SURVEY PURCHASING POWER EQUITY IN IRAN: THE APPROACH OF A BAYESIAN THRESHOLD AUTO REGRESSION MODEL

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Abstract

The main objective of the research is to investigate the purchasing power parity in Iran using a nonlinear Bayesian Threshold model. In this framework, the study of the purchasing power parity in Iran is used to assess the purchasing power in Iran using the currency data of the US dollar, British pound and Japanese one hundred yen, which is related to the period of 2001 - 2016. In the Bayesian method (nonlinear Bayesian Threshold model), the values are not constant, and in other words, it is random, so a distance is defined. The results show that the exchange rate of the US dollar, the British pound and the Japanese one hundred yen has two regimes. The dollar's dollar exchange rate in the low-income regime has moved to a high-ranking regime after reaching the Rials (15010, 12330). The British pound has moved to the top-down regime after reaching the Rials (47180, 20370). Japan's 100-yen exchange rate has moved to the top-down regime after reaching the Rials (31310, 16000).

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In addition, observations show that the reaction of the yen against the Rials is relatively stronger than the other two currencies (especially in the second regime).

   Keywords: exchange rate, purchasing power parity, Bayesian, Threshold Auto regression

   JEL codes: C24, Q56

Introduction

   The theory of purchasing power parity (PPP), is still one of the reported enigmas, and was examined in economic and international finance studies. the reason of validity of the theory is well-known in (Ikay,2015).Due to considering this theory in developing some important theories such as balance than financial theory, It is regarded axial and fundamental.(Dornbusch,1988,Chortareas and Stark 2009).In addition to the most important policies of exchange rate commercial reform, received their instructions from PPP theory.(Layton & Stark 1990).Holmes (2000)expressed that the role of this theory (PPP),firstly was considered as expectation model for exchange rate and also determines the value less or much than the limit of one country's currency , especially in developing countries .Secondly, the most theories of exchange rate are based on this model. The mentioned theory is intended that long run exchange rate between two same countries' currencies are equaled in the ratio of the counties prices.(Bahman Oskooee & Wu 2017).In this case, when PPP model was hold, the nominal exchange rates and relative price would be used for expressing the real exchange. Hence the real exchange should be constant. Furthermore, studies have been tested in PPP hypothesis which the results of these studies have been presented contradictory results. Many of these studies rejected the hypothesizes, so it is concluded to present of the PPP design. In the following due to the disadvantages of linear models and lack of proper affirmation model, researchers turned towards nonlinear models for study. One of the usable model for nonlinear models is autoregressive of threshold rate nonlinear. The motivation for using nonlinear models in this setting is that the original empirical findings used to establish the puzzle may have arisen due to model misspecification. Specifically, linear time series models restrict the degree of adjustment of real exchange rates to their PPP levels to be the same at all points of time. (lo & Morley 2015).Among to nonlinear models, Bayesian model has more advantages against nonlinear threshold models as follows estimating, frequent standardization in nonlinear threshold models which usually are investigated in exchange rate are difficult and time consuming. Because it involves the search process for the parameters of the nonlinear transfer function. But Bayesian mode qualifies simultaneous estimation of the parameters of all models and complex functions of parameters such as half -life measurements are possible based on generalization reaction of functions. Threshold type nonlinear samples is encountered the difficulties due

to the presence of excessive and intrusive parameters in repeated alignment .In small samples may be problematic due to low power of recognition. In the framework of Bayesian model, comparison of the model by means of the final likelihood which reflects the relative ability of the model to predict the data according to the previous beliefs about model parameters. For each set of models, it's conceptually clear and comfortable and also disability in differentiation among models is revealed based on sample information and ratio the proximity to reality. Though the observed findings about the exchange rate can be strongly sensitive to model specifications and interval affirmation. Bayesian model provides the ability to measure the average model which defines an inherent uncertainty about model specifications as follows the level of delay or the probability of nonlinear dynamics. In this way, the aim of current study is to investigate purchasing power of parity by using Bayesian model. Based on this purpose, spot differentiation of this study compared to other studies determines that the current study was considered to respond the purchasing power of parity and, it was used the nonlinear method for answering in order to solve it.

