decades have been largely Conservative versus Labour battles. Not since 1974 has there been a coalition government in the UK, and this coalition is the only non–majority government in the UK in the post–World War II period. Furthermore, the most seats in the House of Commons won by a party other than the Conservatives or Labour in this period is 23 of a total of 650 seats; this was accomplished by the Liberal Party in 1983 (King 1993, p. 249). These facts provide justification for the paper's assumption that British electoral contests are overwhelmingly Conservative–Labour engagements.

As noted previously, the substantive focus of the paper is on the relation between British government and short–term interest rates and aggregate stock market behavior. The primary short–term interest rate in the UK is the three month London Interbank Offered Rate (LIBOR), and as an index of aggregate stock market movement the paper uses the FTSE–100. The three–month LIBOR rate is somewhat analogous to the three month Treasury bill rate in the United States, and the FTSE–100 is similar to the S&P 500 stock index. This section of the paper first explains the relationship between financial derivatives and the three-month LIBOR rate and then discusses how to analyze post–election stock market behavior using the FTSE–100. For additional details on derivatives and other financial instruments, see Hull (1993).

3.1 Modeling LIBOR Derivatives and Post–Election Interest Rates

In general, derivative securities are financial instruments whose value is based on other securities or economic variables, hence the use of the adjective "derivative." For the analysis of UK elections and short–term interest rates, we will consider a type of derivative called a futures contract or, more simply, a future. Broadly speaking, a future is a contract that when purchased specifies the delivery to the owner of a certain quantity at a given, future, time.

If we wish to understand how short–term interest rates in the UK would have behaved had Labour won in 1983, 1987, or 1992, we can perpend prices of futures whose values are based on short–term

[2]There is nothing unique to the UK in this regard. Future research will use the insight developed in this paper to analyze the relation between government partisanship and economics in the United States.

interest rates; thus, we consider a type of derivative called an interest rate future. It is fortuitous from the perspective of this paper that there exist futures that are based on the three–month LIBOR rate. In this paper these futures are called LIBOR futures; they trade on the London International Financial Futures Exchange (LIFFE).[3] Note that the prices of LIBOR futures are determined through the interactions of market traders and are not specified by LIFFE.

As a type of derivative security, associated with each LIBOR future is a delivery month and a payoff function. The delivery month specifies the month and day at which the future contract is settled; the payoff function describes the settlement rules, i.e. what is to transpire upon delivery.[4]

Let r_t denote the three–month LIBOR rate at time t. A LIBOR futures contract delivering at time τ pays out when it delivers $£100 - r_\tau$. However, when bought at time $t < \tau$, the owner does not know the value of r_τ. Consequently, a purchaser of LIBOR futures will consider what he expects r_τ to be when assessing the price at time t of a LIBOR future that expires at time τ.[5]

Suppose for example that at time $t < \tau$, r_τ was known with certainty to be 10%, i.e. $r_\tau = 10$. Therefore, the LIBOR future delivering at τ would with certainty pay $100 - 10 = £90$. Ignoring time discounting, the LIBOR future at time t would cost £90.[6] On the other hand, suppose that at time $t < \tau$ r_τ was known with certainty to be 20%. In this case, the time t price of a LIBOR future, again ignoring time discounting, would be £80. In this example, we calculate the price of a LIBOR future based on a known level of r_τ. It should be clear, though, that the argument can be reversed. If r_τ were known to be fixed between t and τ, then the price of a LIBOR future delivering at time τ specifies the value of r_τ. In particular, in this simple example the relation between the futures price and r_τ with constant r_τ is one–to–one.

From the perspective of this paper, the key value of LIBOR futures is that their prices provide information about the expected future three–month LIBOR rate. Although the assumption of a constant three–month LIBOR rate is unduly restrictive, the intuition provided by the above examples that link time τ levels of the three–month LIBOR rate to time t futures prices is maintained even if the three–month LIBOR is allowed to be stochastic. For instance, suppose at time t that r_τ was known with certainty to be either 10% with probability $\frac{1}{4}$ and 40% with probability $\frac{3}{4}$. If we assume that market traders are

[3] On LIFFE, futures on the three–month LIBOR are called short sterling futures.

[4] LIBOR futures deliver on the third Wednesday of the specified delivery month.

[5] Technically speaking, variations in interest rates in between t and τ will impact the time t price of a LIBOR future; this is because LIBOR futures are marked–to–market on a daily basis. However, in this paper we ignore daily resettlements of futures and price them as if they were forward contracts. Given the short–term nature of the futures considered, this assumption is not very severe.

[6] If not, then a riskless arbitrage profit could be generated. In accordance with standard financial economic theory, we assume that this is not possible.

risk neutral and we ignore time discounting, then the LIBOR future at time t delivering at time τ will be worth $100 - (\frac{1}{4} \times 10 + \frac{3}{4} \times 40) = £67.5$.

Relating this example to UK elections is a straightforward exercise. Suppose that for each election year there exist three times, $t < T < \tau$, and that T is the day following balloting associated with a British election of 1983, 1987, or 1992; henceforth, the dependence of t, T, and τ on a given election year is suppressed for notational clarity. Suppose that if the Conservatives win, r_τ will be r_C and r_τ will be r_L otherwise. Let π_t be the time t probability of a Conservative win at time T; we label π_t an electoral probability. Then, assuming risk neutrality and ignoring time discounting, the price of the LIBOR future will be $100 - (\pi_t r_C + (1 - \pi_t) r_L)$. If, say, r_C were observed because the Conservatives won the race and if π_t were known as well, then using the actual price of the LIBOR future we could solve for r_L.

This observation is striking. With the price of the future combined with knowledge of π_t and r_C, we can estimate what the market believed r_L would be, despite the fact that r_L can never be observed. Of course, the three–month LIBOR is not constant in post–election periods (from T to τ) so this model of futures prices is problematic. However, the intuition it conveys is maintained even when we complicate the process that generates the three–month LIBOR rate.

At this point, we formally derive the price of a LIBOR future in the context of a UK national election. Let T be the date after the given race; suppose that starting on time T, r_T is r_L or r_C depending on the winner of the race; for $t > T$, suppose r_t follows the continuous–time stochastic process defined by

$$dr_t = \rho_\omega(\bar{r}_\omega - r_t)dt + \theta_\omega dB_t, \omega \in \{C, L\}, \tag{1}$$

where B_t is a standard Brownian motion (i.e. $\mathrm{E}[B_t^2] = t$) and ρ_L, ρ_C, $\bar{r}_L$, $\bar{r}_C$, θ_L, and θ_C are fixed parameters. The superscripts in these parameters refer to the election winner: L represents the Labour party, C the Conservative party. What this implies intuitively is that the stochastic process driving the three–month LIBOR after the election of 1992 depends on the election winner. Of course, none of the coefficients in equation (1) is known; all must be estimated. However, since the Conservatives won the races in 1983, 1987, and 1992, r_C but not r_L was observed for each election. Table 1 describes basic data concerning the three most recent British elections.

The process described in equation (1) is a straightforward stochastic differential equation and follows the model described in Vasicek (1977). In the Vasicek paper, though, the stochastic process is assumed to drive the instantaneous interest rate, while in this paper we assume that the process drives the three

Table 1: Basic Data on the British Elections of 1983, 1987, and 1992

Election Year	Voting Date	T	Dates in Sample	r_C
1983	June 9, 1993	June 10, 1983	24	10.0000
1987	June 11, 1987	June 12, 1987	25	8.6250
1992	April 9, 1992	April 10, 1992	22	10.4375

month interest rate.

It is straightforward to solve equation (1) (e.g. Karatzas and Shreve 1991). Then, using Fubini's Theorem it can be shown that for $s > t$ the distribution of r_s conditional on r_t and a Conservative election winner at time T is normal with

$$\mathrm{E}[r_s|r_t] = \bar{r}_C + (r_t - \bar{r}_C)e^{-\rho_C(s-t)} \tag{2}$$

$$\mathrm{Var}\ [r_s|r_t] = \frac{\theta_C^2}{2\rho_C}(1 - e^{-2\rho_C(s-t)}). \tag{3}$$

Conditional on a Labour win, the above two moments would be modified with $\bar{r}_L$ replacing $\bar{r}_C$, etc.

From the mean and variance terms in equations (2) and (3), it is clear that the stochastic process described in equation (1) conditional on a Conservative win is mean reverting to $\bar{r}_C$. That is, for a given $t > T$, as $s \to \infty$, $\mathrm{E}[r_s|r_t] \to \bar{r}_C$. Thus, the parameter $\bar{r}_C$ can be thought of as the long run mean of the r_t process under a Conservatives government. As ρ_C increases, the rate of exponential convergence to $\bar{r}_C$ increases as well. Furthermore, the the variance of the r_t process is increasing in θ_C. When $\theta_C = 0$, the process driving r_t is deterministic.

Then, let π_t denote the probability at time $t < T$ of a Conservative victory at time T. We discuss later how to estimate π_t. Assuming risk neutrality, we can write f_t^τ, the time t price of a future maturing at time $\tau > T$, as

$$f_t^\tau = \mathrm{E}[(100 - r_\tau)(1 + \frac{r_\tau(\tau - t)}{100 \times 360})^{-1}]|\mathcal{F}_t, \tag{4}$$

where $\mathcal{F}_t$ is the information set at time t.[7] The first term of equation (4) represents the payoff of the LIBOR futures contract, the second term a discount factor.[8] A three–month LIBOR rate of n% corresponds to a

[7] In a slightly loose sense, f_t^τ is the σ–algebra generated by the campaign–induced randomness in the π_t terms and the expected post–election coefficients.

[8] Intuitively, the discounting in equation (4), like the discounting used in other pricing formulas in this paper, assumes

90 day rate of $\frac{n}{4}\%$ (Duffie 1989), and we make the further assumption that the daily rate at time τ is $\frac{r_\tau}{360}$.

