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The Short-term and Long-term Relationship between Public Sentiment and Insurgency Violence in 3 Southern Provinces of Thailand

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Approval of the Dissertation Committee

This dissertation has been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of Domrongphol Sangmanee as fulfilling the scope and quality requirements for meriting the degree of Doctor of Philosophy in Political Science

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Abstract

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This dissertation is aimed to developing and improving the theory on the intrastate conflict and public sentiment as well as the conventional wisdom on the conflict study as well as developing new analytical framework for studying intrastate conflict and for informing policymakers to deliver or adjust for a better policy to cope with this problem. The empirical case study is an insurgency conflict in three Southern provinces of Thailand. The study employs multi-variate time-series analysis, namely Vector Autoregressive Model (VAR) and Vector Error Correction Model (VECM), and empirical system dynamics analysis, namely Convergent Cross-Mapping (CCM). The results show that the relationship between public sentiment and the insurgency violence are not empirically supported by all three analysis. The political demographic influence on the violence are empirically supported in all three analysis, especially in long-term relationship. Surprisingly, the socio-economic factors are not consistently supported by the empirical analysis. The results from CCM also suggest the relationship between political demographics and level of violence from insurgency is non-linear and the conventional statistical estimation can be limited in its estimation.

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Chapter 1: Introduction

Introduction

This dissertation is aimed to developing and improving the theory relating on intrastate conflict and public sentiment as well as the conventional wisdom on the conflict study. The study explores the potential theoretical and methodological framework that links structural conditions which can be seen as necessary conditions for intrastate conflict to escalate and the sufficient conditions that enable this social phenomenon to manifest. Also, this study aims to develop new analytical framework for studying intrastate conflict and for informing policymakers to deliver or adjust for a better policy to cope with intrastate conflict.

The case study used to develop the theoretical and methodological framework is an insurgency conflict in three Southern provinces of Thailand. This conflict is ongoing since 1950s and the conflict escalating to the critical level in 2004. Since the escalation of the conflict in 2004, local population become the victim of the violence from the conflict in numerous ways. The consequence of the violence is not limited to only certain group of population, but every local individual suffers indiscriminately.

Background of the Problem

Firstly, the main problem which this study tries to address is a theoretical and methodological framework for studying and predicting the violence from intrastate conflict, such as insurgency, ethnic and religion conflict. In the field of empirical studies on conflict and insurgency, the main two approaches in methodological framework are theory building and

prediction (Berman & Matanock, 2015; Bollfrass & Shaver, 2015; Braha, 2012; Brunborg & Tabeau, 2005; R. Cincotta, 2011; D'Orazio, Yonamine, & Schrodt; Hendrix, 2010; Hutchison & Johnson, 2011; Ward et al., 2013; Ward 2005). This group of study emphasizes on establishing causality between the independent variables and the conflict itself. These studies use different theories to build the empirical models and mostly use different conventional econometric estimation techniques to analyze the data.

On the other hand, (Hammond & Weidmann, 2014; Mahoney, Comstock, deBlois, & Darcy, 2011) use data mining and machine learning techniques to predict the conflict or the escalation of the conflict. These group of study arises from the advancement of computer science and big data that allows researchers to capture more granularity and larger volume of data than the past. However, many studies focus mainly on the performance of the forecasting rather than the explanation from the information that we can extract from data One of the reasons is the limitation of the machine learning techniques which can be considered as a black box for the explanation.

One of the main purpose of this study is to bridge between theory building framework that researchers can establish and explain the causal link and policymakers can use this information to change, adapt or adjust policy to stabilize the security problems and machine-learning and big data techniques that allow researchers to explore the new possibility of an analytical framework that can provide new insights and details including augmented actionability of the study as a policy tools for academics, national and local governments, NGOs to improve the situations in the areas affected by intrastate conflict.

Purpose of the Study

1. Using current theories on intrastate conflict and insurgency with the cutting-edge methodology to study a political conflict at subnational level
2. Bridging a necessary conditions and sufficient conditions which lead to the intrastate conflict and the escalation of conflict
3. Developing new methods in conflict study at subnational level
4. Developing a policy tools for policymakers to monitoring and forecasting intrastate conflict by using analytical techniques

Overview of methodology

This research uses a case study from the ethnic and religion conflict in Southern provinces of Thailand. The data used in the analysis will mainly come from publicly available data including public sentiment from automated sentiment analysis system. The data analysis techniques in this study is multi-variate time-series techniques, namely Vector Autoregression (VAR) and Vector Error-Correction Model (VECM), and Convergent Cross Mapping.

Significance of the Study

The study aims to merge the conventional quantitative analysis techniques for establishing the causality and the analytical framework from machine learning and big data to better understand and provide an insightful relationship of the necessary conditions and sufficient conditions in intrastate conflict. Ultimately, this research is aimed to improve and propose a better theoretical

and methodological framework in the field of conflict study for academics and policymakers to understand and predict the violence from intrastate conflict in hope for a better policy and stability of the society.

Conclusion

In this chapter, I outline the layout of the dissertation. The overview of the main purpose of the study, the research question and the methodology. The details of each components of this research will be discussed in the chapter 2: Review of the Literature and Chapter 3: Methodology.

Chapter 2: Review of the Literature

Introduction

In this chapter, the past researches on the conflict and emergency are discussed. This research is focused on the past empirical study on conflict and insurgency, especially in regard of the major factors in socioeconomic condition and the impact of public sentiment to social phenomena to explain the framework used in this study. In addition, the chapter will present some background on the case study, the intrastate conflict in three Southern provinces of Thailand. Then, I will discuss about the conceptual framework for this study.

Review of Research

Intrastate Conflict and Insurgency

Most of the empirical researches on intrastate conflicts focus on three aspects: onset, intensity and duration (Bagozzi, 2015; Berman & Matanock, 2015; Bollfrass & Shaver, 2015; Brandt, Freeman, & Schrodt, 2011; Hegre, xe, vard, & Sambanis, 2006; Ward 2005). A study on a conflict onset explores the causes of conflict or seeks for signs that will provide researchers and policymakers to monitor and observe when a conflict occurred. This also includes studies of the impacts of factors on the escalation of conflict, such as from a dispute or an unrest to an armed conflict. The second aspect of intrastate conflict study is the intensity of conflict (Chou, 2012; Reed, 2000). Many studies develop their frameworks on how an armed conflict escalate their intensity by using the number of death due to the conflict as a measurement of the intensity of conflict. Lastly, some studies develop a conflict theory based on the duration of an armed conflict

(Box-Steffensmeier, Reiter, & Zorn, 2016; Box-Steffensmeier & Zorn, 2001). These studies look at factors that prolong or avoid termination of an armed conflict by using statistical analysis such as proportional hazards model in the estimation.

The past studies on intrastate conflict or insurgency predominantly focus on ethnicity as a major driving factor in insurgency. One of the main theory about ethnicity and insurgency is a motivation of ethnic groups to rebel against a national government (Gurr, 1971). This theory postulates that an insurgent group has a purpose to readdress religion issues, to strengthen their nationalism or to find a solution for their economic grievance. Gurr emphasizes on the perception of minority or ethnic people and what they have which leads to the dissatisfaction of status quo. In this theory, the main driving force that motivate ethnic group is the grievance sentiment and resentment against the central government (Gurr, 2000).

Nevertheless, the theory on grievance has a methodological limitation in the past empirical literatures that grievance or resentment sentiment is difficult to operationalize into the empirical studies and the past literatures mostly use GINI index or the percent of ethnolinguistic groups in power positions as the proxy of the inequality between the majority and minority population (Forsberg, 2008; Sambanis & Shayo, 2013).

Brandt et al. (2011), on the other hand, argue that insurgent groups are opportunistic actors who rebel against central government when intrastate conditions are in favor of insurgency groups. These conditions mainly are poverty and slow economic growth in the regions, geographical terrains, and the ability of central bureaucratic government in the regions. This finding seems to support the theory on conflict that focus largely on the parity of power between two actors (Kugler & Lemke, 1996). This theory suggest that the conflict will arise when two main actors have

dissatisfaction with status quo, and they have equal or almost equal power. If one party have virtually uneven power to the others, the conflict is less likely to escalate since they do not have power or resource to be able to challenge the other party. Reed (2000) conducts a cross-country study and finds the evidence to support this claim.

R. Cincotta (2015a) predicted and wrote an advice to the Department of State in early 2008 that some countries in middle east, especially Tunisia, will have an intrastate conflict in the near future based on the population structure and the political regime. In political demography theory, civil conflict or intrastate conflict can arise when the demographic structure of a minority group is youthful, but the demographic structure of a majority group is older. The youths among a minority group become a major force which is mobilized to challenge the central power. Without a proper policy to bring the youths among minority group into economic force by a central government, this condition will result in an internal conflict or an internal migration problem. So, a country with large young population, especially in minority groups, and high youth unemployment rate will have a greater probability to have an intrastate conflict (R. Cincotta, 2010, 2011, 2015a, 2015b; R. Cincotta, 2016; R. Cincotta, Goldstone, & Sciubba, 2017; Richard P. Cincotta, 2008; Richard Paul Cincotta, Engelman, Anastasion, & Population Action International., 2003; Richard P. Cincotta & Leahy, 2006).

Public Sentiment and Intrastate Conflict

There are large number of studies on sentiment as a collective actions and these sentiment can influence the outcome of policy on local, national and international level(Gruszczynski, 2013; Mercer, 2005, 2010, 2013, 2014; Reus-Smit, 2014). Mercer (2005) expand the idea of sentiment as the main subject in international relation study that sentiment is not only influenced and result

in personal matters, but sentiment is social. Sentiment helps an individual develop his or her identity to the group they belong to. When they have sentiment, they do not have an sentiment on behalf of that group, but they have a shared sentiment because they are the part of the group. In other word, sentiment of individuals is a reflection of how group feels or react to the surrounding. This postulated concept expand the aspect of the collective action and group identity to the territory beyond institutions or states as conventional wisdom in international relation study (Reus-Smit, 2014).

As discussed above, the studies of conflict in the past are limited by methodological and technological constraints to capture public sentiment in intrastate conflict. The motivation of insurgency group, as explained, are driven by the perception of grievance and resentment against a central government and/or majority population. However, the past literature can only use socioeconomic index as a proxy to operationalize this theory since these measurements were available at the time. Nevertheless, the advance in technology, natural language processing and methodology allows us to capture sentiment of individuals and public in the real time. Arafat, Habib, and Hossain (2013) use sentiment analysis to analyze sentiment from the individual expression on social media as the major factor to forecast financial data. Gruszczynski (2013) also use the similar techniques to study how media can set a tone or sentiment and influence public attention to policy agenda. The recent study also shows similar results (Peng, Sun, & Wu, 2017). The researchers find that public attention on social issue in social network platform can influence the sentiment of public, at the same time, the public sentiment towards a particular social issue also affect the public attention. In other word, the public sentiment and the public attention are endogenous.

The new methodological techniques in natural language processing has allowed social scientists to measure and operationalize the past theories that can never be done before. In this case, it allows researchers in conflict studies to revise their research design and test public sentiment as a factor in intrastate conflict based on the previously mentioned grievance theory (Gurr, 2000) instead of the ratio of minority population and majority population.

Background to Case Study: Security Problems in Three Southern Provinces of Thailand

The three Southern provinces of Thailand, Pattani, Yala, and Narathiwat, has been facing the insurgency problem since 1948. The conflict was escalated in 2004 during Prime Minister Thaksin Sinnawatra Government and the termination of the conflict is still unlikely to happen in the near future (Abuza, 2011). As of 2016, the number of people who died due to the conflict was around 5,892 persons ("Deep South Incident Database (DSID)," 2017). The population in the region are mostly Muslim Malay ethnicity, but the victims from the conflict included both Buddhists and Muslims. The main active separatism groups are National Revolution Front (BRN), Runda Kumpulan Kecil (RKK), Islamic Front for the Liberation of Pattani (BIPP), and Patani United Liberation Organisation (PULO).

The main explanation of the insurgency is historical and ethnical, as the region was Pattani Kingdom before Thailand annex the land in 1909. This explanation views the insurgent groups as a nationalism movement that emphasizes on the past history and ethnicity of the region that becomes a conflict to the majority of Thailand (McCargo, 2004). One of the official explanations by National Reconciliation Commission is socio-economic grievance. This explanation focuses on the lack of resources and opportunity of local people to economic opportunity (Srisompob & Panyasak, 2006). However, some researchers argue this theory based on the fact that at the

beginning of the escalation of the conflict, the rubber price, which is the main economic activity in this region, was very high (Jitpiromsri & McCargo, 2010).

The contest theory on this conflict is the role of the central government in the regions (Jitpiromsri & McCargo, 2010; Wheeler, 2014). First, there is perceived injustice among the local people. This is largely due to the difference between culture and how central government official treats local people. And the second part is the representation and participation of local people in public administration, since Thai government still take a stand on one state policy and the current pollical atmosphere has stopped any attempt to decentralize the power.

Definition of Terms

Intrastate conflict is defined as *a conflict between government and non-government entity over contested incompatibility with use of armed forces which results in at least 25 battle related deaths in one calendar year* (Themnér & Wallensteen, 2012). This type of conflict becomes common conflict in the world, especially after the cold war. The main actors of the conflict have shifted from state-level conflict such as war into state and non-state actors. In this definition, the intrastate conflict ranged from ethnic and religion conflict between minority group against a central government to a civil war conflict where the opposition party almost has symmetrical power relative to a central government (Brandt et al., 2011).

The level of violence from intrastate conflict in this study is operationalized by using the number of incidents from intrastate conflict and the fatalities from the incidents (Chou, 2012; Reed, 2000). The number of incidents from intrastate conflict reflects the prevalence of the conflict in the areas, while the fatalities from the incidents reflects the severity of the conflict.

The socio-economic factors in this study refers to the economic well-being in the area of conflict. We use a similar research framework as found in the works of Bagozzi (2011), Freytag, Krüger, Meierrieks, and Schneider (2011), Reed (2000), and Ward (2005). These factors include the inflation rate, the Gross Provincial Product per capita (GPP per capita), the unemployment rate and the rubber price.

The GPP per capita are used for the economic development in the local area (Freytag et al., 2011; Piazza, 2006). The past literatures suggest these variables to reflect the opportunity cost of the participation in the intrastate conflict. In other word, the increase in the economic wealth in the local area should disincentivize people to participate in a violent act. The inflation rate and the unemployment rate, on the other hand, represents the poor state of local economy and the struggle of local population in the participation of the local economy. Thus, the high unemployment rate should have a positive impact to the level of violence. Lastly, the past literatures on intrastate conflict in Middle-east area (Berman & Laitin, 2008; Berman & Matanock, 2015; Iannaccone & Berman, 2006) use the oil price or oil production as oil is the main source of economic activity in the region. Then, in this case study, we use the rubber price as the rubber is the main agricultural product in the three province of Thailand (Somboonsuke, Phitthayaphinan;, & Kongmane, 2018).

The political demographics factors refers to the demographic pattern in the area of conflict as *a rapidly growing, age-structurally youthful minority that is politically dissonant and regionally or residentially segregated within a more mature country-level population* (R. Cincotta, 2011, 2015a). Thus, this study operationalizes by using the percent of youth population and the total population at provincial level. The percent of youth population is expected to have a positive impact on the level of violence based on political demography theory on the youth population and the intrastate conflict between minority and majority group. For the total population, Krieger and

Meierrieks (2011) found in their empirical study that when the area of conflict is more populated, the number of incidents from the intrastate conflict will be higher than the less populated areas. Thus, we include the total population as a control variable in the framework.

Lastly, the central government is defined as the power of the central government in the area of conflict. Initially, we try to include the parity of power between the central government and the insurgency group in the area. However, due to the limitation of collected data on both sides, the framework of this study is adjusted and only includes the military spending as it reflects the resource allocation for domestic security problem. Freytag et al. (2011) found that the military spending has a negative impact against terrorism activities. The conclusion also supports the power parity theory that the more dominant party has a power, the less likely the conflict will be escalated.

Conceptual Framework

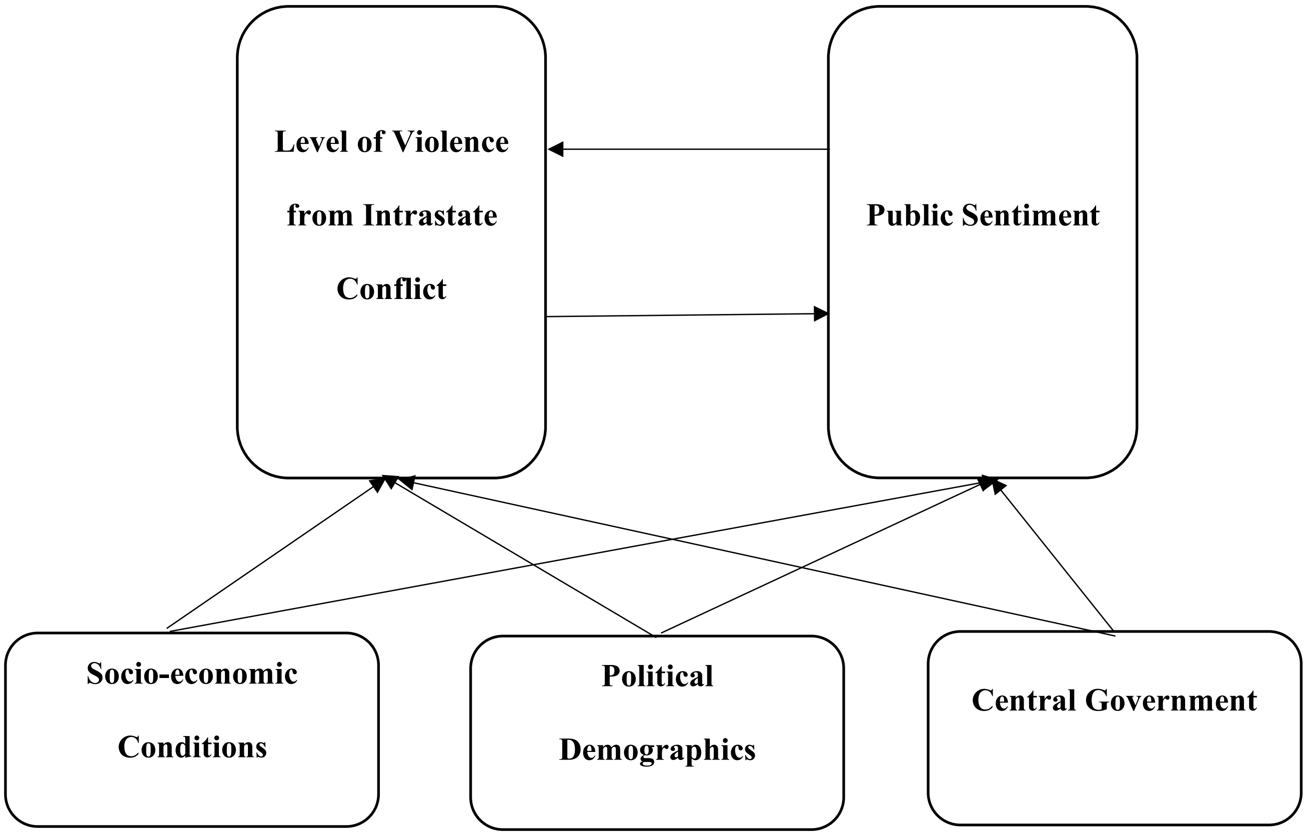


Figure 2-1: The Conceptual Framework

The above diagram shows the conceptual framework of this studies. We postulate that the level of violence from intrastate conflict and public sentiment are endogenous based on the past literatures on public sentiment and public policsy (Gruszczynski, 2013; Peng et al., 2017). That means while public sentiment will affect the level of violence, the violence itself also affects the sentiment of local people affected by the atmosphere from the escalation of conflict. In other word, we expect to see the reinforcement between the level of violence and public sentiment as a positive feedback loop in the system. The interaction of public sentiment and the level of violence is postulated to be in a short-term and long-term behavior similar to the work of Arafat et al. (2013) in financial section.

In addition, the framework of the study also includes socio-economic conditions, political demographics and central government power as control variables based on the past literatures on the determinants of intrastate conflict (Bagozzi, 2015; Chou, 2012; Ward et al., 2013; Ward 2005). The results from the past literature suggest these factors to be exogenous as they affect the level of violence but are not affected by the level of violence. Consequently, the conceptual framework in this study expects the control variables to influence the level of violence and the public sentiment in only one direction.

Chapter 3: Methodology

Introduction

In this chapter, we will discuss about the methodology and research design of this study. The first part of the chapter will discuss about research question and main hypotheses of the studies and how the research design is operationalized to empirical models. The second part of this chapter will discuss about the validity and reliability of sample size and measurement in this study. And lastly, the advantage and the limitation of the estimation techniques used in the study will be discussed.

Research Questions and Hypotheses

a) Research questions

The main research question of this study is that the relation between level of violence from intrastate conflict and the public sentiment is a stochastic process. We can observe the short-term and long-term relationship between them. Then, these two factors will become sufficient conditions to trigger the violence from intrastate conflict. On the other hand, the socio-economic conditions, demographic structures and central government factors are exogeneous factors which play a role as a necessary pre-condition. Then, we can monitor and forecast the level of violence with the proposed methods.

b) Hypotheses

H1: Short-term and long-term negative public sentiment increases domestic instability

H2: Short-term and long-term domestic instability increases negative public sentiment

These two hypotheses summarize the first part of the research question on the endogeneity of these two factors and I speculate that they have a short-term and a long-term relationship between them. To observe the short-term and long-term relationship, we use a statistical technique in stochastic process namely, Vector Error Correction model, and empirical system dynamics estimation model namely, Convergent Cross-Mapping.

The effect of the public sentiment towards the level of violence from intrastate conflict is expected to increase domestic stability when the negative public sentiment increase. This reflects the grievance and frustration of local population that drives the level of violence from the conflict. Also, the level of violence is expected to have a negative effect towards public sentiments. If the level of violence becomes more intensified, the public sentiments will become more negative instead of positive.

H3: Socio-economic conditions decrease domestic instability.

We postulate that the socio-economic conditions that reflects the economic well-being will decrease the level of violence from the intrastate conflict. To operationalize the hypothesis to the actual variables, the variables that reflects the positive aspect of local economy such as gross provincial product will have a negative impact to the domestic instability, while the variables that reflect the negative aspect of local economy such as the unemployment rate will have a positive impact to the domestic instability. In addition, we expect that the socio-economic variables are exogenous factors in the system.

H4: Political demographics increase domestic instability.

We postulate that the political demographics will increase the domestic instability. That means the increase in the total population and the youth population will intensify the domestic instability in the case study. We also expect this factor to be exogenous.

All the hypotheses in this study are summarized with the associated indicators and the reference in Table 3-1: Research Hypotheses, Indicators and Reference.

No.	Hypothesis	Indicators: Independent Variables	Indicators: Dependent Variables	Theory
H1	Short-term and long-term negative public sentiment increases domestic instability	Average tone	The number of incidents The fatalities from incidents	(Gurr, 1971; 2000; Forsberg, 2008; Sambanis & Shayo, 2013))
H2	Short-term and long-term domestic instability increase negative public sentiment	The number of incidents The fatalities from incidents	Average tone	(Gurr, 1971; 2000; Forsberg, 2008; Sambanis & Shayo, 2013))
H3	Socio-economic conditions decrease domestic instability	Inflation rate Rubber price Unemployment rate GPP per capita	The number of incidents The fatalities from incidents	(Bagozzi, 2015; Berman & Matanock, 2015; Bollfrass & Shaver, 2015; Brandt et al., 2011; Hegre, xe, vard, & Sambanis, 2006; Ward 2005)
H4	Political demographics increase domestic instability	Total population Percent of youth population	The number of incidents The fatalities from incidents	(R. Cincotta, 2010, 2011, 2015a, 2015b; 2016; R. Cincotta, Goldstone, & Sciubba, 2017; Richard P. Cincotta, 2008; Richard Paul Cincotta, Engelman, Anastasion, & Population Action International., 2003; Richard P. Cincotta & Leahy, 2006)

Table 3-1: Research Hypotheses, Indicators and Reference

Theoretical/Empirical Model

We speculate the following equation as the main theoretical model.

$$Violence_{it} = f(Emotion_{it-p}, Socio - economic_{it-p}, Demogaphics_{it-p}, Central - government_{it-p}) \quad \text{(3-1)}$$

$$Emotion_{it} = f(Violence_{it-p}, Socio - economic_{it-p}, Demogaphics_{it-p}, Central - government_{it-p}) \quad \text{(3-2)}$$

The above model specifications show that the level of violence from intrastate conflict is a function of the past public sentiment, socio-economic conditions, political demographics and central government factors to period of p. Since the endogeneity of the level of violence from intrastate conflict and the public sentiment is expected, the theoretical model is designed to be a system of equation.

Research Design

This study will use time-series data in the analysis. The target or the case of the study is three provinces in Southern region of Thailand, namely Pattani, Yala and Narathiwat. The study will use publicly available data from 2010 to 2018. Table 3-2: Summary of Research Design summarizes the core research design in this study. We use three different data analysis techniques in this study. Each method shows a different model specification based on the empirical model stated in Equation (3-1) and Equation (3-2).

The first approach for data analysis is Vector Autoregression model (VAR). VAR is a statistical technique in time-series analysis for multivariate analysis. In VAR model, we assume that the variables in the study depend on each other as in one system based on the lag value of the

Models	Indicators	Specification	Note
VAR	Endogenous Variables 1 The number of incidents 2 The fatalities from incidents 3 Average tone 4 Inflation rate 5 Rubber price 6 Unemployment rate 7 GPP per capita 8 Total population 9 Percent of youth population 10 Military Expenditure as a percent of GDP	$Y_t = \sum_{i=1}^{p} A_i Y_{t-i} + c_k + \varepsilon_t$	Y_t is a matrix of all endogenous variables. A_i is a matrix of the coefficients p is a lag order. C_k is a vector of constant terms. ε_t is white noise.
VECM	Endogenous Variables 1 The number of incidents 2 The fatalities from incidents 3 Average tone 4 Inflation rate 5 Rubber price 6 Unemployment rate 7 Percent of youth population Exogenous Variables 1 GPP per capita 2 Total population 3 Military Expenditure as a percent of GDP	$\Delta Y_t = \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \sum_{j=1}^{p} \Pi_j Y_{t-j} + C_k + \Phi D_t + \varepsilon_t$	Y_t is a matrix of all endogenous variables. D is a matrix of all exogenous variable. Γ_i is a matrix of the coefficients for the long-term adjustment. Π_j is a matrix of the coefficients for short-term adjustment. Φ is a matrix of the coefficients for the exogenous variables. p is a lag order. C_k is a vector of constant terms. ε_t is white noise.

Models	Indicators	Specification	Note
CCM	1 The number of incidents 2 The fatalities from incidents 3 Average tone 4 Inflation rate 5 Rubber price 6 Unemployment rate 7 GPP per capita 8 Total population 9 Percent of youth population 10 Military Expenditure as a percent of GDP	$\hat{X} \mid M_y = \sum_{i=1}^{E+1} w_i x_{ti}$	$\hat{X}$ is an estimated value of the independent variable. M_y is a shadow manifold of the dependent variable. *w* is a weighted adjustment from the dependent variable *E* is the optimal number of the embedded dimension

Table 3-2: Summary of Research Design

Sounds interesting but you do not in the theory section mention most of these variables Link must be tight!!!! Look back please

Population and Sample

The case study for this research is the 3 Southern provinces of Thailand where the conflict between Muslim insurgency groups and Thai government still continues. The time periods for the data is between 2010 and 2018. In terms of internal validity, the sample size covers the main parts of the insurgency problem in Thailand which is the focus of the study. However, since the research design and the sample size does not expand beyond other cases, including the other provinces in Thailand and the other regions which have insurgency groups, the external validity of the study is limited.

Data and Measurement

Dependent Variables

- The Level of Violence from Intrastate Conflict

This study will use the monthly number of incidents and the monthly fatality rate from the conflict as a measure of the level of Violence from intrastate conflict. The data is collected by Deep South Watch, a non-profit organization. The data is collected from 2010 to present. Deep South Watch publishes the data on casualty from the intrastate conflict monthly ("Deep South Incident Database (DSID)," 2017).

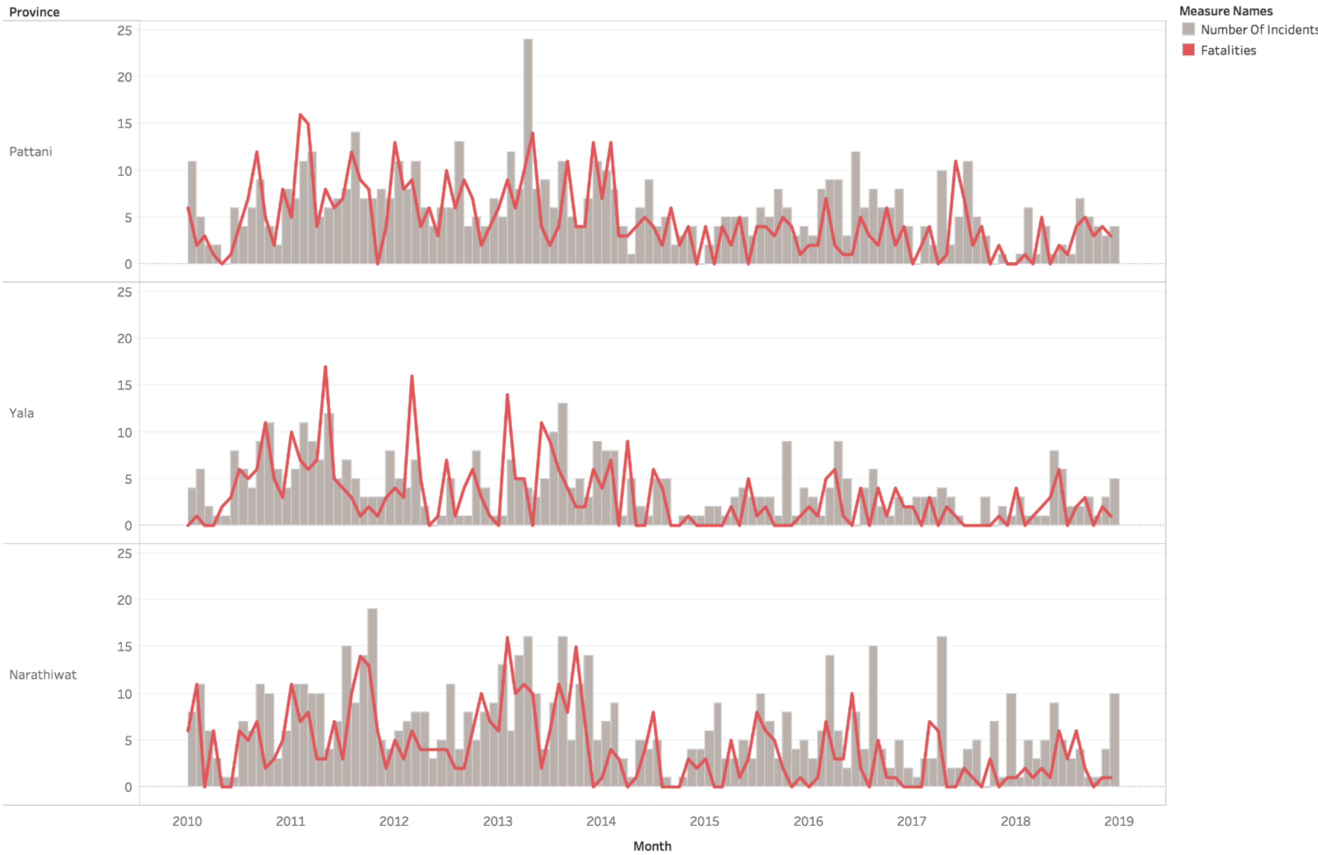


Figure 3-1: Monthly Time-series Data of number of Incident, and Deaths in Southern Thailand

The above graph is the example of the data on the outcomes of the violence from intrastate conflict. The study will test between the monthly number of incidents and deaths as the measures of the level of violence. The reason that these two measures will be used is that the number of deaths is a conventional measure of the severity of conflict, while the number of incidents is a measure of the prevalence of the conflict. These two concepts represent the level of violence form a conflict in a different way. Then, we decide to include both of them in the study.

- The Public Sentiment

The public sentiment data comes from GDELT (Global Data on Events, Locations and Tones). The GDELT data is an automated data collection system. It was developed to capture and store the news around the world as a collection for events data. It uses CAMEO-Code algorithms in interpreting news and article around the world into the database. The data structure comprises of type of events, times, actors involved with the events, location and tones. GDELT data is publicly available (Leetaru & Schrodt, 2013). The studies will use the average tone data from the events related to Southern Conflict of Thailand. The average tone data in GDELT is an output from sentiment analysis to extract tone from the textual data. The scale of the data is between -10 and 10 where – 10 means very negative, 0 means neutral and 10 means very positive.

The average tone data cones from the outputs from the polarity score in the sentiment analysis. It is calculated based on the word polarity dictionary developed by Hu and Liu (2004). The algorithm starts by assigning value to polarity score of each word through matching polarized words in dictionary. Then, one sentence is a list of polarized words and a list of sentence forms a single paragraph.

$$S_{i,j} = \{W_{i,j,1}, W_{i,j,2}, \dots, W_{i,j,n}\} \quad (3\text{-}3)$$

$$D_i = \{S_{i,1}, S_{i,2}, \dots, S_{i,n}\} \quad (3\text{-}4)$$

$W_{i,i,k}$ are the words in the sentences denoted with i for the document index, j for the sentence index and k for the word position in the sentence index. S are the sentence unit and D are the document unit. Each sentence (S_j) is broken into an ordered bag of words. Then, the algorithm

will remove punctuation found in the sentence, except commas, colons, and semicolons which are considered as a word in the sentence.

The algorithms will assign a negative value (-1) or positive value (1) to a word based on the dictionary. The polarized words, then, are processed by forming them into a cluster within the sentences ($C_{i,j,l}$) where q words before and q words after are clustered together as shown in the equation below.

$$C_{i,j,l} = \{W_{i,j,k-q}, \ldots, W_{i,j,k-1}, W_{i,j,k}^{p}, W_{i,j,k+1}, \ldots, W_{i,j,k+q}\} \tag{3-5}$$

Next, the algorithms will classify the words in the cluster as neutral ($W_{i,j,k}^{0}$), negator ($W_{i,j,k}^{n}$), amplifier ($W_{i,j,k}^{a}$), or de-amplifier ($W_{i,j,k}^{d}$). Each word will be weighted by the setting parameters and by the number of shifter words, such as amplifier and de-amplifier surrounding the polarized word. The equation below shows how the context cluster is calculated.

$$C'_{i,j} = \sum\left(\left(1 + +W_{amp} + W_{deamp}\right) \cdot W_{i,j,k}^{p} (-1)^{2+W_{neg}}\right) \tag{3-6}$$

$$\mathrm{W_{amp}} = \sum\left(\mathrm{w_{neg'}} \cdot \mathrm{W^{a}_{i,j,k\pm q}}\right) \tag{3-7}$$

$$W_{deamp} = \max\left(W_{i,j,k\pm \mathrm{q}}^{d}, -1\right) \tag{3-8}$$

$$\mathrm{w_{deamp'}} = \sum\left(-W_{neg} \cdot W_{i,j,k\pm \mathrm{q}}^{a} + W_{i,j,k\pm \mathrm{q}}^{d}\right) \tag{3-9}$$

$$W_{neg} = \sum W_{i,j,k\pm \mathrm{q}}^{n} \ mod\ 2 \tag{3-10}$$

The score from the context cluster ($C'_{i,j}$) is a product of the polarized words ($W^{p}_{i,j,k}$) weighted by negator words (W_{neg}), the amplifier words (W_{amp}), and the de-amplifier words (W_{deamp}) in the clusters. The weight for the negator is a value of 0 or 1 depends on the negator word in the context cluster. The weight of the de-amplifier is calculated from number of amplifier words and number of de-amplifier words. The amplifier words can be positive and negative depending on the weight of the negator. However, the weight of the de-amplifier is capped at -1. For the weight of the amplifier, the amplifier is weighted by the weight of the negator. After the polarity score from each context cluster is calculated we summarize the value by summing all the value from context clusters and divided by the root of word count. Then, we will get the polarity score (δ) for a document.

$$\delta_i = \frac{C'_{i,j}}{\sqrt{n}} \tag{3-11}$$

The average tone data from GDELT dataset for the 3 provinces in this study is shown below.

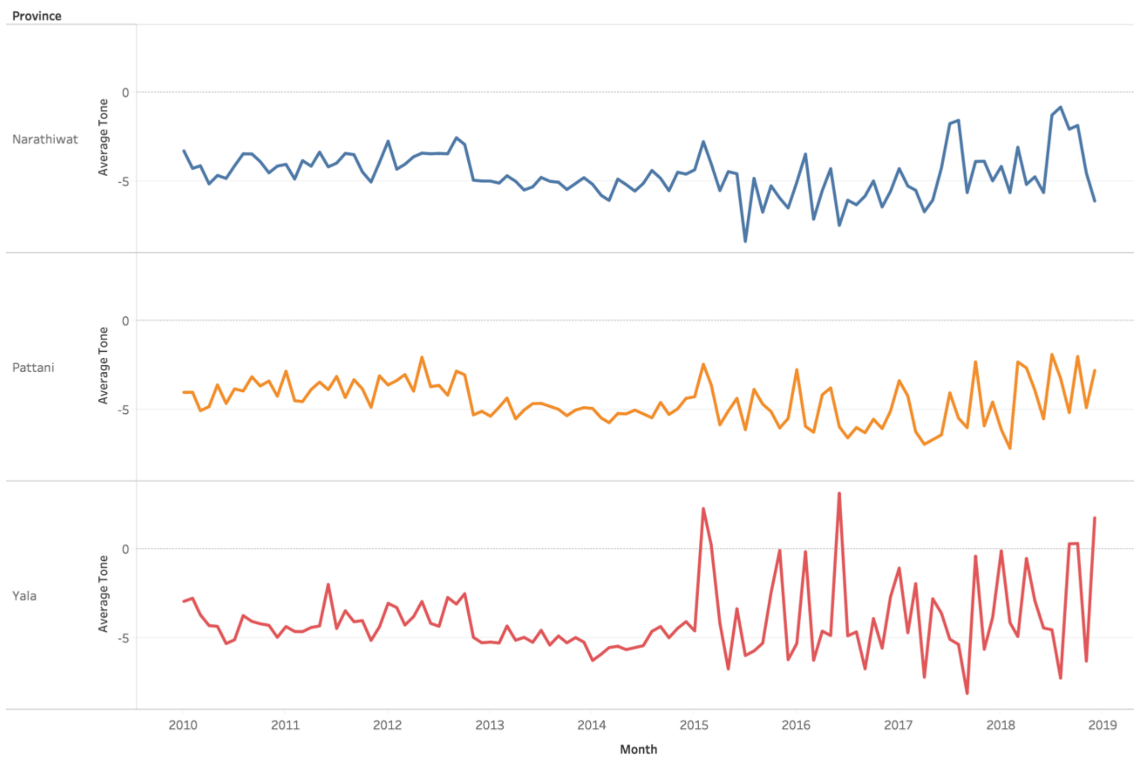


Figure 3-2: Average Tone in 3 Provinces

Control Variables

- Socio-economic Conditions

This study will use Gross Provincial Products per capita (GPP per capita), inflation rate, rubber price, and the unemployment rate as economic conditions. The Gross Provincial Products is collected by Office of the National Economic and Social Development Council (2019). The data on provincial unemployment rate and is published by National Statistical Office National Statistical Office (2019). The regional inflation rate is published by Bank of Thailand (2019). Lastly, the daily rubber price data is collected through Index Mundi (2019).

The data in this category comes with different time frequency and different geographical coverage. To standardize the data into monthly provincial level, we employ data interpolation techniques and data aggregation techniques. For the GPP per capita and the unemployment rate, we use data interpolation techniques to change data structure from yearly data to monthly data. For the inflation rate, the publicly available data only provides at quarterly regional level. Then, we interpolate the data into the monthly data, and we use this data in every province. Lastly, the rubber price data is available in daily format. Then, we aggregate the data by using mean to convert them to monthly data.

- Political Demographics

The study uses the total population and the percent of youth population in the 3 provinces. The data is publicly available from the National Statistical Office (National Statistical Office, 2019). The provided data is in yearly format. Then, we perform data interpolation techniques to convert them into monthly data format.

- Central Government Factors

The study uses the military expenditure as a percent of GDP as a proxy to assert the power of central government in response of the internal security problem. The data is collected by Stockholm International Peace Research Institute (SIPRI) and published by World Bank (2019). This data is also in a yearly format and it needs to be interpolated to convert it to monthly format.

Data Analysis Methods

Data Interpolation Techniques

This study uses 2 data interpolation techniques and compare the results between two techniques before performing data analysis. The two techniques in this study are listed below.

1. Linear Data Interpolation

Linear interpolation is a technique used to estimate the missing value between the two knowns coordinate points ("Linear interpolation," 2019). If the two known coordinate points are (x_0, y_0) and (x_1, y_1). We can derive the value of x or the value of y that fall between the interval (x_0, x_1) and (y_0, y_1) by calculating a slope of the linear function of x and the linear function of y based on the value of y. The equation for the linear function for the interpolation technique is as follow.

$$L(x) = x_0 + \frac{y - y_0}{y_1 - y_2} \cdot (x_1 - x_2) \qquad ; y_0 < y < y_1 \tag{3-12}$$

$L(x)$ is a linear function of x and can be known from the two coordinates and the given value of y under the condition that the value of y is within the interval (y_0, y_1).

2. Cubic Spline Data Interpolation

Cubic spline interpolation is developed to fit the numerical between two or more data points with a piecewise polynomial function $S(x)$ or the spline function ("Cubic Spline Interpolation," 2019; McKinley & Levine, 2013). The spline function form is as

$$S(x) = \begin{cases} s_1(x) & if \quad x_1 \le x < x_2 \\ s_2(x) & if \quad x_3 \le x < x_3 \\ \vdots & \\ s_{n-1}(x) & if \quad x_{n-1} \le x < x_n \end{cases} \tag{3-13}$$

where s_i is a third-degree polynomial defined by

$$s_i(x) = a_i(x - x_i)^3 + b_i(x - x_i)^2 + c_i(x - x_i) + d_i \tag{3-14}$$

for $i = 1,2,3, \dots, n-1$. The polynomial function (s_i) has four parameters a_i, b_i, c_i, and d_i. Based on the equation (3-14), we can write the first and second derivative as

$$s_i'(x) = 3a(x - x_i)^2 + 2b_i(x - x_i) + c_i \tag{3-15}$$

$$s_i''(x) = 6a(x - x_i) + 2b_i \tag{3-16}$$

for $i = 1,2,3, \dots, n-1$. Before the estimation of the four parameters, the four property of the cubic spline must be satisfied as follows.

1. The piecewise function $S(x)$ must interpolate all data points.
2. $S'(x)$ must be continuous on the interval (x_1, x_n)
3. $S''(x)$ must be continuous on the interval (x_1, x_n)
4. $S'''(x)$ must be continuous on the interval (x_1, x_n)

Based on the property of the cubic spline, we can conclude that $S(x_i) = y_i$. Then, we can rewrite the equation (3-14) with

$$y_i = S_i(x_i) \tag{3-17}$$

$$y_i = a_i(x_i - x_i)^3 + b_i(x_i - x_i)^2 + c_i(x_i - x_i) + d_i \tag{3-18}$$

$$y_i = d_i \tag{3-19}$$

As the piecewise function must be continuous for the entire interval in the given data point, we can conclude that the sub-function must join at the data point, as

$$S_i(x_i) = S_{i-1}(x_i) \tag{3-20}$$

for $i = 1,2,3, \dots, n$. Combining the property of equation (3-19) and (3-20), we can conclude that

$$S_i(x_i) = d_i \tag{3-21}$$

and

$$S_{i-1}(x_i) = a_{i-1}(x_i - x_{i-1})^3 + b_{i-1}(x_i - x_{i-1})^2 + c_{i-1}(x_i - x_{i-1}) + d_{i-1} \tag{3-22}$$

$$d_i = a_{i-1}(x_i - x_{i-1})^3 + b_{i-1}(x_i - x_{i-1})^2 + c_{i-1}(x_i - x_{i-1}) + d_{i-1} \tag{3-23}$$

Substitute $h = (x_i - x_{i-1})$, we can rewrite the equation as

$$d_i = a_{i-1}h^3 + b_{i-1}h^2 + c_{i-1}h + d_{i-1} \tag{3-24}$$

for $i = 1,2,3, \dots, n$. Since the cubic spline will draw a smooth line across the interval, the first-order derivative must be equal to the data points, which means

$$S_i'(x_i) = S_{i-1}'(x_i) \tag{3-25}$$

From the equation (3-25), we can derive the property of the function as

$$S_i'(x_i) = c_i \tag{3-26}$$

and

$$S_{i-1}'(x_i) = 3a_{i-1}(x_i - x_{i-1})^2 + 2b_{i-1}(x_i - x_{i-1}) + c_{i-1} \tag{3-27}$$

then,

$$c_i = 3a_{i-1}(x_i - x_{i-1})^2 + 2b_{i-1}(x_i - x_{i-1}) + c_{i-1} \tag{3-28}$$

$$c_i = 3a_{i-1}h^2 + 2b_{i-1}h + c_{i-1} \tag{3-29}$$

for $i = 1,2,3,\ldots,n$. We also set the condition of $s_i''(x)$ with the same process to satisfy the property number 3. We will have

$$s_i''(x_i) = 6a_i(x_i - x_i) + 2b_i \tag{3-30}$$

$$s_i''(x_i) = 2b_i \tag{3-31}$$

for $i = 1,2,3,\ldots,n$. Since $s_i''(x)$ must be continuous across the entire interval, we can conclude that

$$s_i''(x_{i+1}) = 6a_i(x_{i+1} - x_i) + 2b_i \tag{3-32}$$

$$s_{i+1}''(x_{i+1}) = 6a_i(x_{i+1} - x_i) + 2b_i \tag{3-33}$$

$$s_{i+1}''(x_{i+1}) = 6a_ih + 2b_i \tag{3-34}$$

Let denote $s_i''(x_{i+1})$ function with M_i. Then, we can simplify b_i parameter as

$$M_i = 2b_i \tag{3-35}$$

$$b_i = \frac{M_i}{2} \tag{3-36}$$

For d_i, we already derive it as $d_i = y_i$. For a_i, we can derive it as

$$2b_{i+1} = 6a_i h + 2b_i \tag{3-37}$$

$$6a_i h = 2b_i - 2b_{i+1} \tag{3-38}$$

$$a_i = \frac{2b_i - 2b_{i+1}}{6h} \tag{3-39}$$

$$a_i = \frac{2\frac{M_{i+1}}{2} - 2\frac{M_i}{2}}{6h} \tag{3-40}$$

$$a_i = \frac{M_{i+1} - M_i}{6h} \tag{3-41}$$

Lastly, c_i can be derived as

$$d_{i+1} = a_i h^3 + b_i h^2 + c_i h + d_i \tag{3-42}$$

$$c_i h = -a_i h^3 - b_i h^2 - d_i + d_{i+1} \tag{3-43}$$

$$c_i = \frac{-a_i h^3 - b_i h^2 - c_i h - d_i + d_{i+1}}{h} \tag{3-44}$$

$$c_i = -a_i h^2 - b_i h + \frac{-d_i + d_{i+1}}{h} \tag{3-45}$$

$$c_i = -(\frac{M_{i+1} - M_i}{6h} h^2 + \frac{M_i}{2} h) + \frac{-y_i + y_{i+1}}{h} \tag{3-46}$$

$$c_i = -(\frac{M_{i+1} - M_i}{6}h + \frac{3M_i}{6}h) + \frac{-y_i + y_{i+1}}{h} \tag{3-47}$$

$$c_i = \frac{y_{i+1} - y_i}{h} - h(\frac{M_{i+1} - M_i + 3M_i}{6}) \tag{3-48}$$

So, we can write the four parameters into an equation system as follows.

$$\begin{aligned} a_i &= \frac{M_{i+1} - M_i}{6h} \\ b_i &= \frac{M_i}{2} \\ c_i &= \frac{y_{i+1} - y_i}{h} - h\left(\frac{M_{i+1} - M_i + 3M_i}{6}\right) \\ d_i &= y_i \end{aligned} \tag{3-49}$$

Then, we solve these systems of equation to estimate the parameters and calculate the missing data point based on the estimated spline function.

Granger Causality Test

Granger Causality test is used to investigate the causality in the time-series data. It tests the causality between two different variables by using different lag numbers (Pfaff, 2008). Granger Causality test use the null hypothesis as X_t does not Granger cause Y_t. Let Y_t and X_t represents two time-series data where $t \in \{1,2,3, \dots, n\}$. Then we can model Y_t as an AR(p) process with autoregressive model as

$$Y_t = \sum_{i=1}^{\infty} \alpha_i Y_{t-i} + c_1 \tag{3-50}$$

where i is a lag order that we model based on Y_t, $\alpha_i$is the coefficient for the autoregressive lag order, and $c_1$is a constant term. For the model in the equation (3-50), we will refer as the restricted regression model. To test the causality from X_t, we run an autoregressive model with the lag order from X_t. The model can be defined as

$$Y_t = \sum_{i=1}^{\infty} \alpha_i Y_{t-i} + \sum_{j=1}^{\infty} \beta_j X_{t-j} + c_2 \tag{3-51}$$

where j is the lag order of X_t, and β_q is the coefficient for the autoregressive lag order of X_t. We will refer this model as the unrestricted model.

Next, we will use the F-test to evaluate that the addition of the lag order from X_t improve the variance explained by the model or not. The F-test is performed by

$$F = \frac{(RSS_{Res} - RSS_{Unres})/q}{RSS_{Unres}/(N-K)} \tag{3-52}$$

where RSS is the Residual Sum Squared, q is the number of restrictions imposed between the two models, *N* is the sample size, and *K* is the number of parameters in the unrestricted model. If we can reject the null hypothesis, the evidence will confirm that X_t Granger causes Y_t. On the other hand, if we cannot reject the null hypothesis, it means the evidence does not support the claim that X_t Granger causes Y_t.

Vector Autoregression (VAR)

Vector Autoregression is multi-variates time-series techniques that does not require *a priori* knowledge before the estimation like structural models. Thus, it becomes a better suited estimation technique for this study since there is no existing study on political conflict in multivariate time-series data. The estimation uses the autoregressive model as the main core of the model. Then, it is enhanced by introduced the lag order from other series into the model and simultaneously estimate all variables as a system of equation (Pfaff, 2008). In other words, the model estimation speculates that all variables in the model are endogenous.

Let denote the multivariate time-series as $Y_{t,k}$ where Y_t is a time-series data, t is a number of sample size based on time as $t \in \{1,2,3,\dots,n\}$, and k is a number of endogenous variables in the system. The Model specification is

$$\mathrm{Y}_t = A_1 \mathrm{Y}_{t-1,k} + \cdots + A_p \mathrm{Y}_{t-p,k} + c_k + \varepsilon_t \tag{3-53}$$

where A_i is a coefficient matrix $(K \times K)$ for $i = 1,2,\dots,p$, c_k is a coefficient matrix $(K \times 1)$ for the constant terms, and ε_t is a matrix of white-noise. Then, we will have VAR(p) model.

The equation (3-53) can be rewritten as a lag polynomial form.

$$A(L)Y_t = c_t + \varepsilon_t \tag{3-54}$$

$$A(L) = (I_k - A_1 - \cdots - A_p) \tag{3-55}$$

Based on the equation (3-54), it speculates that Y_t must be stationary and its properties must be held. These properties include the time-invariant means, variances, and covariances. If all the

assumptions about the stationary properties of VAR model are held, VAR becomes stable. The stability of VAR can be expressed as a reverse characteristic polynomial,

$$det\left(I_k - A_1 z - \cdots - A_p z^p\right) \neq 0 \quad for\ |z| < 1 \tag{3-56}$$

If the absolute value of z is equal or greater than 1, it means some of the series are not stationary and VAR becomes unstable. We can also evaluate the stability of VAR by calculating the eigenvalue of the coefficient matrix. If the moduli of the eigenvalues is less than 1, we can infer that VAR model is stable and the stationary property is satisfied.

The diagnostics tests for VAR model are Portmanteau Statistic test for serial correlation, ARCH-LM test for heteroskedasticity, Jacque-Bera test for normality assumption, Kurtosis test, and Skewness test. These tests will be performed on the residuals of VAR estimation.

The tools to interpret the results of VAR is Impulse Response Function (IRF). The IRF is used to observe the interaction between a pair of variables. It provides an insight on how a shock in one time-series data will affect the other variables, how long the effect of the shock will take place, and how the effect change over time before it resumes the equilibrium points (Pfaff, 2008).

Vector Error Correction Model (VECM)

Vector Error Correction Model (VECM) can be viewed as the extension from the VAR model described above. VECM incorporate multi-variate time-series data analysis with relaxing the restriction on the stationary assumptions of Y_t (Pfaff, 2008). Since Y_t are not stationary, we can refer to them as I(1) process series. In VECM estimation, it assumes that the I(1) process in

Y_t is cointegrated. That means there is at least one linear combination of I(1) series which is stationary. The cointegration can be mathematically defined as

$$Y_{1,t} - \alpha Y_{2,t} = \epsilon_t \tag{3-57}$$

where ϵ_t is a trend-stationary. Then, $Y_{1,t}$ and $Y_{2,t}$ are cointegrated.

Based on the concept of cointegration, we can adjust the VAR model specification in the equation (3-53) as VECM model specification as follows.

$$\Delta \mathrm{Y}_t = \Gamma_1 \Delta \mathrm{Y}_{t-1} + \cdots + \Gamma_{p-1} \Delta \mathrm{Y}_{t-p+1} + \Pi \ \mathrm{Y}_{t-p} + \mu + \Phi D_t + \varepsilon_t \tag{3-58}$$

$$\Gamma_i = -(I - \Pi_1 - \cdots - \Pi_i) \qquad for\ i = 1, \ldots, p-1 \tag{3-59}$$

$$\Pi = \left(I - \Pi_1 - \cdots - \Pi_p\right) \tag{3-60}$$

where ΔY_t is a vector of differenced Y_t, $\Pi_i (i = 1, \ldots, p)$ is a coefficient matrices of the lagged endogenous variables, $\Gamma_i (i = 1, \ldots, p)$ is a matrices represents the cumulative long-run impacts, μ is a vector of constant term, D_t is an exogenous variables or seasonality adjustment, Φ is a coefficient matrix for D_t, and ε_t is an error term that is assumed to be i.i.d. as $\varepsilon_t \sim \mathcal{N}(0, \Sigma)$.

Based on the structure of the model specification, we can observe the long-term adjustment from the matrix Γ_i and short-term adjustment from the matrix Π_i. One of the restriction of VECM model is the Y_t must be at most I(1) process. If the assumption is held, the VECM estimation will be stationary.

The procedure of the VECM estimation starts from identifying the rank of the cointegrations. There are three possible cases for the number of rank in the process.

1. Rank(Π) = K
2. Rank(Π) = 0
3. 0 < Rank(Π) < K

The first case is called full rank. It implies that Y_t has no unit root and all Y_t are I(0). On the other hand, in the second cases, Π is a null matrix. That means the linear combination between I(1) series does not exist. Then, cointegration between Y_t is absent. In this case, VAR(p) is more appropriate models. The third cases is that the number of rank is greater than 0 but less than the number of series. That means Y_t are cointegrated and we can model the linear combination between Y_t.

To test for the number of ranks, the Johansen procedure will be used in the process. The Johansen procedure uses canonical correlation analysis as a tool to decrease the high volume of information from time-series data into *K*-dimension space that respond with one of *r* cointegration vectors. The process starts from estimating a regression model with ΔY_t as a dependent variable and with lagged difference of Y_t as a regressor. Then, the residuals from the model are collected, denoted as R_{0t}. Next, a regression model with ΔY_{t-p} as a dependent variable and the same set of lagged difference of Y_t as a regressor is estimated. Then, the residuals from the model are collected, denoted as R_{1t}. The two residuals are used to calculate the product moment matrices as

$$\hat{S}_{ij} = \frac{1}{T}\sum_{t=1}^{T} R_{it}\,, R_{jT} \qquad with\ \ i,j = 0,1 \tag{3-61}$$

The outcomes will be evaluated by the likelihood-ratio test statistics for the null hypothesis that there are at most *r* cointegrating vectors as

$$-2\ln(Q) = -T\sum_{i=r+1}^{n}(1-\lambda_i) \tag{3-62}$$

Where $\lambda_{r=1}, \dots, \lambda_p$ are the $n-r$ smallest eigenvalues of the equation.

$$|\lambda\hat{S}_{11} - \hat{S}_{10}\hat{S}_{00}^{-1}\hat{S}_{01}| = 0. \tag{3-63}$$

Once the cointegration ranks is identified, the cointegration vectors can be estimated as

$$\hat{\beta} = (\hat{v}_1, \dots, \hat{v}_r), \tag{3-64}$$

and the adjustment matrix can be estimated as

$$\hat{\alpha} = \hat{S}_{01}\hat{\beta}\left(\hat{\beta}'\hat{S}_{11}\hat{\beta}\right)^{-1} = -\hat{S}_{01}\hat{\beta}\ . \tag{3-65}$$

Lastly, the Π matrix can be estimated as

$$\widehat{\Pi} = \hat{S}_{01}\hat{\beta}\left(\hat{\beta}'\hat{S}_{11}\hat{\beta}\right)^{-1}\hat{\beta}' = -\hat{S}_{01}\hat{\beta}\hat{\beta}'. \tag{3-66}$$

The diagnostics tests for VECM model are Portmanteau Statistic test for serial correlation, ARCH-LM test for heteroskedasticity, Jacque-Bera test for normality assumption, Kurtosis test, and Skewness test. These tests will be performed on the residuals of VECM estimation.

The tools to interpret the results of VECM is Impulse Response Function (IRF) similar to VAR Model. The IRF is used to observe the interaction between a pair of variables. It provides

an insight on how a shock in one time-series data will affect the other variables in both short-term effects and long-term effects (Pfaff, 2008).

Convergent Cross Mapping

In the previous two estimation techniques, VAR and VECM, we estimate the data based under the assumption that the relationship between variables can be modeled as a stochastic process. The underlying assumption in the estimation techniques is a separability of the information about the causal effect from one series to another (Sugihara et al., 2012). The assumption in Granger Causality test shows that the causality in the X_t can be separated and estimated to Y_t. This assumption is the main characteristics of many time-series data estimations that rely on stochastic process principle that the based on the linear system. The Granger Causality test, consequently, has a limitation on estimating the causality in nonlinear system such as in dynamic systems, especially in dynamic systems with weak to moderate coupling (Sugihara et al., 2012).

Convergent Cross Mapping is, then, developed to address the limitation of time-series data analysis where the phenomenon of interests is expected to behave as a dynamic system rather than a stochastic process. The underlying theory of CCM is Takens Theorem. The Takens theorem states that a single observable time-series variable can be used to reconstructed the underlying the dynamic system (Schiecke, Pester, Feucht, Leistritz, & Witte, 2015). For example, the Lorenz Attractor is a dynamic system based on three variables expressed in differential equations as follows.

$$\frac{dx}{dt} = \sigma(y - x)$$

$$\frac{dy}{dt} = x(\rho - z) - y \tag{3-67}$$

$$\frac{dz}{dt} = xy - \beta z$$

We parameterize three parameters, σ, ρ, β as (10, 28, 8/3) and set the initial value for all three variables at 0. Then, we visualize all three variables in 3D graphs as in Figure 3-3: Lorenz Attractor.

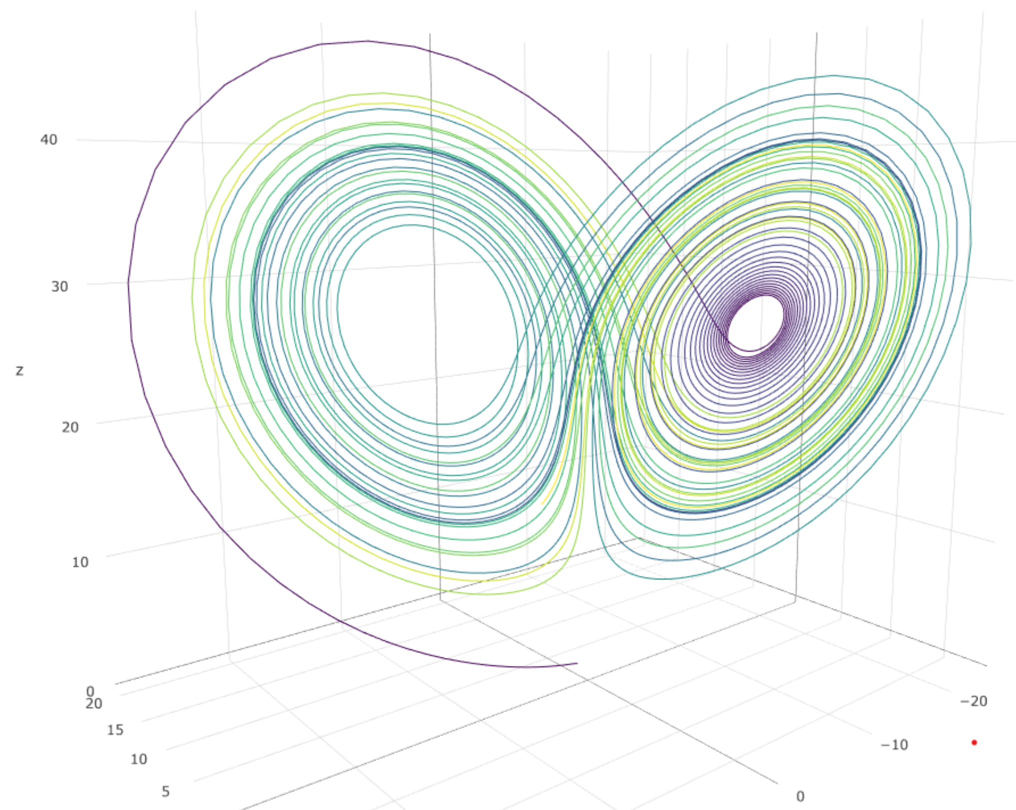


Figure 3-3: Lorenz Attractor

If we assume that the only observable variable in the real world is *X*, the Takens Theorem suggests that we can reconstruct the dynamic pattern that variable *X* is generated by using the lag variables of *X*. The shadow manifold generated from a single variable *X* is shown in Figure 3-4: Lorenz Attractor with Only Variable X.

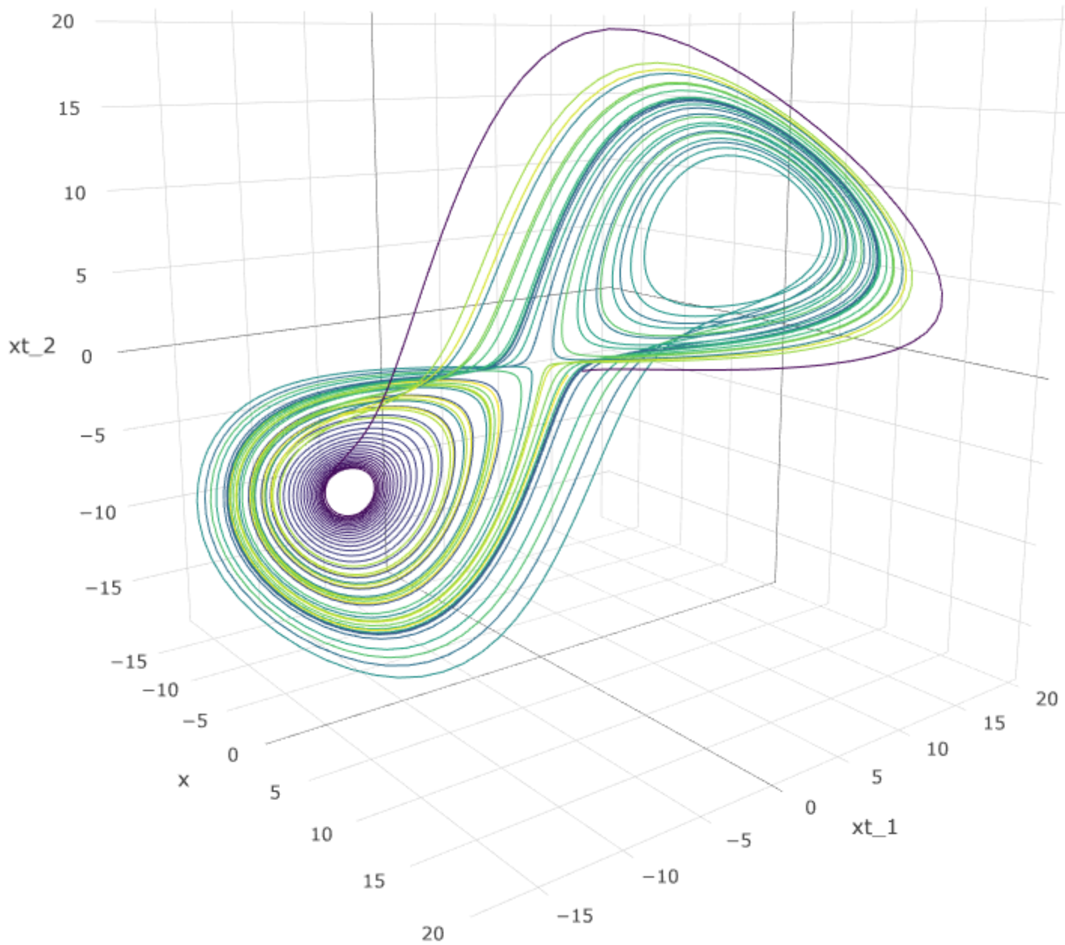


Figure 3-4: Lorenz Attractor with Only Variable X

The CCM method expands the reconstruction of the shadow manifold by using another variable to cross-map the manifold of the original variable. Let *X* and *Y* are the observable time-series data that comes from the same dynamic system. M_x and M_y are the shadow manifolds of the said variables. Then, M_x and M_y will have a property to be diffeomorphic to the actual dynamic system. As a result, M_x and M_y will be diffeomorphic to each other. If *X* has a causal relationship to *Y* variable, we can observe the influence of *X* in the dynamics of *Y*. Then, the M_y

will be able to predict the value of *X*. We denote this cross-map as $\hat{X}|M_y$ (Mønster, Fusaroli, Tylén, Roepstorff, & Sherson, 2017; Schiecke et al., 2015; Sugihara et al., 2012; Ye & Sugihara, 2016). We estimate the value of *X* as

$$\hat{X}|M_y = \sum_{i=1}^{E+1} w_i x_{ti} \qquad (3\text{-}68)$$

where E is an embedding dimension from a single variable manifold reconstruction or Simplex techniques, and w_i are exponentially weights with the Euclidean distance between y_t.

$$w_i = \frac{u_i}{\sum_{j=1}^{E+1} u_j} \qquad (3\text{-}69)$$

$$u_i = \exp\left(-\frac{||y_t - y_{ti}||}{||y_t - y_{t1}||}\right) \qquad (3\text{-}70)$$

where || · || is the Euclidean norm.

After the estimation, the cross-mapping skill is used to evaluate. The cross-mapping skill is the linear correlation between the actual value of *X* or *Y* to the predicted value of the selected variable(Ye & Sugihara, 2016).

Sugihara (2012) provides two examples of the application from CCM methods. One is from the predator-prey system between *Paramecium aurelia* and *Didinium nasutum* and the other is the sardine-anchovy system as shown in Figure 3-5: Applications from CCM methods: Predator-Prey System and Fishery System. Source: (Sugihara, 2012, p.499). In Figure A, the time-series between *Didinium* (predator) and *Paramicium* (prey) is shown as a classic example of predator-prey ecological system. The result of CCM between these two species is presented in Figure B.

Both species show a strong causal coupling between them. However, *Paramicium* has a stronger cross-mapping skill to *Didinium* which suggests the top-down control by the predator in the ecological system. For the sardine-anchovy system, the study uses the collected data of Pacific sardine (*Sardinops sagax*), northern anchovy (*Engraulis mordax*), and sea surface temperature (SST) measured at Scripps Pier and Newport Pier, California as shown in Figure C. The results as shown in Figure D, E, and F show that there is no interaction between sardine population and anchovy population. However, the influence of the sea surface temperature can be found when the sardine population or the anchovy population cross-map to the sea surface temperature. This results mean as shown in Figure E and F suggests the unidirectional causality from sea surface temperature to the fish population, but not the fish population to the sea surface, since there is no trace from sea surface temperature to cross-map and reconstruct the fish population.

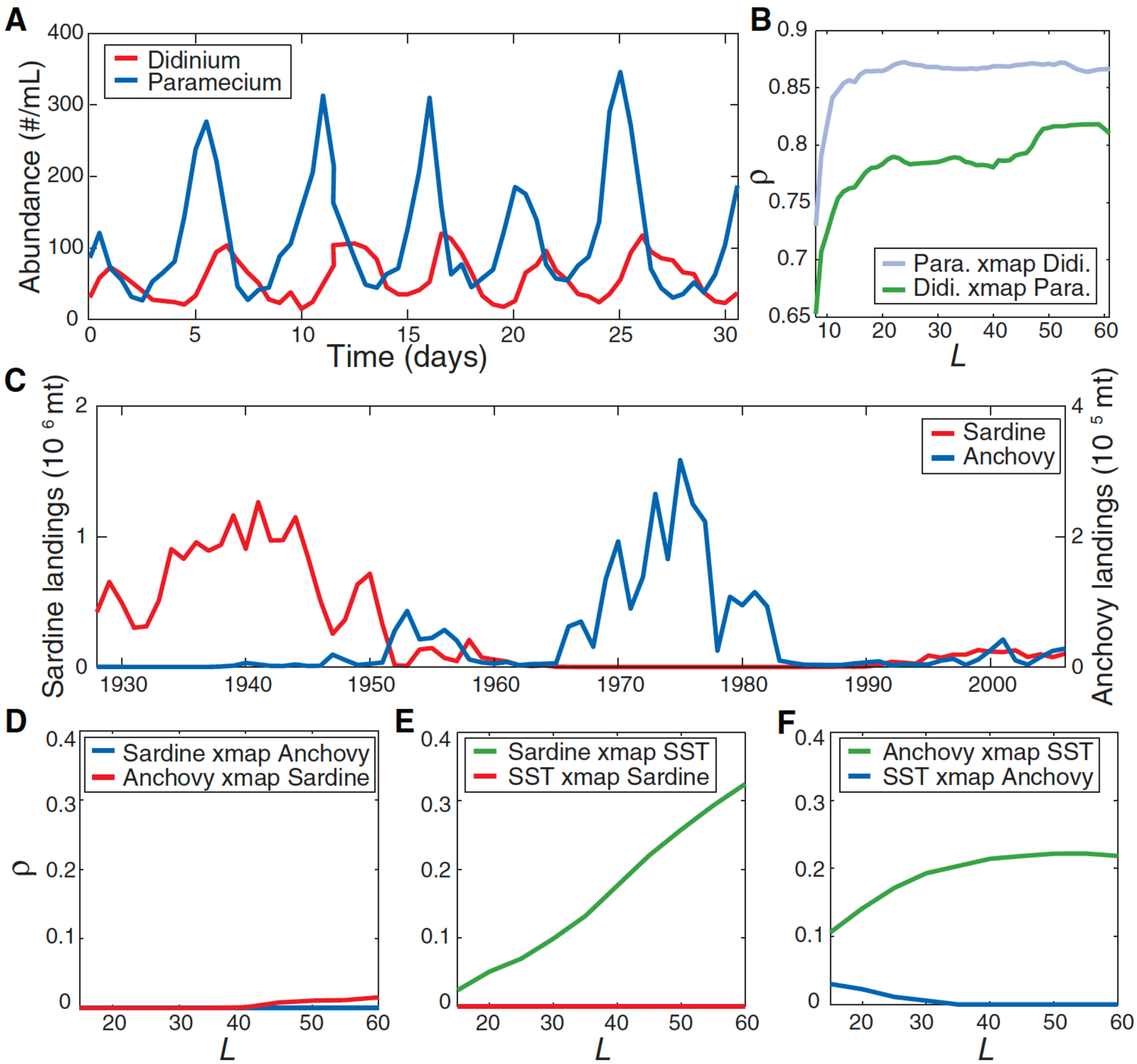


Figure 3-5: Applications from CCM methods: Predator-Prey System and Fishery System. Source: (Sugihara, 2012, p.499)

Chapter 4: Research Findings

Descriptive Statistics

As discussed in Chapter 3, this research collect data from 2010 to 2018 from the three provinces of Thailand. The overall descriptive statistics for the whole data are shown in Table 4-1: Descriptive Statistics.

The data has 324 observations from 3 provinces and 108 months. Some of the variables are not provided in monthly frequency, namely Number of Incidents, Fatalities from Incidents and Inflation Rate. Inflation Rate, nevertheless, is provided at regional level. Unemployment Rate is provided in quarterly frequency, but only provided in regional level instead of provincial level. Gross Provincial Products per Capita, Military Expenditure as a percent of GDP, Total Population and Percent of Youth Population are provided yearly. Only Military expenditure is provided at national level the other variables can be found at provincial level. To constructs a dataset for this study, we design to use data interpolation techniques to interpolate data from quarterly and yearly to monthly data. The techniques which we employ in this study is linear interpolation and cubic spline interpolation. The results of data interpolation techniques are shown in the following figures.

Statistic	N	Mean	St. Dev.	Min	Max
Number of Incidents	324	5.35	3.77	0	24
Fatalities from Incidents	324	3.90	3.69	0	17
Inflation Rate	108	0.001	0.003	-0.008	0.011
Rubber Price	324	2.59	1.16	1.23	6.26
Average Tone	324	-4.40	1.53	-8.38	3.14
Unemployment Rate	36	1.71	1.13	0.23	5.57
Gross Provincial Products per Capita (GPPPC) in Log Form	27	18.20	0.23	17.84	18.70
Military expenditure (as percent of GDP)	9	0.014	0.003	0.010	0.022
Total Population in Log Form	27	13.36	0.19	12.97	13.61
Percent of Youth Population	27	0.18	0.01	0.17	0.21

Table 4-1: Descriptive Statistics

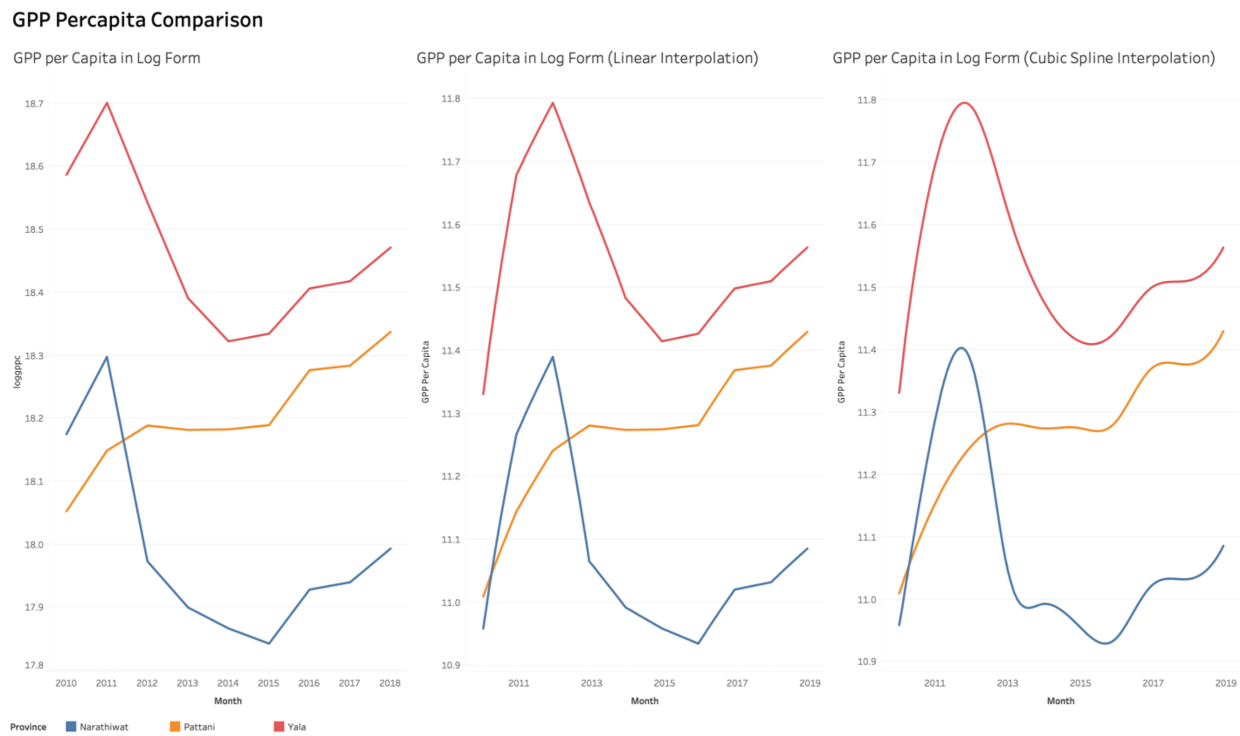


Figure 4-1:GPP per Capita Comparison

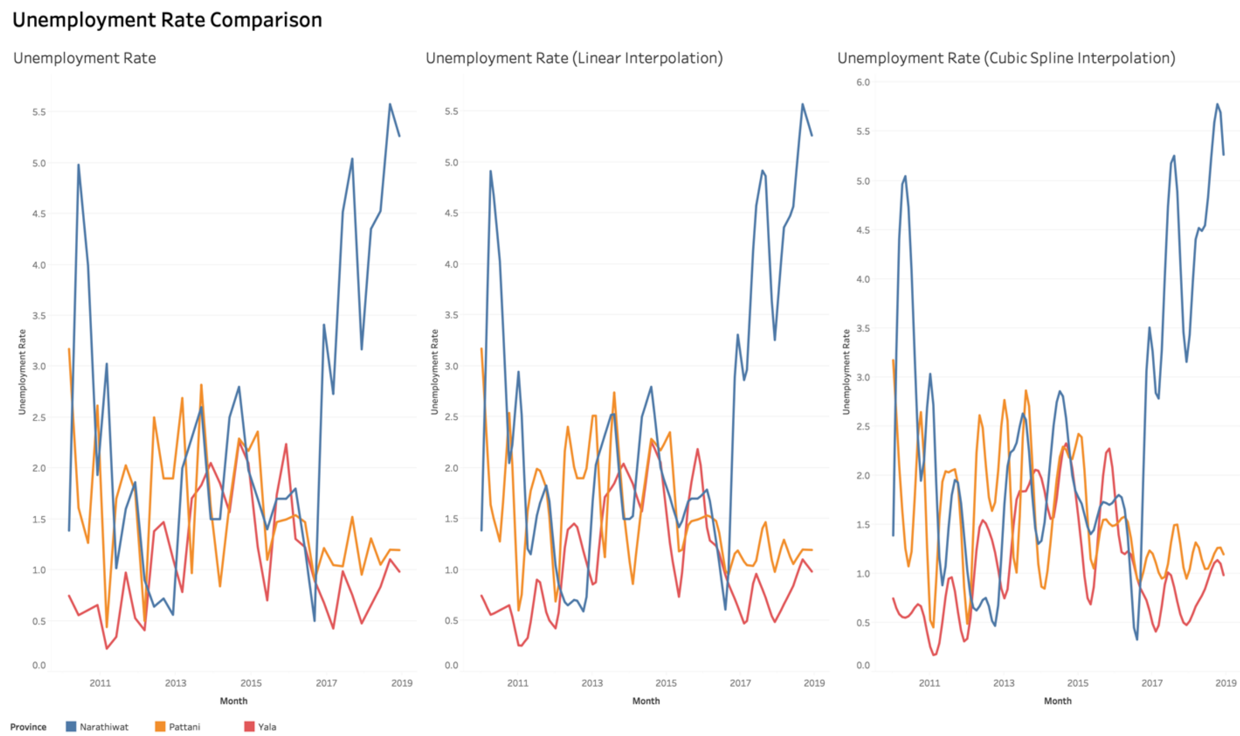


Figure 4-2: Unemployment Rate Comparison

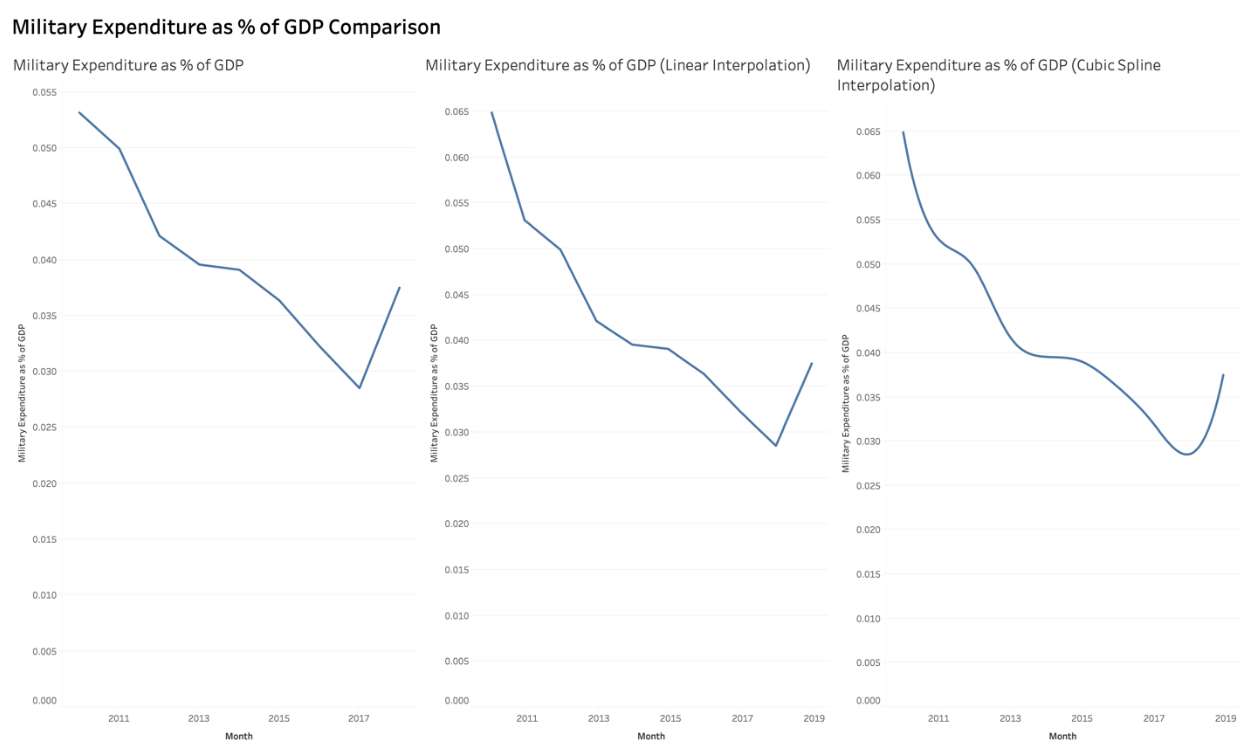


Figure 4-3: Military Expenditure as Percent of GDP Comparison

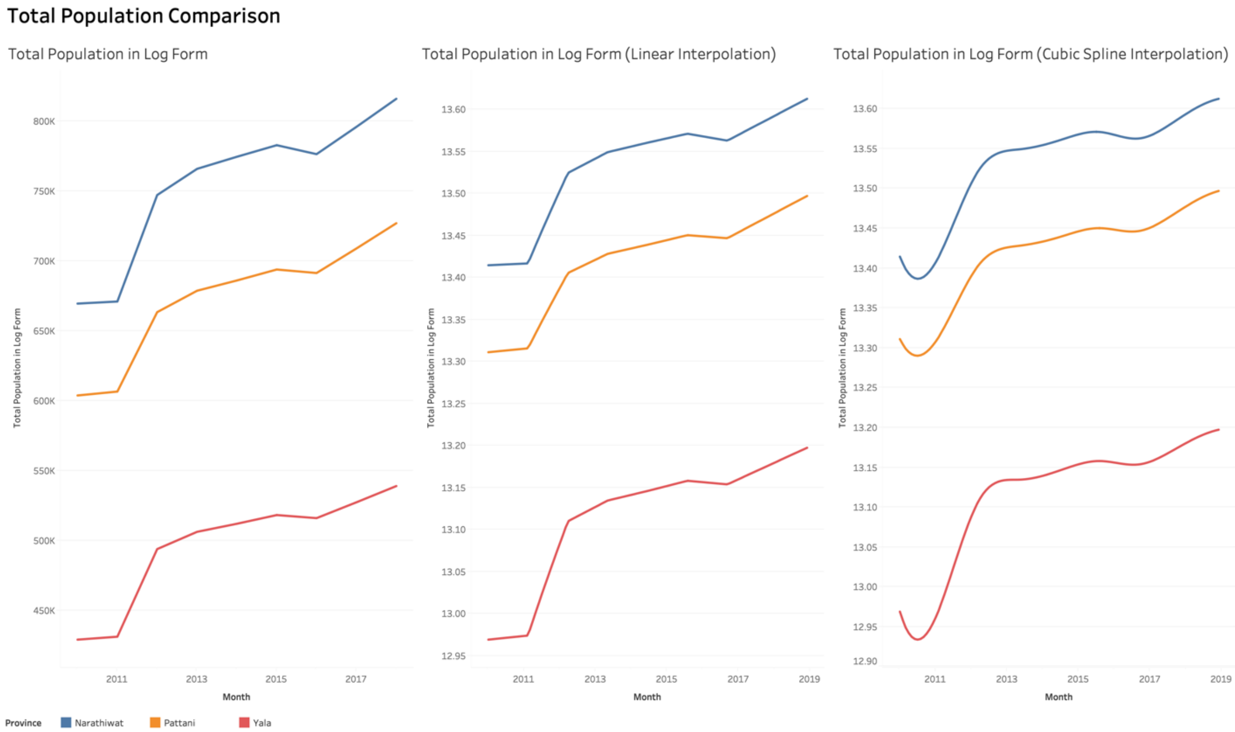


Figure 4-4: Total Population Comparison

Figure 4-5: Youth Population Comparison

The interpolated data still preserve the similar structure of GPP per Capita, Unemployment Rate, Total Population, and Youth Population. As the figures shown, the structure and pattern of these series are not deviated. The linear interpolation techniques are almost identical to the original series with more details on each month. On the other hand, the cubic spline interpolation amplifies change in and smooths the series out. The cubic spline interpolated data, then, will be used in the analysis part. All the variable will be standardized before the modeling process. The standardization process of the data is performed by using the following formula.

$$Z_{it} = \frac{Y_{it} - \overline{Y}_i}{SD_Y} \quad (4\text{-}1)$$

The standardized data of one province in one particular time point is noted as Z_{it} and it is a product of the original value, Y_{it} minus the average value of the variable in the specific province. Then, the value is divided by the standard deviation of the variable in this province.