Theoretical Foundations

In most studies conducted by researchers about international economy it is assumed that global financial markets on their own, can change national capital among countries and willingness to save money in order to maintain capital in the initial country it is considered as a witness to friction in global financial markets.(Ford & Horioka 2016). Although, Ford & Horioka defines that global capital markets are not able to achieve net transfer of financial capital among countries and for joining to financial markets and global goods it is necessary to achieve a net transfer of financial capital among countries. They argued that friction in one or two markets can prevent the net transfer of financial capital among countries. And confirmed the results of Feldstein Horioka (relationship between endemic saving and endemic investment) in (1980), Apergis & Tsoumas (2009).Additionally, they gave some evidence of study (Eaton et al in 2015) which based on that barriers to the movement of goods and services such as transportation, marketing, costs of distribution, technical standards, certification procedures, tariffs and non –tariff commercial barriers are important obstacles to the moving of international capital. Ford & Horioka (2016) expressed that saving and investment have strong relationship not only among international markets but also among goods international markets. Most of studies like Mishkin (1984) and Chung & Crowder (2004) defined that real interest rates are not equal in different countries.Ford & Horioka (2016) since the financial markets alone cannot achieve the net transfer of financial capital among countries so financial markets and global goods also need to equity of interest rates. In fact, similar fluctuations represent a net transfer of capital and real interest rate in the global goods markets among countries. Therefore, the equivalence of expected revenues among countries

shouldn't achieved by adjusting interest rates. Despite, real adjustment rates as important element which leads to purchasing power of parity was considered. Furthermore, Ford & Horioka (2016)supposed that fluctuating in global commodity markets should be solved by PPP enigma which was mentioned by Rogoff (19996),Obstfeld & Rogoff (2000) and MacDonald (1999) in case of unequal real interest rates. Several studies,MIchael and etal (1997),Obstfeld and Taylor (19997) ,Saraetis (1999) and Sarno et al (2004)and Back and etal (2010),investigated nonlinear threshold rate of autoregressive models. The initial roots of these studies can be regarded as Rogoff study. The principal ideas are expressed that transaction costs are able to affirmation whether or not single -price law of exchange rate tend to PPP model. Moreover, nonlinear models which are able to change regimes for real exchange rates, give some estimate for PPP studies that are adopted by reality.

Literature review

Hsing (2006), investigated the shock effect of exchange rate on Hungary's production by VAR autoregressive model. The result of this researcher, revealed the effect of a decrease in the real exchange rate is considered as contraction in the first three months, and also is considered as expansion in the second three months, and after that the effect of that is lost and the nominal exchange rate is reduced in the first three months and the effect disappear after that. Ahmad & Hernandez (2013) investigated the relationship between nonlinear long run price of oil and real exchange rate by using TAR threshold autoregressive technique of some selected importers and exporters countries .And the findings as measured in this study reveals that there are co-accumulation from 6 countries in 12 countries between two variables .And also the effect of positive oil companies are different from oil shocks in Nigeria, Brazil and United Kingdom .since it is considered as asymmetric.

Bahmani (2014) examined the tension of the exchange rate and demand for money by using bounds testing in less developed. The researcher's findings shows that the tension of exchange rate has short effect on M2 real demand. Therefore, the effects are not permanent in these countries. Basher et al (2016), empirically examined the effects of oil shocks on exchange rate in selected exporters and importers countries by using Markov switching model. The experimental results show that the pressure of increase national money is as a result of oil demand shocks in oil exporting countries. In addition, there is insignificant evidence in impact of supply companies on exchange rate. They also concluded that all global demand shocks, influenced both groups of importers and exporters countries. Ford & Horioka (2016) examined, the real affirmation of PPP enigma. The present study showed that global financial markets cannot achieve to financial investment of net transfer and real interest rate alone. And both global and financial markets need to achieve net incomes investment and real interest rate for equality in all country. So, friction (obstacles, movement and change) can disrupt the net transfer of capital among

