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Model Specification and Data Problem: A Case Study of *Market Volatility and Retail Interest Rate Pass-Through*

Abstract:

"W*hat is data and what it means*" can only be understood by using Visualisation. Visualization helps us to observe whether data is according to economic theory or not, and also hilight different issues within data as well. By employing visualization, we found only a few series upon which, we can really apply co-integration. Furthermore, co-integration equation of Wang and Lee (2009) found misspecified due to ARCH effect. After adjusting it, we found significantly different results for the co-integration (for same data set). This significant difference is not only in empirical models but also in implication as well. For example, in the case of the US, we found a complete pass through for the deposit rate model.

Keywords: Data visualization, Co-integration, ARCH effect, Model specification, interest rate pass through.

1. INTRODUCTION

The interest rate pass-through mechanism is one of the crucial gateways for the central bank to achieve the goals of monetary policy. Central bank can manage the retail interest rate by controlling money market rate. Thus, monetary policy affects the outcome of the banks, financial institutions, and the interest rate's market behavior. The success of the monetary policy can be measured by the margin, markup, markdown and the speed of the interest rate pass-through (Bredin et al., 2001 and Bonds, 2005). In industrialized countries, central bank uses a number of channels to implement the monetary policy (Fuertes and Heffernan, 2009), such as; central bank can change money market rate to achieve inflation targets. This tool of the monetary policy successfully controls the future expenditure and the inflation rate.

Interest rate pass-through is one of the most important issues in the field of economics. Empirically, symmetric co-integration is used to estimate pass through, such as; Engle and Granger or ARDL. But recently, Wang and Lee (2009) (hereafter W&L) introduce asymmetric co-integration methodology for the interest rate pass through, because of rigidities in retail interest rates. This methodology works well if all the properties of the data match the assumption of methodology. But (i) we find empirically (for the same data set) the presence of ARCH effect in the long run equation, because interest rate is financial time series, and hence, long run co-integration models are misspecified (table 1). Often it is observed, that due to the presence of ARCH effect the error term makes the coefficient of the estimate model biased (Alexakis and Apergis 1996), even if unit root test confirms the existence of co-integration. (ii) Before econometric modeling, as an econometrician, it is important to know "*what is data, and from where it came*". Whether the data taken for the study is appropriate according to the economic theory or not. Because, econometric models and software, give you statistic, which have persuasiveness,

even though they are misleading. For example; in financial market it is not possible for money market rate to be higher than the lending rate, while W&L data set is quite misleading, i.e. in case of Indonesia (appendix A) not only the money market rate is higher to the lending rate, but the deposit rate is also higher. (iii) Co-integration means if one variable is changing over the time, then other must follow these change, to hold the property of stationary linear combination. Dataset given in W&L have many consistent constant points, which might not follow the properties of co-integration. For example, in the case of Korea (appendix A) approximately 8 years' deposit and lending rate are consistently constant, while the money market rate keeps on changing, which implicitly implies there in no co-integration, for both deposit rate and lending rate models. (iv) Co-integration can also be interpreted as if the linear combination is stationary between two variables. For example; by visualizing all three series of Philippine (appendix A), it can easily be understood that their linear combination is not stationary over the time, i.e. variance is not constant over the time.

Econometric Models and generated statistic from these models are persuasive. Especially, for those Individuals, organizations or governments, who use these persuasive models and statistics for important decisions, based on the organized data set. But this closed eyes persuasiveness could be right away misleading because if the underlying assumption of models and data set are not compatible. Model specification is a general term; it holds for a model only when all the assumption fulfills. And only then econometric models will give reliable inference and prediction, for a specific topic. The econometric model will be misspecified if a single assumption does not hold, and it is an indication of a particular problem to be a deal. Therefore, misspecified model gives spurious and misleading implication, with meaningless inference and prediction.

All these issues lead us to explore a more sophisticated methodology, which depends upon visualization first and then searching for the model based on general to specific approach. The methodology presented in this study will give the direction how to proceed for a research study, otherwise, the result will be quite misleading. This methodology also is applicable to another field of applied economic as well.

The rest of this paper is organized as follows: Section 2 based on precise literature review. Section 3 explains the methodology, which is future based on visualization and econometric methodology. Section 4 explain empirical results and comparison with W&L results. The final section concludes the paper.

Table 1: results took from W&L, with the additional statistic of Durbin-Watson statistics, ARCH effect, and Serial Correlation test:

Deposit Interest Rate Model								
	Indonesia	Japan	Korea	Malaysia	Philippine	Singapore	Thailand	US
D_0	10.350 (0.000)	0.124 (0.512)	4.654 (0.000)	0.876 (0.017)	4.218 (0.000)	0.628 (0.035)	2.716 (0.000)	0.167 (0.626)
D_1	0.452 (0.000)	0.521 (0.000)	0.428 (0.000)	0.876 (0.000)	0.513 (0.000)	0.637 (0.000)	0.637 (0.000)	0.990 (0.000)
R^2	0.642	0.913	0.704	0.929	0.308	0.706	0.710	0.991
DW	0.329	0.132	0.131	1.171	0.463	0.176	0.351	0.480
ARCH effect (nR^2)	66.100 (0.000)	127.608 (0.000)	147.815 (0.000)	12.219 (0.000)	76.705 (0.000)	96.696 (0.000)	47.219 (0.000)	43.517 (0.000)

Lending Interest Rate Model								
	IND	JAP	KOA	MAL	PHI	SIG	THA	US
D_0	16.870 (0.000)	2.135 (0.000)	6.445 (0.000)	5.440 (0.000)	7.925 (0.000)	5.073 (0.000)	7.063 (0.000)	3.442 (0.000)
D_1	0.253 (0.000)	0.731 (0.000)	0.323 (0.000)	0.625 (0.000)	0.582 (0.000)	0.325 (0.000)	0.524 (0.000)	0.857 (0.000)
R-squared	0.592	0.955	0.508	0.737	0.344	0.595	0.718	0.971
DW	0.187	0.067	0.067	0.274	0.601	0.145	0.316	0.091
ARCH effect (nR^2)	89.048 (0.000)	146.854 (0.000)	181.953 (0.000)	105.453 (0.000)	51.136 (0.000)	126.180 (0.000)	144.414 (0.000)	118.060 (0.000)

2. LITERATURE REVIEW

Interest rates are the price of the funds; therefore, these prices should be determined by market forces. In this regards to interest rate pass through was studied by Barnanke (1990), to observe the effectiveness of monetary policy. Later on, Toolsema et al. (2002) add a question of the rigidity of in interest rate pass through and were answer by Lowe and Rohling (2002). The rate of pass through from lending rate depends upon the sample period, and co-integration methodology (Sander and Kleimeier 2002). Complete pass through is found in long run from money market rate to the retail rates, while in short run there is lending rate has low error correction. "*Collusive price arrangements*" and "*adverse customer reaction*" are the basic reason for the asymmetric

adjustment, which ultimately produces rigidities in retail interest rates (Neumark and Sharpe 1992).