As described in Appendix A, equation (4) can be simplified to yield

$$\begin{aligned} f_t^T &= d\sqrt{2}(\pi_t(\frac{d}{\sigma^C}D(\frac{\mu_C+d}{\sigma^c\sqrt{2}})+100\frac{1}{\sigma^C}D(\frac{\mu_C+d}{\sigma_C\sqrt{2}}))+ \\ &\quad (1-\pi_t)(\frac{d}{\sigma_L}D(\frac{\mu_L+d}{\sigma_L\sqrt{2}})+100\frac{1}{\sigma_L}D(\frac{\mu_L+d}{\sigma_L\sqrt{2}})))-d \end{aligned} \tag{5}$$

where $D(\cdot)$ is Dawson's Integral (Abramowitz and Stegun 1964, p. 297), and

$$d = \frac{100\times 360}{\tau - t} \tag{6}$$

$$\mu_L = \bar{r}_L + (r_L - \bar{r}_L)e^{-\rho_L(\tau-T)} \tag{7}$$

$$\mu_C = \bar{r}_C + (r_C - \bar{r}_C)e^{-\rho_C(\tau-T)} \tag{8}$$

$$\sigma_L = (\frac{\theta_L^2}{2\rho_L}(1-e^{-2\rho_L(\tau-T)}))^{1/2} \tag{9}$$

$$\sigma_C = (\frac{\theta_C^2}{2\rho_C}(1-e^{-2\rho_C(\tau-T)}))^{1/2}. \tag{10}$$

It is not possible to produce a complete closed–form representation of the solution of equation (4) as Dawson's Integral cannot be analytically simplified.

The importance of equation (5) is that it expresses the pre–election time t price of a LIBOR future that delivers at time τ given that there is an election at time T with $t < T < \tau$. There are seven unknown parameters in equation (4), and the futures price f_t^τ at time t is a function of the parameters that characterize the LIBOR process after a Conservative win and after a Labour win. Thus, despite the fact that a Labour government was not observed in any of the three most recent British elections, we can use campaign period futures prices to estimate what the LIBOR process was expected to have been had Labour emerged the winner in any of the races.

Suppose that we constrained $\bar{r}_C = \bar{r}_L$, $\rho_C = \rho_L$, and $\theta_C = \theta_L$. In this scenario, the post–election LIBOR rate process would not depend on the election winner at time T. Whether such a constraint is valid in 1983, 1987, or 1992 is, of course, an empirical issue that is considered later in this paper.

In the context of the critique of the literature on government partisanship and economics, it is important

one–time compounding at delivery date. This form of discounting is used because it allows closed–form representations of derivative prices. It probably makes little difference, though, as a higher compounding frequency would have little impact on derivative prices.

to point out the assumptions inherent in equation (5). First, no assumptions are made concerning the stability of the parameters in this equation across different electoral periods. Might $\bar{r}_C$ be different in 1983 compared to its value in 1992? Certainly, and this is not precluded by equation (5). The derivation of LIBOR futures prices does not necessitate that the Conservative versus Labour difference in interest is constant.

Second, given the time t futures that delivery at time τ, the paper assumes that the parameters driving the r_t process are fixed from t to τ. When data issues are broached in the empirical section of the paper, it will be clear that $\tau - t$ is at most two years. When contrasted with the stationarity assumptions that ground most of the existing literature on electoral cycles, this assumption is not severe. Existing studies often assume stationary for several decades.

3.2 Modeling FTSE–100 Derivatives and Post–Election Stock Market Behavior

In the previous section of this paper, we focused on interest rate futures because the pre–election prices of these derivative securities contain information about expected post–election interest rates in 1992. At this point, we accomplish a similar task with respect to analyzing the expected post–election behavior of British stock markets as proxied for by the FTSE–100 index. In this section, we consider consider both FTSE–100 futures and FTSE–100 options; the latter type of a derivative security has a different payoff function than a future, and this is reflected in its pricing behavior.

Let s_t denote the FTSE–100 at time t. A FTSE–100 future delivering at time τ pays s_τ at time τ.[9] This relationship is rather straightforward, and the intuition relating pre–election FTSE–100 futures prices to expected post–election FTSE–100 prices parallels that connecting pre–election LIBOR futures prices and expected post–election LIBOR rates.[10]

The payoff function of FTSE–100 options is slightly more complicated than that of FTSE–100 futures. Associated with a FTSE–100 option are an expiry month and a strike price; note that futures "deliver" while options "expire." The expiry month of an option, like the delivery month of a futures contract, specifies when the option is settled.[11]

The settlement price of an FTSE–100 option depends on the value of the FTSE–100 on the expiry day and also on the option's strike price. Furthermore, there are two types of options, calls and puts, and we

[9] A FTSE–100 future delivers on the third Friday of its designated delivery month.

[10] FTSE–100 futures and options are marked–to–market on a daily basis like LIBOR futures. However, we ignore this fact in calculating theoretical FTSE–100 derivative prices. See fn. 5.

[11] FTSE–100 options like FTSE–100 future are settled on the third Friday of the expiry month.

first consider call options.[12]

A call option with strike price $k > 0$ and expiration date τ gives the option owner the right but not the obligation to purchase one unit of the FTSE–100 at a price of k. Of course, a unit of the FTSE–100, a stock index, does not really exist *per se*. What matters, as will be clear, is the level of the FTSE–100.

Since the owner of a FTSE–100 call option has the right but not the obligation to purchase a unit of the FTSE–100 at time τ at a price of k, the value of the option at settlement time τ depends on the difference of s_τ and k. If, for instance, $s_\tau > k$, then the owner of the option can purchase a share of the FTSE–100 for k, immediately sell it, and receive s_τ. The total profit for this buy–and–sell maneuver would be, ignoring transaction costs, $s_\tau - k > 0$.

If, on the other hand, $s_\tau < k$, then the owner would not spend k to purchase a unit of the FTSE–100, worth less than k. Instead, the FTSE–100 option would not be exercised and would expire worthless. The ability to let an option expire is indicative of the right but not the obligation of an option owner to exercise his option; this explains the origin of the word "option." If $s_\tau = k$, the option again is worthless as it does not matter whether the option owner exercises his right to purchase or ignores this right and allows the option expire without taking action. Overall, at time τ, the option is worth $[s_\tau - k]^+$, where $[x]^+$ denotes the positive part of x, i.e. $[x]^+ = \text{Maximum}\{x, 0\}$.

Whereas a call option gives the owner the right to buy a unit of the FTSE–100 at a price of k, a put option provides the right to sell at a price of k. In this case, logic symmetric to that discussed above shows that the option has positive value if and only if $s_\tau < k$. Thus, the time τ settlement value of a put option is $[k - s_\tau]^+$.

As an example, suppose that at time t the level of the FTSE–100 at time τ was known with certainty to be 2000. Then, ignoring time discounting, the time t price of a FTSE–100 call option with strike price 1700 and expiring at time τ would be worth £300. Moreover, the time t price of a call option with a strike price of 3100 would be zero.

Recalling the previous consideration of LIBOR futures, we were able to express pre–election LIBOR future prices as functions of two post–election interest rate processes, one for Conservatives and one for Labour. We can accomplish a similar task for the FTSE–100 stock market index by allowing the post–election value of the FTSE–100 to depend on the election winner. Then, as will be shown, the *pre–election* prices of FTSE–100 futures and options that deliver and expire, respectively, after the election can be expressed as functions of the expected *post–election* process that drive the FTSE–100.

[12] Options are broken down into European–exercise and American–exercise type derivatives as well. The FTSE–100 options considered in this paper are of the European type, although this has nothing to do with the fact that the UK is located in Europe.

Suppose that after the presidential election at time T, the FTSE–100 follows a process for $t > T$ described by

$$s_t = S_{\omega_T} \exp[\eta_\omega (t-T) + \gamma_\omega \tilde{B}_{t-T}], \omega \in \{L, C\}, \tag{11}$$

where $\tilde{B}_t$ denotes a standard Brownian motion assumed to be independent of the B_t process that drives the three–month LIBOR (see equation (1)). The independence between these Brownian process is an important assumption. In equation (11), η_ω represents a drift and γ_ω a diffusion term controlling the impact of random fluctuations on s_t; S_{ω_T} is the level of the FTSE–100 at time T. The dependence of the post–election FTSE–100 price process on the election winner is indicated by the superscript ω in equation (11). The four drift and diffusion parameters in equation (11) are unknown and must be estimated.

For instance, in equation (11) if $\omega = C$ and $\eta_C > 0$, then s_t drifts upward. If $\eta_C = 0$, then s_t has no drift, and if $\eta_C < 0$ then s_t drifts down. Similarly, γ_C controls the influence of random fluctuations on s_t. If $\gamma_C = 0$, s_t is deterministic. The larger γ_C, the greater the randomness inherent in s_t.

The FTSE–100 did not exist in 1983, so analysis of this stock market index is restricted to 1987 and 1992. In these two latter elections, S_{C_T} was observed since the Conservatives won both races. In 1987, $S_{C_T} = 2289.5$, and in 1992 $S_{C_T} = 2572.6$. For both these elections, S_{L_T} was not observed.

The distribution of the natural logarithm of s_t for $t > T$ is Gaussian due to the Brownian motion term. Thus, conditional on a winner of the 1992 election, s_t for $t > T$ has a lognormal distribution. In particular, for $t > T$, given a Conservative win $\log s_t \sim \mathrm{N}(\log S_{C_T} + \eta_C(t-T), \gamma_C^2(t-T))$. Conditional on a Labour win, $\log s_t \sim \mathrm{N}(\log S_{L_T} + \eta_L(t-T), \gamma_L^2(t-T))$.