countries. In one or both markets the findings of Feldstein & Horioka (1980) confirmed the significantly correlation between investment and saving and it obstacles to make the real interest rate. Moreover, the friction in the global commodity markets can explain the reason for difference between real exchange rate and PPP model. And also, researchers (Obstfeld and Rogoff) (2000), have been able to solve in macroeconomics. Bahmani-Oskooee & Wu (2017, examined 34 OECD countries in purchasing power of parity study. The current study was examined by strong and slight failure together in combined quantile unit root test and the PPP model was examine in OECD countries from 1994 to 2016 years. The results show that there is PPP in 18 countries (Austria, Chile, Estonia, Finland, France, Germany, Italy, Korea, Mexico, New Zealand, Netherlands, Poland, Portugal, Slovenia, Sweden, Switzerland, Turkey, and England). Ikay (2017) investigated stability of real exchange rate in the West African region. In fact, this study reviewed PPP model in examined countries. In this way, combination of time series technique has been used in different periods of time, as many studied researches this study derived that PPP model is not available in these countries. It is faced with challenge, due to the countries which are placed in the West African and potentially can do arithmetic exchange and investment with the others countries.

Bayesian Estimation

In this research was examined Bayesian estimation via a multi-block random-walk chain version of the Metropolis-Hastings (MH) algorithm. Then the draws are accepted or rejected as draws from a target distribution (i.e., the posterior distribution) based on the relative densities of the draws for both the proposal and target distributions. Like any important sampling of algorithm, success posterior simulator depended on proposed distribution for presenting an exact discrete approximation from distribution of aim. The current research, used conventional model for distribution of t multivariate student based on posterior mode and curvature of the posterior in around of relate mode. However, some issues were expressed because of adding of nonlinear MR-LSTAR. Firstly, it was needed to investigate among of threshold parameters for finding posterior mode as well as nonlinear threshold of maximum estimate of likelihood. Firstly, Estimate of threshold Bayesian was based on distribution of aim which was deluded fracture of space sample for threshold parameter and secondly numerical derivatives cannot be evaluated, for curvature of the posterior ratio to threshold parameters by using the estimate threshold parameter web. Since there were not any guidance for numerical optimization in order to for proposed density scale even it was placed in posterior mode. So it is important to emphasis on this point that this mode is just usable for making the distribution of posterior.

Findings of Research

Analysis data are considered in exchange rate of America dollar, British pound and a hundred Japan yen which are related from January 1, 2002 to December 21, 2017 years. And this extract from Bank of Islamic Republic of Iran website. Estimated results model SETAR (1), for exchanges rate, is shown in table (1). All tables are achieved for 20000 repeating, by using Gibbs sampling algorithm. It should be noted that in each part, coefficient $\beta_{1,1}$ indicates width from origin in down threshold, $\beta_{1,2}$ shows variable coefficient in down threshold, $\beta_{1,1}$ points out width from origin in up threshold, $\beta_{2,2}$ describes variable coefficient in up threshold and δ detects mean variable later in threshold.

Table 1: Model Coefficients SETAR (1)

	Coefficient	mean	posterior standard deviations	Monte Carlo Error	Confidence Distance 95%	
US dollar	$\beta_{1,1}$	8.834	31.3	0.3303	-53.72	70.18
	$\beta_{1,2}$	1.009	0.009147	1.08E-04	0.9913	1.027
	$\beta_{2,1}$	0.2127	31.69	0.3195	-62.47	61.59
	$\beta_{2,2}$	-0.2415	31.78	0.3144	-61.1	61.88
	δ	13670	815.5	7.979	12330	15010
	σ_1^2	2.44E-06	4.30E-07	1.03E-08	1.68E-06	3.35E-06
	σ_2^2	494.3	15660	358.1	0.001945	437.8
British pound	$\beta_{1,1}$	5.564	31.74	0.1197	-57.68	68.59
	$\beta_{1,2}$	1.007	0.01005	4.13E-05	0.9872	1.027
	$\beta_{2,1}$	-0.0766	31.86	0.1293	-62.09	62.53
	$\beta_{2,2}$	-0.149	32.12	0.1274	-62.7	62.75
	δ	33940	8165	80.97	20370	47180
	σ_1^2	6.37E-07	1.15E-07	2.82E-09	4.31E-07	8.77E-07
	σ_2^2	268.6	8199	161.2	0.001847	448.9
Japanese one hundred yen	$\beta_{1,1}$	10.74	31.64	0.3493	-50.75	73.76
	$\beta_{1,2}$	1.008	0.009548	1.13E-04	0.9889	1.027
	$\beta_{2,1}$	-0.2799	31.59	0.3365	-63.12	60.96
	$\beta_{2,2}$	-0.5951	31.6	0.3255	-62.25	61.69
	δ	23690	4629	44.52	1.60E+04	31310

