# Unstable Respondents Make Approval Rate Unstable: Beta Binomial Regression for Proportion Data Composed of Heterogeneous Binary Responses Ver.1.2 *

Kentaro Fukumoto †

October 21, 2005

**Abstract**

Most works on approval use linear normal model, though its assumption is seriously flawed and their standard errors are not correct. Instead, I employ beta binomial model with logit link. It not only fixes heteroskedasticity and boundedness of approval but also enables researchers to detect how heterogeneous citizens are and what makes them so. I argue that undecided respondents like Independent voters make apprival rate volatile. Moreover, to many factors which scholars have found affect approval, I add two new ones: international circumsances and prime ministers' youth. An empirical application to approval of the Japanese cabinets shows my model works.

*This is a paper prepared for a workshop at Univeristy of Tokyo. I appreciate Jim Alt, Barry C. Burden, Gary King, Olivia Lau and Jasjeet S. Sekhon for their comment on earlier drafts at Harvard University.

†Associate Professor, Department of Political Science, Gakushuin University, Tokyo, Kentaro.Fukumoto@gakushuin.ac.jp.

(This is work in progress. Comments are really welcome. Please don't cite this paper without author's permission.)

# 1 Introduction

Why is approval rate of the government so volatile? Scholars have argues that political factors (e.g. party support level) and economic ones (e.g. GDP growth rate) affect approval. According to them, when these causes change, approval also change. This is obvious. Even if these explanatory variable have the same value, however, approval still fluctuates. That is a question. Once we pay attention to variance of approval, we need a new method.

Most works on approval use linear normal model, though its assumption is seriously flawed and their standard errors are not correct. Instead, I employ beta binomial model with logit link. It not only fixes heteroskedasticity and boundedness of approval but also enables researchers to detect how heterogeneous citizens are and what makes them so. I argue that undecided respondents like Independent voters make approval rate volatile. Moreover, to many factors which scholars have found affect approval, I add two new ones: international circumsances and prime ministers' youth. An empirical application to approval of the Japanese cabinets shows my model works.

The remainder of this paper is composed as follows. The next section argues that beta binomial model with logit link is more appropriate than linear normal model. It also plugs error correction mechanisim into the model. The third section introduces some explanatory variables. In the following section, my model is applied to approval rate on the Japanese cabinets and present the results utilizing simulation method. Finally, I conclude.

# 2 Model

## 2.1 Heteroskedastic Normal Distribution

Most studies on approval rate (implicitly) assume that the rate follows the homoskedastic normal distribution condional on independent variables. To begin with, by constructing its data generation process, I show the variance is heteroskedastic and homoskedasticity assumtion leads to incorerect standard errors.

Suppose that there are $T$ months. In month $t$, $n_t$ individuals are surveyed ($n_t$ is called sample size). Individual $i$ in month $t$ returns a binary random variable $Y_{it}$, where $i \in \{1, ..., n_t\}$ and $t \in \{1, ..., T\}$. When the respondent approves the current government, $y_{it}$ is 1. Otherwise, it is 0. Let $\pi_{it}$ the individual probability that the respondent gives positive answer ($0 < \pi_{it} < 1$). Then, $Y_{it}$ is the Bernoulli random variable conditional on $\pi_{it}$.

$$\begin{aligned}
Y_{it} &\sim f_{Berboulli}(y_{it}|\pi_{it}) \\
&= \pi_{it}^{y_{it}}(1 - \pi_{it})^{1-y_{it}} \\
E(Y_{it}) &= \pi_{it} \\
V(Y_{it}) &= E({Y_{it}}^2)_t - E(Y_{it})_t^2 \\
&= \{1 \times Pr(Y_{it} = 1) + 0 \times Pr(Y_{it} = 0)\} - E(Y_{it})_t^2 \\
&= \pi_{it}(1 - \pi_{it})
\end{aligned}$$

But we observe not each person's answer $y_{it}$ itself, but the sample mean $\bar{y}_t = (1/n_t)\Sigma_{i=1}^{n_t} y_{it}$ as an approval rate. The rationale to assume that $\bar{Y}_t$ has normal distribution is the Central Limit Theorem. Here I assume that everybody has the same probability to support the government, $\pi_t$ (no $i$ in subscription). Then, according to the theorem,

$$\begin{aligned}
\bar{Y}_t &\overset{a}{\sim} f_{normal}(\bar{y}_t|E(Y_{it})_t, V(Y_{it})_t/n_t) \\
&= f_{normal}(\bar{y}_t|\pi_t, \pi_t(1 - \pi_t)/n_t) \\
&= \sqrt{\frac{1}{2\pi\pi_t(1 - \pi_t)/n_t}} \exp\Big( - \frac{(\bar{y}_t - \pi_t)^2}{2\pi_t(1 - \pi_t)/n_t}\Big)
\end{aligned}$$