Pricing formulas for FTSE–100 derivatives can be developed along the lines of the formulas for LIBOR futures. Let m_t^τ denote the time t price of a FTSE–100 future that delivers at time τ. Assuming risk neutrality,

$$m_t^\tau = \mathrm{E}[s_\tau \, (1 + \frac{r_\tau(\tau - T)}{100 \times 360})^{-1}] | \mathcal{F}_t. \tag{12}$$

The first term in Equation (12) represents the expected value of the FTSE–100 at time τ, while the factors including r_t allow for time discounting. Along with the assumed independence of the Brownian motion terms in equations (1) and (11), we further assume that the post–election coefficients driving the

three–month LIBOR rate and the coefficients associated with the post–election FTSE–100 process are independent. Then, it follows that

$$m_t^\tau = \mathrm{E}[s_\tau]|\mathcal{F}_t \ \mathrm{E}[(1 + \frac{r_\tau(\tau - T)}{100 \times 360})^{-1}]|\mathcal{F}_t. \tag{13}$$

The lognormality of s_t in conjunction with the calculations in Appendix B (see equation (35)) show that

$$\begin{aligned} m_t^\tau = \pi_t(d\sqrt{2}\frac{1}{\sigma_C}D(\frac{\mu_C + d}{\sigma_C\sqrt{2}})e^{a_C + \frac{1}{2}b_C^2}) + \\ (1 - \pi_t)(d\sqrt{2}\frac{1}{\sigma_L}D(\frac{\mu_L + d}{\sigma_L\sqrt{2}})e^{a_L + \frac{1}{2}b_L^2}) \end{aligned} \tag{14}$$

where

$$a_C = \log S_{C_T} + \eta_C(\tau - T) \tag{15}$$

$$b_C = (\gamma_C^2(\tau - T))^{\frac{1}{2}} \tag{16}$$

$$a_L = \log S_{L_T} + \eta_L(\tau - T) \tag{17}$$

$$b_L = (\gamma_L^2(\tau - T))^{\frac{1}{2}}, \tag{18}$$

and d, μ_C, μ_L, σ_C, and σ_L are as defined in Equations (6) – (10).

Turning now toward FTSE–100 options, let $c_t^{k,\tau}$ denote the time t price of a call option on the FTSE–100 with a strike price of k and expiry date of τ. Suppose as before that there is an election at time τ. Assuming risk neutrality,

$$c_t^{k,\tau} = \mathrm{E}[[s_\tau - k]^+(1 + \frac{r_\tau(\tau - T)}{100 \times 360})^{-1}]|\mathcal{F}_t. \tag{19}$$

The first term in equation (19) represents the nominal value of the option at time τ. The second term is a discount factor where, as before, r_τ is the three–month LIBOR. Given the independence assumption discussed in the derivation of m_t^τ,

$$c_t^{k,\tau} = \mathrm{E}[s_\tau - k]^+ | \mathcal{F}_t \; \mathrm{E}[(1 + \frac{r_\tau(\tau - T)}{100 \times 360})^{-1}] | \mathcal{F}_t. \tag{20}$$

The second term in Equation (20) is derived in Appendix B; see equation (35). The first term, as calculated in Appendix C, is

$$\begin{aligned} \mathrm{E}[s_\tau - k]^+ | \mathcal{F}_t &= \pi_t (e^{a_C + \frac{b_C^2}{2}} [1 - \Phi(\frac{\log k - a_C - b_C^2}{b_C})] - k[1 - \Phi(\frac{\log k - a_C}{b_C})]) + \\ & \quad (1 - \pi_t)(e^{a_L + \frac{b_L^2}{2}} [1 - \Phi(\frac{\log k - a_L - b_L^2}{b_L})] - k[1 - \Phi(\frac{\log k - a_L}{b_L})]), \end{aligned} \tag{21}$$

where $\Phi(\cdot)$ denotes the standard normal distribution function.

Substituting into equation (20), it is clear that equations (35) and (21) then fully specify $c_t^{k,\tau}$ in equation (19). Hence, we have written the time t price of a call option with strike price k and expiry date τ in terms of expected post–election variables.

The same can be done accomplished for put options.

$$\begin{aligned} p_t^{k,\tau} &= \mathrm{E}[[k - s_\tau]^+ (1 + \frac{r_\tau(\tau - T)}{100 \times 360})^{-1}] | \mathcal{F}_t \\ &= \mathrm{E}[k - s_\tau]^+ | \mathcal{F}_t \; \mathrm{E}[(1 + \frac{r_\tau(\tau - T)}{100 \times 360})^{-1}] | \mathcal{F}_t. \end{aligned} \tag{22}$$

The second term in equation (22) can be found in equation (35). And, as shown in equation (39),

$$\begin{aligned} \mathrm{E}[k - s_\tau]^+ | \mathcal{F}_t &= \pi_t (k\Phi(\frac{\log k - a_C}{b_C}) - e^{a_C + \frac{b_C^2}{2}} \Phi(\frac{\log k - a_C - b_C^2}{b_C})) + \\ & \quad (1 - \pi_t)(k\Phi(\frac{\log k - a_L}{b_L}) - e^{a_L + \frac{b_L^2}{2}} \Phi(\frac{\log k - a_L - b_L^2}{b_L})). \end{aligned} \tag{23}$$

Substituting equations (23) and (35) into (22) thus demonstrates how the time t price of a put option with strike price k expiring on time τ can be written as a function of post–election FTSE–100 process parameters.

We now have written the prices of LIBOR futures, FTSE–100 futures, FTSE–100 call options, and FTSE–100 put options as functions of expected post–election parameters. Our ability to accomplish this is

what makes derivative prices valuable for the study of elections. However, the parameters included in the f_t^τ, m_t^τ, $c_t^{k,\tau}$, and $p_t^{k,\tau}$ formulas are unknown and must be estimated from financial data generated during the 1992 campaign. The next section of this paper describes how to estimate the unknown parameters in Equations (4), (12), (19), and (22) and thus form inferences about the expected post–election consequences of Conservative and Labour governments.

4 Estimation of Electoral Probabilities

This section of the paper explains how equations (4), (12), (19), and (22) can be used to calculate the expected post–election interest rate and FTSE–100 processes for both Labour and Conservative parties. Note, though, that both of these equations include electoral probabilities, the π_t terms, that characterize the probability of a Conservative victory at time t.

4.1 Electoral Probabilities in 1992

For all national elections, the sequence of electoral probabilities was unobserved and must be estimated before equations the pricing formulas can be used to estimate post–election coefficients. Following Roberts (1990*b*), Gemmill (1992), and Gemmill (1995), we estimate the π_t sequence for 1992 using Ladbrokes betting odds.

Ladbrokes is a betting operation or bookmaker in London that provides odds on *inter alia* UK elections. During the campaign, the odds often changed on a daily basis, reflecting new information concerning the relative standing of the Conservative and Labour parties. Given the odds that bookmakers offered during the 1992 race, it is possible to generate a sequence of electoral probabilities for the 1992 race.

On March 25, 1992, for instance, Ladbrokes offered the following odds:

Conservative	11:10
Labour	4:6
Liberal Democratic	400:1

The interpretation of the March 25 odds is as follows. If one wished to take the Conservative bet, a payment of £10 would be required. If the Conservatives subsequently won the most seats in the 1992 race, then £21 (the original £10 plus £11 for winning) would be paid to the bettor. Otherwise, the better would receive nothing, hence losing £10.

The betting odds quoted above reflect a positive house vigorish. This can be seen from the following: the sum of the probabilities calculated directly from the three bets is $\frac{10}{21} + \frac{6}{10} + \frac{1}{401} = 1.0788 > 1$. This is not surprising, as bookmakers must earn some profit to stay in business. Nonetheless, we can adjust for the vigorish by normalizing the probabilities.[13] After normalization, the probability of a Conservative win is $\frac{10}{21}\frac{1}{1.0788} = 0.4415$.

Ladbrokes odds were published in the Financial Times newspaper during the 1992 campaign, although odds were not published on all days.[14] In order to estimate a sequence of electoral probabilities, we collect the Ladbrokes odds, calculate probabilities using the normalizing method described above, and then linearly interpolated to estimate probabilities for those few days on which Ladbrokes data was not available. Henceforth, we assume that the probability of the Liberal Democrats receiving a majority of seats in the House of Commons was zero. And, we assume that the election constituted a Conservative versus Labour contest. Technically speaking, it was possible that no party would have won a majority in April, 1992, that Parliament would have hung. In this case, though, Labour almost certainly would have formed a coalition with the Liberal Democrats. In this sense, the assumption of a Labour versus Conservative contest is a reasonable conceptualization of the 1992 election campaign. Finally, on April 10, the day after voting in the 1992 election, we impose that the probability of a Conservative win was one and that of a Labour victory was zero.

4.2 Electoral Probabilities in 1983 and 1987

The lack of availability of Ladbrokes betting odds for 1983 and 1987 implies that another scheme must be created to estimate probabilities in these two elections. Thus, we create a mapping of opinion polls into electoral probabilities. Opinion poll data is not inherently useful in the construction of electoral probabilities; see the discussion in Herron et al. (1995) on this subject. Nonetheless, the unavailability of Ladbrokes data makes the use of opinion poll numbers necessary. This paper's mapping of poll data into probabilities is a modification of the method proposed in Gemmill (1992). See Shum (1995) for a discussion of various methods of translating poll figures into probabilities.

Recall that π_t is the probability of a Conservative win at time $T > t$. Let p_{C_t} denote the poll standing of the Conservative party at time t, and define p_{L_t} similarly. That is, p_{C_t} is the percentage of individuals who say they will vote Conservative. Sampling error in polls is ignored, as are individuals who claim they

[13] We assume that the house margin is the same for all bets, that Ladbrokes is risk neutral, and that the betting odds do not reflect time discounting. These are probably not very strong assumptions given the short time horizon of the bets.

[14] On one day, odds from a different bookmaker were published. The author thanks Gordon Gemmill for providing odds data for several days of the campaign.

are agnostic about vote choice. We assume that poll respondents reply to pollsters sincerely.