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σ_1^2	1.98E-06	3.50E-07	9.96E-09	1.35E-06	2.71E-06
σ_2^2	74.15	676.9	10.17	0.002104	447.8

Researcher calculations

In the analysis of the results, firstly was mentioned this point that the values are not constant in elliptic model. On the Other side they are randomly. Since, the mean variable later was examined in a valid distance, which means a change in a minimum value and maximum value in this valid distance. As it was indicated in table (1), minimum value of a threshold variable later δ for exchange rate of dollar is equal to 13670 Rials, and the valid distance of 95 percent of this is included in (20370, 47180) .The mean value of a threshold variable later δ for the exchange rate of pound is equal to 33940 Rials, and valid distance of 95 percent of this is included in (20370, 47180) this threshold value is double from threshold value that was gained by dollar. The mean value of threshold variable later δ for the exchange rate of a hundred of Japan yen is equal to 23690 Rials, and credit distance of 95 percent of that is included in (16000, 31310), the standard deviation above ratio is more much than dollar and is much lesser than pound. Findings indicate that $\beta_{1,2}$ related to dollar is positive and meaningful. The positive sign is associated to expectation, because exchange rate of dollar in down threshold is less than 13670 threshold value. Since the positive sign, means start to increase in long term adjustment path. An analysis can be used about up threshold of dollar. $B_{2,1}$ associated with dollar was negative and meaningful. The sign of negative was in accordance with expectation because high exchange rate, was more than 13670 threshold value , negative sign, meant starting a decline in the long run adjustment path. Hence, the results showed that, $\beta_{1,2}$ and $\beta_{2,2}$ associated to pound is firstly, meaningful and secondly positive and negative respectively. So that analysis existed like dollars analysis in previous lines. In this framework, positive sign in below threshold, is in accordance with expectation, since the exchange rate of pound in below threshold was lower than 33940 threshold value. Therefore, a positive sign means beginning to increase in the long run of adjustment path. So that analysis was used for up threshold of pound .$\beta_{2,2}$ related to pound was negative and meaningful. The negative sign expressed the beginning to decrease in the long run of adjustment path, because exchange rates in up threshold were more than 33940And also viewed $\beta_{1,2}$ and $\beta_{2,2}$ associated with a hundred yen of Japan firstly was meaningful and secondly positive and negative respectively. However, the analysis of this part explained like pound and dollar analysis before. But according to differences between coefficients and confidence interval, we could express that the reaction of the yen changes were more than Rials. The stated issues were compatible with truths. For research in this issue, validity of interval graphs in threshold of exchange rates of dollar, British pound and Japan yen was drawn. According to graph 1,and examine the price trend of exchange rate of dollar was shown, that exchange rate of dollar, pound

and a hundred yen of Japan involved two thresholds. Low threshold of dollar was reached from 1755 in 2012/1/28 to 1226 in 2012/1/28.After from this period, the government settled the exchange rate of dollar to 12260 until 2013/7/2 by adopting supportive policy. Due to inflammation of the exchange, the government was not able to support the fixed of price trend. And all at once, approximately it was increased double. As it was displayed in shape, the up threshold of dollar started from 2546 price in 2013/7/2 to 35859 price in 2017/9/30. And also, down threshold of pound was reached from 2546 price in 2010/1/1/ year to 19289 price in 2011/12/21/ .After these dates, government fixed the exchange rate of dollar by adopting supportive police. After increasing suddenly, the price of dollar and pound was doubled. As it was shown in the shape, up threshold of pound is started from 37575 in 2013/7/2 year and it is ended till 47917 in 2017/12/21 year. Down threshold of Japan yen, was arrived from 1333 price in 2010/1/1 to 15986 in 2011/12/21.Based on pricy of government in fixing exchange of dollar, exchange of a hundred of Japan yen was arrived to 12379 Rials in 2013/7/2.In this year, because of inflammation of exchange, the government was not able to support the fixed of exchange rate, and suddenly the exchange rate of dollar was increased double. Following of that, Japan yen was increased double approximately. So that that price was reached to 2470 in 2013/7/3, and it was ended to 31,619 Rials.