Most of the researcher use linear (or symmetric) models to study the topic of interest rate pass-through. These linear models are not able to take nonlinear factors, for example, market structure or asymmetric information. Wang and Lee (2009) use error correction EGARCH in Mean to capture the nonlinear factors, to study interest rate pass through. For the confirmation of asymmetric co-integration in interest rate pass through, they use threshold and momentum threshold autoregressive (Enders and Siklos 2001). If there is ARCH effect in the long run equation, then the estimated parameter will not be accurate (Alexakis and Apergis 1996). In addition, W&L have ignored Ding et al. (1993) suggested a model for univariate GARCH type models, which leads to different models by restricting different parameters. Furthermore, Hendry's methodology suggests us to visualize data first and then apply methodology according to data properties.

Most of the studies in literature, work in symmetric models, and few of them put their attention on the asymmetric methodology. And based on the literature review, none of the research account for visualization. Because of the different in economic background, and their central bank adopts different monetary policies, hence, leads to different error correction adjustment in the short run. All these factors lead us to add visualization of data at first step and then will apply the appropriate econometric model.

3. DATA AND METHODOLOGY

3.1.The Data:

To investigate the mechanism of interest rate pass-through between money market rate and retail rates, we use monthly data for eight countries. Deposit interest rate, lending rate, and money market rates are included in estimations. The sample period is February 1988 to December 2004. Data is same as per study of W&L, except for two countries, i.e. Hong Kong and Taiwan.[1] Time series graphical representation of the all eight series are presented in appendix A.

Most of the previous study just employed symmetric co-integration in the field of interest rate pass-through. Wang and Lee (2009) suggested an asymmetric co-integration technique, which incorporates all issues that are found in symmetric co-integration. However, we hardly found any study which combines definition of a variable with data set in hand. To cut the likelihood of spurious repression, we have confidence in the graphical representation of data, through which we get a basic idea about issues. Through this graphical representation, we easily combine definition of a variable with actual data in hand.

Our empirical part of study consists of three steps. First step based on visualization of data. In a second step, we test the existence of a long-run relationship between retail interest rates and money market rate. If we detect any possibility of a long-run relationship, then finally we will employ short run relationship or error correction mechanism. We move from the first step to the second step in such a way, if it fulfill all the criteria in the first step, otherwise that particular data will be drop. Similarly, from step two to step three.

3.2. Visualization of Data:

[1] For the Hong Kong the data points are not as much of all other series, and to keep the study sophisticated we left Taiwan. Because the data of Taiwan is taken from different source.

One of the most important benefits of visualization is that it allows us visual access to huge amounts of data in easily digestible visuals. Visualization of data is also important in order to get a basic idea about the issues with the dataset in hand, for example, outliers, trend, structural breaks etc. It is well known that due to these mention issues and number of others, the econometric model gives false implications.

a. Steady Constant Data Points:

   As Econometric Models and generated statistic from these models are persuasive. But this closed eyes persuasiveness could be right away misleading because if the underlying assumption of models and data set are not compatible. Model specification is a general term; it holds for a model only when all the assumption fulfills. And only then econometric models will give reliable inference and prediction, for a specific topic. The econometric model will be misspecified if a single assumption does not hold, and it is an indication of a particular problem to be a deal. Therefore, the misspecified model gives spurious and misleading implication, with meaningless inference and prediction.

   Co-integration can be interpreted as if one variable is changing over the time then another variable must follow these changes, vice versa. One of the special cases is if one variable is changing over the time and other is steady constant over the time.[2] This special case directly an indication of no co-integration. More precisely, non-stochastic series is unable to give co-integration with stochastic series. There is no strict rule or formula to find a number of steady constant observation that limits to apply co-integration. But for simplicity, we use 50% of observation in a series as a threshold, i.e. if the number of steady constant values are more than 50% then there is no need of co-integration.

[2] Observation is called as steady constant value, if current and previous values are same.

b. Money Market Rate is higher than Lending Rate:

Money market rate is the rate on which commercial banks or financial institution buy a fund for lending. And of course, the buyer would not sell these borrowed funds at a cost lower than money market rate. The lender can make a profit only if it gives at the cost of higher than the money market rate. Economically, there is no possibility of higher money market rate to the lending rate.

3.3.The Methodology:

We start with the same methodology which is proposed by W&L. They used Engle and Granger (1987) test to observe co-integration between two series, i.e. deposit or lending rate and money market rate.

$$R_t = d_0 + d_1 M_t + e_t \qquad 1$$

where R_t is deposit or lending rate, M_t is money market rate, d_0 is markup, d_1 is the rate of pass through and e_t long run error term. For the proper and stable relationship e_t should be stationary. If there is problem of autocorrelation in e_t will be resolve in unit root testing. However, interest rate is financial time series, so there is possibility of ARCH effect. If there is problem of ARCH effect in the residual series, then it should be model for proper and stable relationship. To resolve this issue, we are combine Bollerslev (1986) and Engle and Granger (1987):

$$R_t = d_0 + d_1 M_t + c\sigma_t^{\delta} + \varepsilon_t$$

$$\varepsilon_t = z_t \sigma_t$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i} + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \qquad 2$$

This model will resolve the issue found in W&L. If the residual from Eq. 2 is stationary and if d_1 is significant then it implies there is co-integration exist between money market rate and retail interest rates. In addition, we also take the advantage of Enders and Siklos (2001) to confirm (i) long run co-integration, (ii) either the long run co-integration is symmetric or asymmetric. They assume asymmetric adjustment came through positive and negative value of the long run error term i.e. Eq. 2. To examine the existence of asymmetric co-integration we use threshold autoregressive (TAR) model:

$$\Delta e_t = I_t \rho_1 e_{t-1} + (1 - I_t)\rho_2 e_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta e_{t-1} + \varepsilon_t \qquad 3$$

where I_t represents an indicator variable, if

$$I_t = \{1 \text{ if } e_{t-1} \geq \tau \quad \text{or} \quad I_t = \{0 \text{ if } e_{t-1} < \tau$$