Exploratory Data Analysis

Scatterplot Matrix and Correlation

We begin the exploratory data analysis process with a scatterplot matrix and correlation matrix among ten variables in this study. Figure 4-6: The Correlation Matrix and Scatterplot Matrix of the Data below provides the combined correlation matrix and scatterplot matrix with the histogram in the diagonal line showing the distribution of each variable.

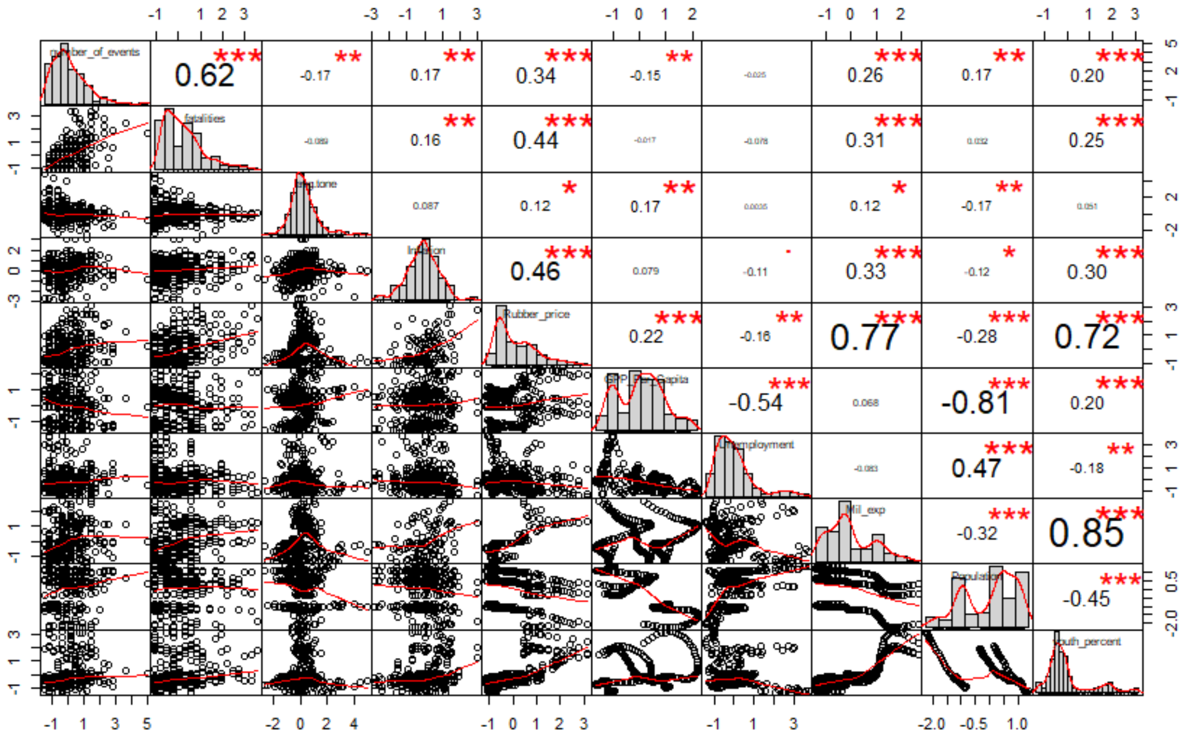


Figure 4-6: The Correlation Matrix and Scatterplot Matrix of the Data

Based on the result shown in the figures above, we observe that Total Population and GPP per Capita are highly negatively correlated at -0.81 Pearson's correlation coefficient. Also, Military Expenditure and Percent of Youth Population are highly correlated at 0.85 Pearson's R-squared. The scatter plots for these pair of variables also suggest the collinear pattern between these variables. Since the correlation between these variables are very high, it is high likely that we might to omit some of these variables in the future when we build the models to avoid multicollinearity problem or to avoid singular matrix problem. The Rubber Price variable also show some strong correlation with Military Expenditure and Percent of Youth Population at 0.77 Pearson's R-squared. These indicators suggest that the analysis and modeling part need to be careful with variable selection. For other variables, the correlation matrix above does not raises a concern to other significant multicollinearity problem within the list of variables. The histograms

on the diagonal line shows the distribution of each variables. The Number of Incidents and the Fatalities from Incidents shows a similar distribution which is skewed to the right. The Average Tone and the Inflation Rate are normally distributed. The GPP per Capita and the Total Population shows a bimodal distribution. These patterns arise as we collect the data from three different province and Yala is the comparatively smaller than Pattani and Narathiwat.

Phase Portrait

Next, we will investigate the relationship between the main dependent variables, namely the Number of Incidents and the Fatalities from Incidents, and the independent variables. Phrase Portrait is a technique in data visualization used to observe nonlinear oscillating relationship which may not be captured by conventional econometric models and in correlation matrix. ****

Figure 4-7: Phrase Portrait of the number of Incident and the Fatalities from the Incidents shows the dynamic between the number of incidents and the fatalities from the incidents. We can see that in all three provinces, the trajectories of the two variables share very similar pattern. The data move on the top right above the means of both the number of incidents and the fatalities rate. The graphs show oscillating patterns and moving to the bottom left after the half perio

d. This inference suggests that the relationship between these two variables may exhibit a nonlinear and dynamic relationship that a linear estimator, namely econometrics, may not be able to capture their relationship.

We also find the change in a relationship in a phase portrait of number of incidents against average tone, rubber price, and inflation. These graphs show that in all three provinces, the dynamical patterns of these variables are likely to exhibit two equilibrium or two attractors in the system. The other pair of relationship between the number of incidents and other independent variables are similar to linear problem.

In addition, the phase portrait of the fatalities against other independent variables also shows similar pattern that we observe in the phase portrait of the number of incidents. The dynamical patterns between the fatality rate against, average tone, inflation rate, rubber price and unemployment suggest the nonlinear and oscillating patterns between their relationship across all three provinces. On the other hand, GPP Per Capita, military expenditure, total population and percent of youth population are more likely to be linear relationship with deterministic trend.

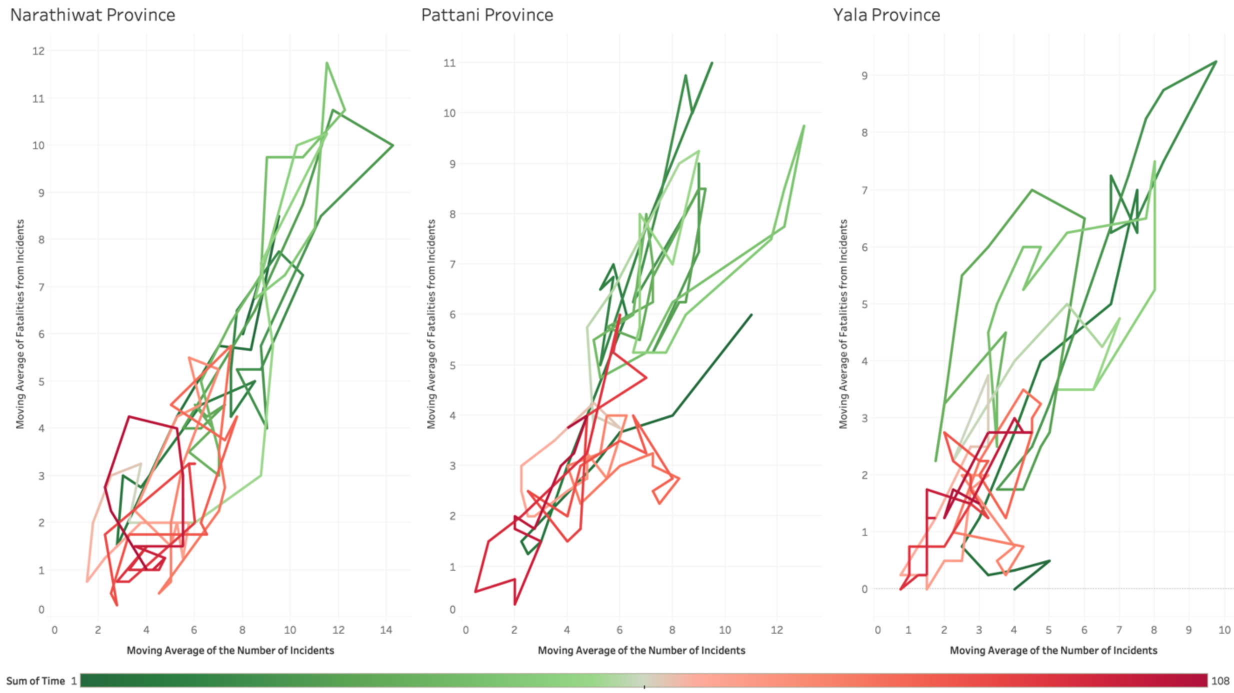


Figure 4-7: Phrase Portrait of the number of Incident and the Fatalities from the Incidents

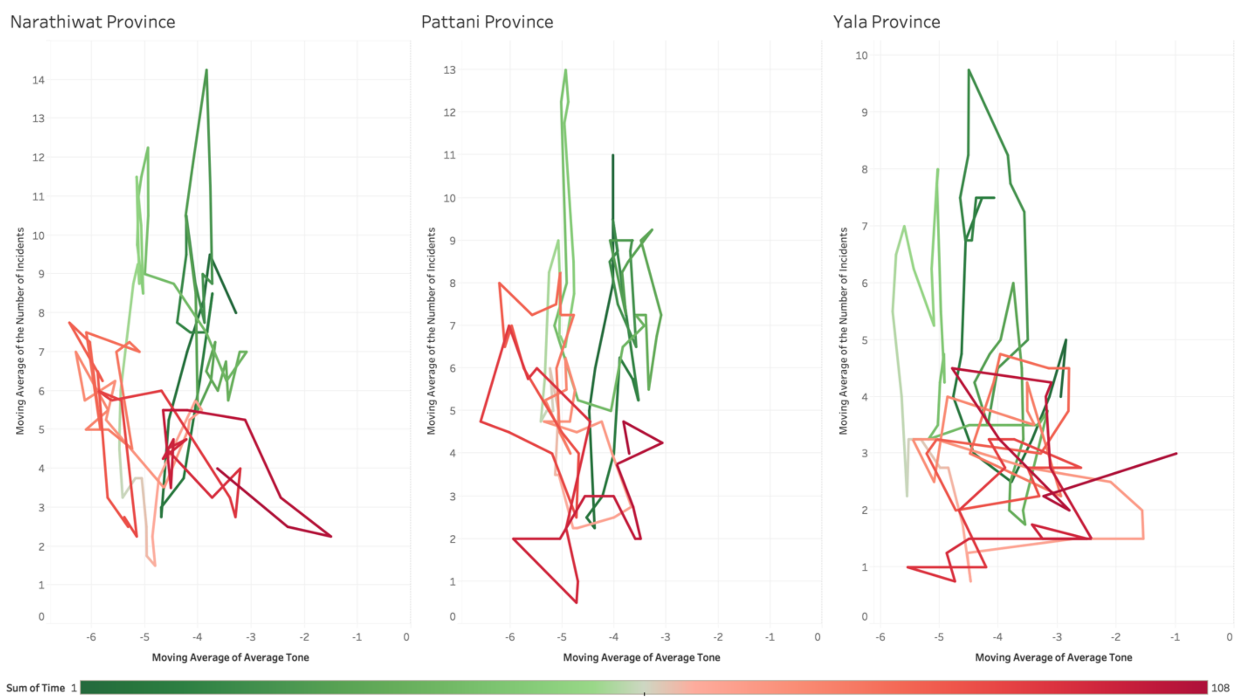


Figure 4-8: Phrase Portrait of the number of Incident and the Average Tone

Figure 4-9:Phrase Portrait of the number of Incident and GPP Per Capita

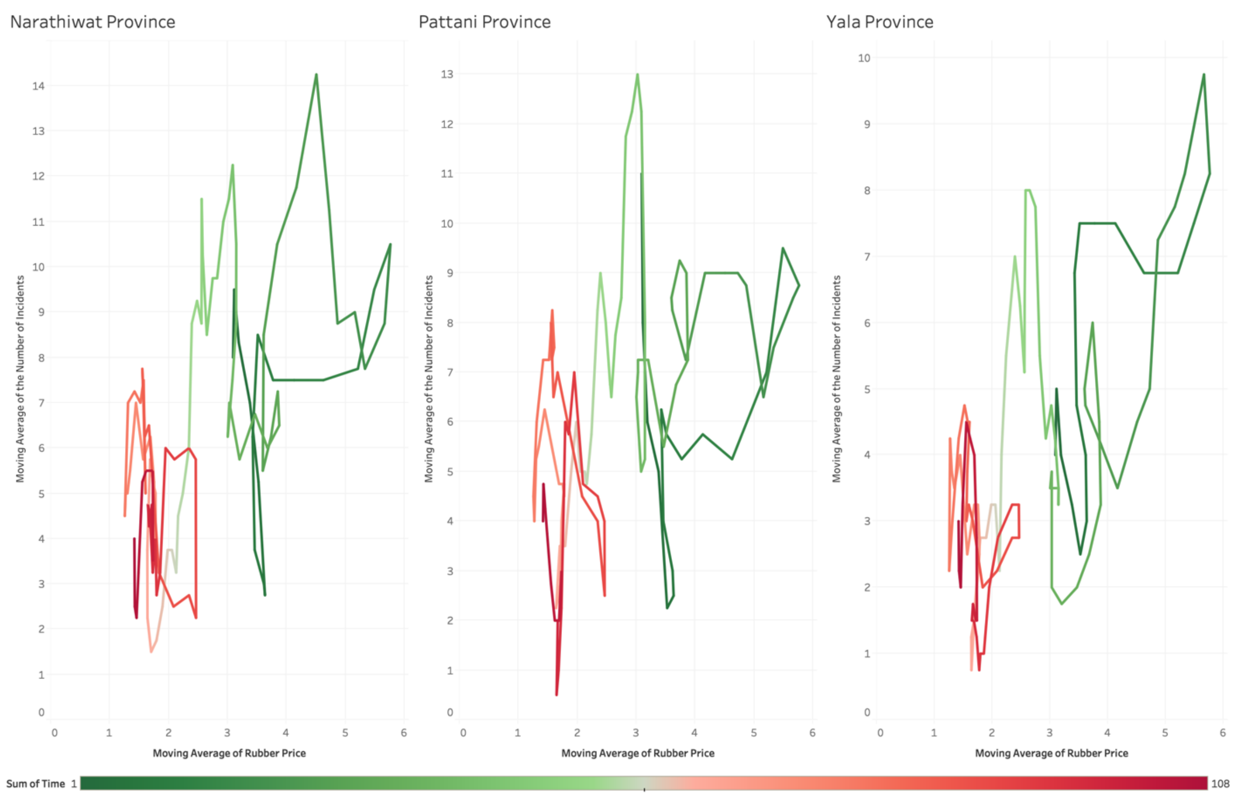


Figure 4-10: Phrase Portrait of the number of Incident and the Rubber Price

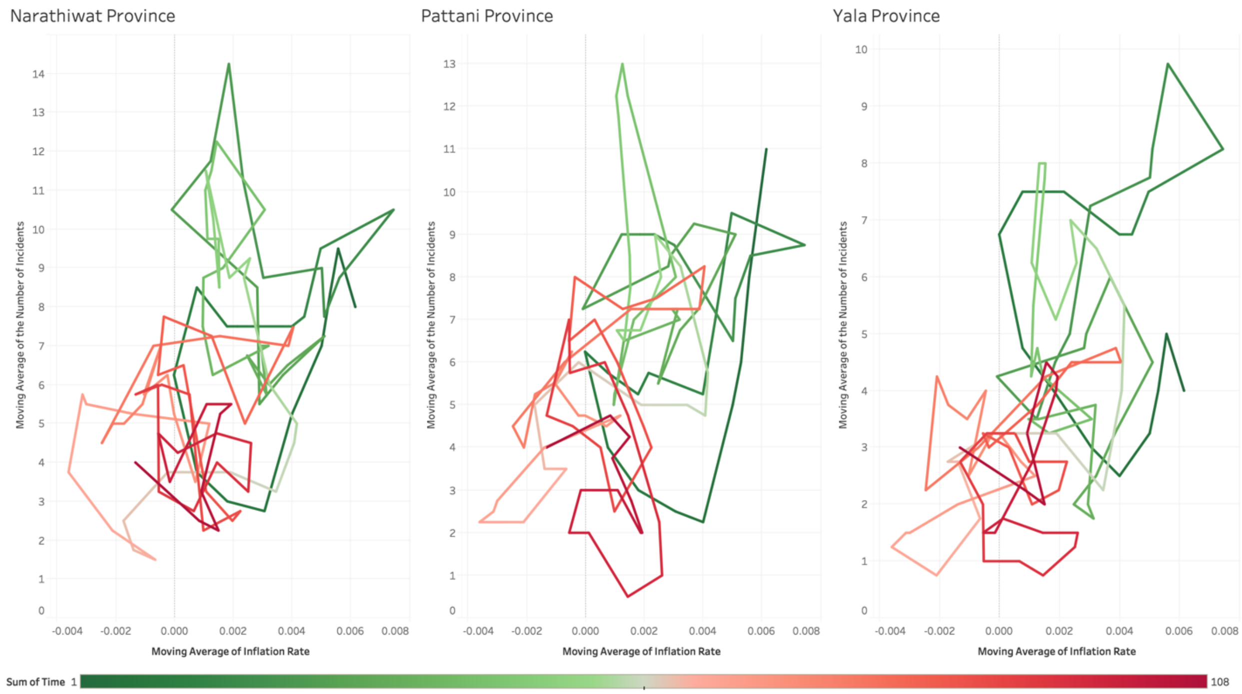


Figure 4-11: Phrase Portrait of the number of Incident and Inflation Rate

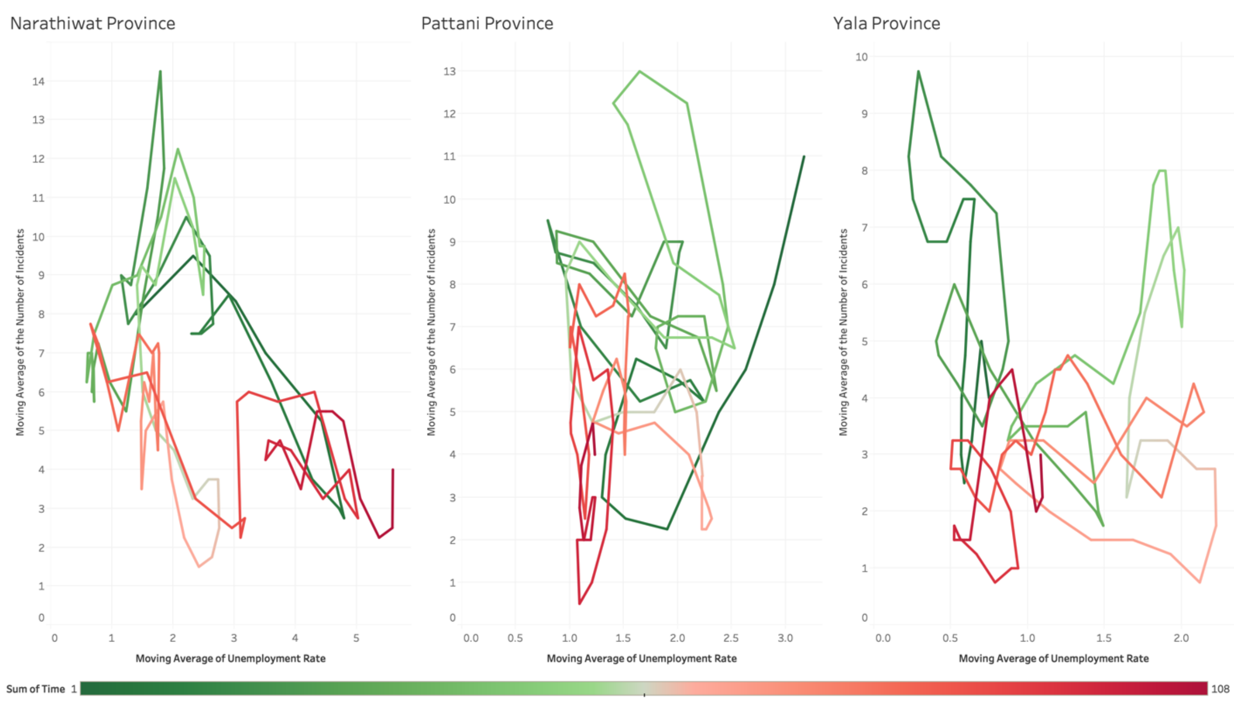


Figure 4-12: Phrase Portrait of the number of Incident and Unemployment Rate

Figure 4-13: Phrase Portrait of the number of Incident and Total Population

Figure 4-14: Phrase Portrait of the number of Incident and Percent of Youth Population

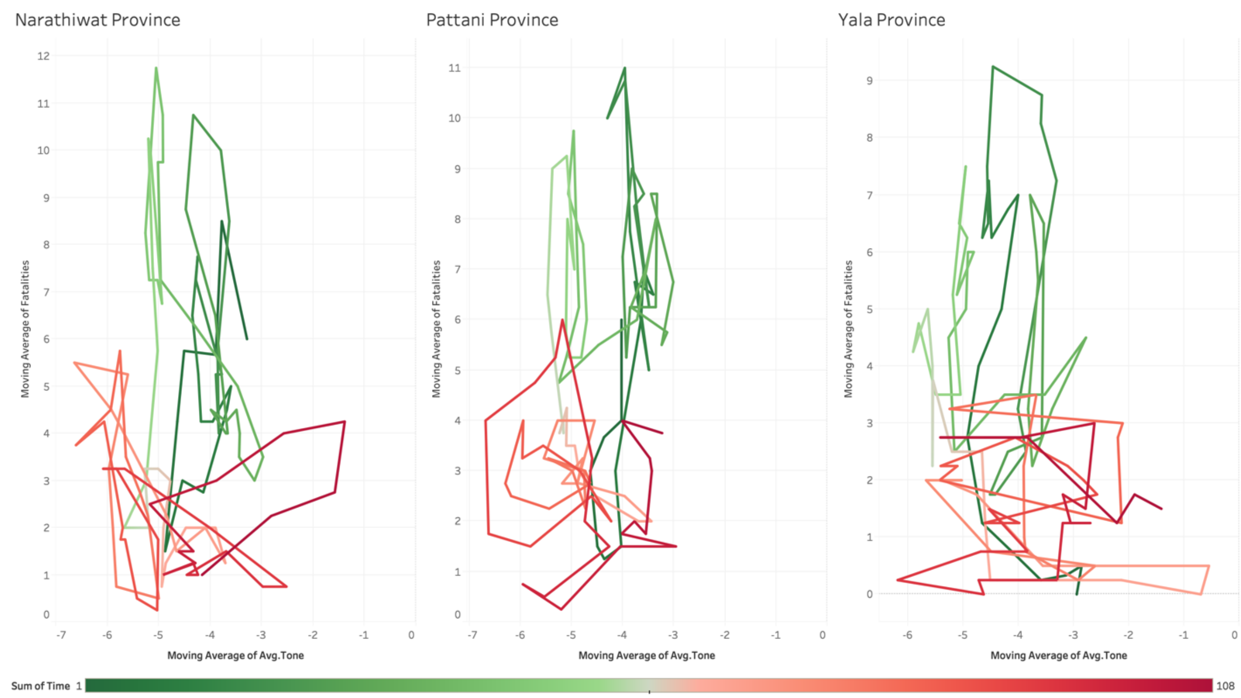


Figure 4-15: Phrase Portrait of the Fatalities from Incidents and the Average Tone

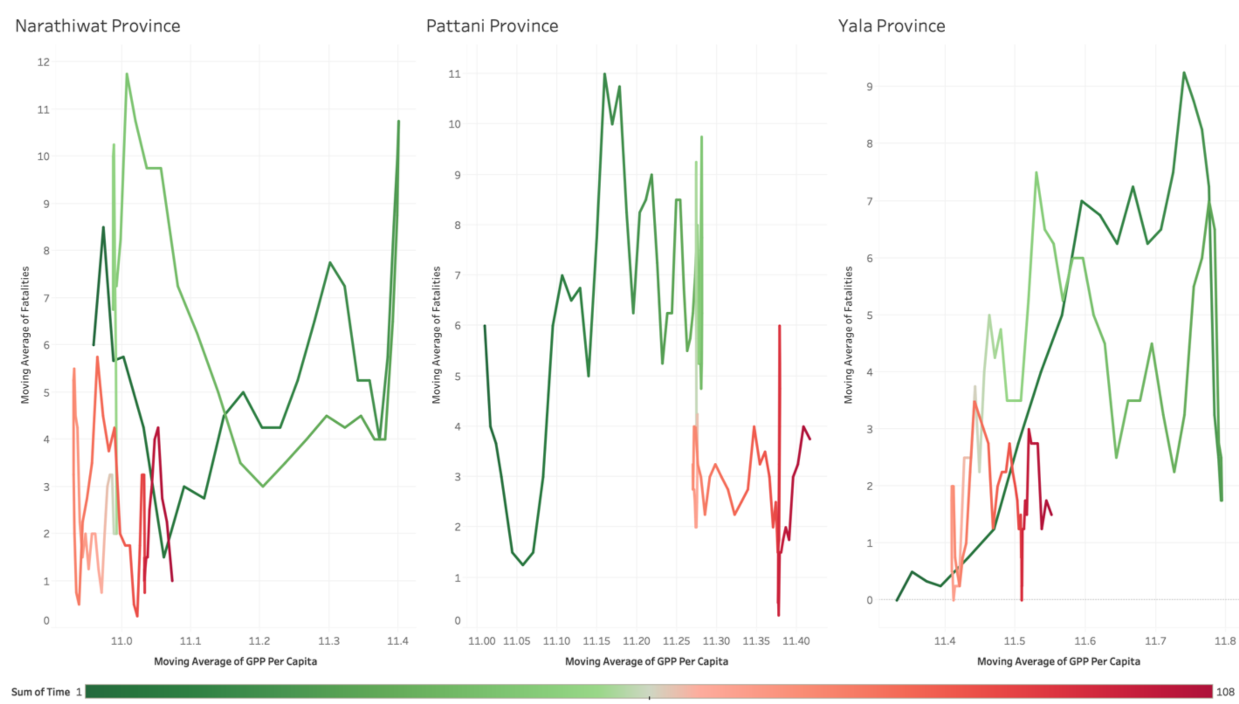


Figure 4-16: Phrase Portrait of the Fatalities from Incidents and GPP Per Capita

Figure 4-17: Phrase Portrait of the Fatalities from Incidents and Inflation Rate

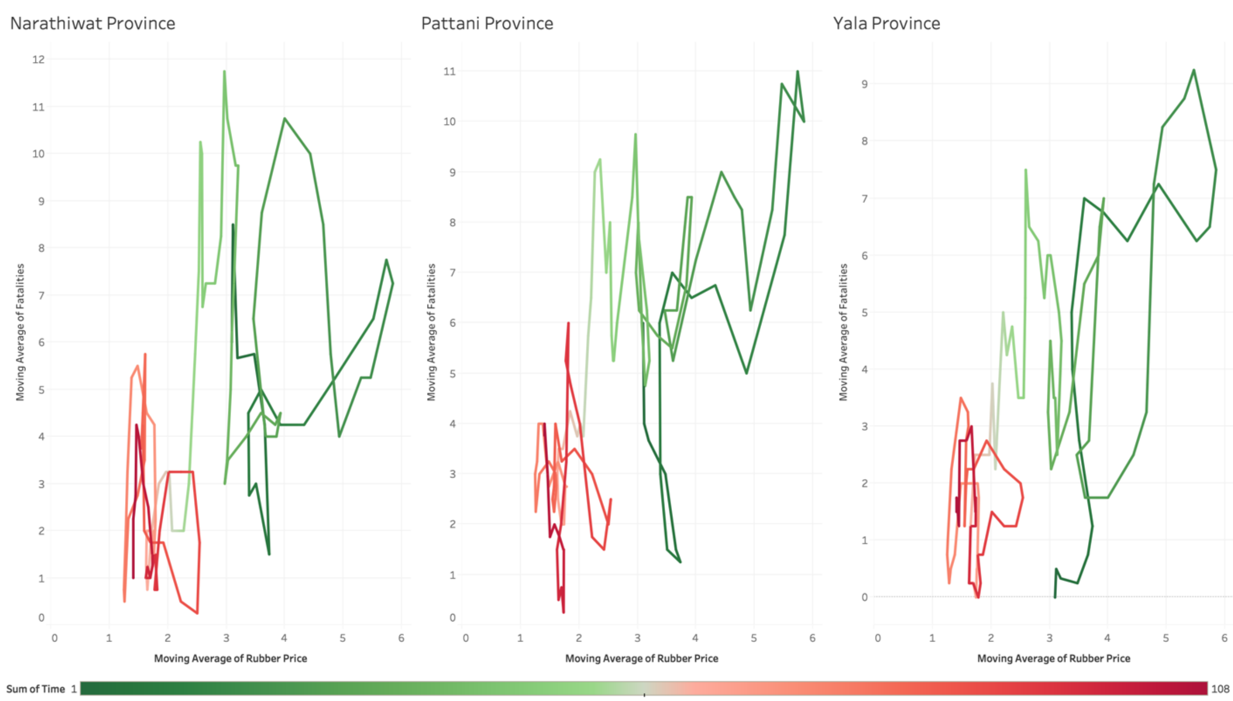


Figure 4-18: Phrase Portrait of the Fatalities from Incidents and Rubber Price

Figure 4-19: Phrase Portrait of the Fatalities from Incidents and Unemployment Rate

Figure 4-20: Phrase Portrait of the Fatalities from Incidents and Military Expenditure

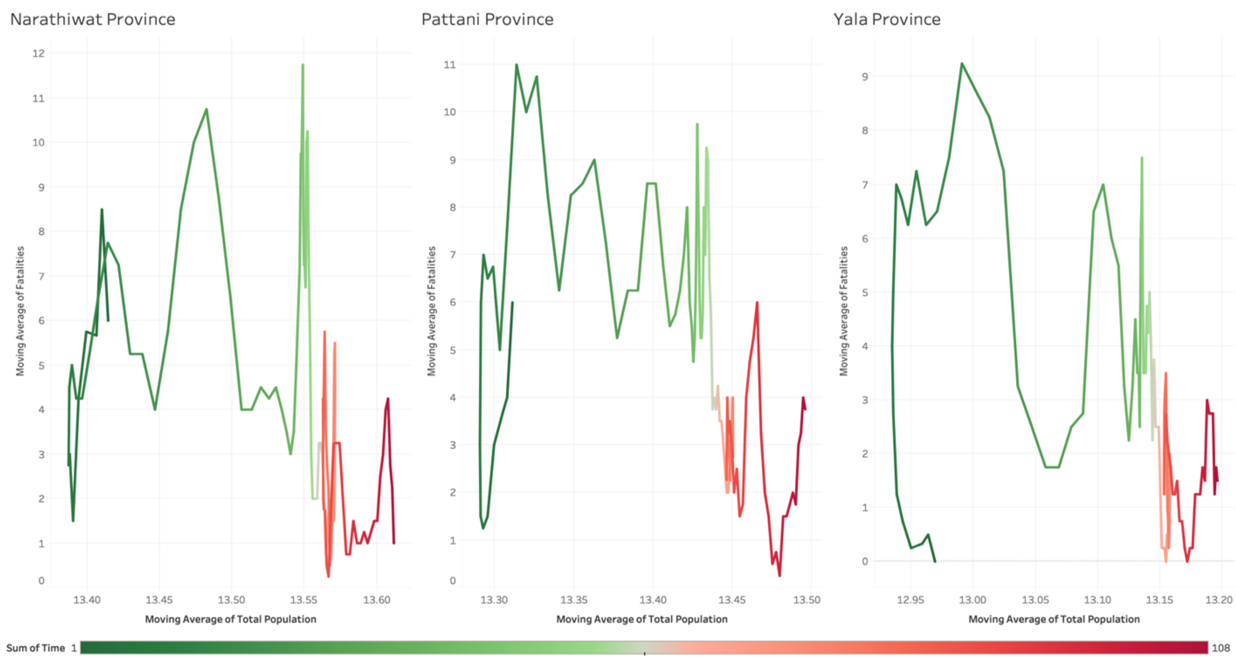


Figure 4-21: Phrase Portrait of the Fatalities from Incidents and Total Population

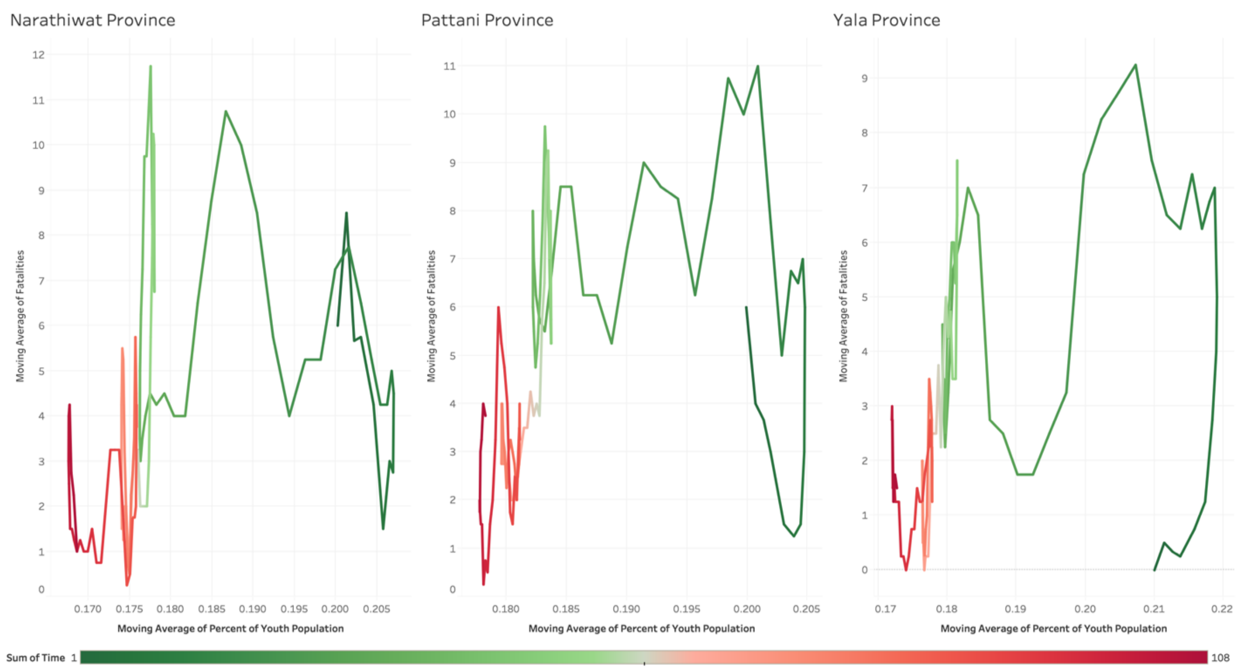


Figure 4-22: Phrase Portrait of the Fatalities from Incidents and Youth Population

Data Analysis

Data Splitting

Based on the goal of this research, we not only develop the analytical framework to explain the causality of the independent variables to the dependent variables, but also to improve the forecast ability of political risk assessment models. Then, the research design in this research will be divided to training dataset and testing dataset where the analytical models will run on training dataset and the testing dataset will be used to evaluate the forecast performance of the models. In our research design, we will divide the data from 2010 to 2017 as a training dataset and the data in 2018 will be used as a testing dataset.

Granger Causality Test

In this section, we will perform a Granger Causality test to see the relationship between the variables in the models. We will divide the data to provincial levels and run the models separately. After we obtain the test results from each dataset, we will summarize the result in form of the network of the Granger Causality. The detail report of the Granger Causality test in three provinces can be found in the Appendix Section.

In Figure 4-23: Granger Causality Relationship - Pattani Province, the network represents the Granger causality between the variables in Pattani dataset. The result shows that the number of incidents is Granger caused by average tone, population and youth population at 95% confidence level. Unemployment and military expenditures also Granger cause the number of incidents at 90% confidence level. On the other hand, the fatalities from the incidents are Granger caused by

most of the socioeconomic data, except inflation rate. It might indicate that the frequency of the incident depends mostly on demographic factors, while the severity of the incidents is broadly affected by socioeconomic factors. Interestingly, the frequency of the incidents shows a sign of Granger causality to the severity of the incidents, but the severity does not show the Granger causality to the frequency of the incidents. For average tone, it shows the sign of the Granger causality to the number of incidents, but not with the fatalities of the incidents and, surprisingly, the average tone is not Granger caused by the number of incidents or the fatalities of the incidents.

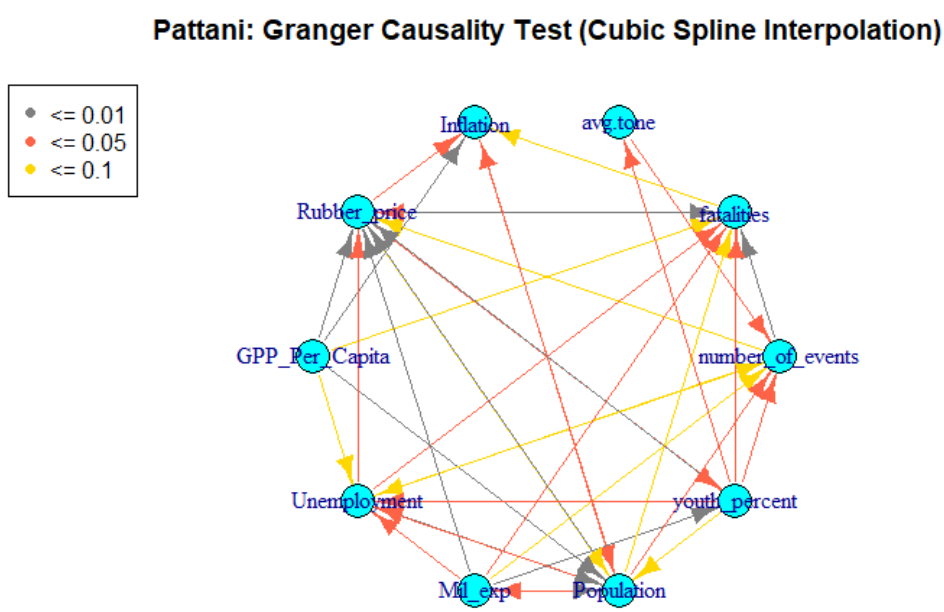


Figure 4-23: Granger Causality Relationship - Pattani Province

In case of Yala as shown in Figure 4-24: Granger Causality Relationship - Yala Province, the number of incidents is Granger caused by rubber price, military expenditure, total population and percent of youth population. For the fatalities from the incidents, the similar pattern of Granger causality is observed as rubber price, GPP Per capita, military expenditure, total population and

percent of youth population Granger cause this variable. However, the number of incidents, the fatalities of the incidents and the average tone do not Granger cause each other. Also, only the number of incidents Granger causes GPP per capita, but the fatalities from the incidents and the average tone does not show any effect towards other socioeconomic factors.

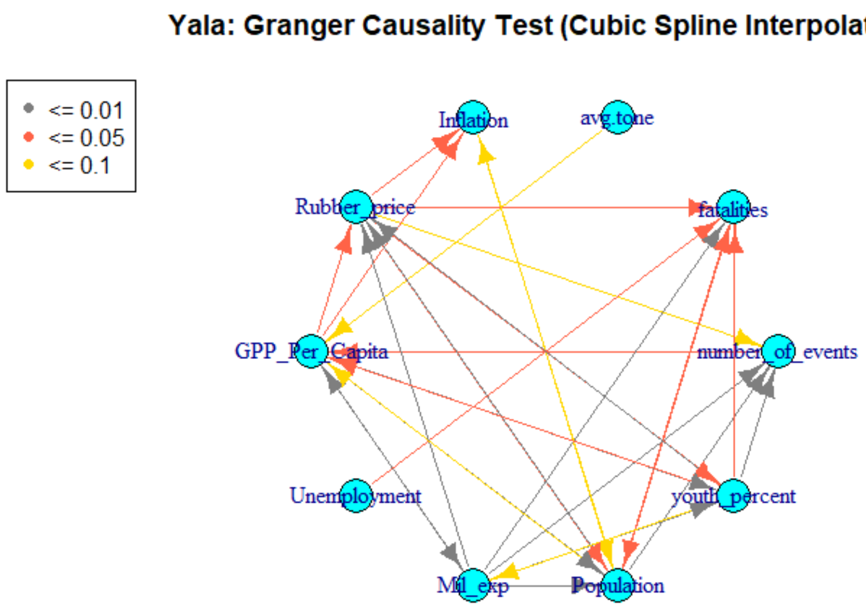


Figure 4-24: Granger Causality Relationship - Yala Province

For Narathiwat dataset, Figure 4-25: Granger Causality Relationship - Narathiwat Province shows the different patterns of Granger causality as in Pattani case or Yala case. The number of incidents is granger caused by most of the variables except the inflation rate. The fatalities of the incidents are Granger caused by GPP per capita, population and the percent of youth population. For average tone, it only Granger causes the number of incidents. The fatalities from the incidents also only Granger causes the number of incidents.

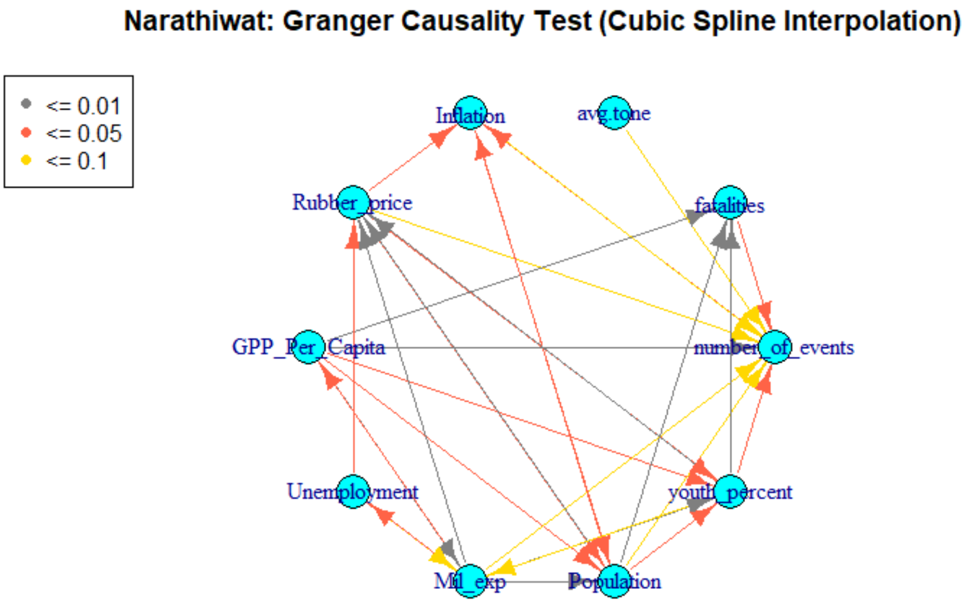


Figure 4-25: Granger Causality Relationship - Narathiwat Province

Table 4-2: Summary of Granger Causality Test with 3 Main Variables at 95% Confidence Level summarizes the Granger causality only with the three main variables: the number of incidents; the fatalities from incidents; and average tone at 95% confidence level in all three provinces. The relationship between the number of incidents and the fatalities from incidents can be observed only in Pattani and Narathiwat. The Granger causality between average tone and the level of violence can only be found in Yala case. The rubber price and the military expenditure shows Granger causality to the level of violence from intrastate conflict in Pattani and Yala, but not in Narathiwat. The political demographics factors: the total population and the percent of youth population, are significant in all 3 provinces.

Province	Findings	
	Independent Variable	**Dependent Variable**
Pattani	The number of incidents	The fatalities from incidents
	The number of incidents	Rubber price
	The fatalities from incidents	Inflation rate
	The fatalities from incidents	Rubber price
	Average tone	The number of incidents
	Rubber price	The fatalities from incidents
	Military Expenditure	The fatalities from incidents
	Total population	The number of incidents
	Percent of youth population	The number of incidents
	Percent of youth population	The fatalities from incidents
	Percent of youth population	Average tone
Yala	The number of incidents	GPP per capita

Province	Findings	
	Independent Variable	**Dependent Variable**
	The fatalities from incidents	Total population
	Rubber price	The fatalities from incidents
	Unemployment rate	The fatalities from incidents
	Military Expenditure	The number of incidents
	Military Expenditure	The fatalities from incidents
	Total population	The number of incidents
	Total population	The fatalities from incidents
	Percent of youth population	The number of incidents
	Percent of youth population	The fatalities from incidents
Narathiwat	The number of incidents	Inflation rate
	The fatalities from incidents	The number of incidents
	GPP per capita	The number of incidents
	GPP per capita	The fatalities from incidents

Province	Findings	
	Independent Variable	**Dependent Variable**
	Total population	The fatalities from incidents
	Percent of youth population	The number of incidents
	Percent of youth population	The fatalities from incidents

Table 4-2: Summary of Granger Causality Test with 3 Main Variables at 95% Confidence Level

Vector Auto Regression Model

Pattani Province

We inspect this dataset to check the stationarity of each variables by using the Augmented Dickey-Fuller test (ADF) to test the stationarity of variables. We observe that the fatalities from the incidents, and the inflation rate are stationary while the rest of the variables are needed to use difference order to address the trend and change in the levels. We, thus, proceed to transform the data by using the first order difference on the non-stationary series and test the differenced series with ADF test again. We found that military expenditure, total population, and percent of youth population are needed to use more than one order of difference to make these variables stationary. The details of the ADF test and number of difference order for each variable are presented in Table 4-3: The Result from Augmented Dickey-Fuller Test - Pattani Province.

Variable	Order of Difference	Dickey Fuller Statistics	P-Value
Fatalities from Incidents	0	-4.21	0.01
Number of Incidents	0	-3.39	0.06
	1	-6.85	0.01
Average Tone	0	-3.33	0.07
	1	-5.85	0.01
Inflation Rate	0	-4.09	0.01
Rubber Price	0	-2.45	0.39
	1	-4.50	0.01
GPP Per Capita	0	-2.80	0.24
	1	-1.82	0.65

	2	-4.13	0.01
Unemployment Rate	0	-2.74	0.27
	1	-8.48	0.01
Military Expenditure	0	-1.98	0.58
	1	-2.89	0.21
	2	-2.88	0.21
	3	-2.76	0.26
	4	-3.73	0.03
Total Population	0	-2.54	0.35
	1	-3.24	0.09
	2	-3.54	0.04
Percent of Youth Population	0	-2.09	0.54
	1	-4.00	0.01

Table 4-3: The Result from Augmented Dickey-Fuller Test - Pattani Province

The data for Pattani Province is also visualized in Figure 4-26: Pattani Data before Stationary Test to show the characteristics of each variable. After the ADF test and the process of differencing the series based on the ADF test as shown in the table above, Figure 4-27:Pattani Data after Stationary Test illustrates the outcome of the transformation when every series is stationary.

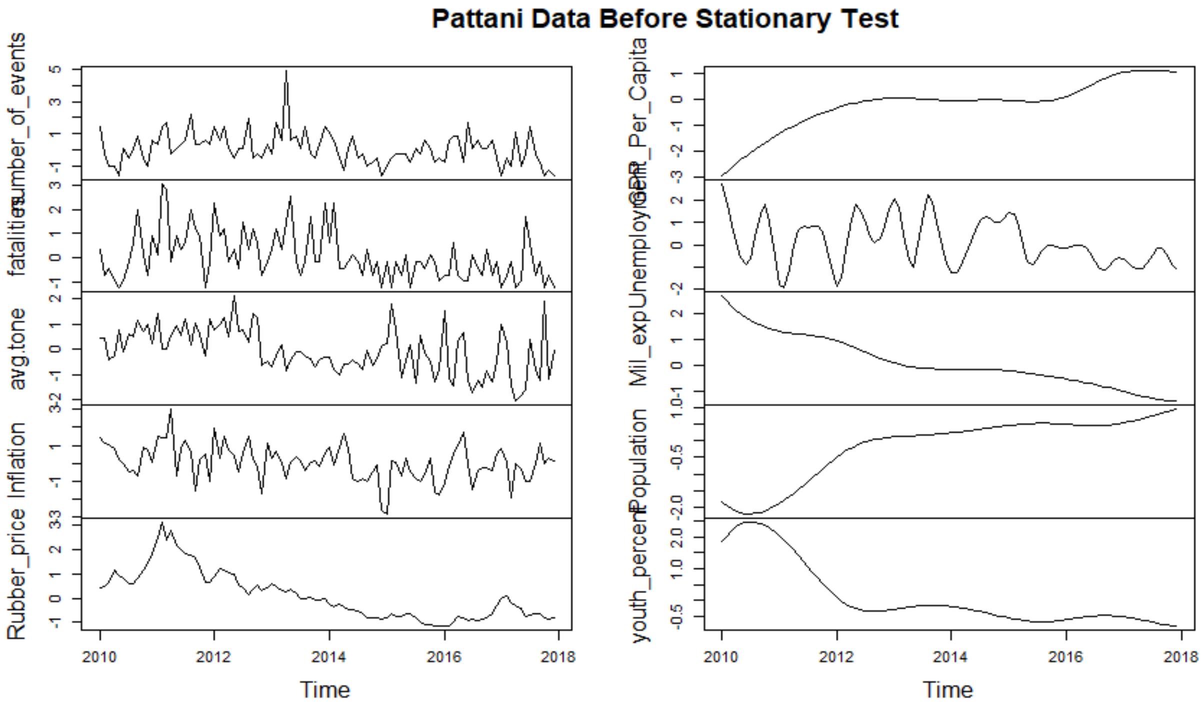


Figure 4-26: Pattani Data before Stationary Test

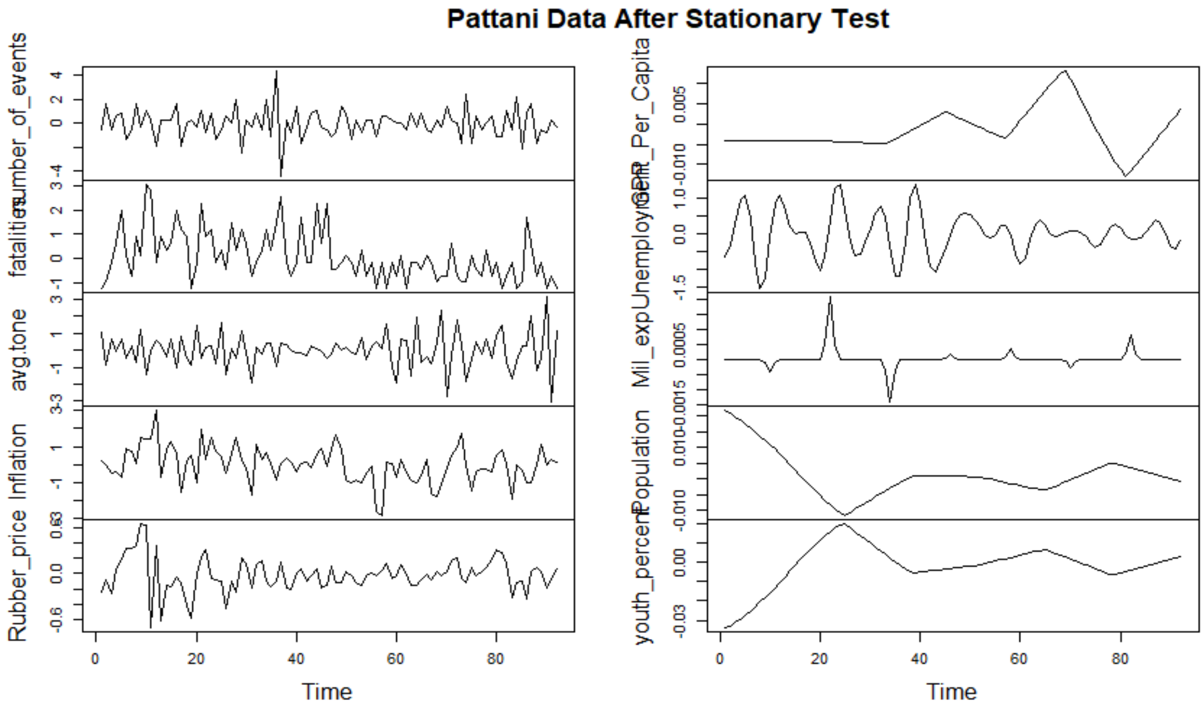


Figure 4-27:Pattani Data after Stationary Test

After we transform the data and we test the data that all series are stationary, we proceed to use the lag order selection test for VAR model to select the optimal number of lag order for the VAR model with AIC as a selection information criterion. For the Pattani province dataset, we will include variables with up to lag order 4 variables in the models since the AIC of the lag order 4 is the smallest among other lag orders tested in this process. The result of selection test is shown below.

Lag Order	AIC	HQ	SC	FPE
1	-67.48	-66.23	-64.39	0.00
2	-75.56	-73.18	-69.65	0.00
3	-76.09	-72.57	-67.36	0.00
4	-76.96	-72.31	-65.42	0.00

Table 4-4: The Result of Lag Order Selection Test for VAR model – Pattani Province

After the optimal number of the lag order operator for the VAR model is tested, we run the VAR model with lag order 4. The result is shown in Table 0-4: VAR Results - Pattani Province in the Appendix section. The result shows that for the number of incidents, the 1st, 2nd , 3rd and 4th lag order of the number of incidents are statistically significant at 99%, 95%, 90% and 95% confidence level respectively. Only the 2nd order lag fatalities form the incidents and the 3rd order lag rubber price are statistically significant at 95% and 90% confidence level respectively. The beta coefficients for these two variables are -0.37 and 1.19. For the fatalities from the incidents, the 1st order lag number of incidents, the 2nd order lag number of incidents, the 2nd order lag inflation rate, the 4th order lag average tone, the 4th order lag total population and the 4th order lag youth population are statistically significant at 99%, 95%, 99%, 90%, 90%, and 90% confidence level, respectively. For the average tone, only the average tone lag variables are statistically significant. All coefficients presented in the table are standardized. All the sub-models in the VAR model except inflation rate model are statistically significant.

To interpret the result, we use the Impulse Response Function (IRF) to estimate the short-term effect of one series to the other variables. In this study, we will focus on the three main variables: the number of incidents, the fatalities from the incidents and the average tone which are

presented below. For the full IRF plots with every variable, we present the IRF plots in the Appendix section.

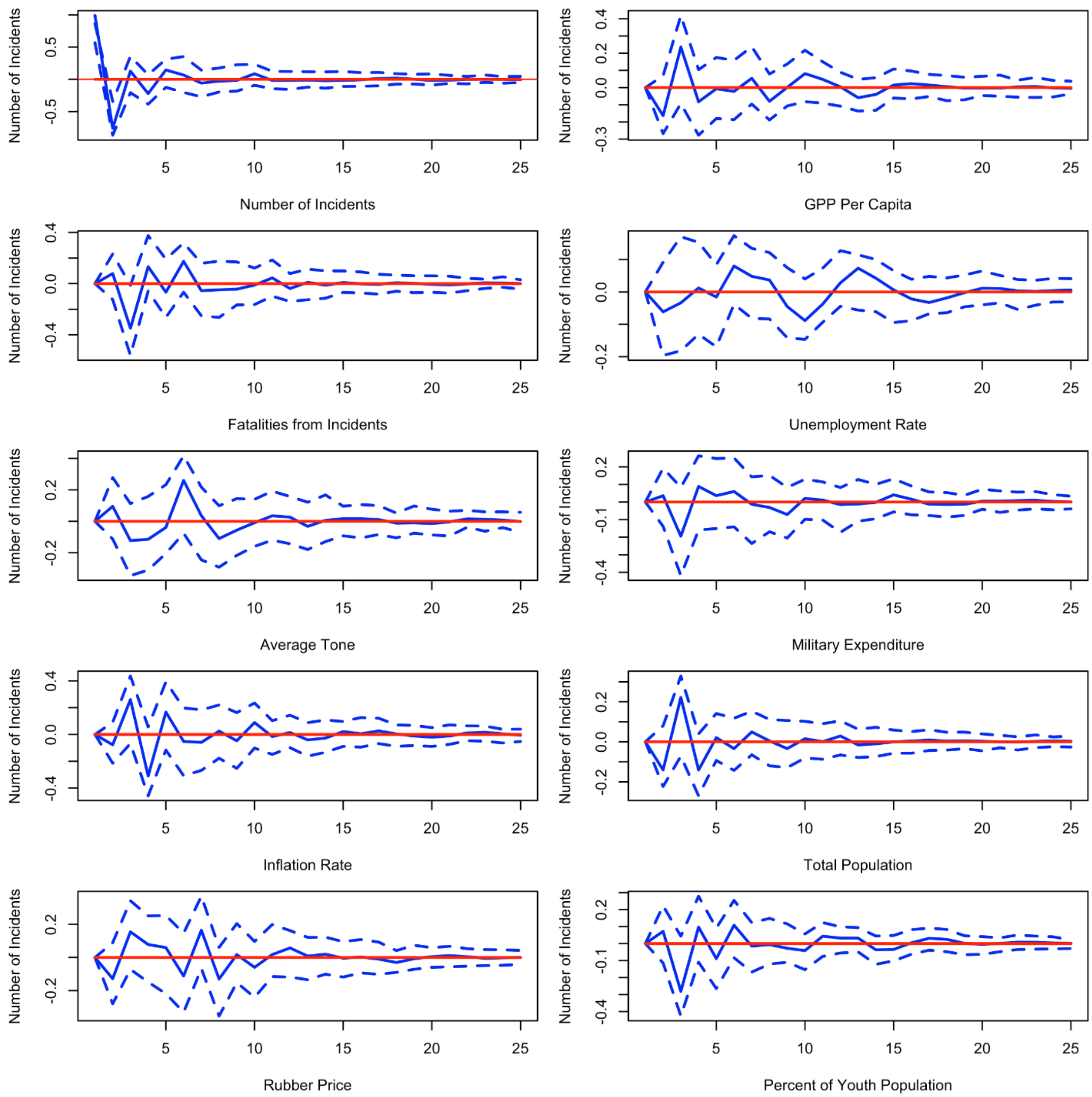


Figure 4-28: Impulse Response Function to Number of Incidents - VAR Model - Pattani Province

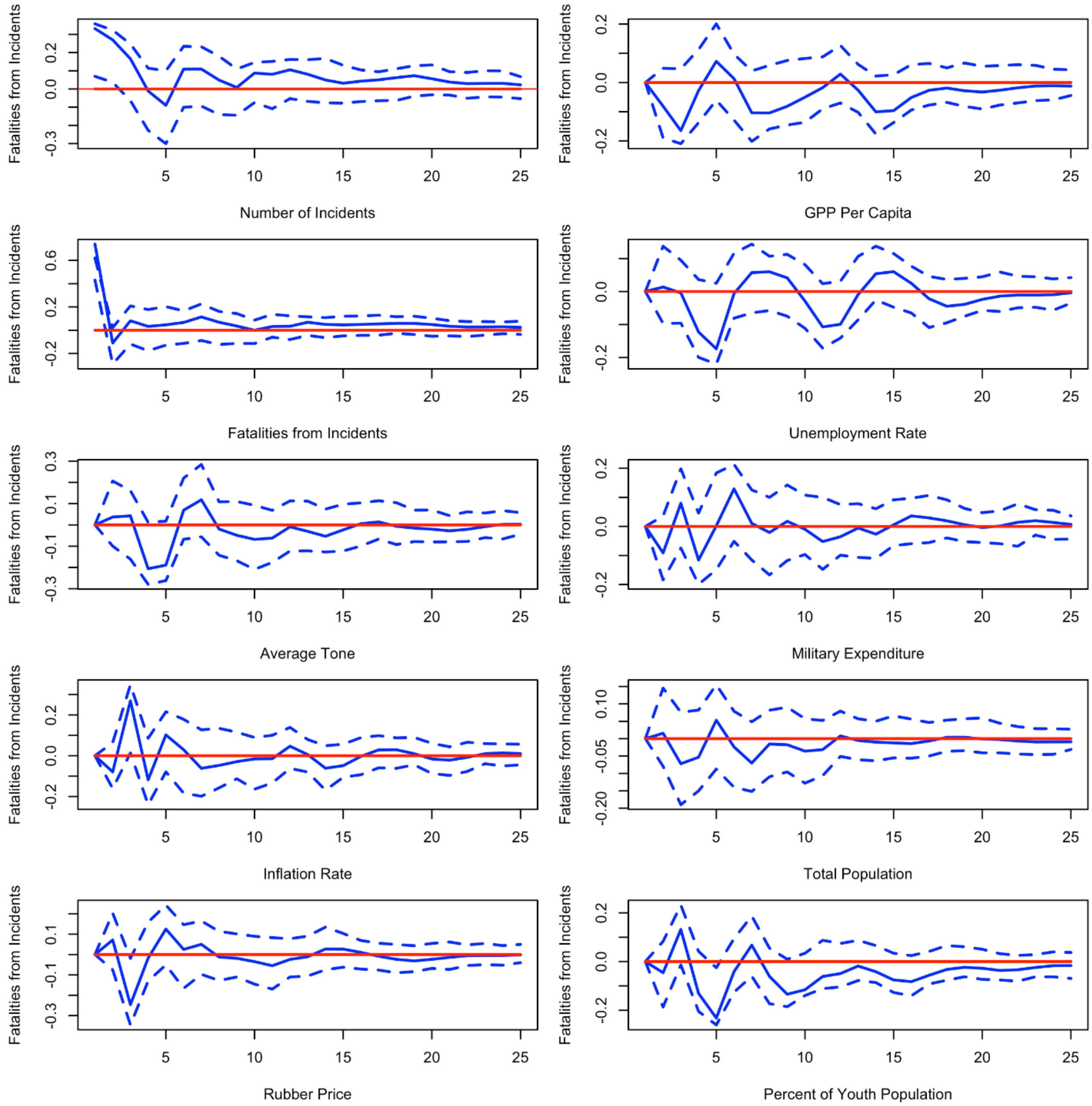


Figure 4-29: Impulse Response Function to Fatalities from Incidents – VAR Model - Pattani Province

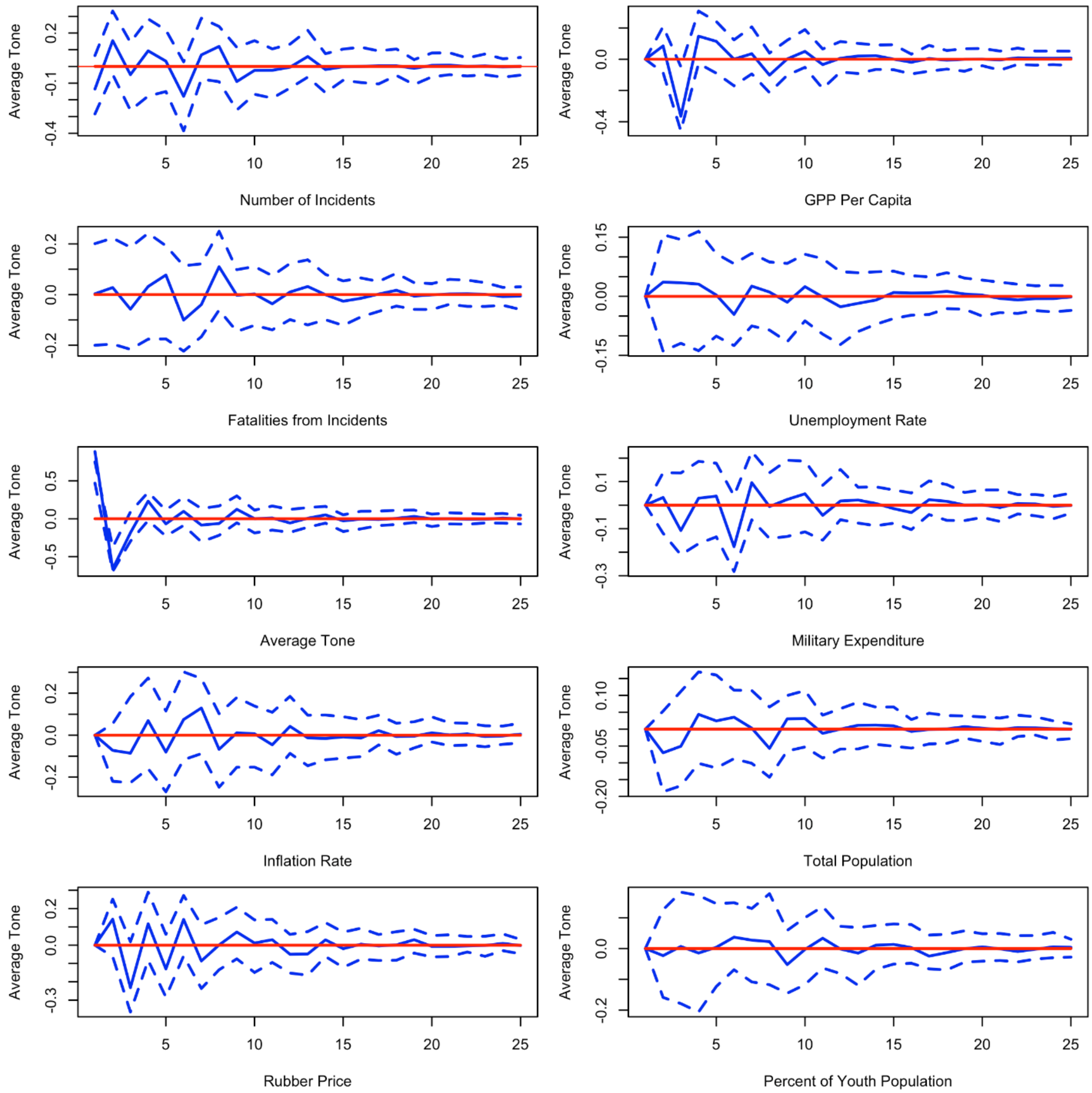


Figure 4-30:Impulse Response Function to Average Tone - VAR Model - Pattani Province

In Figure 4-28: Impulse Response Function to Number of Incidents - VAR Model - Pattani Province, the IRF of the number of incidents show a statistical significant effect of the number of incidents to itself as the confident intervals do not touch zero line for 2 periods before its trajectory correct itself to the equilibrium. This means that the short-term effect of the last period increase deviated from the equilibrium will lead to the system will correct themselves by the decrease in the next period. It will resume to the equilibrium point within 3 periods or 3 months. However, the speed of adjustment will take 5 months to 8 months to resume to the original equilibrium. The other factors are not statistically significant in the IRF estimation for the number of incidents. Most of the series show that the shock in one series will affect the number of incidents by short periods and it will resume to the equilibrium in less than 5 periods. Although the average tone is not statistically significant, but it shows that the effect from its shock tend to stay and have a long positive effect to the number of incidents for 10 months. Additionally, the unemployment rate shows a longer short-term effect since the IRF lasts to 15^{th} period. Nevertheless, the IRF of the unemployment rate is not statistically significant.

For the fatalities from the incidents, the IRF results show that only the fatality rate itself has a significant effect. The shock in the fatality rate in the system in the last period will lead to a dramatic decline in the next period and the series will adjust itself to the equilibrium in 2 periods. The IRF from the number of incidents also shows a short-term effect lasting around 5 periods before the trajectory correct itself. However, the IRF from the number of incidents are statistically significant around 2 – 3 periods. The IRF from other variables show similar pattern as shown in the number of incidents. The effect from other variables tend to last around 5 periods before the fatalities from the incidents resumes to the original path. However, the GPP per capita and the unemployment rate show a longer short-term effect to the fatalities from the incidents. The IRF

shows the effect prolongs to 15 periods. Nevertheless, neither of these variables are statistically significant.

The IRF for average tone shows that only the average tone itself is statistically significant and its effect lasts less than 5 periods. Other variables show a small and statistically insignificant effect against the average tone.

Figure 4-31: Fitted Value and Residuals of Number of Incidents from VAR models - Pattani Province and Figure 4-32: Fitted Value and Residuals of Fatality Rate from VAR models - Pattani Province below show the actual value, the fitted value and the residuals from the models with the number of incidents and the fatalities from the incidents. The forecasting performance of the models is evaluated by using Root Mean Squared Errors (RMSE) on both training and testing dataset. The result is shown in Table 4-5: Predictive Evaluation of VAR Model - Pattani Province. We can see that the difference between RMSE of the training dataset and the testing dataset is considerably large. This might indicate that the VAR model we estimate might suffer from the overfitting problem.

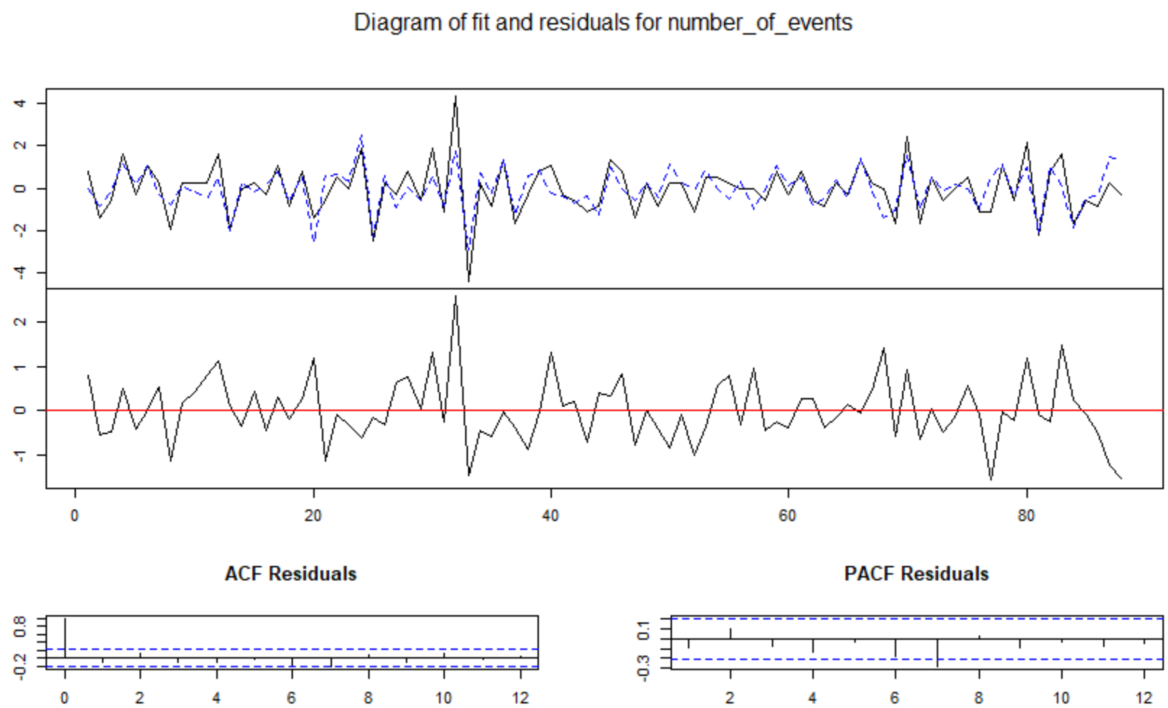


Figure 4-31: Fitted Value and Residuals of Number of Incidents from VAR models - Pattani Province

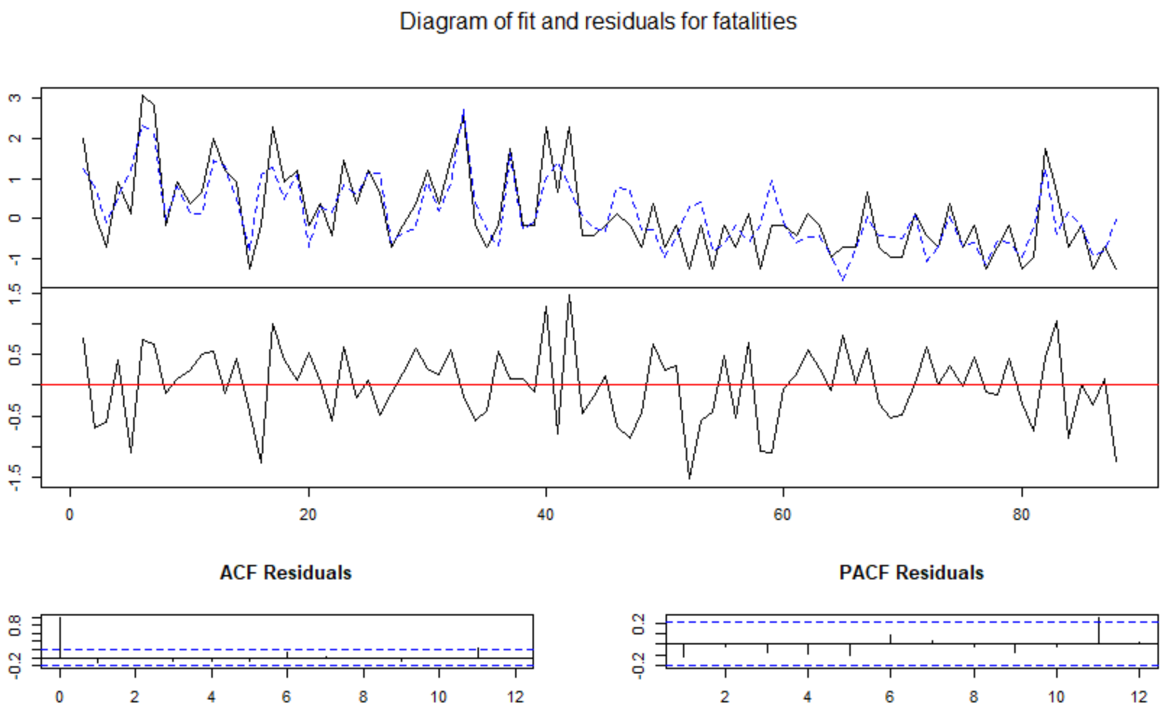
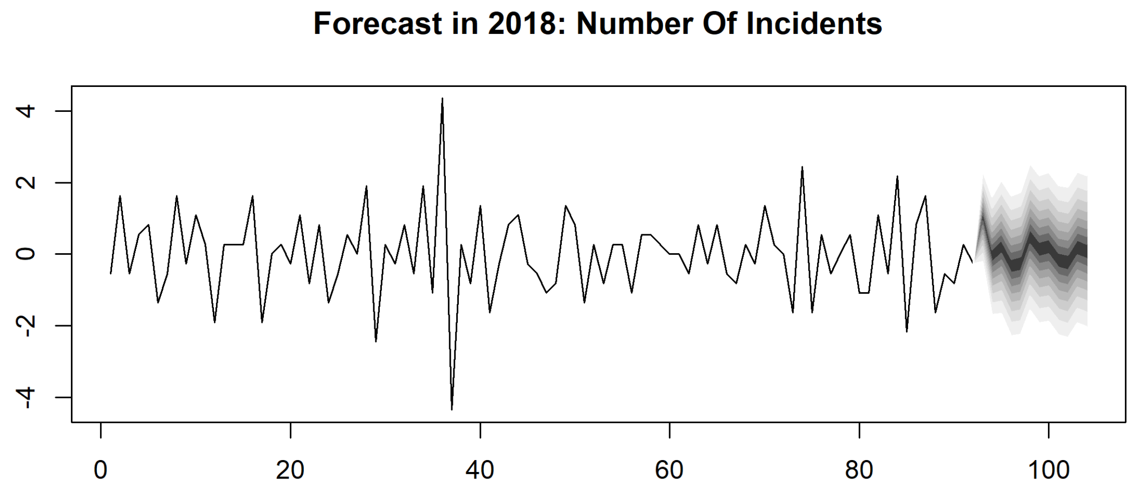


Figure 4-32: Fitted Value and Residuals of Fatality Rate from VAR models - Pattani Province

DV	RMSE	
	Training	Testing
Number of Incidents	0.724	1.112
Fatalities from Incidents	0.592	1.035

Table 4-5: Predictive Evaluation of VAR Model - Pattani Province



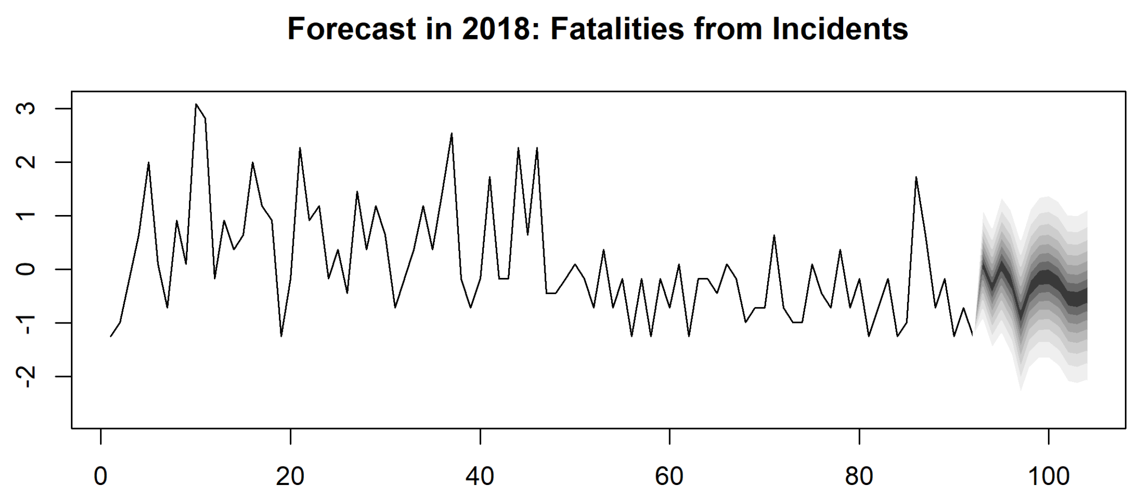


Figure 4-33: Forecasting Result from VAR models - Pattani Province

Figure 4-33: Forecasting Result from VAR models - Pattani Province shows the forecast value in year 2018 based on the model for the number of incidents and the fatalities from the incidents.

We also perform the stability test for VAR model to ensure its inference ability. The eigenvalues we obtain from the coefficient matrix are strictly less than one in their modulus form. Figure 4-34: Roots of the Companion Matrix - VAR Model - Pattani Province visualizes all eigenvalues are within the unit root circle. The result from the stability test confirm that the VAR model is stable and all variables in the model satisfy the stationarity conditions. Then, it can be used for the inference.

We also perform the diagnostic tests on the residuals of the models. Table 4-6: Diagnostics Tests - VAR Full Model - Pattani Province shows that the model does not have a heteroskedasticity problem. However, the models suffer from the serial correlation since the Portmanteau test is significant. We suspect that the serial correlation problem of the residuals is caused by the interpolated variables since their pattern are a smooth function based on different time point. Then, we perform an experiment by running a restricted VAR without the interpolated variables. The result shown in Table 4-7: Diagnostics Tests - VAR Non-interpolated Variable Model - Pattani Province confirm our suspicious since the restricted VAR model does not have a serial correlation problem. In addition, the normality assumption of the residuals of the VAR model is violated since all three condition tests of the residuals are statistically significant. Based on the results of the diagnostic tests, the inference from the model must be approached with cautious since the model suffers from the inefficiency of the estimation. However, the model still provides unbiased estimates.