Figure 1: Threshold validation period
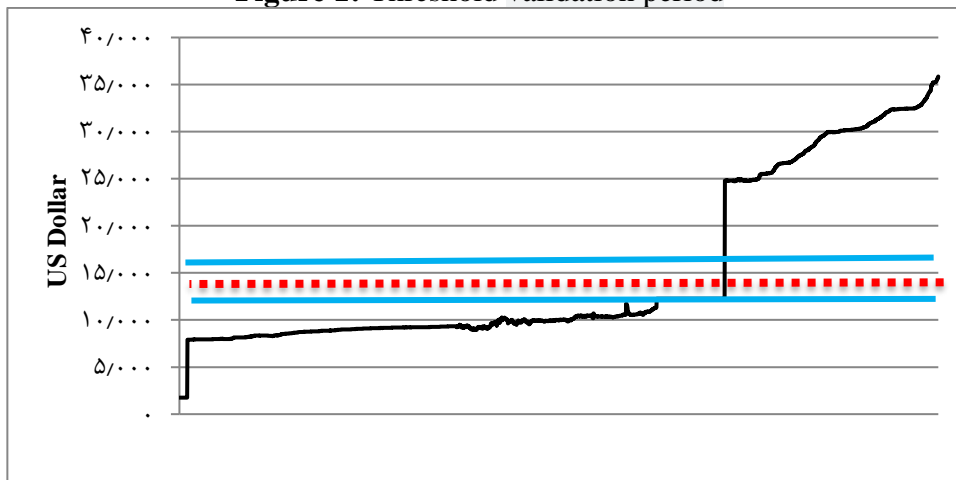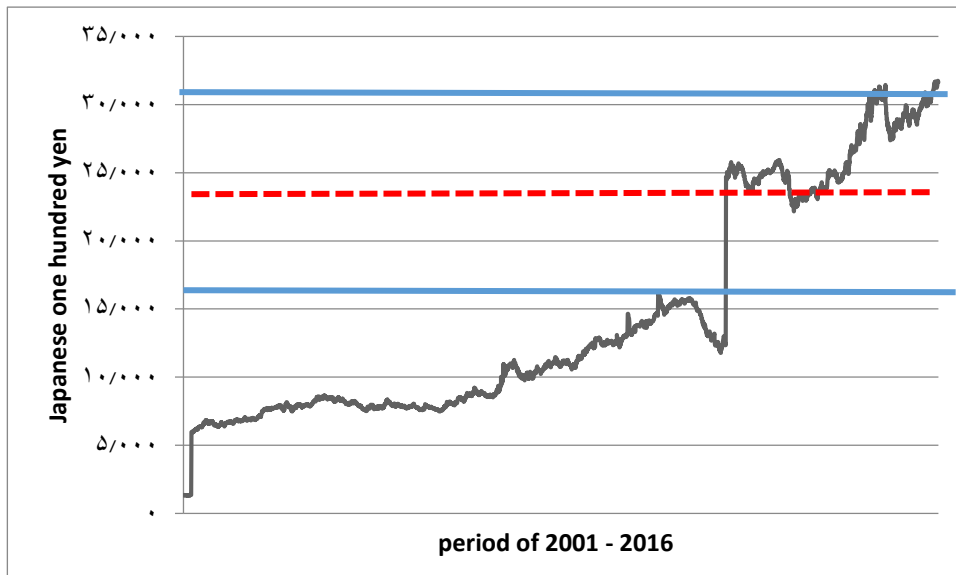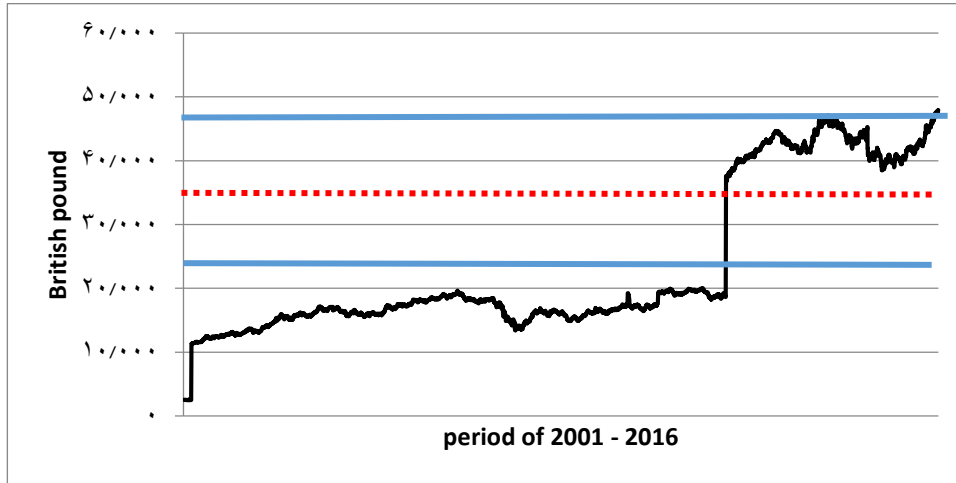
Conclusion and Presentation of Policy Suggestions