Since the true characteristic of the nonlinear model remains unknown, then the first-difference of the error term could represent the momentum of the interest rate adjustment and reveal the asymmetric adjustment of the interest rate. This asymmetric model is called momentum TAR (MTAR);

$$\Delta e_t = M_t \rho_1 e_{t-1} + (1 - M_t)\rho_2 e_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta e_{t-1} + \varepsilon_t \qquad 4$$

where $M_t$is the indicator variable, if

$$M_t = \{1 \text{ if } \Delta e_{t-1} \geq \tau \quad \text{or} \quad M_t = \{0 \text{ if } \Delta e_{t-1} < \tau$$

Sufficient condition for the error term is stationary if it holds then OLS is consistent estimators (ρ_1, ρ_2). The null hypothesis is $\rho_1 = \rho_2 = 0$ and follows F distribution. A rejection of the null hypothesis indicates that the co-integration exists. If co-integration exists, then in second step we apply $\rho_1 = \rho_2$ null hypothesis to confirm symmetric or asymmetric co-integration.

Interest rates are financial variables, which might have stylized properties in short run. To deal properly with stylized properties we are adding Ding et al. (1993), in the presence of Eq. 2 along with Eq. 4 for the short run analysis:

$$\Delta R_t = d_0 + d_1 \Delta M_t + d_2 \sigma_t^{\delta} + M_t \eta_1 e_{t-1} + (1 - M_t)\eta_2 e_{t-1} + \sum_{j=1}^{p} a_j \Delta e_{t-1} +$$

$$\sum_{j=1}^{p} b_j \Delta v_{t-1} + \varepsilon_t v_t$$

$$v_t = z_t \sigma_t$$

$$\sigma_t^{\delta} = \gamma_0 + \sum_{i=1}^{q} \gamma_i (abs(\varepsilon_{t-i}) - \theta_i \varepsilon_{t-i})^{\delta} + \sum_{j=1}^{p} \vartheta_j \sigma_{t-j}^{\delta} \qquad 5$$

W&L has just discussed one of the special cases of it. Ding et al. (1993) is a general model, which can lead us to different final model, by restricting different parameters. Because in real data set we don't know either which process data is following. Testing $H_o \ \eta_1 = \eta_2$ implies symmetric adjustment in the short run, and vice versa. Comparison of absolute values of $\eta_1 \ and \ \eta_2$ shows that upwards rigidity ($|\eta_1| > |\eta_2|$) otherwise it is downwards rigidity.

4. Empirical Analysis:

4.1. Visualization of Data:

Time series graphs (Appendix A) represents that there is a number of constant steady constant observation in series and also money market rate is higher than lending rate. Results are summarized in Table 2. For example, there are 68% and 71% observations are steady constant observation for deposit and lending rate, respectively. While money market has just 1% observation with a steady constant. This directly implies there in no co-integration, because money market keeps on changing while other is not responding. In addition, except the US, for all other countries money market rate is higher than the lending rate. But the lending rate of US has 61%

steady constant values. Which means there is no need to test empirically co-integration in the case of the lending rate for all countries. However, for the deposit rate, there is the possibility of co-integration for Indonesia, Japan, Philippines, Malaysia, and the US.

Table 2: Results based on visualization and possible co-integration

	1.Percentage of steady constant observations			2.Money market rate is higher than lending rate	Possibility of co-integration (Based on 1 & 2)	
	Deposit Rate	Lending Rate	Money Market Rate		Deposit Rate	Lending Rate
Indonesia	1%	4%	0%	YES	**YES**	NO
Korea	51%	47%	9%	YES	NO	NO
Japan	24%	3%	2%	YES	**YES**	NO
Philippines	0%	0%	0%	YES	**YES**	NO
Thailand	68%	71%	1%	YES	NO	NO
Malaysia	35%	4%	0%	YES	**YES**	NO
US	4%	61%	5%	NO	**YES**	NO
Singapore	58%	69%	15%	YES	NO	NO

4.2.Long Run Relationship:

Before conducting the time series analysis, there is a prerequisite to check the stationary of the variables. Table 3 lists the Augmented Dicky Fuller (ADF) unit root test for the level and first

difference values of the variables. Deposit and money market rates are stationary at first different, with 1% significance level.

Table 4 lists the empirical results for the long run relationship between deposit rate and money market rate. Statistically, there is no ARCH effect left in the long-run series. The value of R^2 is quite low for Indonesia and Philippines. Last row of the table presents the ADF unit root testing for the residual of co-integration equation. Which confirms that there is no co-integration in case of Indonesia, while for Japan, Philippines, Malaysia and US there is co-integration. There is significant markup for all countries. For Philippines, markup is 5.76, seems relatively much high and is a good opportunity for investment. Rate of pass through is complete in case of US, while in all other cases there is low rate of pass through.

Table 5 list the results, (1) confirm the presences of long-run relationship, (11) either is co-integration is symmetric or asymmetric. Statistically, it is confirmed that there is co-integration, between deposit rate and money market rate. However, in the case of Malaysia, the co-integration is symmetric, while there is asymmetric co-integration between money market rate and deposit rate for Japan, Philippines, and the US.

Structural break in series affects the power of ADF (Enders, pp 243). To observe the power of ADF, we use visualization of residual for co-integration equation in Figure 1. Where we presented the residual for four countries, Japan, Philippines, Malaysia, and the US. As the statistics directly implies there is the existence of co-integration, but graphically, we observe that there are structural

breaks in residuals. These structural breaks make the statistic of ADF stationary for Japan, Philippines, and Malaysia. While in the case of US there is no such issue.[3]

There is not the only difference in the empirical model but also in the implication as well. In the case of W&L the intercept is biased because of misspecification (specifically due to ARCH effect), and hence incomplete pass through. While our empirical model implies there is complete pass through from the money market rate to the deposit rate and significant intercept.