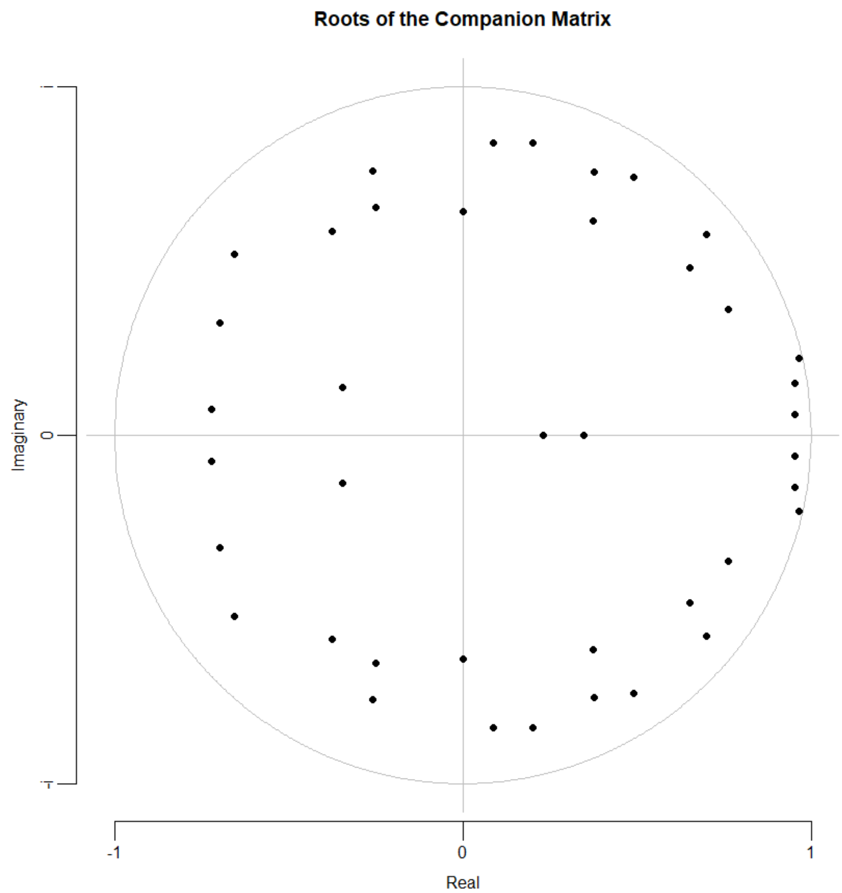


Figure 4-34: Roots of the Companion Matrix - VAR Model - Pattani Province

Test	Statistics	D.F.	P-value
Portmanteau	1410.908	1200.000	<0.001
ARCH VAR	4565.000	15125.000	1.000
JB VAR	421.547	20.000	<0.001
Kurtosis	394.630	10.000	<0.001
Skewness	26.917	10.000	0.003

Table 4-6: Diagnostics Tests - VAR Full Model - Pattani Province

Test	Statistics	D.F.	P-value
Portmanteau	154.94	192	0.98
ARCH VAR	526.00	500	0.20
JB VAR	90.56	8	<0.001
Kurtosis	65.05	4	<0.001
Skewness	25.51	4	<0.001

Table 4-7: Diagnostics Tests - VAR Non-interpolated Variable Model - Pattani Province

Yala Province

We inspect this dataset to check the stationarity of each variables by using the Augmented Dickey-Fuller test (ADF) to test the stationarity of variables. There are five variables which are already stationary, namely, the number of incidents, the fatalities from the incidents, average tone, inflation rate, and GPP per capita while the rest of the variables are needed to use difference order to address the trend and change in the levels. We, thus, proceed to transform the data by using the first order difference on the non-stationary series and test the differenced series with ADF test again. We found that military expenditure, and total population are needed to use more than one order of difference to make these variables stationary. The details of the ADF test and number of difference order for each variable are presented in Table 4-8: The Result from Augmented Dickey-Fuller Test - Yala Province.

The data for Yala Province is also visualized in Figure 4-35: Yala Data before Stationary Test to show the characteristics of each variable. After the ADF test and the process of differencing the series based on the ADF test as shown in the table above, Figure 4-36: Yala Data After Stationary Test illustrates the outcome of the transformation when every series is stationary.

After we transform the data and we test the data that all series are stationary, we proceed to use the lag order selection test for VAR model to select the optimal number of lag order for the VAR model with AIC as a selection information criterion. For the Yala province dataset, we will include variables with up to lag order 4 variables in the models since the AIC of the lag order 4 is the smallest among other lag orders tested in this process. The result of selection test is shown in Table 4-9: The Result of Lag Order Selection Test for VAR model – Yala Province.

Variable	Order of Difference	Dickey Fuller Statistics	P-Value
Fatalities from Incidents	0	-4.59	0.01
Number of Incidents	0	-3.75	0.02
Average Tone	0	-4.06	0.01
Inflation Rate	0	-4.09	0.01
Rubber Price	0	-2.45	0.39
	1	-4.50	0.01
GPP Per Capita	0	-3.50	0.05
Unemployment Rate	0	-0.80	0.96
	1	-5.94	0.01
Military Expenditure	0	-1.98	0.58
	1	-2.89	0.21
	2	-2.88	0.21
	3	-2.76	0.26
	4	-3.73	0.03
Total Population	0	-2.62	0.32
	1	-3.45	0.05
	2	-3.82	0.02
Percent of Youth Population	0	-2.23	0.48
	1	-3.66	0.03

Table 4-8: The Result from Augmented Dickey-Fuller Test - Yala Province

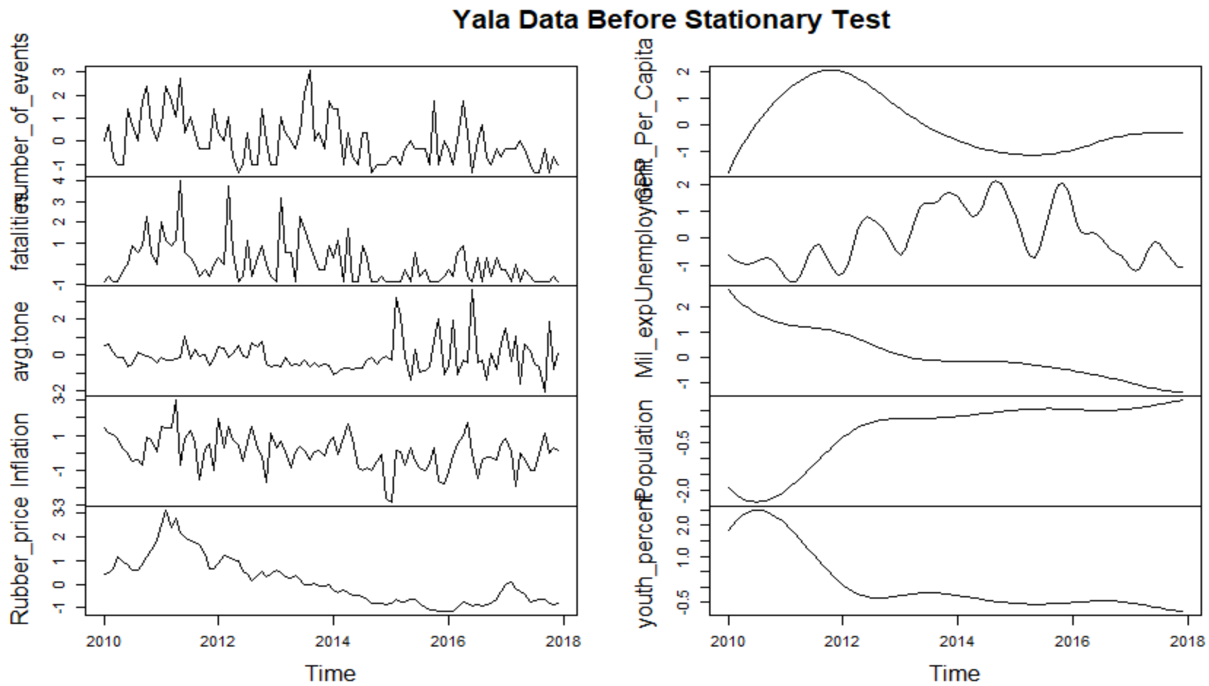


Figure 4-35: Yala Data before Stationary Test

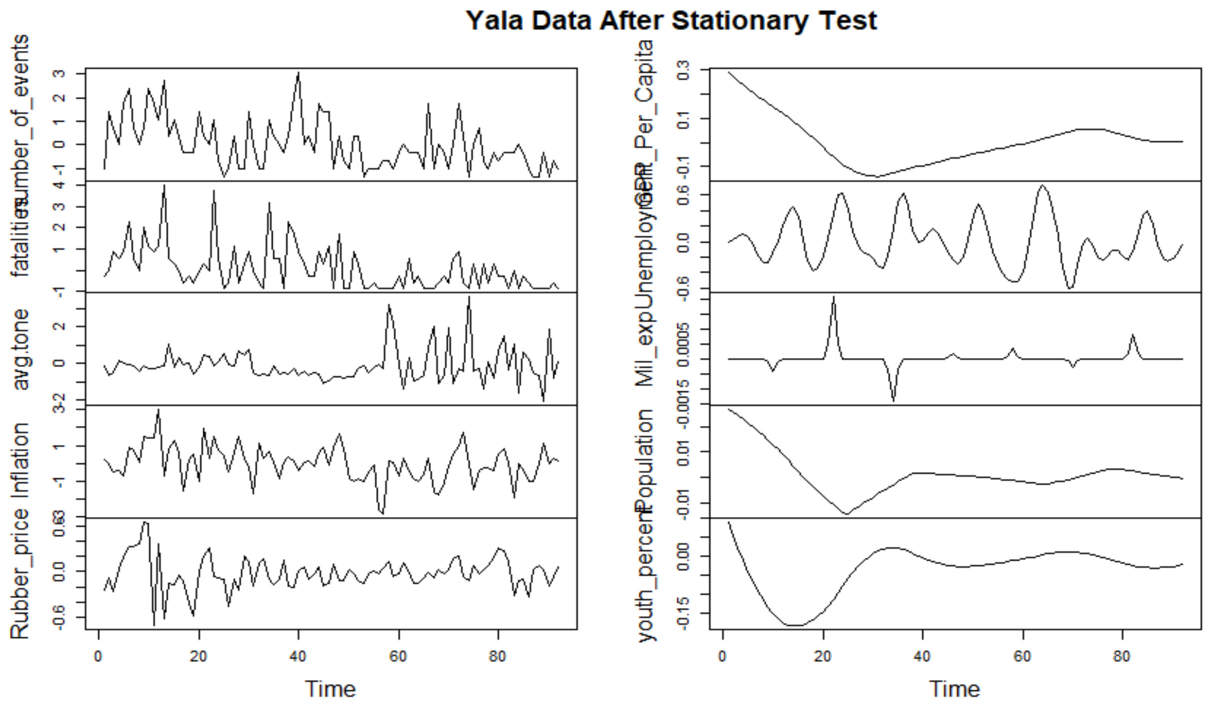


Figure 4-36: Yala Data After Stationary Test

Lag Order	AIC	HQ	SC	FPE
1	-64.88	-63.63	-61.78	0.00
2	-74.15	-71.77	-68.24	0.00
3	-81.09	-77.58	-72.37	0.00
4	-82.16	-77.51	-70.62	0.00

Table 4-9: The Result of Lag Order Selection Test for VAR model – Yala Province

After the optimal number of the lag order operator for the VAR model is tested, we run the VAR model with lag order 4. The result is shown in Table 0-5: VAR Results - Yala Province in the Appendix section. The result shows that for the number of incidents, only the 2nd order lag rubber price, the 3rd order lag number of incidents, and the 4th order lag military expenditure are

statistically significant at 99%, 90% and 95% confidence level respectively. For the fatalities from the incidents, the 1^{st} order lag fatalities from incidents, the 1^{st} order lag GPP per Capita, the 2^{nd} order GPP per Capita, the 3rd order lag GPP per Capita, and the 4^{th} order lag GPP per Capita are statistically significant at 95%, 99%, 99%, 99%, and 99% confidence level, respectively. For the average tone, only the 1^{st} order unemployment rate is statistically significant at 95% confidence level. All coefficients presented in the table are standardized. Two sub-models in the VAR model, namely average tone model and rubber price model are not statistically significant.

To interpret the result, we use the Impulse Response Function (IRF) to estimate the short-term effect of one series to the other variables. In this study, we will focus on the three main variables: the number of incidents, the fatalities from the incidents and the average tone which are presented below. For the full IRF plots with every variable, we present the IRF plots in the Appendix section.

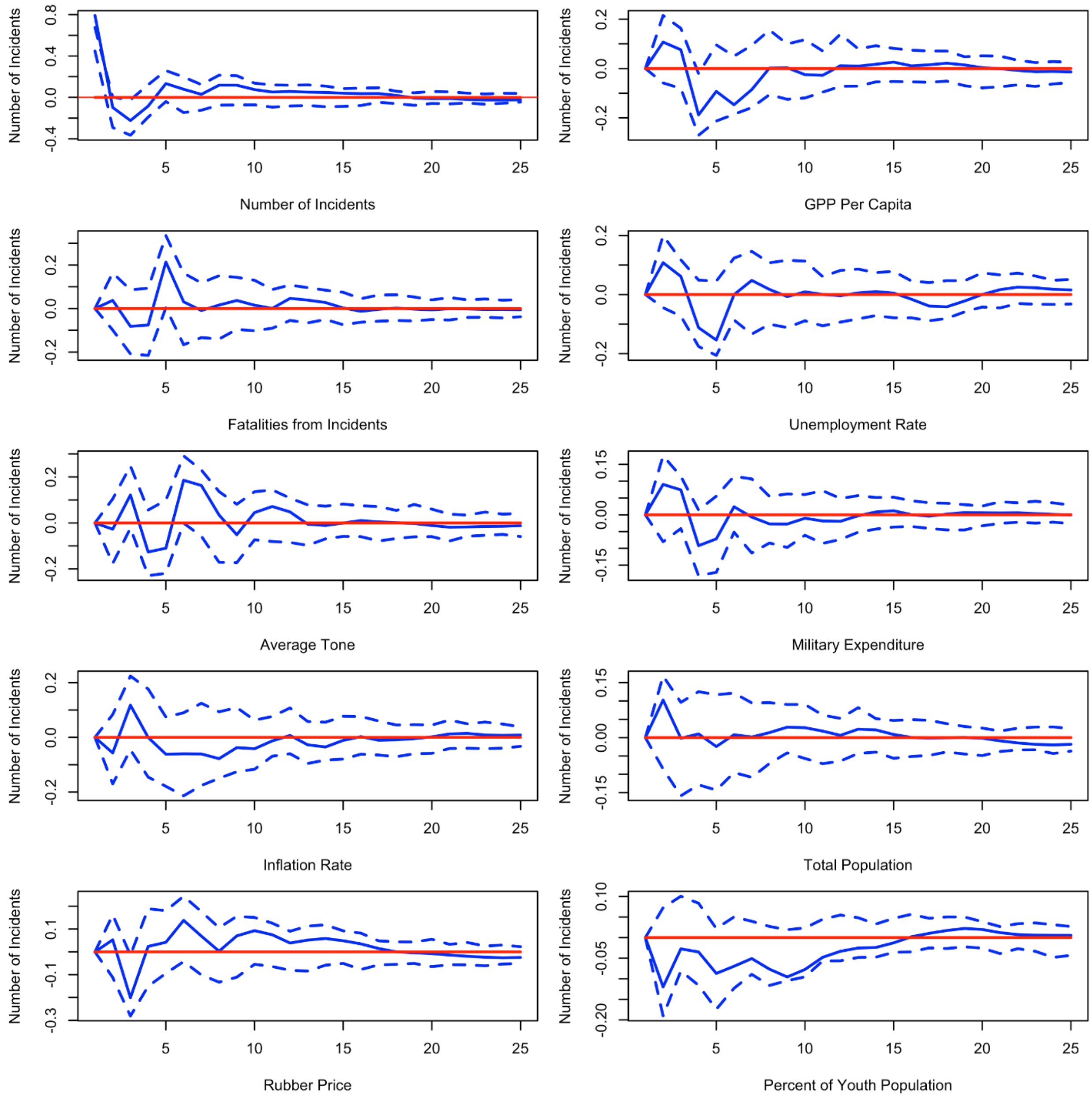


Figure 4-37: Impulse Response Function to Number of Incidents - VAR Model - Yala Province

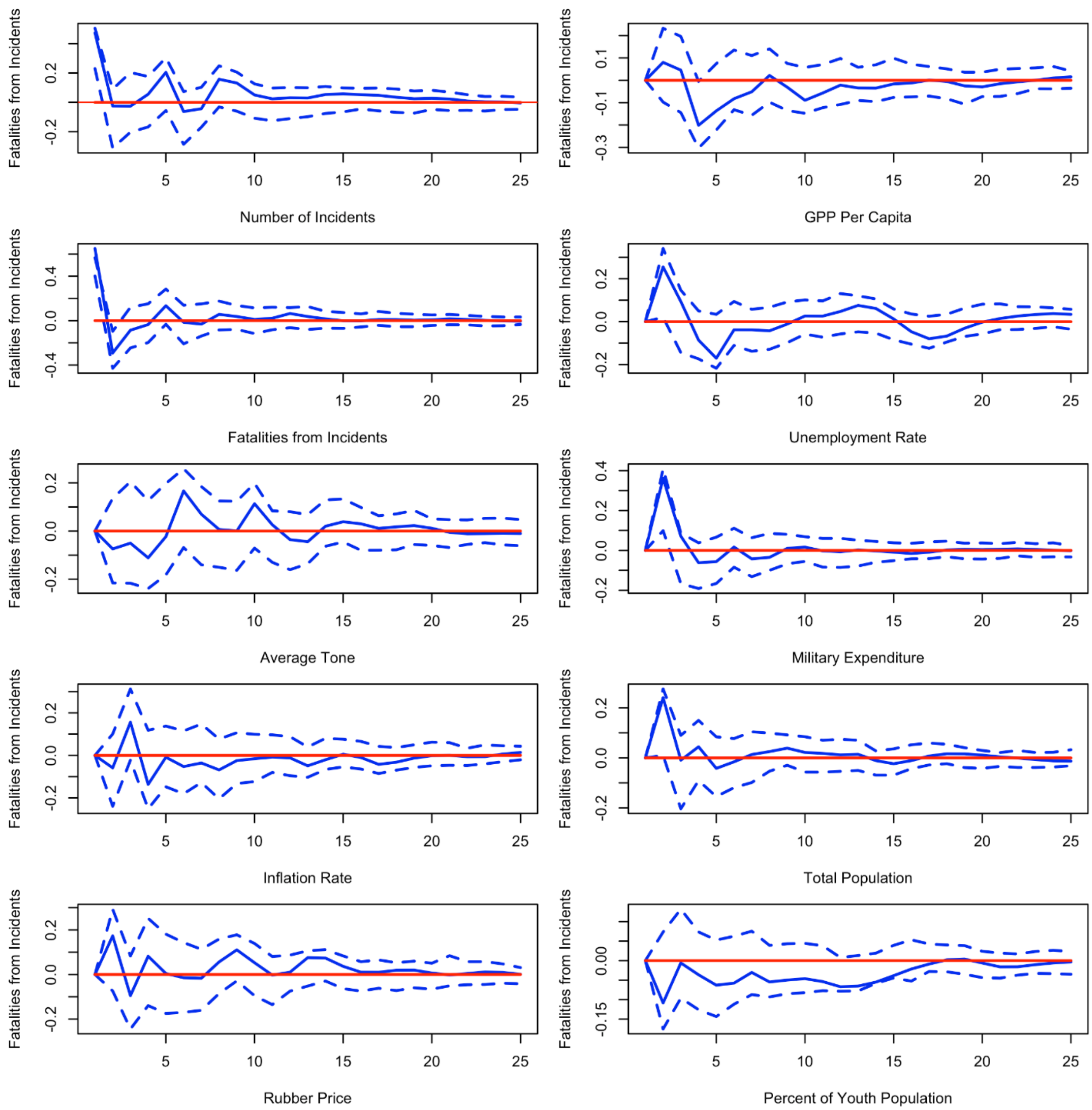


Figure 4-38: Impulse Response Function to Fatalities from Incidents - VAR Model - Yala Province

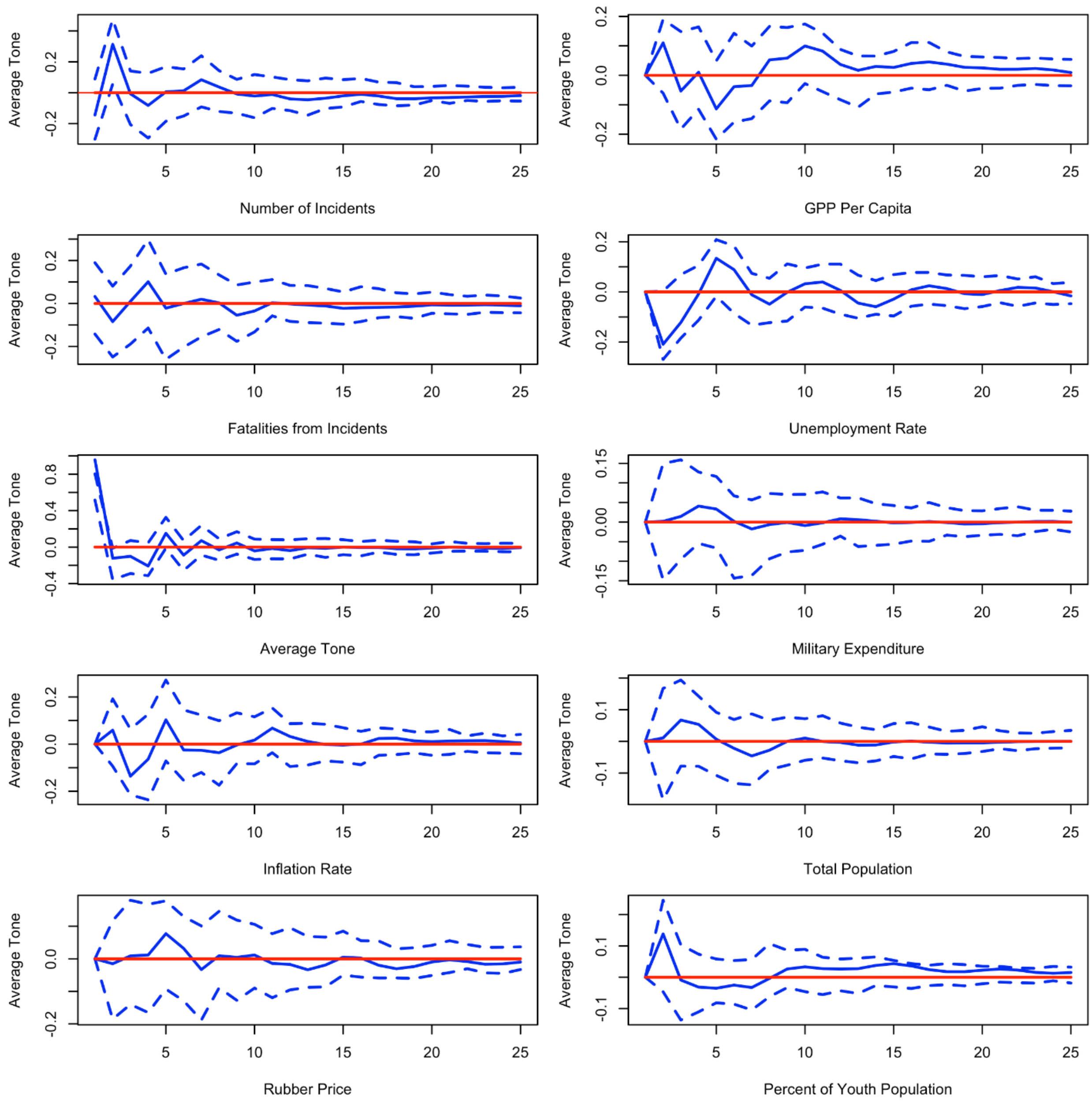


Figure 4-39: Impulse Response Function to Average Tone - VAR Model - Yala Province

In Figure 4-37: Impulse Response Function to Number of Incidents - VAR Model - Yala Province, the IRF of the number of incidents show a statistical significant effect of the number of incidents to itself as the confident intervals do not touch zero line for 2 periods before its trajectory correct itself to the equilibrium. This means that the short-term effect of the last period increase deviated from the equilibrium will lead to the system will correct themselves by the decrease in the next period. It will resume to the equilibrium point within 3 periods or 3 months. However, the speed of adjustment will take only 5 months to resume to the original equilibrium. The other factors are not statistically significant in the IRF estimation for the number of incidents. Most of the series show that the shock in one series will affect the number of incidents by short periods and it will resume to the equilibrium in less than 5 periods. Although the average tone is not statistically significant, but it shows that the effect from its shock tend to stay and have a long positive effect to the number of incidents for 10 months. Additionally, the GPP per capita shows a longer short-term effect since the IRF lasts to 8^{th} period. Nevertheless, the IRF of the GPP per capita is not statistically significant.

For the fatalities from the incidents, the IRF results show that only the fatality rate itself has a significant effect. The shock in the fatality rate in the system in the last period will lead to a dramatic decline in the next period and the series will adjust itself to the equilibrium in 2 periods. The IRF from the number of incidents also shows a short-term effect lasting around 2 periods before the trajectory correct itself and the IRF is statistically significant at 2 periods. The IRF from other variables show similar pattern as shown in the number of incidents. The average tone shows a longer effect against the fatalities from the incidents. Its effect lasts around 10 periods before the adjustment resumes. The effect from other variables tend to last around 5 periods before the fatalities from the incidents resumes to the original path. However, the percent of youth

population show a longer short-term effect to the fatalities from the incidents. The IRF shows the effect prolongs to 15 periods. Nevertheless, neither of these variables are statistically significant.

The IRF for average tone shows that only the average tone itself is statistically significant and its effect lasts less than 5 periods. Other variables show a small and statistically insignificant effect against the average tone and the effects are also not over 5 periods.

Figure 4-40: Fitted Value and Residuals of Number of Incidents from VAR models - Yala Province and Figure 4-41: Fitted Value and Residuals of Fatalities from Incidents from VAR models - Yala Province below show the actual value, the fitted value and the residuals from the models with the number of incidents and the fatalities from the incidents. The forecasting performance of the models is evaluated by using Root Mean Squared Errors (RMSE) on both training and testing dataset. The result is shown in Table 4-10: Predictive Evaluation of VAR Model - Yala Province. The difference between RMSE of the training dataset and the testing dataset is small.

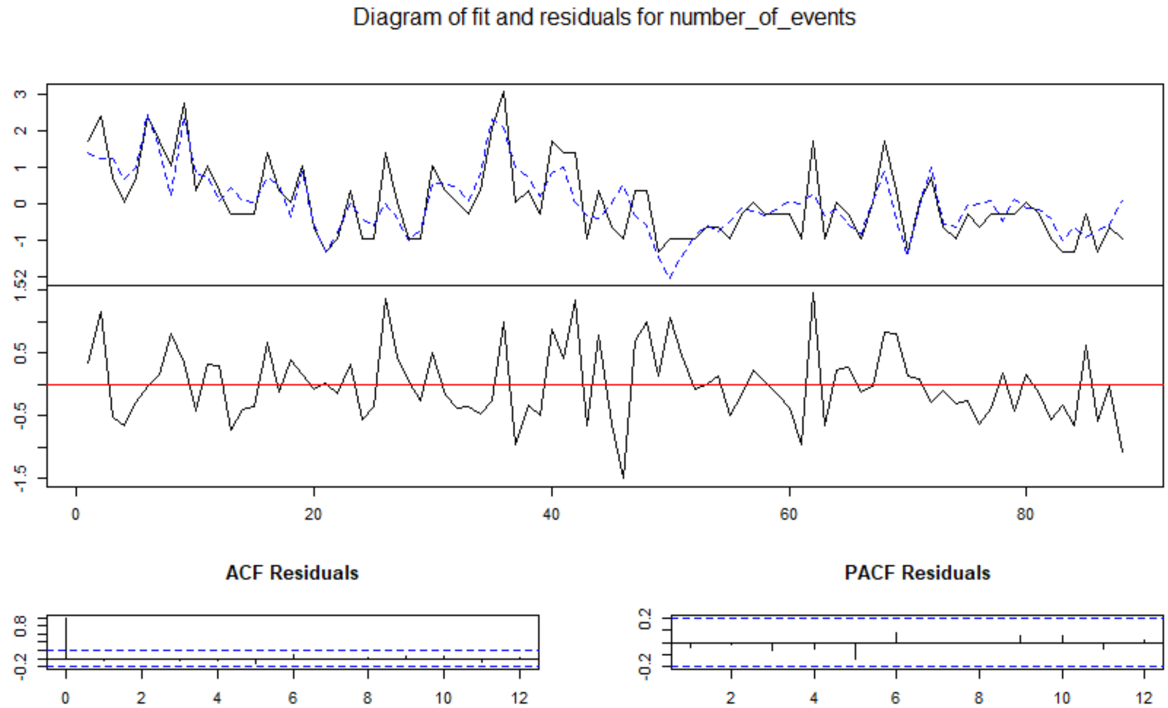


Figure 4-40: Fitted Value and Residuals of Number of Incidents from VAR models - Yala Province

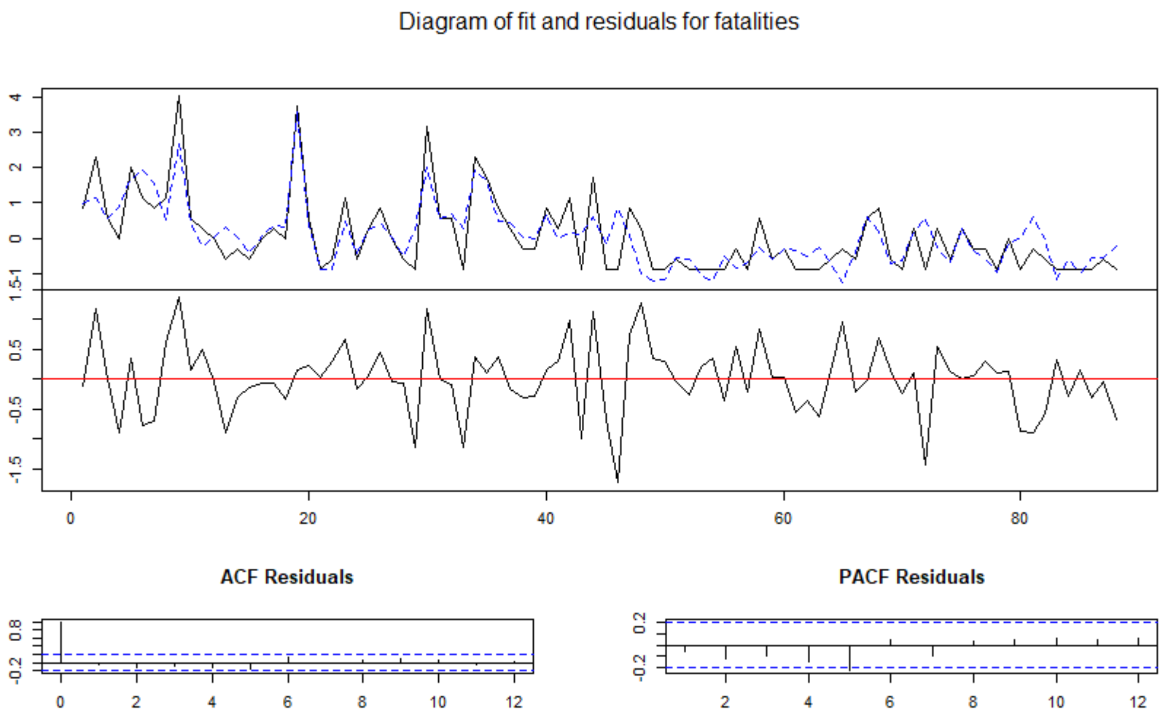


Figure 4-41: Fitted Value and Residuals of Fatalities from Incidents from VAR models - Yala Province

DV	RMSE	
	Training	Testing
Number of Incidents	0.578	0.865
Fatalities from Incidents	0.587	0.743

Table 4-10: Predictive Evaluation of VAR Model - Yala Province

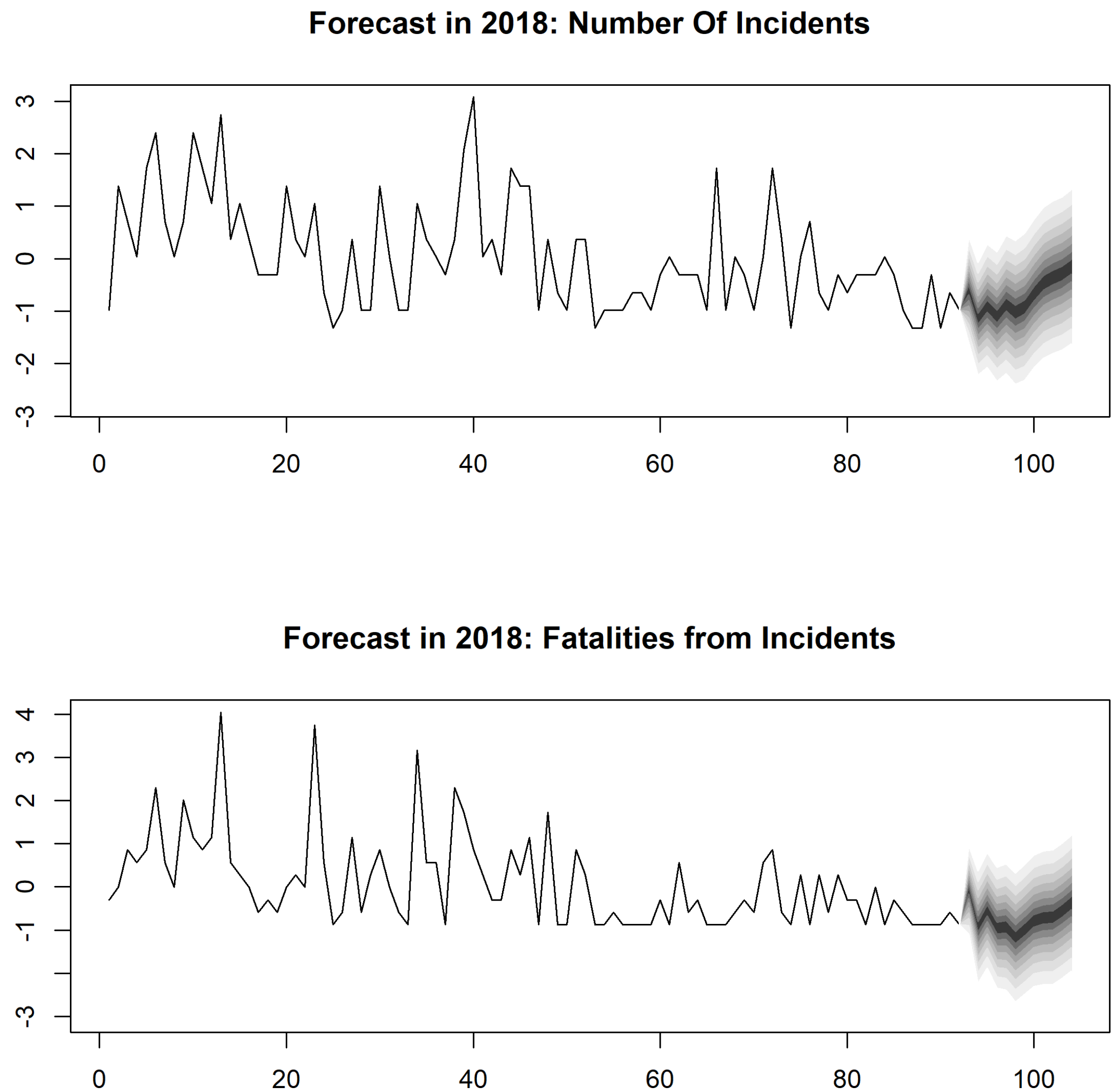


Figure 4-42: Forecasting Result from VAR models - Yala Province

Figure 4-42: Forecasting Result from VAR models - Yala Province shows the forecast value in year 2018 based on the model for the number of incidents and the fatalities from the incidents.

We also perform the stability test for VAR model to ensure its inference ability. The eigenvalues we obtain from the coefficient matrix are strictly less than one in their modulus form. Figure 4-43: Roots of the Companion Matrix - VAR Model - Yala Province visualizes all eigenvalues are within the unit root circle. The result from the stability test confirm that the VAR model is stable and all variables in the model satisfy the stationarity conditions. Then, it can be used for the inference.

We also perform the diagnostic tests on the residuals of the models. Table 4-11: Diagnostics Tests - VAR Model - Yala Province shows that the model does not have a heteroskedasticity problem. However, the models suffer from the serial correlation since the Portmanteau test is significant. We suspect that the serial correlation problem of the residuals is caused by the interpolated variables since their pattern are a smooth function based on different time point. Then, we perform an experiment by running a restricted VAR without the interpolated variables. The result shown in Table 4-12: Diagnostics Tests - VAR Non-interpolated Variable Model - Yala Province confirms our suspicious since the restricted VAR model does not have a serial correlation problem. In addition, the normality assumption of the residuals of the VAR model is violated since all three condition tests of the residuals are statistically significant. Based on the results of the diagnostic tests, the inference from the model must be approached with cautious since the model suffers from the inefficiency of the estimation. However, the model still provides unbiased estimates.

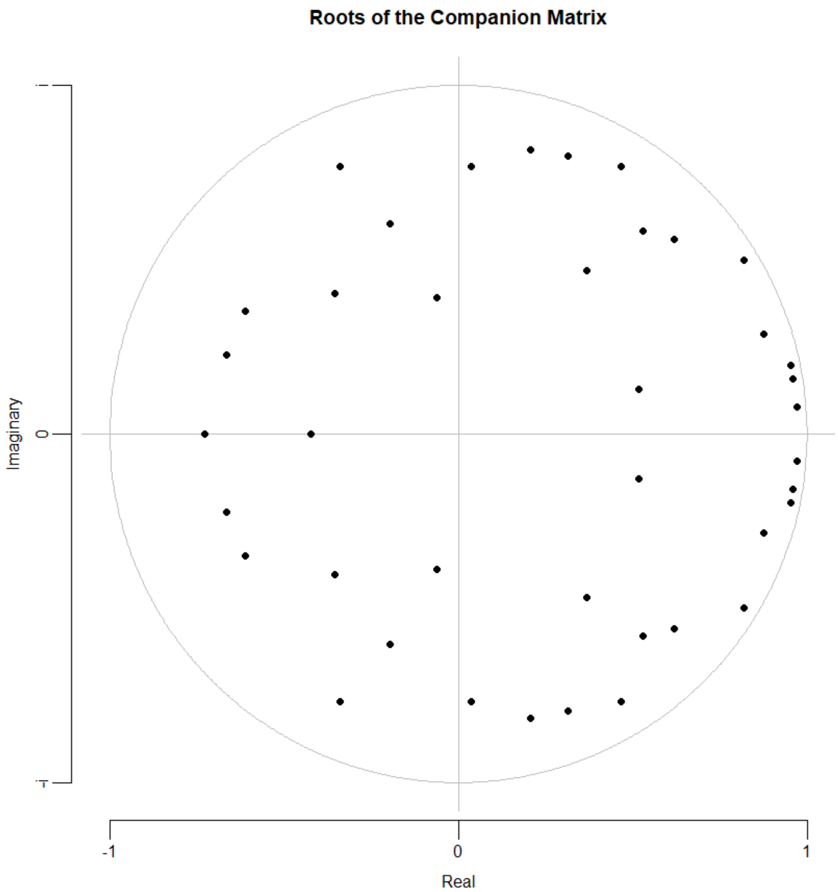


Figure 4-43: Roots of the Companion Matrix - VAR Model - Yala Province

Test	Statistics	D.F.	P-value
Portmanteau	1520.289	1200.000	<0.001
ARCH VAR	4565.000	15125.000	1.000
JB VAR	421.547	20.000	<0.001
Kurtosis	394.630	10.000	<0.001
Skewness	26.917	10.000	0.003

Table 4-11: Diagnostics Tests - VAR Model - Yala Province

Test	Statistics	D.F.	P-value
Portmanteau	217.91	240	0.84
ARCH VAR	488.67	500	0.63
JB VAR	90.56	8	<0.001
Kurtosis	65.05	4	<0.001
Skewness	25.51	4	<0.001

Table 4-12: Diagnostics Tests - VAR Non-interpolated Variable Model - Yala Province

Narathiwat Province

We inspect this dataset to check the stationarity of each variables by using the Augmented Dickey-Fuller test (ADF) to test the stationarity of variables. We observe that the fatalities from the incidents, the number of incidents, and the inflation rate are stationary while the rest of the variables are needed to use difference order to address the trend and change in the levels. We, thus, proceed to transform the data by using the first order difference on the non-stationary series and test the differenced series with ADF test again. We found that GPP per capita, military expenditure, and total population are needed to use more than one order of difference to make these variables stationary. The details of the ADF test and number of difference order for each variable are presented in Table 4-13: The Result from Augmented Dickey-Fuller Test - Narathiwat Province.

The data for Narathiwat Province is also visualized in Figure 4-44: Narathiwat Data before Stationary Test to show the characteristics of each variable. After the ADF test and the process of differencing the series based on the ADF test as shown in the table above, Figure 4-45: Narathiwat Data After Stationary Test illustrates the outcome of the transformation when every series is stationary.

After we transform the data and we test the data that all series are stationary, we proceed to use the lag order selection test for VAR model to select the optimal number of lag order for the VAR model with AIC as a selection information criterion. For the Narathiwat province dataset, we will include variables with up to lag order 4 variables in the models since the AIC of the lag order 4 is the smallest among other lag orders tested in this process. The result of selection test is

shown in Table 4-14: The Result of Lag Order Selection Test for VAR model – Narathiwat Province.

Variable	Order of Difference	Dickey Fuller Statistics	P-Value
Fatalities from Incidents	0	-3.60	0.04
Number of Incidents	0	-3.62	0.04
Average Tone	0	-2.79	0.25
	1	-6.29	0.01
Inflation Rate	0	-4.09	0.01
Rubber Price	0	-2.45	0.39
	1	-4.50	0.01
GPP Per Capita	0	-2.32	0.45
	1	-2.43	0.40
	2	-3.57	0.04
Unemployment Rate	0	-1.82	0.65
	1	-5.45	0.01
Military Expenditure	0	-1.98	0.58
	1	-2.89	0.21
	2	-2.88	0.21
	3	-2.76	0.26
	4	-3.73	0.03
Total Population	0	-2.53	0.36
	1	-3.26	0.08
	2	-3.63	0.04
Percent of Youth Population	0	-2.37	0.42
	1	-3.52	0.04

Table 4-13: The Result from Augmented Dickey-Fuller Test - Narathiwat Province

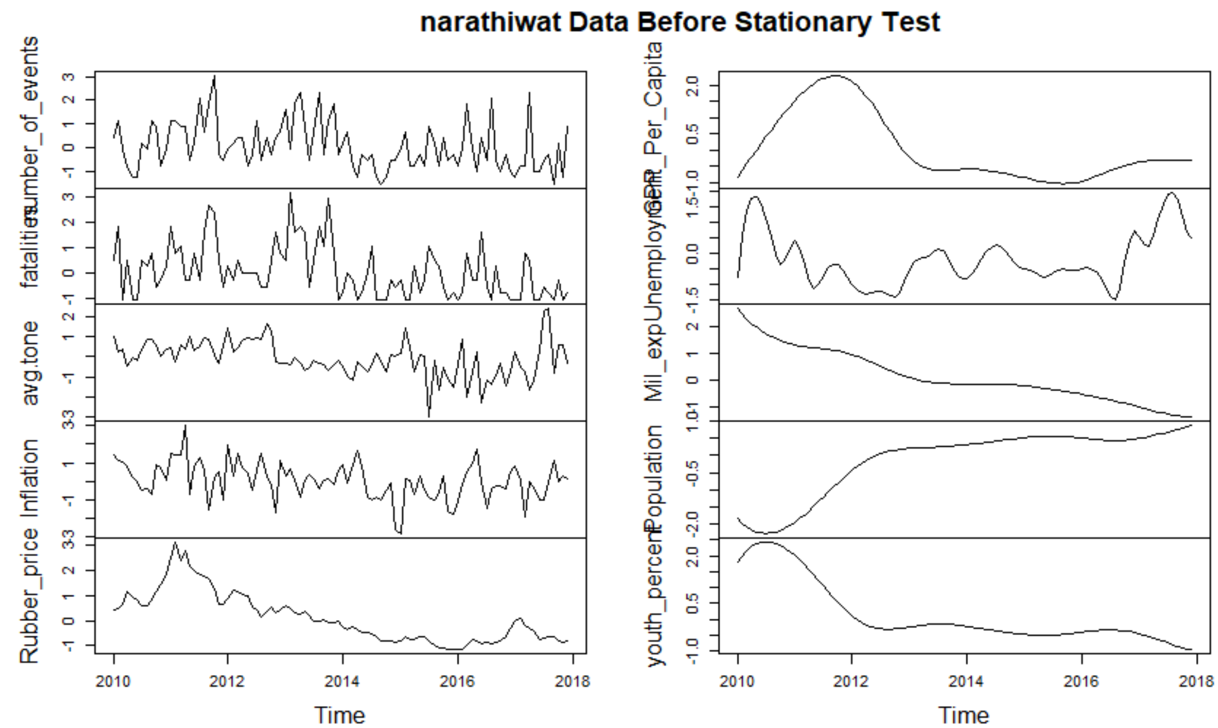


Figure 4-44: Narathiwat Data before Stationary Test

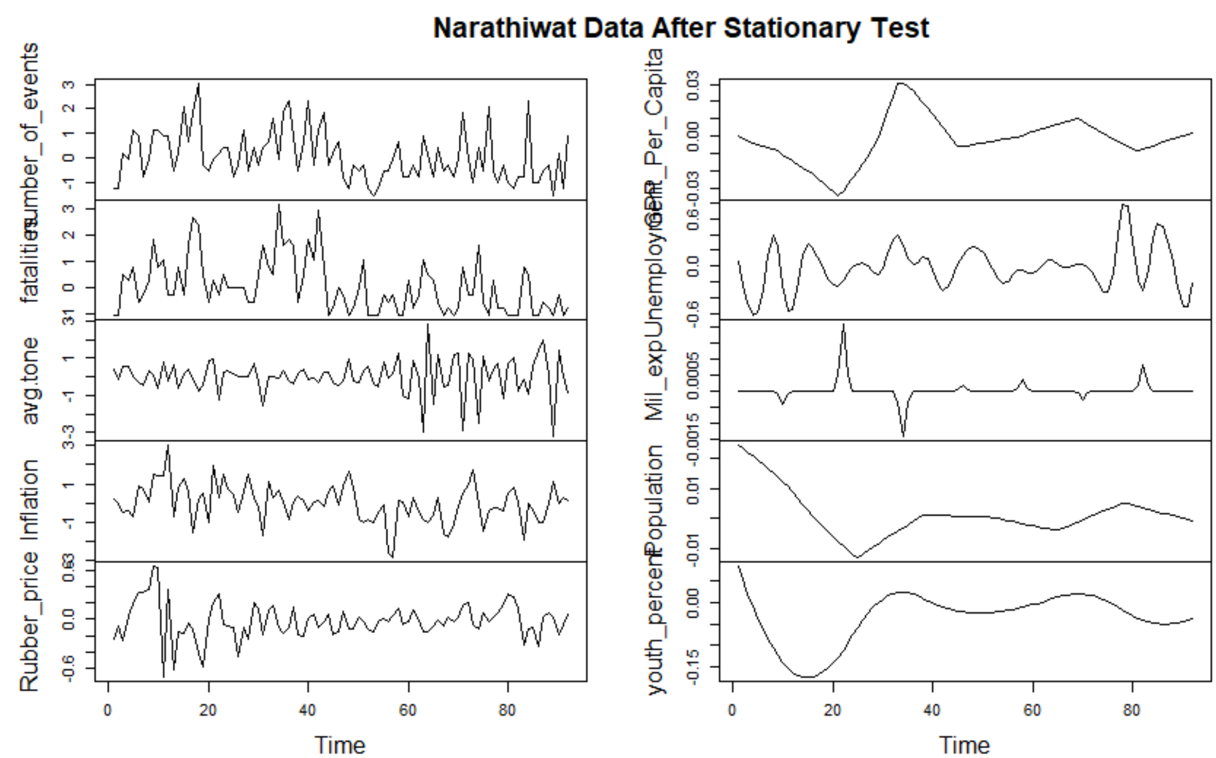


Figure 4-45: Narathiwat Data After Stationary Test

Lag Order	AIC	HQ	SC	FPE
1	-65.80	-64.55	-62.70	0.00
2	-74.22	-71.84	-68.31	0.00
3	-76.71	-73.19	-67.98	0.00
4	-77.30	-72.65	-65.76	0.00

Table 4-14: The Result of Lag Order Selection Test for VAR model – Narathiwat Province

After the optimal number of the lag order operator for the VAR model is tested, we run the VAR model with lag order 4. The result is shown in Table 0-6: VAR Results - Narathiwat Province in the Appendix section. The result shows that for the number of incidents, the 1st lag order of the number of incidents, the 1st order lag fatalities from incidents, the 2nd lag order of the number of incidents, the 2nd order lag military expenditure and the 4th order lag GPP per capita are statistically significant at 99%, 95%, 95%, 95% and 95% confidence level respectively. For the fatalities from the incidents, only the 2nd order lag inflation rate, and the 4th order lag rubber price are statistically significant at 99, and 90% confidence level, respectively. For the average tone, the average tone in 1st, 2nd, and 3rd lag order are statistically significant at 99%, 99% and 95% confidence level respectively. The 2nd order lag inflation rate is also statistically significant at 95% confidence level. All coefficients presented in the table are standardized. All the sub-models in the VAR model except inflation rate model are statistically significant.

To interpret the result, we use the Impulse Response Function (IRF) to estimate the short-term effect of one series to the other variables. In this study, we will focus on the three main variables: the number of incidents, the fatalities from the incidents and the average tone which are

presented below. For the full IRF plots with every variable, we present the IRF plots in the Appendix section.

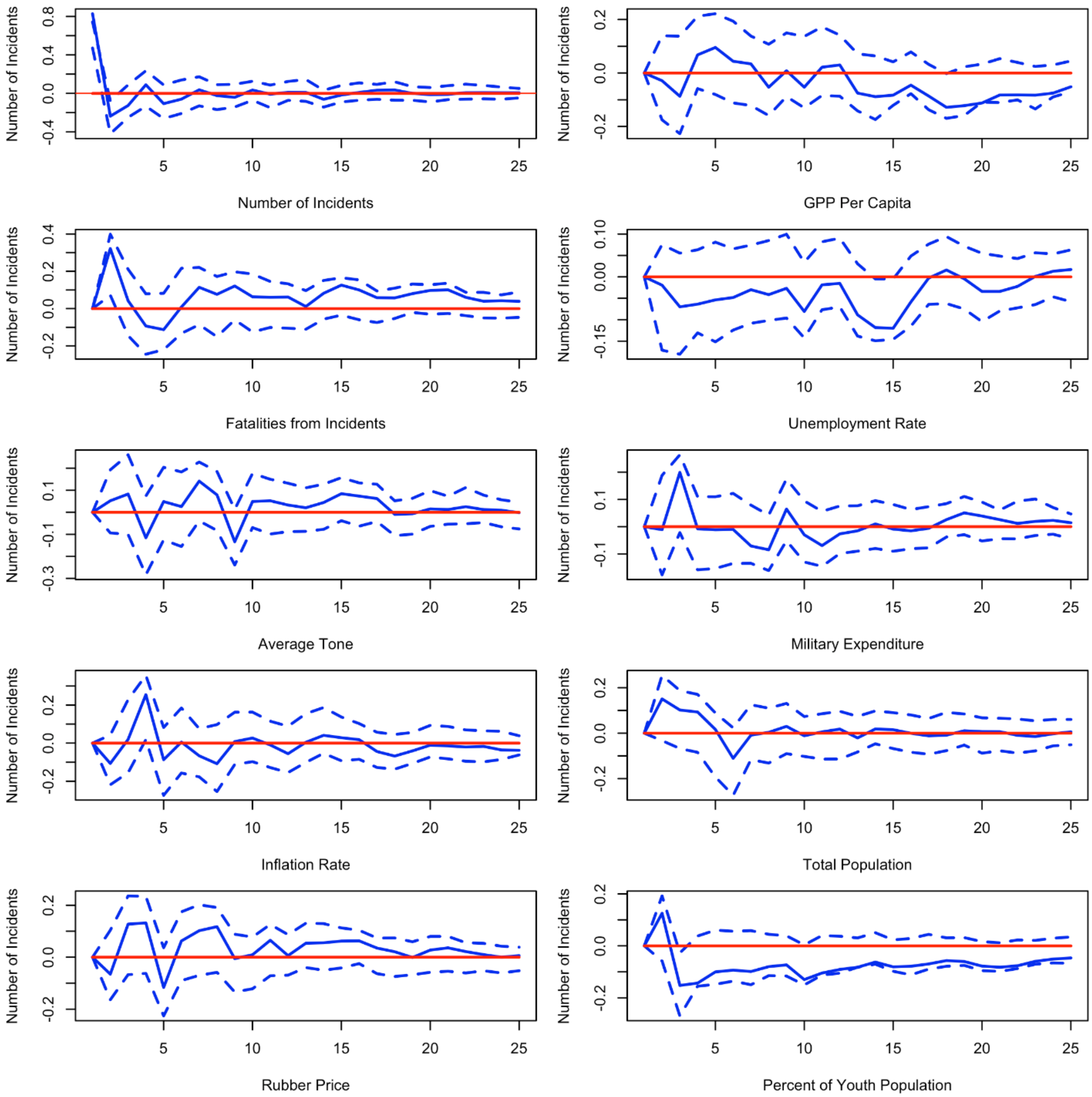


Figure 4-46: Impulse Response Function to Number of Incidents - VAR Model - Narathiwat Province

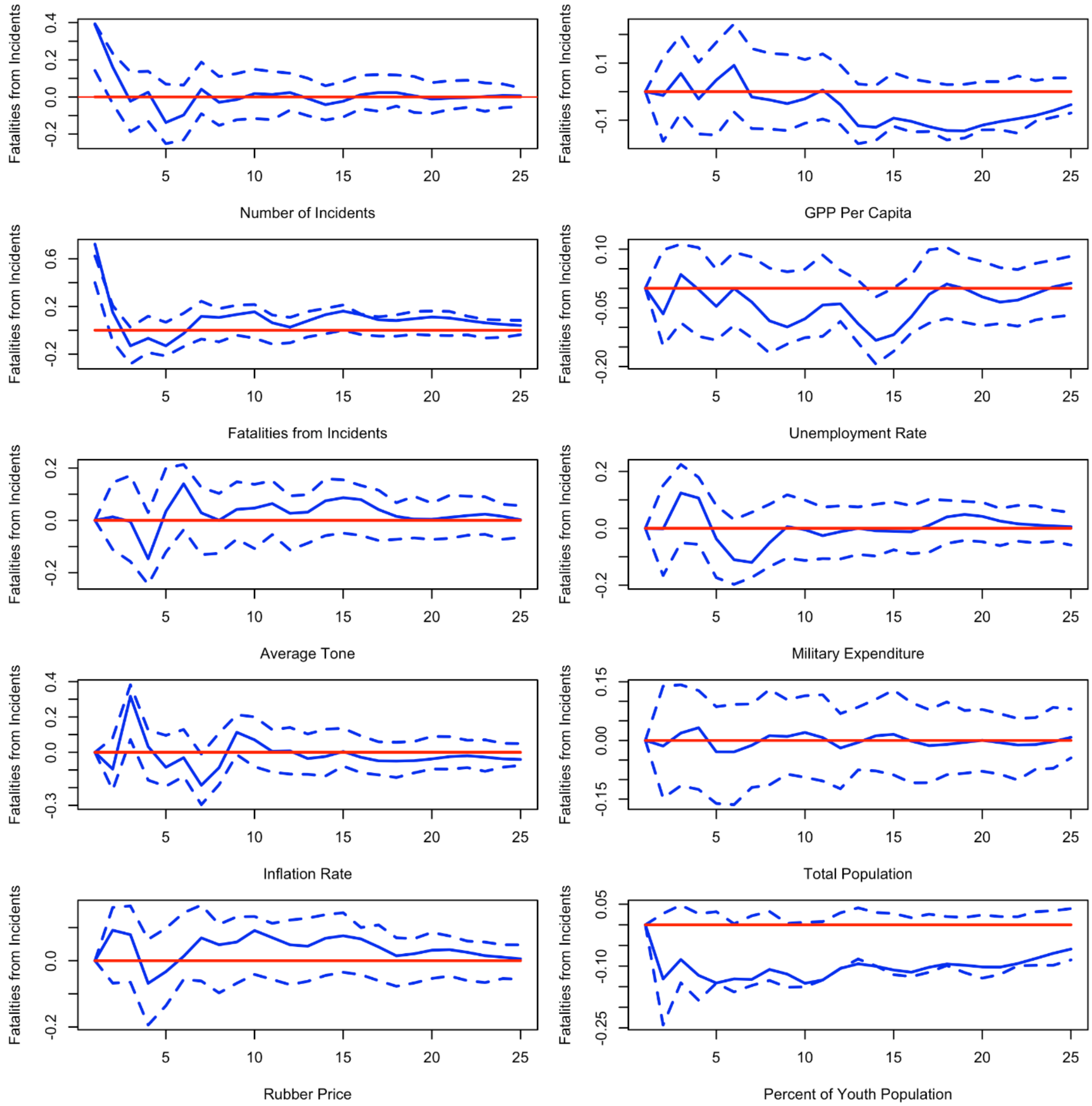


Figure 4-47: Impulse Response Function to Fatalities from Incidents - VAR Model - Narathiwat Province

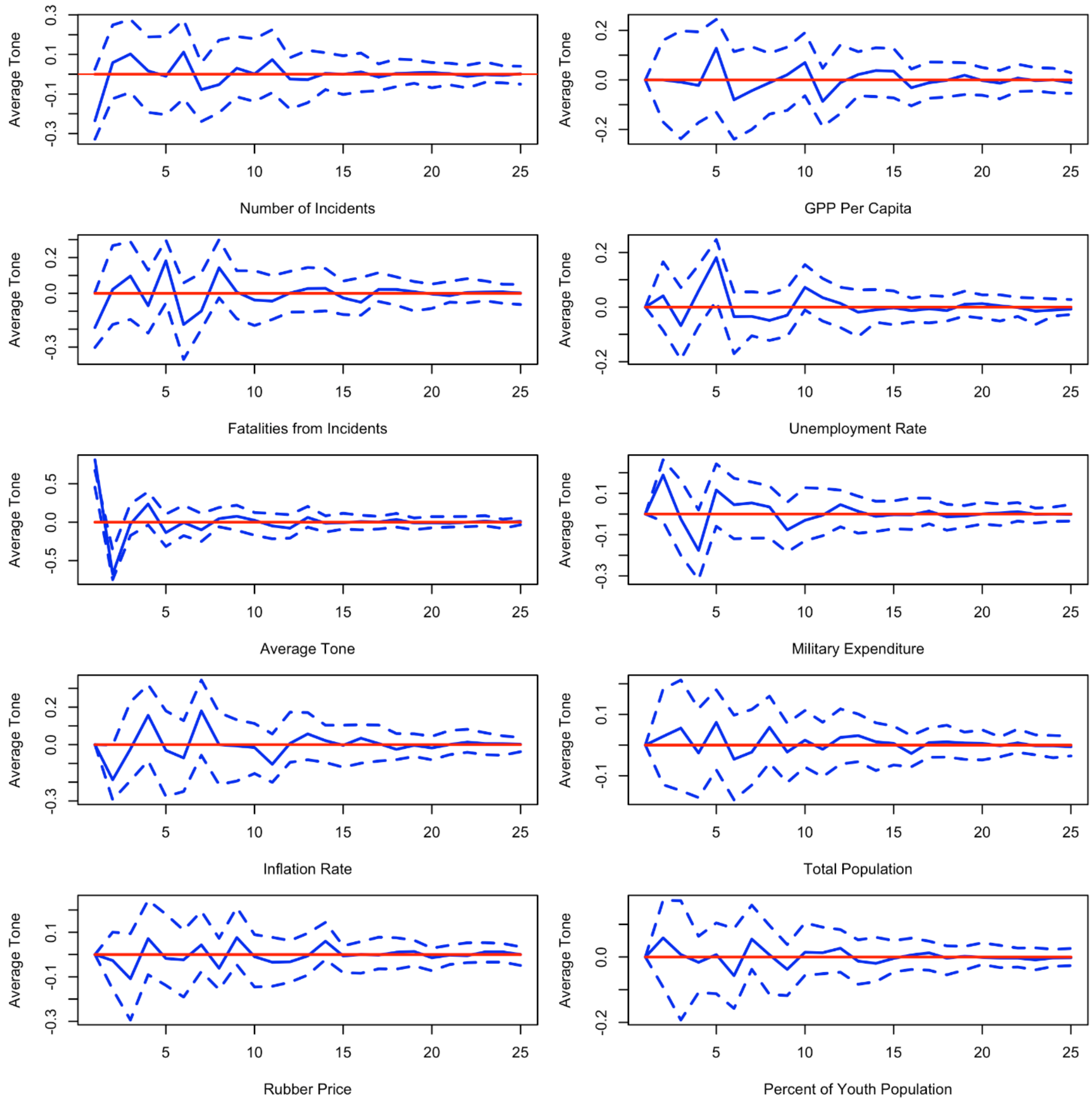


Figure 4-48: Impulse Response Function to Average Tone - VAR Model - Narathiwat Province

In Figure 4-46: Impulse Response Function to Number of Incidents - VAR Model - Narathiwat Province, the IRF of the number of incidents show a statistical significant effect of the number of incidents to itself as the confident intervals do not touch zero line for 2 periods before its trajectory correct itself to the equilibrium. This means that the short-term effect of the last period increase deviated from the equilibrium will lead to the system will correct themselves by the decrease in the next period. It will resume to the equilibrium point within 3 periods or 3 months. However, the speed of adjustment will take only 5 months to resume to the original equilibrium. The fatalities from the incidents is also statistically significant at 2 periods. The effect of the shock from the fatalities will influence the number of incidents by increasing the number of incidents for 2 periods before it reduces and corrects itself within 5th period. The other factors are not statistically significant in the IRF estimation for the number of incidents. Most of the series show that the shock in one series will affect the number of incidents by short periods and it will resume to the equilibrium in less than 5 periods. Although the unemployment rate is not statistically significant, but it shows that the effect from its shock tend to stay and have a long positive effect to the number of incidents for more than 15 months. Additionally, the percent of youth population shows a longer effect since the IRF lasts to 25th period. Nevertheless, the IRF of the percent of youth population is not statistically significant.

For the fatalities from the incidents, the IRF results show that the fatality rate itself has a significant effect. The shock in the fatality rate in the system in the last period will lead to a dramatic decline in the next period and the series will adjust itself to the equilibrium in 5 periods. The IRF from the number of incidents also shows a statistically significant short-term effect lasting around 2 periods before the trajectory correct itself and the IRF is statistically significant at 2 periods. The direction of the effect is negative which means the shock in the number of the

incidents will influence the decline in the fatalities of the incident before the fatalities from the incidents resume its equilibrium within 5 periods. The military expenditure shows a longer effect against the fatalities from the incidents. Its effect lasts around 10 periods before the adjustment resumes. The effect from other variables tend to last around 5 periods before the fatalities from the incidents resumes to the original path. However, the GPP per capita and percent of youth population show a longer effect to the fatalities from the incidents. The IRF from these two variables show the effect prolongs to 25 periods and the trajectory does not resume to the equilibrium. Nevertheless, neither of these variables are statistically significant.

The IRF for average tone shows that only the average tone itself is statistically significant and its effect lasts less than 5 periods. Other variables show a small and statistically insignificant effect against the average tone and the effects are also not over 5 periods.

Figure 4-49: Fitted Value and Residuals of Number of Incidents from VAR models - Narathiwat Province and Figure 4-50: Fitted Value and Residuals of Fatalities from Incidents from VAR models - Narathiwat Province below show the actual value, the fitted value and the residuals from the models with the number of incidents and the fatalities from the incidents. The forecasting performance of the models is evaluated by using Root Mean Squared Errors (RMSE) on both training and testing dataset. The result is shown in Table 4-15: Predictive Evaluation of VAR Model - Narathiwat Province. The difference between RMSE of the training dataset and the testing dataset is small.

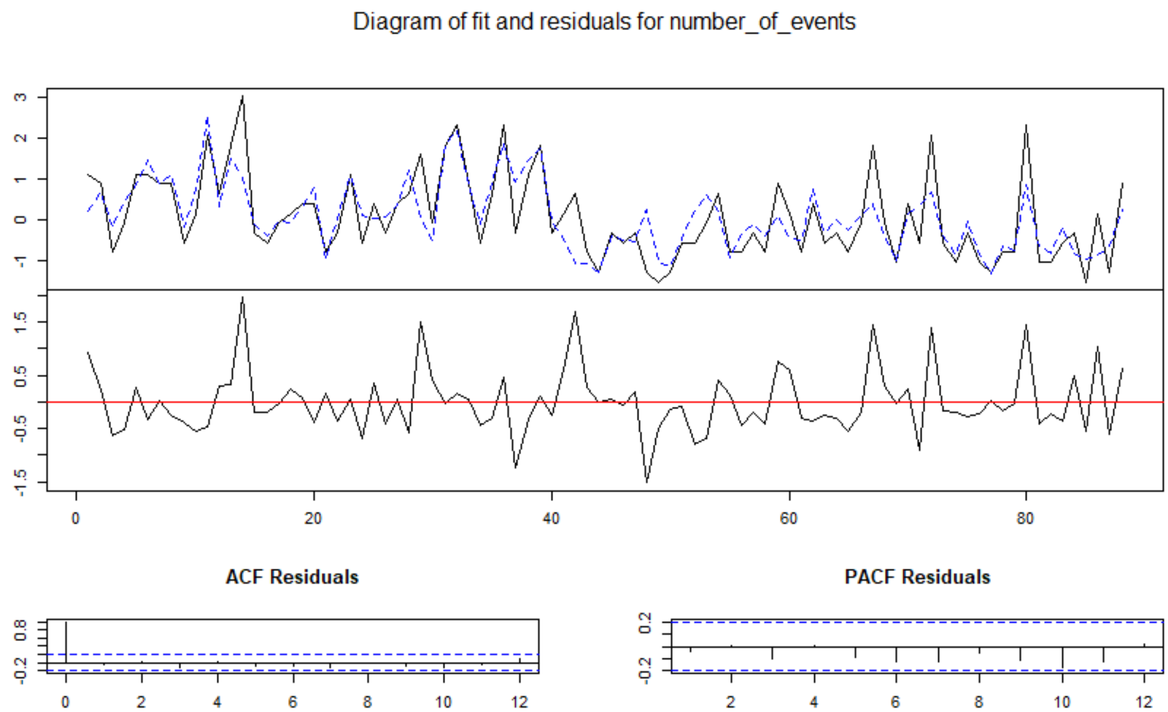


Figure 4-49: Fitted Value and Residuals of Number of Incidents from VAR models - Narathiwat Province

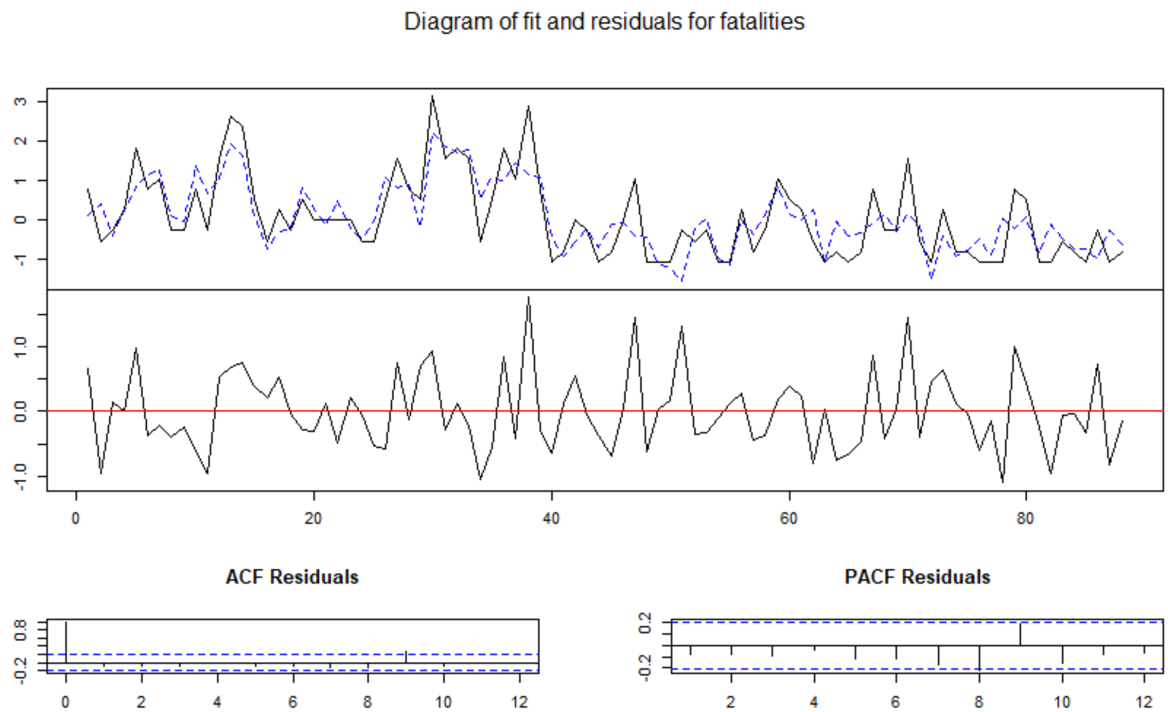


Figure 4-50: Fitted Value and Residuals of Fatalities from Incidents from VAR models - Narathiwat Province

DV	RMSE	
	Training	Testing
Number of Incidents	0.605	0.863
Fatalities from Incidents	0.600	0.843

Table 4-15: Predictive Evaluation of VAR Model - Narathiwat Province

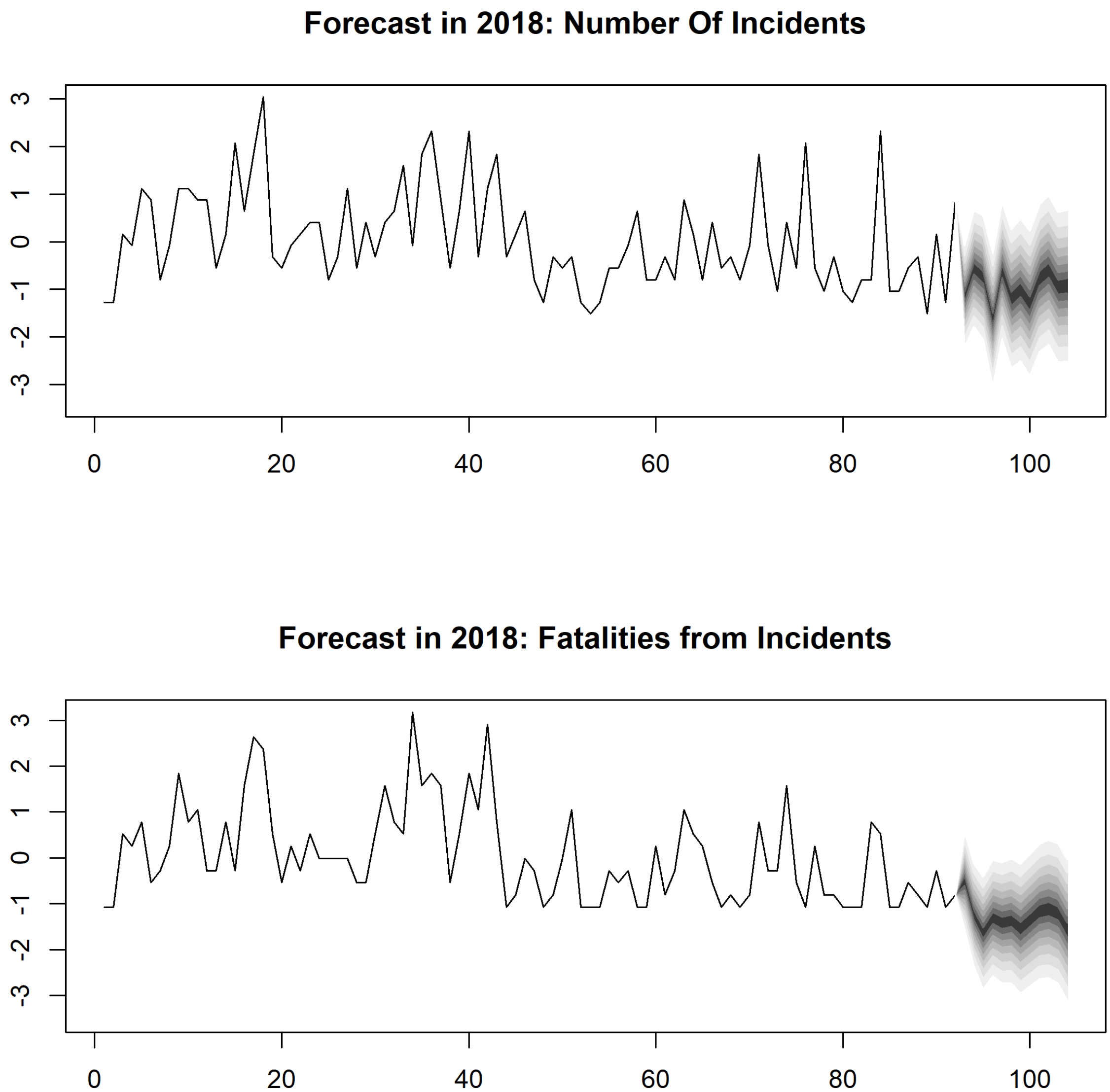


Figure 4-51: Forecasting Result from VAR models - Narathiwat Province

Figure 4-51: Forecasting Result from VAR models - Narathiwat Province shows the forecast value in year 2018 based on the model for the number of incidents and the fatalities from the incidents.

We also perform the stability test for VAR model to ensure its inference ability. The eigenvalues we obtain from the coefficient matrix are strictly less than one in their modulus form. Figure 4-52: Roots of the Companion Matrix - VAR Model - Narathiwat Province visualizes all eigenvalues are within the unit root circle. The result from the stability test confirm that the VAR model is stable and all variables in the model satisfy the stationarity conditions. Then, it can be used for the inference.

We also perform the diagnostic tests on the residuals of the models. Table 4-16: Diagnostics Tests - VAR Model - Narathiwat Province shows that the model does not have a heteroskedasticity problem. However, the models suffer from the serial correlation since the Portmanteau test is significant. We suspect that the serial correlation problem of the residuals is caused by the interpolated variables since their pattern are a smooth function based on different time point. Then, we perform an experiment by running a restricted VAR without the interpolated variables. The result shown in Table 4-17: Diagnostics Tests - VAR Non-interpolated Variable Model - Narathiwat Province confirms our suspicious since the restricted VAR model does not have a serial correlation problem. In addition, the normality assumption of the residuals of the VAR model is violated since all three condition tests of the residuals are statistically significant. Based on the results of the diagnostic tests, the inference from the model must be approached with cautious since the model suffers from the inefficiency of the estimation. However, the model still provides unbiased estimates.

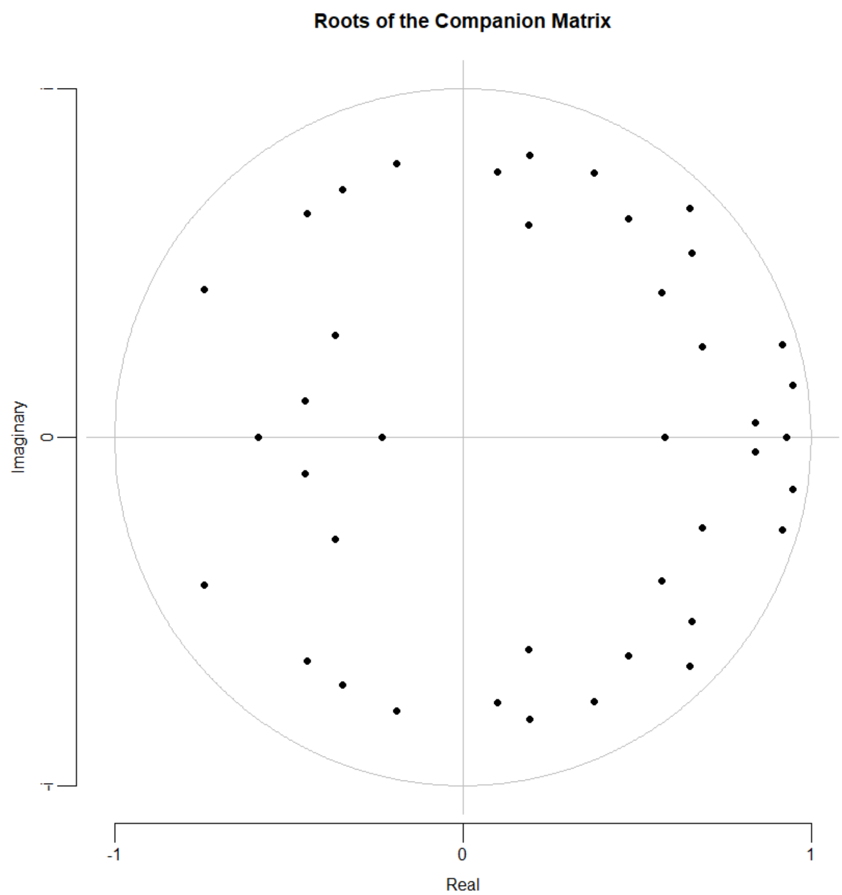


Figure 4-52: Roots of the Companion Matrix - VAR Model - Narathiwat Province

Test	Statistics	D.F.	P-value
Portmanteau	1391.402	1200.000	<0.001
ARCH VAR	4565.000	15125.000	1.000
JB VAR	421.547	20.000	<0.001
Kurtosis	394.630	10.000	<0.001
Skewness	26.917	10.000	0.003

Table 4-16: Diagnostics Tests - VAR Model - Narathiwat Province

Test	Statistics	D.F.	P-value
Portmanteau	179.65	240	0.99
ARCH VAR	514.80	500	0.31
JB VAR	90.56	8	<0.001
Kurtosis	65.05	4	<0.001
Skewness	25.51	4	<0.001

Table 4-17: Diagnostics Tests - VAR Non-interpolated Variable Model - Narathiwat Province

Vector Error Correction Models

Pattani Province

We use Johansen Procedure to test for cointegration and identify the cointegration rank before we model VECM for Pattani dataset. For this test, we will use number of lag order that we use in VAR estimation at lag order 4. The initial result is shown in Table 0-7: The Result from Johansen Cointegration Test – VECM with 10 Variables - Pattani Province in the Appendix section. The test procedure shows that the series have a rank cointegration at 9 since we can reject the null hypothesis for every number of rank up until the hypothesis of rank number equal or less than 9 at 99% confidence level. This result shows a warning sign that the VECM model may not be appropriate the dataset since the cointegration components may have a full rank ($r = 10$) in the dataset. Unfortunately, the Johansen procedure does not provide the result of rank test with rank equal or less than 10. We suspect that this problem arises since one of the assumptions of the VECM model is the series is $I(1)$ process or the first difference of the series must be $I(0)$ process. However, based on the Augmented Dickey-Fuller test in VAR section, there are 3 variables which are not $I(1)$ process. GPP per capita and the total population is $I(2)$ process, while the military expenditure is $I(4)$ process. Thus, we decide to not include these three variables in the VECM as an endogenous variable, but these three variables are used as an exogenous variable.

The result from Johansen Procedure with 7 endogenous variables and 3 exogenous variables is shown in Table 4-18: The Result from Johansen Cointegration Test - Pattani Province. Based on the result, we can reject the null hypotheses up until $r <= 4$ but we cannot reject the

null hypothesis at $r <= 5$. So, rank number at 4 is chosen to be used in the VECM modeling process.

	Johansen Test-Statistics	X10pct	X5pct	X1pct
r <= 6 |	9.86	7.52	9.24	12.97
r <= 5 |	14.84	13.75	15.67	20.20
r <= 4 |	27.24	19.77	22.00	26.81
r <= 3 |	35.59	25.56	28.14	33.24
r <= 2 |	47.85	31.66	34.40	39.79
r <= 1 |	69.31	37.45	40.30	46.82
r = 0 |	84.88	43.25	46.45	51.91

Table 4-18: The Result from Johansen Cointegration Test - Pattani Province

The result of VECM estimation is shown in Table 0-8: VECM Results - Pattani Province in the Appendix section. Since the cointegration rank is identified at 4 ranks from the Johansen procedure test, the model will contain 4 error correction terms (noted as ect_r) in the model. The composition and the coefficients for each error correction terms are shown in Table 0-9: The Error Correction Term Composition Table - Pattani Province. The error correction terms can be constructed as the equation below.

$$ect_r = \begin{bmatrix} 1 & 0 & 0 & 0 & -5.97 & 8.26 & 2.21 & 2.69 \\ 0 & 1 & 0 & 0 & -2.11 & 1.95 & -2.15 & -0.58 \\ 0 & 0 & 1 & 0 & 0.33 & -0.50 & -2.65 & -0.20 \\ 0 & 0 & 0 & 1 & -1.50 & 3.11 & -8.12 & -1.45 \end{bmatrix} * \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \\ Y_7 \\ \nu \end{bmatrix} \quad (4\text{-}2)$$

The ect_r is a matrix $(n * r)$ of the error correction terms where n represents the number of observation and r represent the number of selected ranks. The first matrix component of the function is the coefficients inside the error correction function. Y_p represents the vectors of the variables in the models where, in this model, we have 7 variables. ν represents the constant and time trend adjustment.

The equation (4-2) shows the full construction of the error correction. If we rewrite the error correction terms with only the statistically significant variables, we can get the following function for the first error correction term.

$$ect_1 = Y_{1,t-4} - 5.97Y_{5,t-4} + 8.62Y_{6,t-4} - 2.69\nu \quad \text{(4-3)}$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the number of incidents is influenced by the rubber price and the unemployment. If the rubber price increases by 1 standard deviation, the number of incidents is expected to be decreased by almost 6 standard deviation. On the other hand, if the unemployment increases by 1 standard deviation, the number of incidents is expected to be increased by 8.62 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_2 = Y_{2,t-4} - 2.11Y_{5,t-4} + 1.95Y_{6,t-4} - 2.15Y_{7,t-4} - 0.56\nu \quad \text{(4-4)}$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the fatalities from incidents is influenced by the rubber price, the unemployment rate and the percent of youth population. If the rubber price increases by 1 standard deviation, the fatalities from incidents is expected to be decreased by 2.11 standard deviation. On the other hand,

if the unemployment increases by 1 standard deviation, the fatalities from incidents is expected to be increased by almost 2 standard deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the fatalities from incidents is expected to be decreased by 2.15 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_3 = Y_{3,t-4} + 0.33Y_{5,t-4} - 0.5Y_{6,t-4} - 2.65Y_{7,t-4} - 0.21\nu \quad (4\text{-}5)$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the average tone is influenced by the rubber price, the unemployment rate and the percent of youth population. If the rubber price increases by 1 standard deviation, the average tone is expected to be increased by 0.33 standard deviation. On the other hand, if the unemployment increases by 1 standard deviation, the average tone is expected to be decreased by 0.5 standard deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the average tone is expected to be decreased by 2.65 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_4 = Y_{4,t-4} - 1.50Y_{5,t-4} + 3.11Y_{6,t-4} - 8.12Y_{7,t-4} - 1.45\nu \quad (4\text{-}6)$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the inflation rate is influenced by the rubber price, the unemployment rate and the percent of youth population. If the rubber price increases by 1 standard deviation, the inflation rate is expected to be decreased by 1.5 standard deviation. On the other hand, if the unemployment increases by 1 standard deviation, the inflation rate is expected to be increased by 3.11 standard

deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the inflation rate is expected to be decreased by 8.12 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

Table 0-8: VECM Results - Pattani Province in the Appendix section shows the result of the estimation by VECM model. In summary, the number of incidents model shows that only the 2^{nd} error correction term is statistically significant at 95% confidence level. The beta coefficients are -1.056. That means the speed of adjustment from the long-term relationship of the disequilibrium from the 2^{nd} error correction term will be corrected to the equilibrium path in one period. For the short-term adjustment, the 1^{st} order lag of the number of incidents, the 2^{nd} order lag of the number of incidents, the ^{2nd} order lag of the fatalities from incidents, the 3^{rd} order lag of the fatalities from incidents, and the 3^{rd} order lag of the rubber price are statistically significant at 95%, 99%, 90%, 95%, 95% and 95% confidence level respectively. The adjusted R-squared for the number of incidents model is at 0.348 and the model is overall statistically significant at 99% confidence level.