Therefore, asymptotically, an approval rate can be approximated by the heteroskedastic normal distribution. Most scholars, however, implicitly regard its variance, $\pi_t(1-\pi_t)/n_t$, as a constant value and estimate it. This is impossible. As a result, standard errors are not correct and they can not know whether each independent variables' coefficients are significantly different from zero or not. Besides, the range of rate is bounded between 0 and 1, though normal distribution is not bounded. Despite these problems, if one uses normal distribution, it is necessary at least to constrain its variance in the way as shown above. This also improves efficiency by decreasing the number of parameters to be estimated. [1]

## 2.2 Beta Binomial Distribution

The heteroskedastic normal distribution is, however, asymptotic approximation, anyway. In fact, the exact distribution is available. As long as $Y_{it}$ is independently and identically distributed (iid) with the common probability $\pi_t$, the number of respondents who give positive answer, $n_t\bar{Y}_t = \Sigma_{i=1}^{n_t} Y_{it}$, follows binomial distribution. Therefore, the distribution of collective proportion, $\bar{Y}_t$, is derived from it by the Jacobian method.

$$
\begin{aligned}
n_t\bar{Y}_t &\sim f_{binomial}(n_t\bar{y}_t|\pi_t) \\
&= \frac{n_t!}{n_t\bar{y}_t!(n_t(1-\bar{y}_t))!}\pi_t^{n_t\bar{y}_t}(1-\pi_t)^{n_t(1-\bar{y}_t)} \\
\therefore \bar{Y}_t &\sim n_t f_{binomial}(n_t\bar{y}_t|\pi_t)
\end{aligned}
$$

Political scientists, however, may well be interested in how heterogeneous individual probabilities (or tendencies) to approve the government, $\pi_{it}$'s, are, in which case $Y_{it}$ is not identically distributed. For instance, consider a decided respondents' observation $t$ and an undecided respondents' one $u$. In the former, there are a strong government supporter $i$ and a weak one $j$, whose probabilities to answer positively, $\pi_{it}$ and $\pi_{jt}$, are 0.9 and 0.1, respectively. Unless something bad happens, $i$ will approves the government. By contrast, $j$ rarely expresses approval if asked. Thus, approval rate $\bar{Y}_t$) is usually 0.5 (accurately, with the probability of 82%). It is seldom be 0 or 1 (9% for both). The

[1]Another way to address heteroskedasticity (and boundedness) is to assume that log odds of rate follows normal distribution and you can model variance with some covariates. But this model is not based on data generation process.

latter sample is composed of respondents $k$ and $l$ who wonder if the government is good or bad. Both tendencies to support the government, $\pi_{ku}$ and $\pi_{lu}$, are 0.5. They flip-flop at poll. As a result of this, approval rate $\bar{Y}_u$) is less likely to be 0.5 (every other times). It may be 0 or 1 (every four times). The two observations have the same value of expected approval rate, $E(\bar{Y}_t) = E(\bar{Y}_u) = 0.5$, while the undecided respondents' observation has wider variance ($V(\bar{Y}_u) = 0.125$) than the decided respondents' one $V(\bar{Y}_t) = 0.045$.

Below, I generalize this example formally. Let $\bar{\pi}_t$ and $V(\pi_t)$ sample mean and variance of $\pi_{it}$'s in observation $t$, respectively.

$$\bar{\pi}_t = \frac{1}{n}\sum_{i=1}^{n}\pi_{it}$$
$$V(\pi_t) = \left(\frac{1}{n}\sum_{i=1}^{n}\pi_{it}^2\right) - \bar{\pi}_t^2$$

Without specifying distribution of $\bar{Y}_t$, its mean and variance are:

$$\begin{aligned}
E(\bar{Y}_t) &= E\left(\frac{1}{n}\sum_{i=1}^{n}Y_{it}\right) \\
&= \frac{1}{n}\sum_{i=1}^{n}E(Y_{it}) \\
&= \frac{1}{n}\sum_{i=1}^{n}\pi_{it} \\
&= \bar{\pi}_t \\
V(\bar{Y}_t) &= V\left(\frac{1}{n}\sum_{i=1}^{n}Y_{it}\right) \\
&= \frac{1}{n^2}\sum_{i=1}^{n}V(Y_{it}) \qquad (\because \mathrm{Cor}(Y_{it}, Y_{jt}) = 0 \quad \text{for} \quad i \neq j) \\
&= \frac{1}{n^2}\sum_{i=1}^{n}(\pi_{it} - \pi_{it}^2) \\
&= \frac{\bar{\pi}_t}{n} - \frac{1}{n^2}\sum_{i=1}^{n}\pi_{it}^2 \\
&= \frac{\bar{\pi}_t - \bar{\pi}_t^2 - V(\pi_t)}{n}
\end{aligned}$$