In This study, were examined the experimental findings about real exchange rate stability by using analysis of Bayesian model. The current outcomes defined the power of nonlinear model and also it has shown new perspectives in this area. Due to existing uncertainty, nonlinear models were presented exact results than linear models. Based on analysis in this study, although exists probability of linear dynamics ,evidence showed that the real exchange rate stability is less than the exchange rate stability that it was

mentioned in Rogoff study .So, results were collected from this study ,are according to nonlinear models. The partial result that was achieved from stability of purchasing power parity was considered that exchange rates like the other linear models supposed to be unstable. The findings which are achieved from this study shows that posterior of mean value of threshold variable δ for exchange rate of dollar is equal to 13670 Rials, for exchange rate of pound is equal to 33940 Rials and for exchange rate a hundred Yen is equal to 23690 Rials. Therefore, it shows that $\beta_{1,2}$ and $\beta_{2,2}$ associated with dollar firstly is meaningful and secondly is positive and negative respectively. , and $\beta_{2,2}$ associated with pound is negative and meaningful. Finally $\beta_{1,2}$ and $\beta_{2,2}$ associated with 0ne hundred Yen of Japan, firstly is meaningful and secondly is positive and negative respectively .Examination of price trend of exchange rate of dollar shows that rate of exchange rate of dollars, British pound and Japan yen, have two thresholds. The findings which are achieved from this study, is based on purchasing power parity hypothesis that this hypothesis states that it occurs in long run. However, may be has been existed a small step element(such as Kim & Engle 1999,Engle 2000) which may effects to continuity of deviation from the long run equilibrium level of real exchange rate. So, the nonlinear transient dynamics in a model with an invisible elements leads to randomly permanent changes in the real exchange rate .Due to this, nonlinear model is a complex economic problem that examination in this area was suggested to researchers. But changes of rate should be calculated only in order to sustainability reduction for real exchange rate which it reinforces the results of this study. Thus, the results detects, whenever the government has benefited for fixing exchange rate from supportive politics, the exchange rate has increased significantly and a sudden leak has been experienced .According to these effects ,it was suggested to politicians , follow the floating exchange politics. And it was replaced by management floating politics. And also, it was applied to indirect supportive politics such as producers of goods which are related to exchange in order to control fluctuations of exchange rate.(such as drug market),In other word , it increases the attractiveness of alternative markets in order to decrease inflammation of exchange market and make lasting effects in economy.