For the fatalities from the incidents, all error correction terms are statistically significant. The beta coefficients are 0.59, -2.03, -0.58, and -0.51 for the 1^{st}, 2^{nd}, 3^{rd} and 4^{th} terms. That means the speed of adjustment from the long-term relationship of the disequilibrium from error correction terms will be corrected to the equilibrium path in roughly 2, 0.5, 2 and 2 periods, respectively. For the short-term adjustment, the total population, the 1^{st} order lag of the number of incidents, the 1^{st} order lag of the fatalities from incidents, the 1^{st} order lag of the inflation rate, the 1^{st} order lag of the rubber price, the 1^{st} order lag of the percent of youth population, the 2^{nd} order lag of the number of incidents, the ^{2nd} order lag of the fatalities from incidents, the ^{2nd} order lag of the percent of youth population, the 3^{rd} order lag of the number of incidents, the 3^{rd} order lag of the fatalities from

incidents, the 3^{rd} order lag of the average tone, the 3^{rd} order lag of the inflation rate, the 3^{rd} order lag of the rubber price, and the 3^{rd} order lag of the percent of youth population are statistically significant. The adjusted R-squared for the number of incidents model is at 0.67 and the model is overall statistically significant at 99% confidence level.

For the average tone, only 3^{rd} error corrections term is statistically significant at 99% confidence level. The beta coefficients are -1.69. That means the speed of adjustment from the long-term relationship of the disequilibrium from error correction term will be corrected to the equilibrium path in roughly 0.5 period, respectively. For the short-term adjustment, the total population, the 1^{st} order lag of the average tone, the 1^{st} order lag of the percent of youth population, the 2^{nd} order lag of the average tone, the ^{2nd} order lag of the percent of youth population, the 3^{rd} order lag of the average tone, and the 3^{rd} order lag of the percent of youth population are statistically significant. The adjusted R-squared for the number of incidents model is at 0.45 and the model is overall statistically significant at 99% confidence level.

All estimated models in VECM are statistically significant at 99% confidence level.

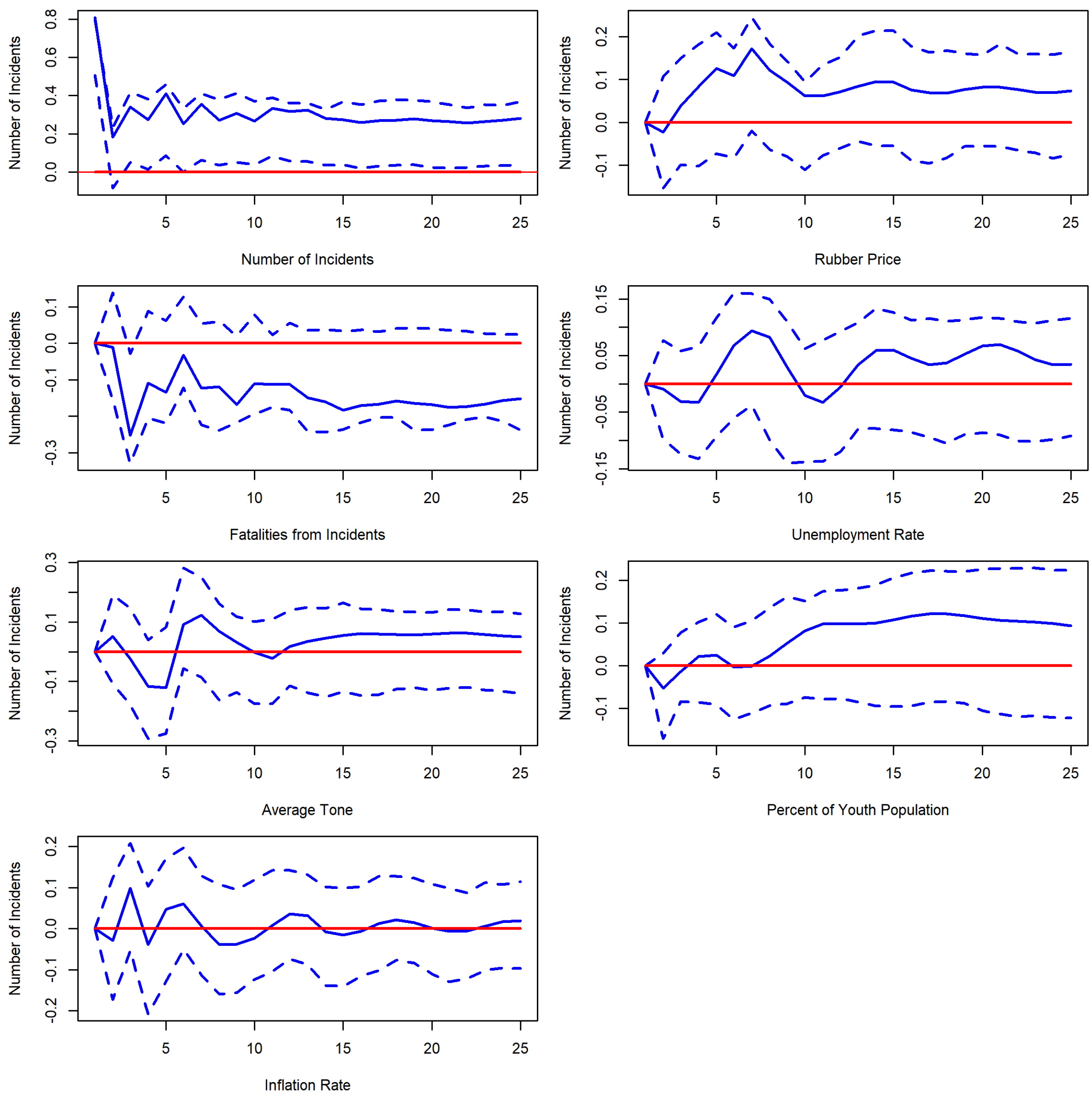


Figure 4-53: Impulse Response Function to Number of Incidents - VECM Model - Pattani Province

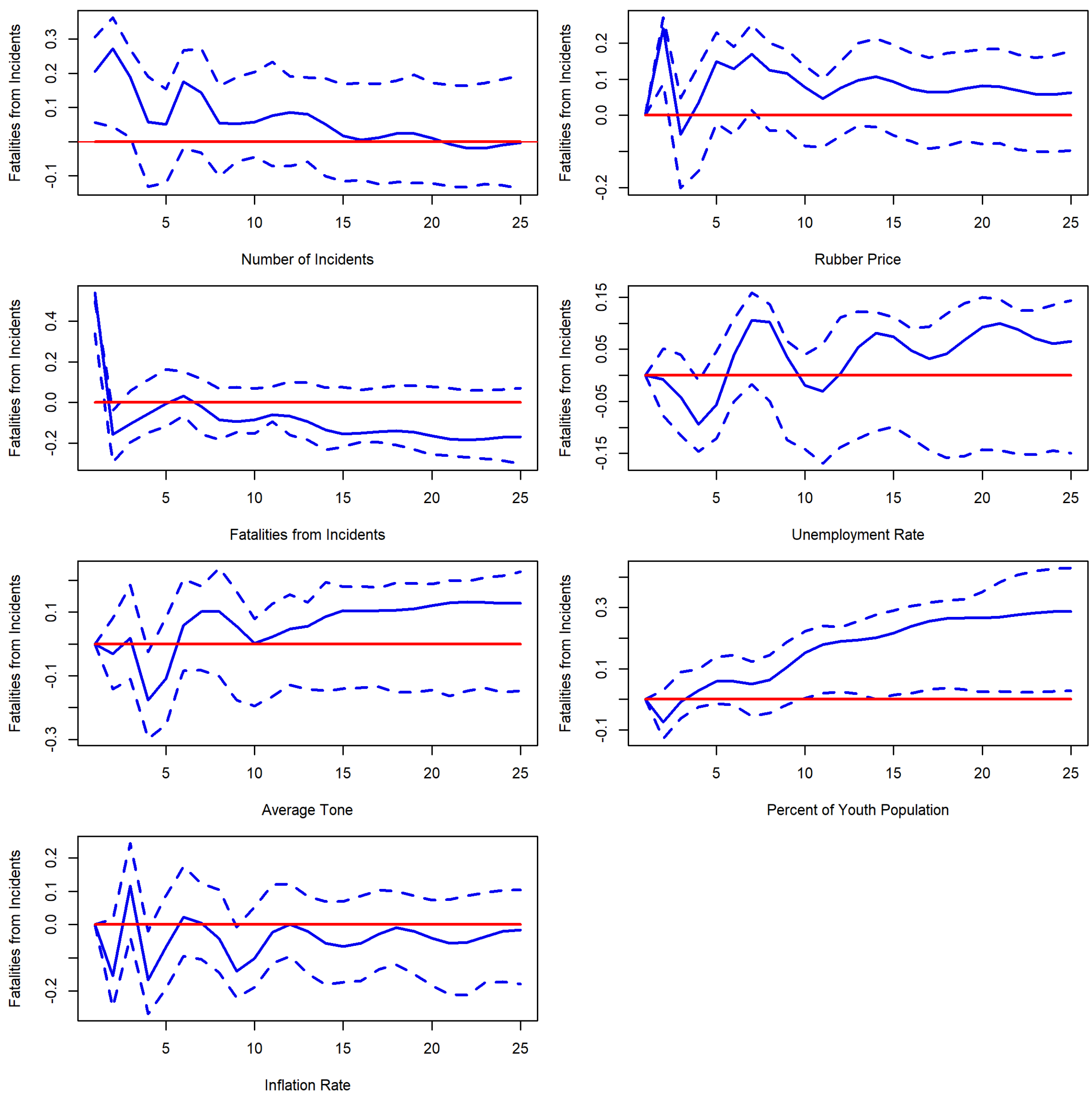


Figure 4-54: Impulse Response Function to Fatalities from Incidents - VECM Model - Pattani Province

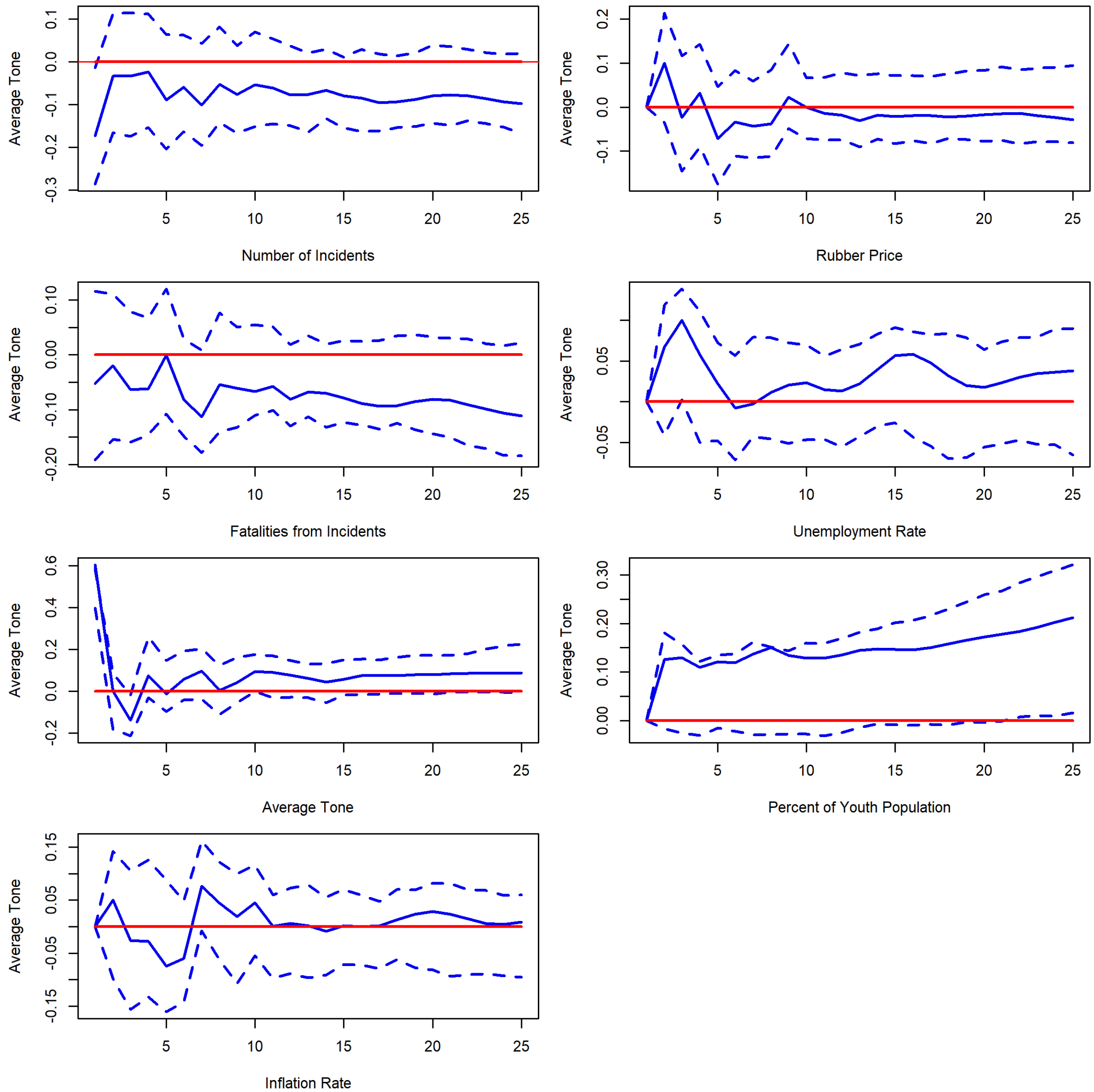


Figure 4-55: Impulse Response Function to Average Tone - VECM Model - Pattani Province

In Figure 4-53: Impulse Response Function to Number of Incidents - VECM Model - Pattani Province, the IRF of the number of incidents show a statistical significant effect of the number of incidents to itself as the confident intervals do not touch zero line for 2 periods before the confidence interval touch zero line. This means that the shock from the number of incidents will decrease the number of incidents itself within 2 period. After the decline, we observe that the effect of the shock stays permanently and has a positive impact on itself and it will never resume to the original equilibrium. The other factors are not statistically significant in the IRF estimation for the number of incidents. For the fatalities from the incidents, the shock from the fatalities from the incidents will permanently introduce the negative impact against the number of incidents. The average tone does not show the long-term effect on the number of incidents. However, compared the results with the results from VAR estimation, the average term shows a longer short-term effect to 10 periods before it resumes to the equilibrium. The inflation rate, also, does not exhibit the long-term effect against the number of incidents. The rubber price, the unemployment rate and the percent of youth population shows a long-term positive effect against the number of incidents. Nevertheless, they are not statistically significant.

For the fatalities from the incidents, the IRF results show that the fatalities have a statistically significant effect. The shock in the fatality rate in the system in the last period will lead to a dramatic decline in the next period and the series will adjust itself to the equilibrium in 2 periods. However, the trajectory also moves towards negative effect in the long run. For the number of incidents, the shock in the number of incidents will have a positive effect in 3 period before correcting the trajectory within 15 periods. The effect is statistically significant until 3rd period. The IRF from rubber price shows the positive effect to 2 periods before a sharp drop in the 3rd period. Then, the effect will stay positive permanently. The effect is statistically significant

until the 3rd period. For the average tone, the initial response of the shock from the average tone has a very small effect towards the fatalities from the incidents. However, in the long run, the effect exhibits the change in the trajectories, and it shows the positive effect to the fatalities from the incidents. This pattern of behavior is also found in the IRF of the unemployment rate and the percent of youth population.

The IRF for average tone shows that only the average tone itself is statistically significant and its effect lasts less than 5 periods after the sharp drop in the first 2 periods. The number of incidents and the fatalities from the incidents shares a similar pattern in the long-term positive impact against the average tone, but they are not statistically significant. In addition, the percent of youth population shows the permanent shocks towards the average tone with the positive trajectory. However, the IRF is not statistically significant.

The forecasting performance of the models is evaluated by using Root Mean Squared Errors (RMSE) on both training and testing dataset. The result is shown in Table 4-19: Predictive Evaluation of VECM Model - Pattani Province. We can see that the difference between RMSE of the training dataset and the testing dataset is considerably large. This might indicate that the VAR model we estimate might suffer from the overfitting problem.

DV	RMSE	
	Training	Testing
Number of Incidents	0.810	2.319
Fatalities from Incidents	0.577	2.423

Table 4-19: Predictive Evaluation of VECM Model - Pattani Province

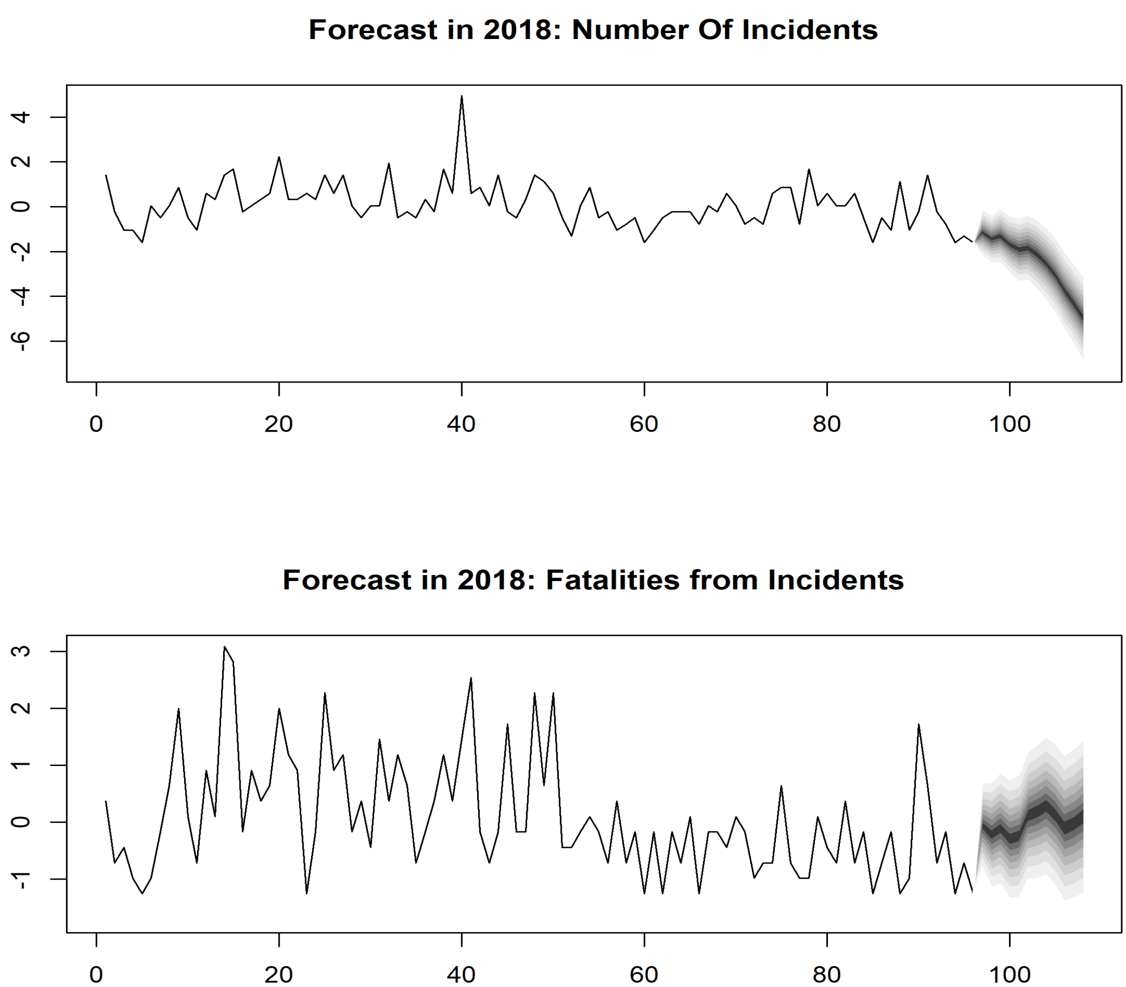


Figure 4-56: Forecasting Result from VECM models - Pattani Province

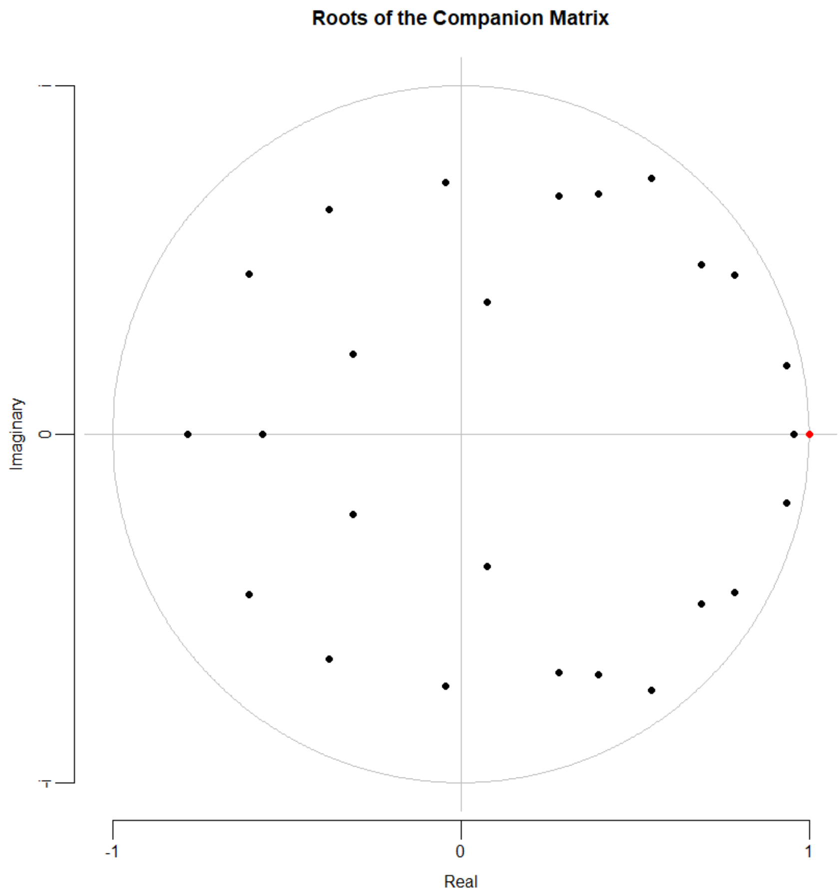


Figure 4-57: Roots of the Companion Matrix - VECM Model - Pattani Province

Test	Statistics	D.F.	P-value
Portmanteau	652.75	595	0.051
ARCH VAR	2436	3920	1.000
JB VAR	90.56	8	<0.001
Kurtosis	65.05	4	<0.001
Skewness	25.51	4	<0.001

Table 4-20: Diagnostics Tests - VECM Model - Pattani Province

Figure 4-56: Forecasting Result from VECM models - Pattani Province shows the forecast value in year 2018 based on the model for the number of incidents and the fatalities from the incidents.

We also perform the stability test for VECM model to ensure its inference ability. The eigenvalues we obtain from the coefficient matrix are not strictly less than one in their modulus form. There is one eigenvalue equal to one. Figure 4-57: Roots of the Companion Matrix - VECM Model - Pattani Province visualizes all eigenvalues. Most of the eigenvalue are within the unit root circle barring one eigen value visualized in red. The result from the stability test alarms that the VECM model may not be stable and not all variables in the model satisfy the stationarity conditions. Consequently, the inference from the model must be used with cautious.

We also perform the diagnostic tests on the residuals of the models. Table 4-20: Diagnostics Tests - VECM Model - Pattani Province shows that the model does not have a heteroskedasticity problem. However, the models may suffer from the serial correlation since the Portmanteau test is borderline statistically significant at 95%. In addition, the normality assumption of the residuals of the VAR model is violated since all three condition tests of the residuals are statistically significant. Based on the results of the diagnostic tests, the inference from the model must be approached with cautious since the model suffers from the inefficiency of the estimation. However, the model still provides unbiased estimates.

Yala Province

We use Johansen Procedure to test for cointegration and identify the cointegration rank before we model VECM for Yala dataset. For this test, we will use number of lag order that we use in VAR estimation at lag order 4. The initial result is shown in Table 0-10: The Result from Johansen Cointegration Test – VECM with 10 Variables - Yala Province in the Appendix section. The test procedure shows that the series have a rank cointegration at 9 since we can reject the null hypothesis for every number of rank up until the hypothesis of rank number equal or less than 9 at 99% confidence level. This result shows a warning sign that the VECM model may not be appropriate the dataset since the cointegration components may have a full rank ($r = 10$) in the dataset. We suspect the same problem as in Pattani dataset. Thus, we decide to not include three variables, namely GPP per capita, military expenditure and the total population, in the VECM as an endogenous variable, but these three variables are used as an exogenous variable.

The result from Johansen Procedure with 7 endogenous variables and 3 exogenous variables is shown in Table 4-21: The Result from Johansen Cointegration Test - Yala Province. Based on the result, we can reject the null hypotheses up until $r <= 5$ but we cannot reject the null hypothesis at $r <= 6$. So, rank number at 5 is chosen to be used in the VECM modeling process.

	Johansen Test-Statistics	X10pct	X5pct	X1pct
r <= 6 |	9.01	10.49	12.25	16.26
r <= 5 |	24.12	16.85	18.96	23.65
r <= 4 |	32.77	23.11	25.54	30.34
r <= 3 |	34.37	29.12	31.46	36.65
r <= 2 |	51.21	34.75	37.52	42.36
r <= 1 |	68.76	40.91	43.97	49.51
r = 0 |	115.29	46.32	49.42	54.71

Table 4-21: The Result from Johansen Cointegration Test - Yala Province

The result of VECM estimation is shown in Table 0-11: VECM Results - Yala Province in the Appendix section. Since the cointegration rank is identified at 5 ranks from the Johansen procedure test, the model will contain 5 error correction terms (noted as ect_r) in the model. The composition and the coefficients for each error correction terms are shown in Table 0-12: The Error Correction Term Composition Table - Yala Province. The error correction terms can be constructed as the equation below.

$$ect_r = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & -0.12 & 23.77 & -0.5 \\ 0 & 1 & 0 & 0 & 0 & -0.63 & -0.05 & -0.01 \\ 0 & 0 & 1 & 0 & 0 & 2.62 & -35.60 & 0 \\ 0 & 0 & 0 & 1 & 0 & -2.97 & 21.74 & -0.06 \\ 0 & 0 & 0 & 0 & 0 & 0.84 & 8.07 & 0.06 \end{bmatrix} * \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \\ Y_7 \\ \nu \end{bmatrix} \tag{4-7}$$

The ect_r is a matrix $(n * r)$ of the error correction terms where n represents the number of observation and r represent the number of selected ranks. The first matrix component of the function is the coefficients inside the error correction function. Y_p represent the vectors of the variables in the models where, in this model, we have 7 variables. ν represents the constant and time trend adjustment.

The equation (4-7) shows the full construction of the error correction. If we rewrite the error correction terms with only the statistically significant variables, we can get the following function for the first error correction term.

$$ect_1 = Y_{1,t-4} - 23.77Y_{7,t-4} - 0.05\nu \tag{4-8}$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the number of incidents is influenced by the percent of youth population. If the percent of youth population increases by 1 standard deviation, the number of incidents is expected to be decreased by 23.77 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_2 = Y_{2,t-4} - 0.63Y_{6,t-4} \tag{4-9}$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the fatalities from incidents is influenced by the unemployment rate. If the unemployment rate increases by 1 standard deviation, the fatalities from incidents is expected to be decreased by 0.63 standard deviation.

$$ect_3 = Y_{3,t-4} + 2.62Y_{6,t-4} - 35.6Y_{7,t-4} \qquad (4\text{-}10)$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the average tone is influenced by the unemployment rate and the percent of youth population. If the unemployment increases by 1 standard deviation, the average tone is expected to be increased by 2.62 standard deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the average tone is expected to be decreased by 35.6 standard deviation.

$$ect_4 = Y_{4,t-4} - 2.97Y_{6,t-4} + 21.74Y_{7,t-4} - 0.06\nu \qquad (4\text{-}11)$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the inflation rate is influenced by the unemployment rate and the percent of youth population. If the unemployment increases by 1 standard deviation, the inflation rate is expected to be decreased by almost 3 standard deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the inflation rate is expected to be increased by 21.74 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_5 = Y_{5,t-4} + 0.84Y_{6,t-4} - 8.07Y_{7,t-4} - 0.06\nu \qquad (4\text{-}12)$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the rubber price is influenced by the unemployment rate and the percent of youth population. If the unemployment rate increases by 1 standard deviation, the rubber price is

expected to be increased by almost 0.84 standard deviation. On the other hand, if the percent of youth population increases by 1 standard deviation, the number of incidents is expected to be decreased by roughly 8 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

Table 0-11: VECM Results - Yala Province in the Appendix section shows the result of the estimation by VECM model. In summary, the number of incidents model shows that the 1^{st}, 2^{nd}, and 4^{th}error correction term are statistically significant at 95% confidence level. The beta coefficients are -1.64, -0.6, and 0.39. That means the speed of adjustment from the long-term relationship of the disequilibrium from the 1^{st} error correction term will be corrected to the equilibrium path in 1 period. the speed of adjustment from the long-term relationship of the disequilibrium from the 2^{nd} error correction term will be corrected to the equilibrium path in roughly 2 periods and the speed of adjustment from the long-term relationship of the disequilibrium from the 4^{th} error correction term will be corrected to the equilibrium path in 3 periods. All exogenous variables in the model are statistically significant at 99%. For the short-term adjustment, the difference of the number of the incidents in all three lag orders are statistically significant at 99% confidence level. For other variables, the 1^{st} order lag of the unemployment rate, the 2^{nd} order lag of the average tone, the 2^{nd} order lag of the inflation rate, and the 3^{rd} order lag of the fatalities from the incidents are statistically significant at 95% confidence level. The 2^{nd} order lag of the fatalities from the incidents, the 2^{nd} order lag of the average tone, the 2^{nd} order lag of the inflation rate are statistically significant at 90% confidence level. The adjusted R-squared for the number of incidents model is at 0.513 and the model is overall statistically significant at 99% confidence level.

For the fatalities from the incidents, only 2nd error corrections term is statistically significant at 99% confidence level. The beta coefficients are -1.58. That means the speed of adjustment from the long-term relationship of the disequilibrium from error correction term will be corrected to the equilibrium path in roughly 0.75 period. The exogenous variables are not statistically significant. For the short-term adjustment, the difference of the fatalities from the incidents in all three lag orders are statistically significant at 99% confidence level. For other variables, the 1st order lag of the unemployment rate, the 2nd order lag of the unemployment rate, and the 3rd order lag of the unemployment rate are statistically significant at 95%, 95%, and 90% confidence level. The adjusted R-squared for the number of incidents model is at 0.248 and the model is overall statistically significant at 99% confidence level.

For the average tone, that the 3rd, 4th, and 5th error correction term are statistically significant at 99% confidence level. The beta coefficients are -1.15, -0.67, and 1.63. That means the speed of adjustment from the long-term relationship of the disequilibrium from the 3rd error correction term will be corrected to the equilibrium path in 1 period. the speed of adjustment from the long-term relationship of the disequilibrium from the 4th error correction term will be corrected to the equilibrium path in roughly 2 periods and the speed of adjustment from the long-term relationship of the disequilibrium from the 5th error correction term will be corrected to the equilibrium path in 0.75 periods. All exogenous variables in the model are not statistically significant. For the short-term adjustment, the difference of the average tone in all three lag orders are statistically significant at 99% confidence level. For other variables, the 1st order lag of the unemployment rate, the 2nd order lag of the inflation rate, the 2nd order lag of the unemployment rate, the 3rd order lag of the inflation rate, and the 3rd order lag of the unemployment rate are

statistically significant. The adjusted R-squared for the number of incidents model is at 0.506 and the model is overall statistically significant at 99% confidence level.

All estimated models in VECM except the inflation rate are statistically significant at 99% confidence level. The inflation rate model is statistically significant at 95% confidence level.

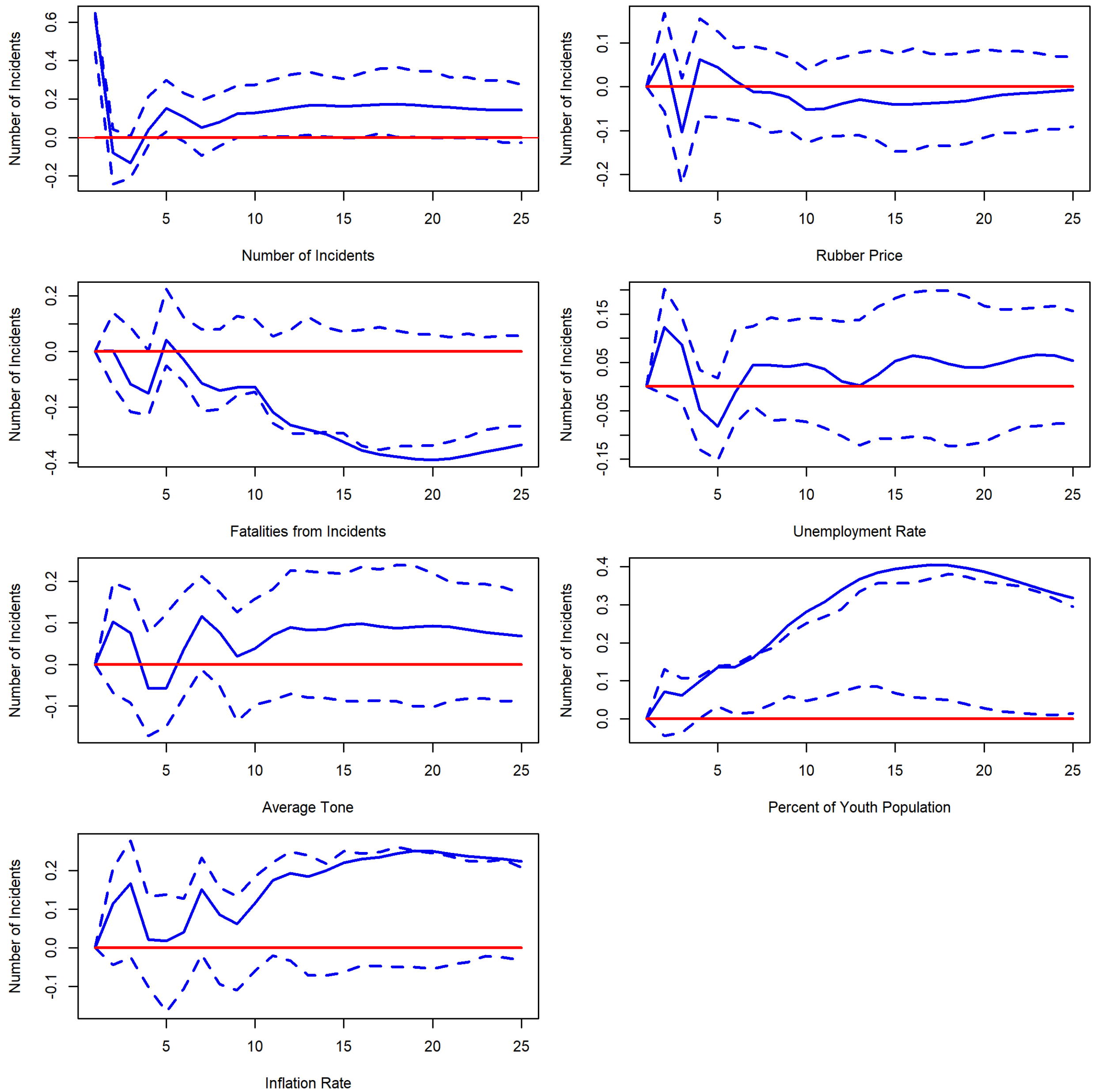


Figure 4-58: Impulse Response Function to Number of Incidents - VECM Model - Yala Province

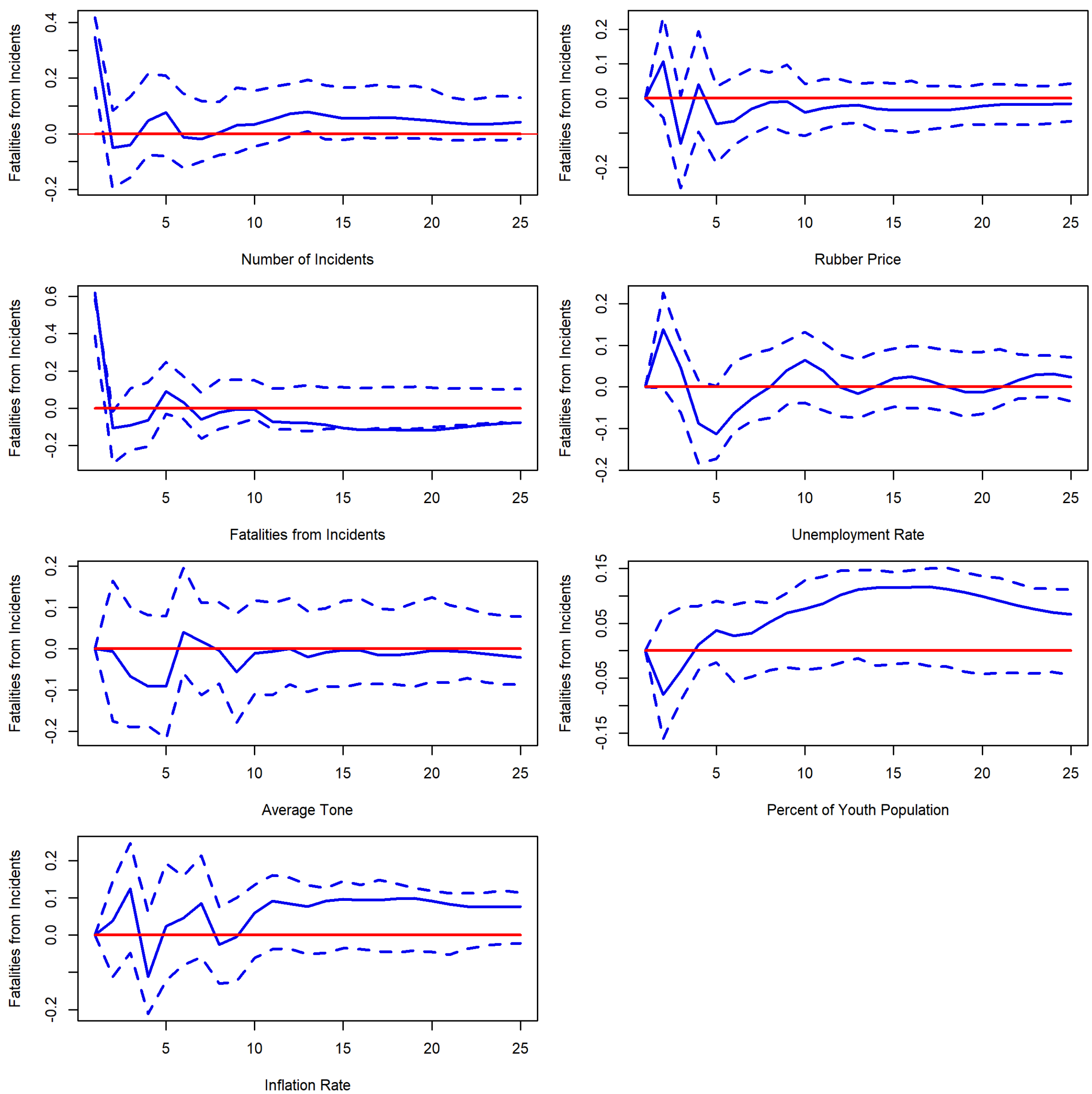


Figure 4-59: Impulse Response Function to Fatalities from Incidents - VECM Model - Yala Province

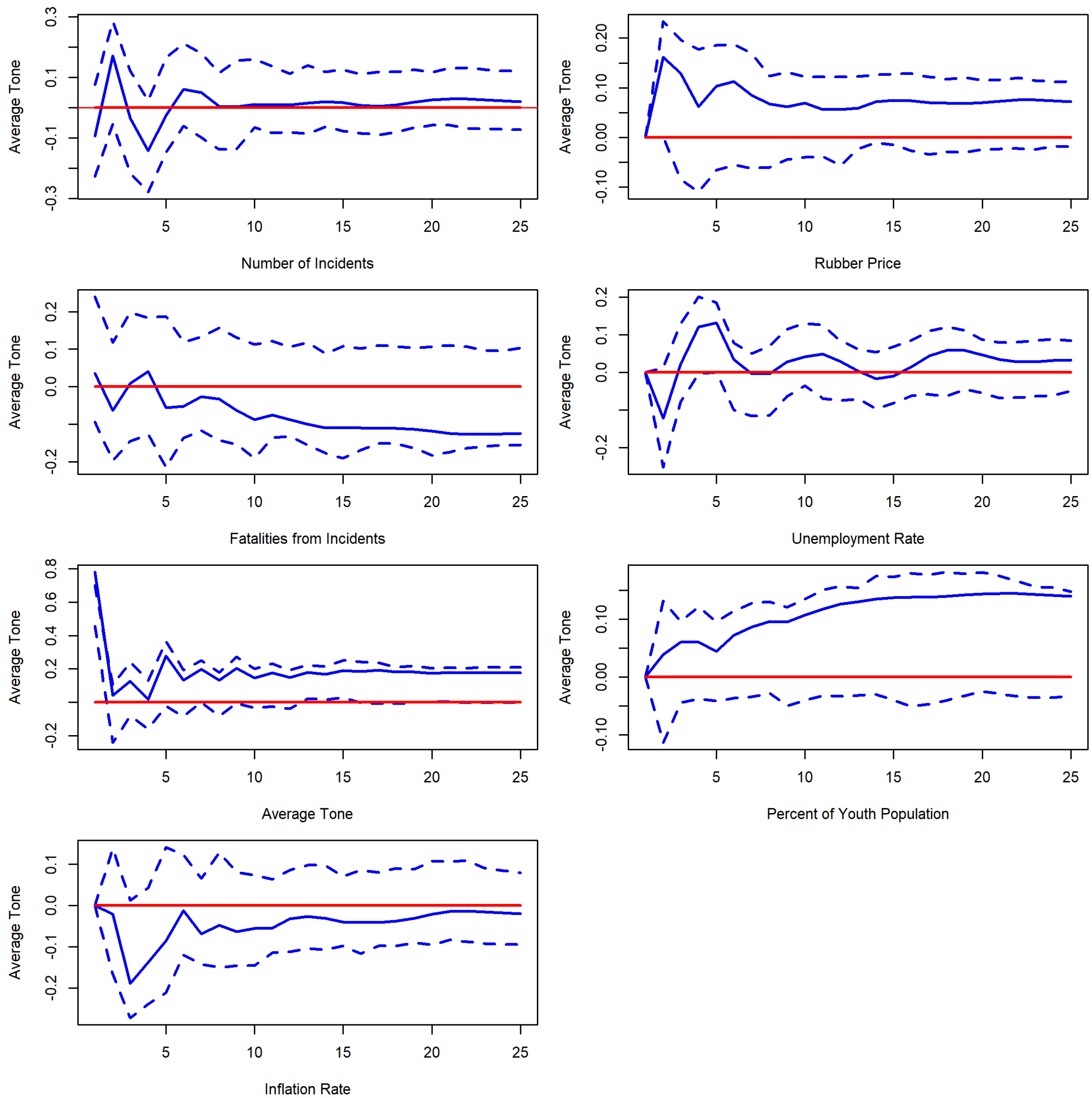


Figure 4-60: Impulse Response Function to Average Tone - VECM Model - Yala Province

In Figure 4-58: Impulse Response Function to Number of Incidents - VECM Model - Yala Province, the IRF of the number of incidents show a statistical significant effect of the number of incidents to itself as the confident intervals do not touch zero line for 2 periods before the confidence interval touch zero line. This means that the shock from the number of incidents will decrease the number of incidents itself within 2 period. After the decline, we observe that the effect of the shock stays permanently and has a positive impact on itself and it will never resume to the original equilibrium. The other factors are not statistically significant in the IRF estimation for the number of incidents. For the fatalities from the incidents, the shock from the fatalities from the incidents will permanently introduce the negative impact against the number of incidents. The average tone shows the long-term positive effect on the number of incidents. The inflation rate also exhibits the long-term positive effect against the number of incidents. The rubber price, the unemployment rate, on the other hand, does not show a long-term effect against the number of incidents. Lastly, the percent of youth population shows a long-term positive effect against the number of incidents as a permanent shock. Nevertheless, the IRF of the percent of youth population is not statistically significant.

For the fatalities from the incidents, the IRF results show that the fatalities have a statistically significant effect. The shock in the fatality rate in the system in the last period will lead to a dramatic decline in the next period and the series will adjust itself to the equilibrium in 2 periods. However, the trajectory also moves towards negative effect in the long run. For the number of incidents, the shock in the number of incidents will have a negative effect in 2 periods before correcting the trajectory within 5 periods. The effect is statistically significant until 2nd period. The IRF from inflation rate and the percent of youth population shows the adjusting period

at the first 5 periods. Then, the effect will stay positive permanently. We cannot observe the long-term effect from the other variables.

The IRF for average tone shows that only the average tone itself is statistically significant and its effect lasts less than 5 periods after the sharp drop in the first 2 periods. The number of incidents does not show any sign of the long-term effect, while the fatalities from the incidents exhibit a pattern in the long-term negative impact against the average tone, but they are not statistically significant. In addition, the rubber price and the percent of youth population show the permanent shocks towards the average tone with the positive trajectory. However, the IRF is not statistically significant.

The forecasting performance of the models is evaluated by using Root Mean Squared Errors (RMSE) on both training and testing dataset. The result is shown in Table 4-22: Predictive Evaluation of VECM Model - Yala Province. We can see that the difference between RMSE of the training dataset and the testing dataset is considerably large. This might indicate that the VAR model we estimate might suffer from the overfitting problem.

DV	RMSE	
	Training	Testing
Number of Incidents	0.631	4.790
Fatalities from Incidents	0.710	4.864

Table 4-22: Predictive Evaluation of VECM Model - Yala Province

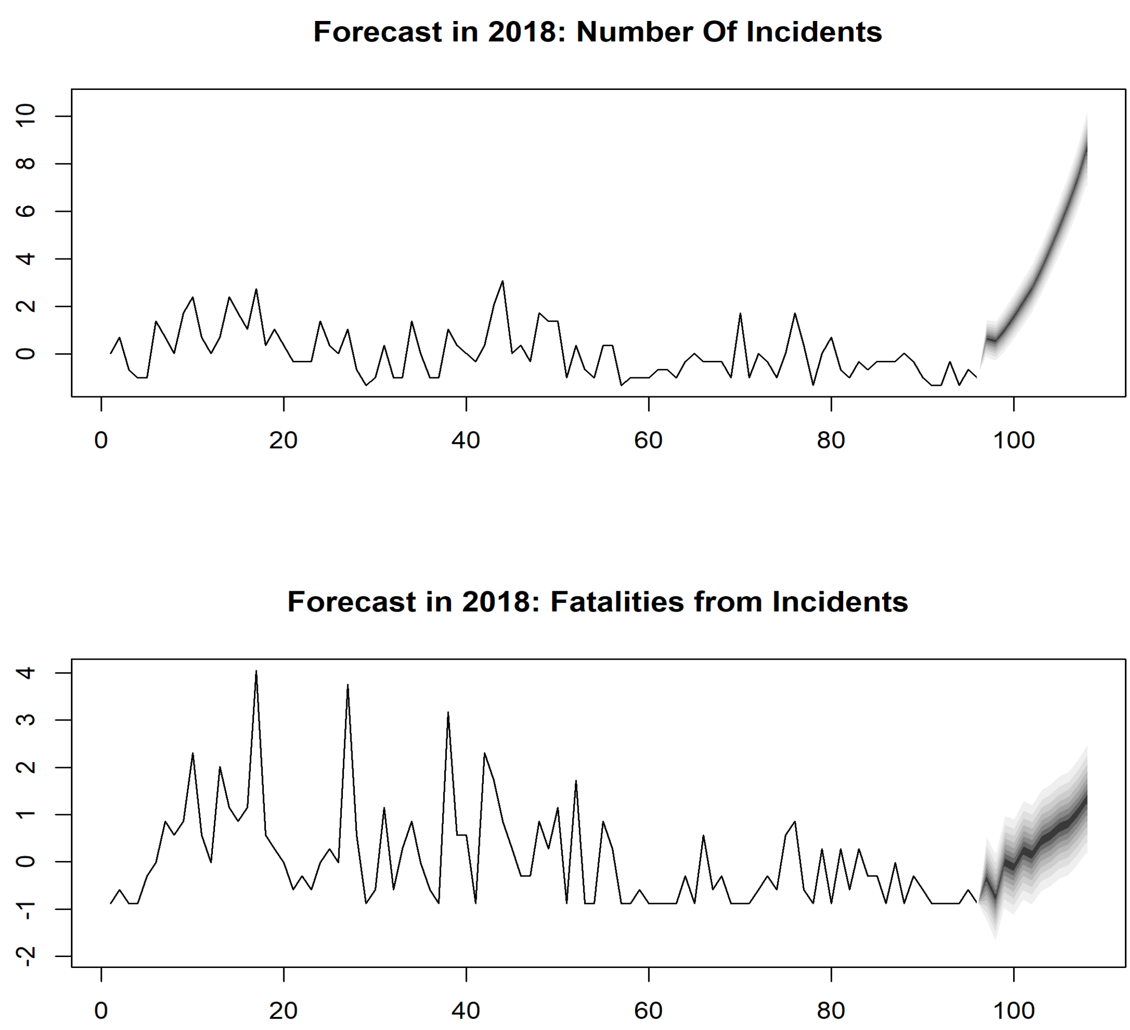


Figure 4-61: Forecasting Result from VECM models - Yala Province

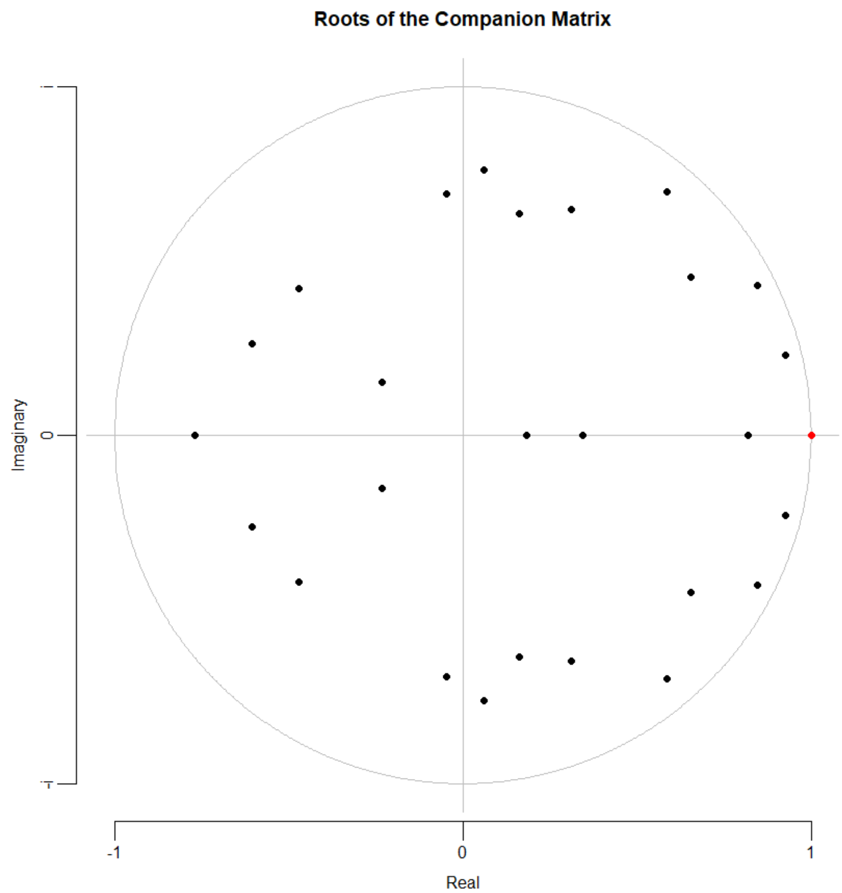


Figure 4-62: Roots of the Companion Matrix - VECM Model - Yala Province

Test	Statistics	D.F.	P-value
Portmanteau	781.91	1210	<0.001
ARCH VAR	2436	15125	1.000
JB VAR	90.56	8	<0.001
Kurtosis	65.05	4	<0.001
Skewness	25.51	4	<0.001

Table 4-23: Diagnostics Tests - VECM Model - Yala Province

Figure 4-61: Forecasting Result from VECM models - Yala Provinceshows the forecast value in year 2018 based on the model for the number of incidents and the fatalities from the incidents.

We also perform the stability test for VECM model to ensure its inference ability. The eigenvalues we obtain from the coefficient matrix are not strictly less than one in their modulus form. There is one eigenvalue equal to one. Figure 4-62: Roots of the Companion Matrix - VECM Model - Yala Province visualizes all eigenvalues. Most of the eigenvalue are within the unit root circle barring one eigen value visualized in red. The result from the stability test alarms that the VECM model may not be stable and not all variables in the model satisfy the stationarity conditions. Consequently, the inference from the model must be used with cautious.

We also perform the diagnostic tests on the residuals of the models. Table 4-23: Diagnostics Tests - VECM Model - Yala Province shows that the model does not have a heteroskedasticity problem. However, the models suffer from the serial correlation since the Portmanteau test is statistically significant at 99%. In addition, the normality assumption of the residuals of the VAR model is violated since all three condition tests of the residuals are statistically significant. Based on the results of the diagnostic tests, the inference from the model must be approached with cautious since the model suffers from the inefficiency of the estimation. However, the model still provides unbiased estimates.

Narathiwat Province

We use Johansen Procedure to test for cointegration and identify the cointegration rank before we model VECM for Narathiwat dataset. For this test, we will use number of lag order that we use in VAR estimation at lag order 4. The initial result is shown in Table 0-13: The Result from Johansen Cointegration Test – VECM with 10 Variables - Narathiwat Province in the Appendix section. The test procedure shows that the series have a rank cointegration at 9 since we can reject the null hypothesis for every number of rank up until the hypothesis of rank number equal or less than 9 at 99% confidence level. This result shows a warning sign that the VECM model may not be appropriate the dataset since the cointegration components may have a full rank ($r = 10$) in the dataset. We suspect the same problem as in Pattani dataset. Thus, we decide to not include three variables, namely GPP per capita, military expenditure and the total population, in the VECM as an endogenous variable, but these three variables are used as an exogenous variable.

The result from Johansen Procedure with 7 endogenous variables and 3 exogenous variables is shown in Table 4-24: The Result from Johansen Cointegration Test - Narathiwat Province. Based on the result, we can reject the null hypotheses up until $r <= 4$ but we cannot reject the null hypothesis at $r <= 5$. So, rank number at 4 is chosen to be used in the VECM modeling process.

	Johansen Test-Statistics	X10pct	X5pct	X1pct
r <= 6 |	13.01	10.49	12.25	16.26
r <= 5 |	17.71	16.85	18.96	23.65
r <= 4 |	30.80	23.11	25.54	30.34
r <= 3 |	35.54	29.12	31.46	36.65
r <= 2 |	55.56	34.75	37.52	42.36
r <= 1 |	68.10	40.91	43.97	49.51
r = 0 |	113.37	46.32	49.42	54.71

Table 4-24: The Result from Johansen Cointegration Test - Narathiwat Province

The result of VECM estimation is shown in Table 0-14: VECM Results - Narathiwat Province in the Appendix section. Since the cointegration rank is identified at 4 ranks from the Johansen procedure test, the model will contain 4 error correction terms (noted as ect_r) in the model. The composition and the coefficients for each error correction terms are shown in Table 0-15: The Error Correction Term Composition Table - Narathiwat Province. The error correction terms can be constructed as the equation below.

$$ect_r = \begin{bmatrix} 1 & 0 & 0 & 0 & -8.54 & -7.89 & -78.25 & 0.69 \\ 0 & 1 & 0 & 0 & -12.17 & -11.28 & -109.41 & -0.98 \\ 0 & 0 & 1 & 0 & 0.64 & -0.84 & 24.36 & -0.08 \\ 0 & 0 & 0 & 1 & 12.94 & 11.97 & 105.3 & -1.13 \end{bmatrix} * \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \\ Y_5 \\ Y_6 \\ Y_7 \\ \nu \end{bmatrix} \quad (4\text{-}13)$$

The ect_r is a matrix $(n * r)$ of the error correction terms where n represents the number of observation and r represent the number of selected ranks. The first matrix component of the function is the coefficients inside the error correction function. Y_p represents the vectors of the

variables in the models where, in this model, we have 7 variables. ν represents the constant and time trend adjustment.

The equation (4-13) shows the full construction of the error correction. If we rewrite the error correction terms with only the statistically significant variables, we can get the following function for the first error correction term.

$$ect_1 = Y_{1,t-4} - 8.54Y_{5,t-4} - 7.89Y_{6,t-4} - 78.25Y_{7,t-4} - 0.69\nu \qquad (4\text{-}14)$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the number of incidents is influenced by the rubber price and the unemployment. If the rubber price increases by 1 standard deviation, the number of incidents is expected to be decreased by almost 8.54 standard deviation. On the other hand, if the unemployment increases by 1 standard deviation, the number of incidents is expected to be decreased by almost 8 standard deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the fatalities from incidents is expected to be decreased by 78.25 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_2 = Y_{2,t-4} - 12.17Y_{5,t-4} - 11.28Y_{6,t-4} - 109.41Y_{7,t-4} - 0.98\nu \qquad (4\text{-}15)$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the fatalities from incidents is influenced by the rubber price, the unemployment rate and the percent of youth population. If the rubber price increases by 1 standard deviation, the fatalities from incidents is expected to be decreased by 12.17 standard deviation. On the other hand, if the unemployment increases by 1 standard deviation, the fatalities from incidents is

expected to be decreased by 11.28 standard deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the fatalities from incidents is expected to be decreased by 109.41 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_3 = Y_{3,t-4} + 0.64Y_{5,t-4} + 0.84Y_{6,t-4} + 24.36Y_{7,t-4} + 0.08\nu \quad \textit{(4-16)}$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the average tone is influenced by the rubber price, the unemployment rate and the percent of youth population. If the rubber price increases by 1 standard deviation, the average tone is expected to be increased by 0.64 standard deviation. On the other hand, if the unemployment increases by 1 standard deviation, the average tone is expected to be increased by 0.84 standard deviation. For the percent of youth population, if the percent of youth population increases by 1 standard deviation, the average tone is expected to be increased by 24.36 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

$$ect_4 = Y_{4,t-4} + 12.94Y_{5,t-4} + 11.97Y_{6,t-4} + 105.3Y_{7,t-4} + 1.13\nu \quad \textit{(4-17)}$$

In the above equation, the long-term relationship is represented as the error terms or the innovation of the inflation rate is influenced by the rubber price, the unemployment rate and the percent of youth population. If the rubber price increases by 1 standard deviation, the inflation rate is expected to be increased by 12.94 standard deviation. On the other hand, if the unemployment increases by 1 standard deviation, the inflation rate is expected to be increased by almost 12 standard deviation. For the percent of youth population, if the percent of youth

population increases by 1 standard deviation, the inflation rate is expected to be increased by 105.3 standard deviation. In addition, the trend adjustment also has a statistically significant effect.

Table 0-14: VECM Results - Narathiwat Province in the Appendix section shows the result of the estimation by VECM model. In summary, the number of incidents model shows that only the 1st error correction term is statistically significant at 99% confidence level. The beta coefficients are -1.947. That means the speed of adjustment from the long-term relationship of the disequilibrium from the 1st error correction term will be corrected to the equilibrium path in 0.5 period. For the exogenous variable, the military expenditure shows a positive effect on the number incident. For the short-term adjustment, the 1st order lag of the average tone, the 1st order lag of the inflation rate, the 2nd order lag of the fatalities from incidents, the 2nd order lag of the unemployment rate, and the 2nd order lag of the percent of youth population are statistically significant. The adjusted R-squared for the number of incidents model is at 0.513 and the model is overall statistically significant at 99% confidence level.

For the fatalities from the incidents, the 2nd and 3rd error corrections term are statistically significant. The beta coefficients are -0.716, and 0.288 respectively. That means the speed of adjustment from the long-term relationship of the disequilibrium from error correction terms will be corrected to the equilibrium path in roughly 1.5 and 4 periods, respectively. For the exogenous variable, the total population shows a positive effect on the number incident. For the short-term adjustment, the 1st order lag of the rubber price, the 2nd order lag of the number of incidents, the 2nd order lag of the fatalities from incidents, the 2nd order lag of the rubber price, the 3rd order lag of the number of incidents, and the 3rd order lag of the rubber price are statistically significant. The

adjusted R-squared for the number of incidents model is at 0.248 and the model is overall statistically significant at 99% confidence level.

For the average tone, only 4th error corrections term is statistically significant at 99% confidence level. The beta coefficients are -0.232. That means the speed of adjustment from the long-term relationship of the disequilibrium from error correction term will be corrected to the equilibrium path in roughly 4 period. For the exogenous variable, the GPP per capita and the total population show a statically significant effect on the number incident. For the short-term adjustment, the 1st order lag of the unemployment, the 2nd order lag of the rubber price, the 3rd order lag of the number of incidents, the 3rd order lag of the fatalities from the incidents, the 3rd order lag of the average tone, and the 3rd order lag of the inflation rate are statistically significant. The adjusted R-squared for the number of incidents model is at 0.506 and the model is overall statistically significant at 99% confidence level.

All estimated models in VECM except the inflation rate model are statistically significant at 99% confidence level. The inflation rate model is statistically significant at 95% confidence level.

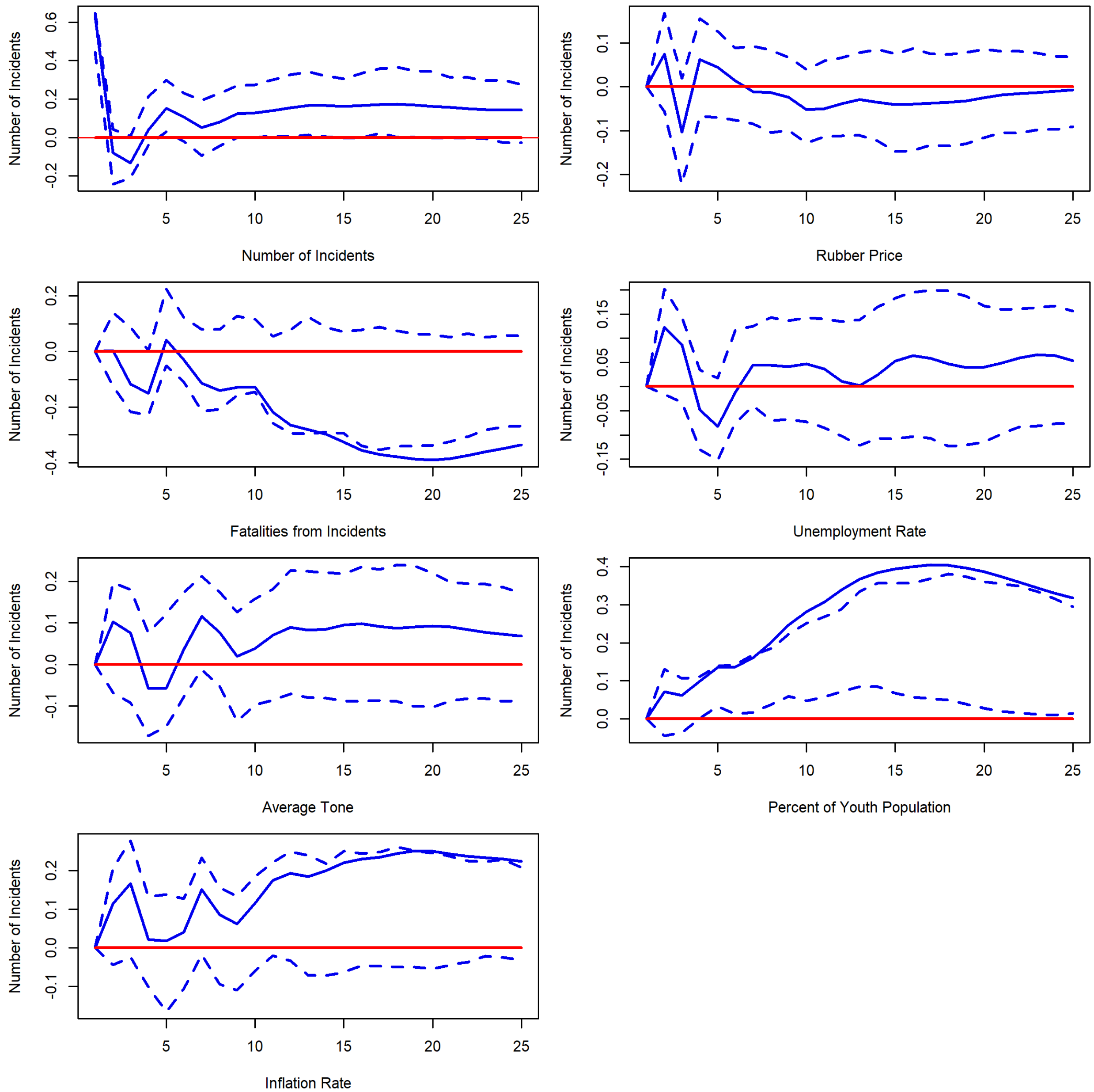


Figure 4-63: Impulse Response Function to Number of Incidents - VECM Model - Narathiwat Province

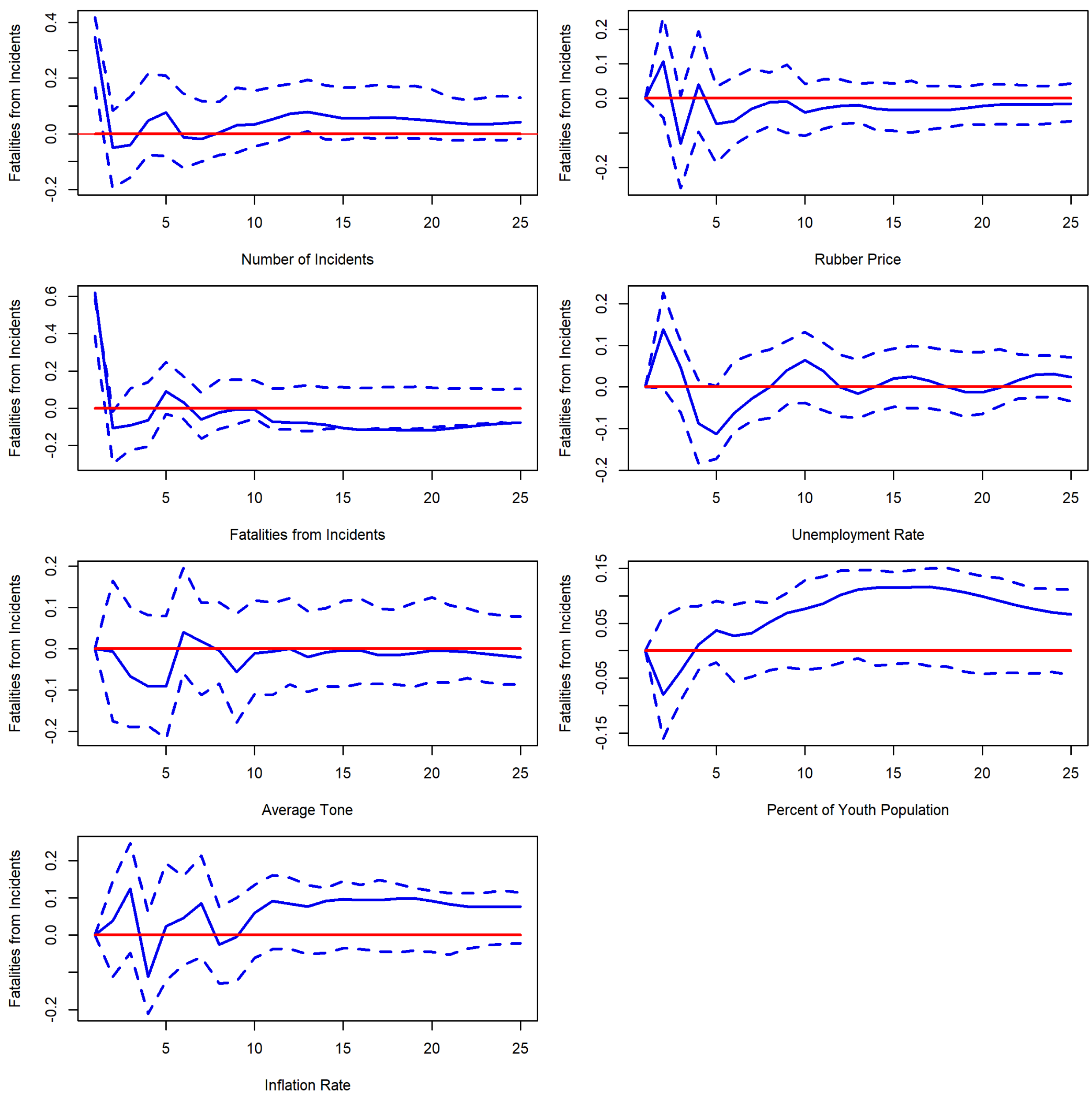


Figure 4-64: Impulse Response Function to Fatalities from Incidents - VECM Model - Narathiwat Province

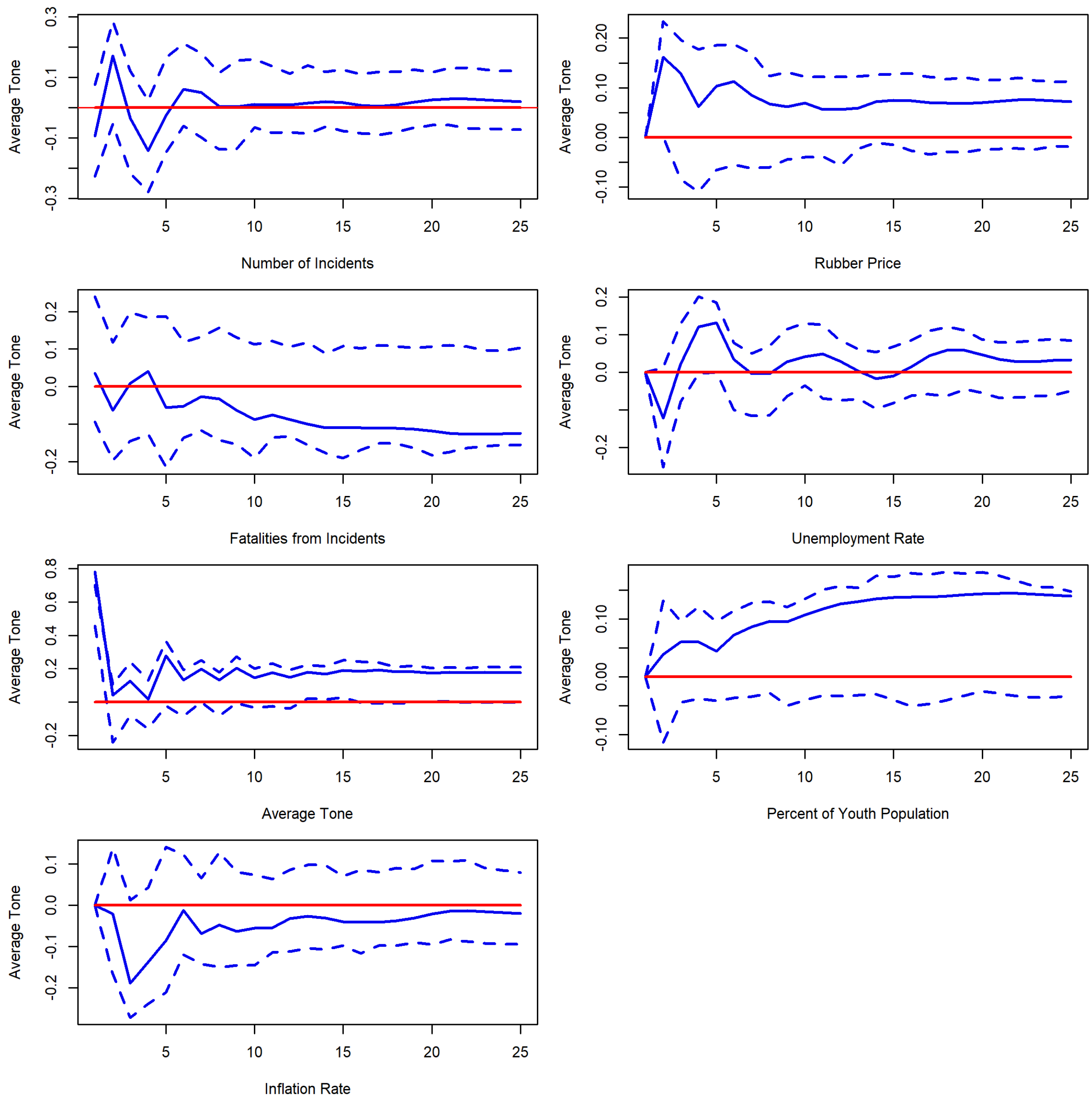


Figure 4-65: Impulse Response Function to Average Tone - VECM Model - Narathiwat Province

In Figure 4-63: Impulse Response Function to Number of Incidents - VECM Model - Narathiwat Province, the IRF of the number of incidents show a statistical significant effect of the number of incidents to itself as the confident intervals do not touch zero line for 2 periods before the confidence interval touch zero line. This means that the shock from the number of incidents will decrease the number of incidents itself within 2 period. After the decline, we observe that the effect of the shock stays permanently and has a positive impact on itself and it will never resume to the original equilibrium. The other factors are not statistically significant in the IRF estimation for the number of incidents. For the fatalities from the incidents, the shock from the fatalities from the incidents will permanently introduce the negative impact against the number of incidents. The average tone shows the long-term positive effect on the number of incidents after the adjustment periods at the first 5 periods. The inflation rate and the percent of youth population, also, exhibit the long-term positive effect against the number of incidents similar to the average tone. Nevertheless, they are not statistically significant. Additionally, the rubber price, and the unemployment rate do not show a long-term positive effect against the number of incidents.

For the fatalities from the incidents, the IRF results show that the fatalities have a statistically significant effect. The shock in the fatality rate in the system in the last period will lead to a dramatic decline in the next period and the series will adjust itself to the equilibrium in 2 periods. However, the trajectory also moves towards negative effect in the long run. For the number of incidents, the shock in the number of incidents will have a positive effect in 2 period before correcting the trajectory within 5 periods. The effect is statistically significant until 3rd period. The IRF from inflation rate and the percent of youth population shows the positive effect after the adjustment periods. Then, the positive effect will stay positive permanently. Other variables do not show a long-term effect against the fatalities from the incidents.

The IRF for average tone shows that only the average tone itself is statistically significant and its effect lasts less than 5 periods after the sharp drop in the first 2 periods. Then, the positive effect will persist permanently. The fatalities from the incidents shares a similar pattern in the long-term negative impact against the average tone, but they are not statistically significant. In addition, the rubber price and the percent of youth population shows the permanent shocks towards the average tone with the positive trajectory. However, the IRF is not statistically significant. Other variables do not show a long-term effect against the average tone.

The forecasting performance of the models is evaluated by using Root Mean Squared Errors (RMSE) on both training and testing dataset. The result is shown in Table 4-25: Predictive Evaluation of VECM Model - Narathiwat Province. We can see that the difference between RMSE of the training dataset and the testing dataset is considerably large. This might indicate that the VAR model we estimate might suffer from the overfitting problem.

DV	RMSE	
	Training	Testing
Number of Incidents	0.726	1.703
Fatalities from Incidents	0.735	1.132

Table 4-25: Predictive Evaluation of VECM Model - Narathiwat Province

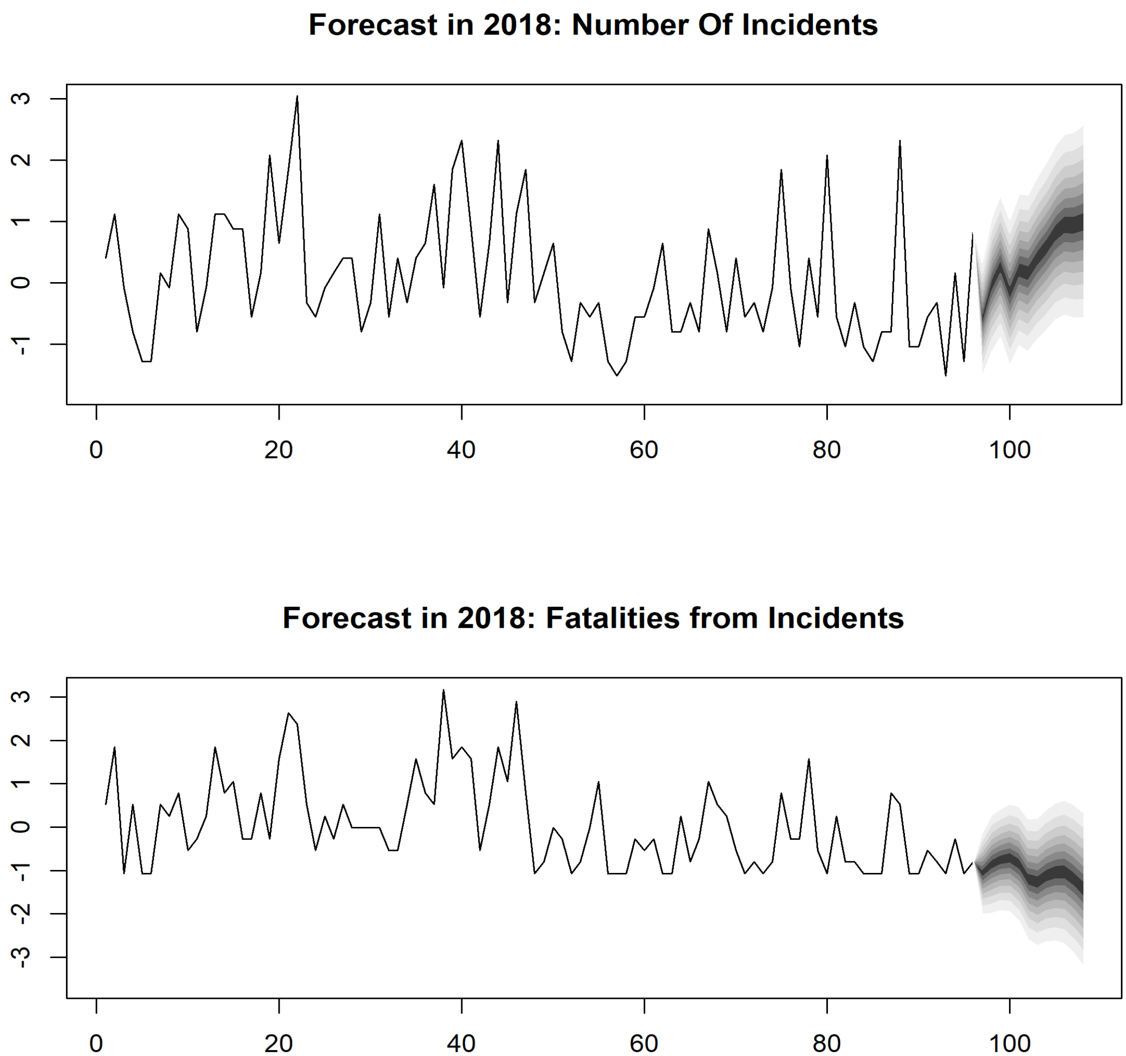


Figure 4-66: Forecasting Result from VECM models - Narathiwat Province

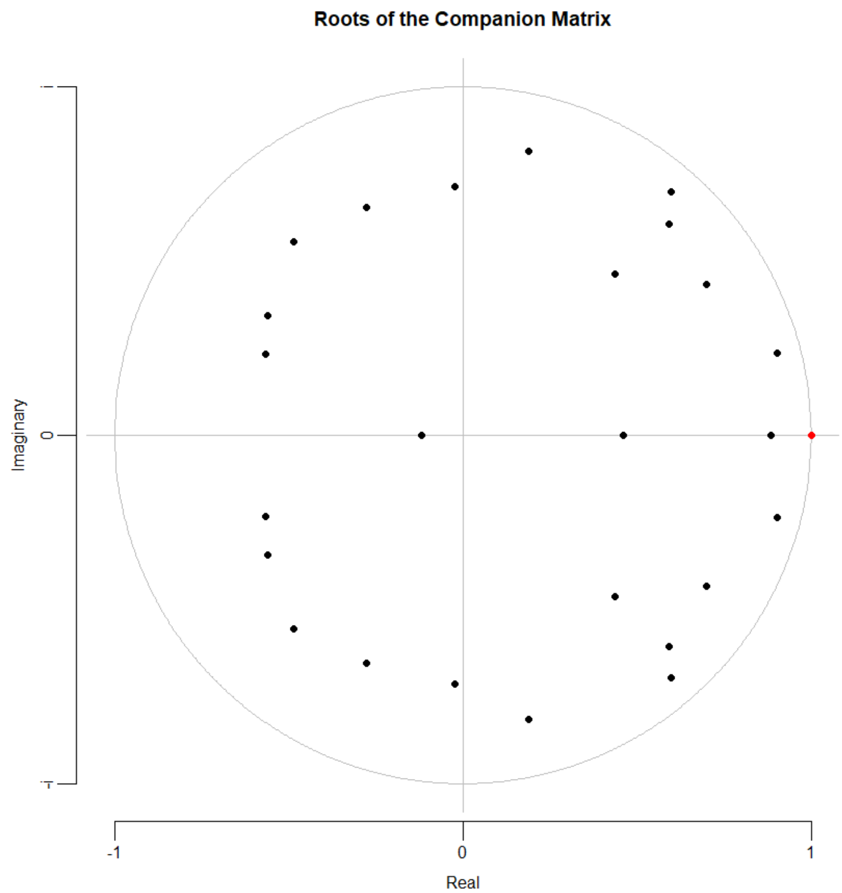


Figure 4-67: Roots of the Companion Matrix - VECM Model - Narathiwat Province

Test	Statistics	D.F.	P-value
Portmanteau	779.18	1210	<0.001
ARCH VAR	2436	15125	1.000
JB VAR	90.56	8	<0.001
Kurtosis	65.05	4	<0.001
Skewness	25.51	4	<0.001

Table 4-26: Diagnostics Tests - VECM Model - Narathiwat Province

Figure 4-66: Forecasting Result from VECM models - Narathiwat Province shows the forecast value in year 2018 based on the model for the number of incidents and the fatalities from the incidents.

We also perform the stability test for VECM model to ensure its inference ability. The eigenvalues we obtain from the coefficient matrix are not strictly less than one in their modulus form. There is one eigenvalue equal to one. Figure 4-67: Roots of the Companion Matrix - VECM Model - Narathiwat Province visualizes all eigenvalues. Most of the eigenvalue are within the unit root circle barring one eigen value visualized in red. The result from the stability test alarms that the VECM model may not be stable and not all variables in the model satisfy the stationarity conditions. Consequently, the inference from the model must be used with cautious.

We also perform the diagnostic tests on the residuals of the models. Table 4-26: Diagnostics Tests - VECM Model - Narathiwat Province shows that the model does not have a heteroskedasticity problem. However, the models suffers from the serial correlation since the Portmanteau test is statistically significant at 99%. In addition, the normality assumption of the residuals of the VAR model is violated since all three condition tests of the residuals are statistically significant. Based on the results of the diagnostic tests, the inference from the model must be approached with cautious since the model suffers from the inefficiency of the estimation. However, the model still provides unbiased estimates.

Convergent Cross Mapping Models

Pattani Province

The first process of Convergent Cross Mapping model is to find the optimal number of embedding dimension size for each variable. The embedding dimension is used to reconstruct the approximate one-to-one original attractor manifold from the time-series data. For this process, we perform Simplex Projection in each variable and obtain the optimal number of embedding dimensions by evaluation the forecast skill (ρ) as an evaluative matrix. The forecast skill in this method is the correlation between the actual values and the predicted values. If the forecast skill is at maximum which is 1, it means the Simplex Projection can reconstruct the attractor manifold and predict the value at the exact same value as the actual value. On the other hand, if the Simplex Projection is performed with the wrong number of the embedding dimensions, the reconstructed attractor manifold will misrepresent the system of the variable and the correlation between the actual values and the predicted value will be close to zero. The result of the Simplex Projection is shown in the figure below. And the optimal number of embedding dimensions is shown in Table 4-27: The Optimal Embedding Dimensions - Pattani Province.