Let $\delta_t = p_{C_t} - p_{L_t}$. Then, $\pi_t = \mathrm{P}(\delta_T > 0)$, where $\mathrm{P}(\cdot)$ denotes probability. We further assume that changes in δ_t follow a random walk with $\delta_t - \delta_{t-1} \sim \mathrm{N}(\mu, \sigma^2)$, $t = 1, \ldots, \mathrm{T}$. Intuitively, this implies that each day's poll differential is subjected to a random shock; the shocks are assumed to be independent and identically distributed (i.i.d) normal random variables.[15] The parameter μ represents a drift in the direction of the Conservatives if $\mu > 0$ and in the direction of Labour otherwise. The variance parameter σ^2 reflects uncertainty regarding the election. The higher is σ^2, the more uncertain at any time $t < T$ the eventual election outcome.

Let $\epsilon_t \sim \mathrm{N}(\mu, \sigma^2)$. Intuitively, ϵ_t is the random shock to time t's poll disparity between the two competing parties. Then,

$$\begin{aligned}
\pi_t &\equiv \mathrm{P}(\text{ConservativeParty wins}) \\
&= \mathrm{P}(\delta_t + \sum_{j=t+1}^{T} \epsilon_j > 0) \\
&= \mathrm{P}(\delta_t + (T-t)\epsilon_t > 0) \\
&= \mathrm{P}(\epsilon_t > -\frac{\delta_t}{T-t}) \\
&= 1 - \mathrm{P}(\epsilon_t < -\frac{\delta_t}{T-t}) \\
&= 1 - \Phi(\frac{-\frac{\delta_t}{T-t} - \mu}{\sigma}) \qquad (24)
\end{aligned}$$

where $\Phi(\cdot)$, as before, is the standard normal distribution function. Note that the third equality follows from the i.i.d. assumption regarding shocks to δ_t.

This formulation of π_t has some intuitive implications. For instance, suppose $\mu = 0$ and let t be arbitrary. Then, as $\sigma^2 \to 0$, $\pi_t \to 1$ if $\delta_t > 0$ and $\pi_t \to 0$ otherwise. Also, as $\mu \to \infty$, $\pi_t \to 1$; similarly, as $\mu \to -\infty$, $\pi_t \to 0$. All of these implications are natural given the characterization of poll movement.

To estimate π_t, let $\hat{\mu}$ and $\hat{\sigma}^2$ denote the maximum likelihood estimators of μ and σ^2, respectively. These can be estimated from poll data which defines the δ_t sequence. Then, π_t can be estimated by substituting $\hat{\mu}$ for μ and similarly for $\hat{\sigma}^2$ in equation (24).

Poll data from the 1983 and 1987 British elections is culled from Butler and Kavanagh (1984, p. 125) and Butler and Kavanagh (1988, p. 125), respectively. For days on which multiple polls were released,

[15] Technically, the normality assumption allows δ_t to leave the interval $[-100, 100]$. This is unfortunate but not unreasonable from a modeling perspective.

p_{C_t} and p_{L_t} are unweighted averages of the day's poll results.[16] Linear interpolation is used to generate p_{C_t} and p_{L_t} figures for those days on which no polls were released.

Figure 1 consists of a plot of the probability of a Conservative victory as estimated by betting odds (1992) and opinion polls (1983 and 1987). In this figure, day 0 represents election day and day -1 the day after voting.

Figure 1 here

The electoral probabilities associated with 1983 and 1987 suggest that the Conservative party held a dominant position throughout the full campaign in both these election years. Although the beginning of the two campaigns witnessed probabilities close to 0.5, both elections were heavily slanted toward the Conservatives in the last ten days of campaigning. Indeed, the 1983 and 1987 races, according to the probability estimates developed in this paper, exhibited almost no uncertainty on voting day.

In contrast, Figure 1 demonstrates that the standing of the Conservative party in the 1992 national election fell throughout the majority of the campaign period. After beginning on March 12 with a probability of victory of 0.5642, the probability of a Conservative win increased over the next five days and subsequently began a precipitous decline to 0.2302 on April 7, two days before the election. Over April 8 and 9, the standing of the Conservative party increased dramatically; the party's probability of victory rose to 0.7496 on election day.

5 Estimation of Post–Election LIBOR and FTSE–100 Parameters

Now that we have generated a sequence of electoral probabilities for the British elections of 1983, 1987, and 1992, we turn to equation (5) and consider estimating the expected post–election LIBOR process under Conservative and Labour governments. Recall that f_t^T is the time t price of a LIBOR future delivering at time τ where $t < T < \tau$. We assume that the three election outcomes became known precisely at time T, and that the LIBOR rate subsequently followed a stochastic process whose coefficients might have depended on the election outcome. The expression for f_t^T in equation (5) depends on seven unknown parameters, r_L, $\bar{r}_C$, $\bar{r}_L$, ρ_C, ρ_L, θ_C, and θ_L. As such, we can write $f_t^T = f_t^T(r_L, \bar{r}_C, \bar{r}_L, \rho_C, \rho_L, \theta_C, \theta_L)$.

[16] A poll is considered valid on the final day of surveying; this ignores the fact that most opinion polls require multiple days for sampling. For example, the first poll in the dataset for the 1987 election was conducted on May 6–11. In this paper, the results from this poll are considered valid on May 11 only.

From t = the day after the election was called until T = the day after voting, we collect a data set of LIBOR futures that traded on LIFFE. See Table 1 for basic information on the three elections. The column in the table labeled "Dates in Sample" is the number of total days considering by the paper; note that LIFFE was not open on weekends.

For instance, during the 1992 campaign period there were a total of eight different LIBOR futures contracts that traded on LIFFE: in particular, we have data on the LIBOR futures contracts that delivered in June 1992, September 1992, December 1992, March 1993, June 1993, September 1993, December 1993, and March 1994. The prices of these contracts changed on a daily basis during the 1992 campaign, and Figure 2 plots the prices of two of the contracts, June, 1992 and March, 1994, during the campaign.

Figure 2 here

Three features of Figure 2 are noteworthy. First, since the March 1994 contract price was greater than that of the June 1992 contract, we conclude that LIBOR rates were expected to decrease by 1994 compared to the election period. The supporting logic is as follows. When the expected future rate r_τ decreases, then the pay off from the futures contract $100 - r_\tau$ increases.

Second, in both series plotted in Figure 2 there is a slight downward trend, more pronounced in the March 1994 contract price, during the middle fifteen days of the 1992 campaign. Comparing this trend with the patterns in Figure 1, we note that this period was one in which Labour's electoral standing was growing. This is rough evidence for the conclusion that higher interest rates were expected if Labour won the 1992 race.

Third, the last few days of the 1992 campaign featured a large rise in futures prices. Again consulting Figure 1, we note that the electoral probability of the Conservative party increased over the last four days of the race. This constitutes additional evidence that a Conservative win is associated with lower expected LIBOR rates.

Nonetheless, to examine rigorously the impact of UK government partisanship on the LIBOR rate, we use the pricing formula f_t^τ spelled out in equation (5). Let $\beta = (r_L, \bar{r}_C, \bar{r}_L, \rho_C, \rho_L, \theta_C, \theta_L)'$ so that β is the vector of unknown parameters relevant to LIBOR futures prices. Hence, $f_t^\tau = f_t^\tau(\beta)$. Let $\hat{\beta}$ denote an estimate of β and let $f_t^\tau(\hat{\beta})$ be f_t^τ evaluated at $\beta = \hat{\beta}$. For 1983, 1987, and 1992, $N = 112$, 192, and 176, respectively.

Consider the most recent election, 1992. For a given future i, $i = 1, \ldots, 176$, at a time $t(i) < T$ with a delivery date of $\tau(i) > T$, let the actual price of the future be denoted as y_i. We write $t(i)$ and $\tau(i)$ to

denote the dependence of price date and delivery date on i. Let $d_i = \tau(i) - t(i)$ so that d_i is the number of days in between t and the future's delivery date. We assume

$$y_i = f_{t(i)}^{\tau(i)}(\beta) + \epsilon_i. \tag{25}$$

In other words, equation (25) expresses the actual future price y_i as the sum of the future price formula from equation (5) and an error term which is assumed to be normally distributed with mean zero, variance of $\nu^2 d_i^\alpha$, and serially uncorrelated over i.[17]

We use maximum likelihood to estimate the unknown parameters in equation (25). The loglikelihood function $\log L$ is

$$\log L = -\frac{N}{2}\log(2\pi) - \frac{1}{2}\sum_{i=1}^{N}(\log(\nu^2 d_i^\alpha) + \frac{1}{\nu^2 d_i^\alpha}(y_i - f_{t(i)}^{\tau(i)}(\beta))) \tag{26}$$

For each of the three elections examined by this paper, equation (26) appears to have numerous local minima, and the choice of starting values in the maximization algorithm is non–trivial.[18] However, after considering numerous different choices of starting values, equation (26) is minimized when $\hat{\beta}$ is as specified in Table 2.[19]

The coefficient estimates in Table 2 testify strongly to a political influence on expected LIBOR rates following the British elections of 1983, 1987, and 1992.[20] Recall that r_L is the LIBOR rate at time T, conditional on a Labour victory. This parameter, unlike r_C, was not observed and can only be estimated; the three observed values of r_C can be found in Table 1. For the 1983 and 1987, the estimated r_L value in Table 2 is not significantly different from observed r_C value at conventional significance levels; indeed, the estimated r_L in 1983 is not significantly different than zero. Some intuition on the 1983 case is discussed later in this section of the paper.

However, the 1992 estimated value of r_L is significantly different from $r_C = 10.4365$, the observed

[17] For an empirical finance paper with a similar error structure, see Brown and Dybvig (1986).

[18] An additional numerical problem is that the step size at numerous β values was calculated as less than machine precision. When the optimizing code was faced with this problem, it ceased calculations.

[19] All likelihood function derivatives are calculated numerically using finite–differences. The estimated variance–covariance matrix of the estimated parameters is calculated using the inverse of the outer product of the matrix of loglikelihood function gradients. This measure of the estimated variance–covariance in theory will always be positive–definite. However, if the step size used in the finite difference calculations was smaller than, in general, 5×10^{-7}, it proved impossible to invert the outer product of the matrix of gradients. The conditioning index in this case was simply too small and the resulting matrix was effectively rank deficient.