Thus, variance of $\bar{Y}_t$ is a decreasing function of sample variance of $\pi_{it}$'s. That is, the more firmly respondents' mind is decided (in either direction), the less volatile approval rate is. [2]

Once we take into consideration heterogeneity of respondents, the distribution of the number of supporters, $n_t\bar{Y}_t$, is underdispersed than binomial distribution. On the other hand, omitted explanatory variables (or random effects) and covariate measurement errors bring about overdispersion. In order to address them, I assume $n_t\bar{Y}_t$ follows beta binomial distribution with a dipersion parameter $\gamma_t > 0$ (King, 1989; Palmquist, 1997; Prentice,

[2]Readers may wonder why I do not model sampling random draws from a certain population whose distribution is $f$. In this case, $\pi_{it}$ is a random variable: $\pi_{it} \sim f(\pi_{it})$. Redefine $\bar{\pi}_t$ as population mean: $\bar{\pi}_t = \int_0^1 \pi_{it} f(\pi_{it}) d\pi_{it}$. Then,

$$
\begin{aligned}
E(\bar{Y}_t) &= E\left(\frac{1}{n}\sum_{i=1}^{n} Y_{it}\right) \\
&= \frac{1}{n}\sum_{i=1}^{n} E(Y_{it}) \\
&= \frac{1}{n}\sum_{i=1}^{n} \int_0^1 \pi_{it} f(\pi_{it}) d\pi_{it} \\
&= \bar{\pi}_t \\
.V(\bar{Y}_t) &= V\left(\frac{1}{n}\sum_{i=1}^{n} Y_{it}\right) \\
&= \frac{1}{n^2}\sum_{i=1}^{n} V(Y_{it}) \\
&= \frac{1}{n}\left\{\left(\int_0^1 \pi_{it} f(\pi_{it}) d\pi_{it}\right) - \left(\int_0^1 \pi_{it} f(\pi_{it}) d\pi_{it}\right)^2\right\} \\
&= \frac{\bar{\pi}_t - \bar{\pi}_t^2}{n}
\end{aligned}
$$

Thus, expected value of collective rate is the same as population mean of individual probability, though variance of collective rate is neither overdispersion nor underdispersion (because a binary response loses much information about individual tendency and random sampling cancels out the effects of heterogeneity). We can not derive heterogeneirty of respondents from the data by this random sampling model.

1986).[3]

$$
\begin{aligned}
n_t\bar{Y}_t &\sim f_{BetaBinomial}(n_t\bar{y}_t|\bar{\pi}_t,\gamma_t)\\
&= \frac{n_t!}{n_t\bar{y}_t!(n_t(1-\bar{y}_t))!}\frac{\left(\Pi_{j=0}^{n_t\bar{y}_t-1}(\bar{\pi}_t+\gamma_t j)\right)\left(\Pi_{j=0}^{n_t(1-\bar{y}_t)-1}((1-\bar{\pi}_t)+\gamma_t j)\right)}{\Pi_{j=0}^{n_t-1}(1+\gamma_t j)}\\
\therefore \bar{Y}_t &\sim n_t f_{BetaBinomial}(n_t\bar{y}_t|\bar{\pi}_t,\gamma_t)\\
V(\bar{Y}_t) &= \frac{\bar{\pi}_t(1-\bar{\pi}_t)}{n_t(1+\gamma_t^{-1})}
\end{aligned}
$$

where variance of $\bar{Y}_t$ is an increasing function of $\gamma_t$.

Beta binomial model can be applied not only to approval rate but also to any proportion data composed of heterogeneous binary responses. Examples are percentage of party identifiers at survey, share of votes in elections and seats in the legislature, legislative productivity, viewership of campaign ads programs on TV and so on. A merit of the model is the ability to study how heterogeneous binary responses are and what affects heterogeneity. In spite of this, very few works employ this model (or heteroskedastic normal model) in political science (an exception is Hansen (2003)). To my knowledge, the present paper is the first to use it for approval rate.

[3] I will use extended beta binomial distribution in a revised vesion. King (1989, 48) reads "heterogeneity among the $\pi$s causes *overdispersion*" (emphasis original). This is misleading. As Palmquist (1997) and I prove, it causes *under*dispersion.