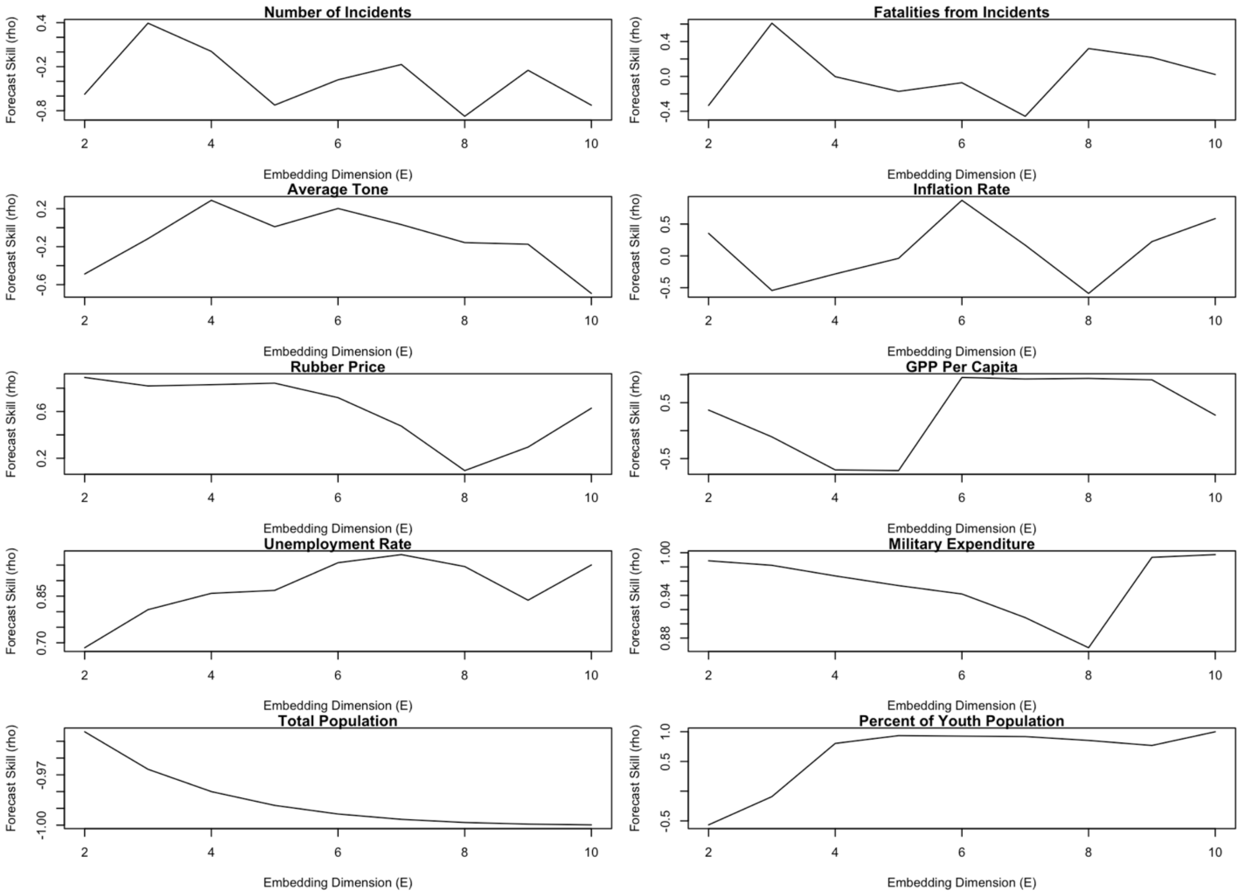


Figure 4-68: Number of Embedding Dimension for all Variables and the Forecast Skill (Rho) - Pattani Province

Variables	Optimal Embedding Dimensions
Number of Incidents	3
Fatalities from Incidents	3
Average Tone	4
Inflation Rate	6
Rubber Price	2
GPP Per Capita	6
Unemployment Rate	7
Military Expenditure	10
Total Population	2
Percent of Youth Population	10

Table 4-27: The Optimal Embedding Dimensions - Pattani Province

Figure 4-69: S-map Nonlinearity Test and Forecast Skill (Rho) - Pattani Province shows the result from the S-map with the optimal embedding dimensions with the different parameter for the nonlinear index (θ). The purpose of this test is to identify the characteristics of the variable system as a linear system or nonlinear system. When the $\theta = 0$, it means we run a S-map under the assumption that the variable system is a linear system. On the other hand, when the $\theta > 0$, we run the model with the assumptions that the variable system is nonlinear.

The results from nonlinear test shows that the number of incidents, the fatalities from incidents, the average tone, and the total population should be modeled as a nonlinear model since the forecast skills are increased when we increase θ. On the other hand, the inflation rate, the rubber price, GPP per capita, the unemployment rate, the military expenditure and the percent of youth population are a linear system since the forecast skill at $\theta = 0$ is the highest.

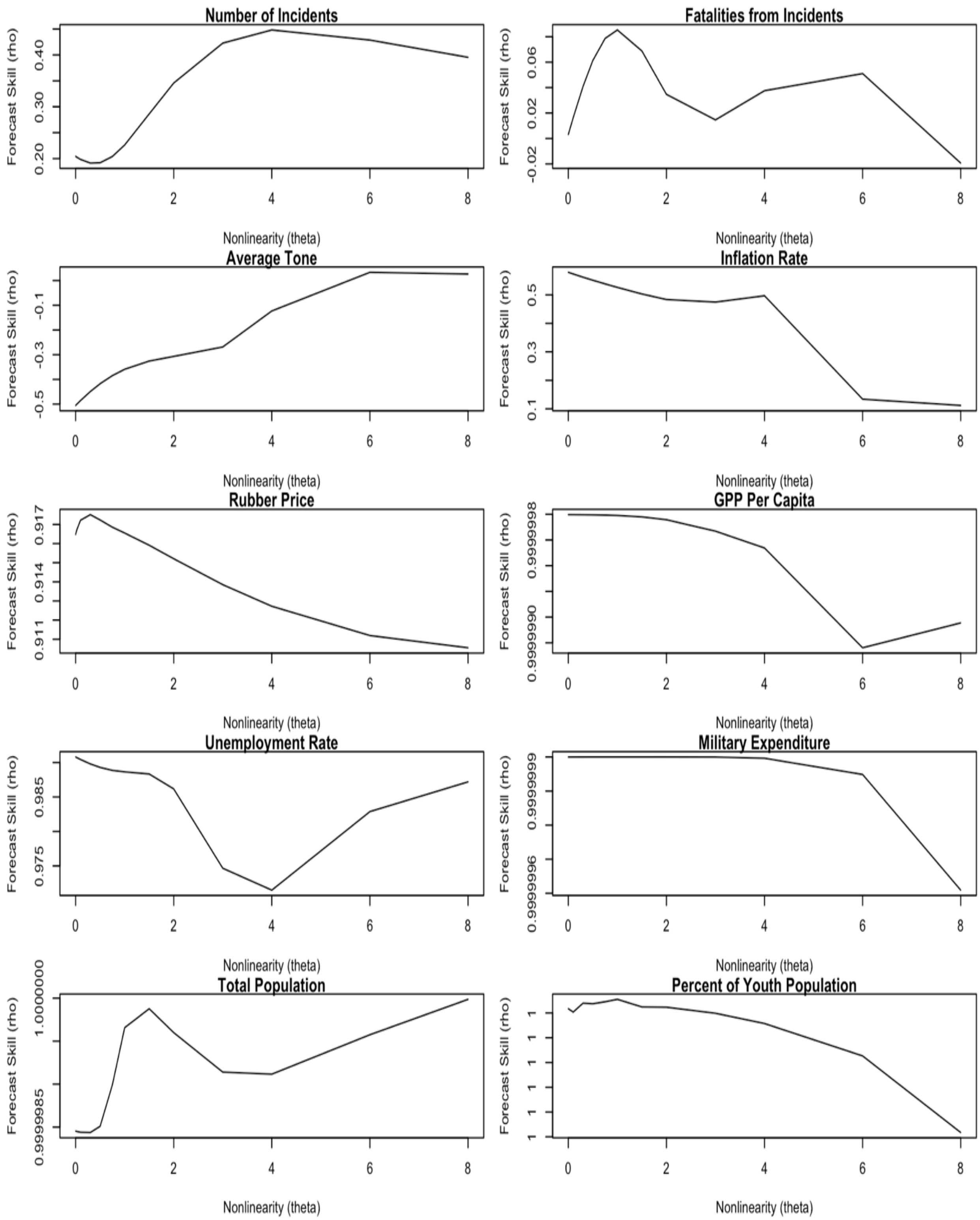


Figure 4-69: S-map Nonlinearity Test and Forecast Skill (Rho) - Pattani Province

Next, we look at the causality from the Convergent Cross Mapping model based on the optimal number of embedded dimensions. The models will try to map the lag value of one variable (denoted as Y) to the other variable (denoted as X). If Y can cross-map X, it suggests that X has causality to Y. The figures below show the interaction between the number of incidents, the fatalities from the incidents and the average tone against other variables in the study. In each graph, we benchmark the Cross-Map skill (ρ) with the correlation from simple linear correlation between the variables.

Figure 4-70: Causality Test with Convergent Cross Mapping against Number of Incidents - Pattani Province shows the causality derived from CCM method. The inflation rate shows the CCM causality that exceeds the linear causality when the library size is above 60 to the number of incidents as the number of incident cross-map the inflation rate. We also observe the similar pattern with the unemployment rate, but the unemployment rate only requires the library number to be over 40. The fatalities from the incidents and the rubber price also shows a moderate CCM causality against the number of incidents. However, the forecast skills for these two variables do not exceed the linear correlation.

For the fatalities from the incidents, we observe a strong CCM causality from the unemployment rate to the fatalities from the incidents. The number of incidents and the rubber price also shows a moderate CCM causality against the number of incidents. However, the forecast skills for these two variables do not exceed the linear correlation.

For the average tone, we do not observe any variable that exhibit a strong CCM causality exceeding the linear correlation benchmark. However, the rubber price has a moderate CCM

causality towards the average tone. On the other hand, the average tone has a moderate CCM causality towards the inflation rate, the unemployment rate and the military expenditure.

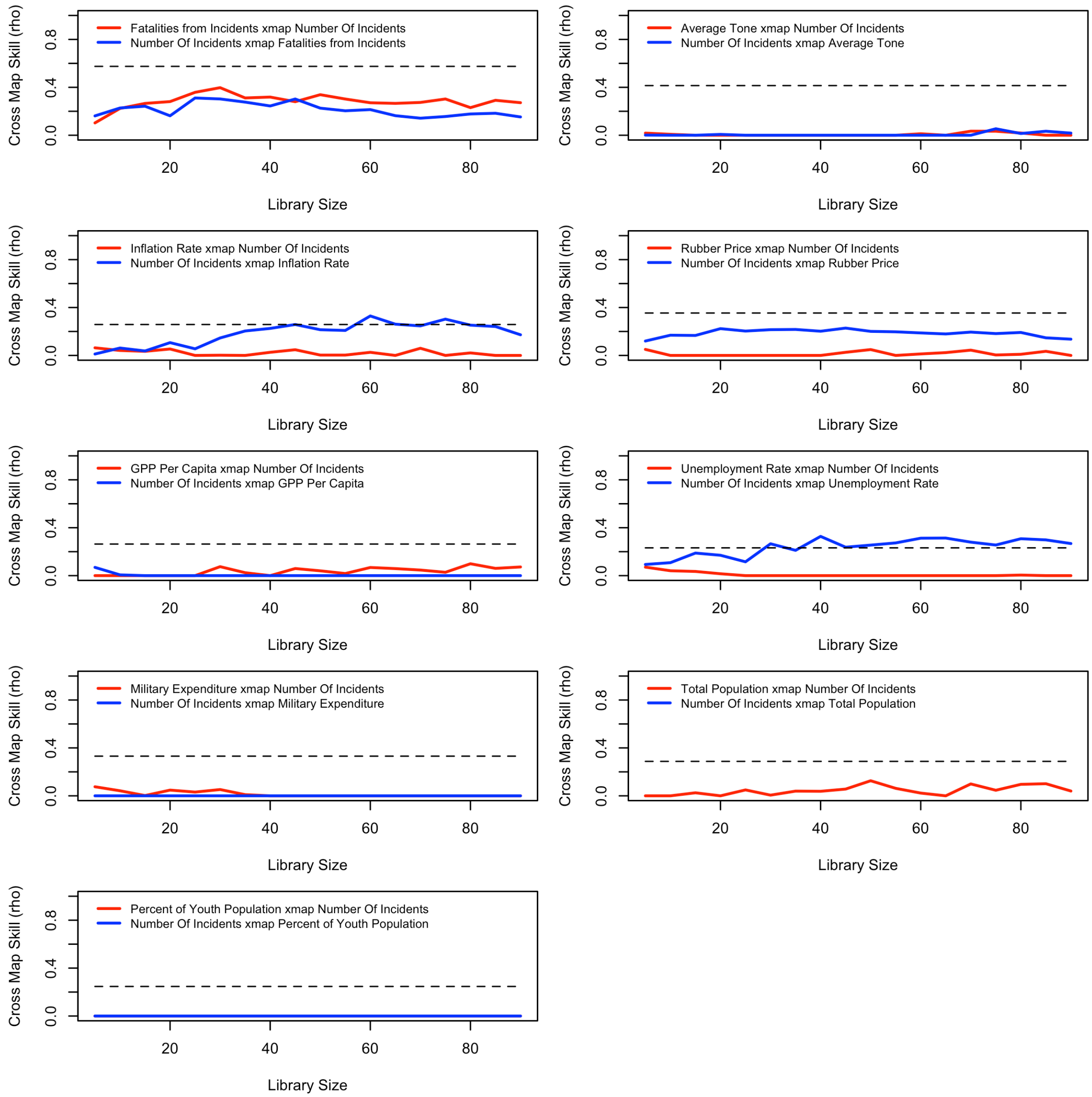


Figure 4-70: Causality Test with Convergent Cross Mapping against Number of Incidents - Pattani Province

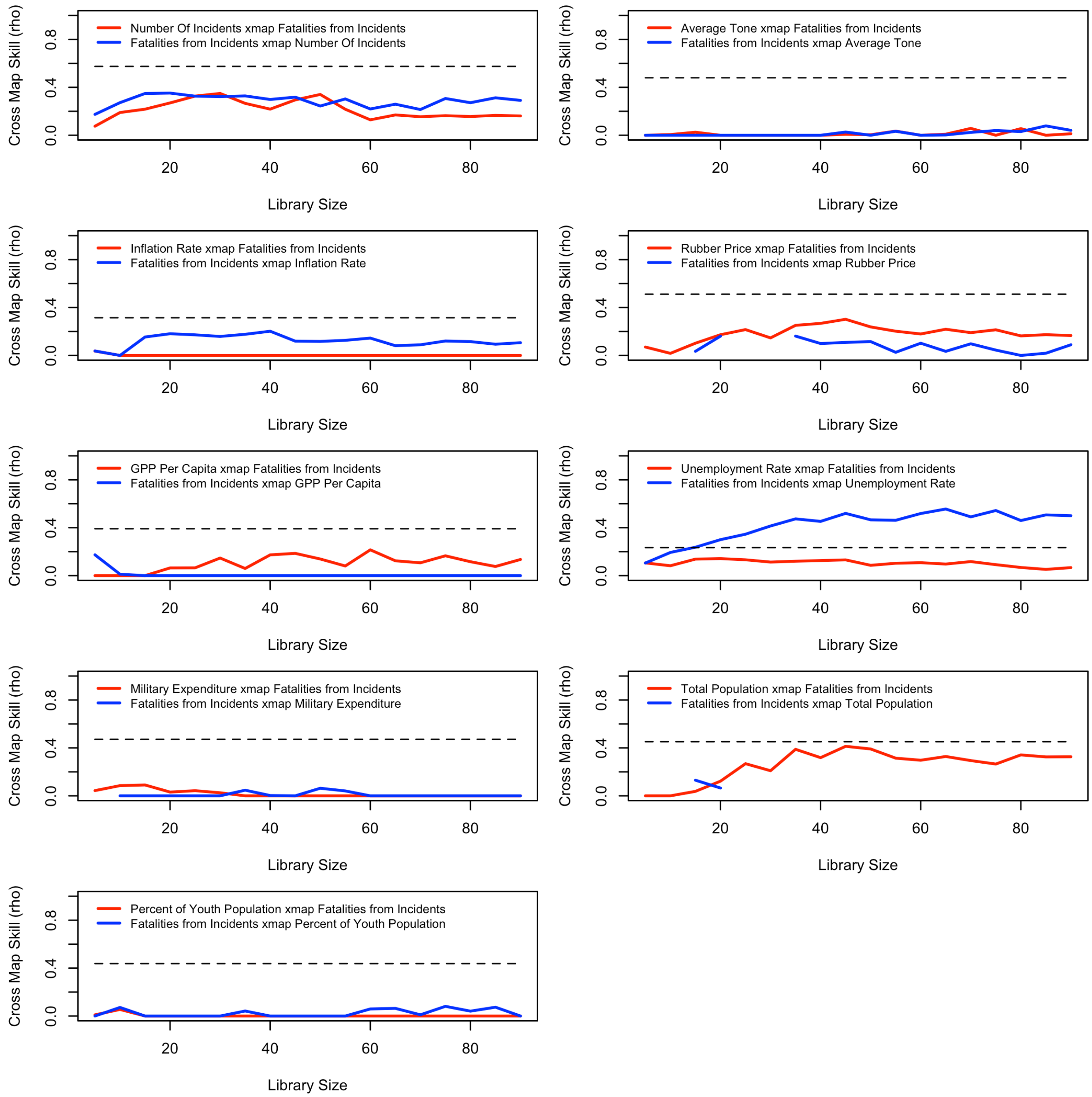


Figure 4-71: Causality Test with Convergent Cross Mapping against Fatalities from Incidents - Pattani Province

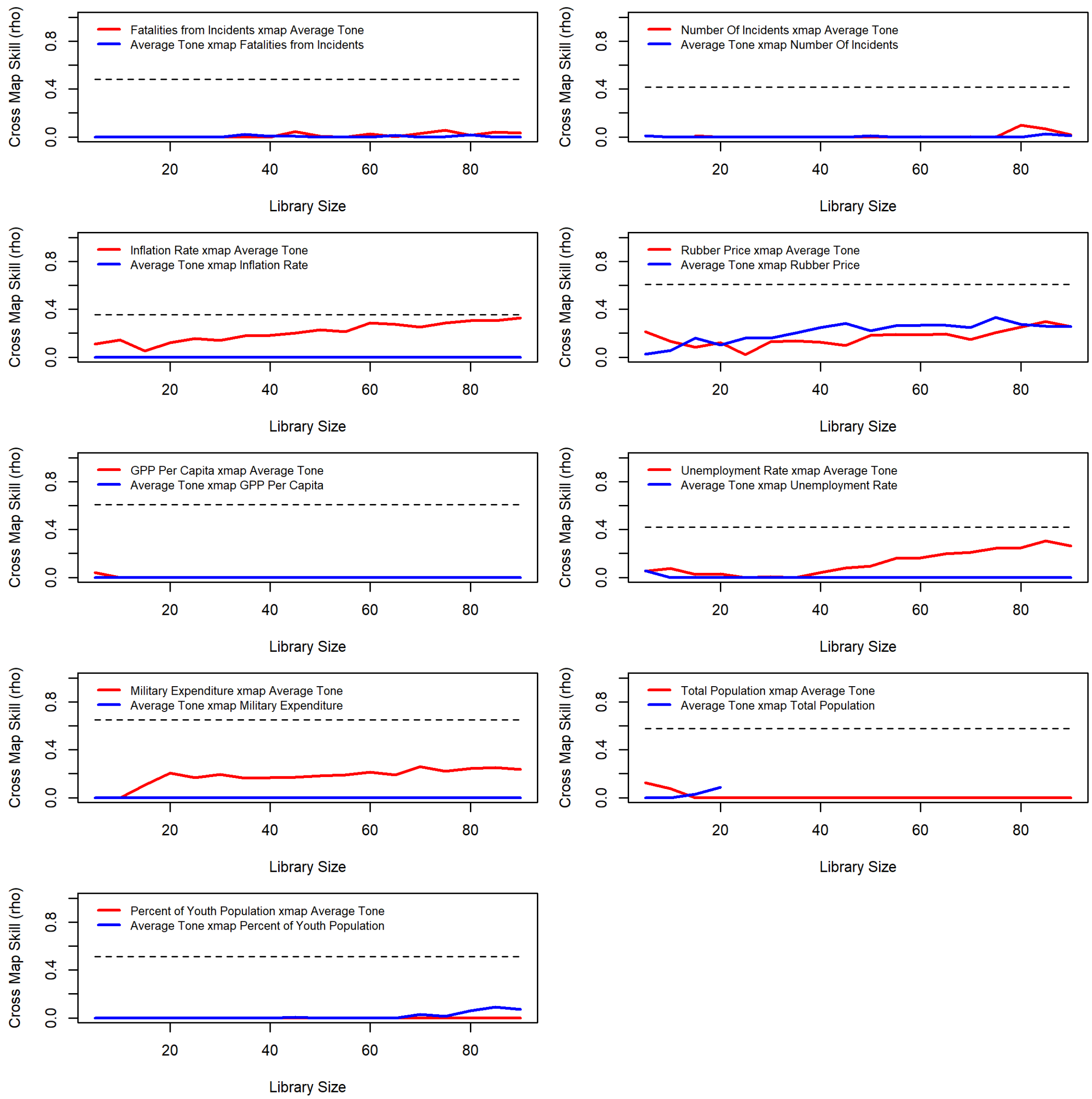


Figure 4-72: Causality Test with Convergent Cross Mapping against Average Tone- VECM Model - Pattani Province

Next, we conduct an experiment for the optimal lag number in the CCM framework. The purpose of the experiment is not only to find the best number of lag order we should use in the modeling, but also to interpret the time and causality between the variables. The parameter setting in this experiment is slightly different from the previous CCM causality test. We set the library size at 50 – 90 with the incremental interval at 5 unit. The reason we pick this range of parameter is that we observe the coupling signal from the variables when, on average, the library size in the model is larger than 50. Then, the value of the forecast skill from the small library size can influence the outcomes since the final evaluative matrix that we use is the average value of the forecast skill from the different size of the library against the different value of the lag number. All other parameter is similar to the previous CCM test. The results are shown in the following figures.

For the number of incidents, we can observe that the effect from the fatalities from the incident is strong at 0 lag number and its effect decline over the period of time which suggests that the fatalities from the incidents are more likely to have a short-term effect against the number of incidents. For the average tone, the effect is hardly observable until the lag number 6. It suggests that the average tone may slowly affect the number of incidents and it will take time until we see the effect. This pattern of the causality, also, can be observed within the socio-economic factors, namely, the inflation rate, the rubber price, the GPP per capita, and the unemployment rate where the optimal number for the lag number is around 5 and 6. At this range of past periods, we can see a strong CCM causality towards the number of incidents. The percent of youth population also shares a similar pattern as the optimal number of lags is at 5. It suggests that the percent of youth population also has a longer period to take an effect. For other variables, they have a weak CCM causality and it is consistent across the lag number.

For the fatalities from the incidents, we also observe the similar short-term pattern with the number of incidents. However, the socio-economic factors exhibit the different pattern from the number of incidents. The optimal number for lag number for the socio-economic factors are shorter than the optimal numbers we found against the number of incidents. This might suggest that the socio-economic factors will have a more rapid effect towards the intensity of the conflict than the prevalence of the conflict.

For the average tone, only two variables, the CCM causality can be observed in the later periods in many variables. The optimal number of lag number for the number of incidents is at 5 which means the number of the incidents slowly influence the average tone after 5 months. However, the magnitude of the causality measured by the cross-mapping skill is moderate. On the contrary, the fatalities from incidents show a stronger effect at the lag number equal to 6 and the cross-mapping skill is almost equal to 1. It strongly suggests that the fatalities from the incidents CCM causes the average tone in a long term, but the short-term effect may be difficult to observe since the cross-mapping skill values at the early periods are close to zero. For the rubber price and the unemployment, we observe two maxima at the lag number 3as the local maxima and the lag number 6 as the global maxima. It suggests the time-delaying causal effect of these two variables can be seasonal. The military expenditure also shares a similar pattern, but it is less dramatic than the rubber price and the unemployment rate. We do not observe CCM causality from the GPP per capita, the total population and the percent of youth population.

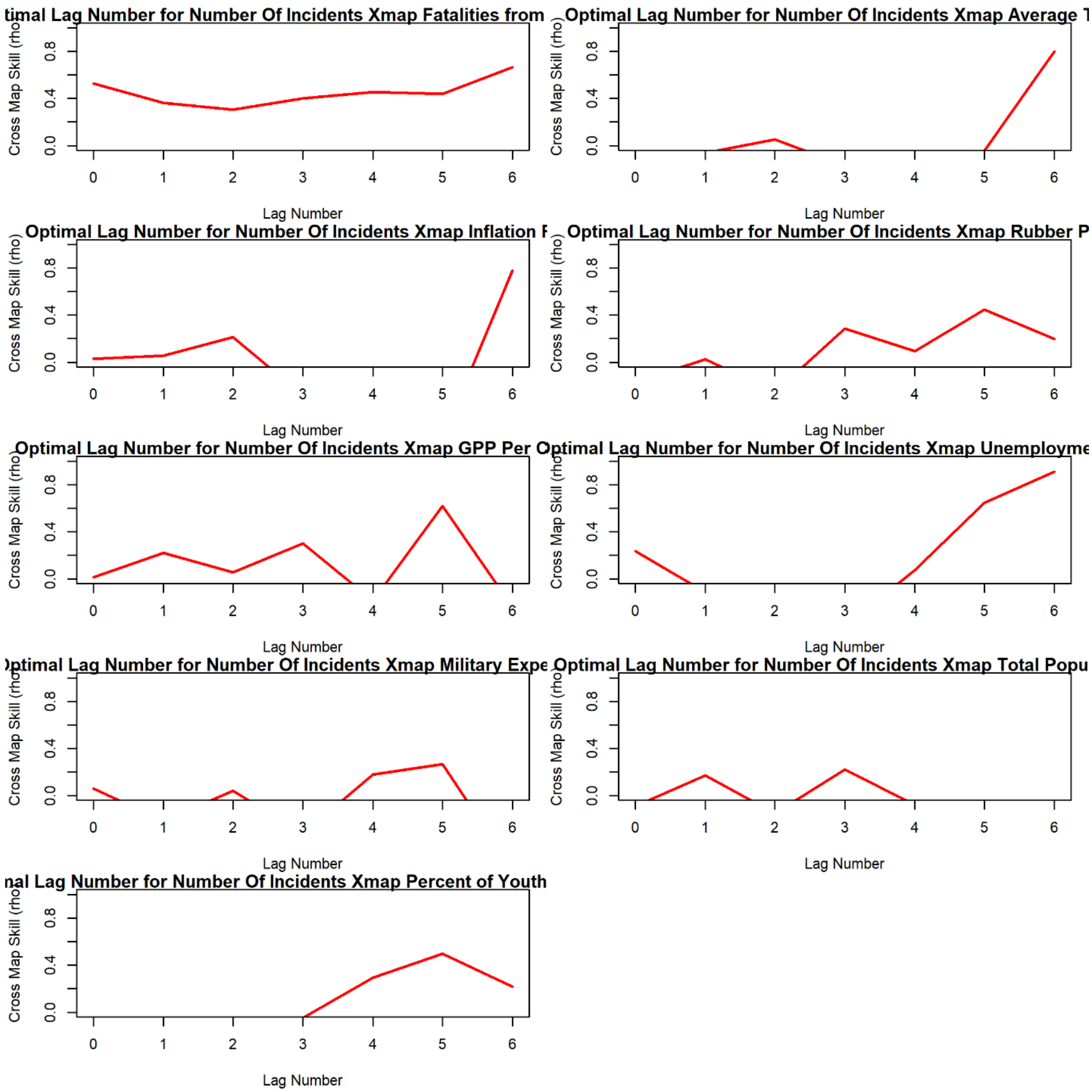


Figure 4-73: The Optimal Lag Number for the Number of Incidents - Pattani Province

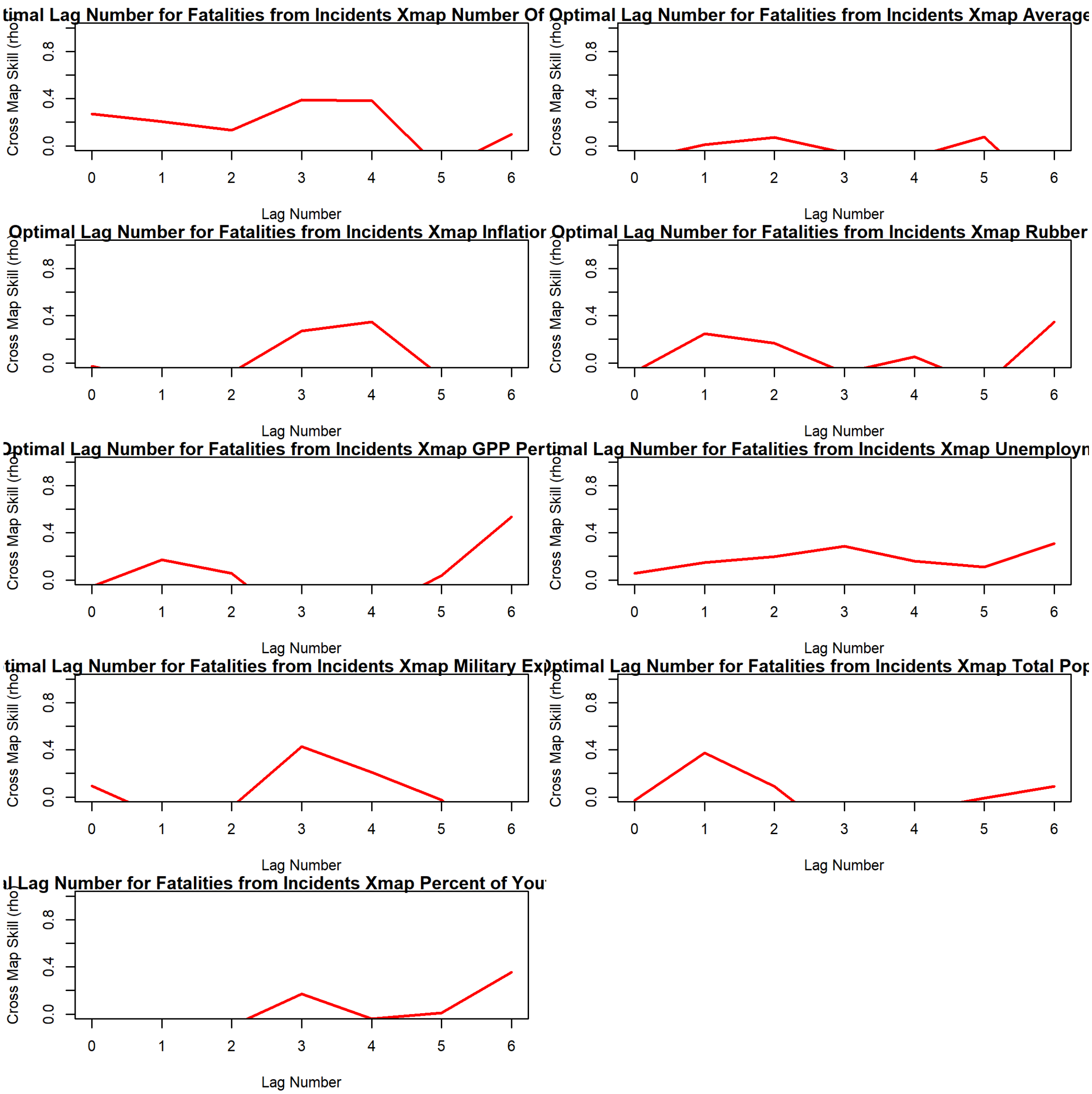


Figure 4-74: The Optimal Lag Number for the Fatalities from Incidents - Pattani Province

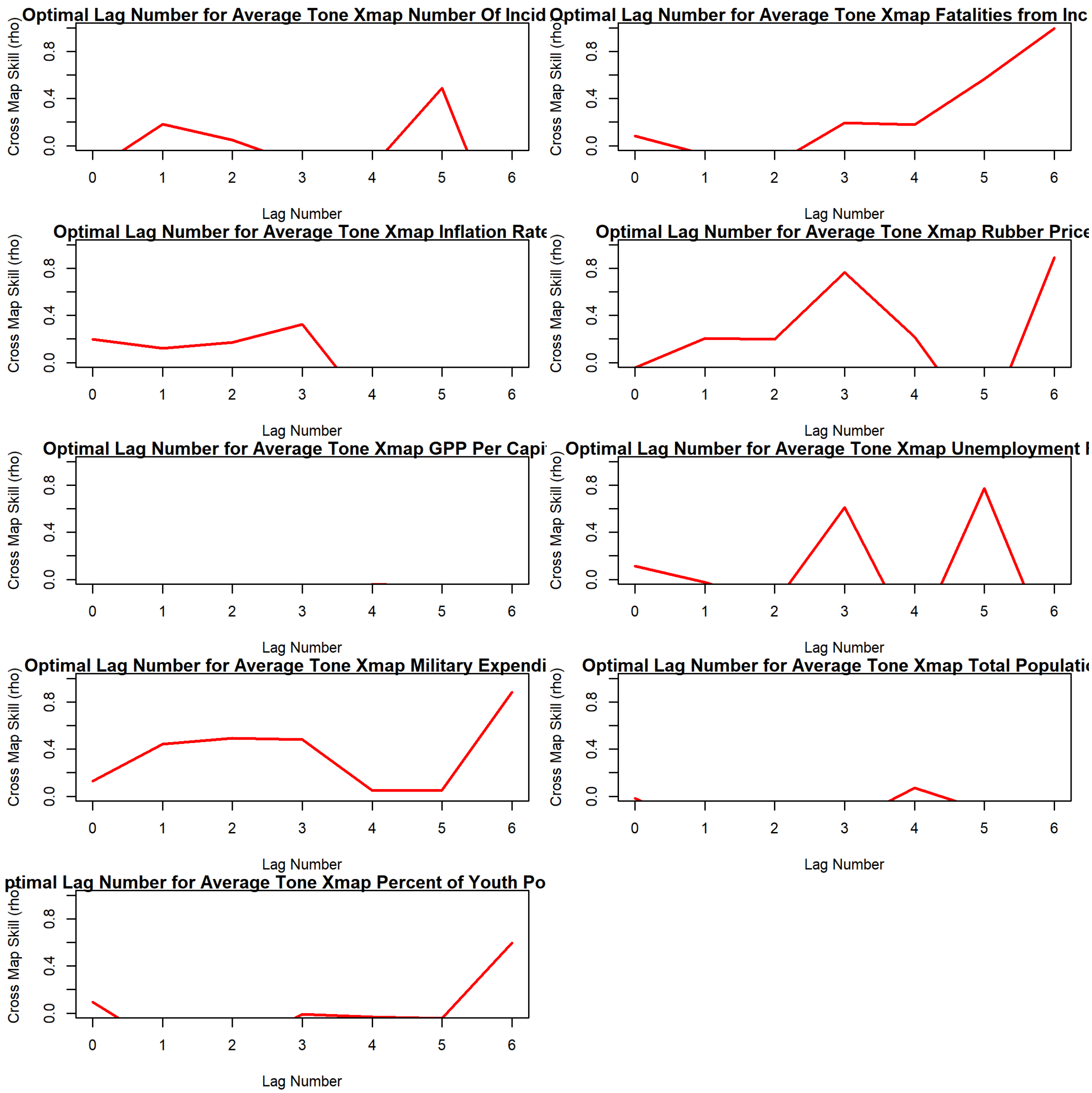


Figure 4-75: The Optimal Lag Number for the Average Tone - Pattani Province

Table 4-28: Predictive Evaluation of CCM Model - Pattani Province shows the forecasting evaluation from the CCM model. The RMSE for the training dataset is larger than the RMSE from the VAR and VECM model. However, the RMSE for the testing dataset is smaller than the training dataset which shows a good sign that the data may need to be modeled under the nonlinear assumption.

DV	RMSE	
	Training	Testing
Number of Incidents	0.975	0.733
Fatalities from Incidents	0.920	0.541

Table 4-28: Predictive Evaluation of CCM Model - Pattani Province

Yala Province

The result of the Simplex Projection is shown in the figure below. And the optimal number of embedding dimensions is shown in Table 4-29: The Optimal Embedding Dimensions - Yala Province.

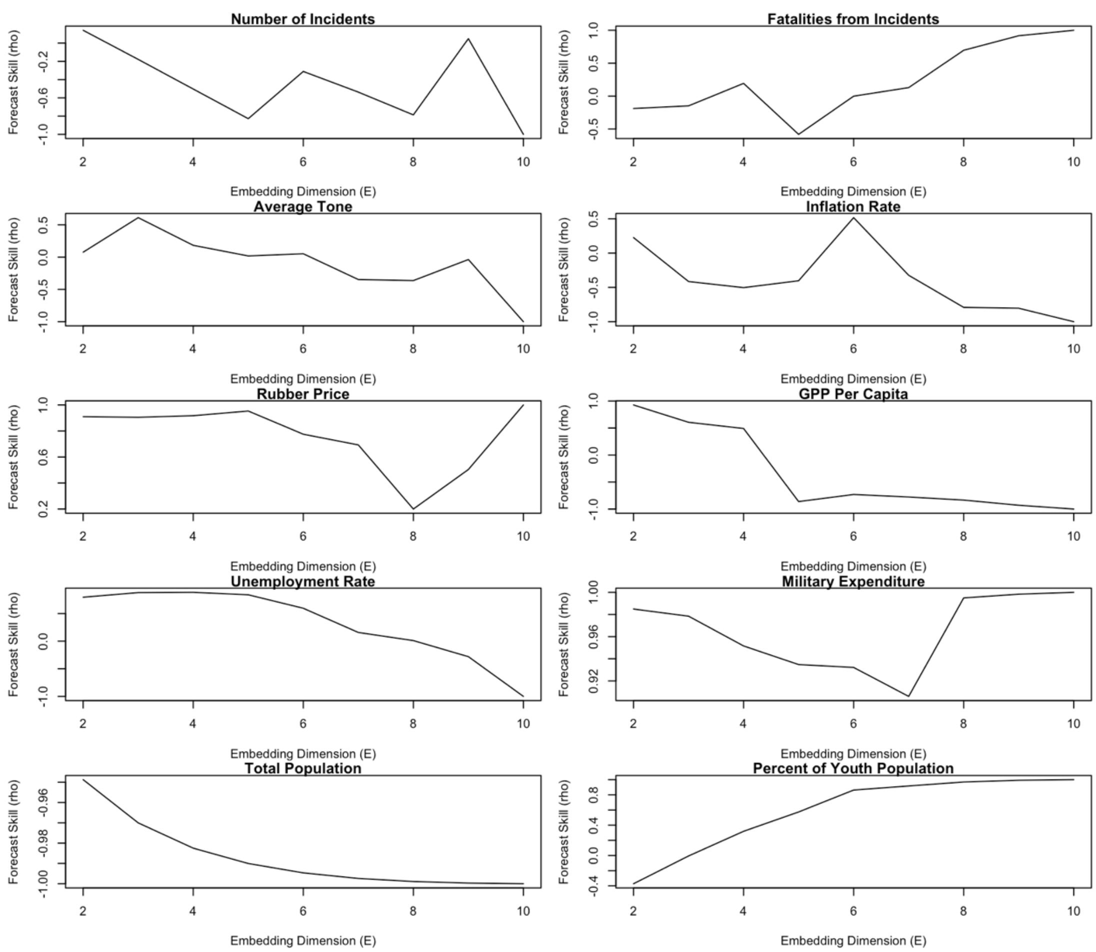


Figure 4-76: Number of Embedding Dimension for all Variables and the Forecast Skill (Rho) - Yala Province

Variables	Optimal Embedding Dimensions
Number of Incidents	2
Fatalities from Incidents	10
Average Tone	3
Inflation Rate	6
Rubber Price	10
GPP Per Capita	2
Unemployment Rate	4
Military Expenditure	10
Total Population	2
Percent of Youth Population	10

Table 4-29: The Optimal Embedding Dimensions - Yala Province

Figure 4-69: S-map Nonlinearity Test and Forecast Skill (Rho) - Pattani Province shows the result from the S-map with the optimal embedding dimensions with the different parameter for the nonlinear index (θ). The results from nonlinear test shows that the number of incidents, the fatalities from incidents, the average tone, the inflation rate, the rubber price, the GPP per capita, the military expenditure, the total population, and the percent of youth population should be modeled as a nonlinear model since the forecast skills are increased when we increase θ. On the other hand, the unemployment rate, is a linear system since the forecast skill at $\theta = 0$ is the highest.

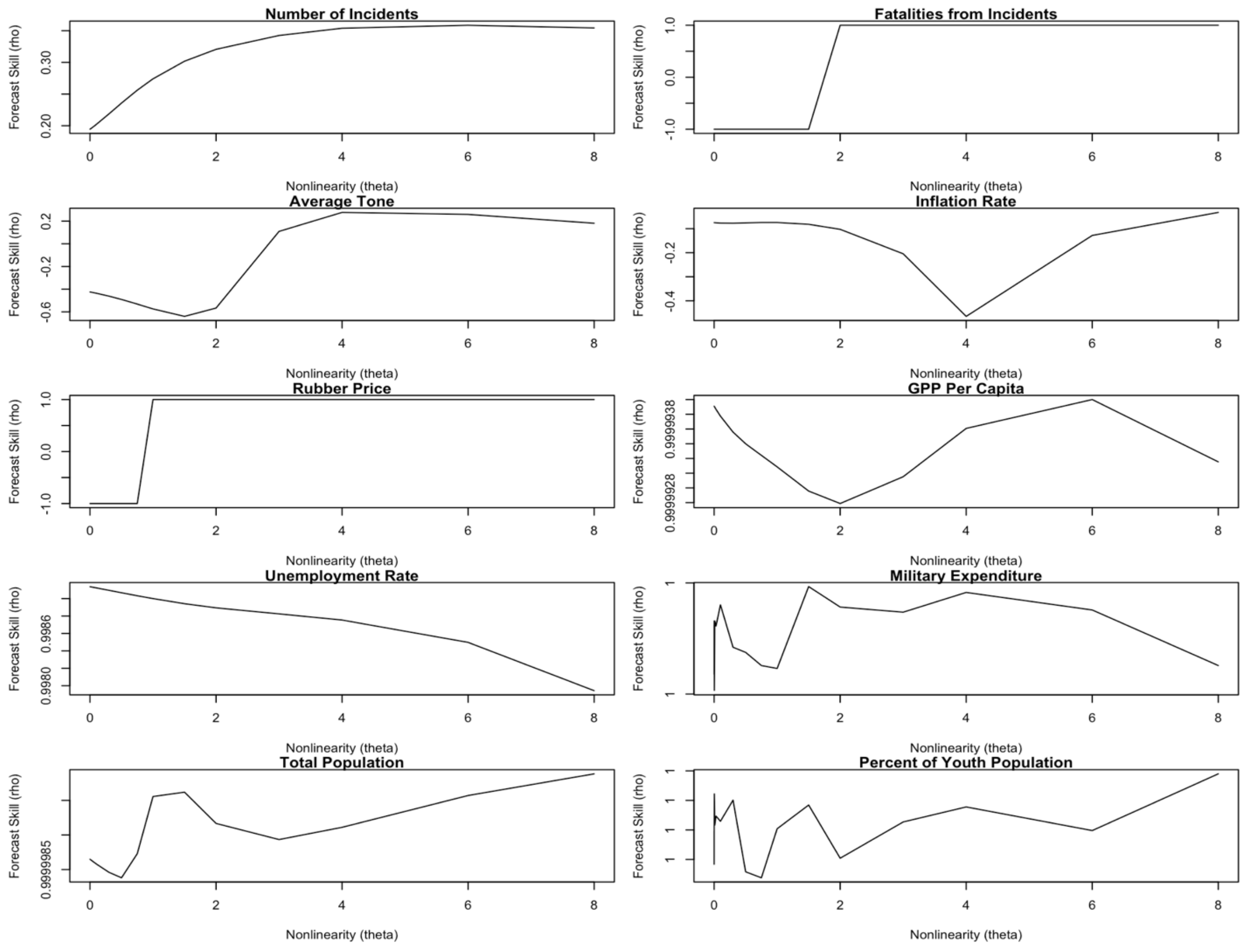


Figure 4-77S-map Nonlinearity Test and Forecast Skill (Rho) - Yala Province

Next, we look at the causality from the Convergent Cross Mapping model based on the optimal number of embedded dimensions. Figure 4-78: Causality Test with Convergent Cross Mapping against Number of Incidents - Yala Province shows the causality derived from CCM method. Based on the results, we do not observe any variables which are able to cross-map to the number of inflation and the cross-map skill exceeds the benchmark level. Only the fatalities from the incidents shows a strong cross-mapping skill, but it is still under the benchmark level from the linear correlation. On the other hand, the unemployment rate shows the CCM causality from the number of incidents that exceeds the linear causality when the library size is above 30 as unemployment rate cross-map the number of incidents.

For the fatalities from the incidents, we observe a moderate CCM causality from the inflation rate and the rubber price to the fatalities from the incidents. The inflation rate's cross-mapping skill match with the benchmark level from the linear correlation. Similar patter can be observed in the CCM causality from the rubber price. The cross-mapping skills from these two variables also consistent across different library size. We also observe the moderate CM causality from the total population, but the cross-mapping skill does not exceed the benchmark level from the linear correlation. Lastly, the fatalities from the incidents shows a moderate CCM causality to the unemployment rate as the unemployment can cross-map to the fatalities from the incidents and the cross-mapping skill exceed the benchmark level.

For the average tone, we do not observe any variable that exhibit a strong CCM causality exceeding the linear correlation benchmark. However, the average tone has a moderate CCM causality towards the military expenditure under the small library size, the unemployment rate and the military expenditure.

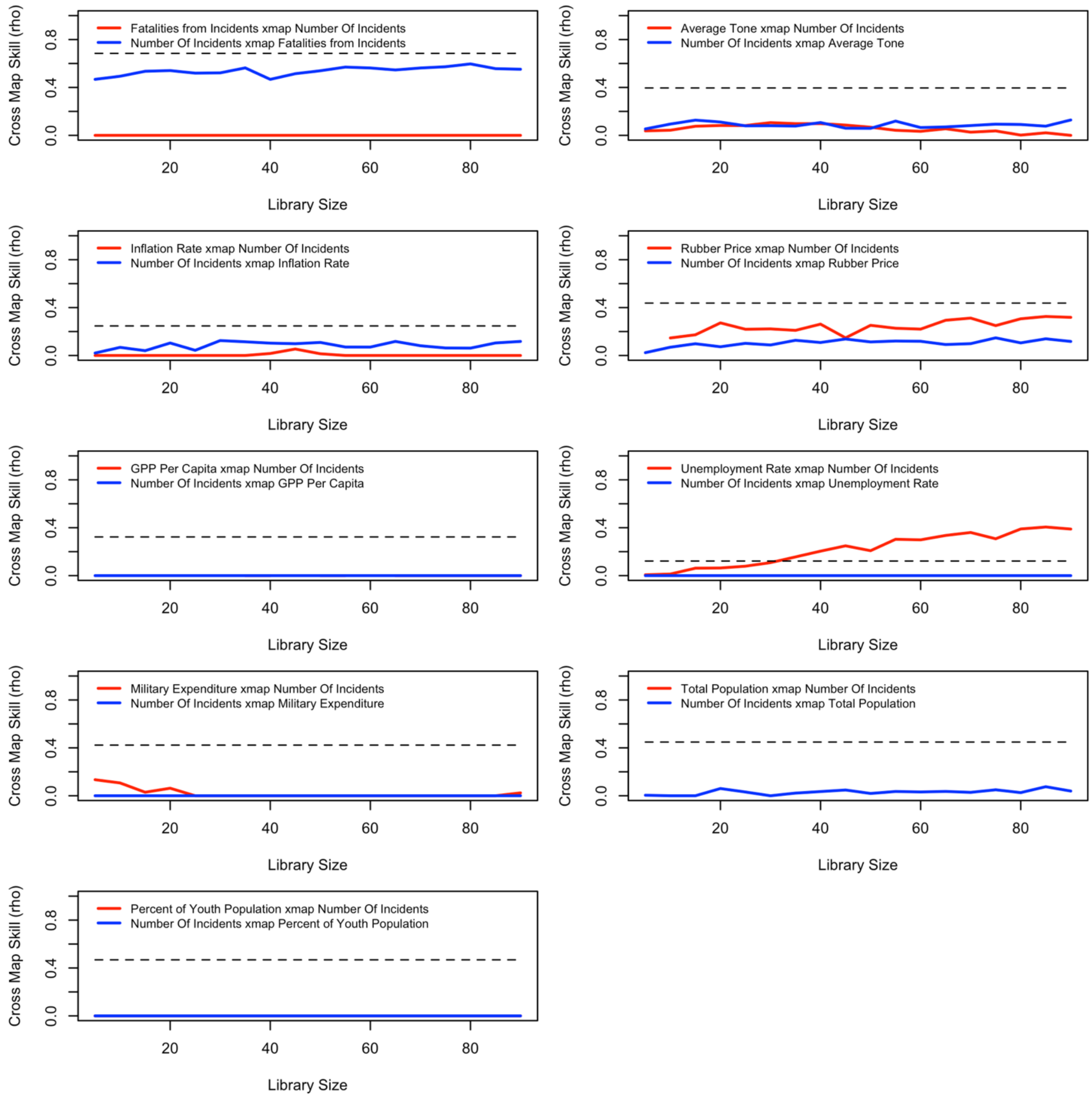


Figure 4-78: Causality Test with Convergent Cross Mapping against Number of Incidents - Yala Province

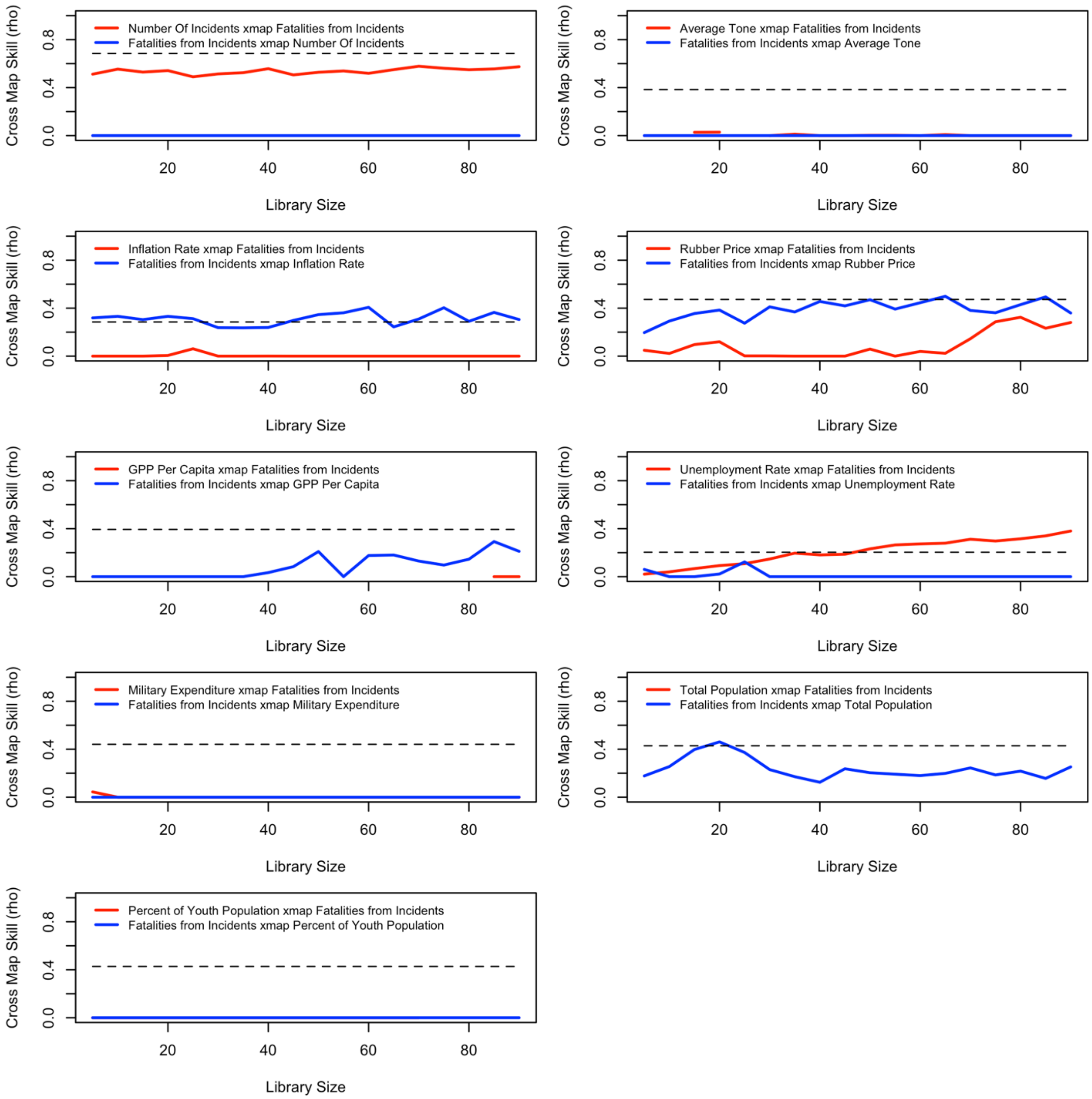


Figure 4-79: Causality Test with Convergent Cross Mapping against Fatalities from Incidents - Yala Province

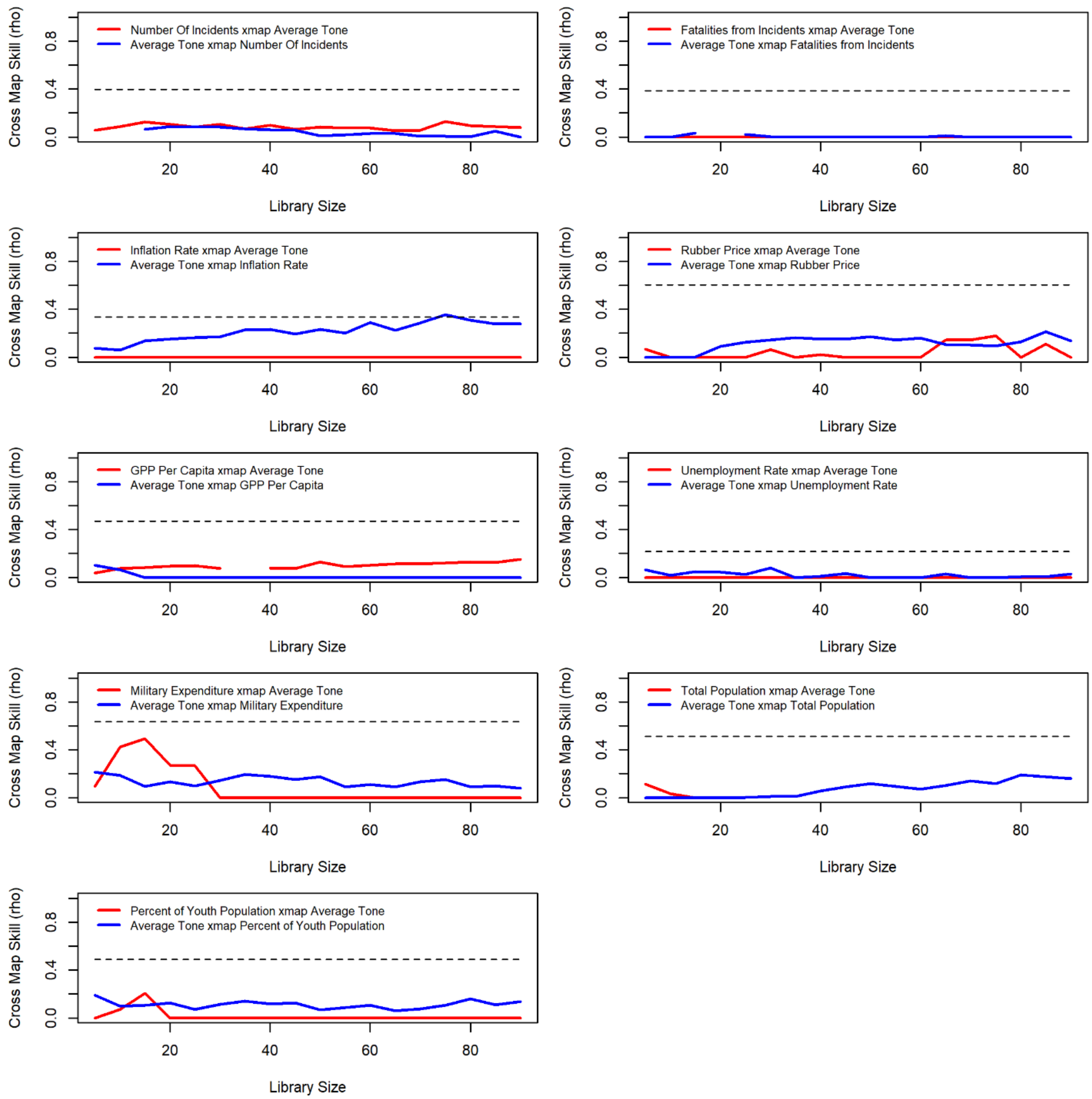


Figure 4-80: Causality Test with Convergent Cross Mapping against Average Tone- VECM Model - Yala Province

The experiment for the optimal lag number in the CCM framework is conducted in a similar setting as the experiment with Pattani dataset. The results are shown in the following figures. For the number of incidents, we can observe that the effect from the fatalities from the incident is strong at 0 lag number and its effect decline over the period of time which suggests that the fatalities from the incidents are more likely to have a short-term effect against the number of incidents. For other variables, the cross-mapping skill shows a small average cross-mapping skill from every time lag number.

For the fatalities from the incidents, we also observe the similar short-term pattern with the number of incidents where the lag number = 0 shows a strong cross-mapping skill before a small decline. The average tone shows a small CCM causality at the lag number = 5. For other factors, only the GPP per capita shows a moderate CCM causality at the lag number equal to 6.

For the average tone, the fatalities from incidents show a moderate effect at the lag number equal to 3 and 5. It strongly suggests that the fatalities from the incidents CCM causes the average tone in a long term, but the short-term effect may be difficult to observe since the cross-mapping skill values at the early periods are close to zero. The cross-mapping skill from the inflation rate shows a moderate result at the early lag number which suggest the short-term impact from the inflation rate. The military expenditure shows a moderate CCM causality at the lag number equal to 5. The other variables have a very small CCM causality effect.

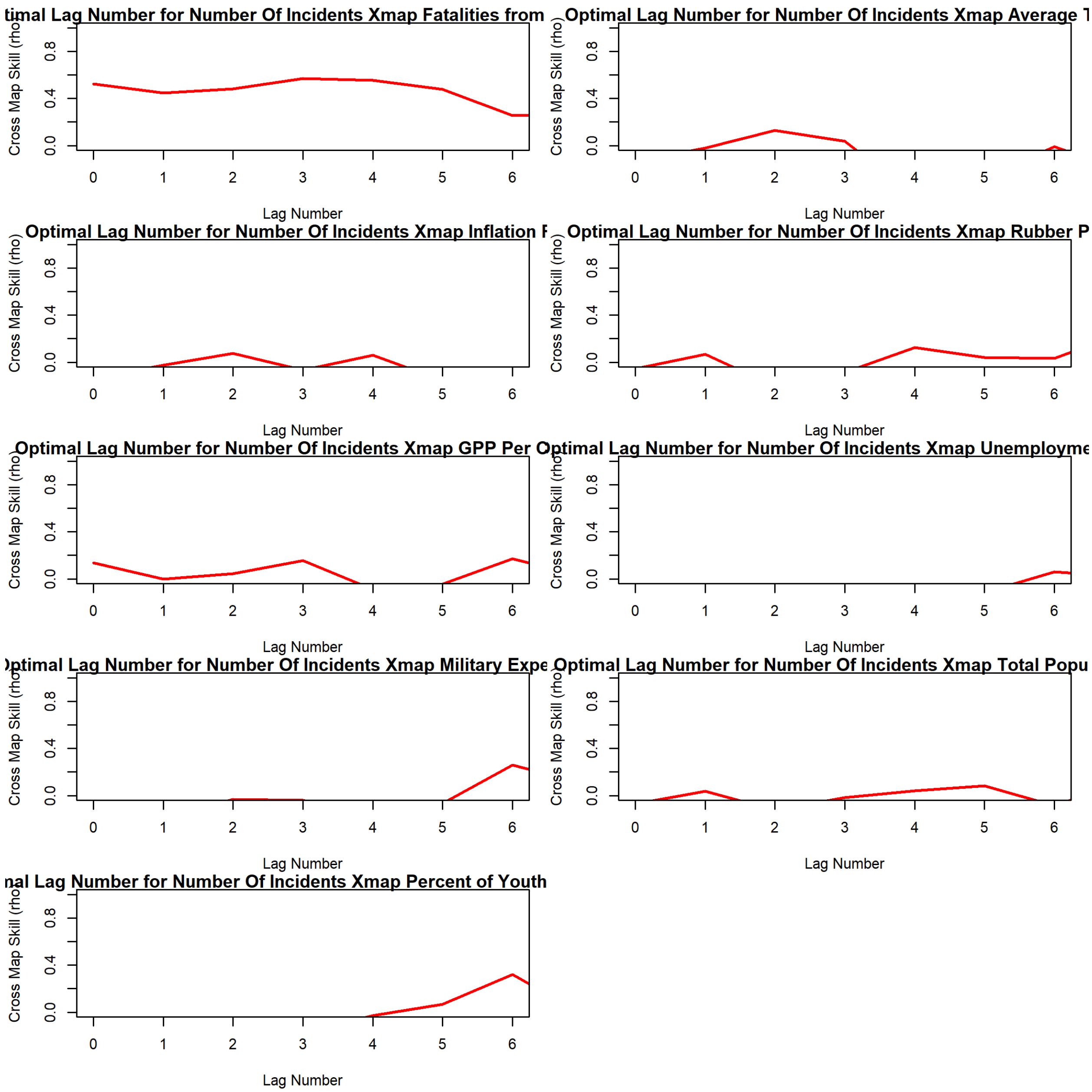


Figure 4-81: The Optimal Lag Number for the Number of Incidents - Yala Province

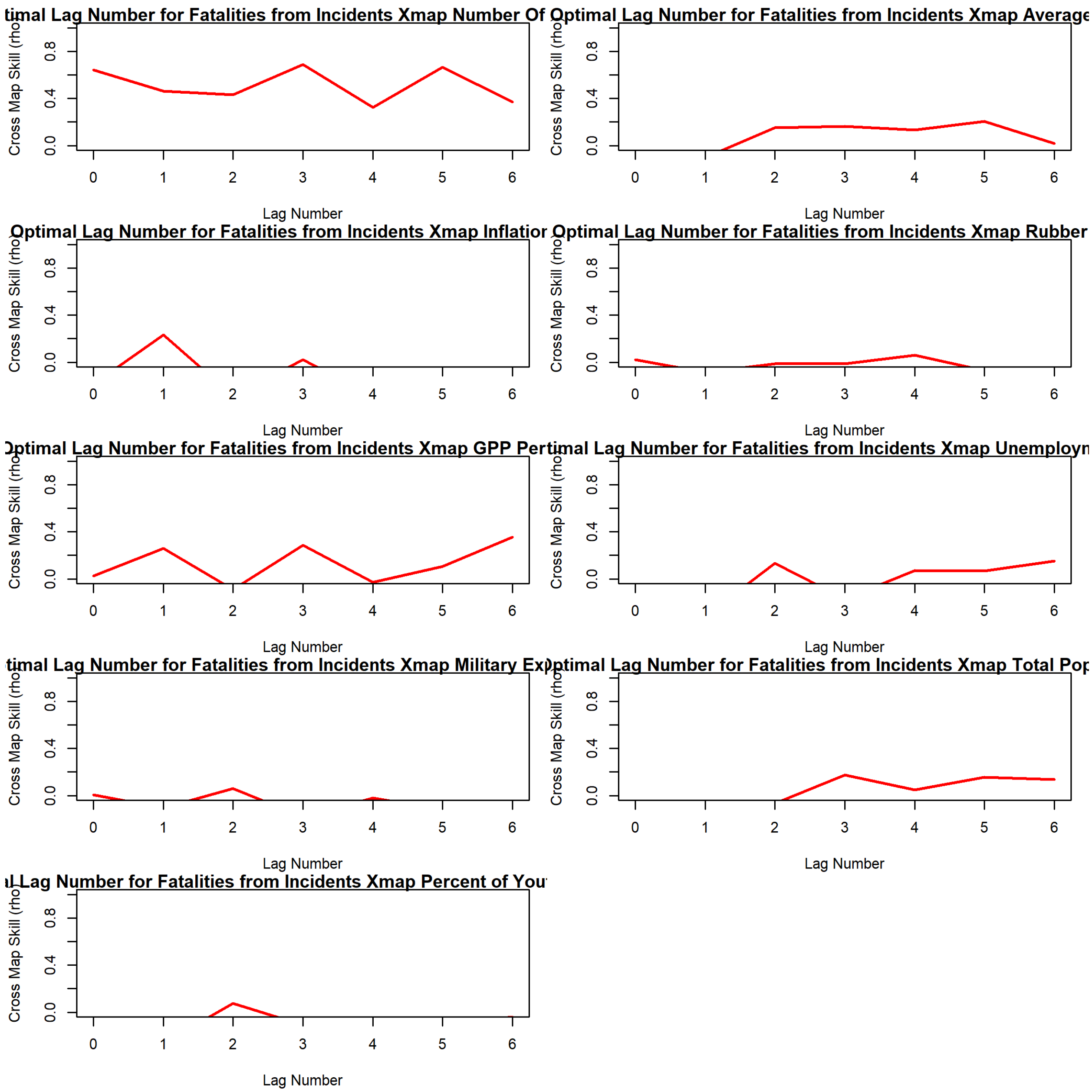


Figure 4-82: The Optimal Lag Number for the Fatalities from Incidents - Yala Province

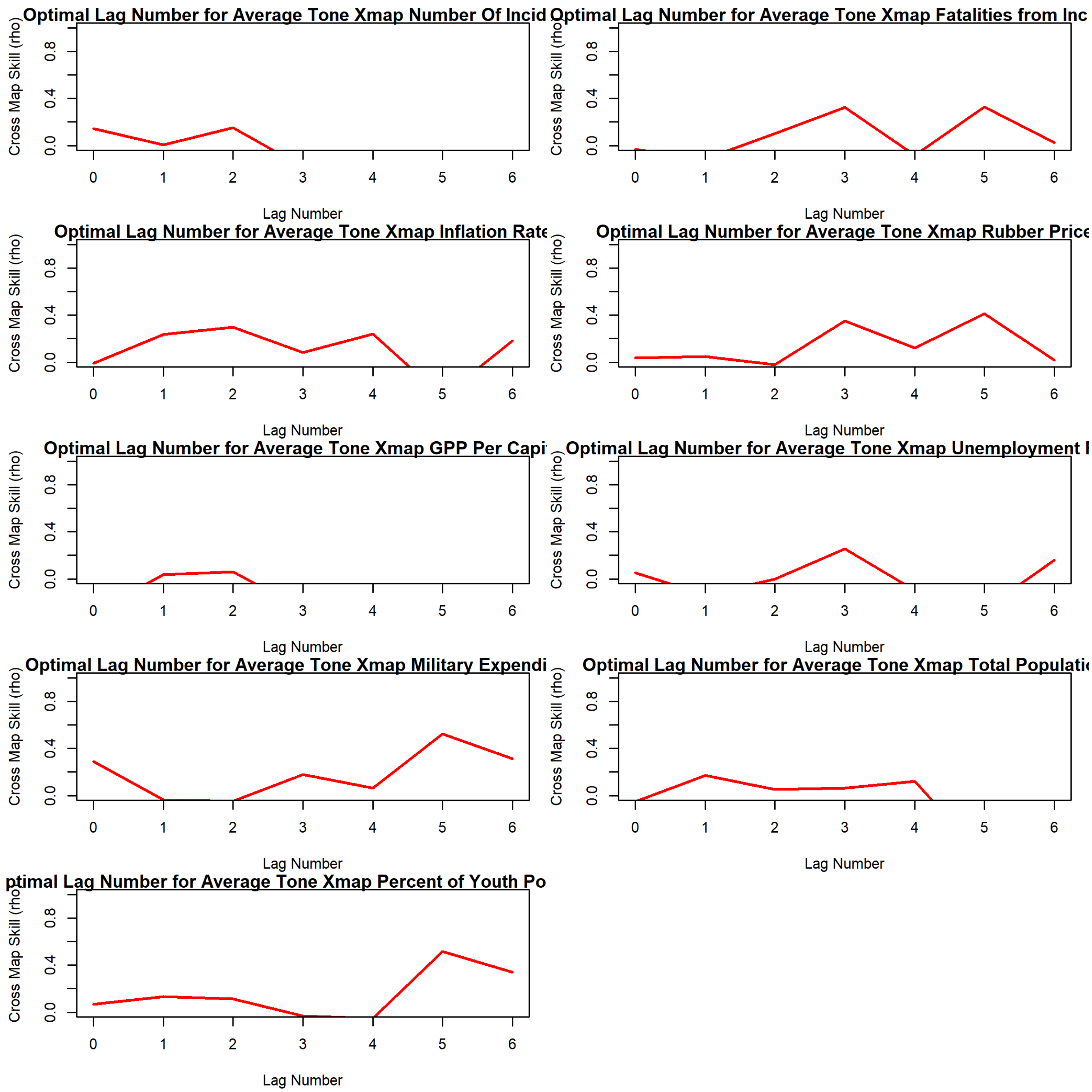


Figure 4-83: The Optimal Lag Number for the Average Tone - Yala Province

Table 4-30: Predictive Evaluation of CCM Model - Yala Province shows the forecasting evaluation from the CCM model. The RMSE for the training dataset is larger than the RMSE from the VAR and VECM model. However, the RMSE for the testing dataset is smaller than the training dataset which shows a good sign that the data may need to be modeled under the nonlinear assumption.

DV	RMSE	
	Training	Testing
Number of Incidents	0.952	0.735
Fatalities from Incidents	0.948	0.507

Table 4-30: Predictive Evaluation of CCM Model - Yala Province

Narathiwat Province

The result of the Simplex Projection is shown in the figure below. And the optimal number of embedding dimensions is shown in Table 4-31: The Optimal Embedding Dimensions - Narathiwat Province.

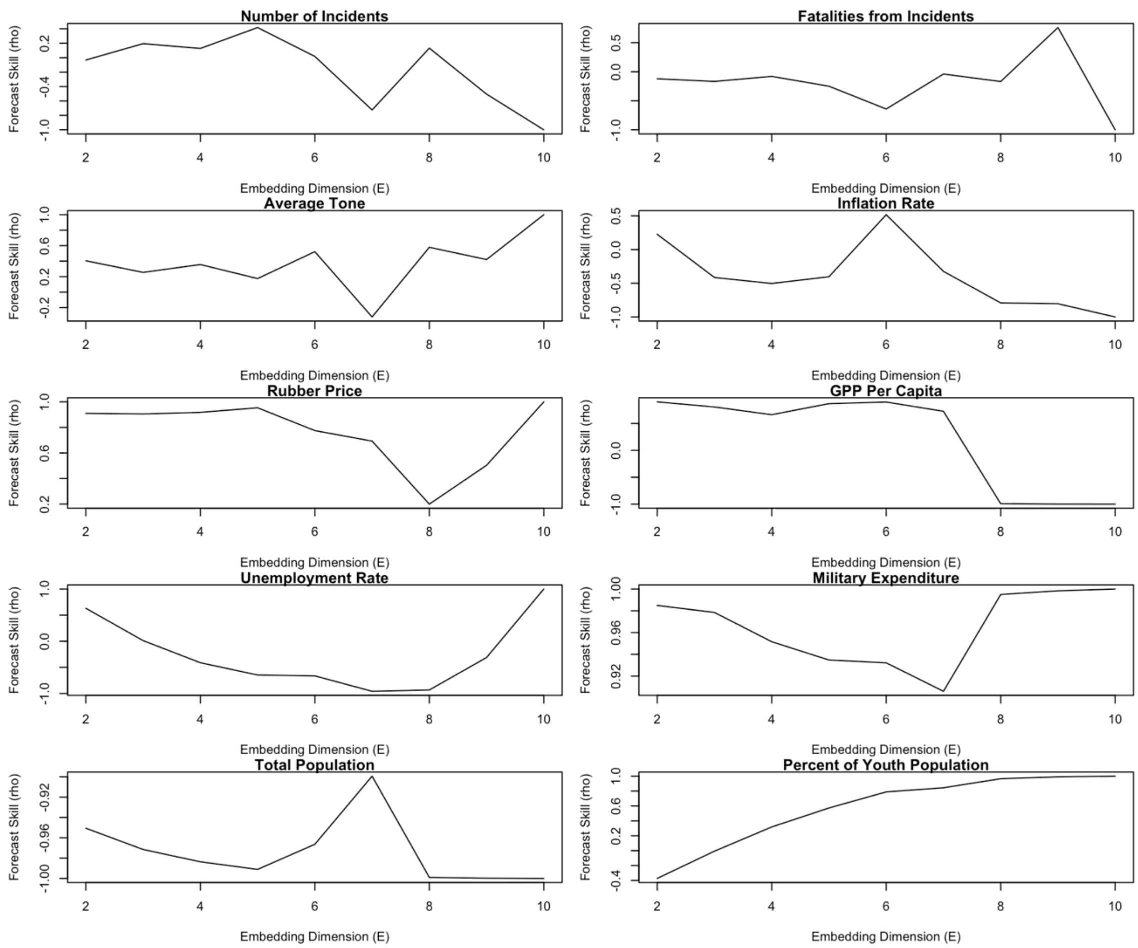


Figure 4-84: Number of Embedding Dimension for all Variables and the Forecast Skill (Rho) - Narathiwat Province

Variables	Optimal Embedding Dimensions
Number of Incidents	5
Fatalities from Incidents	9
Average Tone	10
Inflation Rate	6
Rubber Price	10
GPP Per Capita	2
Unemployment Rate	10
Military Expenditure	10
Total Population	7
Percent of Youth Population	10

Table 4-31: The Optimal Embedding Dimensions - Narathiwat Province

Figure 4-85: S-map Nonlinearity Test and Forecast Skill (Rho) - Narathiwat Province shows the result from the S-map with the optimal embedding dimensions with the different parameter for the nonlinear index (θ). The results from nonlinear test shows that the average tone, the inflation rate, the rubber price, the military expenditure, and the total population should be modeled as a nonlinear model since the forecast skills are increased when we increase θ. On the other hand, the number of incidents, the fatalities from incidents, the GPP per capita, the unemployment rate, and the percent of youth population are a linear system since the forecast skill at $\theta = 0$ is the highest.

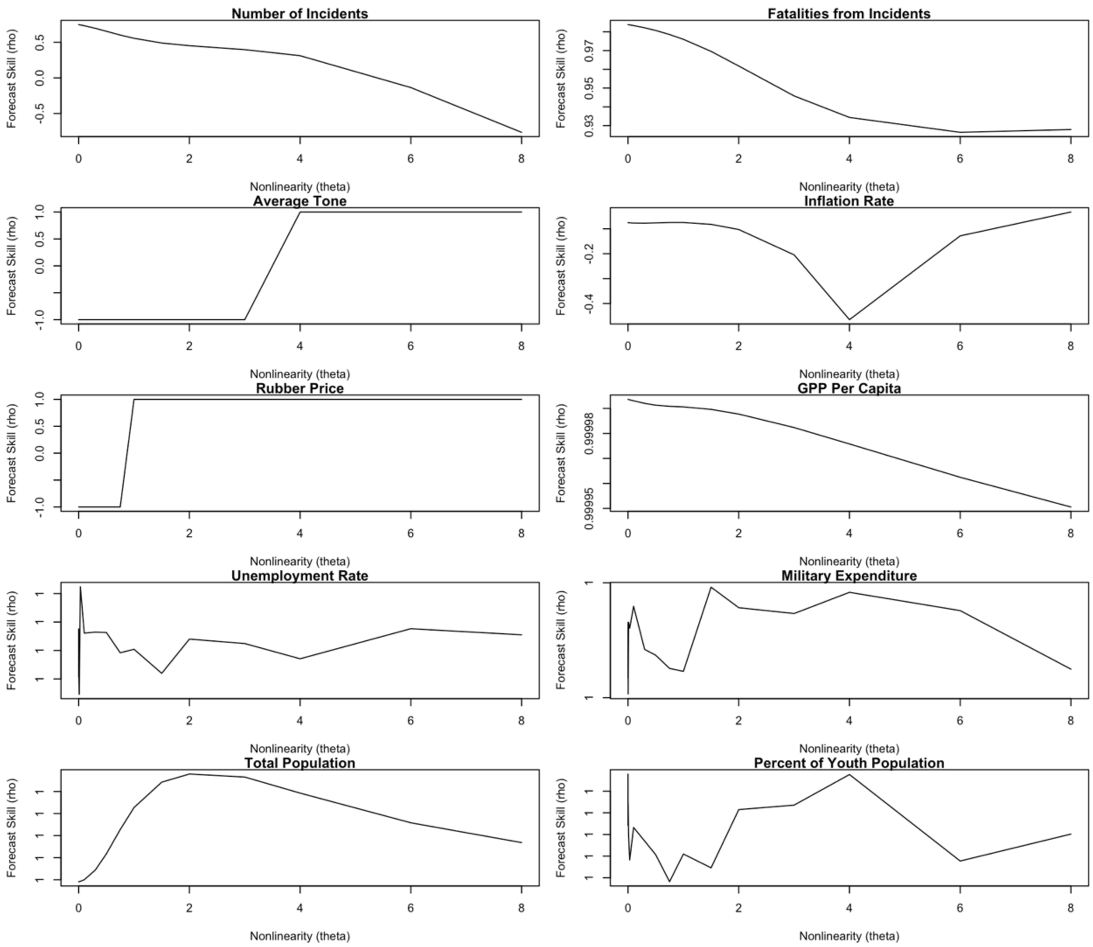


Figure 4-85: S-map Nonlinearity Test and Forecast Skill (Rho) - Narathiwat Province

Next, we look at the causality from the Convergent Cross Mapping model based on the optimal number of embedded dimensions. Figure 4-86: Causality Test with Convergent Cross Mapping against Number of Incidents - Narathiwat Province shows the causality derived from CCM method. Based on the results, we observe the strong CCM causality between the number of incidents and the unemployment rate in both direction and the cross-mapping skill almost double the value of the benchmark from linear correlation. This result suggests a strong coupling or synchronization phenomenon between the unemployment rate and the number of incidents. However, we do not observe this pattern with other variables. The fatalities from the incidents and the rubber price show a small CCM causality against the number of incidents, and the effects are below the benchmark level. Most of the variables do not show the CCM causality to the number of incidents. On the other hand, we observe a strong CCM causality from the number of incidents to the military expenditure and the percent of youth population.

For the fatalities from the incidents, we observe a strong CCM causality from the GPP per capita to the fatalities from the incidents. The GPP per capita starts to show a strong sign of CCM causality when we increase the library size in the test. We also observe a similar pattern with the military expenditure, but the magnitude is smaller. The inflation rate's cross-mapping skill match with the benchmark level from the linear correlation. The inflation rate and the unemployment rate show a moderate CCM causality to the fatalities from incidents and their effect also exceeds the benchmark level from the linear correlation. The cross-mapping skills from these two variables also consistent across different library size. The average tone shows a moderate CCM causality when the size of the library is increased, but the effect is below the benchmark level. The CCM causality from the number of incidents and the total population is small and under the benchmark level.

For the average tone, we do not observe any variable that exhibit a strong CCM causality exceeding the linear correlation benchmark. However, the average tone has a strong CCM causality towards the unemployment rate, the military expenditure, and the percent of youth population consistently across different library sizes.