Table 3: ADF unit root test

	Indonesia	Japan	Philippines	Malaysia	US
Level					
Deposit rate	-1.1194	-0.97462	-0.7877	-0.5917	-1.1185
Money market rate	-1.5626	-1.31019	-1.3123	-0.6198	-1.3112
First difference value					
Deposit rate	-9.2362***	-12.0105***	-14.9968***	-10.0434***	-7.6654***
Money market rate	-17.090***	-3.10093***	-16.7622***	-21.8197***	-4.7888***

Table 4: Deposit rate model

	Indonesia	Japan	Philippines	Malaysia	US
d_0	17.15394 (0.0000)	0.03587 (0.0000)	5.76314 (0.0000)	1.25105 (0.0000)	0.05383 (0.0105)

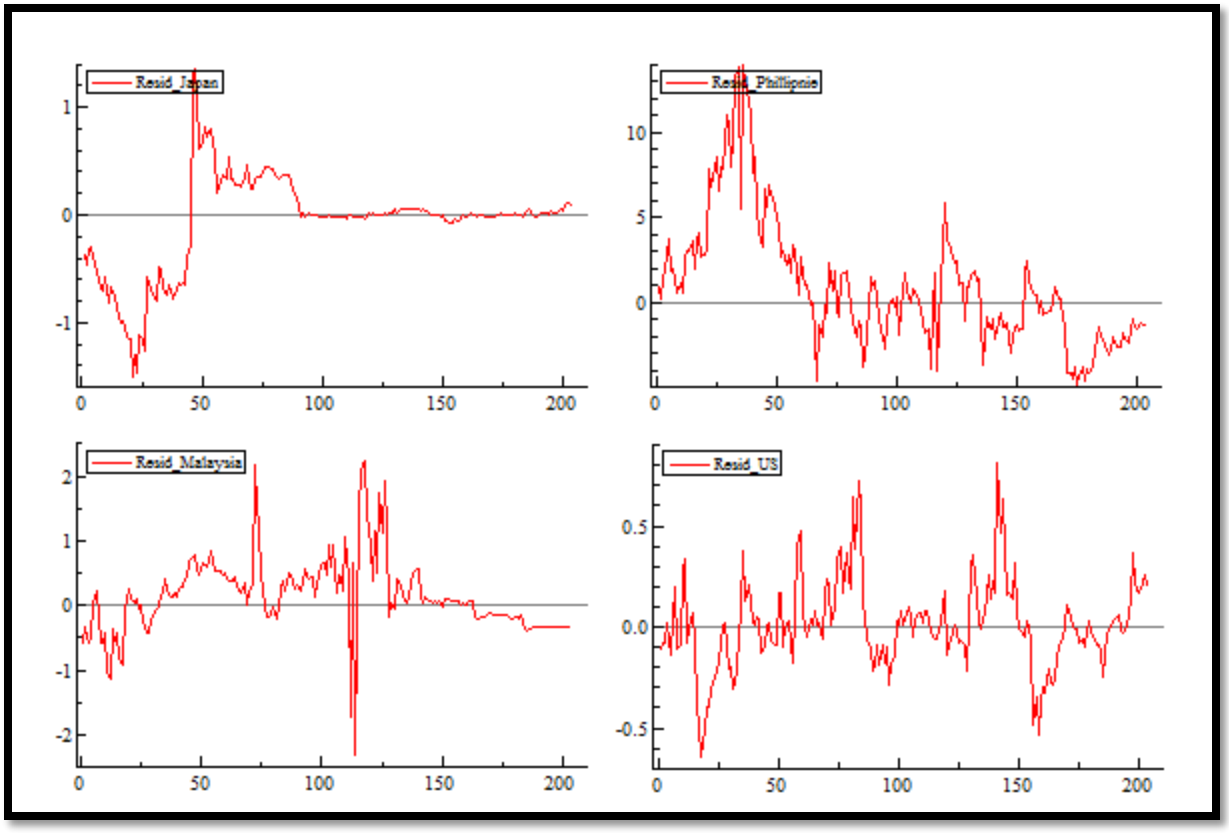
[3] As this study is comparison with actual study, i.e. Wang and Lee (2009). For this reason, we use ADF. However, there is as vast literature available to properly deal with structural breaks in unit root testing.

d_1	0.140976 (0.0000)	0.58273 (0.0000)	0.30717 (0.0000)	0.76833 (0.0000)	1.01140 (0.0000)
α_0		0.00013 (0.0345)	1.401777 (0.0001)	0.01687 (0.0033)	0.00643 (0.0000)
α_1	0.808663 (0.0000)	0.72283 (0.0306)	0.939747 (0.0002)	1.65942 (0.0000)	1.17053 (0.0000)
α_2	0.328832 (0.0000)	0.38664 (0.0767)			0.21322 (0.0167)
R^2	0.35	0.89	0.21	0.91	0.99
ARCH LM-test (nR^2)	0.75	0.03	1.32	0.81	0.37
ADF unit root test on error at level	-1.52818 (0.1185)	-2.46042 (0.0138)	-2.34718 (0.0186)	-2.50595 (0.0122)	-5.09287 (0.0000)

Table 5: TAR and MTAR co-integration tests

	Japan		Philippines		Malaysia		US	
	TAR	MTAR	TAR	MTAR	TAR	MTAR	TAR	MTAR
Co-integration	12.180***	18.897**	11.191***	30.594***	46.220***	45.172***	27.106***	38.350***
Symmetric/ Asymmetric	5.006**	12.497**	1.395	19.898***	1.910	1.051	1.149	11.108***

Figure 1: Residual of co-integration equation.



4.3.Short Run Relationship:

In the classical approach, we have data in hand and then we are searching for the appropriate model, as we don't know the data generating process of the real data set, it could be possible that we find more than one empirical model. In addition, we are using a general model which also provides the simplification for multiple models, by restriction of different parameters. However, in the case of W&L only E-GARCH-ECM is under analysis, and then fitting the data set at hand, which is not the appropriate way. Table 5 list the empirical results for short run relationship. The empirical model is ECM-EGARCH-M, where all the statistic supports the goodness of fit. In short run, with the change in one unit in money market rate will lead to changes 98 basis points in the deposit rate, while keeping all other things constant. Furthermore, 1.01 and 0.98 are the rate of a

long run and short run interest rate pass through, respectively. The difference is very minute, for this reason, the rate of error correction is quite low, ($\eta_1 + \eta_2 = 0.029$) In addition, it also implies that there are a minor error correction form positive and negative error terms (η_1, η_2). We reject the null hypothesis $\eta_1 = \eta_2$ significantly with Chi-Square value 1256 at 1% significance level. This is an indication for asymmetric adjustment in the short run, with downward rigidity ($|\eta_1| < |\eta_2|$) in the deposit rate.