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Appendix

   a) **US dollar:**

In the table below, the posterior variance corresponds to the two regimes

Table 2: Prevails in both regimes SETAR (1) The Bayes for US$ variance δ_{in}^2

| Coefficient	mean	posterior standard deviations	Monte Carlo Error	95% Confidence Distance	
σ_1^2	2.44E-06	4.30E-07	1.03E-08	1.68E-06	3.35E-06
σ_2^2	494.3	15660	358.1	0.001945	437.8

According to the results of table2, when the exchange rate is less than the value of the posterior thresholds δ The exchange rate varies considerably less than when the exchange rate is greater than the threshold value (in the two-regime regime, more than regime one). In other words, modifying one regime towards a long-term equilibrium is much more reliable than adjusting to a long-term path in the two regimes. Because the volatility in terms of the exchange rate increase is very high. In the following graph, the distribution of the late estimates of the adjustment coefficients in two regimes is shown:

Fig 2: Distribution of adjustment coefficients in the regime1, 2
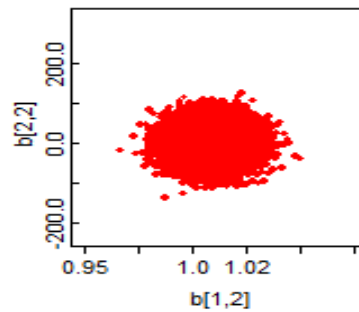
According to the above diagram, the independency two distribution are well defined. This indicates an appropriate sample split for both regimes 1 and 2. The posterior distribution of the adjusted coefficients along with the distribution of the posterior threshold values is shown in the following fig2.

Fig 3: posterior distribution of adjustment coefficients in two regimes with a threshold value (dollar exchange rate)
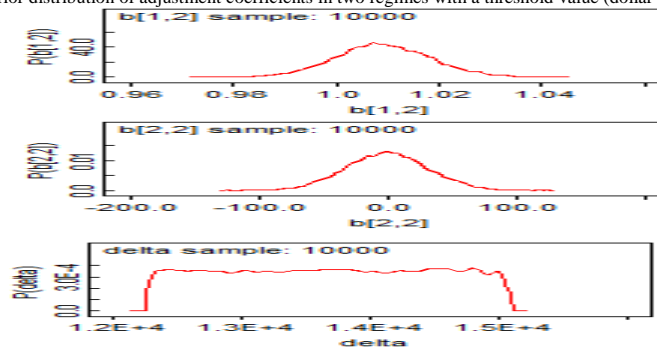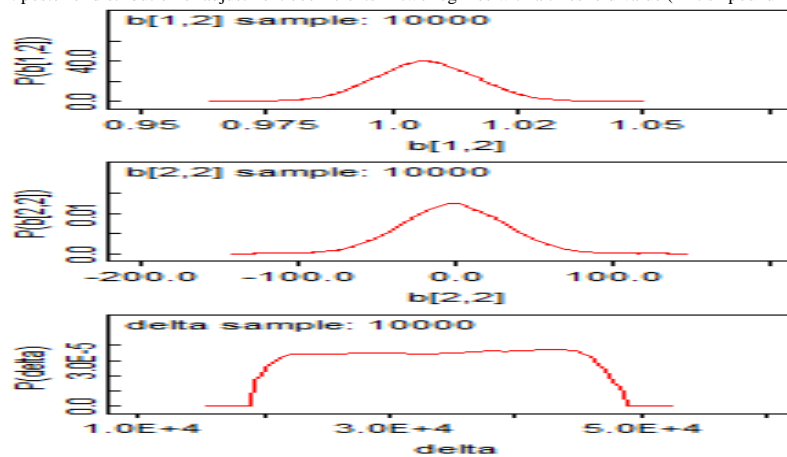

The distribution of the two regimen adjustment coefficients, as shown by the graph, is one-Mode and symmetric.

b) **British pound**

In the figure below, posterior Density of adjustment coefficients the two-regime with the threshold adjustment variable are shown below. These figures do not differ significantly in the shape and scope of the changes (except for the threshold variables) with the dollar exchange rate.

Fig 4: posterior distribution of adjustment coefficients in two regimes with a threshold value (British pound rate)

c) **Japanese one hundred yen**

Fig 5: posterior distribution of adjustment coefficients in two regimes with a threshold value (Japanese one hundred yen)