[20] All estimates and estimated standard errors are to four significant figures.

Table 2: Coefficient Estimates for Post–Election LIBOR Processes

	1983	1987	1992
r_L	10.14	8.072	11.45
	(20.47)	(2.563)	(0.1468)
$\bar{r}_C$	6.894	4.523	4.765
	(0.2500)	(0.3026)	(0.02977)
$\bar{r}_L$	7.164	6.203	5.651
	(0.4606)	(0.4730)	(0.1183)
ρ_C	0.007212	0.004718	0.005281
	(0.002087)	(0.001917)	(0.001385)
ρ_L	0.08258	0.01365	0.004924
	(0.003940)	(0.004170)	(0.001004)
θ_C	1.601	0.7528	0.9497
	(0.0094207)	(0.03891)	(0.001554)
θ_L	5.804	2.001	1.052
	(0.29726)	(0.1220)	(0.001951)
ν	0.1078	0.04974	0.4128
	(1.033)	(51.59)	(5.777)
α	-0.2009	0.0451	-0.4556
	(1.933)	(1.842)	(2.393)

(Estimated Standard Errors in Parentheses)

three–month LIBOR rate after the Conservatives won their third consecutive election. As expected, the three–month LIBOR rate the day after a Labour win was expected to be larger than that observed under the Conservative victory. Of further interest is the difference between the estimated values of $\bar{r}_C$ and $\bar{r}_L$, ρ_C and ρ_L, and θ_C and θ_L. These differences are listed in Table 3.[21]

Several patterns are visible in Table 3. First, the top and bottom rows of the table, pertaining to estimated values of $r_C - r_L$ and $\theta_C - \theta_L$, feature only negative entries. This cursory observation suggests that interest rates are lower under Conservatives than under Labour and also that interest rate uncertainty is greater under Labour. Of the six estimated coefficient differences in these two rows, four are individually significant at the 0.05 level.

Turning to the top row of Table 3, two of three estimated $r_C - r_L$ pairs is significantly different from zero at the 0.05 level. This is strong testimony to a political impact on the three–month LIBOR rate. Furthermore, the difference in 1987, -1.680, is larger than the estimated difference in 1992, -0.8855. This suggests that the Labour–Conservative disparity *vis–a–vis* the three–month LIBOR was greater in 1987 than in 1992. In general, high interest rates are associated with expected future inflation, so that the

[21] The standard errors of the estimated coefficient differences in Table 3 reflect estimated covariances that are not listed in Table 2. A full set of results, including all estimated covariances, is available from the author.

Table 3: Estimated Coefficient Differences for Post–Election LIBOR Processes

	1983	1987	1992
$r_C - r_L$	-0.2697	-1.680*	-0.8855*
	(0.7267)	(0.7411)	(0.3483)
$\rho_C - \rho_L$	-0.07537	-0.008930	0.0003570
	(0.2008)	(0.07270)	(0.04750)
$\theta_C - \theta_L$	-4.203*	-1.248*	-0.1020
	(0.5330)	(0.3606)	(0.1542)

* $p < 0.05$, individual coefficient two–tail test
(Estimated Standard Errors in Parentheses)

incidence of higher interest rates under Labour is tantamount to higher inflation under Labour.

This finding is entirely commensurate with the informal literature on British politics. The Labour Party in 1987 was perceived as a strong leftist party, and it attempted to shed some of this image prior to the 1992 election. As documented in Seyd (1993), the Labour party following its third loss at the polls in 1987 began a siginificant policy review. The party altered its stance on public versus private ownership in favor of the latter and claimed that a Labour government would intervene in the market only when market forces proved unsatistactory (p. 76). Inasmuch as left parties are associated with high interest rates and high levels of inflation, the analysis of LIBOR futures suggests that Labour's post–1987 election move to the right was real rather than purely titular.

The middle row of Table 3 lists coefficients differences that all fail to be significantly different than zero. Recall from the discussion of equation (2) that the ρ parameter controls the rate of mean reversion. When row two estimates in Table 3 suggest that there was no appreciable political influence on the rate of mean reversion of the three–month LIBOR.

Finally, the bottom row to Table 3 is testament to policy uncertainty induced by a potential Labour government. Note that the difference in θ coefficients is significantly negative for both the 1983 and 1987 elections. The implication is that a Labour government in both of these two elections would be accompanied by significant uncertainty over interest rates; it is not possible to establish political bias on interest rate uncertainty for the 1992 race.

Furthermore, the difference in θ coefficients is greater in 1983 compared to 1987 and the same is true comparing 1987 and 1992. This is commensurate with a Labour move politically right. As the Labour party gradually stabilized its platform and headed in the direction of the political center, the uncertainty surrounding the interest rate implications of its policies attenuated from a high in 1983 to statistically

insignificant levels in 1992.

What we have garnered from the LIBOR rate estimation is the following. Given the economic conditions surrounding the UK in 1983, 1987, and 1992 and the nature of the Conservative and Labour parties during their election battles of those years, we conclude that the financial markets believed that the Labour party was *ceteris paribus* associated with higher interest rates and greater policy uncertainty. Furthermore, the estimates in Table 2 and Table 3 identify a temporal dimension to the Labour–Conservative battle. Namely, the implications of a Labour victory were not fixed; they varied in time, in a fashion commensurate with intuitive and informal judgements of British politics. Broadly, since higher interest rates are associated with high inflation rates, this paper has adduced additional evidence that left–wing governments are more inflation–prone than their right–wing counterparts.

As advanced above, the primary concern with Table 2 is the imprecision of the estimated r_L coefficient for the 1983 election. Most likely, the high estimated standard error of 20.47 is a function of the uneven election campaign of 1983. The election of 1983, and that of 1987 as well, was never a contest in the manner of the 1992 race. While on the theoretical side this does not diminish the validity of the pricing formulas developed in previous sections of this paper, from an intuitive angle elections with lopsided campaigns are more difficult to analyze with the methodology described in this paper. The amount of Labour information contained in the LIBOR prices of 1983 and 1987 is small on account of the sequence of low Labour electoral probabilities. To the extent, then, that the real LIBOR prices are noisy, the ability to extract Labour information from LIBOR prices in 1983 and 1987 is diminished. This most likely accounts for the imprecise 1983 coefficients in Table 2.

We turn next to the analysis of the expected post–election FTSE–100 process. As in the case of LIBOR futures, we collect a set of FTSE–100 futures and options that traded on LIFFE during the 1987 and 1992 election campaigns. However, as noted the FTSE–100 did not exist during 1983, so this prevents our investigating this index in the context of the 1983 election. Furthermore, data on FTSE–100 options is only electronically available for the 1992 campaign; for the 1987 we have only FTSE–100 future data.[22]

Across the various strike prices and including calls and puts, the option sample for 1992 has a total of 1355 observations and there are 52 future price observations; the full sample is thus 1407. The 1987 sample is very small; there are only 49 future price observations available. Given this small sample and the fact that the estimates in this paper rely on asymptotic theory, we should expect the 1987 estiamtes to be quite unreliable.

[22]The 1992 FTSE–100 option sample begins a day later than the 1992 LIBOR futures sample because of institutional changes in the UK. In March 1992, LIFFE merged with the London Traded Options Market, and LIFFE listed the FTSE–100 options beginning on March 13, 1992.

Figure 3 here

The campaign period prices of two May 1992 FTSE–100 call options, strike prices of 2225 and 2425, are plotted in Figure 3. The trends in Figure 3 bear resemblance to those illustrated in Figure 2. Both option prices captured in the figure ease downward during most of the campaign and then rapidly increase at the campaign's conclusion. Since *ceteris paribus* the price of call options increases when the future value of the underlying index increases, the trends in Figure 3 constitute casual evidence that a Conservative win in 1992 was associated with higher expected FTSE–100 values.

Let $\alpha = (S_{L_T}, \eta_C, \eta_L, \gamma_C, \gamma_L)'$ so that α is the vector of unknown parameters that drive the post–election FTSE–100. We denote a FTSE–100 future's price as $m_t^\tau(\alpha)$; for a call option, we denote its price as $c_t^{k,\tau}(\alpha)$, whereas a put option's price is written $p_t^{k,\tau}(\alpha)$.

In order to estimate α, we follow a similar procedure to that used to estimate β, the vector of parameters that drives the post–election LIBOR process. For a FTSE–100 derivative i, $i = 1, \ldots, N$, $N = 49$ or 1407 depending on the election year, let the real price of the option be denote x_i. Depending on i's type, the theoretical price of the derivative, $d_t^{k,\tau}$, may be $c_t^{k,\tau}$ if i is a call option, $p_t^{k,\tau}$ if a put option, and m_t^τ if i is a future.[23] Since m_t^τ, $c_t^{k,\tau}$, and $p_t^{k,\tau}$ depend on α, we write $m_t^\tau = m_t^\tau(\alpha)$, $p_t^{k,\tau} = p_t^{k,\tau}(\alpha)$, and $p_t^{k,\tau} = p_t^{k,\tau}(\alpha)$. For a given estimate $\hat{\alpha}$ of α, we write the estimate of option i's price as $d_t^{k,\tau}(\hat{\alpha})$.

As can be seen in equations (12), (19) and (22), the prices of FTSE–100 derivatives depend on the expected three–month LIBOR rate. For the calculation of FTSE–100 derivative prices, we assume that the interest rate parameters, estimated above using LIBOR futures, are fixed at their estimated values in Table 2. We also assume that

$$x_i = d_{t(i)}^{\tau(i)}(\alpha) + \epsilon_i \tag{27}$$

where, as before, we assume ϵ_i is a normally distributed mean zero, serially uncorrelated error term with variance $\phi_\omega^2 \, d_i^{\xi_\omega}$, $\omega \in \{\text{future}, \text{option}\}$, and $d_i = \tau(i) - t(i)$. In this formulation, typeω denotes futures and options, so that the variance of the error term in equation (27) depends on i's type.