4.4.Economic Significance:

According to the Bertrand model (classical theory), if the financial transactions system is perfectly competitive and the information is completely transparent then the price of the market is equal to the marginal cost. In this case, there is one to one relationship between the price of the market and marginal cost, and hence the ratio of change in price perfectly reveal the changes of marginal cost. Our empirical results imply that there is complete pass through for the US.

While in the case of short run, the market is not perfectly competitive, and the information is not completely transparent. Then the ratio of change in prices is not equal to the marginal cost. This is the process of short run, and the phenomena are known as an oligopoly. Our empirical result supports Bertrand model in long run and oligopoly in short run, for the US.

Why pass through mechanism does not exist for other countries? If the interest rate is determined outside the market, then borrower and lender are not sensitive to the change in cost. In this case, commercial banks will not maximize their profit. In this case, the major factor to affect the deposit and lending rate is government policies, for example, fixed deposit and lending rate (steady constant). Because of this rigidity in retail interest rate will decrease the efficiency of monetary policy. Hence, the interest rate pass-through mechanism is an ineffective tool for these countries.

Table 6: Short run Lending rate model for the US	
	US
Variable	Coefficient
$ARCH\_Mean$	-0.54675 (0.0000)
d_0	0.05824 (0.0000)
d_1	0.98173 (0.0000)
η_1	-0.19057 (0.0000)
η_2	0.21962 (0.0000)
α_0	-0.55385 (0.0000)
α_1	-0.07205 (0.0000)
$EGARCH$	0.46290 (0.0000)
β_0	0.85797 (0.0000)

R-squared	0.487896
RSS	5.040247
Log likelihood	136.0931
DW	2.290102

4.5.Comparison with W&L:

The methodology presented by W&L is much impressive. But they ignored the visualization of data. Due to which they were unable to observe the problem in data set, and also unable to know what is data and what it means. They rely only on methodology, which gives them spurious implication. In this study, we visualize data first, where we observe the problem of repeated value, and data not according to the definition of variables. According to our set criteria only one series, i.e. deposit rate and money market rate. By improving methodology little, we found a significant difference in our empirical results. Our empirical results imply complete pass through in long run, while in W&L it was incomplete. Even in short run, the rate of pass-through is little high in our case.

5. Conclusion:

Basically, there are two objectives of this study; firstly, to visualization of data properly and then modeling data according to properties. Because if we don't know what is data, and what does it mean, then we cannot get the fruitful results.

Initially, by deeply understanding and visualization of data set we came to know that only one series is accurate in a sense to apply the co-integration test. Because either money market rate is

higher than the lending rate, or one series is showing fluctuation and other don't. Therefore, it implies there no co-integration. We found a significant difference in our empirical deposit rate model for the US. Our empirical results implies that there is complete pass through, while in the case of W&L the pass through was incomplete. This significant change in the empirical model is because of the misspecification of ARCH effect in the long run. It is also a significant difference in error correction model. In addition, empirical model leads to different implications as well.

This model is general, which can be extended to a number of other models and based upon the parameter restriction, and properties of data, i.e. normal and student t distribution. Proper unit root testing with the structural break is also required to improve methodology.