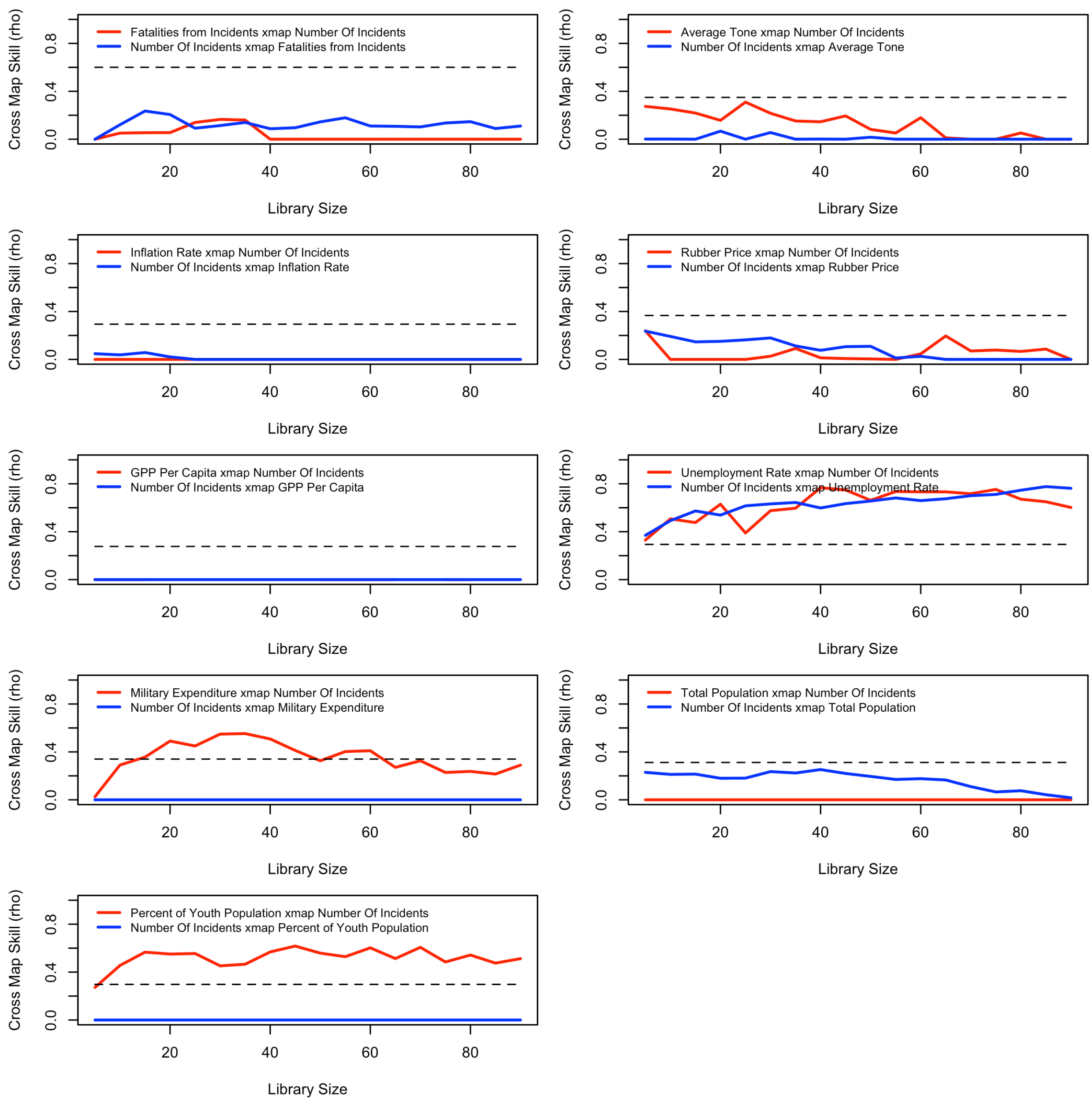


Figure 4-86: Causality Test with Convergent Cross Mapping against Number of Incidents - Narathiwat Province

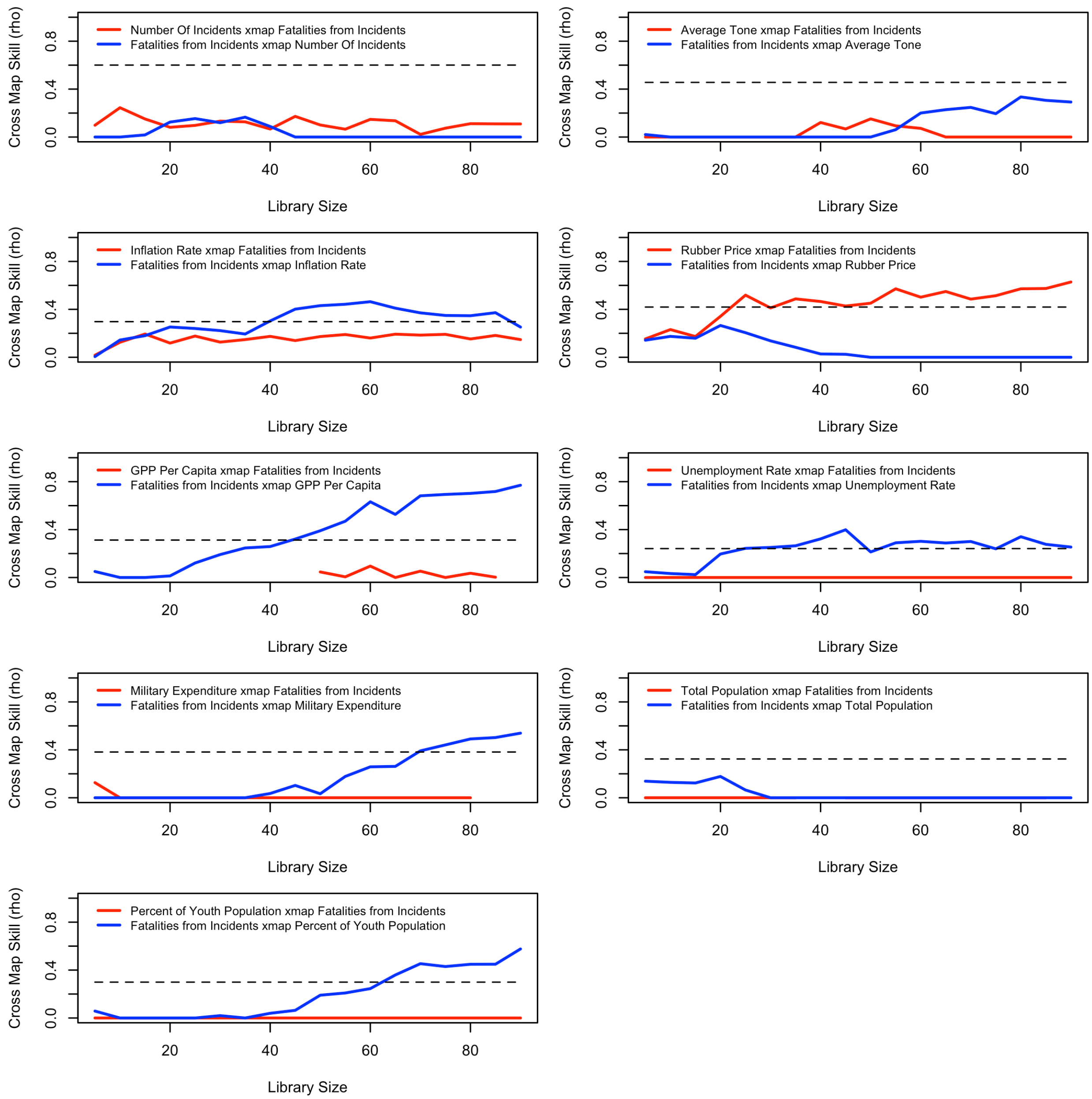


Figure 4-87: Causality Test with Convergent Cross Mapping against Fatalities from Incidents - Narathiwat Province

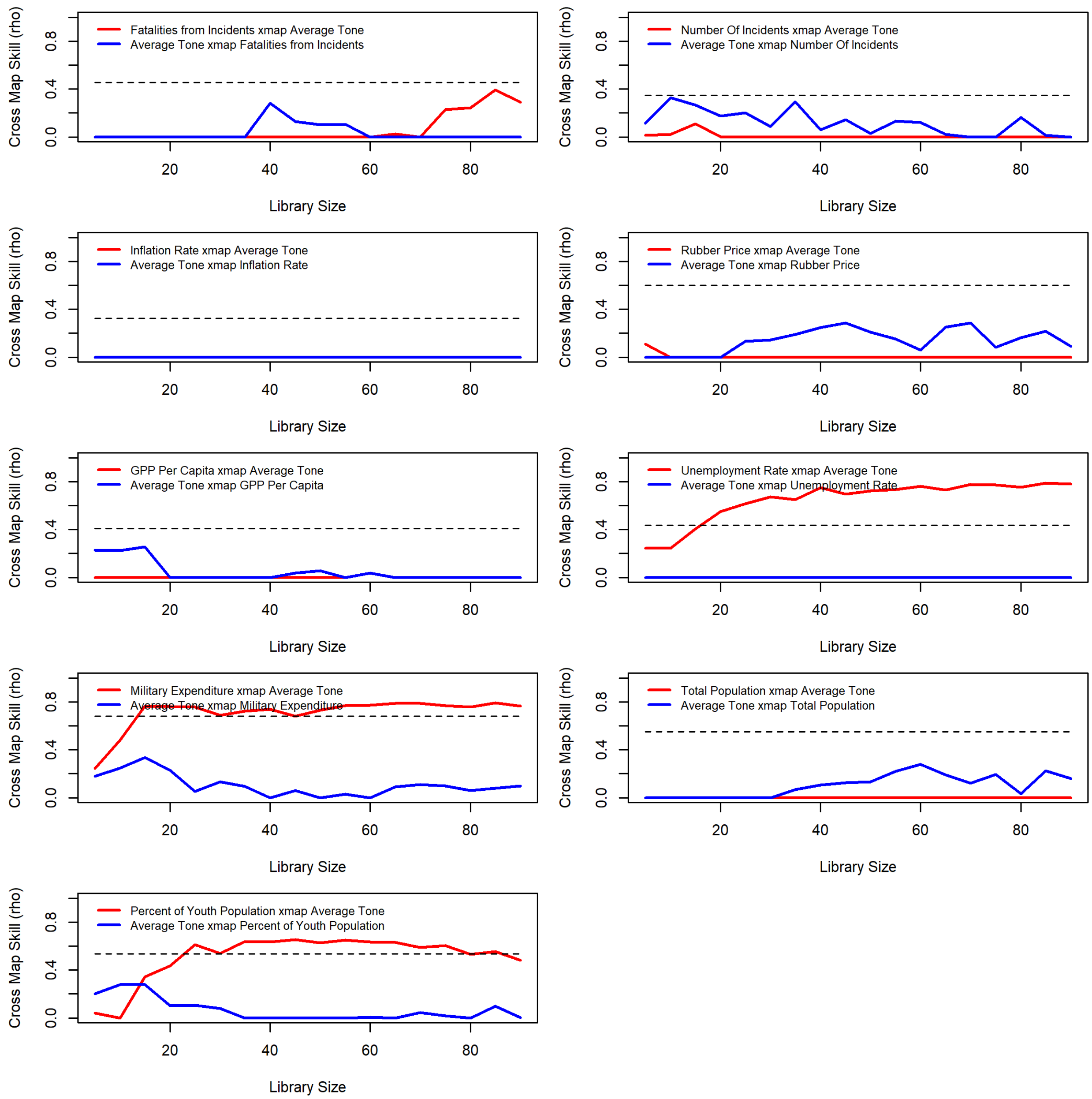


Figure 4-88: Causality Test with Convergent Cross Mapping against Average Tone- VECM Model - Narathiwat Province

The experiment for the optimal lag number in the CCM framework is conducted in a similar setting as the experiment with Pattani dataset. The results are shown in the following figures. For the number of incidents, we can observe that the effect from the average tone at the lag number equal to 4 which suggest a time-delayed effect from the average tone to the number of incidents. We observe a similar pattern in the rubber price, the GPP per capita, the military expenditure and the percent of youth population. On the other hand, the unemployment rate shows a shorter effect towards the number of incidents.

For the fatalities from the incidents, we also observe the long-term effect with the inflation rate where the lag number = 4 shows a strong cross-mapping skill. The other variables show a small effect of CCM causality across different number of lag periods.

The similar long-term effect with the inflation rate can be observed in the average tone where the lag number = 4 shows a strong cross-mapping skill. The other variables show a small effect of CCM causality across different number of lag periods.

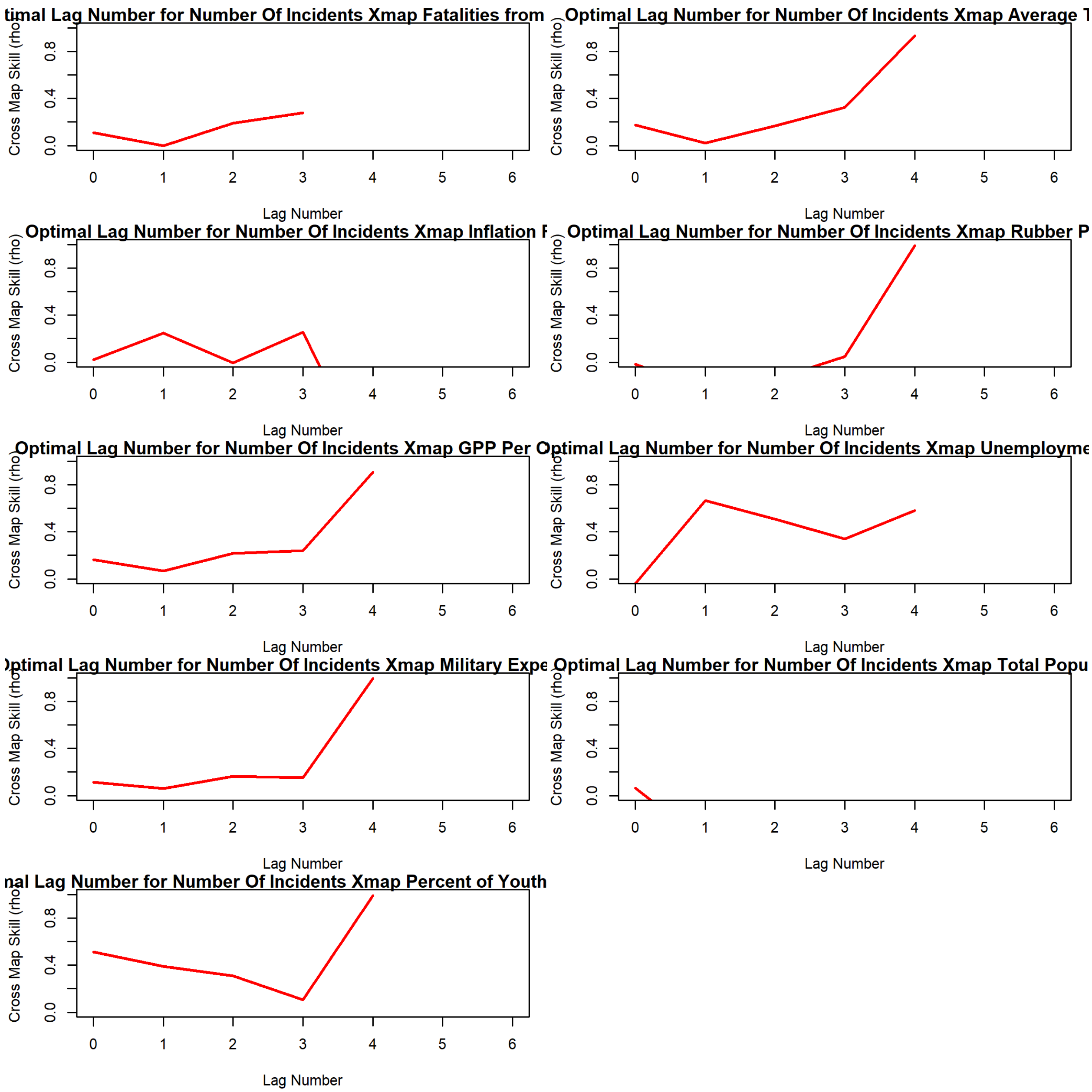


Figure 4-89: The Optimal Lag Number for the Number of Incidents - Narathiwat Province

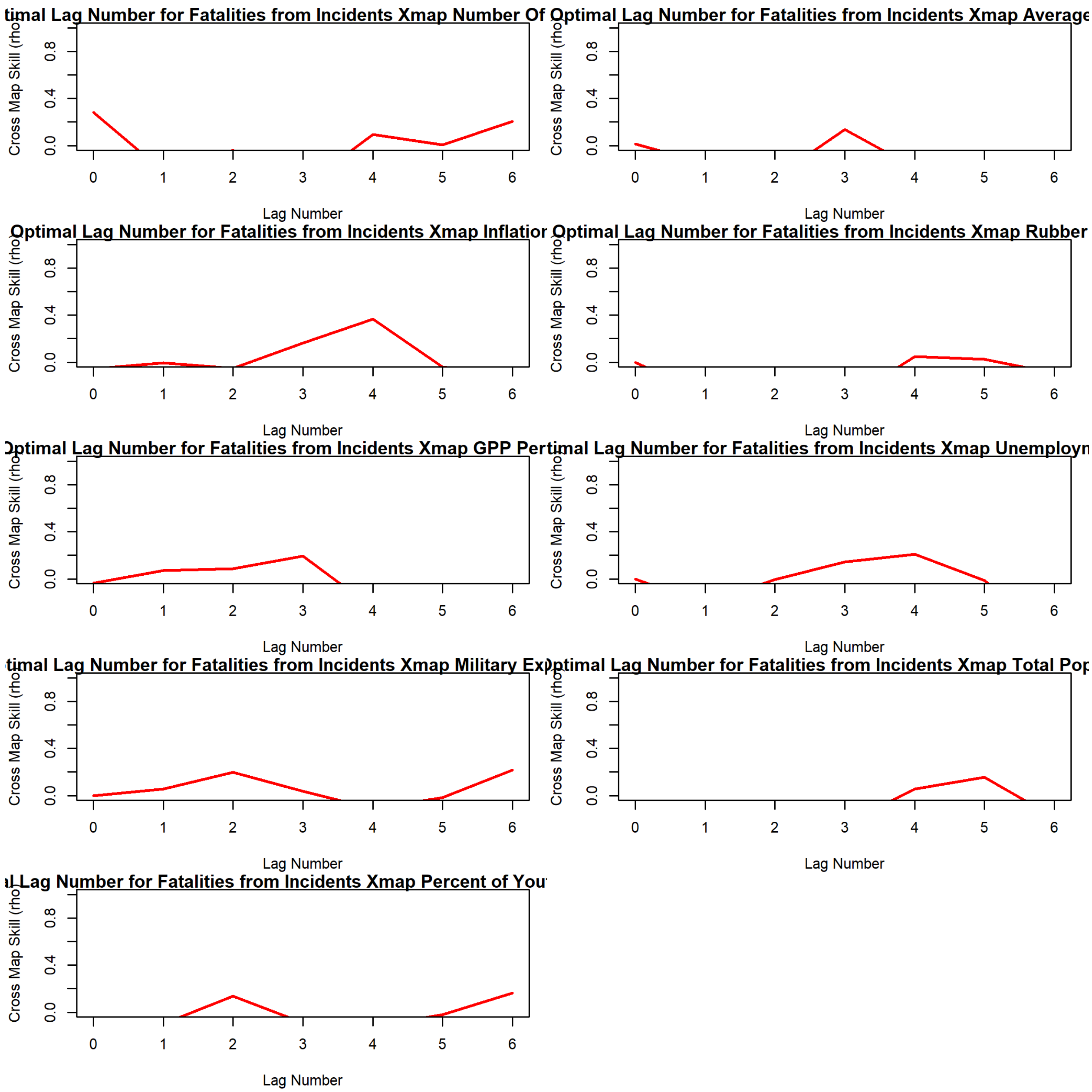


Figure 4-90: The Optimal Lag Number for the Fatalities from Incidents - Narathiwat Province

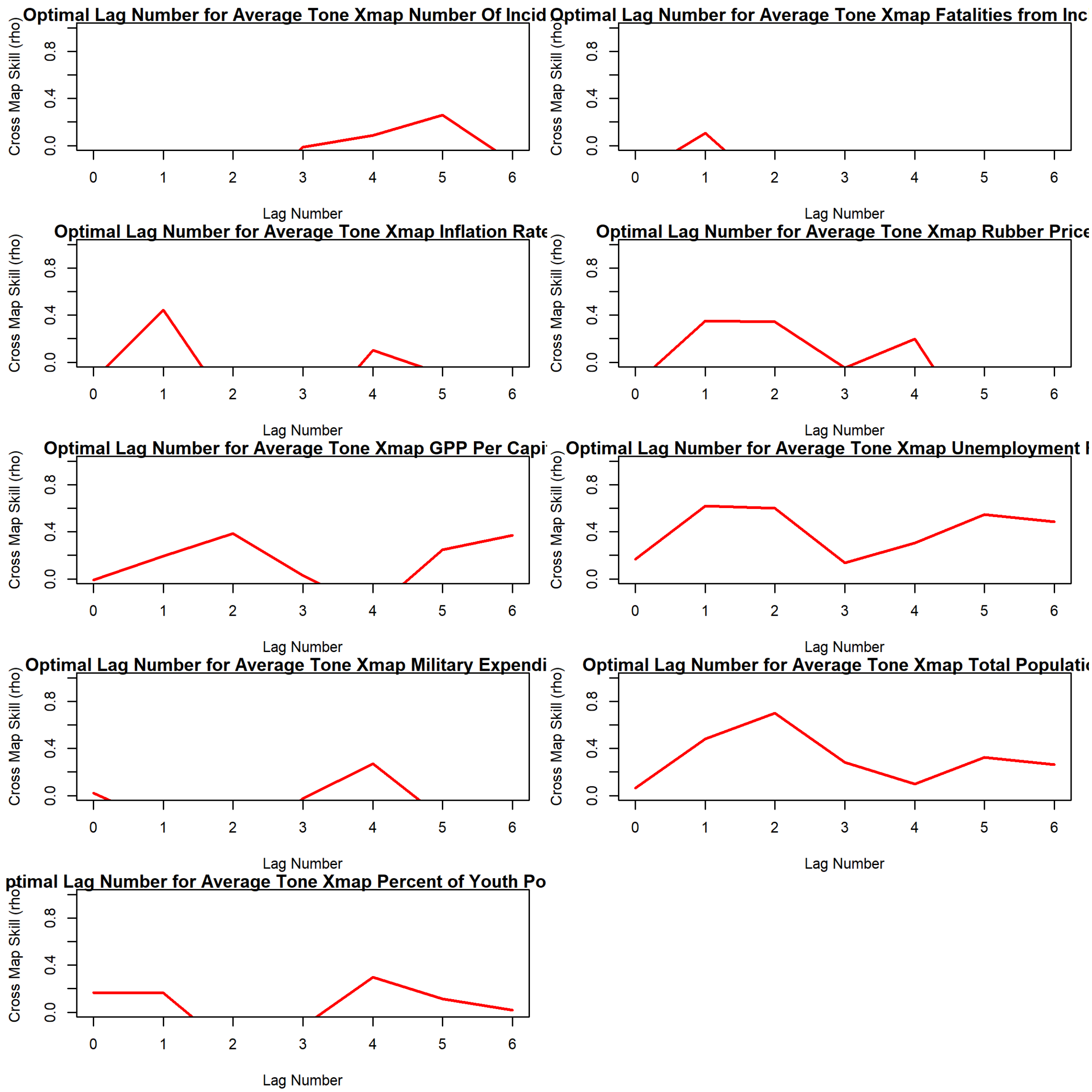


Figure 4-91: The Optimal Lag Number for the Average Tone - Narathiwat Province

Figure 4-31: Fitted Value and Residuals of Number of Incidents from VAR models - Pattani Province shows the forecasting evaluation from the CCM model. The RMSE for the training dataset is larger than the RMSE from the VAR and VECM model. However, the RMSE for the testing dataset is smaller than the training dataset which shows a good sign that the data may need to be modeled under the nonlinear assumption.

DV	RMSE	
	Training	Testing
Number of Incidents	0.986	0.680
Fatalities from Incidents	0.953	0.486

Table 4-32: Predictive Evaluation of CCM Model - Narathiwat Province

Table 4-33: Summary of Cross-Mapping Causality with 3 main variables shows the causality across three provinces. The results show that the socio-economic factors have a cross-mapping causality against the level of violence across three provinces. The inflation rate has a causality in all three provinces, while the unemployment rate shows a strong causality in Pattani and Narathiwat. The political demographics factors show a cross-mapping causality in Yala and Narathiwat. The military expenditure effect can only be observed in Narathiwat. Unfortunately, we do not observe a cross-mapping causality between the public sentiment and the level of violence. In addition, the result suggests that these three provinces are heterogenous since Narathiwat shows many signs of causality, while Pattani and Yala have a limited number of causality.

Province	Findings	
	Independent Variable	Dependent Variable
Pattani	Inflation rate	The number of incidents
	Unemployment rate	The number of incidents
	Unemployment rate	The fatalities from incidents
Yala	The number of incidents	Unemployment rate
	Inflation rate	The fatalities from incidents
	Rubber price	The fatalities from incidents
	Total population	The fatalities from incidents
	Inflation rate	Average tone
Narathiwat	The number of incidents	Unemployment rate
	Unemployment rate	The number of incidents
	The number of incidents	Military Expenditure
	The number of incidents	Percent of youth population
	The fatalities from incidents	Rubber price
	Inflation rate	The fatalities from incidents
	GPP per capita	The fatalities from incidents
	Unemployment rate	The fatalities from incidents
	Military Expenditure	The fatalities from incidents
	Percent of youth population	The fatalities from incidents
	Average tone	Unemployment rate
	Average tone	Military Expenditure
	Average tone	Percent of youth population

Table 4-33: Summary of Cross-Mapping Causality with 3 main variables

Chapter 5: Discussion

Summary

In this section, we will summarize the research findings based on the hypotheses proposed in the Chapter 3.

Research Hypotheses

H1: Short-term and long-term negative public sentiment increases domestic instability.

The results from the Granger causality test shows the Granger causality from the average tone to the number of incidents at 95% confidence level in Pattani and at 90% confidence level in Narathiwat, but the Granger causality between the average tone to the number of incidents cannot be found in Yala province. The results from VAR models in the three provinces also does not support the hypothesis that the public sentiment has a causality to the conflict, either the prevalence or the severity of the conflict. On the other hand, the results from the VECM models shows that the average tone may have an impact on the level of conflict as the short-term adjustment. In Pattani Model, the second lag order of differenced average tone is statistically significant at 90% confidence level in the fatalities from the incidents model. In Yala, the second lag order of differenced average tone is statistically significant at 95% confidence level in the number of incidents model. Also, the first lag order of differenced average tone is statistically significant at 95% confidence level in the number of incidents model in Narathiwat province. Next, we investigate the causality between public sentiment and the level of intrastate conflict under nonlinear assumptions. The result from CCM shows that the CCM causality between these two variables is not present in all three provinces dataset.

In summary, the evidence of the causality from the public sentiment to the level of conflict as a short-term relationship weakly suggests that there is a short-term relationship between the them. However, only the Granger causality test and VECM estimation confirm this relationship. Also, if we set the confidence level at 95%, the evidence supporting this hypothesis will become much weaker. Lastly, the absence of the short-term effect from the public sentiment towards the level of intrastate conflict in VAR estimation is more likely to support the rejection of this hypothesis.

For the long-term effect, the VECM estimation provides an insight on the long-term effect of the public sentiment to the level of violence from intrastate conflict. In Pattani province, we observe the error correction terms from the average terms is statistically significant at 95% confidence level. The IRF from the average tone, although, is not statistically significant, it projects that the effect of the average tone has a long-term positive effect to both the number of incidents and the fatalities from the incidents. The similar result can also be found in Narathiwat case where the error correction terms from the average terms is statistically significant at 95% confidence level, but the IRF is not statistically significant. In Yala province, the error correction terms and the IRF from the average terms is not statistically significant and the direction of the effect is positive. Next, we investigate the long-term effect by CCM method. The result shows that the optimal numbers of lag for the average tone to the number of incidents in Pattani and in Narathiwat are 6 and 4 respectively. This suggests the long-term causality from the public sentiment towards the level of violence from the intrastate conflict. However, we do not observe the CCM causality in Yala dataset.

In summary, the evidence from Pattani province and Narathiwat province suggests that the public sentiment may have a long-term effect on the level of violence from the intrastate conflict.

However, the evidences found in this study can be considered weak since the IRF from the estimation is not significant and we cannot find the evidence in Yala case.

H2: Short-term and long-term domestic instability increases negative public sentiment

Based on the evidence from the Granger causality test, the Granger causality from the level of violence from intrastate conflict to the public sentiment cannot be observed in all three provinces cases. The results from VAR models in the three provinces also does not support this hypothesis as none of the level of violence from intrastate conflict is statistically significant in all three provinces datasets. For the VECM models, we cannot find any short-term relationship from the level of violence from intrastate conflict to the public sentiment in Pattani province and in Yala province. However, we observe the short-term adjustment from the number of incidents in the second order lag differenced number of incidents at 95% confidence level and the third order lad differenced number of incidents at 90% confidence level. The third order lag differenced number of incidents also shows a statistically significant short-term adjustment at 90% confidence level. Next, we investigate the causality between public sentiment and the level of intrastate conflict under nonlinear assumptions. The result from CCM shows that the CCM causality between these two variables is not present in Pattani dataset and in Yala dataset. However, in Narathiwat dataset, we observe a small CCM causality from the number of incidents to the average tone, but the CCM causality does not exceeds the benchmark level from linear correlation. The optimal lag number experiment suggests that the causality from the number of incidents to the average tone is short-term since the optimal number is at 1.

In summary, most of the evidence from the study strongly suggest that the hypothesis the level of conflict from intrastate conflict to the public sentiment is not true. We can only observe the trace of the short-term causality only in Narathiwat dataset. Nevertheless, the statistical estimates that support this proposition is still not strong since they are at 90% confidence level. The results from the CCM also does not strongly support this hypothesis. We only observe the small to medium CCM causality from the level of violence from intrastate conflict to the public sentiments.

The results from the VECM estimation does not show any sign of the long-term effect of the level of violence from the intrastate conflict to the public sentiment. All three provinces estimations show statistically insignificant result in the error correction terms from the level of violence from the intrastate conflict. The IRF from both the number of incidents and the fatalities from the incidents show a negative effect to the average tone. Unfortunately, the IRF in all three provinces are not statistically significant. In the CCM method, we find the long-term moderate effect from the number of incidents and the long-term strong effect from the fatalities from the incidents to the average terms as the optimal number of lags is equal to 5 and 6 respectively. However, we do not find the same results in Yala province and Narathiwat Province.

In summary, the hypothesis that the level of violence from the intrastate conflict has a long-term effect to the public sentiment is not well supported by the evidence from the study. The VECM estimation cannot confirm this hypothesis, while the results from nonlinear techniques from CCM methods only shows the evidence from one province.

H5: Socio-economic conditions decrease domestic instability.

The results from the Granger causality test show that the socio-economic factors Granger cause the level of violence from intrastate conflict in all three provinces. The opposite direction can only be found in Pattani province where the fatalities from incidents Granger cause the inflation rate at 95% confidence level. In the VAR estimation, we also see the same conclusion from the Granger causality test. The socio-economic factors have a statistically significant coefficients in both the number of incidents model and the fatalities from the incidents model in all three provinces. However, we do not observe the opposite direction since neither the number of incidents nor the fatalities from incidents have a statistically significant coefficients in the socio-economic variable models. The VECM estimation also confirm the causal pattern we find in the previous two tests. The socio-economic variables show a one-direction causal inference from the socio-economic variables to the level of violence from intrastate variables in both short-term relationship and long-term relationship through the error correction terms and the short-term adjustment coefficients. Unfortunately, the IRF from the socio-economic variables are not statistically significant. The IRF direction shows a positive impact to the level of violence from intrastate conflict. Lastly, we observe the one-direction causal relationship from the socio-economic variables to the level of violence from intrastate variables in CCM method. Interestingly, most of the variables show a strong magnitude that exceeds the benchmark level. Additionally, the results from the optimal number of lag test suggest the long-term causal relationship.

In summary, the evidence from the finding overwhelmingly support the hypothesis that the socio-economic factors are exogenous factors to the level of violence from intrastate conflict. The direction of the causal link in all 3 analytical models and in all 3 provinces show one-directional causation from the socio-economic variables to the level of violence from intrastate variables.

H6: Political demographics increase domestic instability.

The results from the Granger causality test show that the political demographics, both the total population and the percent of youth population, Granger cause the level of violence from intrastate conflict in both the number of incidents and the fatalities from the incidents in all three provinces. We also do not observe any Granger causality from the level of violence from intrastate conflict to the political demographic factors in all three provinces in this study. For the VAR estimation, we do not observe any statistically significant relationship between these two variables in Pattani province. In Yala, the fatalities from the incidents variable has a statistically significant effect on both the total population and the percent of youth population at 95% confidence level. We also find the similar results in Narathiwat province. In addition, the number of incidents variable in Narathiwat province has a statistically significant effect on both the total population and the percent of youth population at 95% confidence level.

The estimation from VECM model in Pattani province shows that the percent of youth population has both long-term and short-term effect to the level of violence from intrastate conflict through the cointegrated error correction terms and the short-term adjustment. However, the IRF is not statistically significant, but it shows a long-term positive impact on both the number of incidents and the fatalities from incidents. This pattern of the relationship also repeats in both Yala case and Narathiwat cases. Interestingly, in Yala case and Narathiwat case, we observe both long-term and short-term effect from the level of violence from intrastate conflict through the cointegrated error correction terms and the short-term adjustment. In the CCM method, we only observe CCM causality in Pattani province from the political demographic factors to the level of

violence from intrastate conflict at the lag number equal to 5 which suggests the long-term relationship from the political demographics. In Yala, the moderate CCM causality from the total population to the fatalities from the incidents can be observed, but the magnitude does not exceed the benchmark level. In Narathiwat, the percent of youth population CCM causes the fatalities from the incidents with a strong magnitude and it exceeds the benchmark level. In addition, we also observe the strong CCM causality from the number of incidents to the percent of youth population and the magnitude exceeds the benchmark level.

In summary, the evidence from the analysis strongly support that the political demographics has a causal relationship to the level of violence from intrastate conflict. However, we also the findings from Yala dataset and Narathiwat dataset also support the notion that the political demographics is an endogenous factor instead of an exogenous factor as stated in the hypothesis. Only the findings in Pattani dataset that suggests the political demographics as an exogenous factor.

Other Findings

The results from the Granger Causality test shows that the military expenditure Granger causes both the number of incidents and the fatalities from the incidents in all three provinces, but the number of incidents and the fatalities from the incidents do no Granger cause the military expenditure. In VAR estimation, we observe the statistically significant coefficients from the military expenditure to the number of incidents in Yala province and Narathiwat province. The fatalities from the incidents model from Yala also show a statistically significant effect from the military expenditure. However, we do not observe any statistically significant coefficients from

the military expenditure to the level of violence from intrastate conflict in Pattani province. In addition, the causalities from the level of violence from intrastate conflict are not statistically significant in all three provinces. The results from VECM estimation shows the statistically significant effect from the military expenditure to the number of incidents as the exogenous effect. However, the causal explanation from VECM in case of the military expenditure is limited since we do not include this variable as an endogenous variable. In CCM methods, we do not observe the CCM causality between these two factors in Pattani dataset and in Yala dataset. However, we observe a moderate CCM causality from the military expenditure to the fatalities from incidents in Narathiwat and the magnitude is over the benchmark line. We also observe a moderate CCM causality from the number of incidents to the military expenditure and the magnitude is over the benchmark line.

In summary, the evidence from different models in different province suggest that the central government factor as expressed as the military expenditure is an exogenous factor to the level of violence from the intrastate conflict, but the opposite causal direction is rarely observed.

The results from Granger Causality test do not support the hypothesis that the socio-economic factors are exogenous factor to the public sentiment since the test fails to show a statistically significant relationship between socio-economic variables and the average tone at 9f5% confidence level in all three provinces. The results from VAR estimation in Pattani province and Yala province also confirm the absence of the relationship between these two factors. However, in Narathiwat province, we observe the relationship from the rubber price to the average tone in the second order lag at 95% confidence level. Additionally, the average tone also has an effect to the unemployment rate for all 4 lag orders. For the VECM estimation, the results from the Pattani province show that the rubber price has a long-term relationship to the average tone via

the error correction terms. In Yala, the long-term relationship from the socio-economic factors represented in the inflation rate, the rubber price and the unemployment rate towards the average tone can be observed in the error correction terms. Additionally, the inflation rate, the rubber price, and the unemployment rate also show a statistically significant effect to the average tone in the short-term adjustment coefficients. We observe a similar pattern in the causality characteristics from the socio-economic factors to the average tone in Narathiwat province. In addition, we also observe that the average tone has a short-term relationship to the inflation rate as the short-term adjustment coefficients in all lag order from the average tone are statistically significant. Next, we investigate the causal relationship between these two factors under nonlinear assumptions with CCM method. In Pattani case, we find a small CCM causality between the rubber price and the average tone in both directions. However, the magnitude from the cross-mapping skill is still under the benchmark level. Also, the results from the optimal lag number shows that the rubber price and the unemployment may have a time-delayed effect since the optimal lag number is 3 and 6 respectively. The results from Yala province shows a moderate CCM causality from the inflation rate to the average tone but the magnitude is still under the benchmark level. The optimal lag for the inflation rate is at the early periods which suggest the short-term effect. In Narathiwat case, the CCM causality from the rubber price to the average tone can be observed, but the magnitude of the causality is small and not over the benchmark level. On the other hand, the result shows the strong CCM causality from the average tone to the unemployment rate and the magnitude is over the benchmark level. The result from optimal number of lag test suggests the short-term effect from the inflation rate, the rubber price and the GPP per capita, while the unemployment has a strong effect on both short-term and long-term effect.

In summary, many evidences suggest the presence of the causality from the socio-economic factors to the public sentiments. The relationship from the socio-economic factors to the public sentiments tends to be a long-term relationship based on the results. However, the evidence from Pattani case is weaker than the other province which suggests that the locality effect is potentially interacted with the relationship. On the other hand, the public sentiments are hardly influence socio-economic factors. The evidence from Pattani province and Yala province strongly suggests that socio-economic factors is an exogenous factor to the public sentiments. On the contrary, the results from Narathiwat support the notion that both socio-economic factors and the average tone are coupling, and they have an effect to each other. Thus, the socio-economic factors are not the exogenous factors, but the endogenous factors. Since only one case support this proposition, it can be postulated that there is also a locality effect that may not be explained in the study which change the direction of the causality between these two factors.

In the Granger causality test, only the percent of youth population in Pattani province shows a statistically significant effect to the average tone at 95% confidence level. The results from the VAR estimation in all three provinces do not provide any statistically significant coefficients from the political demographic factors to the public sentiment and vice versa. However, the VECM estimation shows the opposite conclusion. We can observe the effect from the youth population to the average terms in both long-term effect in the error correction terms and the short-term effect in the short-term adjustment coefficients in all three provinces. The IRF, nevertheless, are not statistically significant in all three provinces, but the IRF show a long-term positive impact to the average tone. The results from the CCM method shows the CCM causality of the percent of youth population to the average tone as the long-term effect since the optimal number of lags is over 5.

In summary, the evidence from the study support the hypothesis. The political demographics tends to have a causality to the public sentiment, but the public sentiments do not cause the political demographics. In addition, the results from different modeling techniques suggests that the political demographics has a long-term effect on the public sentiments, but not the short-term effect.

The result from the Granger causality test shows that the Granger causality between a central government factor and the public sentiment cannot be observed in all three provinces cases. The results from VAR models in all three provinces also do not support this hypothesis as neither a central government factor nor public sentiments are statistically significant in the average tone models and in the military expenditure models. For the VECM models, we cannot find any form of relationship from the central government factor to the public sentiment in all three provinces. We look into the short-term adjustment and the error correction terms for the long-term relationship, but they are not statistically significant. Next, we investigate the causality between public sentiment and the level of intrastate conflict under nonlinear assumptions. In addition, we test the short-term causality under CCM methods with non-linear assumptions and the results still share a similar pattern. The short-term CCM causality cannot be found in Pattani province and Yala province. We observe the small CCM causality from average tone to the military expenditure in Pattani province, but it does not exceed the benchmark line. In Yala province, the CCM causality is small and does not converge when we increase the library size in the test. In Narathiwat province, a strong CCM causality from the average tone to the military expenditure can be observed. However, when we look at the results from the optimal lag number test, we find that the results of CCM from the average tone to the military expenditure is inconsistent across different lag number.

The summary of the hypothesis testing is shown in Table 5-1: Summary of Research Hypothesis Testing. In summary, most of the evidence from the study strongly suggest that the hypothesis the central government factor is an exogenous factor is not true. We hardly find any evidence that shows these two variables have the relationship between each other.

No.	Hypothesis	Indicators		Results		
		Independent Variables	Dependent Variables	VAR	VECM	CCM
H1	Short and long term negative public sentiment increases domestic instability.	Average tone	The number of incidents The fatalities from incidents	Reject	Reject	Reject
H2	Short-term and long-term domestic instability increases the negative public sentiment	The number of incidents The fatalities from incidents	Average tone	Reject	Reject	Reject
H3	Socio-economic conditions decrease domestic instability	Inflation rate Rubber price	The number of incidents	Affirm	Affirm	Affirm

No.	Hypothesis	Indicators		Results		
		Independent Variables	Dependent Variables	VAR	VECM	CCM
		Unemployment rate GPP per capita	The fatalities from incidents			
H4	Political demographics increase domestic instability	Total population Percent of youth population	The number of incidents The fatalities from incidents	Affirm	Affirm	Affirm

Table 5-1: Summary of Research Hypothesis Testing

Conclusion

The results of the study suggest that the effect from the public sentiments to the level of violence from intrastate conflicted are hardly observed and the level of violence from intrastate conflict also do not have a causal relationship to the public sentiments. These finding can be interpreted with two explanation. One is that the public sentiments or the grievance of general public may not be a key driver in the conflict since all three analytical techniques in three cases fail to find a significant evidence to support this claim. The other explanation is that the measures for the public sentiments are problematic and they do not reflect the sentiments from the local population. This explanation comes from the fact that the measures we used in this study focus on the publicly available media as a main source. It is possible that there is a huge difference between the sentiments of the local population and the sentiments from the media who report the events in the local areas. Also, the messages from the media are susceptible to the censorship imposed by the government which make the measured public sentiments reflect only in the certain direction.

The findings also confirm the theory of intrastate conflict on the other factors, such as the socio-economic factors, the political demographics, and the power of central government. For the socio-economic factors, we see the one-directional causal links to the level of violence from intrastate conflict. The findings from the study also reveal the characteristics of the causal effect between these factors. The results suggest both short-term and long-term effects are present in the system. It means that the change in the socio-economic factors can immediately and permanently affect the level of violence. In addition, it also means that the local economy may not be heavily affected by the security problem in the local areas. However, we must be careful to draw this conclusion since the data we collect only dated back to 2010, after the crisis already took place.

On the contrary, the central government power as measured by the military spending seems to only have a short-term effect. That means the security measures should be used as an immediate solution but should not expect to be used as a long-term solution. Interestingly, we find the relationship between the political demographics and the level of violence are coupling or synchronized to each other. That means both factors interact and affect each other. In addition, we also find their relationship intertwined in both short-term and long-term where the percent of youth population has a positive influence towards the level of violence from intrastate conflict and the level of violence from intrastate conflict has a negative influence towards the youth population. Then, we find a negative feedback loop within these factors.

For the public sentiments, the findings only show that the socio-economic has a one-direction long-term effect to the public sentiment. However, the effect is only found in one case of the study. The population also shows one-direction long-term causal relationship to the public sentiment. Lastly, the central government power and the public sentiment are not related as the study fails to find any significant evidence between them.

The other purpose of this study is to develop an analytical framework to analyze and predict the intrastate conflict. The findings suggest that the relationship in the system of the intrastate conflict is a combination of linear relationship and nonlinear relationship. Then, the estimation or the analytical frameworks that rely only on the linear assumptions will have a limited power in terms of prediction and explanation. We can see that Convergent Cross Mapping produces a superior prediction, especially for out-of-sample dataset without compromising the ability to explain the relationship between variables based on the results in Table 5-2: Summary of Model Performance Evaluation: The Number of Incidents and Table 5-3: Summary of Model Performance Evaluation: The fatalities from Incidents.

Model	Province	Training Set	Testing Set
VAR	Pattani	0.724	1.112
	Yala	0.578	0.865
	Narathiwat	0.605	0.863
VECM	Pattani	0.81	2.319
	Yala	0.631	4.79
	Narathiwat	0.726	1.703
CCM	Pattani	0.975	0.733
	Yala	0.952	0.735
	Narathiwat	0.986	0.68

Table 5-2: Summary of Model Performance Evaluation: The Number of Incidents

Model	Province	Training Set	Testing Set
VAR	Pattani	0.592	1.035
	Yala	0.587	0.743
	Narathiwat	0.6	0.843
VECM	Pattani	0.577	2.423
	Yala	0.71	4.864
	Narathiwat	0.735	1.132
CCM	Pattani	0.92	0.541
	Yala	0.948	0.507
	Narathiwat	0.953	0.486

Table 5-3: Summary of Model Performance Evaluation: The fatalities from Incidents

Policy Implication

Based on the results, we can propose the policy solution with regards to the internal security problem as follow.

i) Media censorship policy has a little impact on the reduction in the level of violence.

Based on the results of the study, the public sentiments via general media has a little impact on the level of violence. That means the media censorship is not necessary if this type of policy has not yet implemented. If the media censorship already is in the effect, the findings also cannot show that this type of policy is effective in the reduction in the level of violence.

ii) Economic factors do not have a conclusive result as we expect.

The results on economic factor, surprisingly, do not have conclusive findings among different modeling techniques. In VAR and VECM models, we do not find any significant effect in all three provinces. We only find the significant effect in CCM model in Narathiwat province. This result suggests that the economic factors may not have any effect on the conflict, at least in the case study, or we cannot find the result due to the limitation of modeling techniques or data.

iii) Public policy targeting youth population will have a large impact to the internal security

The results show that the youth population is more susceptible to increase the level of violence. Then, the policy designed towards the youth population group, such as education, jobs training, will have a great outcome in the reduction in the level of violence.

iv) The defense policy can be used as a short-term solution, but should not be expected to be used as long-term solution

The defense policy has an impact on the level of violence, but its effect can only be found as the short-term effect. Then, that means the defense policy is a necessary policy solution to be used in the area of conflict, but it should be used as an immediate response and solution. In a long term, defense policy does not reduce the level of violence.

v) An analytical platform that helps policymakers monitor and predict the conflict should be employed in the area of the conflict.

This study demonstrates that an analytical solution with quantitative analysis can be used to monitor, predict, and manage the internal security policy. Then, the analytical tools and platform that integrate the relevant data, internal intelligence and local information will be very useful for policymakers in assisting them to make a proper policy and solution for internal security.

Limitations

One of the limitations of this study is the area of the study. In this study, we choose the three provinces in Southern part of Thailand. As the results suggested, there is a locality effect that can be found in the finding. That means the findings may not be generalizable to the other areas of conflict. Also, all three provinces in this study share many characteristics in terms of the level of violence, economy, demographic structure. Hence, the models and the findings are resulted from one narrow example that may not reflect the other parts of the world.

The study is also limited its inference and conclusion due to the limited choices for the measures in the study. For example, the public sentiments in this study used the sentiment analysis from the public media. Thus, the sentiments we observe may not reflect the sentiments of the local

population. In addition, many variables in the study is collected from the aggregated level in both areas and time, such as national level or yearly data. The research design, then, needs to adjust with the limitation of the data by using data interpolation techniques. However, the data interpolation techniques will smooth the data and we cannot observe the variance or fluctuation of the data based on areas or time frequency.

Lastly, the study only employs 3 different techniques in data analysis, namely Vector Auto Regression, Vector Error Correction Model, and Convergent Cross Mapping. We strongly believe that the new techniques in both econometrics and nonlinear time-series data will help the researchers in the future estimate and find a new insight that is limited from the estimation techniques in this study.

Recommendations for Future Research

For the future research, we recommend replicating the framework in this study to different areas of conflict. The study only collects the data from three similar provinces. The future research can expand the findings from this study to more generalizable theory by increasing the areas of study that reflect the heterogeneity of human society in the real world.

We also believe that the future research will be greatly improved if the new measures is used in the future study. For example, the public sentiments can be changed from the messages found in the public media to the messages found in the social media platform that local population used. However, the future research needs to address the privacy concerns raised from the use of social media data. Also, the new algorithms or methods in sentimental analysis can be used to

enhance the resolution of the public sentiment data. Local natural language processing (NLP) techniques is also necessary to improve the quality of measures.

In addition, the future research can apply and experiment with the new data analysis techniques from econometrics to machine-learning techniques that can help the future research increase their ability to explain the phenomenon and their predictability of the conflict events and violence. The results from CCM also shows a promising outcome for the future research to experiment with nonlinear data analysis techniques or empirical techniques on data-driven discovery of partial differential equation. We hope that the results from this study will encourage the future researchers to go beyond conventional statistical methods to complex system analysis.

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Appendix

Table 0-1:The Result of Granger-Causality Test - Pattani Province

Independent Variable	Dependent Variable	F-Statistics	P-Value
Fatalities from Incidents	Number of Incidents	1.08	0.38
	Average Tone	0.45	0.89
	Inflation Rate	2.05	0.05
	Rubber Price	2.22	0.03
	GPP Per Capita	0.54	0.82
	Unemployment Rate	1.49	0.17
	Military Expenditure	0.74	0.66
	Total Population	1.19	0.32
	Percent of Youth Total Population	1.08	0.38
Number of Incidents	Fatalities from Incidents	3.14	0.00
	Average Tone	0.47	0.87
	Inflation Rate	1.00	0.44
	Rubber Price	2.03	0.05
	GPP Per Capita	1.19	0.31
	Unemployment Rate	2.01	0.06
	Military Expenditure	0.31	0.96
	Total Population	0.32	0.96
	Percent of Youth Total Population	0.44	0.89
Average Tone	Fatalities from Incidents	1.53	0.16
	Number of Incidents	2.07	0.05
	Inflation Rate	0.54	0.82
	Rubber Price	0.59	0.79
	GPP Per Capita	0.63	0.75
	Unemployment Rate	0.32	0.96

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Military Expenditure	1.07	0.39
	Total Population	0.43	0.90
	Percent of Youth Total Population	1.06	0.40
Inflation Rate	Fatalities from Incidents	1.10	0.37
	Number of Incidents	0.56	0.81
	Average Tone	0.84	0.57
	Rubber Price	1.36	0.22
	GPP Per Capita	0.56	0.81
	Unemployment Rate	1.49	0.17
	Military Expenditure	1.59	0.14
	Total Population	2.07	0.05
	Percent of Youth Total Population	1.33	0.24
Rubber Price	Fatalities from Incidents	2.85	0.01
	Number of Incidents	1.32	0.25
	Average Tone	1.00	0.44
	Inflation Rate	2.15	0.04
	GPP Per Capita	0.40	0.92
	Unemployment Rate	0.60	0.77
	Military Expenditure	0.87	0.55
	Total Population	2.04	0.05
	Percent of Youth Total Population	2.11	0.04
GPP Per Capita	Fatalities from Incidents	1.91	0.07
	Number of Incidents	1.10	0.37
	Average Tone	1.73	0.10
	Inflation Rate	3.13	0.00

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Rubber Price	3.77	0.00
	Unemployment Rate	1.79	0.09
	Military Expenditure	0.99	0.45
	Total Population	3.16	0.00
	Percent of Youth Total Population	0.45	0.89
Unemployment Rate	Fatalities from Incidents	2.12	0.04
	Number of Incidents	1.75	0.10
	Average Tone	0.61	0.77
	Inflation Rate	0.77	0.63
	Rubber Price	2.10	0.04
	GPP Per Capita	1.01	0.43
	Military Expenditure	1.32	0.25
	Total Population	3.06	0.00
	Percent of Youth Total Population	1.65	0.12
Military Expenditure	Fatalities from Incidents	2.56	0.02
	Number of Incidents	1.84	0.08
	Average Tone	1.34	0.24
	Inflation Rate	1.32	0.25
	Rubber Price	3.18	0.00
	GPP Per Capita	1.32	0.25
	Unemployment Rate	2.17	0.04
	Total Population	7.38	0.00
	Percent of Youth Total Population	5.73	0.00
Total Population	Fatalities from Incidents	1.94	0.07
	Number of Incidents	2.25	0.03

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Average Tone	1.72	0.11
	Inflation Rate	2.38	0.02
	Rubber Price	4.46	0.00
	GPP Per Capita	1.36	0.23
	Unemployment Rate	2.15	0.04
	Military Expenditure	2.06	0.05
Percent of Youth Total Population	Fatalities from Incidents	2.33	0.03
	Number of Incidents	2.28	0.03
	Average Tone	2.20	0.04
	Inflation Rate	1.72	0.10
	Rubber Price	4.19	0.00
	GPP Per Capita	1.35	0.23
	Unemployment Rate	2.19	0.04
	Military Expenditure	1.52	0.16
	Total Population	2.00	0.06

Table 0-2:The Result of Granger-Causality Test - Yala Province

Independent Variable	Dependent Variable	F-Statistics	P-Value
Fatalities from Incidents	Number of Incidents	1.23	0.29
	Average Tone	0.33	0.95
	Inflation Rate	1.41	0.21
	Rubber Price	1.26	0.28
	GPP Per Capita	1.16	0.33
	Unemployment Rate	0.37	0.93
	Military Expenditure	0.83	0.58
	Total Population	2.21	0.03
	Percent of Youth Total Population	1.39	0.21
Number of Incidents	Fatalities from Incidents	0.99	0.45
	Average Tone	1.13	0.35
	Inflation Rate	1.29	0.26
	Rubber Price	1.03	0.42
	GPP Per Capita	2.31	0.03
	Unemployment Rate	0.23	0.99
	Military Expenditure	1.53	0.16
	Total Population	0.80	0.60
	Percent of Youth Total Population	0.53	0.83
Average Tone	Fatalities from Incidents	0.37	0.93
	Number of Incidents	0.33	0.95
	Inflation Rate	0.84	0.57
	Rubber Price	0.14	1.00
	GPP Per Capita	1.86	0.08
	Unemployment Rate	0.61	0.77
	Military Expenditure	1.18	0.32

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Total Population	0.30	0.96
	Percent of Youth Total Population	0.13	1.00
Inflation Rate	Fatalities from Incidents	1.27	0.27
	Number of Incidents	0.44	0.89
	Average Tone	0.50	0.85
	Rubber Price	1.36	0.22
	GPP Per Capita	1.30	0.26
	Unemployment Rate	1.23	0.29
	Military Expenditure	1.59	0.14
	Total Population	1.87	0.08
	Percent of Youth Total Population	1.06	0.40
Rubber Price	Fatalities from Incidents	2.51	0.02
	Number of Incidents	1.81	0.09
	Average Tone	0.34	0.95
	Inflation Rate	2.15	0.04
	GPP Per Capita	1.45	0.19
	Unemployment Rate	1.29	0.26
	Military Expenditure	0.87	0.55
	Total Population	2.45	0.02
	Percent of Youth Total Population	2.33	0.03
GPP Per Capita	Fatalities from Incidents	1.60	0.14
	Number of Incidents	1.06	0.40
	Average Tone	0.49	0.86
	Inflation Rate	2.18	0.04
	Rubber Price	2.34	0.03

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Unemployment Rate	1.65	0.12
	Military Expenditure	4.10	0.00
	Total Population	3.87	0.00
	Percent of Youth Total Population	3.03	0.00
Unemployment Rate	Fatalities from Incidents	2.22	0.03
	Number of Incidents	1.13	0.35
	Average Tone	1.25	0.28
	Inflation Rate	1.28	0.26
	Rubber Price	0.78	0.62
	GPP Per Capita	1.59	0.14
	Military Expenditure	1.29	0.26
	Total Population	1.15	0.34
	Percent of Youth Total Population	1.08	0.39
Military Expenditure	Fatalities from Incidents	3.10	0.00
	Number of Incidents	2.76	0.01
	Average Tone	0.58	0.79
	Inflation Rate	1.32	0.25
	Rubber Price	3.18	0.00
	GPP Per Capita	3.07	0.00
	Unemployment Rate	0.37	0.93
	Total Population	8.69	0.00
	Percent of Youth Total Population	6.32	0.00
Total Population	Fatalities from Incidents	2.17	0.04
	Number of Incidents	2.85	0.01
	Average Tone	0.75	0.65

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Inflation Rate	1.87	0.08
	Rubber Price	4.64	0.00
	GPP Per Capita	1.98	0.06
	Unemployment Rate	1.18	0.32
	Military Expenditure	1.42	0.20
	Percent of Youth Total Population	0.89	0.53
Percent of Youth Total Population	Fatalities from Incidents	2.10	0.04
	Number of Incidents	3.57	0.00
	Average Tone	0.60	0.78
	Inflation Rate	1.57	0.15
	Rubber Price	4.16	0.00
	GPP Per Capita	2.46	0.02
	Unemployment Rate	0.94	0.49
	Military Expenditure	1.92	0.07
	Total Population	0.69	0.70

Table 0-3:The Result of Granger-Causality Test - Narathiwat Province

Independent Variable	Dependent Variable	F-Statistics	P-Value
Fatalities from Incidents	Number of Incidents	2.47	0.02
	Average Tone	0.41	0.91
	Inflation Rate	1.27	0.27
	Rubber Price	1.07	0.39
	GPP Per Capita	1.30	0.25
	Unemployment Rate	1.22	0.30
	Military Expenditure	1.30	0.26
	Total Population	0.77	0.63
	Percent of Youth Total Population	0.81	0.60
Number of Incidents	Fatalities from Incidents	0.79	0.61
	Average Tone	0.72	0.67
	Inflation Rate	2.07	0.05
	Rubber Price	1.24	0.29
	GPP Per Capita	1.23	0.29
	Unemployment Rate	1.04	0.41
	Military Expenditure	1.18	0.32
	Total Population	1.04	0.41
	Percent of Youth Total Population	1.17	0.33
Average Tone	Fatalities from Incidents	1.41	0.20
	Number of Incidents	1.90	0.07
	Inflation Rate	0.25	0.98
	Rubber Price	0.11	1.00
	GPP Per Capita	1.04	0.41
	Unemployment Rate	1.07	0.39
	Military Expenditure	1.34	0.24

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Total Population	0.87	0.54
	Percent of Youth Total Population	1.22	0.30
Inflation Rate	Fatalities from Incidents	1.73	0.10
	Number of Incidents	1.91	0.07
	Average Tone	0.59	0.78
	Rubber Price	1.36	0.22
	GPP Per Capita	1.45	0.19
	Unemployment Rate	1.08	0.38
	Military Expenditure	1.59	0.14
	Total Population	2.08	0.05
	Percent of Youth Total Population	1.17	0.33
Rubber Price	Fatalities from Incidents	1.26	0.28
	Number of Incidents	1.96	0.06
	Average Tone	0.75	0.65
	Inflation Rate	2.15	0.04
	GPP Per Capita	0.84	0.57
	Unemployment Rate	0.88	0.54
	Military Expenditure	0.87	0.55
	Total Population	2.07	0.05
	Percent of Youth Total Population	2.23	0.03
GPP Per Capita	Fatalities from Incidents	2.87	0.01
	Number of Incidents	3.22	0.00
	Average Tone	0.75	0.65
	Inflation Rate	1.72	0.11
	Rubber Price	1.23	0.29

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Unemployment Rate	0.76	0.64
	Military Expenditure	4.60	0.00
	Total Population	2.23	0.03
	Percent of Youth Total Population	2.23	0.03
Unemployment Rate	Fatalities from Incidents	0.41	0.91
	Number of Incidents	0.56	0.81
	Average Tone	1.66	0.12
	Inflation Rate	1.12	0.36
	Rubber Price	2.48	0.02
	GPP Per Capita	1.13	0.35
	Military Expenditure	1.92	0.07
	Total Population	0.54	0.82
	Percent of Youth Total Population	0.79	0.61
Military Expenditure	Fatalities from Incidents	1.01	0.44
	Number of Incidents	2.00	0.06
	Average Tone	0.48	0.87
	Inflation Rate	1.32	0.25
	Rubber Price	3.18	0.00
	GPP Per Capita	2.73	0.01
	Unemployment Rate	2.47	0.02
	Total Population	7.35	0.00
	Percent of Youth Total Population	6.79	0.00
Total Population	Fatalities from Incidents	3.07	0.00
	Number of Incidents	1.93	0.07
	Average Tone	1.30	0.26

Independent Variable	Dependent Variable	F-Statistics	P-Value
	Inflation Rate	2.33	0.03
	Rubber Price	4.75	0.00
	GPP Per Capita	1.06	0.40
	Unemployment Rate	0.91	0.51
	Military Expenditure	1.34	0.24
	Percent of Youth Total Population	2.21	0.03
Percent of Youth Total Population	Fatalities from Incidents	3.15	0.00
	Number of Incidents	2.07	0.05
	Average Tone	0.93	0.49
	Inflation Rate	1.60	0.14
	Rubber Price	3.53	0.00
	GPP Per Capita	1.61	0.13
	Unemployment Rate	0.71	0.68
	Military Expenditure	1.76	0.10
	Total Population	1.15	0.34

Table 0-4: VAR Results - Pattani Province

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Number of Incidents - L1	-0.78***	0.33***	0.04	0.05	0.06**	-0.0001	0.004	-0.0000	0.0000	-0.0000
	(0.15)	(0.12)	(0.13)	(0.14)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Fatalities from Incidents - L1	0.09	-0.15	0.07	0.25	-0.05	-0.0001	-0.02	-0.0000	0.0000	-0.0001
	(0.19)	(0.15)	(0.17)	(0.18)	(0.04)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Average Tone - L1	0.18	0.06	-0.79***	0.04	0.02	-0.0001	0.02	0.0000	0.0000	-0.0000
	(0.15)	(0.12)	(0.14)	(0.15)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L1	-0.06	-0.06	-0.09	0.13	0.001	-0.0000	0.03*	0.0001**	-0.0000	0.0000
	(0.15)	(0.12)	(0.13)	(0.14)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L1	-0.49	0.49	0.48	-0.65	-0.11	0.0004	-0.03	-0.0000	0.0001	-0.0001
	(0.73)	(0.60)	(0.66)	(0.71)	(0.14)	(0.0003)	(0.08)	(0.0002)	(0.0001)	(0.0002)
GPP Per Capita - L1	-401.69	-213.11	348.45	-486.80	-177.42**	2.01***	-95.05**	-0.13	0.11*	-0.18*
	(382.28)	(312.79)	(345.91)	(372.07)	(74.56)	(0.14)	(41.66)	(0.09)	(0.06)	(0.10)
Unemployment Rate - L1	-0.43	0.25	0.47	0.20	0.02	-0.0002	2.17***	0.0002	0.0001	-0.0003
	(1.17)	(0.96)	(1.06)	(1.14)	(0.23)	(0.0004)	(0.13)	(0.0003)	(0.0002)	(0.0003)
Military Expenditure - L1	30.34	-364.60	111.86	415.54	224.18*	-0.14	90.90	0.27*	-0.02	0.05
	(589.42)	(482.27)	(533.34)	(573.68)	(114.97)	(0.21)	(64.23)	(0.15)	(0.09)	(0.15)
Total Population - L1	2,117.60	-1,879.05	-1,507.33	-1,810.71	-448.33	3.84*	-135.83	1.49	2.26**	-0.06
	(5,881.71)	(4,812.45)	(5,322.07)	(5,724.61)	(1,147.21)	(2.13)	(640.89)	(1.46)	(0.89)	(1.54)
Percent of Youth Population - L1	1,822.43	-1,157.73	-580.77	-1,005.14	-257.18	2.09*	-98.22	0.95	0.12	1.99**
	(3,390.58)	(2,774.19)	(3,067.97)	(3,300.02)	(661.32)	(1.23)	(369.45)	(0.84)	(0.51)	(0.89)
Number of Incidents - L2	-0.44**	0.42**	-0.01	0.04	0.03	-0.0001	0.02	-0.0000	0.0000	-0.0001*
	(0.20)	(0.16)	(0.18)	(0.20)	(0.04)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0001)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Fatalities from Incidents - L2	-0.37**	-0.06	-0.01	0.24	0.03	-0.0001	-0.03	-0.0000	-0.0000	0.0000
	(0.17)	(0.14)	(0.16)	(0.17)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Average Tone - L2	0.07	0.07	-0.69***	-0.08	-0.02	-0.0000	0.01	0.0001*	0.0000	-0.0001
	(0.19)	(0.15)	(0.17)	(0.18)	(0.04)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L2	0.19	0.38***	-0.06	-0.19	-0.04	0.0000	0.0002	-0.0001**	-0.0000	0.0000
	(0.15)	(0.12)	(0.14)	(0.15)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L2	0.42	-0.88	-0.61	1.63**	0.26*	0.0000	0.06	0.0001	-0.0001	0.0001
	(0.68)	(0.56)	(0.61)	(0.66)	(0.13)	(0.0002)	(0.07)	(0.0002)	(0.0001)	(0.0002)
GPP Per Capita - L2	989.05	51.94	-1,244.89	392.87	297.89*	-1.47***	232.99**	0.29	-0.18	0.29
	(908.92)	(743.69)	(822.44)	(884.65)	(177.28)	(0.33)	(99.04)	(0.23)	(0.14)	(0.24)
Unemployment Rate - L2	0.11	-0.38	0.08	-2.26	-0.33	0.001	-2.50***	-0.001	-0.0005	0.001
	(2.37)	(1.94)	(2.15)	(2.31)	(0.46)	(0.001)	(0.26)	(0.001)	(0.0004)	(0.001)
Military Expenditure - L2	-460.44	140.01	-491.72	227.34	-57.71	-0.28	-82.07	-0.44***	0.06	-0.10
	(612.59)	(501.22)	(554.30)	(596.22)	(119.48)	(0.22)	(66.75)	(0.15)	(0.09)	(0.16)
Total Population - L2	-12,075.06	10,007.74	777.10	-129.35	781.77	-7.21	249.73	-1.68	-3.13	2.21
	(13,948.78)	(11,412.96)	(12,621.57)	(13,576.21)	(2,720.68)	(5.04)	(1,519.91)	(3.46)	(2.10)	(3.65)
Percent of Youth Population - L2	-8,749.61	6,001.11	300.69	-523.31	415.00	-3.68	185.27	-1.10	-0.98	-0.11
	(7,955.95)	(6,509.60)	(7,198.95)	(7,743.45)	(1,551.79)	(2.88)	(866.91)	(1.97)	(1.20)	(2.08)
Number of Incidents - L3	-0.37*	0.20	0.12	-0.37*	-0.06	0.0001	0.002	0.0000	0.0000	-0.0001
	(0.19)	(0.16)	(0.17)	(0.19)	(0.04)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0001)
Fatalities from Incidents - L3	-0.24	0.04	0.001	0.19	0.01	-0.0001**	0.0003	-0.0000	0.0000	-0.0000
	(0.17)	(0.14)	(0.15)	(0.16)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Average Tone - L3	-0.06	-0.10	-0.40**	-0.14	-0.0004	0.0000	0.02	0.0001**	0.0000	-0.0000
	(0.19)	(0.15)	(0.17)	(0.18)	(0.04)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Inflation Rate - L3	-0.16	-0.23	-0.05	0.02	0.04	0.0000	0.05**	0.0001**	-0.0000	0.0000
	(0.17)	(0.14)	(0.15)	(0.16)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L3	1.19*	0.33	0.33	0.29	-0.16	0.0001	-0.13*	-0.0005***	0.0000	-0.0001
	(0.70)	(0.57)	(0.63)	(0.68)	(0.14)	(0.0003)	(0.08)	(0.0002)	(0.0001)	(0.0002)
GPP Per Capita - L3	-751.97	394.25	1,438.23*	634.16	-101.80	0.63*	-177.35*	-0.30	0.08	-0.13
	(942.62)	(771.26)	(852.93)	(917.44)	(183.86)	(0.34)	(102.71)	(0.23)	(0.14)	(0.25)
Unemployment Rate - L3	0.08	-0.56	-0.23	3.05	0.36	-0.001	1.46***	0.001	0.001	-0.001
	(2.28)	(1.87)	(2.06)	(2.22)	(0.44)	(0.001)	(0.25)	(0.001)	(0.0003)	(0.001)
Military Expenditure - L3	-130.65	-511.28	106.17	474.40	202.07*	-0.25	11.79	0.12	0.15*	-0.23
	(563.94)	(461.42)	(510.28)	(548.88)	(110.00)	(0.20)	(61.45)	(0.14)	(0.09)	(0.15)
Total Population - L3	14,189.92	-16,833.73	3,041.53	4,450.67	-855.34	3.30	24.92	-0.90	2.79	-3.36
	(13,805.81)	(11,295.98)	(12,492.20)	(13,437.06)	(2,692.79)	(4.99)	(1,504.33)	(3.42)	(2.08)	(3.61)
Percent of Youth Population - L3	10,130.67	-9,666.56	1,295.99	3,209.90	-490.34	1.56	-12.81	-0.38	1.23	-1.30
	(7,859.02)	(6,430.29)	(7,111.25)	(7,649.11)	(1,532.88)	(2.84)	(856.35)	(1.95)	(1.19)	(2.05)
Number of Incidents - L4	-0.33**	-0.03	0.09	-0.31**	-0.03	0.0001	0.03*	0.0001	0.0000	-0.0000
	(0.14)	(0.12)	(0.13)	(0.14)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Fatalities from Incidents - L4	-0.13	0.15	0.15	0.001	0.01	-0.0001	-0.001	-0.0000	0.0000	-0.0000
	(0.16)	(0.13)	(0.15)	(0.16)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Average Tone - L4	-0.19	-0.23*	-0.25*	-0.01	-0.01	0.0001	0.01	0.0001*	0.0000	-0.0000
	(0.16)	(0.13)	(0.14)	(0.15)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L4	0.26	0.20	-0.15	-0.05	-0.08**	-0.0000	-0.0001	-0.0000	0.0000	-0.0001
	(0.17)	(0.14)	(0.16)	(0.17)	(0.03)	(0.0001)	(0.02)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L4	0.01	0.003	-0.58	0.12	-0.04	0.0003	0.06	-0.0001	0.0001	-0.0002
	(0.67)	(0.55)	(0.60)	(0.65)	(0.13)	(0.0002)	(0.07)	(0.0002)	(0.0001)	(0.0002)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
GPP Per Capita - L4	197.85	-262.88	-547.68	-555.31	-18.69	-0.25	34.28	0.13	0.01	-0.02
	(412.54)	(337.54)	(373.29)	(401.52)	(80.47)	(0.15)	(44.95)	(0.10)	(0.06)	(0.11)
Unemployment Rate - L4	-0.05	0.57	0.45	-1.83*	-0.16	0.0003	-0.47***	-0.0005*	-0.0002	0.0003
	(1.04)	(0.85)	(0.94)	(1.01)	(0.20)	(0.0004)	(0.11)	(0.0003)	(0.0002)	(0.0003)
Military Expenditure - L4	87.15	383.27	-203.21	-347.81	-53.07	-0.54**	-23.73	-0.09	0.40***	-0.72***
	(599.31)	(490.36)	(542.29)	(583.31)	(116.90)	(0.22)	(65.30)	(0.15)	(0.09)	(0.16)
Total Population - L4	-4,458.49	8,414.97*	-2,265.23	-2,436.48	527.50	-0.06	-142.05	1.06	-0.93	1.22
	(5,446.87)	(4,456.66)	(4,928.61)	(5,301.39)	(1,062.40)	(1.97)	(593.51)	(1.35)	(0.82)	(1.42)
Percent of Youth Population - L4	-3,355.23	4,640.02*	-981.67	-1,661.66	321.79	-0.03	-74.61	0.53	-0.37	0.42
	(3,110.18)	(2,544.77)	(2,814.25)	(3,027.11)	(606.63)	(1.12)	(338.90)	(0.77)	(0.47)	(0.81)
Constant	0.09	0.01	-0.08	-0.10	-0.02	-0.0000	-0.0005	-0.0000	0.0000	-0.0000
	(0.13)	(0.11)	(0.12)	(0.13)	(0.03)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Observations	88	88	88	88	88	88	88	88	88	88
R^2	0.64	0.67	0.59	0.50	0.61	1.00	0.98	0.65	1.00	1.00
Adjusted R^2	0.34	0.39	0.25	0.08	0.27	1.00	0.97	0.35	1.00	1.00
Residual Std. Error (df = 47)	0.99	0.81	0.90	0.96	0.19	0.0004	0.11	0.0002	0.0001	0.0003
F Statistic (df = 40; 47)	2.12***	2.37***	1.72**	1.19	1.82**	453.71***	62.99***	2.15***	2,966.53***	2,556.89***

Note: *p<0.1; **p<0.05; ***p<0.01

Table 0-5: VAR Results - Yala Province

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Number of Incidents - L1	-0.17	0.12	0.27	-0.15	-0.08*	-0.0000	-0.003	-0.0000	-0.0000	-0.0000
	(0.17)	(0.18)	(0.21)	(0.18)	(0.05)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Fatalities from Incidents - L1	0.08	-0.35**	0.03	0.22	0.06	0.0001	-0.01	0.0000	-0.0000	0.0000
	(0.16)	(0.17)	(0.20)	(0.17)	(0.04)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Average Tone - L1	-0.03	-0.15	-0.12	-0.25*	-0.03	0.0001*	-0.01	0.0000	0.0000	-0.0000
	(0.12)	(0.12)	(0.15)	(0.13)	(0.03)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L1	0.0002	0.08	0.07	-0.05	-0.03	0.0001*	0.01	0.0000	-0.0000	0.0000
	(0.12)	(0.12)	(0.15)	(0.13)	(0.03)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L1	0.05	0.71	0.22	-0.35	-0.04	0.0003*	-0.03	0.0003*	0.0001	-0.0003*
	(0.53)	(0.53)	(0.64)	(0.56)	(0.14)	(0.0002)	(0.03)	(0.0001)	(0.0001)	(0.0001)
GPP Per Capita - L1	-483.04	-3,758.08***	559.40	-1,099.35	-238.53	3.27***	-12.53	-0.11	-0.08	0.13
	(1,193.24)	(1,211.63)	(1,460.91)	(1,258.96)	(322.33)	(0.39)	(69.61)	(0.31)	(0.22)	(0.33)
Unemployment Rate - L1	2.10	3.18	-5.07**	1.40	-0.47	-0.0002	2.50***	-0.0001	-0.0003	0.0003
	(1.93)	(1.96)	(2.37)	(2.04)	(0.52)	(0.001)	(0.11)	(0.001)	(0.0003)	(0.001)
Military Expenditure - L1	1,474.88	5,777.88***	-75.13	2,036.80	444.10	-0.33	18.85	0.13	-0.07	0.20
	(1,507.50)	(1,530.74)	(1,845.67)	(1,590.53)	(407.23)	(0.49)	(87.94)	(0.39)	(0.27)	(0.41)
Total Population - L1	-3,133.63	-1,722.11	4,595.86	1,688.52	1,368.63	2.23**	-257.53	1.83**	1.71***	0.31
	(3,281.77)	(3,332.36)	(4,017.94)	(3,462.52)	(886.52)	(1.07)	(191.44)	(0.85)	(0.59)	(0.90)
Percent of Youth Population - L1	-2,642.90	-2,394.55	3,051.51	663.04	957.25	1.57**	-167.04	1.28**	0.05	2.77***
	(2,153.39)	(2,186.58)	(2,636.44)	(2,271.99)	(581.70)	(0.70)	(125.62)	(0.56)	(0.39)	(0.59)
Number of Incidents - L2	-0.30	0.11	0.15	-0.26	0.03	0.0001	-0.01	0.0001**	-0.0000	0.0000
	(0.19)	(0.19)	(0.23)	(0.20)	(0.05)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Fatalities from Incidents - L2	-0.11	-0.27	-0.07	0.37**	0.02	-0.0000	-0.01	-0.0001	0.0001**	-0.0001**

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
	(0.16)	(0.16)	(0.20)	(0.17)	(0.04)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Average Tone - L2	0.05	-0.07	-0.15	-0.24*	-0.01	0.0001*	-0.003	0.0000	0.0000	-0.0000
	(0.12)	(0.12)	(0.15)	(0.13)	(0.03)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L2	0.20	0.33**	-0.18	-0.35**	-0.06	-0.0001**	0.004	-0.0001**	0.0000	-0.0000
	(0.13)	(0.13)	(0.16)	(0.14)	(0.04)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L2	-1.58***	-0.92	0.12	0.07	0.06	0.0004*	-0.02	0.0003*	0.0001	-0.0001
	(0.55)	(0.55)	(0.67)	(0.58)	(0.15)	(0.0002)	(0.03)	(0.0001)	(0.0001)	(0.0001)
GPP Per Capita - L2	1,524.33	11,464.99***	-1,653.17	3,535.63	726.11	-4.11***	46.67	0.09	0.26	-0.45
	(3,578.31)	(3,633.46)	(4,381.00)	(3,775.39)	(966.63)	(1.17)	(208.74)	(0.93)	(0.65)	(0.98)
Unemployment Rate - L2	-4.44	-5.74	8.96	-8.34*	0.54	0.001	-3.12***	0.0003	0.0003	-0.001
	(4.38)	(4.45)	(5.36)	(4.62)	(1.18)	(0.001)	(0.26)	(0.001)	(0.001)	(0.001)
Military Expenditure - L2	928.36	854.82	-633.14	-15.68	-278.03*	-0.50**	31.83	-0.42***	-0.23**	0.42**
	(588.11)	(597.17)	(720.03)	(620.50)	(158.87)	(0.19)	(34.31)	(0.15)	(0.11)	(0.16)
Total Population - L2	3,878.23	1,443.16	-10,017.76	-7.01	-2,295.26	-3.93*	400.78	-3.38**	-0.59	-0.76
	(6,158.32)	(6,253.25)	(7,539.77)	(6,497.51)	(1,663.58)	(2.02)	(359.24)	(1.60)	(1.11)	(1.69)
Percent of Youth Population - L2	5,883.60	4,824.86	-9,638.19	-317.65	-2,532.26	-4.16**	451.82	-3.51**	0.14	-3.08*
	(6,054.04)	(6,147.36)	(7,412.09)	(6,387.48)	(1,635.41)	(1.98)	(353.15)	(1.57)	(1.10)	(1.66)
Number of Incidents - L3	-0.33*	0.0000	-0.16	-0.27	-0.04	-0.0000	0.0001	0.0000	-0.0000	0.0000
	(0.18)	(0.18)	(0.22)	(0.19)	(0.05)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Fatalities from Incidents - L3	-0.18	-0.23	0.23	0.49***	0.11**	-0.0000	-0.01	-0.0000	0.0001**	-0.0001**
	(0.16)	(0.16)	(0.20)	(0.17)	(0.04)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Average Tone - L3	-0.20	-0.15	-0.32*	-0.10	0.002	0.0000	-0.0004	0.0000	0.0000	-0.0000
	(0.13)	(0.14)	(0.16)	(0.14)	(0.04)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L3	0.04	0.07	-0.03	-0.03	0.002	0.0001*	0.01	0.0001**	0.0000	-0.0000
	(0.14)	(0.14)	(0.17)	(0.15)	(0.04)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Rubber Price - L3	-0.40	0.03	0.18	-0.58	-0.12	-0.0002	0.001	-0.0002*	0.0000	-0.0001
	(0.57)	(0.58)	(0.70)	(0.60)	(0.15)	(0.0002)	(0.03)	(0.0001)	(0.0001)	(0.0002)
GPP Per Capita - L3	-1,513.49	-11,626.68***	1,643.79	-3,793.56	-753.16	2.36*	-54.59	0.10	-0.31	0.53
	(3,590.20)	(3,645.54)	(4,395.56)	(3,787.94)	(969.84)	(1.18)	(209.43)	(0.93)	(0.65)	(0.99)
Unemployment Rate - L3	3.18	4.36	-6.57	9.92**	-0.35	-0.0001	2.06***	0.0001	-0.0000	0.0003
	(4.31)	(4.38)	(5.28)	(4.55)	(1.16)	(0.001)	(0.25)	(0.001)	(0.001)	(0.001)
Military Expenditure - L3	349.64	574.33	532.83	664.94	137.28	0.04	-26.90	0.03	-0.13	0.33**
	(532.15)	(540.35)	(651.52)	(561.45)	(143.75)	(0.17)	(31.04)	(0.14)	(0.10)	(0.15)
Total Population - L3	-1,571.64	767.01	6,064.55	-3,301.86	957.45	1.70	-155.24	1.54*	-0.18	0.42
	(3,356.79)	(3,408.53)	(4,109.78)	(3,541.67)	(906.79)	(1.10)	(195.81)	(0.87)	(0.61)	(0.92)
Percent of Youth Population - L3	-4,951.19	-2,886.90	10,467.58	-1,875.48	2,223.61	3.76*	-433.33	3.28**	-0.42	1.73
	(5,895.40)	(5,986.27)	(7,217.86)	(6,220.10)	(1,592.55)	(1.93)	(343.90)	(1.53)	(1.07)	(1.62)
Number of Incidents – L4	-0.23	0.16	0.20	-0.14	0.03	-0.0001	-0.01	-0.0000	0.0000	-0.0000
	(0.18)	(0.18)	(0.22)	(0.19)	(0.05)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Fatalities from Incidents – L4	0.21	0.01	-0.04	-0.11	-0.01	-0.0001	0.01	-0.0001	0.0000	-0.0000
	(0.17)	(0.17)	(0.21)	(0.18)	(0.05)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Average Tone – L4	-0.22	-0.20	0.10	-0.15	-0.02	0.0000	-0.003	0.0000	0.0000	-0.0001
	(0.14)	(0.14)	(0.17)	(0.14)	(0.04)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate – L4	0.16	0.11	-0.03	-0.25*	-0.10***	-0.0001	0.001	-0.0000	0.0000	-0.0000
	(0.13)	(0.14)	(0.16)	(0.14)	(0.04)	(0.0000)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Rubber Price – L4	-0.25	0.50	0.52	0.11	0.06	0.0000	0.001	0.0000	0.0001	-0.0002
	(0.52)	(0.52)	(0.63)	(0.54)	(0.14)	(0.0002)	(0.03)	(0.0001)	(0.0001)	(0.0001)
GPP Per Capita – L4	480.64	3,920.12***	-546.00	1,364.99	266.14	-0.52	20.61	-0.09	0.12	-0.21
	(1,203.95)	(1,222.51)	(1,474.02)	(1,270.26)	(325.23)	(0.39)	(70.23)	(0.31)	(0.22)	(0.33)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Unemployment Rate – L4	-1.31	-1.52	1.25	-6.11***	-0.12	-0.0001	-0.69***	-0.0002	0.0000	-0.0002
	(1.98)	(2.01)	(2.43)	(2.09)	(0.54)	(0.001)	(0.12)	(0.001)	(0.0004)	(0.001)
Military Expenditure – L4	1,177.55**	616.75	-640.04	-1,093.09*	-320.40**	-0.34*	40.17	-0.28*	0.09	-0.05
	(576.98)	(585.87)	(706.41)	(608.76)	(155.86)	(0.19)	(33.66)	(0.15)	(0.10)	(0.16)
Total Population – L4	-482.52	-789.94	-247.63	857.25	-8.32	0.16	-29.85	0.13	0.01	-0.01
	(514.02)	(521.94)	(629.32)	(542.33)	(138.85)	(0.17)	(29.98)	(0.13)	(0.09)	(0.14)
Percent of Youth Population – L4	1,673.40	425.19	-3,878.10	1,515.33	-646.17	-1.16*	148.01	-1.05**	0.23	-0.43
	(1,998.02)	(2,028.82)	(2,446.22)	(2,108.07)	(539.73)	(0.65)	(116.55)	(0.52)	(0.36)	(0.55)
Constant	-0.98***	-0.78***	0.07	-0.73**	-0.01	0.0001	-0.02	0.0001	0.0002***	-0.0003***
	(0.27)	(0.27)	(0.33)	(0.29)	(0.07)	(0.0001)	(0.02)	(0.0001)	(0.0000)	(0.0001)
Observations	88	88	88	88	88	88	88	88	88	88
R^2	0.69	0.69	0.41	0.63	0.52	1.00	0.99	0.75	1.00	1.00
Adjusted R^2	0.42	0.43	-0.09	0.31	0.11	1.00	0.98	0.54	1.00	1.00
Residual Std. Error (df = 47)	0.79	0.80	0.97	0.83	0.21	0.0003	0.05	0.0002	0.0001	0.0002
F Statistic (df = 40; 47)	2.58***	2.65***	0.82	1.98**	1.27	228,437.40***	100.13***	3.56***	4,526.47***	161,345.50***