There is a measurement problem, too. Ordinarily, rounded, not exact, $\bar{y}_t$ is reported. For example, only up to the fisrt decimal place of percentage are reported as $\bar{y}_{t,report}$. Denote not rounded true $\bar{y}_t$ as $\bar{y}_{t,true}$. Then,

$$
\bar{y}_{t,report} - 0.0005 < \bar{y}_{t,true} \leq \bar{y}_{t,report} + 0.0005
$$

$$
f_{BetaBinomial}(n_t\bar{y}_{t,report}) = \sum_{i=\text{round}(n_t\bar{y}_{t,report}-0.0005)}^{\text{round}(n_t\bar{y}_{t,report}+0.0005)} f_{BetaBinomial}(i)
$$

Using Taylor series expansion around $\bar{y}_{t,report}$, this value is approximated by $f_{BetaBinomial}(n_t\bar{y}_{t,report}) \times \text{round}(0.001n_t)$. When, like survey, $n_t$ does not vary so much and round$(0.001n_t)$ is constant, we do not have to care about this rounding problem. For the data I will use in this paper, since $n_t$ is about 1500 and round$(0.001n_t)$ is 1 or 2, there is no problem.

## 2.3 Error Correction Model

Data this paper will analyze is approval rate of the Japanese Cabinet. Several scholars have studied it. Besides using normal distribution, however, all of them fail to take its dynamic nature into account appropriatel. Matsumoto (2001) just describes trends by age and sex, and do not use statistical analysis at all. Inoguchi (1983, ch. 4) considers the effects of economy on approval and checks Durbin Watson ratio and concludes data does not have serial correlation. Time dependence is, however, not "nuisance" to be discarded but "substance" to carry useful infomation and to be studied. Nishizawa (2001) takes advantage of ARIMA and Iida (2005) utilizes ARFIMA model. They pay more attention to dynamism of approval, though they still have two flaws. ARIMA(p,1,q) and ARFIMA(p,d,q) lack any theoretical ground. Not theory but data decides how many autoregressive terms (p) and moving average terms (q) as well as how fractionally a dependent variable is integrated (d). Moreover, since approval series is non stationary, they (fractionally) differentiate approval: $\Delta\bar{y}_t = \bar{y}_t - \bar{y}_{t-1}$. Thus, they can explain its difference (or change) only, not level. But reseacrchers are curious about long term trend as much as short term fluctuation.

In the literature, one of the common methods to study both is error correction model (ECM). Its idea is that the *short* term *change* of approval "corrects" deviation (or "error") of the pervious month's approval from its *long* term *level* trend. That is, it supposes that the change from the previous realized approval ($\bar{y}_{t-1}$) to the current expected one ($\bar{\pi}_t$) is the current short term fluctuation of the expected approval ($\Delta\bar{\pi}_t$) minus part (discount parameter $\delta$) of previous disequilibrium of the realized approval ($\bar{y}_{t-1}$) from the long term equilibrium level ($\bar{y}_{L,t-1}$). In order to address boundedness of approval, I use the inverse logit function $g^{-1}(x) = \log\big(x/(1-x)\big)$ (namely, the logit link or log odds).

$$g^{-1}(\bar{\pi}_t) - g^{-1}(\bar{y}_{t-1}) = \Delta g^{-1}(\bar{\pi}_t) - \delta\big\{g^{-1}(\bar{y}_{t-1}) - g^{-1}(\bar{y}_{L,t-1})\big\}$$
$$\therefore \bar{\pi}_t = g\big\{\Delta g^{-1}(\bar{\pi}_t) + (1-\delta)g^{-1}(\bar{y}_{t-1}) + \delta g^{-1}(\bar{y}_{L,t-1})\big\}$$

Let short term fluctuation and long term equilibrium level functions of some covariates: $\Delta g^{-1}(\bar{\pi}_t) = \Delta x_{S,t}\beta_S$ and $g^{-1}(\bar{y}_{L,t}) = x_{L,t}\beta_L$. [4] Change of short term covariates $x_{S,t}$ affects approval quickly, though their influence fades out soon. By contrast, change of long term covariates $x_{L,t}$ may not have immediate effects, approval will reach its level eventually. How soon short term effects vanish or long term ones appear dependes on how large the discount parameter $\delta$ is. It expresses the degree to which disequilbrium from the long term relationship between $\bar{y}_{L,t}$ and $x_{L,t}$, which is called shock or innovation, is compensated. To put it differently, the larger $1 - \delta$ is, the better the electorate "remembers" shocks. Shocks arise from previous short term change, change of long term equilibrium and random errors $g^{-1}(\bar{y}_{t-1}) - g^{-1}(\bar{\pi}_{t-1})$. If $1 - \delta$ is 1 (that is, $\{g^{-1}(\bar{Y}_t\}$ is an integrated time series and has an unit root), voters are said to have "long memory". Short term shock effects continue for ever and the long term equilibrium is never reached. On the other hand, when $1 - \delta$ is 0, citizens "forget" all past innovations and have no memory. In this case, the current expected approval is the previous value plus the current short term