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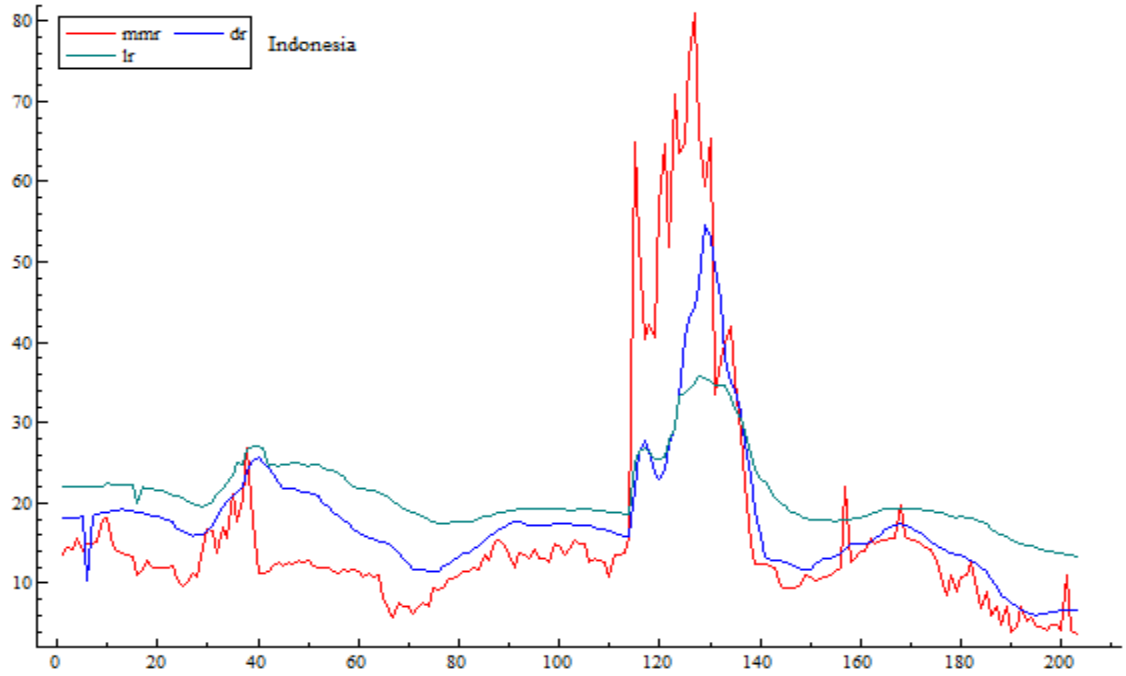
Appendix A: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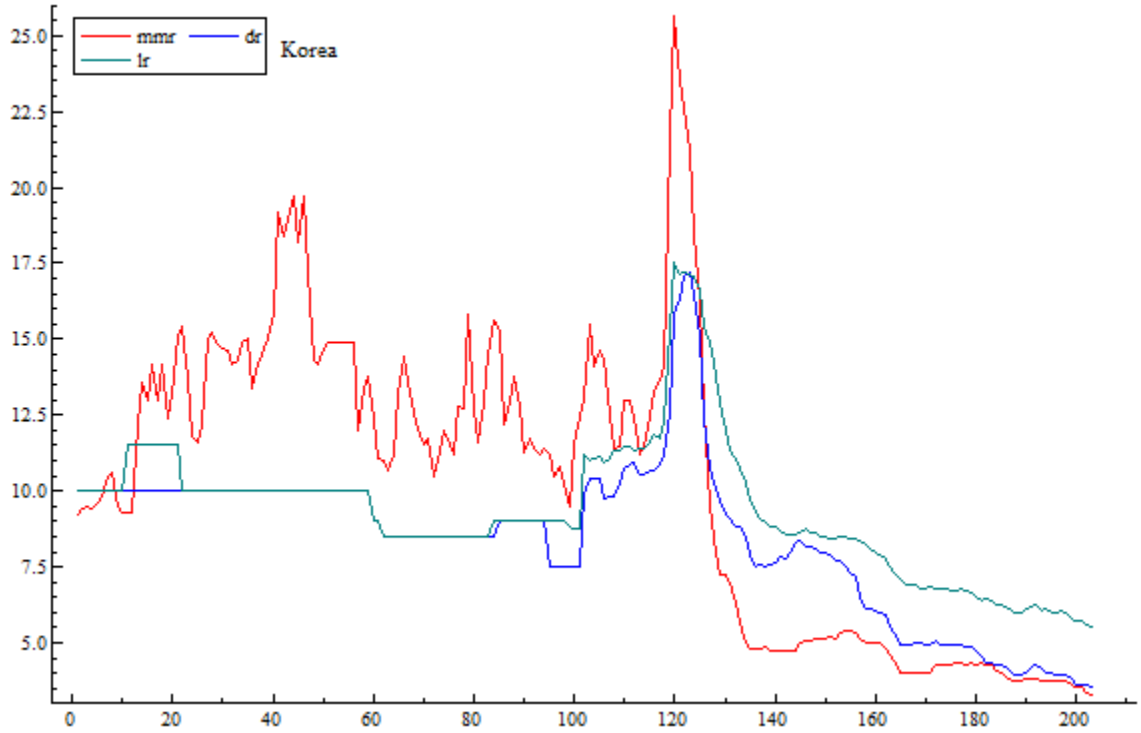
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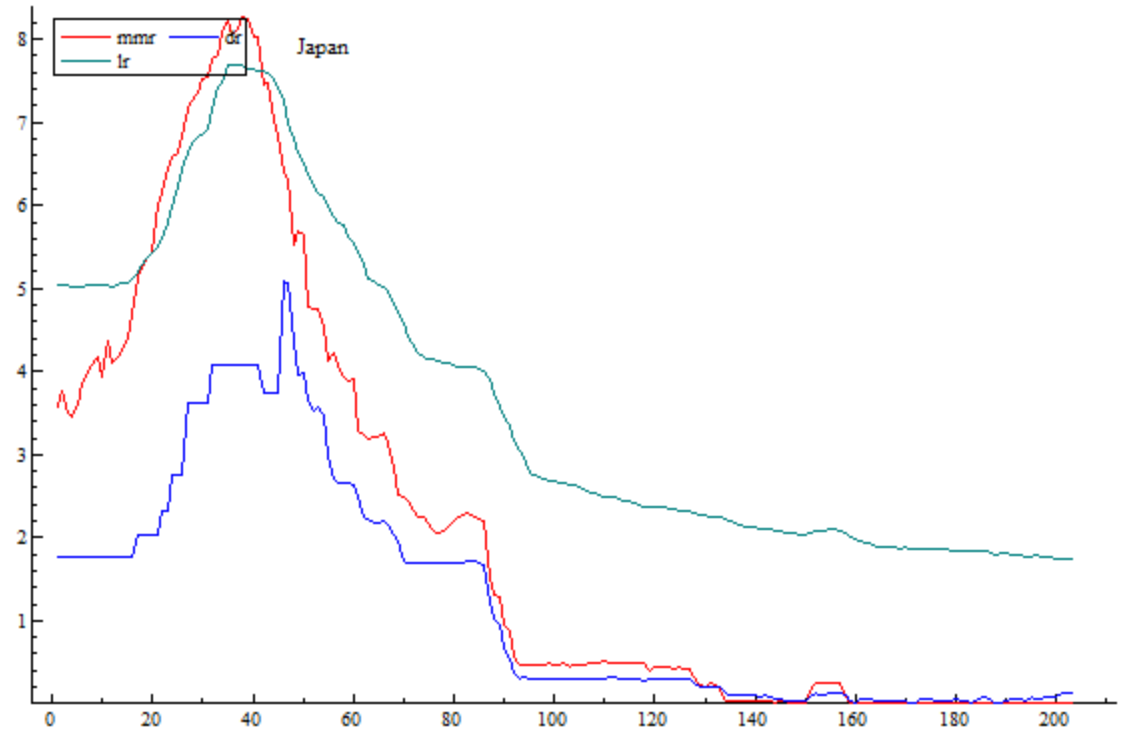