Note: *p<0.1; **p<0.05; ***p<0.01

Table 0-6: VAR Results - Narathiwat Province

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Number of Incidents - L1	-0.48***	0.19	-0.03	0.20	-0.06	-0.0003*	0.01	-0.0001*	0.0000	-0.0000
	(0.16)	(0.16)	(0.17)	(0.21)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Fatalities from Incidents - L1	0.43**	0.14	-0.24	-0.07	0.08**	0.0001	-0.03***	0.0000	0.0000	-0.0001
	(0.18)	(0.18)	(0.18)	(0.23)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Average Tone - L1	0.02	0.03	-0.89***	0.01	-0.004	0.0001	-0.02**	0.0000	0.0000	-0.0000
	(0.14)	(0.14)	(0.15)	(0.18)	(0.03)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L1	-0.14	-0.10	-0.20	0.09	-0.01	0.0002*	-0.01	0.0000	-0.0000	0.0000
	(0.12)	(0.12)	(0.13)	(0.16)	(0.03)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L1	-0.36	0.35	-0.36	-0.17	-0.11	0.0001	-0.003	0.0002	0.0002*	-0.0004**
	(0.55)	(0.55)	(0.58)	(0.71)	(0.12)	(0.001)	(0.03)	(0.0001)	(0.0001)	(0.0002)
GPP Per Capita - L1	-86.36	55.99	-347.83	-256.42	-0.98	2.46***	-6.04	-0.01	0.03	-0.03
	(245.27)	(243.08)	(256.25)	(314.53)	(54.70)	(0.24)	(13.05)	(0.06)	(0.05)	(0.08)
Unemployment Rate - L1	-0.71	-1.76	-0.48	-3.82	0.05	0.001	2.40***	0.0003	-0.0002	0.0003
	(2.13)	(2.11)	(2.22)	(2.73)	(0.47)	(0.002)	(0.11)	(0.001)	(0.0004)	(0.001)
Military Expenditure - L1	198.53	-97.87	1,645.56	1,466.51	257.20	-1.71*	-6.03	0.02	-0.05	0.09
	(944.76)	(936.32)	(987.05)	(1,211.55)	(210.71)	(0.92)	(50.27)	(0.24)	(0.19)	(0.30)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Total Population - L1	3,503.86	-2,765.15	1,367.98	-97.42	661.54	0.66	-44.42	0.11	2.24***	-0.12
	(2,227.74)	(2,207.83)	(2,327.45)	(2,856.82)	(496.86)	(2.16)	(118.54)	(0.57)	(0.44)	(0.70)
Percent of Youth Population - L1	1,679.26	-1,757.45	782.51	-396.31	242.90	1.06	-44.46	0.18	0.10	2.94***
	(1,403.45)	(1,390.91)	(1,466.27)	(1,799.76)	(313.02)	(1.36)	(74.68)	(0.36)	(0.28)	(0.44)
Number of Incidents - L2	-0.36**	0.09	0.13	0.16	-0.05	-0.0001	0.002	-0.0000	0.0001**	-0.0001**
	(0.17)	(0.17)	(0.18)	(0.22)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Fatalities from Incidents - L2	0.19	-0.27	-0.07	-0.11	-0.03	-0.0000	-0.002	-0.0000	-0.0001**	0.0001*
	(0.19)	(0.19)	(0.20)	(0.25)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Average Tone - L2	0.09	-0.03	-0.81***	0.03	-0.02	0.0001	-0.03***	-0.0000	0.0000	-0.0000
	(0.16)	(0.16)	(0.17)	(0.21)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Inflation Rate - L2	-0.04	0.36***	-0.19	-0.20	-0.04	-0.0003**	0.003	-0.0001***	0.0000	-0.0000
	(0.13)	(0.13)	(0.14)	(0.17)	(0.03)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L2	-0.30	0.24	-1.28**	0.63	-0.11	0.001*	-0.04	0.0003**	-0.0001	0.0001
	(0.58)	(0.58)	(0.61)	(0.75)	(0.13)	(0.001)	(0.03)	(0.0001)	(0.0001)	(0.0002)
GPP Per Capita - L2	-308.76	-242.16	541.87	868.07	-91.32	-2.60***	-6.57	-0.15	-0.06	0.09
	(629.82)	(624.19)	(658.01)	(807.67)	(140.47)	(0.61)	(33.51)	(0.16)	(0.13)	(0.20)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Unemployment Rate - L2	-2.08	4.04	-2.33	6.10	-0.69	-0.003	-2.93***	-0.001	0.0001	-0.0002
	(4.69)	(4.65)	(4.90)	(6.02)	(1.05)	(0.005)	(0.25)	(0.001)	(0.001)	(0.001)
Military Expenditure - L2	1,995.61**	1,132.44	1,080.54	-1,343.89	46.43	-0.05	103.19**	-0.13	-0.07	0.12
	(952.75)	(944.24)	(995.40)	(1,221.79)	(212.50)	(0.92)	(50.70)	(0.24)	(0.19)	(0.30)
Total Population - L2	-7,054.39	3,715.68	-1,599.51	611.14	-1,386.57	-1.75	61.53	-0.52	-1.73**	0.30
	(4,278.52)	(4,240.28)	(4,470.02)	(5,486.70)	(954.26)	(4.14)	(227.66)	(1.09)	(0.85)	(1.34)
Percent of Youth Population - L2	-5,713.39	3,960.73	-1,963.27	1,443.39	-671.04	-3.30	118.93	-0.66	-0.18	-3.26**
	(3,920.83)	(3,885.79)	(4,096.32)	(5,028.00)	(874.48)	(3.80)	(208.63)	(1.00)	(0.78)	(1.23)
Number of Incidents - L3	-0.14	0.15	0.18	0.23	-0.07*	-0.0000	-0.003	-0.0000	0.0000	-0.0000
	(0.17)	(0.16)	(0.17)	(0.21)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Fatalities from Incidents - L3	0.001	-0.21	-0.11	0.01	0.07*	-0.0001	-0.01	-0.0000	0.0000	-0.0001
	(0.17)	(0.17)	(0.18)	(0.22)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Average Tone - L3	-0.09	-0.26	-0.40**	0.14	-0.03	0.0001	-0.03***	-0.0000	0.0000	-0.0000
	(0.17)	(0.17)	(0.18)	(0.22)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)
Inflation Rate - L3	0.03	-0.002	0.05	0.11	-0.02	0.0002	0.002	0.0000	0.0000	-0.0001
	(0.14)	(0.14)	(0.14)	(0.18)	(0.03)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Rubber Price - L3	-0.05	-0.79	-0.45	0.21	-0.09	-0.0002	-0.01	-0.0002	-0.0000	0.0000
	(0.55)	(0.55)	(0.58)	(0.71)	(0.12)	(0.001)	(0.03)	(0.0001)	(0.0001)	(0.0002)
GPP Per Capita - L3	999.64	482.65	30.79	-914.74	198.44	1.50^{**}	34.22	0.24	0.06	-0.12
	(652.10)	(646.28)	(681.29)	(836.25)	(145.44)	(0.63)	(34.70)	(0.17)	(0.13)	(0.20)
Unemployment Rate - L3	2.79	-4.13	5.87	-4.10	1.17	0.001	1.87^{***}	0.0001	-0.0000	0.0001
	(4.80)	(4.76)	(5.02)	(6.16)	(1.07)	(0.005)	(0.26)	(0.001)	(0.001)	(0.002)
Military Expenditure - L3	-279.89	-348.92	86.56	120.29	88.02	-0.46	-6.23	-0.05	0.15	-0.12
	(540.81)	(535.98)	(565.02)	(693.53)	(120.62)	(0.52)	(28.78)	(0.14)	(0.11)	(0.17)
Total Population - L3	3,043.13	-1,747.40	238.16	-576.76	$1,016.12^{*}$	0.71	10.46	0.37	0.63	-0.46
	(2,538.91)	(2,516.22)	(2,652.55)	(3,255.85)	(566.26)	(2.46)	(135.10)	(0.65)	(0.51)	(0.80)
Percent of Youth Population - L3	5,843.53	-3,152.18	1,528.66	-1,903.02	555.76	3.32	-118.16	0.72	0.13	1.58
	(3,763.94)	(3,730.30)	(3,932.41)	(4,826.81)	(839.49)	(3.65)	(200.28)	(0.96)	(0.75)	(1.18)
Number of Incidents - L4	-0.10	0.01	-0.05	0.17	0.06^{*}	-0.0001	-0.004	0.0000	-0.0000	0.0000
	(0.15)	(0.15)	(0.16)	(0.19)	(0.03)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Fatalities from Incidents - L4	-0.21	-0.24	0.28	-0.09	-0.01	0.0002	0.01	0.0000	0.0000	-0.0000
	(0.17)	(0.16)	(0.17)	(0.21)	(0.04)	(0.0002)	(0.01)	(0.0000)	(0.0000)	(0.0001)

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
Average Tone - L4	0.01	-0.12	-0.24	0.22	0.05	0.0000	-0.01*	-0.0000	0.0000	-0.0000
	(0.15)	(0.15)	(0.16)	(0.19)	(0.03)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Inflation Rate - L4	-0.004	0.10	0.07	-0.12	-0.10***	0.0000	0.01	-0.0000	0.0000	-0.0001*
	(0.14)	(0.14)	(0.15)	(0.19)	(0.03)	(0.0001)	(0.01)	(0.0000)	(0.0000)	(0.0000)
Rubber Price - L4	-0.71	-0.91*	0.08	0.87	0.16	-0.0003	-0.06**	-0.0001	0.0002	-0.0003
	(0.53)	(0.53)	(0.55)	(0.68)	(0.12)	(0.001)	(0.03)	(0.0001)	(0.0001)	(0.0002)
GPP Per Capita - L4	-586.84**	-262.01	-241.71	266.28	-126.82**	-0.44	-23.14	-0.10	-0.02	0.05
	(279.99)	(277.48)	(292.52)	(359.05)	(62.45)	(0.27)	(14.90)	(0.07)	(0.06)	(0.09)
Unemployment Rate - L4	-2.93	2.25	-3.55	0.37	-1.03*	-0.0002	-0.53***	0.0003	-0.0001	0.0001
	(2.33)	(2.30)	(2.43)	(2.98)	(0.52)	(0.002)	(0.12)	(0.001)	(0.0005)	(0.001)
Military Expenditure - L4	242.00	637.63	446.54	-823.98	-376.95***	-0.21	29.76	-0.11	0.24**	-0.34*
	(553.06)	(548.11)	(577.81)	(709.23)	(123.35)	(0.54)	(29.43)	(0.14)	(0.11)	(0.17)
Total Population - L4	-114.68	164.46	15.77	-195.08	-347.22***	0.14	-41.98	-0.04	-0.11	0.19
	(546.60)	(541.72)	(571.07)	(700.95)	(121.91)	(0.53)	(29.09)	(0.14)	(0.11)	(0.17)
Percent of Youth Population - L4	-1,842.33	931.14	-351.79	851.73	-127.75	-1.07	43.37	-0.25	-0.04	-0.27
	(1,250.90)	(1,239.72)	(1,306.89)	(1,604.13)	(278.99)	(1.21)	(66.56)	(0.32)	(0.25)	(0.39)
Constant	-0.89***	-0.56**	-0.24	-0.19	-0.05	0.0003	-0.01	0.0000	0.0001*	-0.0002**

	Dependent variable:									
	Number of Incidents	Fatalities from Incidents	Average Tone	Inflation Rate	Rubber Price	GPP Per Capita	Unemployment Rate	Military Expenditure	Total Population	Percent of Youth Population
	(0.26)	(0.26)	(0.27)	(0.33)	(0.06)	(0.0003)	(0.01)	(0.0001)	(0.0001)	(0.0001)
Observations	88	88	88	88	88	88	88	88	88	88
R^2	0.65	0.66	0.59	0.40	0.64	1.00	0.98	0.74	1.00	1.00
Adjusted R^2	0.36	0.37	0.23	-0.11	0.34	1.00	0.97	0.52	1.00	1.00
Residual Std. Error (df = 47)	0.83	0.82	0.87	1.06	0.18	0.001	0.04	0.0002	0.0002	0.0003
F Statistic (df = 40; 47)	2.20***	2.28***	1.66**	0.78	2.10***	624.63***	74.60***	3.32***	3,040.04***	106,494.90***
Note:										*p<0.1; **p<0.05; ***p<0.01

Figure 0-1: Impulse Response Function to Number of Incidents - VAR Model - Pattani Province

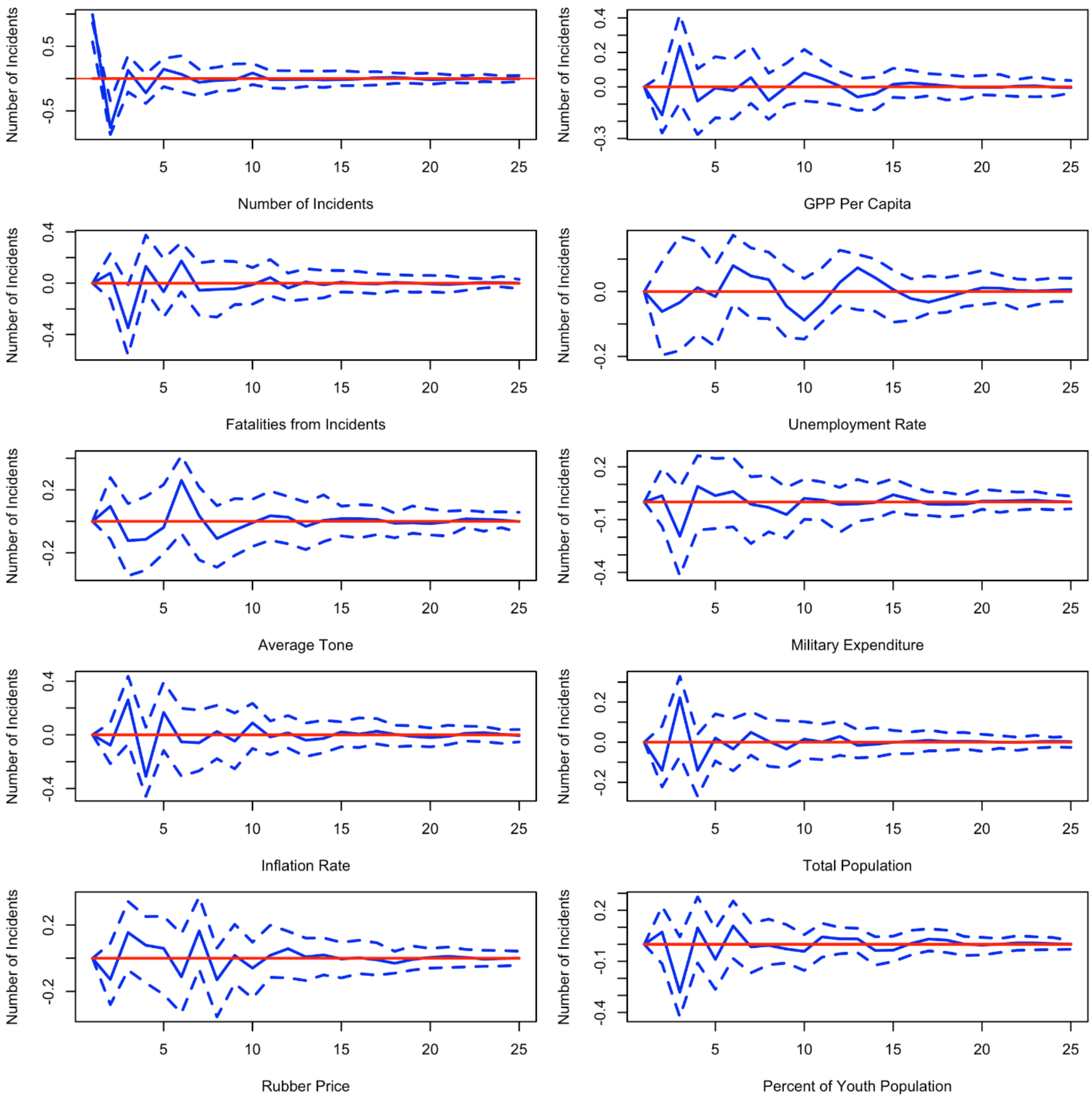

Figure 0-2: Impulse Response Function to Fatalities from Incidents - VAR Model - Pattani Province

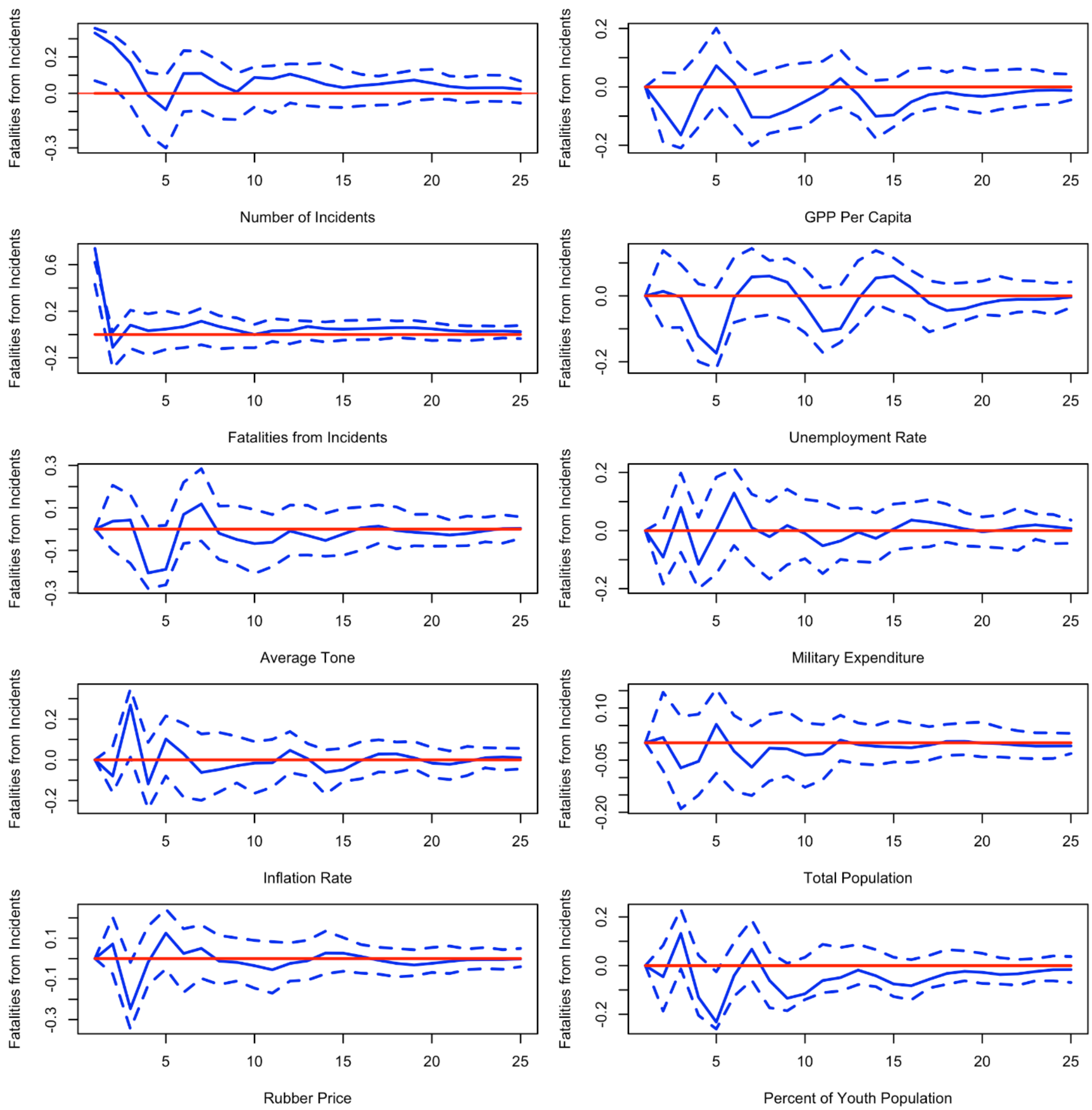

Figure 0-3: Impulse Response Function to Average Tone- VAR Model - Pattani Province

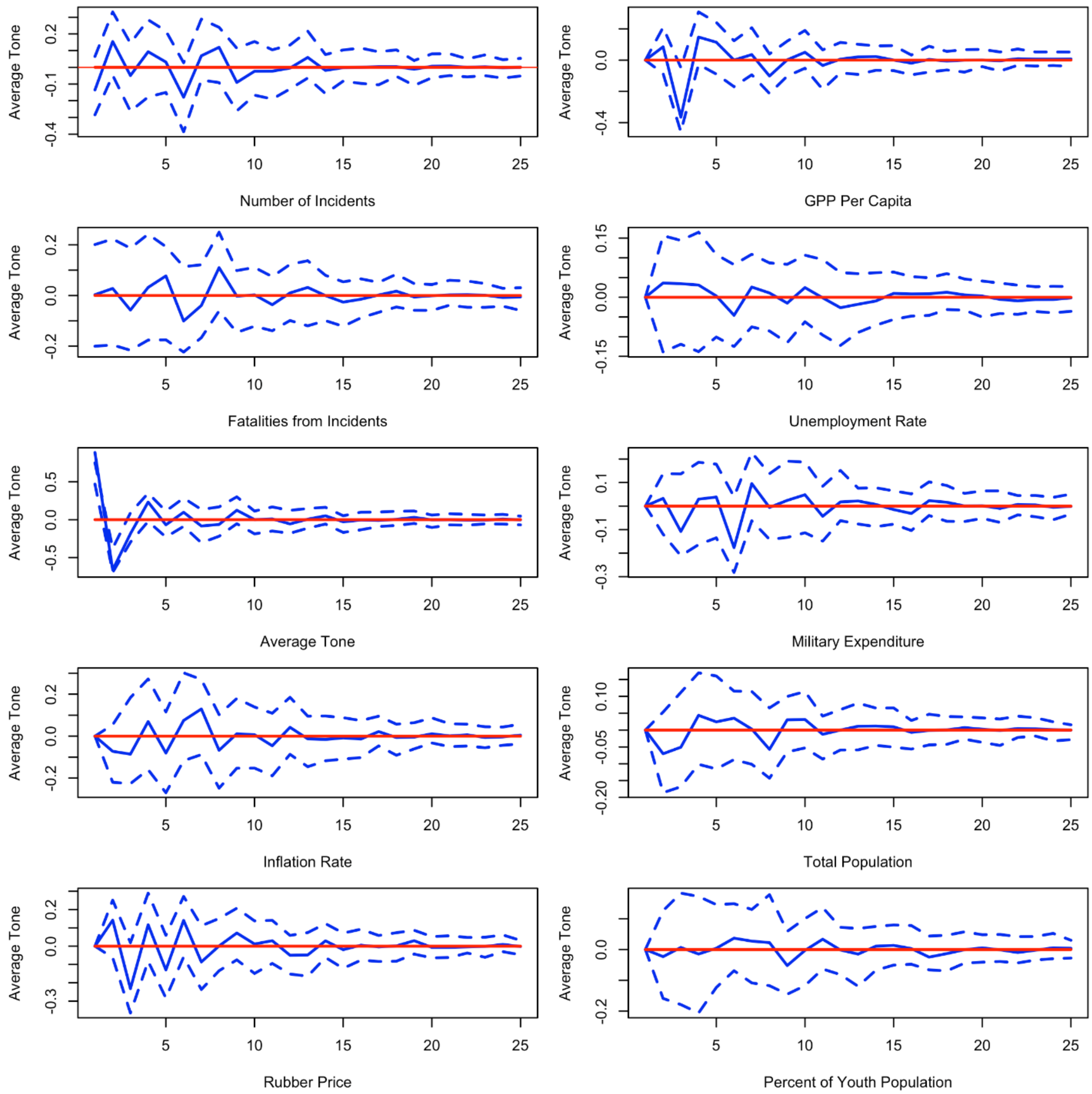

Figure 0-4: Impulse Response Function to Inflation Rate- VAR Model - Pattani Province

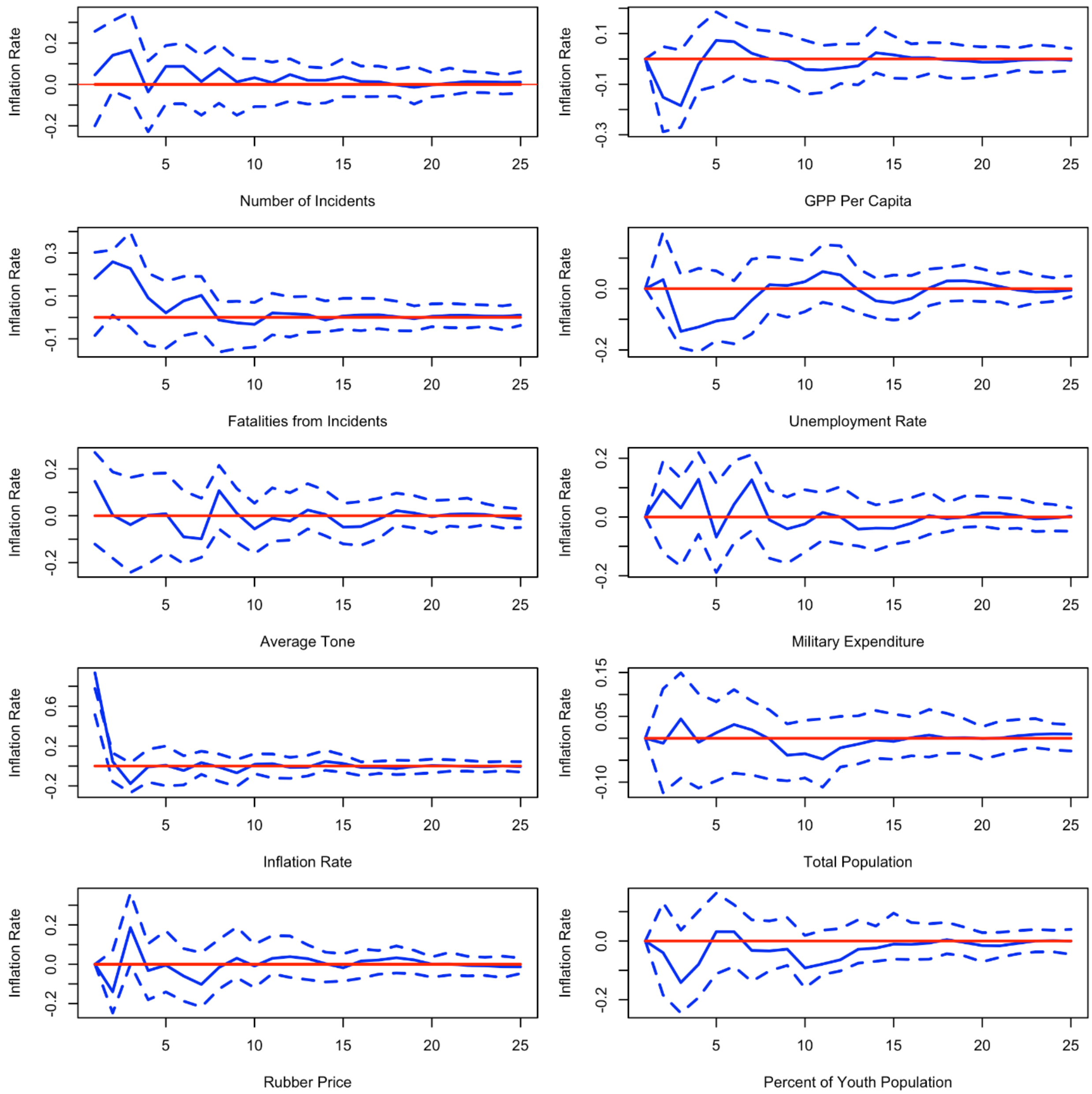

Figure 0-5: Impulse Response Function to Rubber Price- VAR Model - Pattani Province

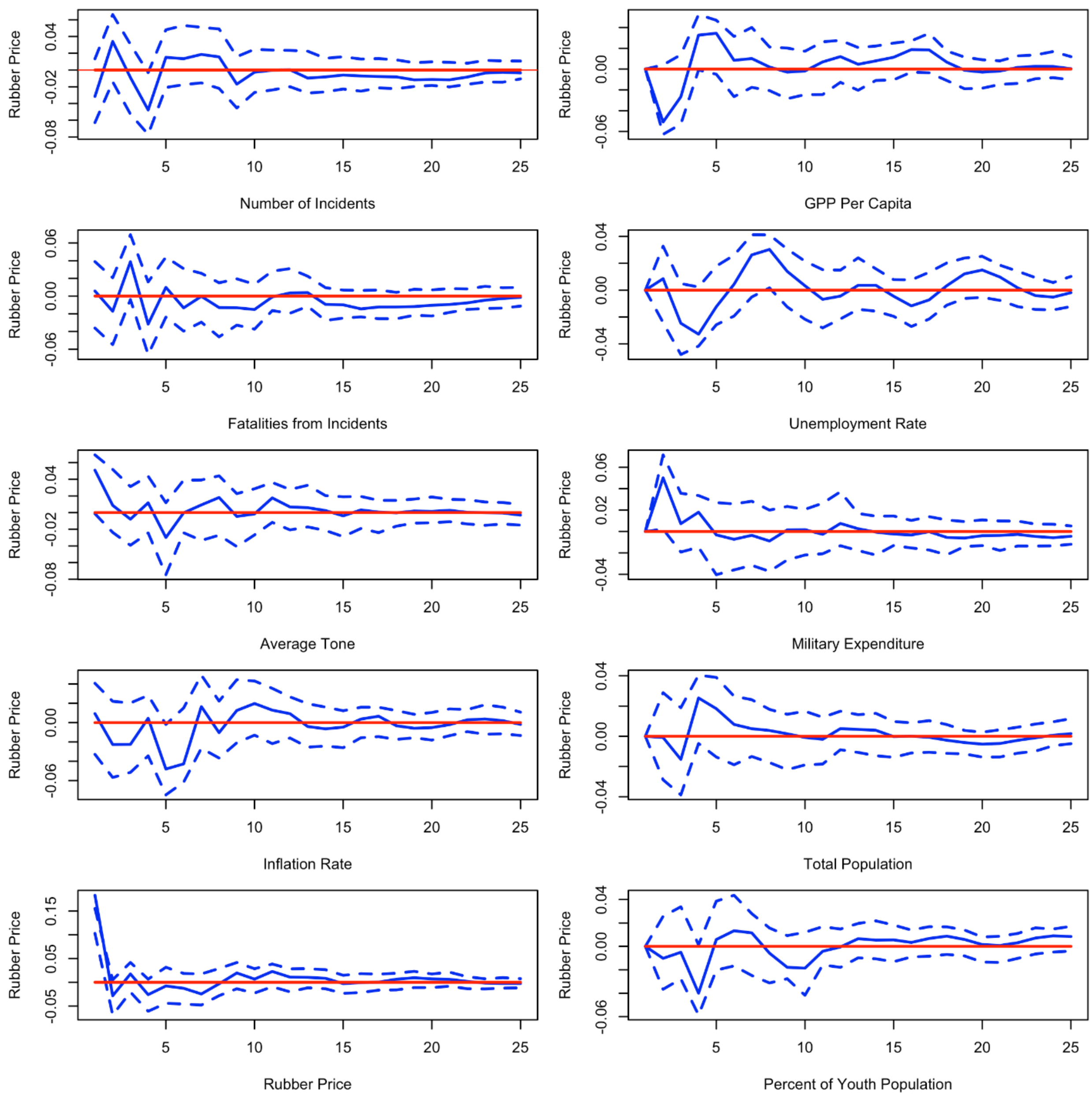

Figure 0-6: Impulse Response Function to GPP per Capita - VAR Model - Pattani Province

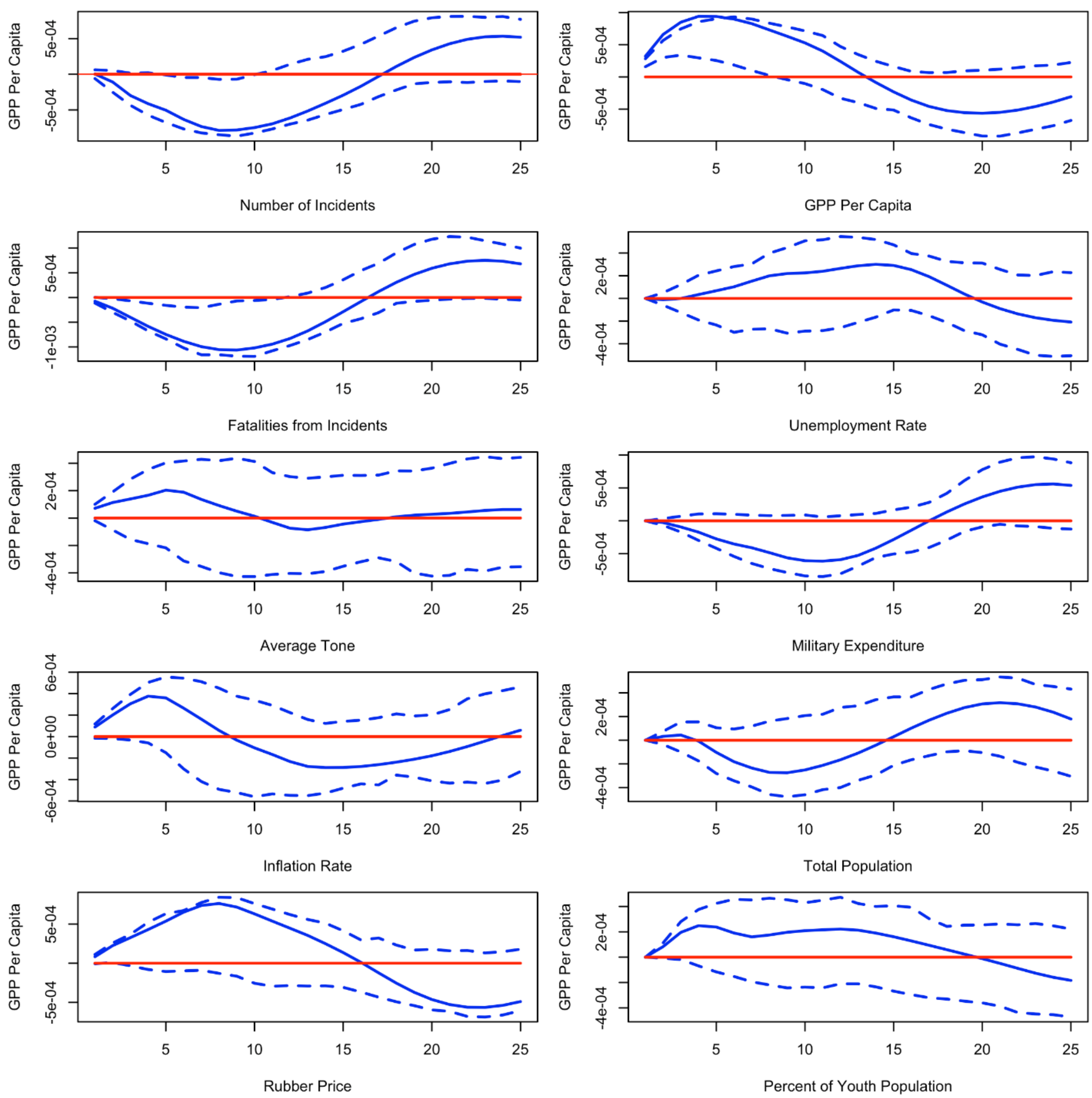

Figure 0-7: Impulse Response Function to Unemployment Rate - VAR Model - Pattani Province

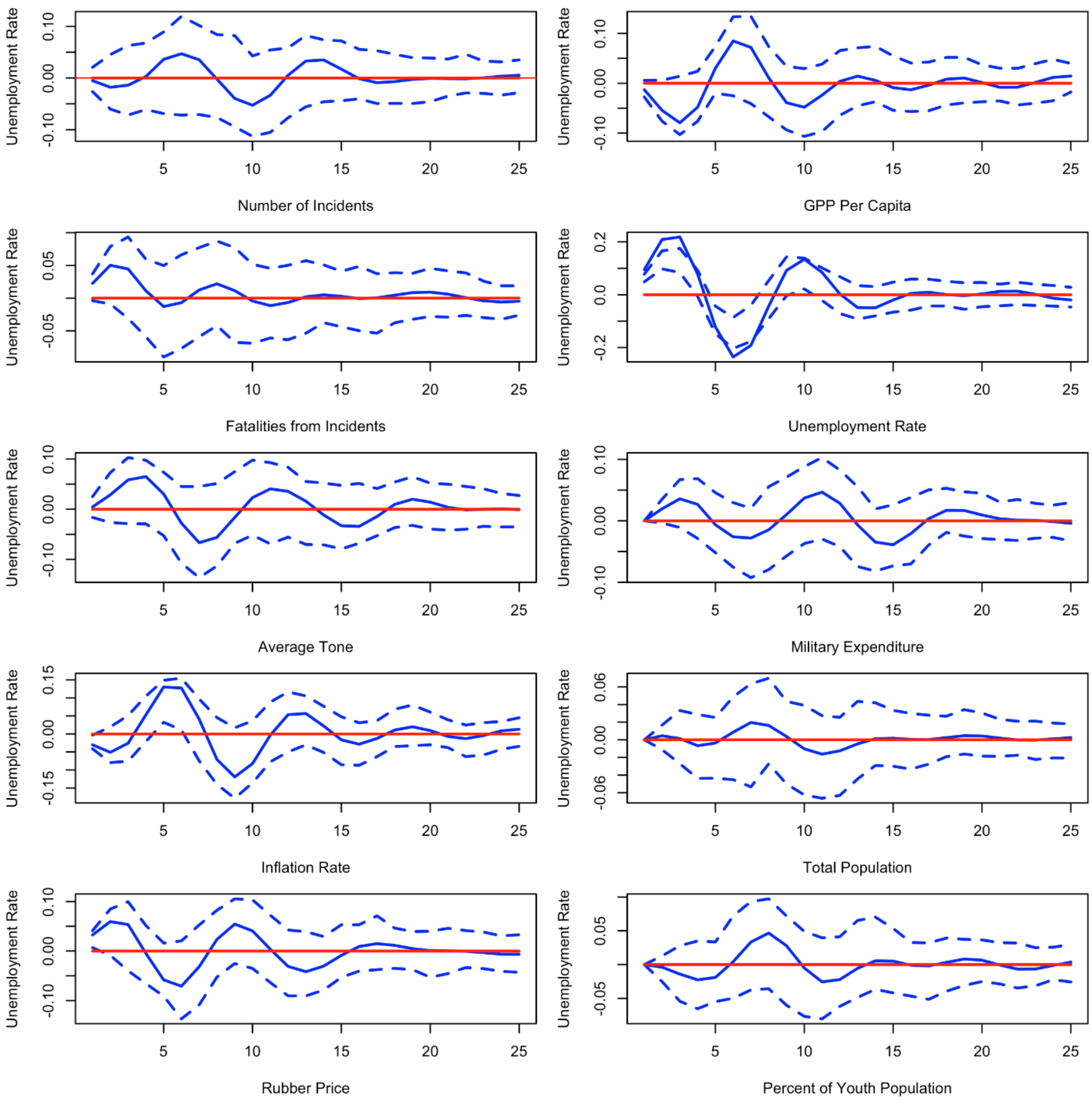

Figure 0-8: Impulse Response Function to Military Expenditure - VAR Model - Pattani Province

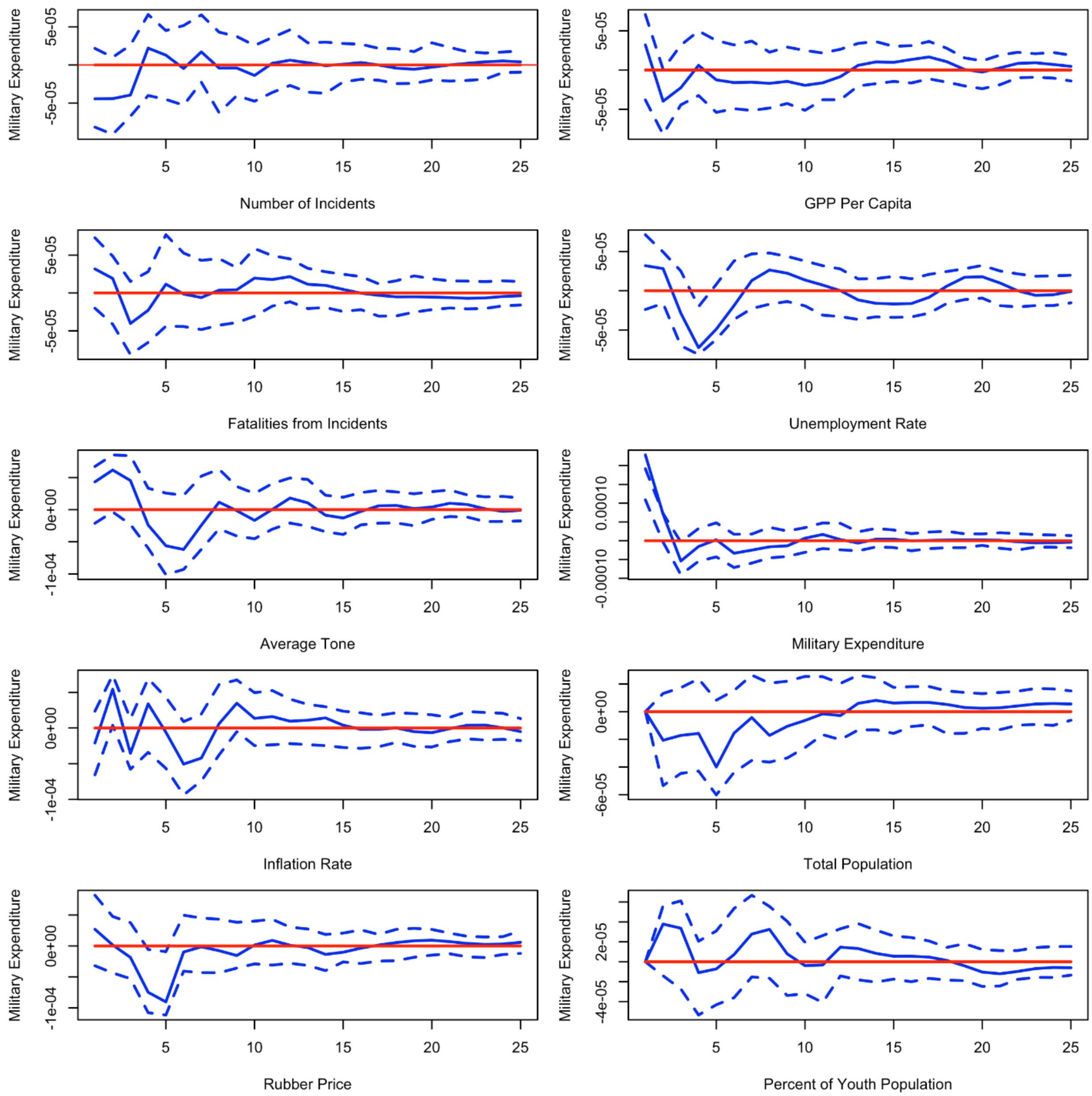

Figure 0-9: Impulse Response Function to Total Population - VAR Model - Pattani Province

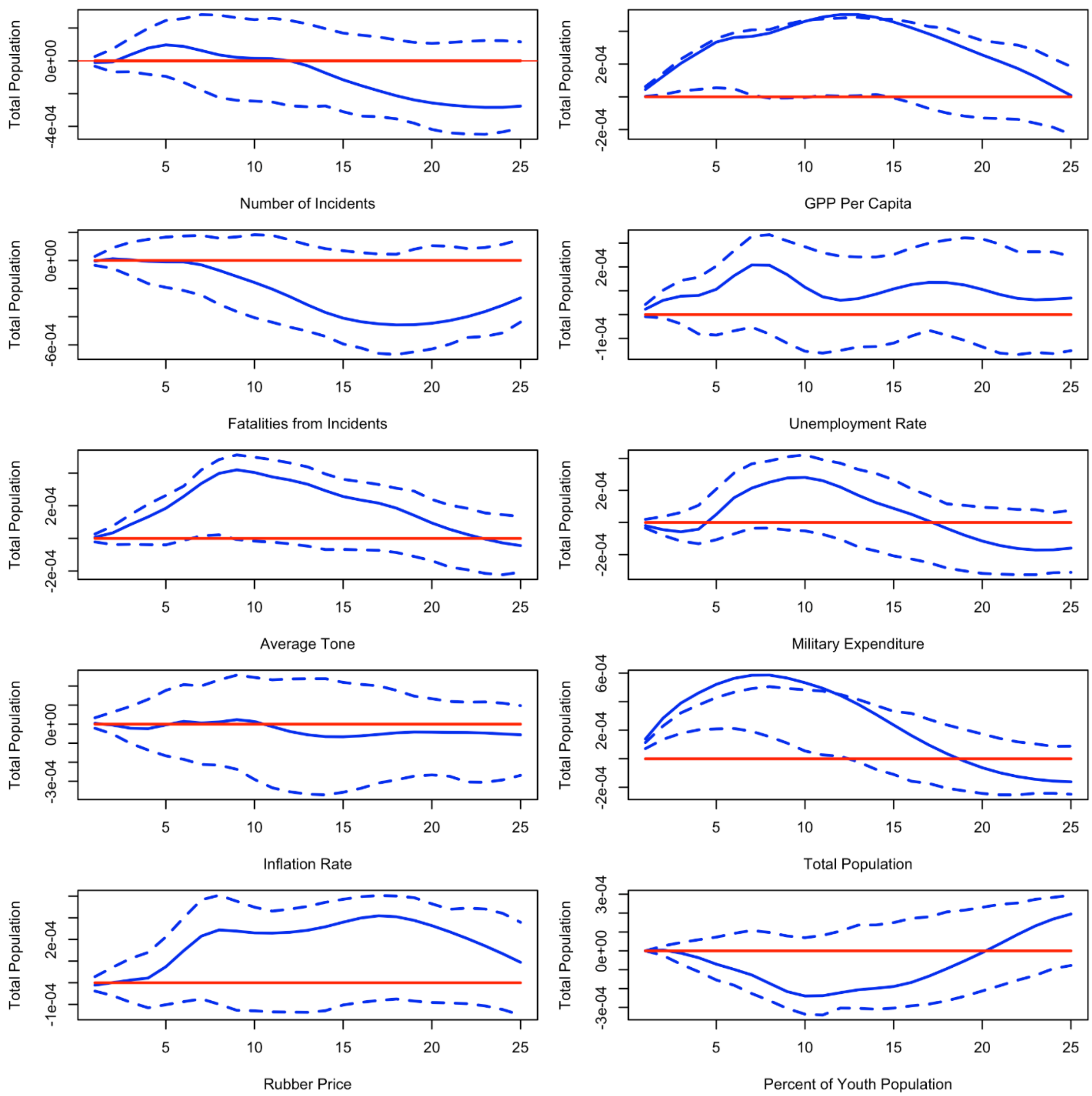

Figure 0-10: Impulse Response Function to Percent of Youth Population - VAR Model - Pattani Province

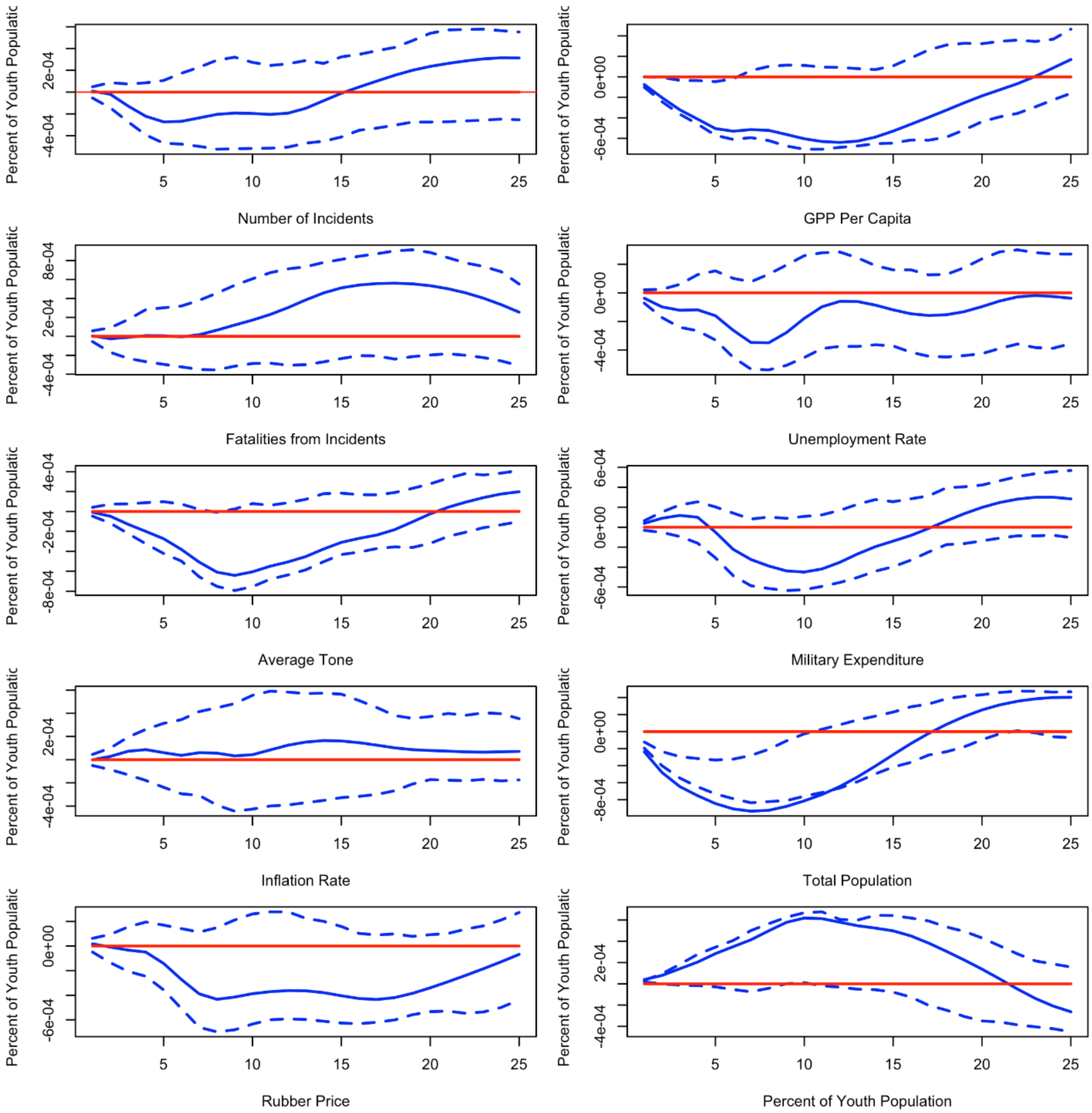

Figure 0-11: Impulse Response Function to Number of Incidents - VAR Model - Yala Province

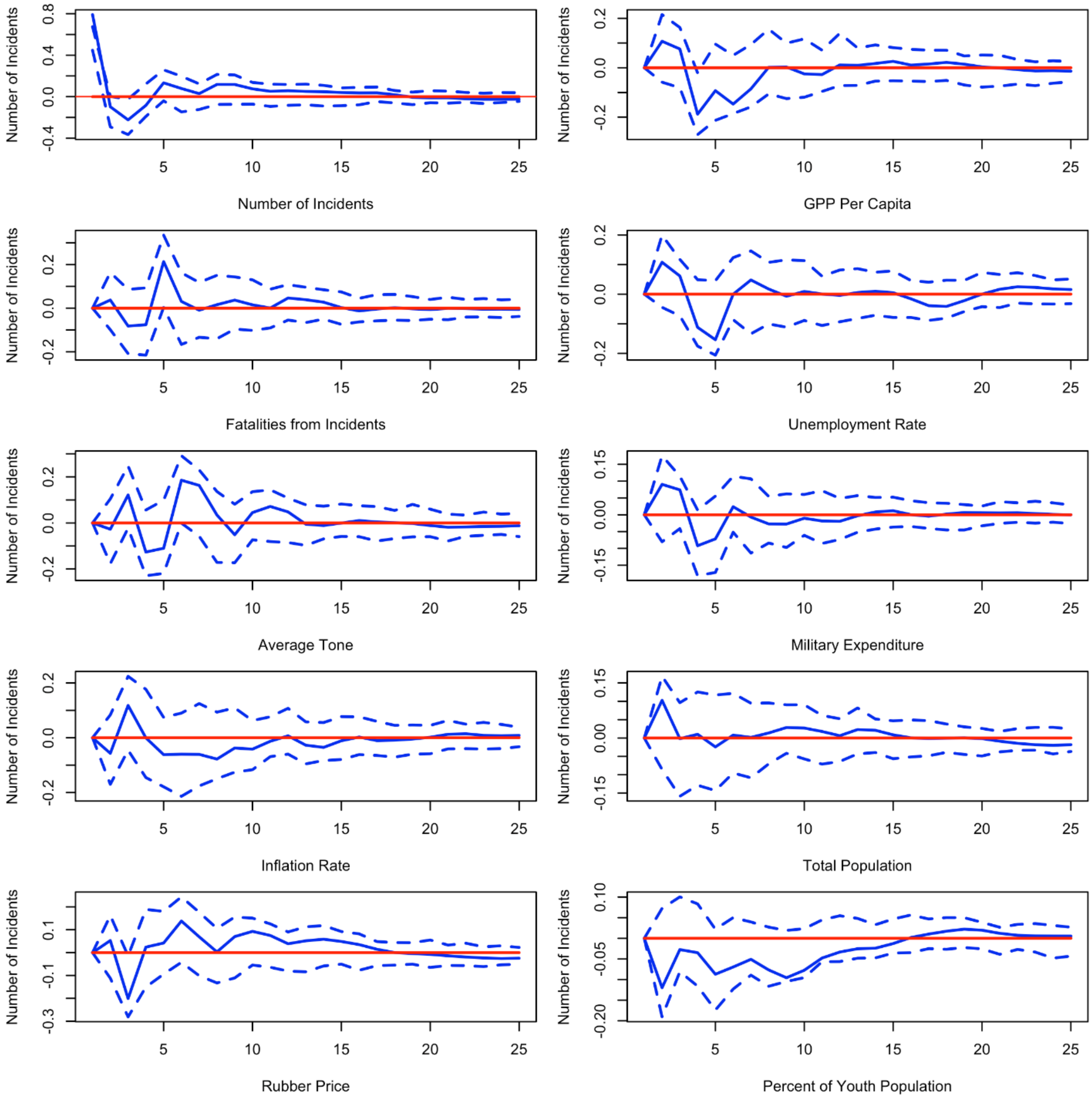

Figure 0-12: Impulse Response Function to Fatalities from Incidents - VAR Model - Yala Province

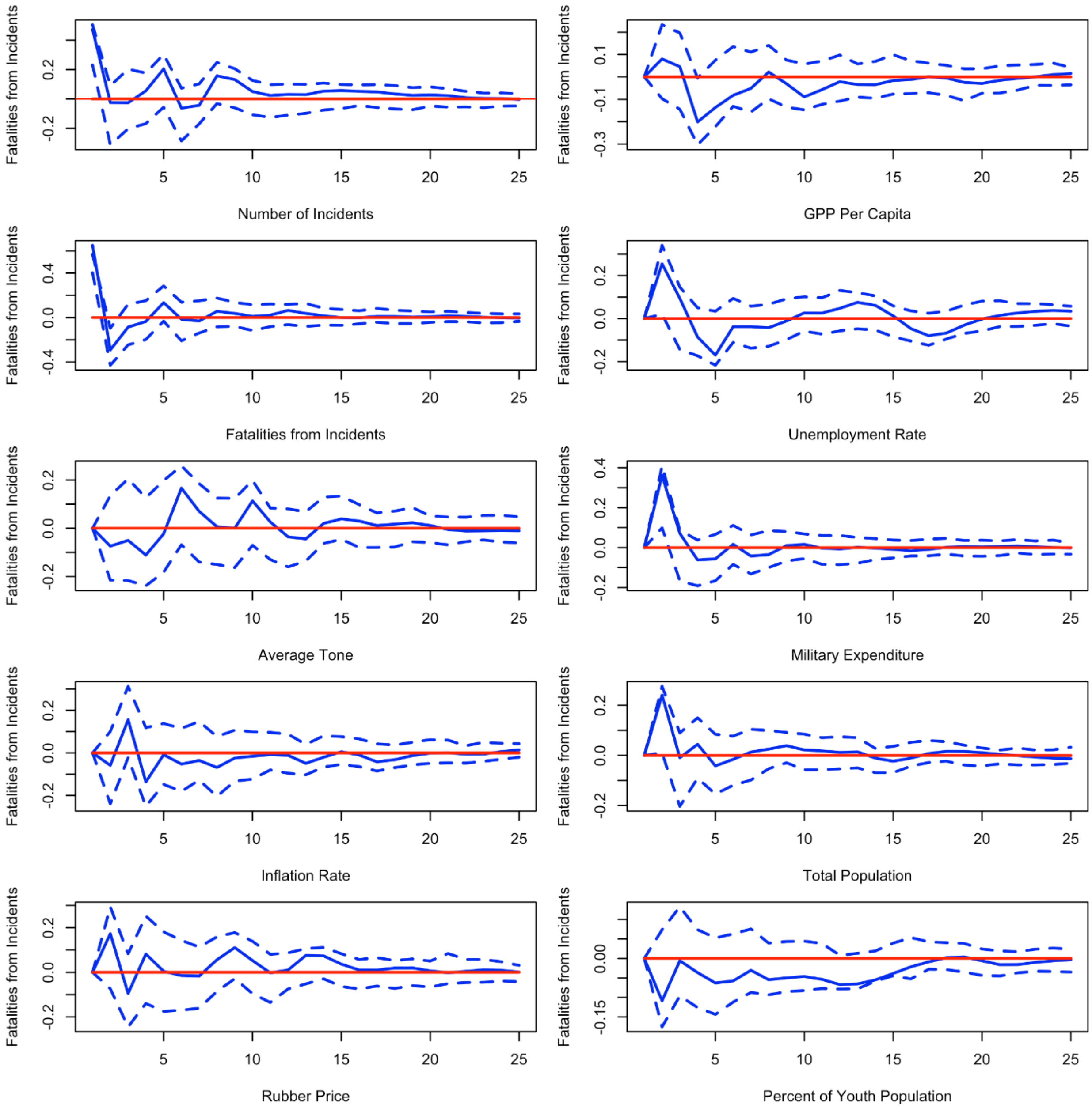

Figure 0-13: Impulse Response Function to Average Tone- VAR Model - Yala Province

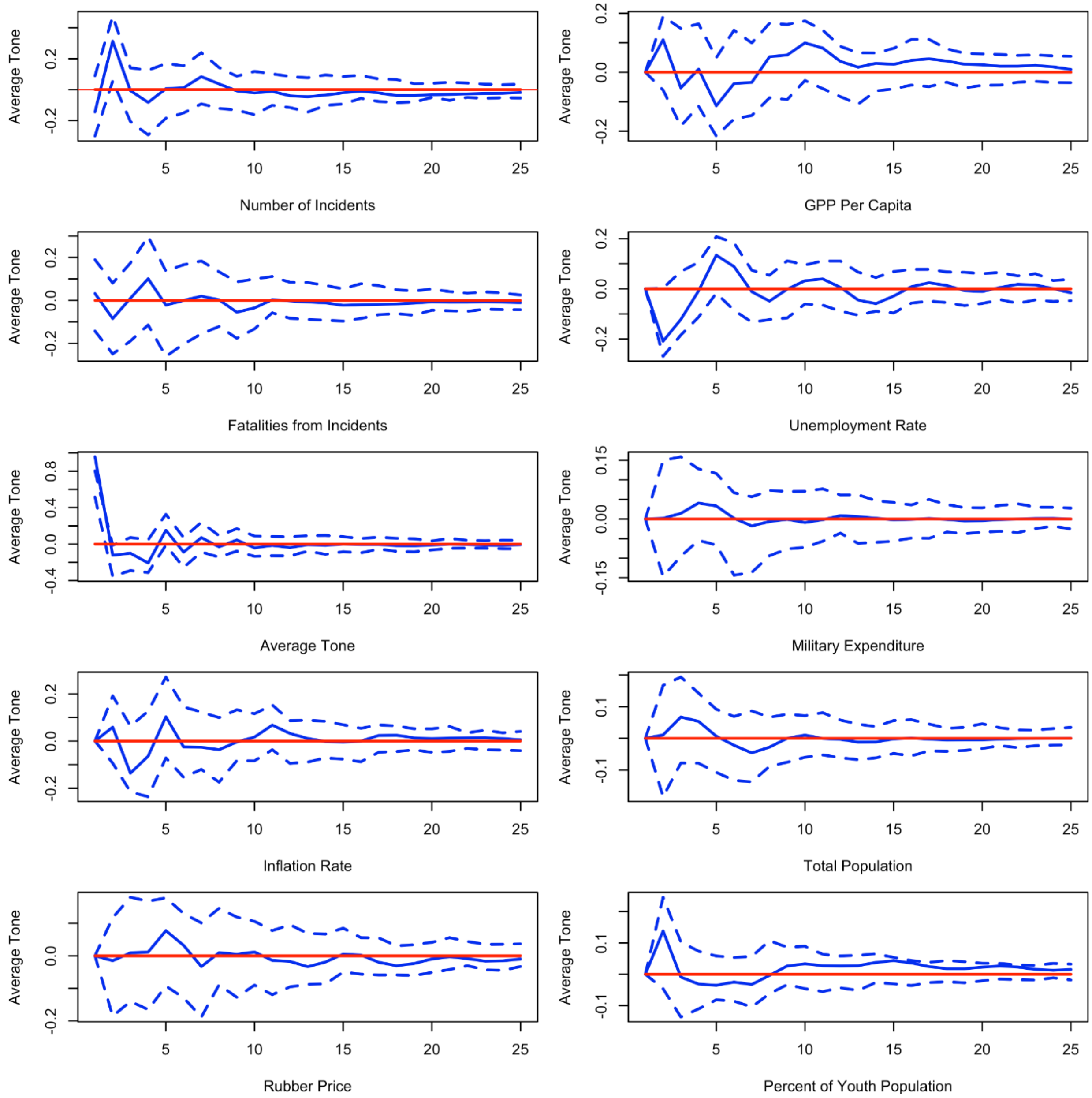

Figure 0-14: Impulse Response Function to Inflation Rate- VAR Model - Yala Province

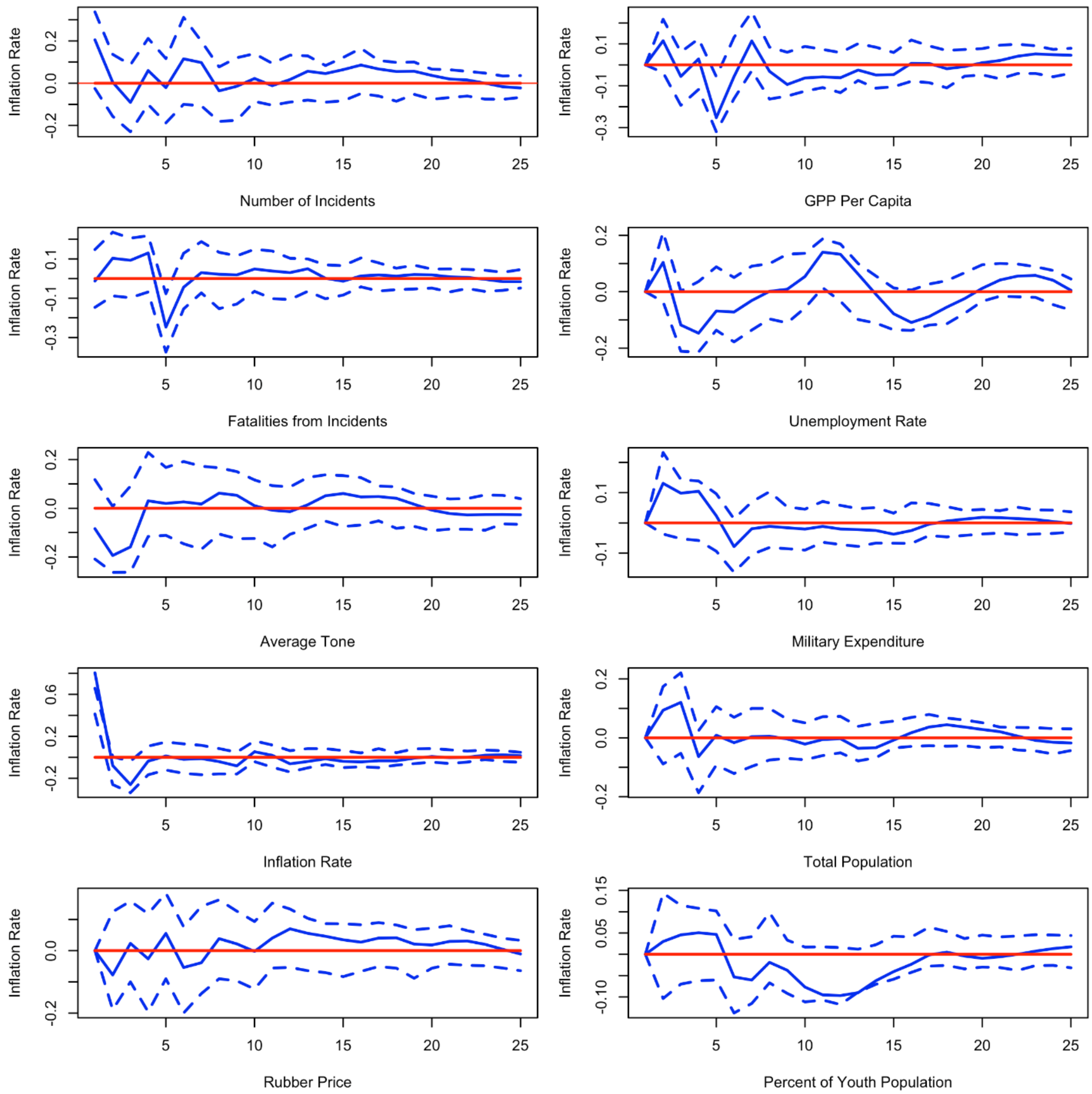

Figure 0-15: Impulse Response Function to Rubber Price- VAR Model - Yala Province

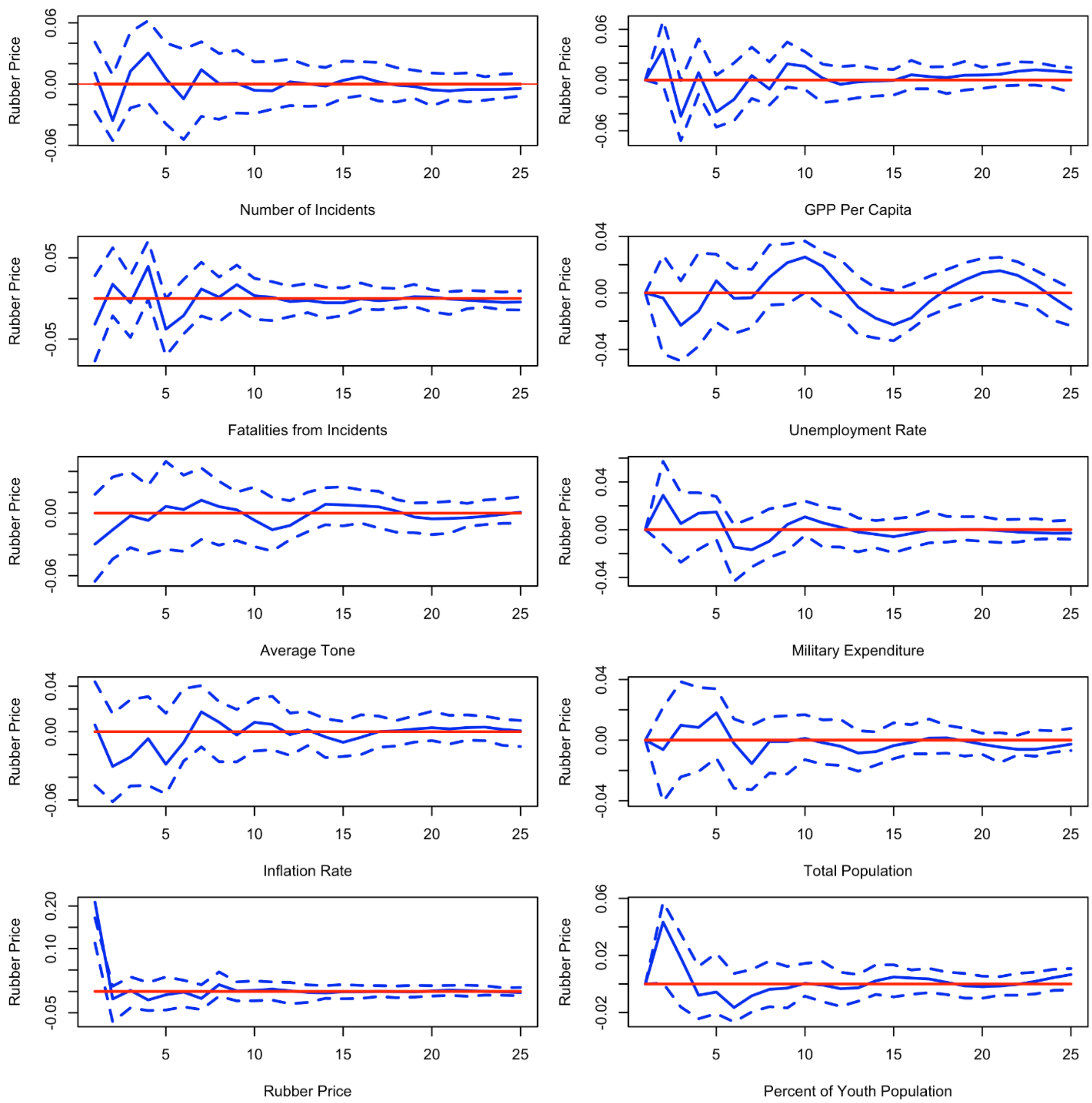

Figure 0-16: Impulse Response Function to GPP per Capita - VAR Model - Yala Province

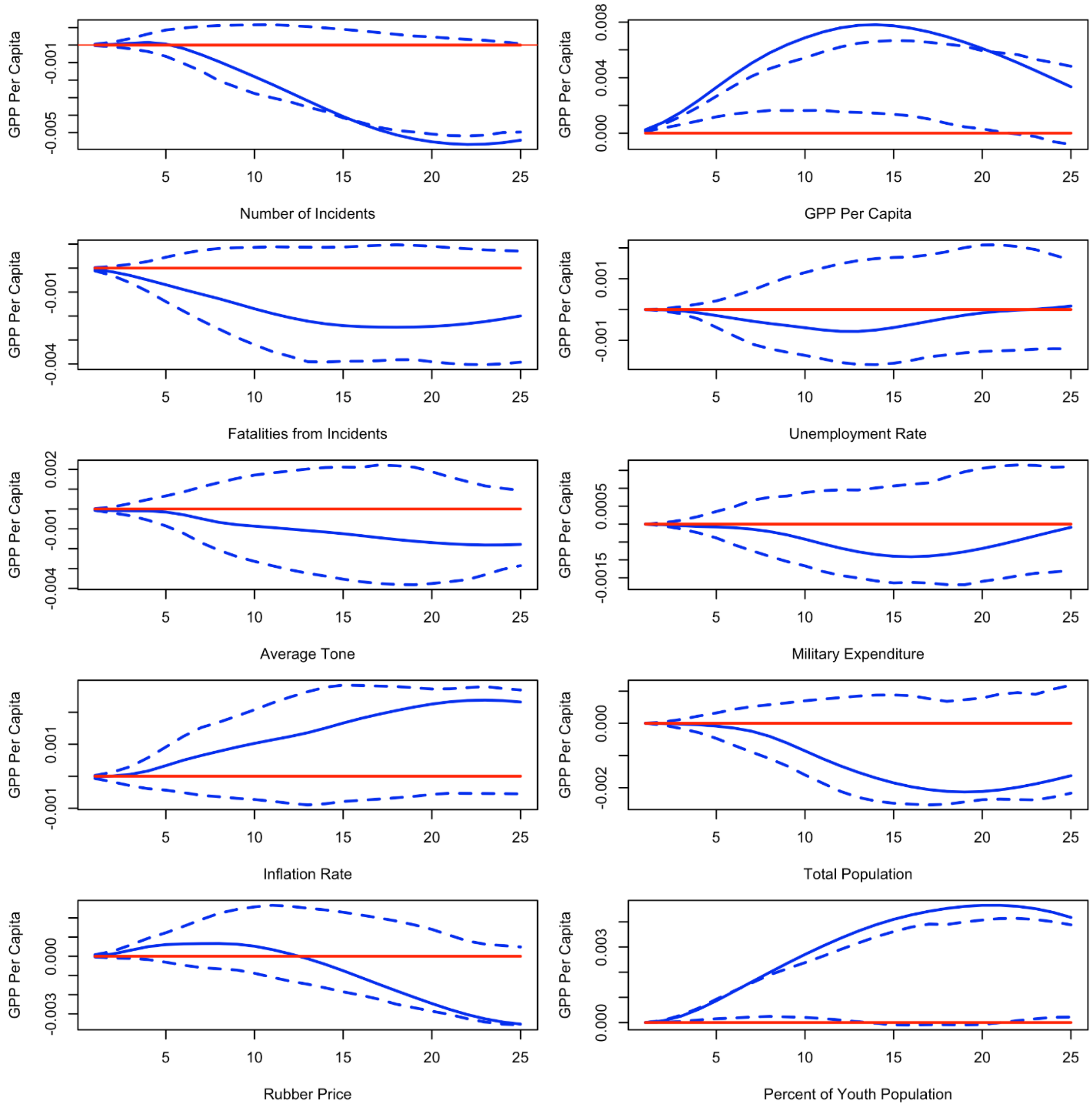

Figure 0-17: Impulse Response Function to Unemployment Rate - VAR Model - Yala Province

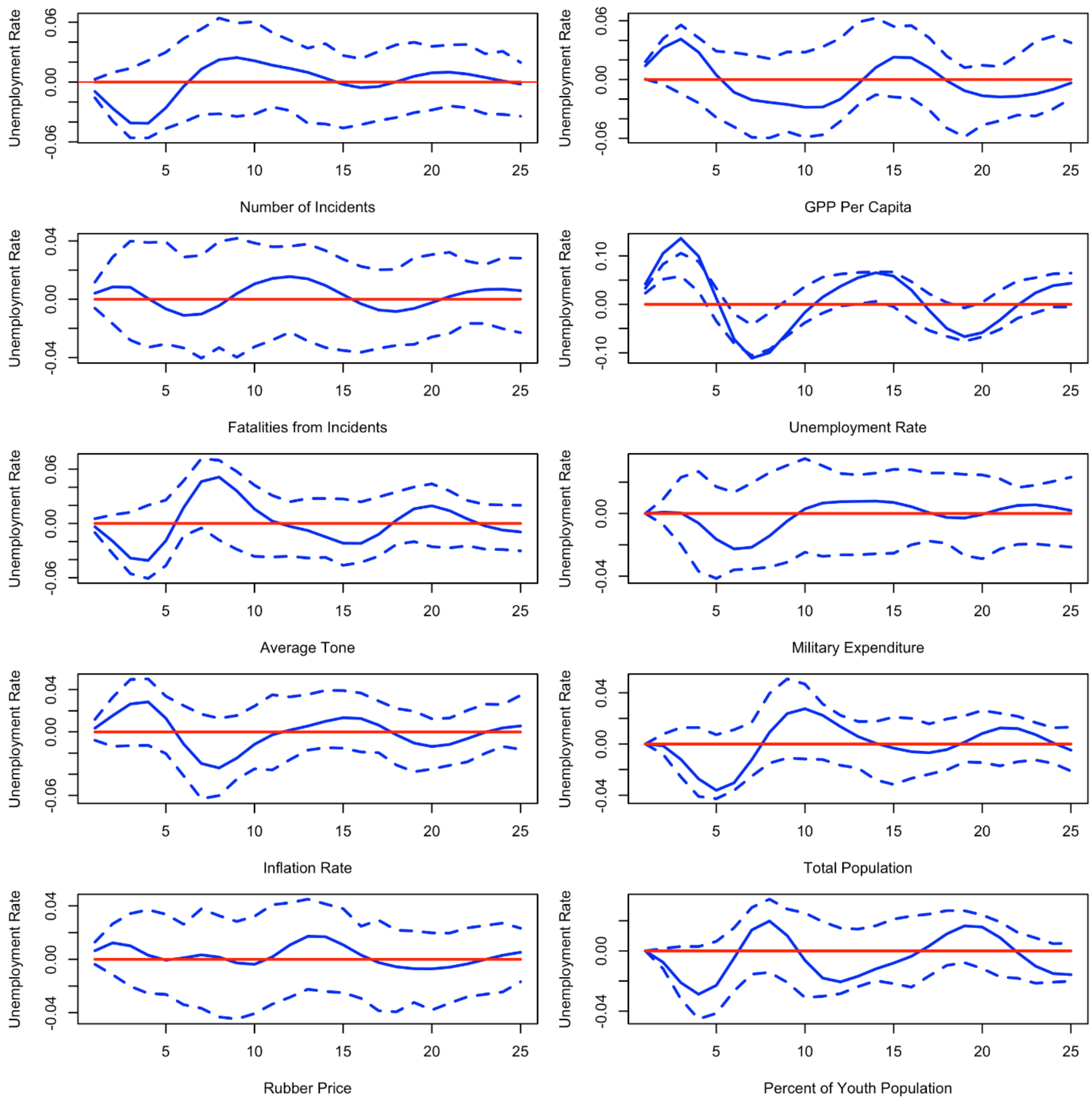

Figure 0-18: Impulse Response Function to Military Expenditure - VAR Model - Yala Province

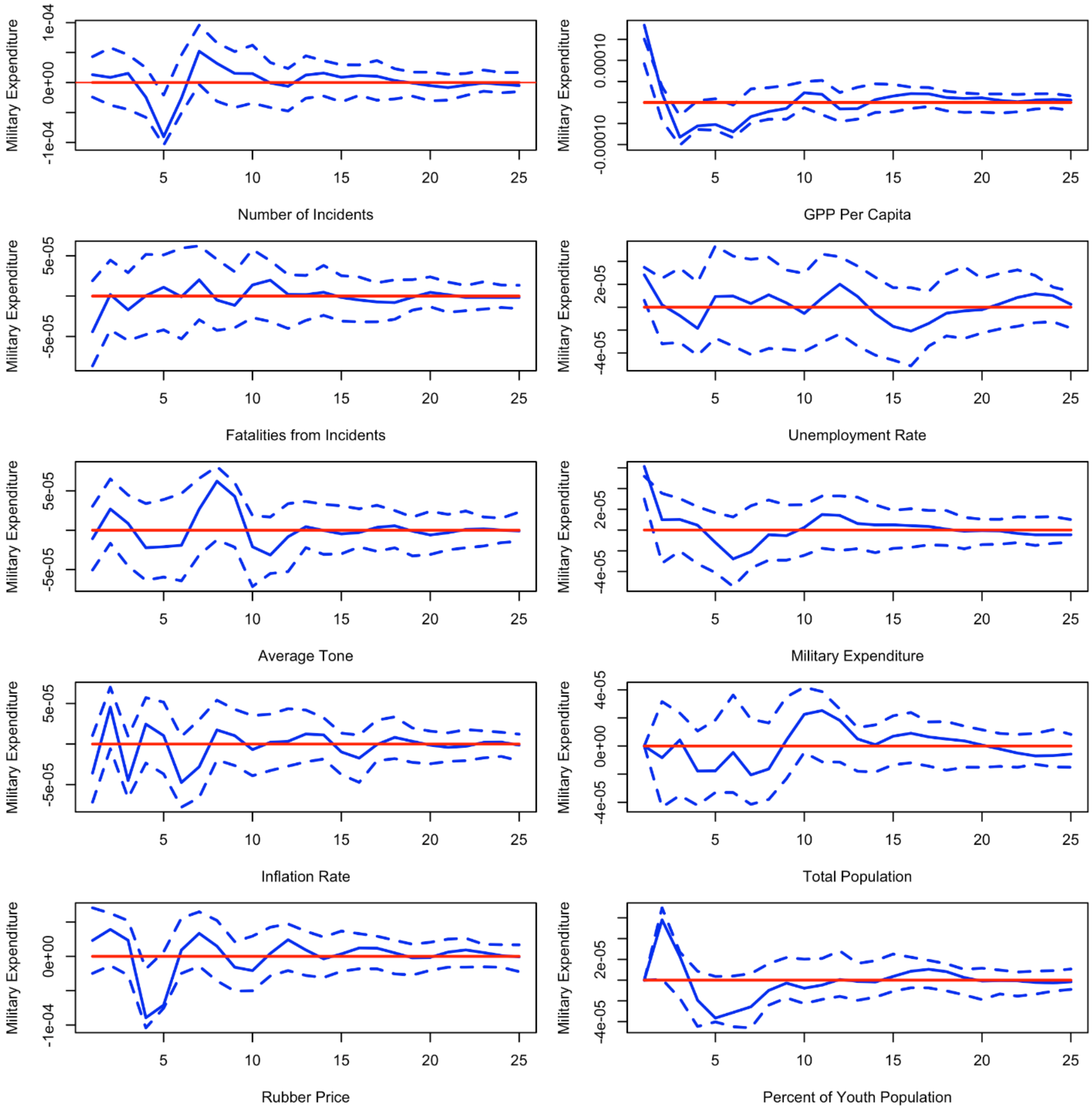

Figure 0-19: Impulse Response Function to Total Population - VAR Model - Yala Province

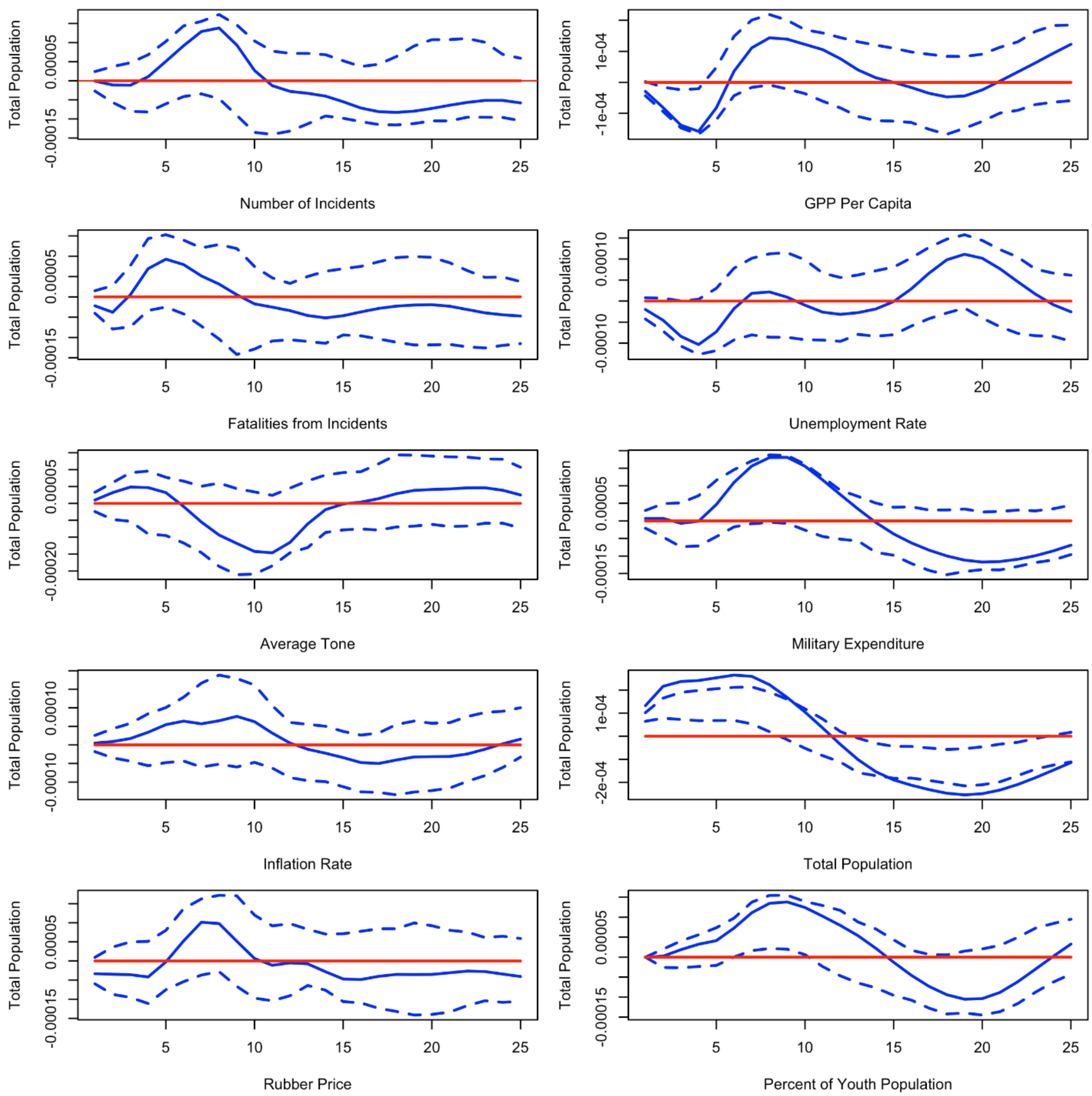

Figure 0-20: Impulse Response Function to Percent Of Youth Population - VAR Model - Yala Province