# 3 Explanatory Variables

The most important feature of beta binomial regression is its ability to model a dispersion parameter $\gamma_t$ as $\gamma_t = e^{z_t\eta}$ (since $\gamma_t > 0$, I use an exponential function). What makes approval rate unstable (larger $\gamma_t$) by making repondents unstable, namely, narrowing sample variance of $\pi_{it}$'s? My idea is that Independent voters, or those who support no party, do not have strong evaluation toward the government like $\pi_{it} = 0$ or 1. As

[4] In studying an approval rate, most research to date inadvertently assume $\bar{\pi}_t$ is a linear combination of covariates, $\bar{\pi}_t = x_t\beta$. Therefore, many precedent works are flawed in this regard, too.

The inverse logit function is preferable because the effect of covariates' change becomes smaller when a depent variable approaches its upper or lower bounds (0 or 1). For exapmle, suppose 1% point unemployment change affects an approval rate by 4% points when approval is 50%. If approval is 20%, the same 1% point unemployment rise may prevent only 2% points core suppoters from approving the government, because they have already committed to the government due to some other reasons such as security or religious issues. Similarly, as an approval rate is 80%, 1% point unemployment decrease can persuades approval from just 2% points core oppositions.

a result, the more Independent voters there are, the more volatile an approval rate is. Thus, I include proportion of Independent voters (INDEPENDENT) as covariates of $\gamma_t$. In addition, the longer the government stays in power, the more familar people are with it and the firmer opinion about it they hold (Gronke and Brehm, 2002; Maestas and Preuhs, 2000). How many months the current prime minister serves (DURATION, log) decrease $\gamma_t$ and variance of $\bar{Y}_t$. (In this paper, I fail to include this variable into analysis.)

As for covariates of $\bar{\pi}_t$, i.e., $x_{S,t}$ and $x_{L,t}$, the literature has found a lot. Among them, I choose six variables described below, mainly due to data availability. First, three political factors are in order. The portion of respondents who support any of governing parties (PARTY) is expected to raise approval. [5] Clarke and Lebo (2003) reverse causality and explain British governing party support by prime ministerial approval. But since party identification is rooted more deeply in voter's mind and less volatile than approval rates, the former should cause the latter, not vice versa. DURATION and how many months have passed since the last general election (ELECTION, log) may dumpen approval because people get tired of the prime minister or a newly established cabinet.

Regarding economic variables, there are huge debates over pocket book voting vs sociotropic voting as well as over "bankers" (expectation) or "peasants" (retrospection) (Erikson, MacKuen and Stimson, 2002). The portion of those who feel personal prosperity *is* very good or just good (PERSONAL) represents pocket book voting, while the rate of those who reply national business *becomes* better or a little better (NATIONAL) stands for sociotropic voting. Though both are based on retrospection and will contribute to higher approval, the variable EXPECTATION measures how many percentage of samples answer that the price level *will* rise. It will damage approval.

I also add two new predictors to the existing repertory. One is the age the current prime minister start his job (AGE).[6] My sense is that younger premiers are more popular. Its coefficient is predicted to be negative. Another is how many percentage of respondents like the United States (USA). Genreally, when more people agree with the government's

[5] All portion data are the ratios to the whole sample size which includes those who give DK/NA.
[6] I do not use the current age, because DURATION is included.

diplomacy, they are more likely to be in favor of the cabinet. Most administrations in postwar Japan are monoploized by the Liberal Democratic Party, which makes much of the bilateral relationship with America. Thus, as more people is in favor of the U.S., they also support the Japanese government, especially in the age of the Cold War.

I do not include DURATION and ELECTION into the short term component because their changes are almost constant. The other covariates are used both in the short term component and in the long term one.

# 4 Data and Result

I analyze the approval rate of the Japanese cabinets. Data source of all variables except DURATION, ELECTION and AGE is monthly public opinion survey by Jiji Tsushin Sha (1981), Jiji Tsushin Sha and Chuo Chosa Sha (1992) and Jiji Tsushin Sha (various years) from January 1964 (including lagged variables) to August 2004, 488 months (observations). I calculate AGE from the data in Shugiin and Sangiin (1990). I drop NATIONAL because its inclusion makes all three economic variables not significant.

Results are summarized in Table 1. First, I look at the model of the dispersion paramter, $\gamma$. Suppose approval is at its average, 35.6 %. When INDEPENDENT is at its minimum, 30.4 %, $\gamma$ is calculated as 0.003. If INDEPENDENT is at its maximum, 68.9 %, $\gamma$ is 0.033, ten times as large as the previous value. The coefficient of INDEPENDENT is significantly non zero. Therefore, my hypothesis is confirmed.