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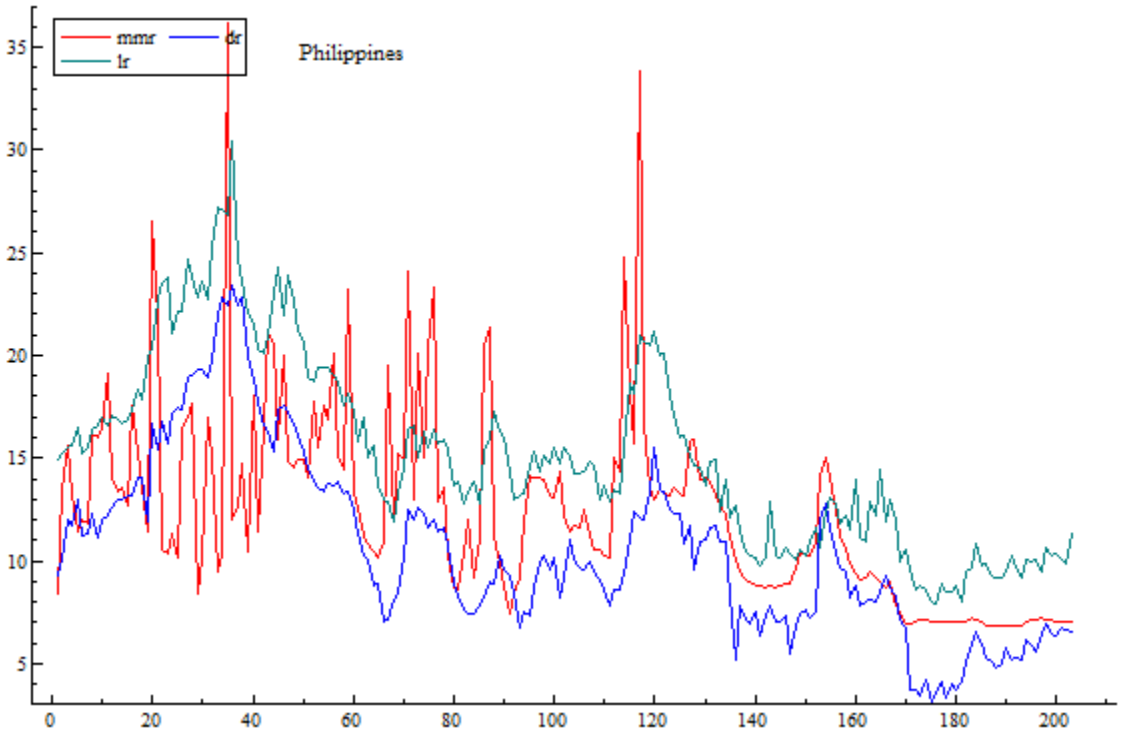
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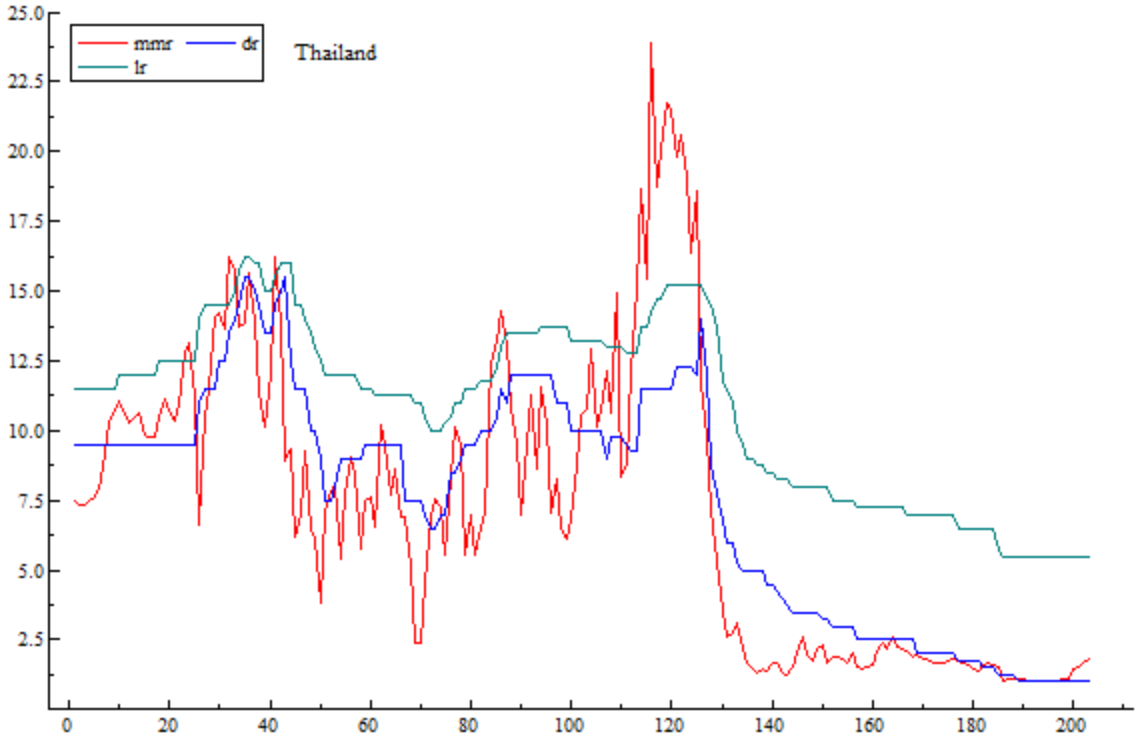
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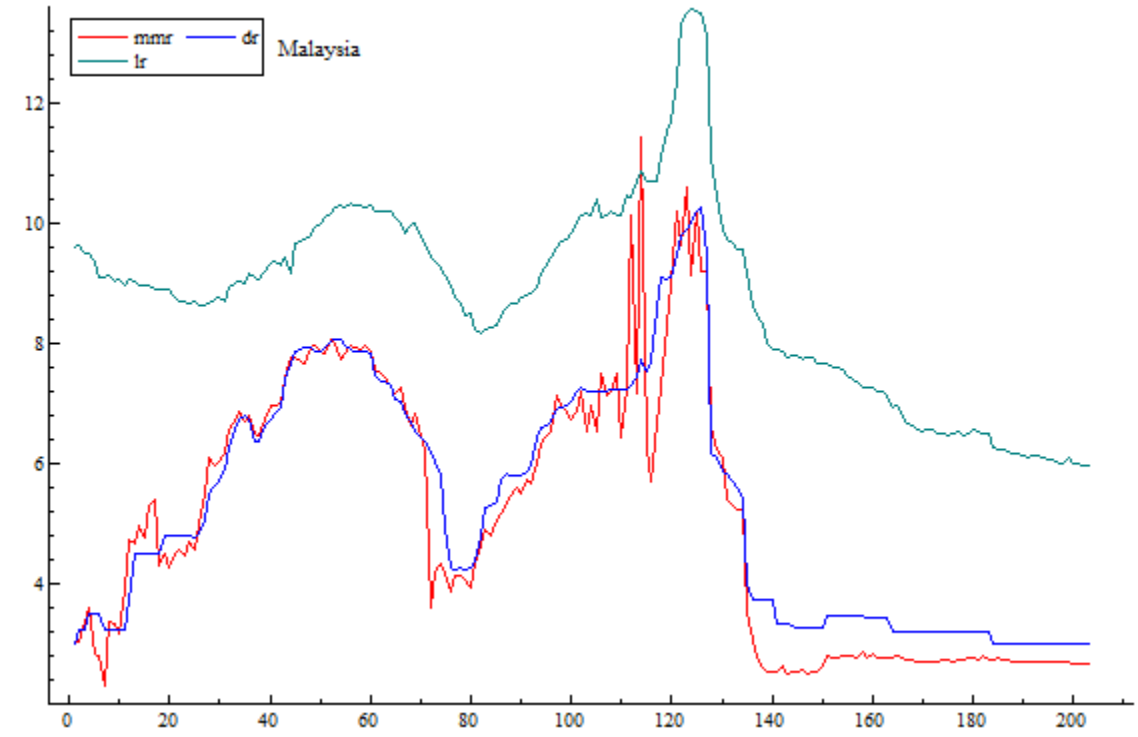