The likelihood function for the FTSE–100 derivatives is the same as that given in equation 26 and thus is not repeated. Numerically speaking, the likelihood function for FTSE–100 derivatives is reasonably well–behaved. The optimal values of $\hat{\alpha}$, elements of which are listed in Table 4, are not sensitive to starting

[23] This notational convention appears to suggest that future prices depend on a value of k, but this is not the case.

values.[24] However, the pricing errors resulting from the FTSE–100 estimates are in general proportionately larger than pricing errors generated by equation (26).[25]

Table 4: Coefficient Estimates for Post–Election FTSE–100 Process

	1987	1992
S_{L_T}	2112	2324
	(102.9)	(125.7)
η_C	-7.035×10^{-5}	2.176×10^{-5}
	(100.3)	(5.530×10^{-4})
η_L	-2.2362×10^{-4}	3.143×10^{-4}
	(3774)	(1.077×10^{-3})
γ_C	9.773×10^{-4}	9.980×10^{-5}
	(2007)	(2.172×10^{-4})
γ_L	1.002×10^{-3}	1.364×10^{-4}
	(7547)	(2.790×10^{-4})
ϕ_{future}	538.9	275.9
	(4815)	(3946)
ξ_{future}	3.251×10^{-2}	5.628×10^{-1}
	(2.216)	(28.08)
ϕ_{option}	—	2303
		(22419)
ξ_{option}	—	-5.161×10^{-1}
		(2.491)

(Estimated Standard Errors in Parentheses)

The estimates in Table 4, like those in Table 2, confirm the existence of government partisan effects on the economy; the results in the table are not particularly strong, though. Turning first to the 1987 estimates, recall that the FTSE–100 observed the day after the election was $S_{C_T} = 2289.5$. A 90% confidence interval for S_{L_T} is (1942,2882), and this suggests that the Labour Party in 1992 was associated with lower equity markets than the Conservative Party.[26] The point–estimate of the percentage difference is 8.4%. However, the sizable imprecision of the other 1987 estimates in Table 4 cast doubt on the value of the FTSE–100 analysis for 1987. As noted, due to the lack of FTSE–100 options, the full 1987 FTSE–100 sample is extremely small. It is thus not surprising that we are unable to say very much about the political influence on British equity markets in 1987.

Considering 1992, recall that the level of the FTSE–100 index was 2572.6 after the third consecutive re–election of the Conservative Party was confirmed. According to the estimate of S_{L_T}, the FTSE–100

[24] The lack of sensitivity to starting values break down only when the starting values are absurd.
[25] See fn. 19 for comments on the calculations of the standard errors Table 4.
[26] A value of S_{L_T} is significantly less than 2289.5, the observed FTSE–100 index after the 1992 election, using a one–tailed hypothesis test.

would have been 2327.97 had Labour won; this difference is approximately 10.5%; a 95% confidence interval for S_{L_T} is (2078,2570). In another paper that considers option prices in the 1992 British election, Gemmill (1995, p. 25) estimates that the Conservative–Labour difference in the FTSE–100 index would have been 14%. However, Gemmill's (1995) 14% figure ignores partisan induced changes in interest rates and results not from statistical estimation but rather from the fact that a pricing equation in Gemmill's paper is infeasible for values lower than 14%.[27] Nonetheless, Gemmill notes that the British press posited a 10% Conservative–Labour difference in the FTSE–100 index. This number is remarkably close to the 10.5% estimate generated by this paper. Indeed, the similarity in these numbers constitutes support for this paper's conclusions.

Considering the other FTSE–100 coefficient estimates, we see that the other substantive coefficients of interest, η_C, η_L, γ_C, and γ_L, all fail to be insignificantly different than zero. While this is not the most heartening finding, it is worth mentioning that the t–ratios in 1992 are much larger than those for the 1987 estimates. This suggests that a larger sample size in 1987 would have improved the extensive standard errors in the first column of Table 4.

Overall, the picture painted by Table 4 is that a Labour victory in 1992 would have dealt a strong blow to British stock markets. However, following the shock, the estimates say little about future stock market behavior. Needless to say, the approximate 10% drop in the FTSE–100 index is quite meaningful. The 1987 estimate of the immediate post–election drop is less precise, but still highly suggestive that the British equity markets would have fallen drastically had Labour won in 1987.

In the discussion of the LIBOR results in Tables 2 and 3, we noted that the temporal variation in coefficient differences was logical given the vagaries of British politics during the past two decade. Unfortunately, it is not possible to construct this form of argument for the FTSE–100 data because the index *per se* did not exist in 1983, and the FTSE–100 1987 data sample is extremely small.

6 Conclusion

The purposes of this paper are twofold. First, we have developed a methodology capable of analyzing the relation between government partisanship and national economics. Importantly, the methodology extends the analytical reach beyond what the current literature on electoral cycles is capable of considering. In particular, the methodology generates snapshots of government partisanship in individual election years.

[27] Consequently, the precision of the 14% figure is questionable and Gemmill provides no standard errors for his estimates of what the FTSE–100 would have been had Labour won in 1992. In fact, no standard errors are given in the entire paper.

When employing the tools developed in this paper to several elections in a given country, each election may be considered unique and researchers need not assume that the effects of government partisan on the economy are identical across different elections.

Second, we applied the methodology to the British elections of 1983, 1987, and 1992 and found strong evidence for the existence of government partisanship effects on the UK economy. Recalling that the Conservative party won all of these elections, we estimated that interest rates would have been higher had Labour won any of the elections, and we estimate that stock market prices would have been lower had Labour been victorious in 1992. We also estimated the expected dynamics of these two economic variables under Labour and Conservative governments, and the analysis suggests greater interest rate uncertainty under Labour than under Conservative rule. Overall, the paper provides a precise characterization of the impact of partisanship in the UK during the past fifteen years.

The assumptions regarding party stationary made in this paper are in general weaker than those made in the existing literature that covers the relation between government partisanship and economic effects. As such, the conclusions we generated can be considered plausibly robust and a strong confirmation of the nexus between government policies and economic outcomes. Furthermore, by allowing government partisanship to have a temporal dimension, the papers contributes to the understanding of the relation between partisanship and national–level economics.

Importantly, this paper has found concrete evidence for the existence of temporal variability in government partisanship effects on the economy. The assumption of no temporal variability in partisanship effects is key to the empirical analyses ensconced within most of the present body of scholarship which considers the impact of government partisanship. Therefore, a corollary to this paper's empirical results is that the findings contained in the current literature may rest on tenuous assumptions.

The results in this paper have theoretical import in several fashions. First, we conclude from the estimates in the paper that left–wing governments are substantively distinct from their right–wing counterparts, at least in the UK since 1983. That a Labour government would have induced higher interest rates than what was observed under winning Conservative governments is testimony to higher inflation rates under Labour. The finding regarding stock market behavior translates to slower economic growth under Labour, although the conclusions concerning stock market behavior are somewhat tentative.

Second, the paper has implications for theories of domestic politics in light of growing international trade. Some recent scholarship has theorized that domestic distinctions will become increasingly vacuous as nations become increasingly connected via international economics. Nonetheless, the results of this

paper demonstrate that domestic government partisanship influenced national–level economics as late as 1992. It is true that the estimated impact of UK government partisanship on economics appears to have diminished from 1983 to 1992. Whether this is evidence solely of Conservative–Labour dynamics or a function of international factors is beyond the scope of this paper.

It is indeed unfortunate that the three most recent British elections, those for which data availability is feasible, all featured incumbents defeating challenging parties. It is possible that some of the points articulated in this paper are biased by this fact. When the analysis is extended to the next British election, due in 1996 or 1997, it may be possible to address this issue if Labour proves victorious in the campaign. In addition, the analytical techniques posited in this paper will be applied to recent American elections. This may yield results that have bearing on government partisanship effects in parliamentary versus presidential nations.

In summary, this paper has developed a new system with which to assess the impact of government partisanship on the economy, and the methodology developed in this paper opens up the door for numerous research programs. Using the tools in this paper, we can rigorously track political parties and government partisanship over time, something that literature in political science has yet to accomplish. Furthermore, the methodology is not country specific, so comparative analyses across countries and different political institutions will be facilitated by the methods developed here.

A Calculations for LIBOR futures price

This appendix calculates the price of a LIBOR future; this is necessary to complete Equation (4). Recall that the time t price of a LIBOR futures depends on the expected LIBOR rate r_τ at time $\tau > t$. Let $m = \frac{\tau - t}{360 \times 100}$ and $d = \frac{1}{m}$. Then,

$$\begin{aligned} f_t^\tau &= \mathrm{E}[(100 - r_\tau)(1 + \frac{r_\tau}{d})^{-1}]|\mathcal{F}_t \\ &= \mathrm{E}[(100 - r_\tau)\frac{d}{r_\tau + d}]|\mathcal{F}_t \\ &= 100d\mathrm{E}[\frac{1}{r_\tau + d}]|\mathcal{F}_t - d\mathrm{E}[\frac{r_\tau}{r_\tau + d}]|\mathcal{F}_t \end{aligned} \tag{28}$$