Next, the discount parameter $\delta$ is $1 - 0.8 = 0.2$. It is significantly larger than zero. It implies that, three months after the shock, its effect becomes half ($0.8^3 = 0.51$) and a year after it is only 7%. Thus, I can conclude citizens have short memory. To get more intuitive interpretation of the results, I perform several simuations. I set independnet variables except DURATION and ELECTION in the long term component at their mean and those in the short term at zero. I assume the expected values are realized. The expected approval is plotted against the values of DURATION (its exponential). Provided

| | Coef | SE | t |
|---|---|---|---|
| Dispersion | | | |
| Constant | -7.568 | 0.454 | -16.660 |
| INDEPENDENT | 0.061 | 0.009 | 6.735 |
| Short Term | | | |
| $\Delta$ PARTY | 0.032 | 0.004 | 8.181 |
| $\Delta$ PERSONAL | 0.016 | 0.008 | 1.958 |
| $\Delta$ EXPECTATION | -0.004 | 0.003 | -1.343 |
| $\Delta$ AGE | -0.088 | 0.009 | -10.260 |
| $\Delta$ USA | 0.012 | 0.004 | 3.390 |
| Long Term | | | |
| 1 - $\delta$ | 0.805 | 0.029 | 28.166 |
| PARTY | 0.008 | 0.003 | 2.600 |
| DURATION | -0.010 | 0.010 | -0.924 |
| ELECTION | -0.017 | 0.011 | -1.471 |
| PERSONAL | 0.001 | 0.005 | 0.119 |
| EXPECTATION | -0.001 | 0.001 | -1.470 |
| AGE | -0.006 | 0.003 | -2.491 |
| USA | 0.002 | 0.002 | 0.973 |
| Constant | 0.121 | 0.161 | 0.750 |

Table 1: Beta Binomial Regeression of Approval on the Japanese Cabinet

that the cabinet is established just after an election, ELECTION has the same value as DURATION. We look at 4 years simulation because it is the term for the House of Representatives. In Figure 1 (1), one standard deviation size of random error (8.9 %) occurs at the second month (DURATION = log(2)). Solid lines are the expected and realized approval rates, while dotted lines rerpesents the long term trends. As expected, the long term trend changes little. Indeed, it is the equilibrium. And approval quickly adjust to it. One year after, deviation almost vanish. This shows how the discount parameter works.

Third, both level and diffference of political factors such as governing PARTY support and premier's AGE have significantly non zero effects as expected, while PERSONAL prosperity and favor for USA rewards approval only for a short period. DURATION and ELECTION are not effective. Figure 1 (1) shows DURATION does not affect. In Figure 1 (2) we find the case where governing PARTY support rises by one standard error, 4.9 % (from 30.4 % to 35.3 %). Because PARTY has long term effect, the equilibrium