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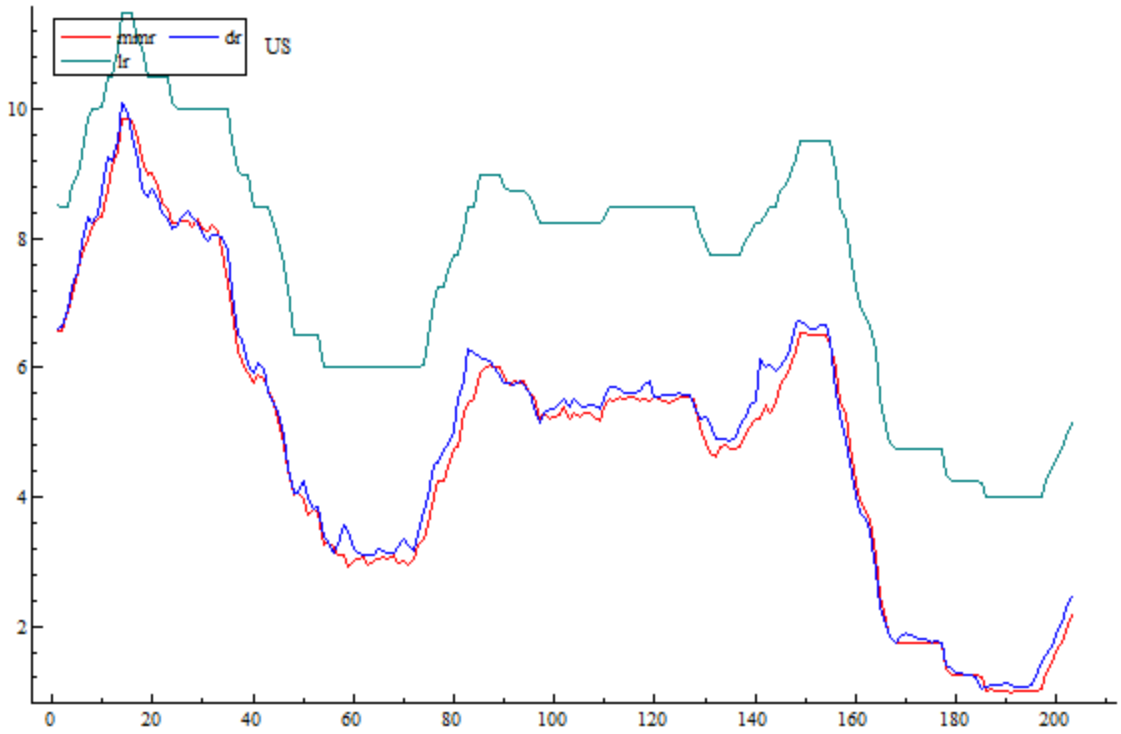
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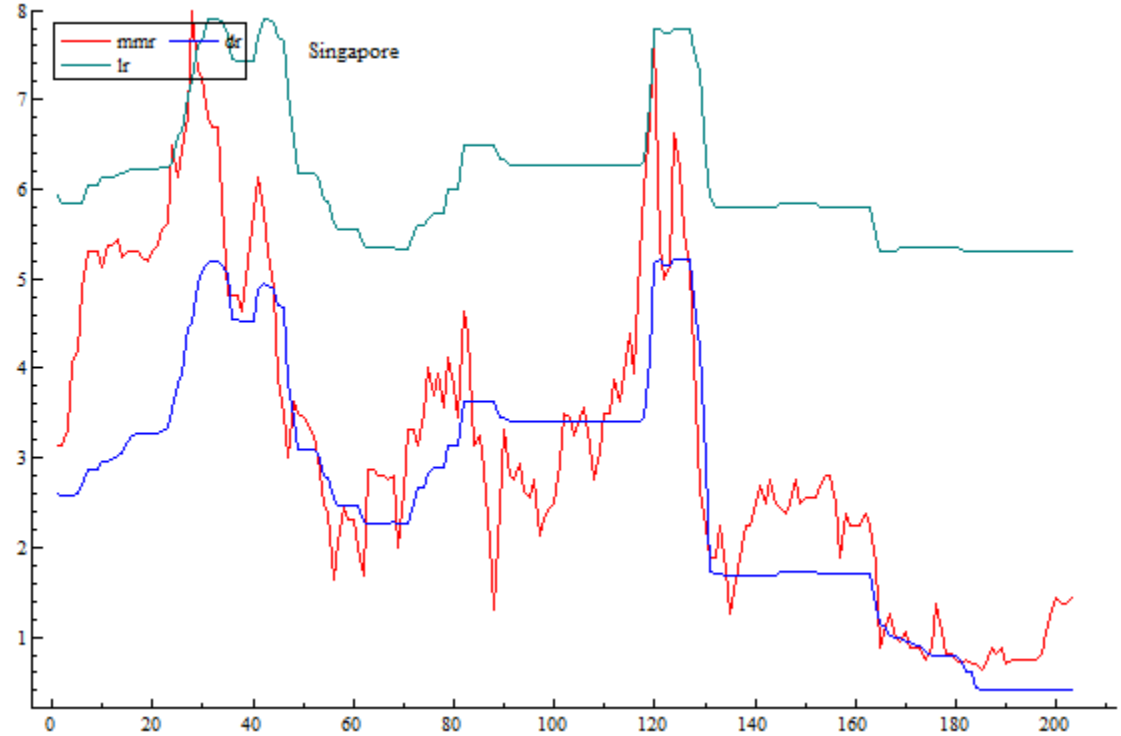
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