Before continuing with Equation (28), we perform several calculations. Let $x \sim \mathrm{N}(\mu, \sigma^2)$. Then,

$$
\begin{aligned}
\mathrm{E}[\frac{1}{x+m}] &= \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\sigma} \frac{1}{x+d} e^{-\frac{1}{2\sigma^2}(x-\mu)^2} dx \\
&= \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\sigma} \frac{1}{y} e^{-\frac{1}{2\sigma^2}(y-d-\mu)^2} dy \\
&= \frac{1}{\sqrt{2\pi}\sigma} \int_{-\infty}^{\infty} \frac{1}{y} e^{-\frac{1}{2\sigma^2}(y-d-\mu)^2} dy \\
&= \frac{1}{\sqrt{2\pi}\sigma} [\pi e^{-\frac{\mu+d}{2\sigma^2}} \mathrm{erfi}(\frac{\mu+m}{\sigma\sqrt{2}})] \\
&= \frac{\sqrt{\pi}}{\sigma\sqrt{2}} e^{-\frac{\mu+d}{2\sigma^2}} \mathrm{erfi}(\frac{\mu+m}{\sigma\sqrt{2}})
\end{aligned}
\tag{29}
$$

where $\mathrm{erfi}(\cdot)$ is the imaginary error function and the fourth equality can be calculated using Mathematica. Also, note that

$$
\begin{aligned}
\mathrm{erfi}(x) &= -i\mathrm{erf}(ix) \\
&= i(1 - \mathrm{erfc}(-ix)) \\
&= iD(x)\frac{2}{\sqrt{\pi}} \frac{1}{i} e^{x^2} \\
&= \frac{2}{\sqrt{\pi}} e^{x^2} D(x)
\end{aligned}
\tag{30}
$$

where $D(\cdot)$ is Dawson's Integral. Substituting Equation (30) into Equation (29) yields

$$
\mathrm{E}[\frac{1}{x+m}] = \frac{\sqrt{2}}{\sigma} D(\frac{\mu+m}{\sigma\sqrt{2}}) \tag{31}
$$

Conditional on a win by party $\omega \in \{L, C\}$, $r_\tau \sim \mathrm{N}(\mu_L, \sigma_L^2)$ where $\mu_L$and σ_L are defined as in equations (2) and (2). Therefore, the first term in Equation (28) is

$$
\pi_t(100d\frac{\sqrt{2}}{\sigma_C})D(\frac{\mu_C+d}{\sigma_C\sqrt{2}}) + (1-\pi_t)(100d\frac{\sqrt{2}}{\sigma_L}D(\frac{\mu_L+d}{\sigma_L\sqrt{2}})) \tag{32}
$$

To calculate the second term,

$$
\begin{aligned}
d\mathrm{E}[\frac{r_\tau}{r_\tau + d}] &= d\int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\sigma}\frac{x}{x+d}e^{-\frac{1}{2\sigma^2}(x-\mu)^2}dx \\
&= d\int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\sigma}\frac{y-d}{y}e^{-\frac{1}{2\sigma^2}(y-d-\mu)^2}dy \\
&= d - \frac{d^2}{\sqrt{2\pi}\sigma}\int_{-\infty}^{\infty}\frac{1}{y}e^{-\frac{1}{2\sigma^2}(y-d-\mu^2)}dy \\
&= d - d^2\frac{\sqrt{2}}{\sigma}D(\frac{\mu+d}{\sigma\sqrt{2}}) \qquad (33)
\end{aligned}
$$

Therefore, the second term in Equation (28) is

$$
\pi_t(d - d^2\frac{\sqrt{2}}{\sigma_C}D(\frac{\mu_C+d}{\sigma_C\sqrt{2}})) + (1-\pi_t)(d - d^2\frac{\sqrt{2}}{\sigma_L}D(\frac{\mu_L+d}{\sigma_L\sqrt{2}})). \qquad (34)
$$

Finally, substituting Equations (32) and (34) into (28) gives the expression in Equation (5).

B Calculations for Interest Rate Adjustments

The time t present value of a 1 unit of account at time $\tau > t$ is

$$
\begin{aligned}
\mathrm{E}[(1 + r_\tau\frac{\tau - t}{100\times 360})^{-1}]|\mathcal{F}_t &= \mathrm{E}[(\frac{d+r_\tau}{d})^{-1}]|\mathcal{F}_t \\
&= \mathrm{E}[\frac{d}{d+r_\tau}] \\
&= d\sqrt{2}[\pi_t\frac{1}{\sigma_C}D(\frac{\mu_C+d}{\sigma_C\sqrt{2}}) + (1-\pi_t)\frac{1}{\sigma_L}D(\frac{\mu_L+d}{\sigma_L\sqrt{2}})] \qquad (35)
\end{aligned}
$$

where the third equality follows from the calculations in Appendix A.

C Calculations for FTSE–100 Option Prices

To calculate the price of a FTSE–100 call option, we need to simplify $\mathrm{E}[s_\tau - k]^+|\mathcal{F}_t$. Recall that $\log(s_t)$ conditional on an election outcome at T is normally distributed with mean μ_ω and variance $\sigma^2_\omega, \omega \in \{L, C\}$; these terms are defined in Equations (15) through (18). We temporarily ignore the distinction between a_L and a_C and b_L and b_C. We then have that

$$\begin{aligned}
\mathrm{E}[s_\tau - k]^+|\mathcal{F}_t &= \int_0^\infty \frac{1}{xb\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2][x-k]^+ dx \\
&= \int_k^\infty \frac{1}{xb\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2][x-k] dx \\
&= \int_k^\infty \frac{1}{b\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2] dx - k\int_k^\infty \frac{1}{xb\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2] dx \quad (36)
\end{aligned}$$

The first term in Equation (36) is

$$\begin{aligned}
\int_k^\infty \frac{1}{b\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2] dx &= \int_{\log k - a}^\infty \frac{1}{b\sqrt{2\pi}} e^{-\frac{1}{2b^2}u^2} e^u e^a du \\
&= e^a \int_{\log k - a}^\infty \frac{1}{b\sqrt{2\pi}} e^{-\frac{u^2}{2b^2}+u} du \\
&= e^{a+\frac{b^2}{2}} \int_{\log k - a}^\infty \frac{1}{b\sqrt{2\pi}} e^{-\frac{1}{2b^2}(u-b^2)^2} du \\
&= e^{a+\frac{b^2}{2}}(1 - \Phi(\frac{\log k - a - b^2}{b})) \quad (37)
\end{aligned}$$

The second term in Equation (36) is

$$\begin{aligned}
k\int_k^\infty \frac{1}{xb\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2] dx &= k\int_{\log k - a}^\infty \frac{1}{b\sqrt{2\pi}} e^{-\frac{1}{2b^2}u^2} du \\
&= k(1 - \Phi(\frac{\log k - a}{b})) \quad (38)
\end{aligned}$$

Substituting equations (37) and (38) into (36), and distinguishing between a_L and a_L and $b_L$and b_C, then yields equation (21).

The time t price of a FTSE–100 put option may be calculated similarly.

$$\begin{aligned}
\mathrm{E}[k - s_\tau]^+|\mathcal{F}_t &= \int_0^\infty \frac{1}{xb\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2][k-x]^+ dx \\
&= \int_0^k \frac{1}{xb\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2][k-x] dx \\
&= k\int_0^k \frac{1}{xb\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2] dx - \int_0^k \frac{1}{b\sqrt{2\pi}} \exp[-\frac{1}{2b^2}(\log x - a)^2] dx \quad (39)
\end{aligned}$$

The first term in equation (39) is

$$\begin{aligned} k\int_0^k \frac{1}{xb\sqrt{2\pi}}\exp[-\frac{1}{2b^2}(\log x - a)^2]dx &= k\int_{-\infty}^{\log k - a} \frac{1}{b\sqrt{2\pi}} e^{-\frac{1}{2b^2}u^2}du \\ &= k\Phi(\frac{\log k - a}{b}) \end{aligned} \tag{40}$$

and the second term is

$$\begin{aligned} \int_0^k \frac{1}{b\sqrt{2\pi}}\exp[-\frac{1}{2b^2}(\log x - a)^2]dx &= e^a\int_{-\infty}^{\log k - a} \frac{1}{b\sqrt{2\pi}} e^{-\frac{1}{2b^2}u^2+u}du \\ &= e^{a+\frac{b^2}{2}}\int_{-\infty}^{\log k - a} \frac{1}{b\sqrt{2\pi}} e^{-\frac{1}{2b^2}(u-b^2)^2}du \\ &= e^{a+\frac{b^2}{2}}\Phi(\frac{\log k - a - b^2}{b}) \end{aligned} \tag{41}$$

Substituting equations (40) and (41) into equation (39) yields equation (23).