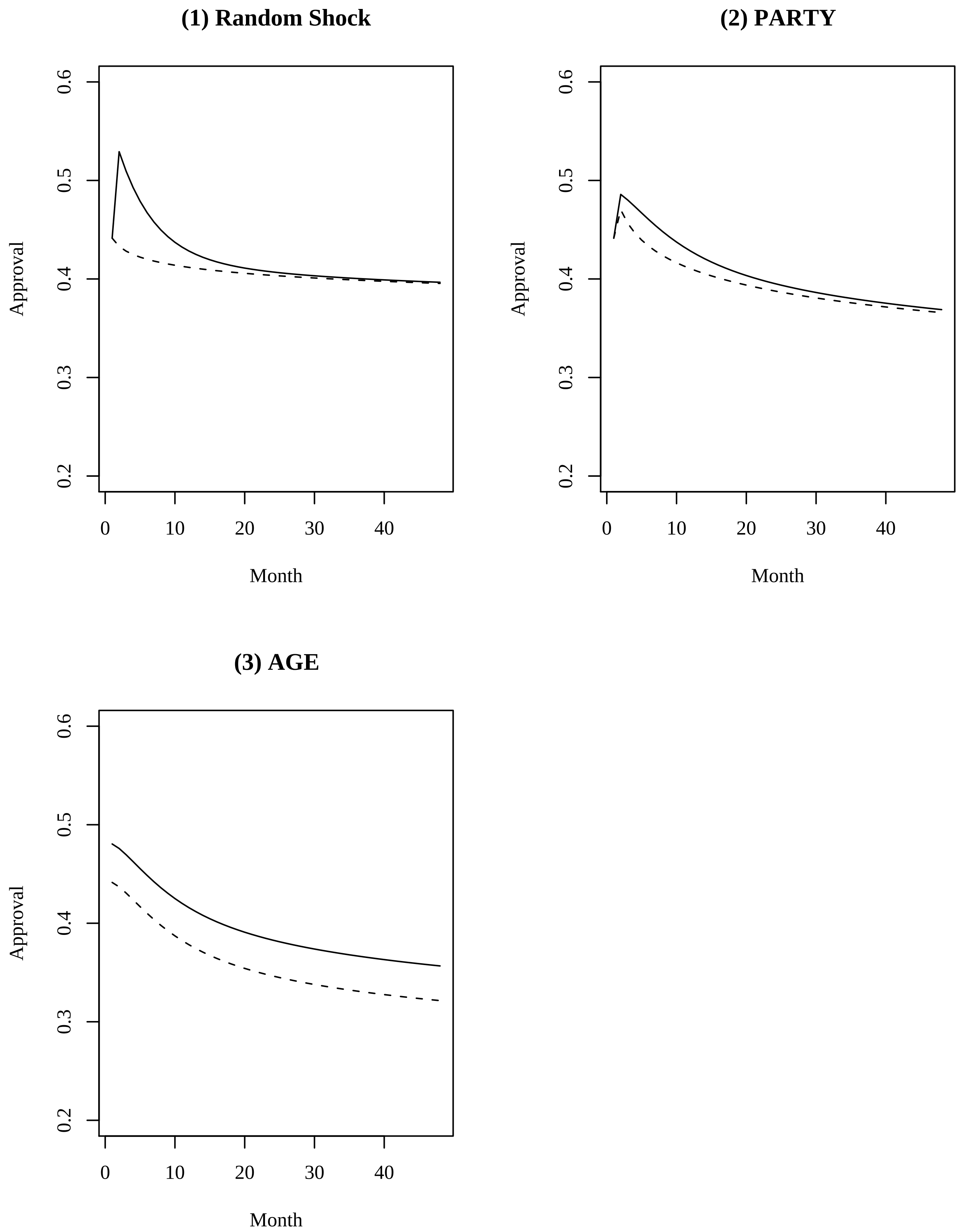


Figure 1: The Expected Values and the Long Term Equilibrium of Approval with Shocks at the Second Months

level also increases. In the next month after the shock, approval "overshoots", that is, grows more than the long term trend. Hence, after the second month, it decreases to fit the appropriate level. The initial AGE of the premier can not change during one cabinet. Therefore, I compare two cabinets. One has an average age (63.7 years *old*) prime minister (dotted line). Another is led by 4.9 years (one standard error) younger top (solid line) (Figure 1 (3)). Difference is clear and continue.

# 5 Conclusion

I summarize the new findings of this paper. First, when there are more Independent voters, the expected approval rate has wider range. Second, citizen have so short memory that they forget half of shock effects in three months and almost everything in a year. Third, agreement on the current diplomacy and the national leader' youth improve approval. Most economic indicators can not explain political evaluatuion of the government. These empirical findings are based on approval data of the Japanese cabinets. Methodologically, I use beta binomial regression with logit link and error correction model instead of linear normal model.

# 6 Appendix

How well does my model explain the data? Figure 2 illustrates observed appoval (a solid line, $\bar{y}_t$), long term equilibrium (a bold line, $\bar{y}_{L,t}$) and expected approval (a dotted line, $\bar{\pi}_t$, which takes into consideration both short term fluctuation and long term equilibrium). It may be no wonder that expected values of approval is close to observed one because the former uses lagged values of the latter. But it is not a matter of course that long term equilibrium really follows observed approval.