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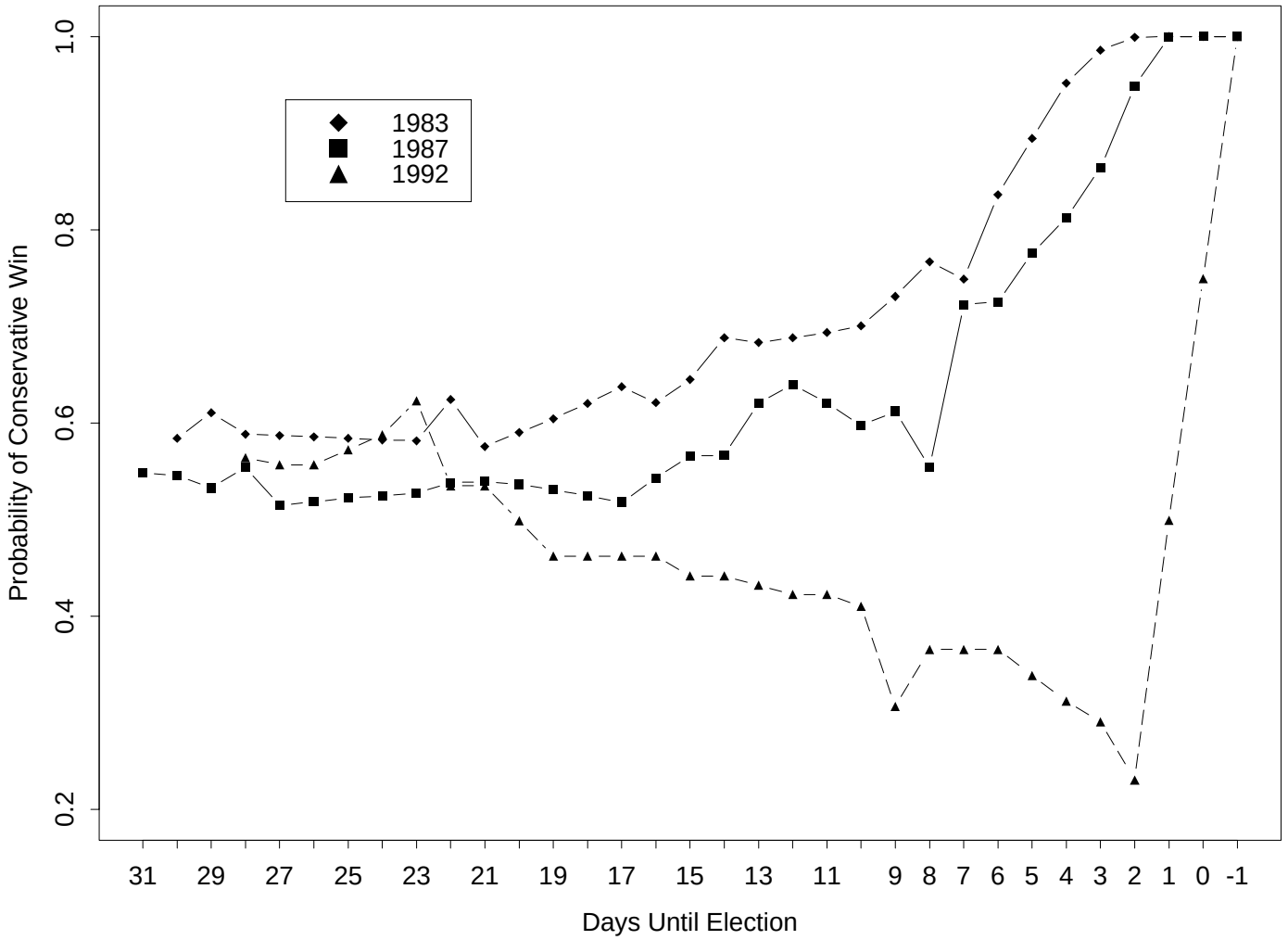

Figure 1: Plot of Conservative Electoral Probabilities

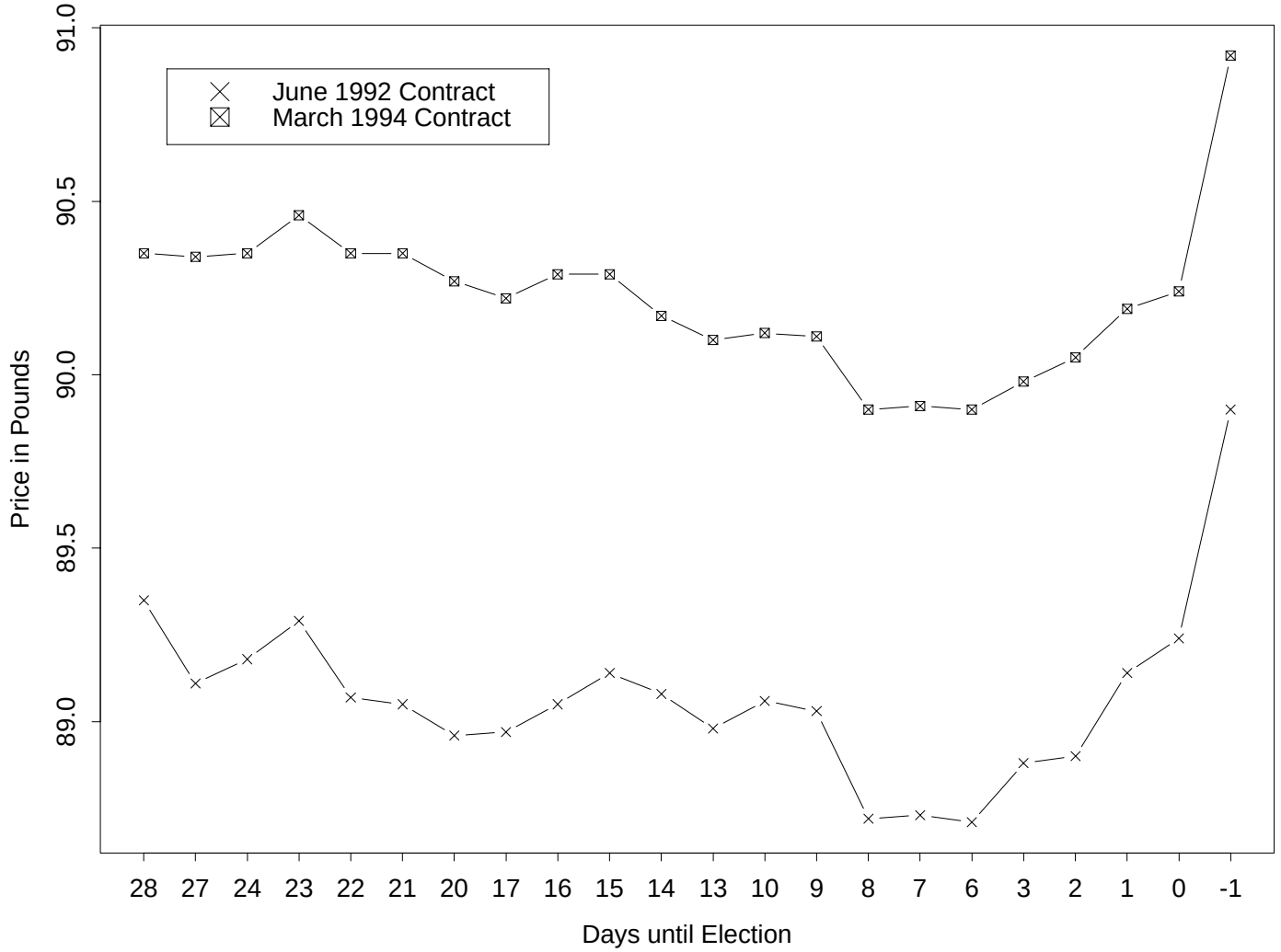

Figure 2: Plot of Futures Contract Prices During the 1992 Campaign

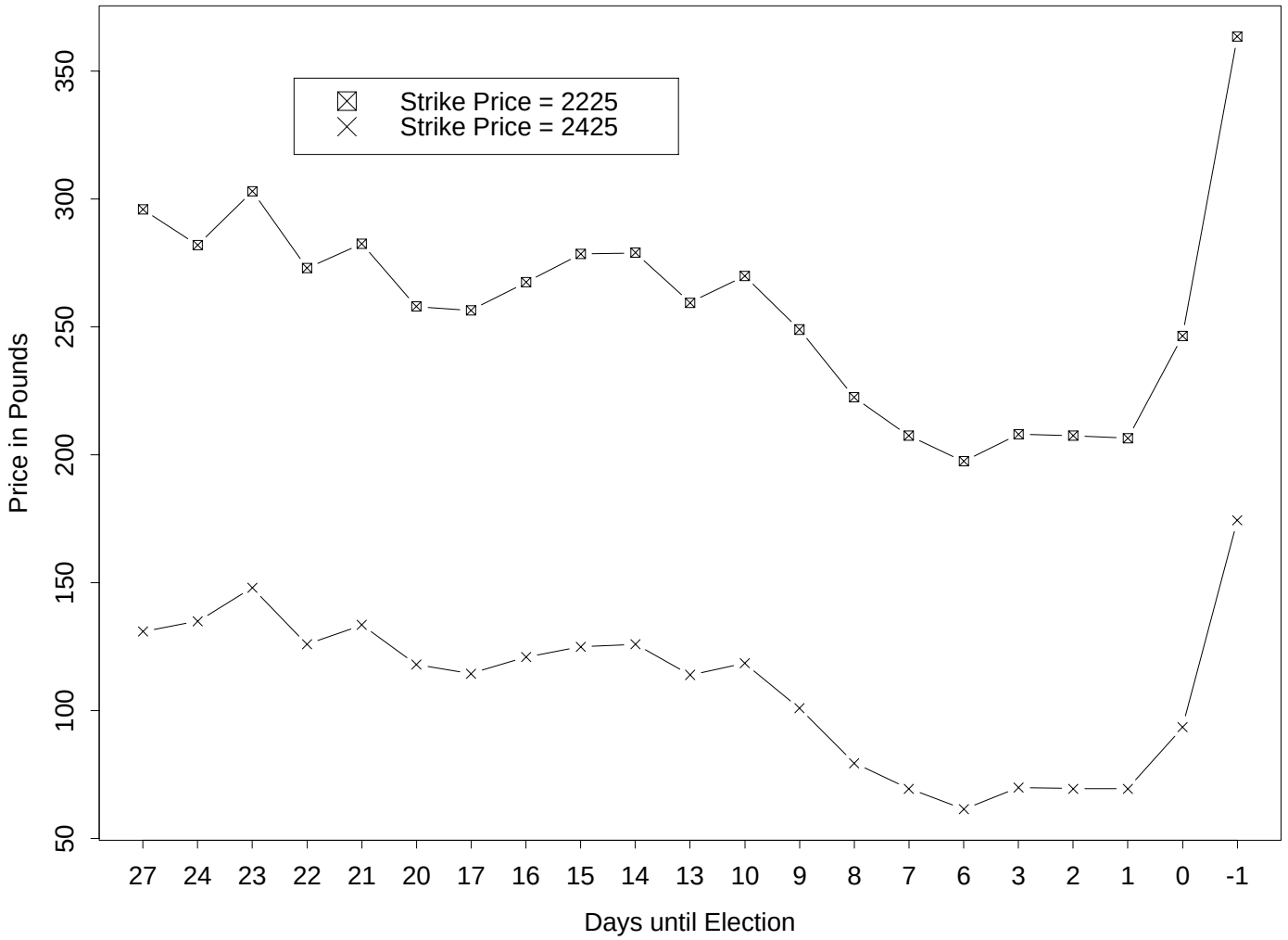

Figure 3: Plot of Call Option Prices During the 1992 Campaign