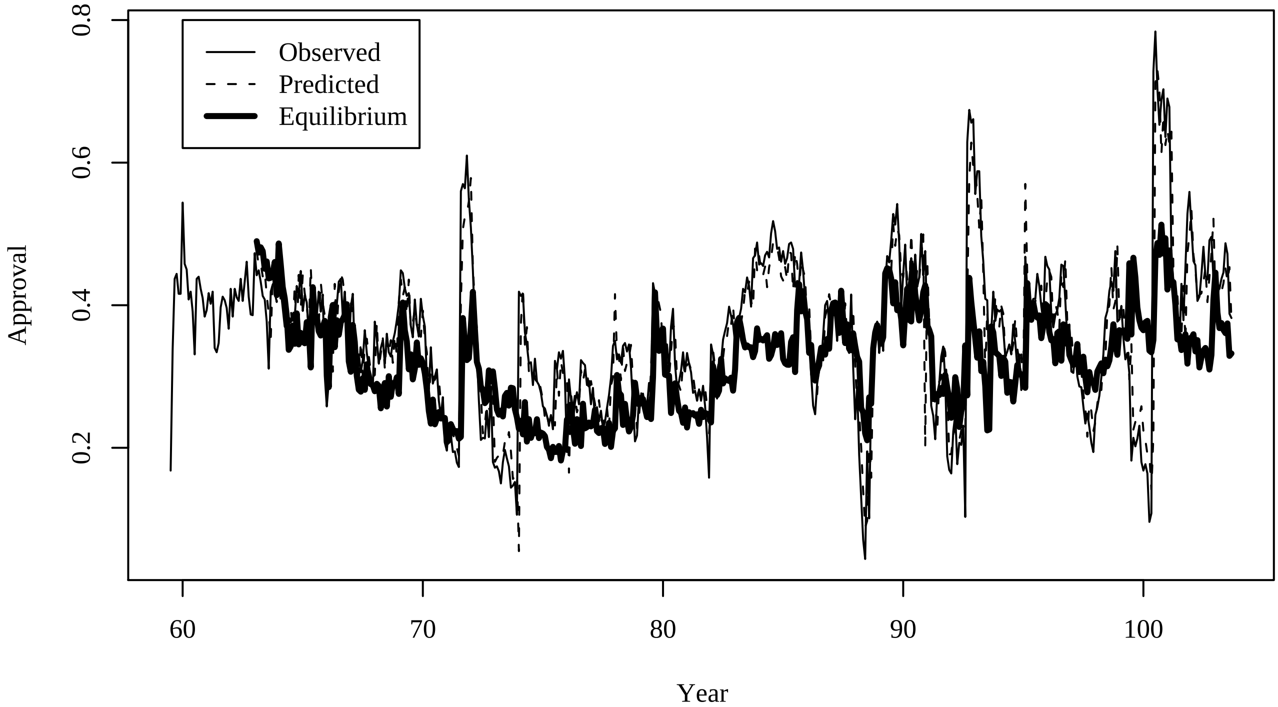


Figure 2: Approval Rate of the Japanese Cabinet: Observation and Prediction

# References


Clarke, Harold D. and Matthew Lebo. 2003. "Fractionally (Co)integration and Governig Party Support in Britain." *British Journal of Political Science* 33:283–301.

Erikson, Robert S., Michael B. MacKuen and James A. Stimson. 2002. *The Macro Polity.* Cambridge, UK: Cambridge University Press.

Gronke, Paul and John Brehm. 2002. "History, Heterogeneity, and Presidential Approval: A Modified ARCH Approach." *Electoral Studies* 21:425–52.

Hansen, Bruce E. 2003. "Recounts from Undervotes: Evidence from the 2000 Presidentail Election." *Journal of American Statistical Association* 98:292–98.

Iida, Takeshi. 2005. "The Change in the Effect of Part Suppoert on Cabinet Support Over Time: An Analysis Using ARFIMA and Time Varying parameter Modeling [in Japanese]." *Review of Electoral Studies* 4:41–61.

Inoguchi, Takashi. 1983. *Contemporary Japanese Political Economy: Government and Market [in Japanese].* Tokyo: Toyo Keizai Shimposha Publishing Co.

King, Gary. 1989. *Unifying Political Methodology.* Cambridge: Cambridge Univeristy Press.

Maestas, Cherie and TRobert R. Preuhs. 2000. "Moeling Volatility in Political Time Series." *Electoral Studies* 19:95–110.

Matsumoto, Masao. 2001. *Political Attitude Data [in Japanese].* Tokyo: Chuo Koron Publishing Co.

Nishizawa, Yoshitaka. 2001. "Cabinet Approval and Economic Performance Evaluation [in Japanese]." In *Politics and Economy in the 1955 System: An Analysis of Jiji Survey Data*, ed. Ichiro Miyake, Yoshitaka Nishizawa and Masaru Kohno. Tokyo: Bokutakusha Publishing Co. pp. 139–59.

Palmquist, Bradey. 1997. Heterogeneity and Dispersion in the Beta-Binomial Model. In *the Annual Meeting of the American Political Science Association.* Washington D.C.: .

Prentice, R. L. 1986. "Binary Regression Using an Extended Beta-Bonomial Distribution, With Discussion of Correlation Induced by Covariate Measurement Errors." *Journal of American Statistical Association* 81:321–27.

Jiji Tsushin Sha and Chuo Chosa Sha, eds. 1992. *Parties and Cabinets in Japan: 1981-91 [in Japanese].* Tokyo: Jiji Tsushin Sha.

Jiji Tsushin Sha, ed. 1981. *Parties and Cabinets in Postwar Japan [in Japanese].* Tokyo: Jiji Tsushin Sha.

Jiji Tsushin Sha, ed. various years. *Special Reports of Jiji Public Opinion Polls [in Japanese].* Tokyo: Jiji Tsushin Sha.

Shugiin and Sangiin. 1990. *100 Years History of Parliamentary System [in Japanese].* Tokyo: Okurasho Insatsukyoku.