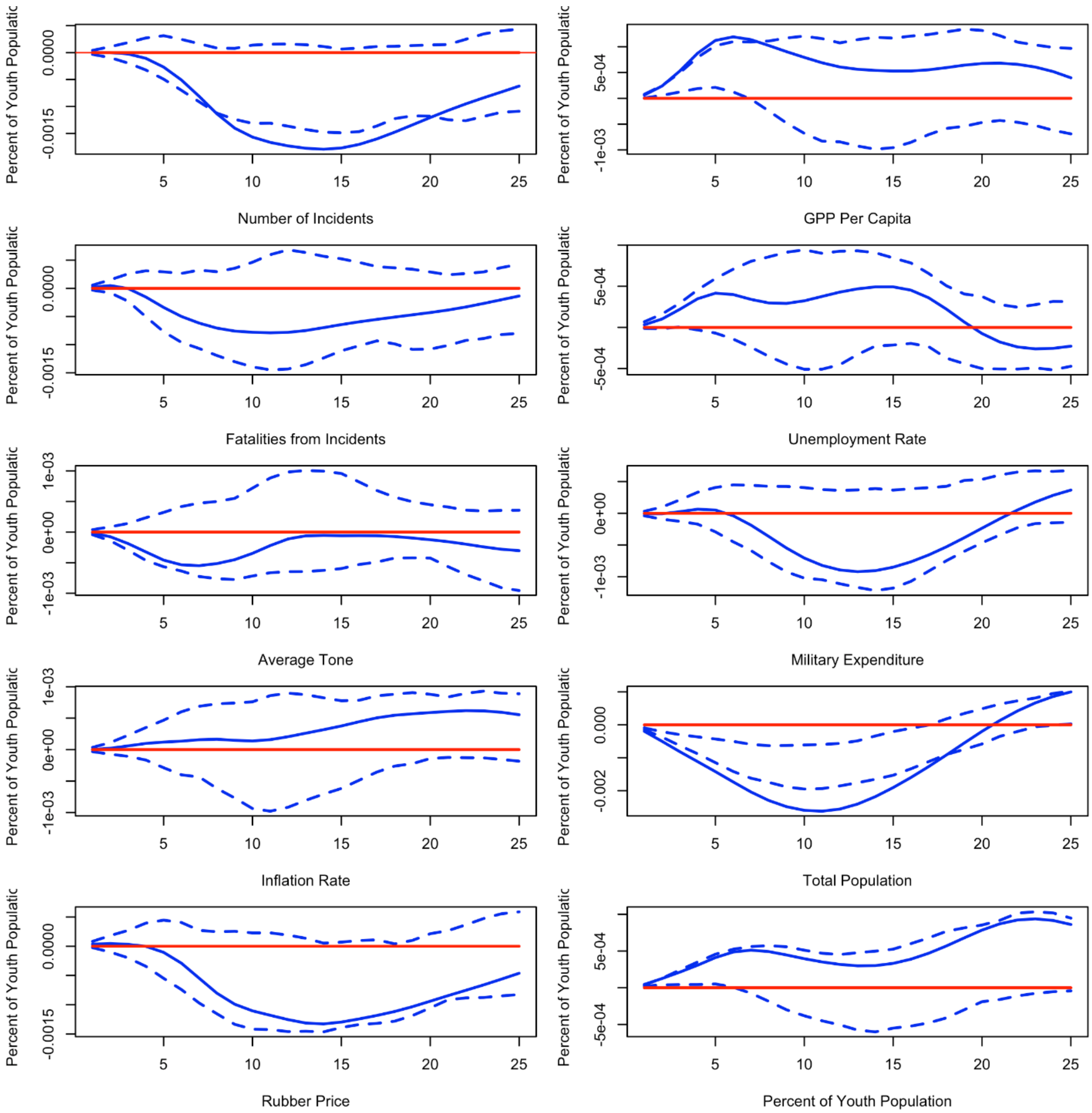

Figure 0-21: Impulse Response Function to Number of Incidents - VAR Model - Narathiwat Province

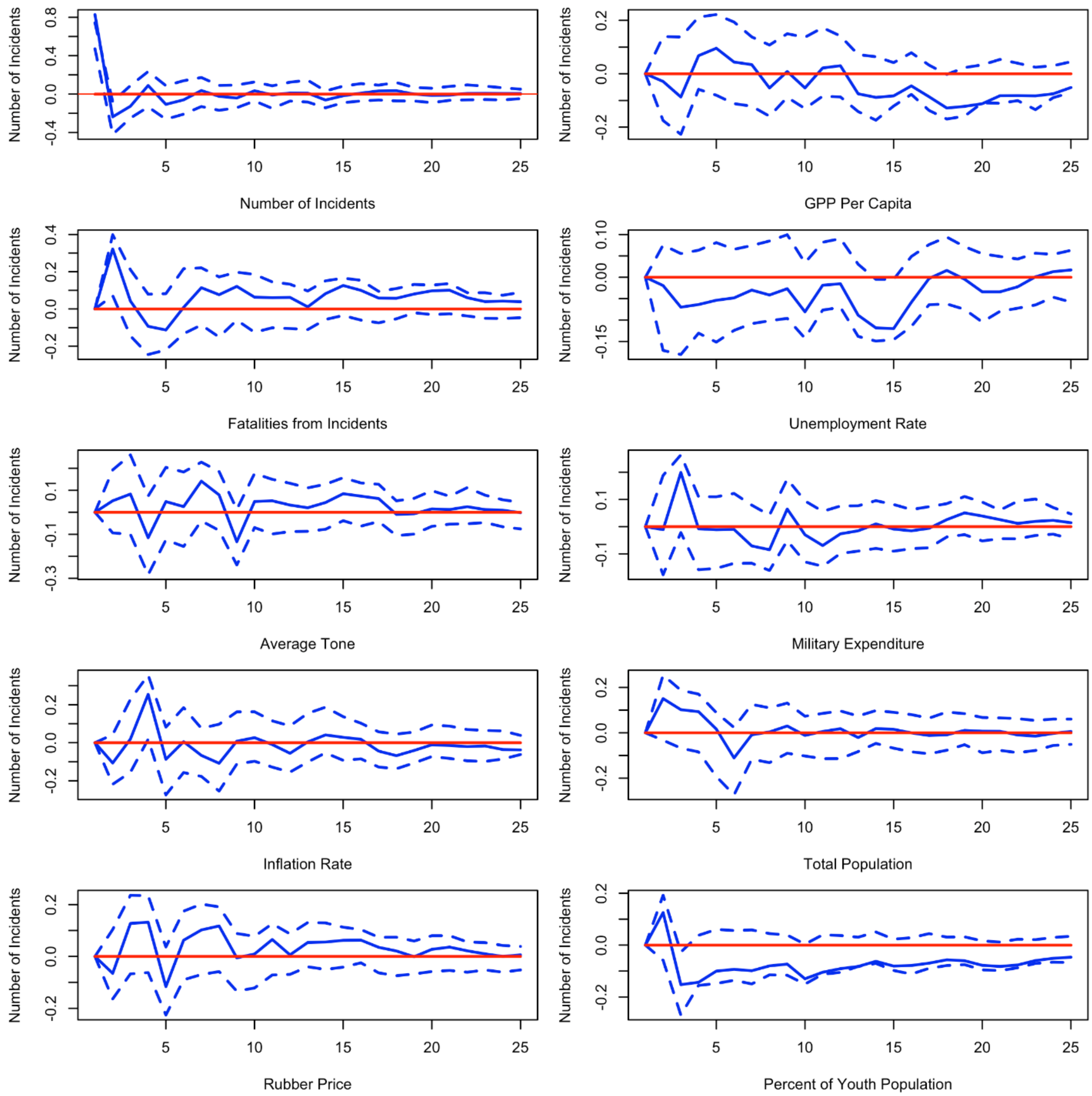

Figure 0-22: Impulse Response Function to Fatalities from Incidents - VAR Model - Narathiwat Province

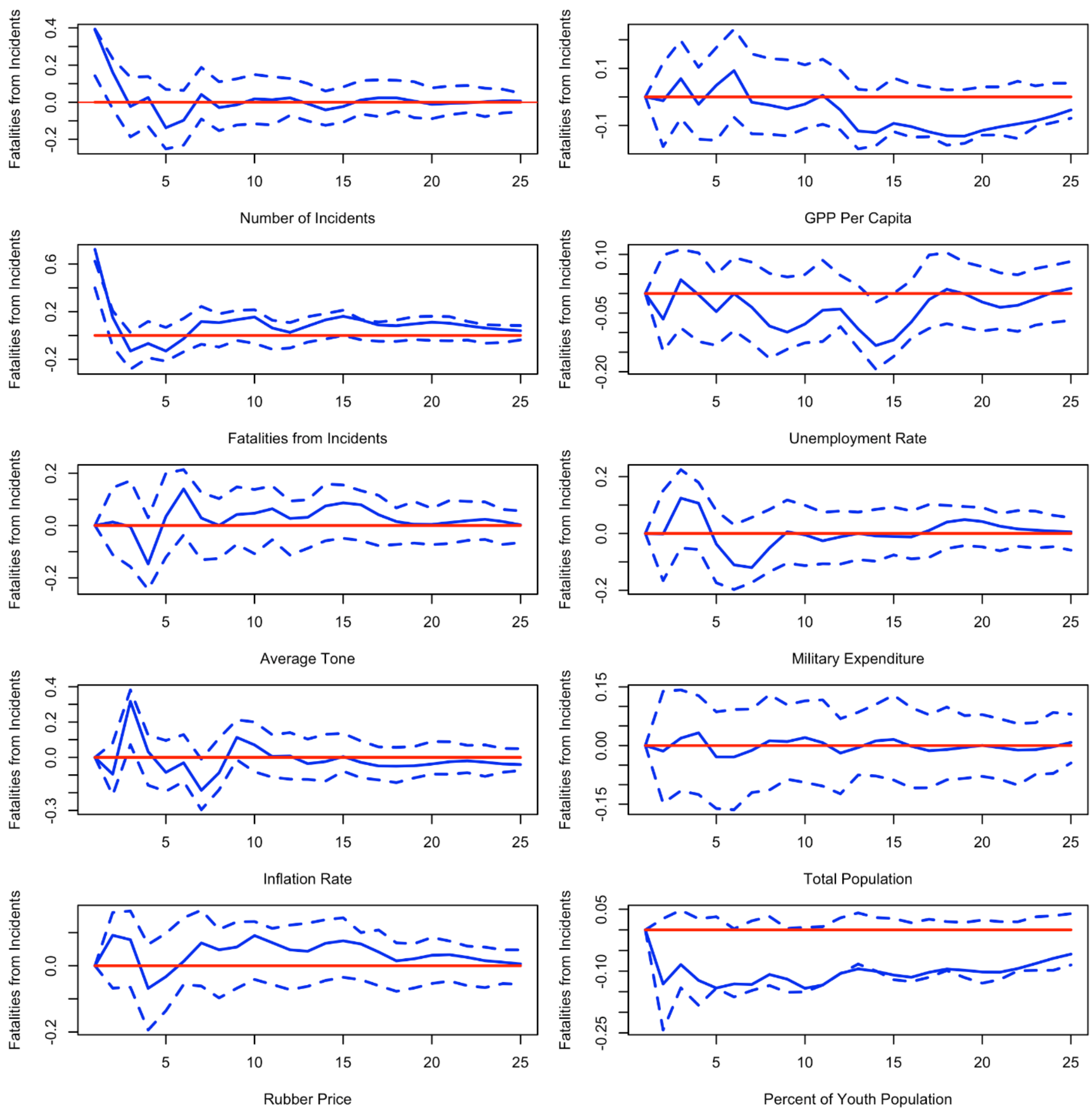

Figure 0-23: Impulse Response Function to Average Tone- VAR Model - Narathiwat Province

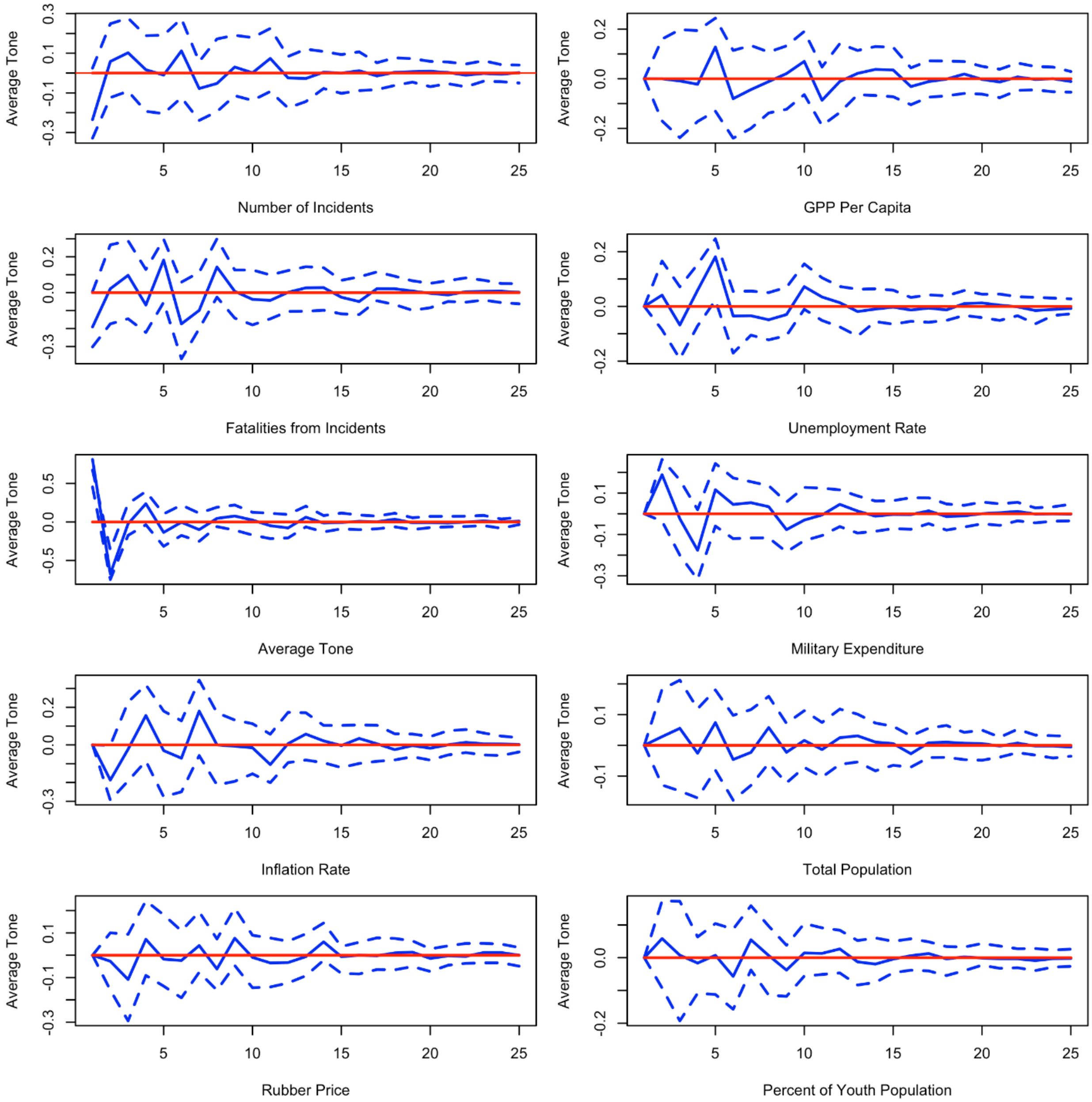

Figure 0-24: Impulse Response Function to Inflation Rate- VAR Model - Narathiwat Province

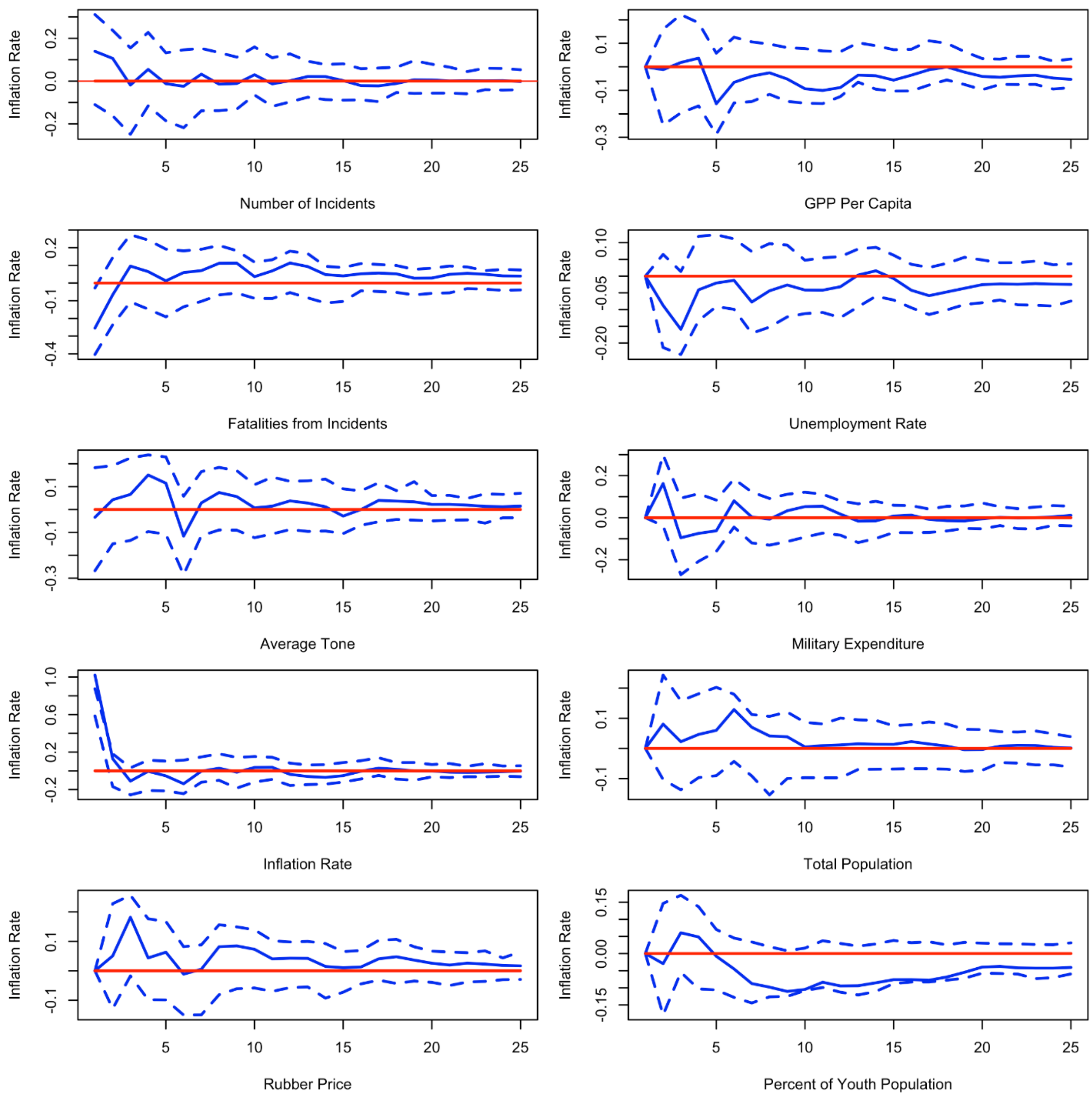

Figure 0-25: Impulse Response Function to Rubber Price- VAR Model - Narathiwat Province

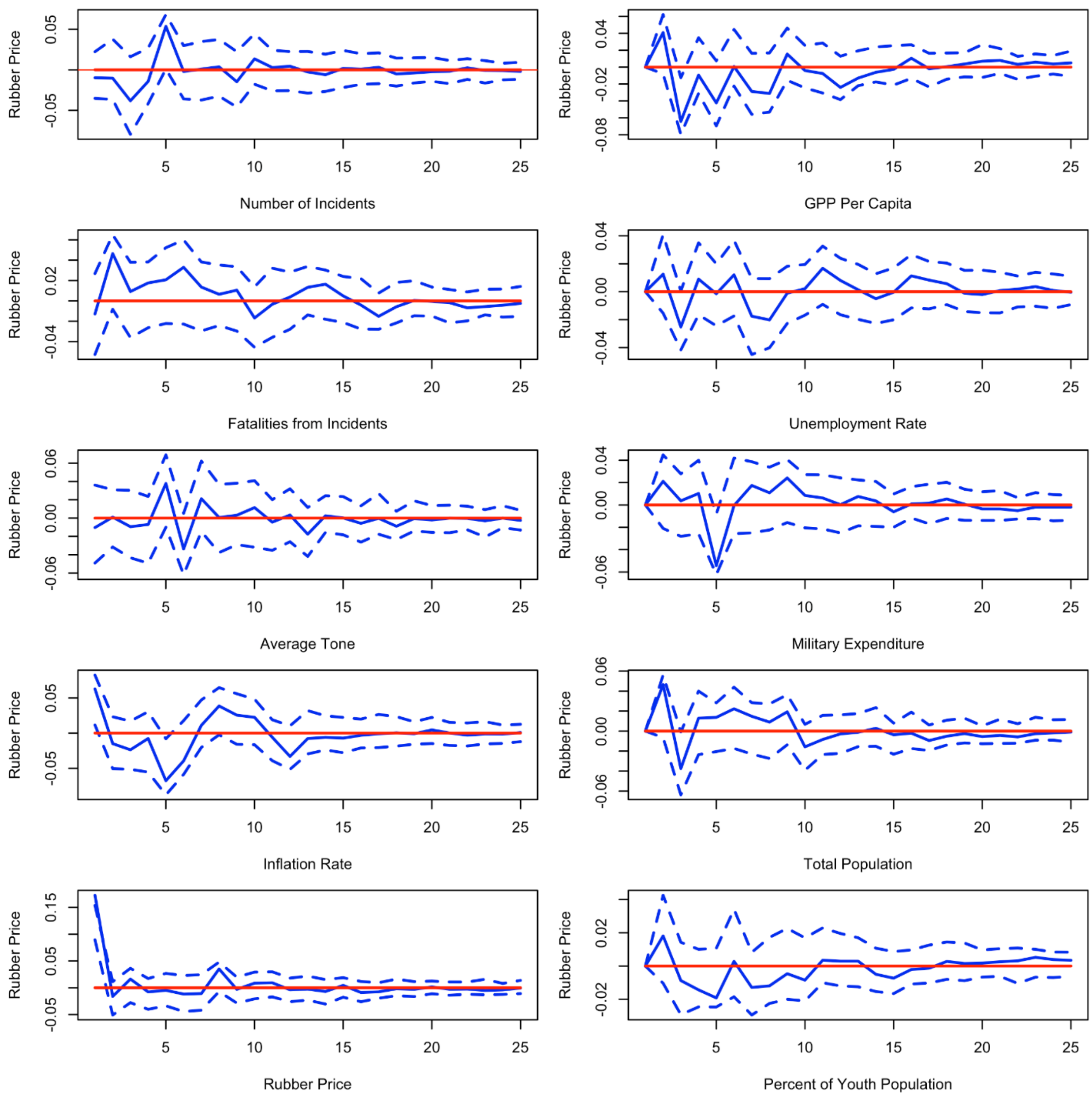

Figure 0-26: Impulse Response Function to GPP per Capita - VAR Model - Narathiwat Province

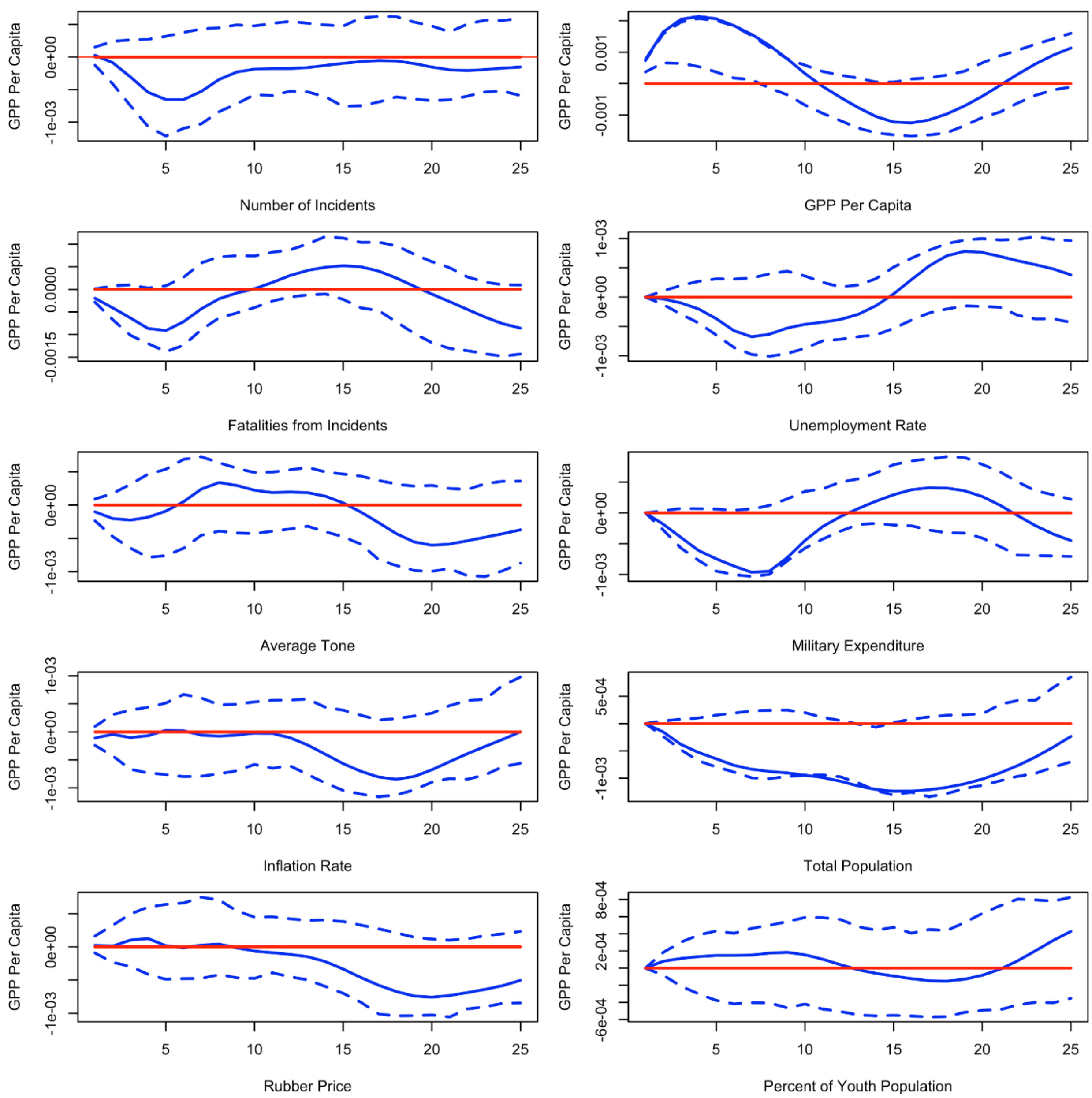

Figure 0-27: Impulse Response Function to Unemployment Rate - VAR Model - Narathiwat Province

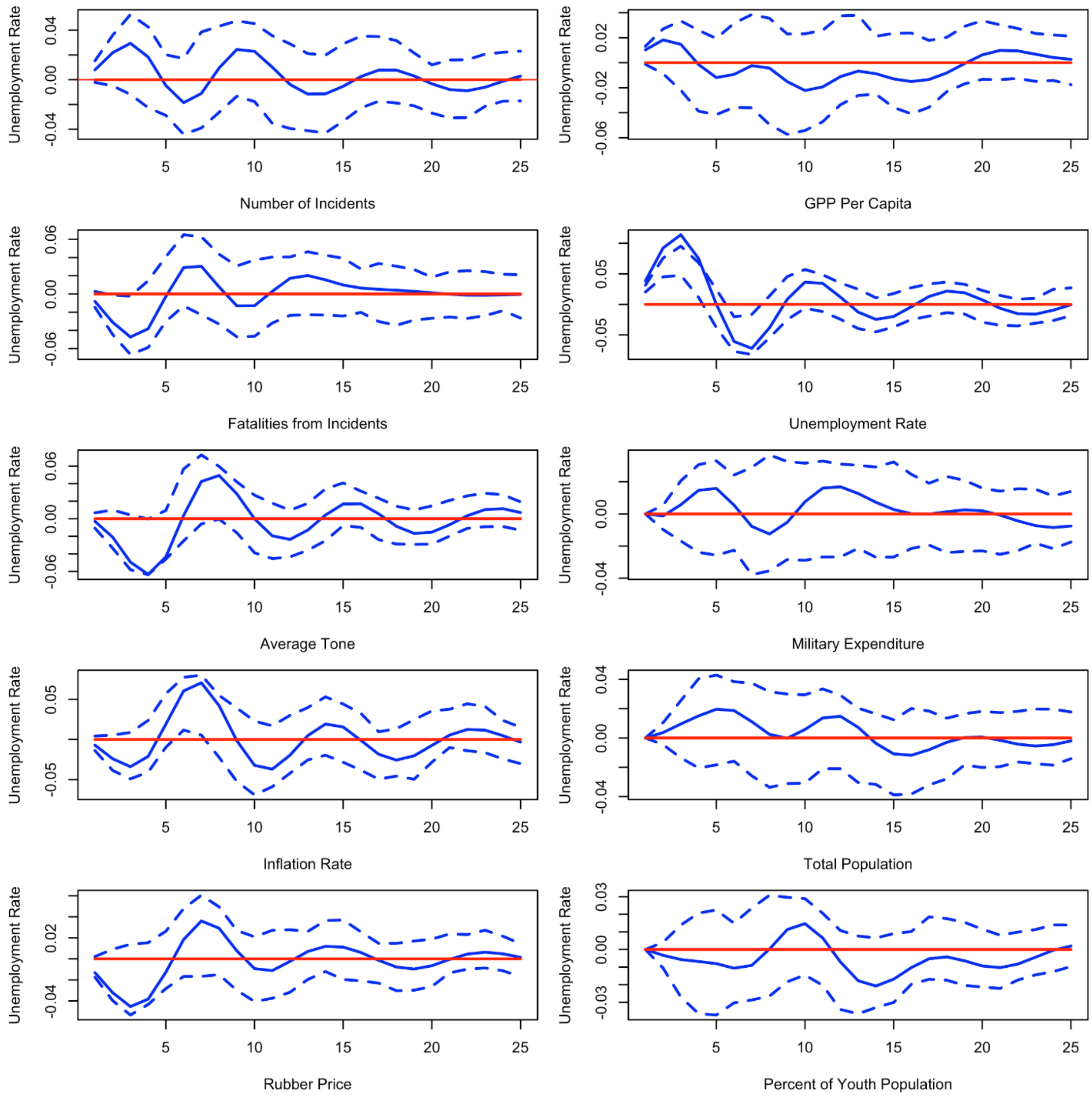

Figure 0-28: Impulse Response Function to Military Expenditure - VAR Model - Narathiwat Province

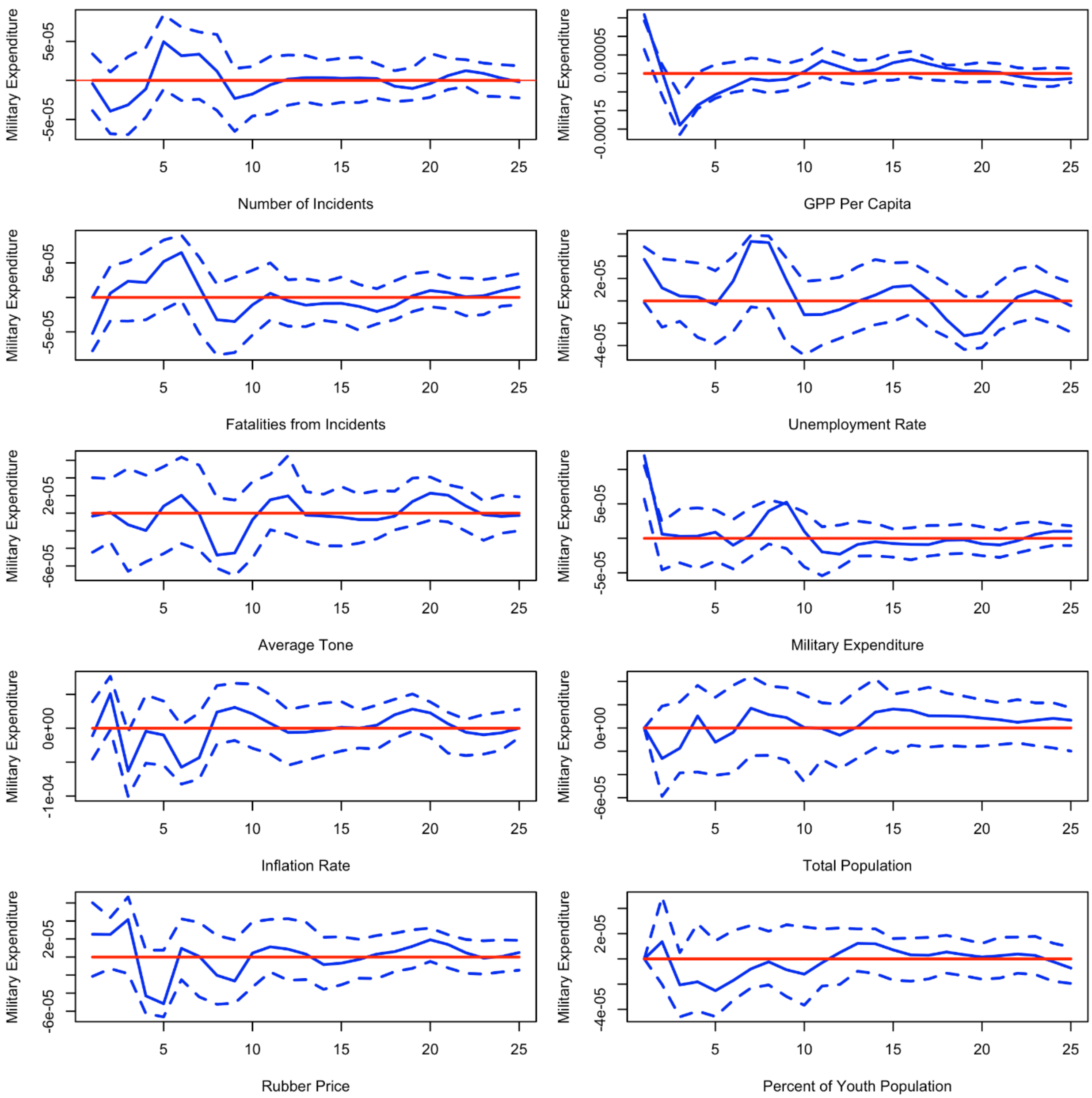

Figure 0-29: Impulse Response Function to Total Population - VAR Model - Narathiwat Province

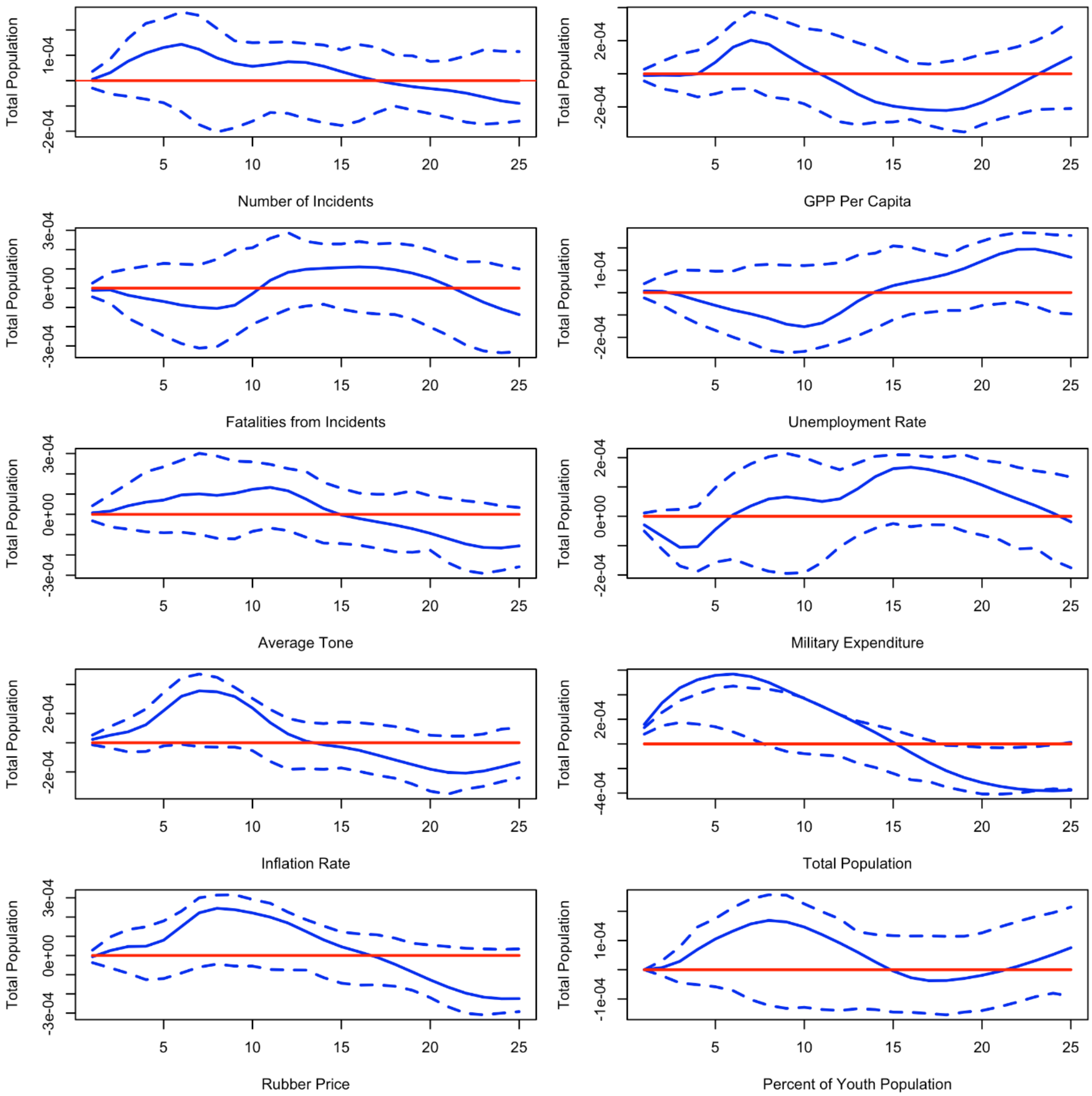

Figure 0-30: Impulse Response Function to Percent Of Youth Population - VAR Model - Narathiwat Province

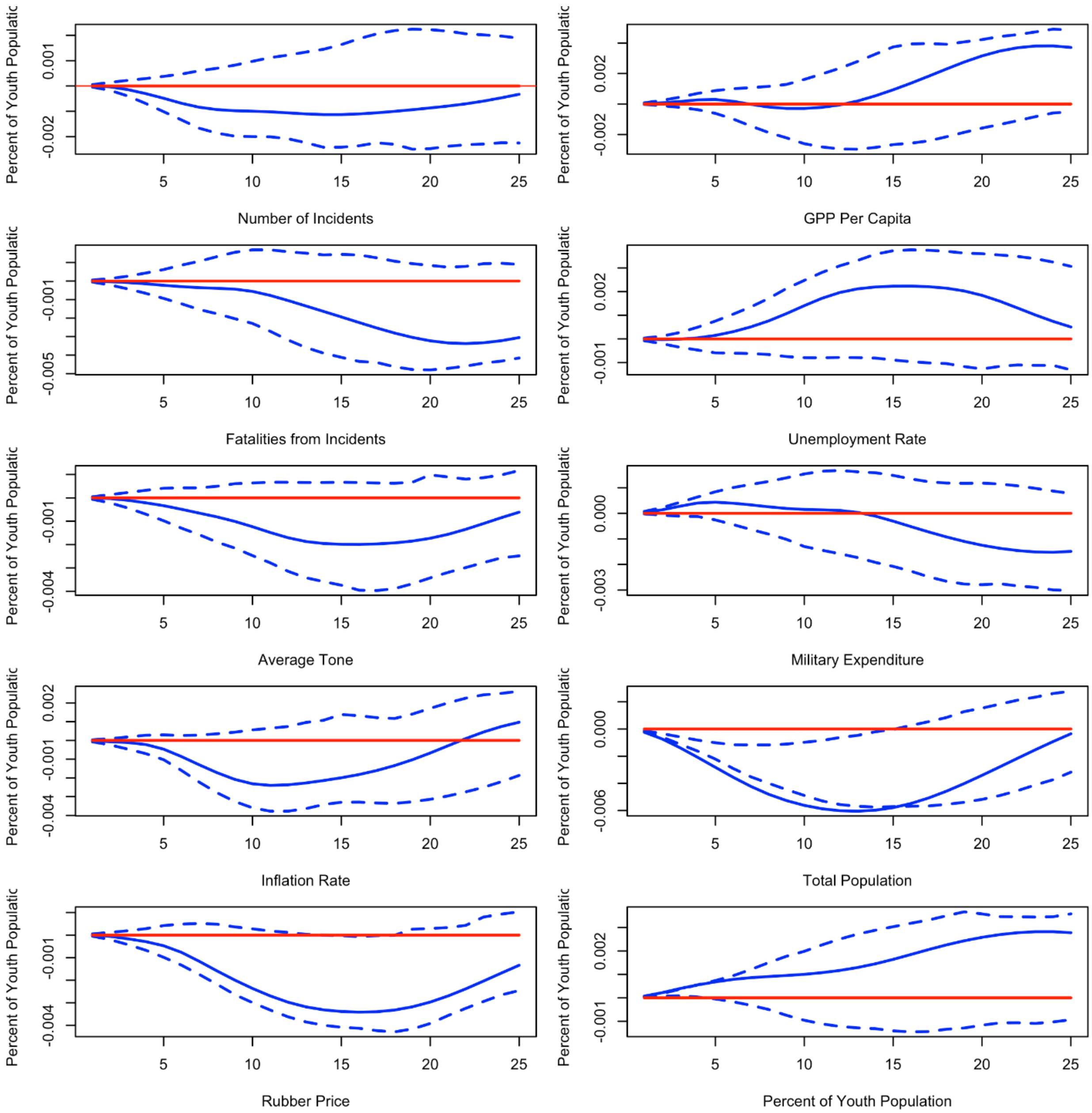

Table 0-7: The Result from Johansen Cointegration Test – VECM with 10 Variables - Pattani Province

	Johansen Test-Statistics	X10pct	X5pct	X1pct
r <= 9 |	27.22	10.49	12.25	16.26
r <= 8 |	59.80	22.76	25.32	30.45
r <= 7 |	94.20	39.06	42.44	48.45
r <= 6 |	145.04	59.14	62.99	70.05
r <= 5 |	212.11	83.2	87.31	96.58
r <= 4 |	288.11	110.42	114.9	124.75
r <= 3 |	379.84	141.01	146.76	158.49
r <= 2 |	506.56	176.67	182.82	196.08
r <= 1 |	641.32	215.17	222.21	234.41
r = 0 |	795.67	256.72	263.42	279.07

Table 0-8: VECM Results - Pattani Province

	Dependent variable:						
	Number of Incidents	Fatalities from Incidents from Incidents	Average Tone	Inflation Rate	Rubber Price	Unemployment Rate	Percent of Youth Total Population
ect1	0.225 (0.148)	0.592*** (0.106)	-0.065 (0.116)	0.401*** (0.143)	0.037 (0.029)	0.009 (0.016)	< 0.001* (<0.001)
ect2	-1.056** (0.441)	-2.035*** (0.314)	0.094 (0.343)	-0.051 (0.423)	0.109 (0.087)	-0.05 (0.048)	> -0.001 (<0.001)
ect3	-0.474 (0.374)	-0.575** (0.266)	-1.609*** (0.291)	0.421 (0.359)	0.06 (0.074)	0.042 (0.041)	< 0.001 (<0.001)
ect4	0.008 (0.254)	-0.506*** (0.181)	0.066 (0.198)	-1.193*** (0.244)	-0.171*** (0.05)	-0.053* (0.028)	> -0.001 (<0.001)
GPP Per Capita	-1.243 (0.75)	-0.671 (0.534)	0.695 (0.583)	1.393* (0.72)	0.343** (0.148)	-0.079 (0.082)	< 0.001* (<0.001)
Military Expenditure	-0.733 (1.278)	1.426 (0.91)	-0.078 (0.994)	2.883** (1.228)	0.28 (0.252)	0.273* (0.14)	< 0.001 (<0.001)
Total Population	2.728 (2.875)	9.847*** (2.048)	0.902 (2.238)	8.372*** (2.764)	0.642 (0.566)	0.784** (0.314)	0.001 (<0.001)
Number of Incidents.D1	-0.733*** (0.123)	0.425*** (0.087)	-0.076 (0.096)	0.174 (0.118)	0.077*** (0.024)	-0.007 (0.013)	> -0.001 (<0.001)
Fatalities from Incidents.D1	-0.034 (0.184)	-1.404*** (0.131)	0.009 (0.143)	-0.006 (0.177)	-0.027 (0.036)	-0.022 (0.02)	> -0.001 (<0.001)
Average Tone.D1	0.116 (0.159)	-0.064 (0.114)	-1.083*** (0.124)	0.058 (0.153)	0.012 (0.031)	0.026 (0.017)	< 0.001 (<0.001)
Inflation Rate.D1	-0.039 (0.134)	-0.23** (0.095)	0.088 (0.104)	-0.864*** (0.129)	-0.027 (0.026)	-0.021 (0.015)	< 0.001 (<0.001)
Rubber Price.D1	-0.05 (0.592)	1.697*** (0.421)	0.285 (0.461)	-0.107 (0.569)	-0.033 (0.117)	0.032 (0.065)	> -0.001 (<0.001)
Unemployment Rate.D1	-0.199 (0.787)	-0.216 (0.56)	1.07* (0.613)	-0.978 (0.757)	0.122 (0.155)	1.717*** (0.086)	< 0.001 (<0.001)
Percent of Youth Total Population.D1	-222.247 (198.174)	-312.343** (141.12)	526.824*** (154.235)	-95.121 (190.475)	15.771 (39.017)	-20.442 (21.641)	2.744*** (0.062)
Number of Incidents.D2	-0.279* (0.167)	0.638*** (0.119)	-0.144 (0.13)	0.32** (0.16)	0.075** (0.033)	0.013 (0.018)	> -0.001 (<0.001)
Fatalities from Incidents.D2	-0.548** (0.268)	-1.714*** (0.191)	0.022 (0.209)	> -0.001 (0.258)	0.021 (0.053)	-0.044 (0.029)	> -0.001 (<0.001)
Average Tone.D2	0.015 (0.23)	-0.136 (0.164)	-1.362*** (0.179)	0.066 (0.221)	0.007 (0.045)	0.04 (0.025)	< 0.001 (<0.001)
Inflation Rate.D2	0.077 (0.177)	-0.073 (0.126)	0.101 (0.138)	-1.12*** (0.17)	-0.072** (0.035)	-0.037* (0.019)	< 0.001 (<0.001)
Rubber Price.D2	0.369 (0.618)	0.503 (0.44)	-0.55 (0.481)	1.032* (0.594)	0.115 (0.122)	0.073 (0.067)	> -0.001 (<0.001)
Unemployment Rate.D2	-0.127 (1.068)	-0.449 (0.76)	-0.379 (0.831)	0.234 (1.026)	-0.317 (0.21)	-1.819*** (0.117)	> -0.001 (<0.001)

	Dependent variable:						
	Number of Incidents	Fatalities from Incidents from Incidents	Average Tone	Inflation Rate	Rubber Price	Unemployment Rate	Percent of Youth Total Population
Percent of Youth Total Population.D2	528.277 (383.653)	769.466*** (273.201)	-847.941*** (298.591)	298.394 (368.749)	-14.964 (75.535)	42.769 (41.896)	-2.542*** (0.119)
Number of Incidents.D3	-0.016 (0.168)	0.631*** (0.119)	-0.047 (0.13)	0.216 (0.161)	0.007 (0.033)	0.005 (0.018)	< 0.001 (<0.001)
Fatalities from Incidents.D3	-0.848** (0.36)	-1.949*** (0.257)	-0.026 (0.281)	-0.023 (0.346)	0.046 (0.071)	-0.052 (0.039)	> -0.001 (<0.001)
Average Tone.D3	-0.219 (0.302)	-0.384* (0.215)	-1.384*** (0.235)	0.224 (0.29)	0.041 (0.059)	0.054 (0.033)	< 0.001 (<0.001)
Inflation Rate.D3	-0.141 (0.223)	-0.387** (0.159)	0.152 (0.174)	-1.125*** (0.214)	-0.085* (0.044)	-0.035 (0.024)	< 0.001 (<0.001)
Rubber Price.D3	1.538** (0.582)	0.845** (0.414)	-0.116 (0.453)	-0.229 (0.559)	-0.236** (0.114)	0.032 (0.064)	> -0.001 (<0.001)
Unemployment Rate.D3	0.173 (0.768)	-0.06 (0.547)	0.569 (0.598)	-0.587 (0.738)	0.208 (0.151)	0.532*** (0.084)	> -0.001 (<0.001)
Percent of Youth Total Population.D3	-300.746 (189.937)	-432.751*** (135.255)	340.989** (147.825)	-177.015 (182.559)	3.191 (37.396)	-19.954 (20.742)	0.796*** (0.059)
Residual standard error	0.971	0.692	0.756	0.934	0.191	0.106	<0.001
Adjusted R-squared	0.348	0.665	0.449	0.325	0.273	0.967	1
F-statistic	2.753	7.508	3.677	2.583	2.232	97.35	168600
p-value	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001

Table 0-9: The Error Correction Term Composition Table - Pattani Province

	ect1	ect2	ect3	ect4
Number of Incidents.l4	1 ()	> -0.001 (0.058)	< 0.001 (0.101)	> -0.001 (0.157)
Fatalities from Incidents.l4	> -0.001 (0.281)	1 ()	> -0.001 (0.147)	> -0.001 (0.231)
Average Tone.l4	> -0.001 (0.295)	> -0.001 (0.088)	1 ()	> -0.001 (0.168)
Inflation Rate.l4	> -0.001 (0.231)	> -0.001 (0.07)	< 0.001 (0.085)	1 ()
Rubber Price.l4	-5.967*** (0.345)	-2.111*** (0.099)	0.328** (0.128)	-1.502*** (0.179)
Unemployment Rate.l4	8.263*** (0.258)	1.949*** (0.078)	-0.503*** (0.09)	3.111*** (0.124)
Percent of Youth Total Population.l4	-2.21 (2.801)	-2.145*** (0.742)	-2.651** (1.122)	-8.116*** (1.762)
trend.l4	-2.694*** (0.231)	-0.577*** (0.067)	-0.206** (0.087)	-1.448*** (0.131)

Table 0-10: The Result from Johansen Cointegration Test – VECM with 10 Variables - Yala Province

	Johansen Test-Statistics	X10pct	X5pct	X1pct
r <= 9 |	21.14	10.49	12.25	16.26
r <= 8 |	33.22	16.85	18.96	23.65
r <= 7 |	42.84	23.11	25.54	30.34
r <= 6 |	46.74	29.12	31.46	36.65
r <= 5 |	59.21	34.75	37.52	42.36
r <= 4 |	66.22	40.91	43.97	49.51
r <= 3 |	87.57	46.32	49.42	54.71
r <= 2 |	95.12	52.16	55.5	62.46
r <= 1 |	114.46	57.87	61.29	67.88
r = 0 |	149.79	63.18	66.23	73.73

Table 0-11: VECM Results - Yala Province

	Dependent variable:						
	Number of Incidents	Fatalities from Incidents from Incidents	Average Tone	Inflation Rate	Rubber Price	Unemployment Rate	Percent of Youth Total Population
ect1	-1.635***	0.273	0.334	0.591	0.043	0.024	< 0.001***
	(0.331)	(0.372)	(0.413)	(0.414)	(0.08)	(0.019)	(<0.001)
ect2	-0.604**	-1.575***	0.025	0.047	0.079	-0.014	> -0.001***
	(0.276)	(0.31)	(0.344)	(0.345)	(0.067)	(0.016)	(<0.001)
ect3	0.392	-0.138	-1.15***	-0.879***	0.049	-0.015	< 0.001
	(0.248)	(0.279)	(0.31)	(0.31)	(0.06)	(0.014)	(<0.001)
ect4	0.39**	0.107	-0.671***	-0.778***	-0.086**	0.027***	< 0.001
	(0.16)	(0.18)	(0.2)	(0.201)	(0.039)	(0.009)	(<0.001)
ect5	0.171	-0.429	1.632***	-0.237	-0.479***	-0.011	> -0.001**
	(0.443)	(0.499)	(0.554)	(0.555)	(0.108)	(0.025)	(<0.001)
const	-3.347**	1.129	-5.352***	0.107	1.224***	0.184**	0.001**
	(1.53)	(1.721)	(1.911)	(1.915)	(0.372)	(0.086)	(<0.001)
GPP Per Capita	2.335***	0.584	0.094	0.042	-0.002	-0.089***	> -0.001
	(0.539)	(0.606)	(0.673)	(0.675)	(0.131)	(0.03)	(<0.001)
Military Expenditure	5.23***	0.455	2.729	-0.378	-0.899***	0.089	> -0.001
	(1.377)	(1.549)	(1.72)	(1.723)	(0.334)	(0.077)	(<0.001)
Total Population	36.113***	5.538	4.561	1.013	-1.271	0.791*	-0.005**
	(7.449)	(8.377)	(9.303)	(9.32)	(1.809)	(0.419)	(0.002)
Number of Incidents.D1	-1.194***	-0.008	0.296	0.119	-0.026	0.001	< 0.001
	(0.15)	(0.169)	(0.187)	(0.188)	(0.036)	(0.008)	(<0.001)
Fatalities from Incidents.D1	-0.034	-1.166***	-0.048	0.063	0.013	-0.002	< 0.001
	(0.124)	(0.139)	(0.154)	(0.155)	(0.03)	(0.007)	(<0.001)
Average Tone.D1	0.122	0.003	-1.014***	-0.257**	0.018	-0.006	< 0.001
	(0.102)	(0.115)	(0.127)	(0.128)	(0.025)	(0.006)	(<0.001)
Inflation Rate.D1	0.111	0.02	-0.064	-0.825***	-0.016	0.012*	< 0.001
	(0.104)	(0.117)	(0.13)	(0.13)	(0.025)	(0.006)	(<0.001)
Rubber Price.D1	0.421	0.817	1.062*	-0.219	-0.244**	-0.022	> -0.001
	(0.481)	(0.54)	(0.6)	(0.601)	(0.117)	(0.027)	(<0.001)
Unemployment Rate.D1	3.494**	4.018**	-3.531*	-1.366	0.018	1.902***	< 0.001
	(1.475)	(1.659)	(1.842)	(1.846)	(0.358)	(0.083)	(<0.001)
Percent of Youth Total Population.D1	390.182	-439.551	211.677	-42.296	-46.401	10.941	2.495***
	(246.806)	(277.555)	(308.227)	(308.8)	(59.947)	(13.887)	(0.078)
Number of Incidents.D2	-1.452***	0.009	0.392	0.236	0.003	0.006	< 0.001**
	(0.216)	(0.243)	(0.27)	(0.27)	(0.052)	(0.012)	(<0.001)
Fatalities from Incidents.D2	-0.308*	-1.364***	-0.048	0.08	0.033	-0.009	> -0.001**
	(0.18)	(0.203)	(0.225)	(0.225)	(0.044)	(0.01)	(<0.001)
Average Tone.D2	0.332**	0.019	-1.04***	-0.493**	0.041	-0.011	< 0.001
	(0.15)	(0.169)	(0.188)	(0.188)	(0.036)	(0.008)	(<0.001)
Inflation Rate.D2	0.301**	0.213	-0.337**	-0.949***	-0.045	0.018**	< 0.001
	(0.128)	(0.144)	(0.16)	(0.16)	(0.031)	(0.007)	(<0.001)

	Dependent variable:						
	Number of Incidents	Fatalities from Incidents from Incidents	Average Tone	Inflation Rate	Rubber Price	Unemployment Rate	Percent of Youth Total Population
Rubber Price.D2	-0.529	-0.514	0.95	0.44	-0.22*	-0.017	> -0.001
	(0.492)	(0.553)	(0.614)	(0.615)	(0.119)	(0.028)	(<0.001)
Unemployment Rate.D2	-3.029	-5.301**	6.186**	-0.031	-0.189	-1.897***	> -0.001
	(2.178)	(2.45)	(2.72)	(2.725)	(0.529)	(0.123)	(<0.001)
Percent of Youth Total Population.D2	-615.156	814.302	-247.258	187.447	84.133	-13.463	-2.152***
	(439.114)	(493.822)	(548.393)	(549.413)	(106.656)	(24.707)	(0.138)
Number of Incidents.D3	-1.608***	0.121	0.237	0.367	0.004	0.016	< 0.001***
	(0.273)	(0.307)	(0.341)	(0.342)	(0.066)	(0.015)	(<0.001)
Fatalities from Incidents.D3	-0.578**	-1.536***	0.056	0.221	0.089	-0.014	> -0.001***
	(0.225)	(0.253)	(0.281)	(0.281)	(0.055)	(0.013)	(<0.001)
Average Tone.D3	0.385*	-0.037	-1.29***	-0.67***	0.048	-0.013	< 0.001
	(0.199)	(0.223)	(0.248)	(0.248)	(0.048)	(0.011)	(<0.001)
Inflation Rate.D3	0.312*	0.052	-0.523**	-0.875***	-0.041	0.024***	< 0.001
	(0.161)	(0.181)	(0.201)	(0.202)	(0.039)	(0.009)	(<0.001)
Rubber Price.D3	0.336	0.332	0.836	-0.045	-0.412***	0.007	> -0.001
	(0.48)	(0.54)	(0.599)	(0.6)	(0.117)	(0.027)	(<0.001)
Unemployment Rate.D3	1.605	2.483*	-3.76**	-0.568	-0.065	0.65***	< 0.001
	(1.3)	(1.462)	(1.624)	(1.627)	(0.316)	(0.073)	(<0.001)
Percent of Youth Total Population.D3	338.021	-371.713	70.085	-135.356	-43.302	4.766	0.627***
	(215.222)	(242.036)	(268.783)	(269.282)	(52.275)	(12.109)	(0.068)
Residual standard error	0.8777	0.889	0.679	1.022	0.177	0.042	<0.001
Adjusted R-squared	0.513	0.248	0.506	0.191	0.376	0.975	1
F-statistic	4.346	2.045	4.251	1.749	2.914	126.2	150600
p-value	<0.001	0.009	<0.001	0.033	<0.001	<0.001	<0.001

Table 0-12: The Error Correction Term Composition Table - Yala Province

	ect1	**ect2**	**ect3**	**ect4**	**ect5**
Number of Incidents.l4	1	> -0.001	> -0.001	< 0.001	> -0.001
	()	(0.152)	(0.178)	(0.222)	(0.096)
Fatalities from Incidents.l4	> -0.001	1	> -0.001	< 0.001	> -0.001
	(0.103)	()	(0.176)	(0.215)	(0.094)
Average Tone.l4	> -0.001	> -0.001	1	< 0.001	> -0.001
	(0.087)	(0.126)	()	(0.179)	(0.075)
Inflation Rate.l4	> -0.001	> -0.001	> -0.001	1	> -0.001
	(0.072)	(0.102)	(0.118)	()	(0.061)
Rubber Price.l4	> -0.001	> -0.001	< 0.001	> -0.001	1
	(0.159)	(0.23)	(0.254)	(0.315)	()
Unemployment Rate.l4	-0.123	-0.625***	2.617***	-2.968***	0.841***
	(0.094)	(0.143)	(0.155)	(0.209)	(0.085)
Percent of Youth Population.l4	-23.767***	-0.052	-35.603***	21.736***	-8.067***
	(2.215)	(3.609)	(4.194)	(5.173)	(2.055)
trend.l4	-0.046***	-0.011	0.004	-0.061*	0.061***
	(0.014)	(0.022)	(0.024)	(0.032)	(0.011)

Table 0-13: The Result from Johansen Cointegration Test – VECM with 10 Variables - Narathiwat Province

	Johansen Test-Statistics	X10pct	X5pct	X1pct
r <= 9 |	18.53	10.49	12.25	16.26
r <= 8 |	27.38	16.85	18.96	23.65
r <= 7 |	35.06	23.11	25.54	30.34
r <= 6 |	47.71	29.12	31.46	36.65
r <= 5 |	67.56	34.75	37.52	42.36
r <= 4 |	75.08	40.91	43.97	49.51
r <= 3 |	90.88	46.32	49.42	54.71
r <= 2 |	110.77	52.16	55.5	62.46
r <= 1 |	121.32	57.87	61.29	67.88
r = 0 |	151.49	63.18	66.23	73.73

Table 0-14: VECM Results - Narathiwat Province

	Dependent variable:						
	Number of Incidents	Fatalities from Incidents from Incidents	Average Tone	Inflation Rate	Rubber Price	Unemployment Rate	Percent of Youth Total Population
ect1	-1.947*** (0.467)	0.036 (0.473)	1.07 (0.362)	0.246 (0.545)	-0.237 (0.094)	0.057 (0.022)	< 0.001*** (<0.001)
ect2	0.977 (0.408)	-0.716*** (0.413)	-1.095 (0.315)	-0.701 (0.475)	0.116** (0.082)	-0.026 (0.019)	> -0.001 (<0.001)
ect3	0.481 (0.368)	0.288** (0.373)	-1.702 (0.285)	0.611 (0.429)	0.173 (0.074)	-0.061 (0.018)	> -0.001 (<0.001)
ect4	-0.347 (0.178)	-0.609 (0.18)	-0.232*** (0.138)	-0.534 (0.207)	-0.084 (0.036)	0.007 (0.008)	> -0.001 (<0.001)
const	-0.897 (1.407)	0.404 (1.425)	2.436 (1.089)	2.32** (1.64)	1.295 (0.284)	0.368 (0.067)	< 0.001 (<0.001)
GPP Per Capita	4.169 (1.428)	3.393 (1.446)	-4.611** (1.105)	3.028*** (1.664)	0.221 (0.288)	-0.407 (0.068)	< 0.001 (<0.001)
Military Expenditure	2.025*** (1.494)	1.311 (1.513)	-2.732 (1.156)	-1.026* (1.741)	-1.306* (0.302)	-0.471 (0.071)	< 0.001** (<0.001)
Total Population	24.398 (9.011)	21.555** (9.126)	-33.384* (6.97)	17.937 (10.499)	0.685*** (1.819)	-2.776 (0.43)	0.002 (0.003)
Number of Incidents.D1	-1.306 (0.145)	0.085 (0.147)	0.154 (0.112)	0.145** (0.169)	-0.038** (0.029)	0.023*** (0.007)	< 0.001 (<0.001)
Fatalities from Incidents.D1	0.563 (0.151)	-0.577 (0.153)	-0.282 (0.117)	-0.357*** (0.176)	0.024 (0.03)	-0.01 (0.007)	> -0.001 (<0.001)
Average Tone.D1	0.243*** (0.162)	0.104 (0.164)	-1.129 (0.125)	0.03** (0.189)	0.045 (0.033)	-0.014 (0.008)	> -0.001** (<0.001)
Inflation Rate.D1	-0.188*** (0.118)	-0.331 (0.119)	-0.133 (0.091)	-0.77 (0.137)	0.001** (0.024)	-0.006 (0.006)	< 0.001 (<0.001)
Rubber Price.D1	0.016 (0.593)	0.727*** (0.6)	0.469 (0.458)	-0.343 (0.691)	-0.366** (0.12)	-0.027 (0.028)	< 0.001 (<0.001)
Unemployment Rate.D1	0.695 (1.603)	1.871 (1.624)	-5.851*** (1.24)	-0.242** (1.868)	< 0.001** (0.324)	1.729 (0.077)	< 0.001 (<0.001)
Percent of Youth Total Population.D1	-120.036 (198.649)	38.231** (201.185)	-370.652 (153.658)	246.735*** (231.455)	85.801 (40.102)	-14.448 (9.48)	2.649 (0.071)
Number of Incidents.D2	-1.658 (0.257)	0.032* (0.261)	0.498** (0.199)	0.169*** (0.3)	-0.131 (0.052)	0.045** (0.012)	> -0.001 (<0.001)
Fatalities from Incidents.D2	0.78** (0.234)	-0.619* (0.237)	-0.651 (0.181)	-0.534** (0.273)	0.036 (0.047)	-0.019 (0.011)	> -0.001*** (<0.001)
Average Tone.D2	0.382 (0.235)	0.149 (0.238)	-1.435 (0.182)	0.139** (0.274)	0.062*** (0.047)	-0.036 (0.011)	> -0.001 (<0.001)
Inflation Rate.D2	-0.202 (0.155)	-0.111 (0.157)	-0.266 (0.12)	-0.905** (0.181)	-0.016 (0.031)	-0.002 (0.007)	> -0.001 (<0.001)
Rubber Price.D2	0.417 (0.579)	0.822** (0.586)	-0.357** (0.448)	0.436* (0.675)	-0.25 (0.117)	-0.058 (0.028)	< 0.001 (<0.001)

	Dependent variable:						
	Number of Incidents	Fatalities from Incidents from Incidents	Average Tone	Inflation Rate	Rubber Price	Unemployment Rate	Percent of Youth Total Population
Unemployment Rate.D2	0.866*** (2.141)	-0.782 (2.169)	6.595 (1.656)	1.24** (2.495)	-0.233 (0.432)	-1.764** (0.102)	> -0.001** (<0.001)
Percent of Youth Total Population.D2	408.938*** (365.604)	113.561 (370.27)	441.89 (282.799)	-337.111 (425.98)	-162.285 (73.805)	5.072*** (17.448)	-2.384 (0.131)
Number of Incidents.D3	-1.826 (0.377)	-0.018*** (0.381)	0.919*** (0.291)	0.321 (0.439)	-0.224 (0.076)	0.056** (0.018)	< 0.001 (<0.001)
Fatalities from Incidents.D3	0.973 (0.324)	-0.608 (0.328)	-0.973*** (0.251)	-0.603*** (0.377)	0.065 (0.065)	-0.028** (0.015)	> -0.001* (<0.001)
Average Tone.D3	0.305 (0.313)	-0.047 (0.317)	-1.459*** (0.242)	0.486*** (0.365)	0.093 (0.063)	-0.058*** (0.015)	> -0.001 (<0.001)
Inflation Rate.D3	-0.181 (0.181)	-0.368 (0.183)	-0.26* (0.14)	-0.682*** (0.21)	-0.025 (0.036)	0.002 (0.009)	> -0.001 (<0.001)
Rubber Price.D3	0.714 (0.568)	0.417** (0.575)	0.183 (0.439)	-0.242** (0.662)	-0.421 (0.115)	-0.069 (0.027)	< 0.001 (<0.001)
Unemployment Rate.D3	-0.826 (1.469)	1.02 (1.488)	-4.11 (1.136)	0.055 (1.711)	0.086*** (0.297)	0.568 (0.07)	< 0.001 (<0.001)
Percent of Youth Total Population.D3	-192.606 (178.55)	-64.712 (180.829)	-206.534 (138.111)	165.413** (208.036)	80.856** (36.044)	-2.229 (8.521)	0.733* (0.064)
Residual standard error	0.8777	0.889	0.679	1.022	0.177	0.042	<0.001
Adjusted R-squared	0.513	0.248	0.506	0.191	0.376	0.975	1
F-statistic	4.346	2.045	4.251	1.749	2.914	126.2	150600
p-value	<0.001	0.009	<0.001	0.033	<0.001	<0.001	<0.001

Table 0-15: The Error Correction Term Composition Table - Narathiwat Province

	ect1	**ect2**	**ect3**	**ect4**
Number of Incidents.l4	1 ()	> -0.001 (0.066)	> -0.001 (0.1)	> -0.001 (0.322)
Fatalities from Incidents.l4	> -0.001 (0.048)	1 ()	> -0.001 (0.088)	> -0.001 (0.274)
Average Tone.l4	< 0.001 (0.064)	> -0.001 (0.077)	1 ()	< 0.001 (0.252)
Inflation Rate.l4	> -0.001 (0.054)	> -0.001 (0.063)	< 0.001 (0.066)	1 ()
Rubber Price.l4	-8.536*** (0.111)	-12.173*** (0.132)	0.635*** (0.136)	12.944*** (0.334)
Unemployment Rate.l4	-7.889*** (0.084)	-11.277*** (0.1)	0.842*** (0.104)	11.97*** (0.281)
Percent of Youth Total Population.l4	-78.246*** (1.665)	-109.41*** (2.198)	24.358*** (1.806)	105.3*** (6.24)
trend.l4	-0.692*** (0.008)	-0.978*** (0.009)	0.084*** (0.009)	1.131*** (0.027)

Figure 0-31: Impulse Response Function to Number of Incidents - VECM Model - Pattani Province

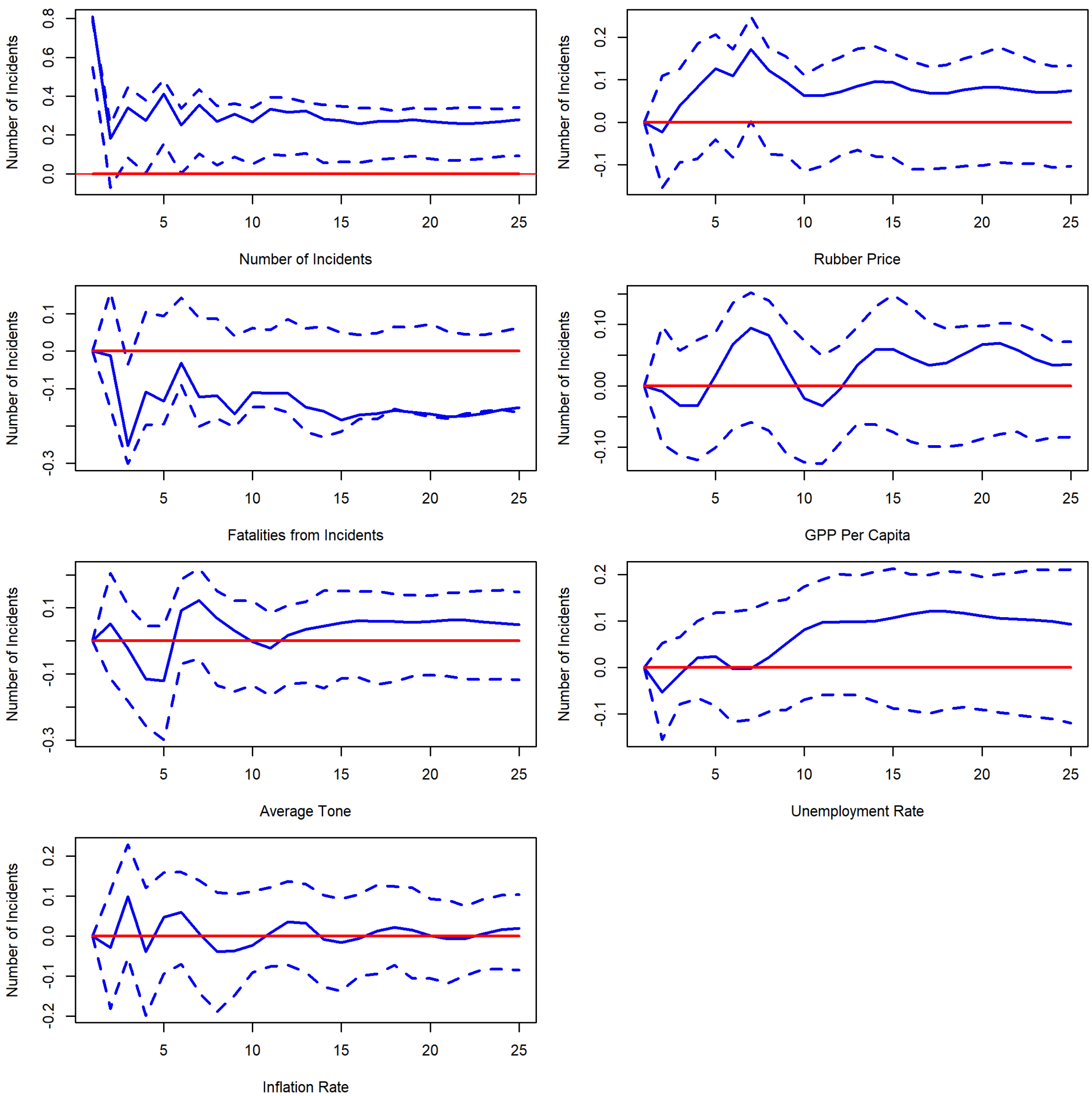

Figure 0-32: Impulse Response Function to Fatalities from Incidents - VECM Model - Pattani Province

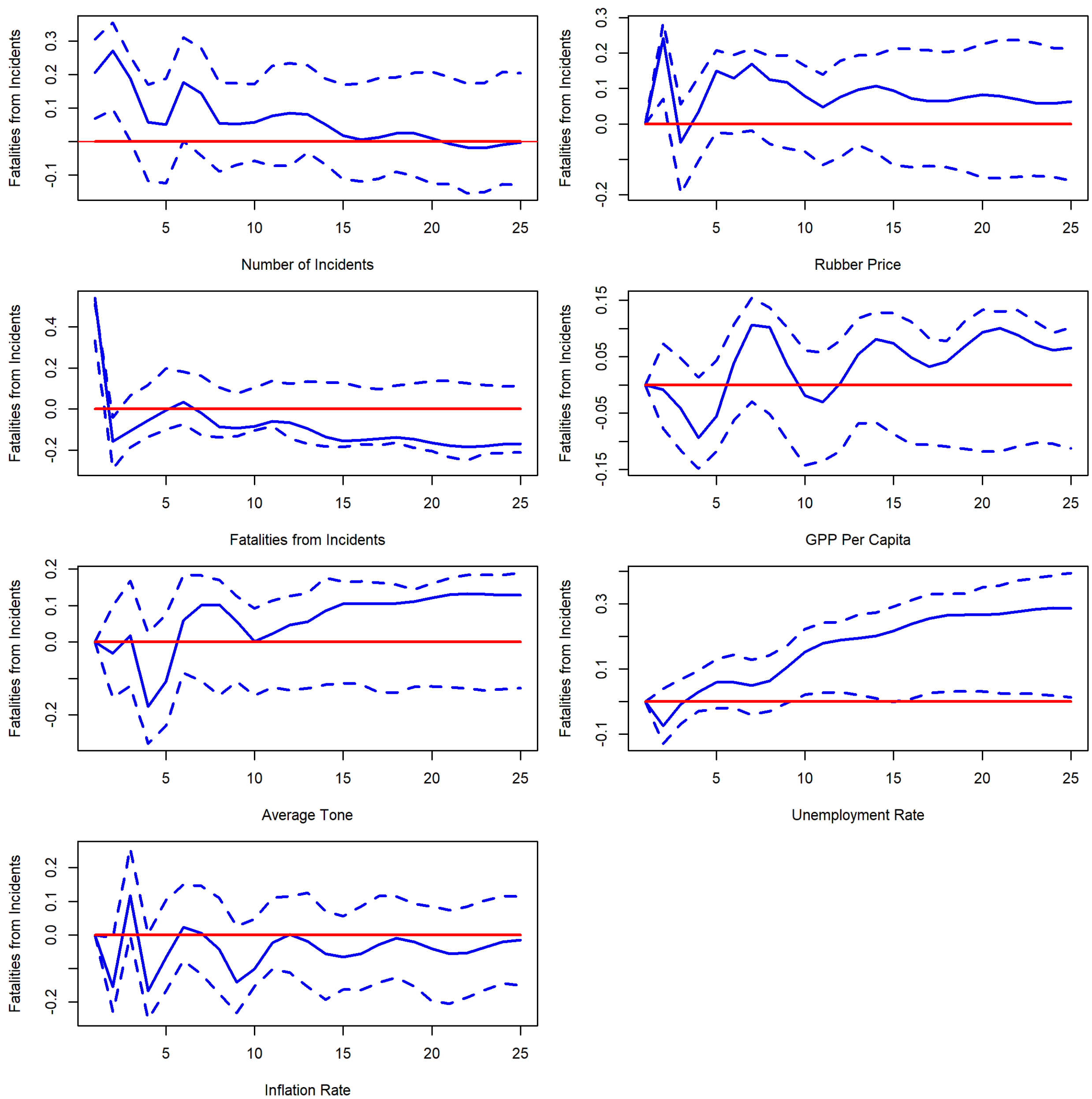

Figure 0-33: Impulse Response Function to Average Tone- VECM Model - Pattani Province

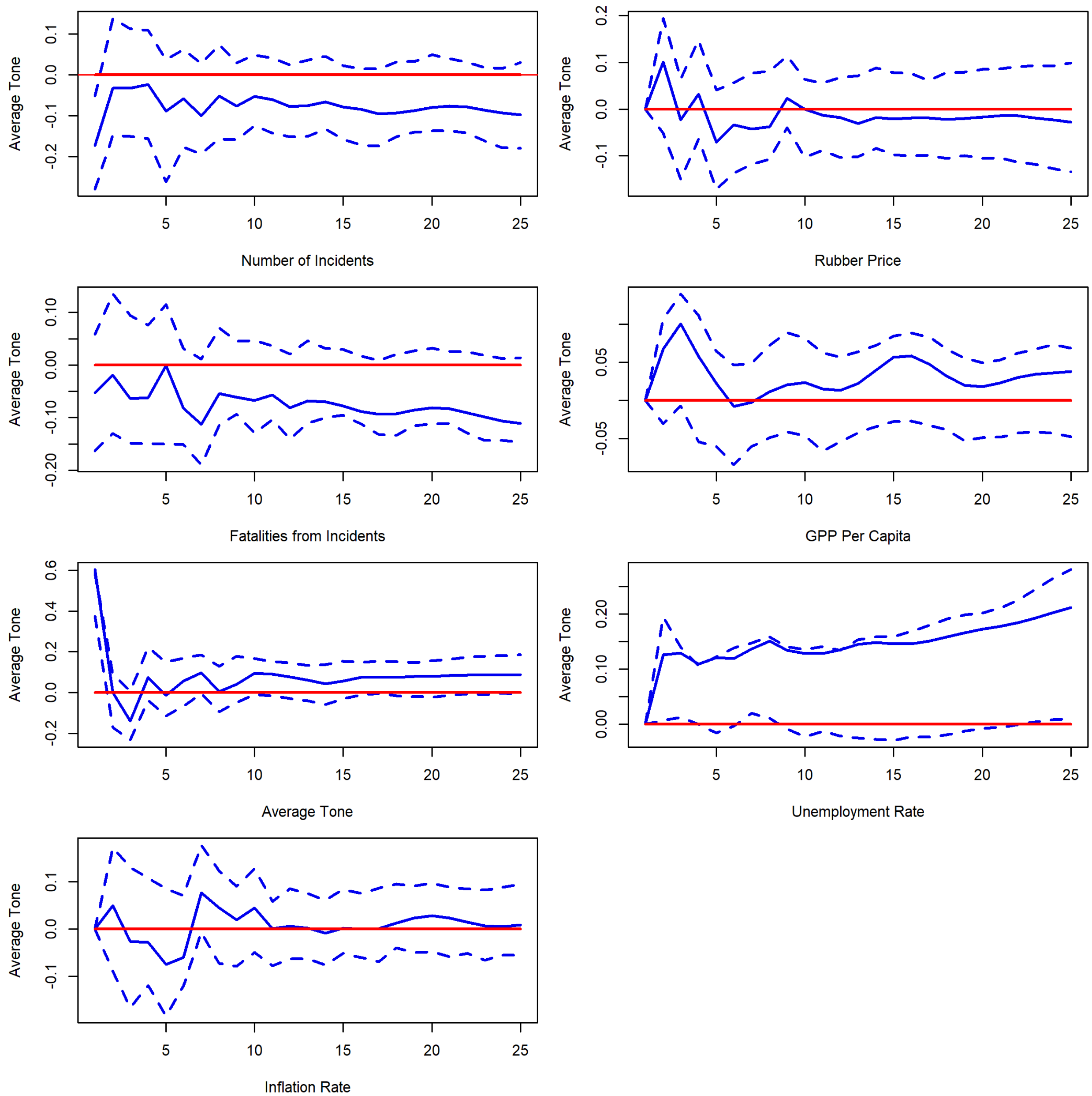

Figure 0-34: Impulse Response Function to Inflation Rate- VECM Model - Pattani Province

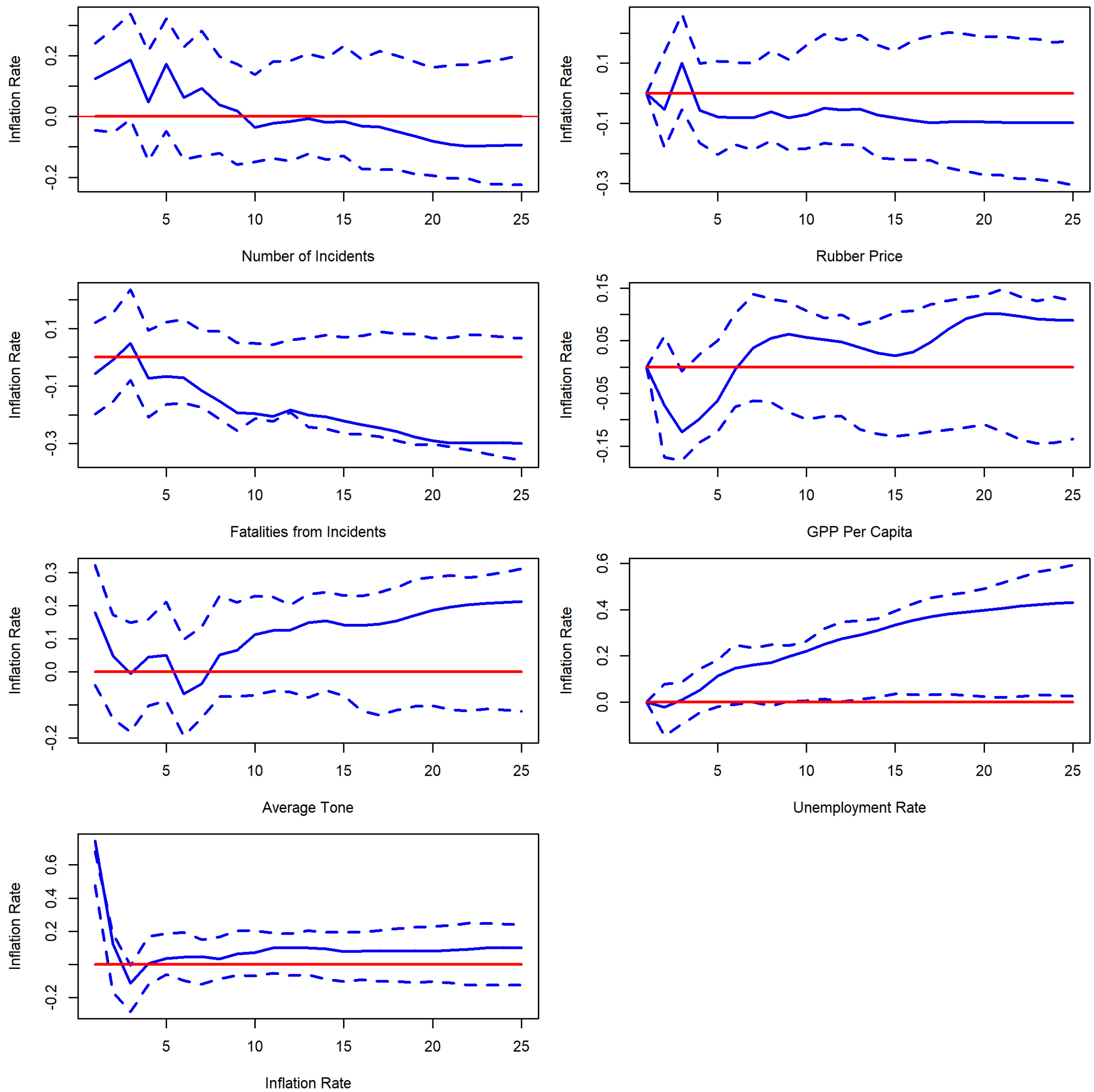

Figure 0-35: Impulse Response Function to Rubber Price- VECM Model - Pattani Province

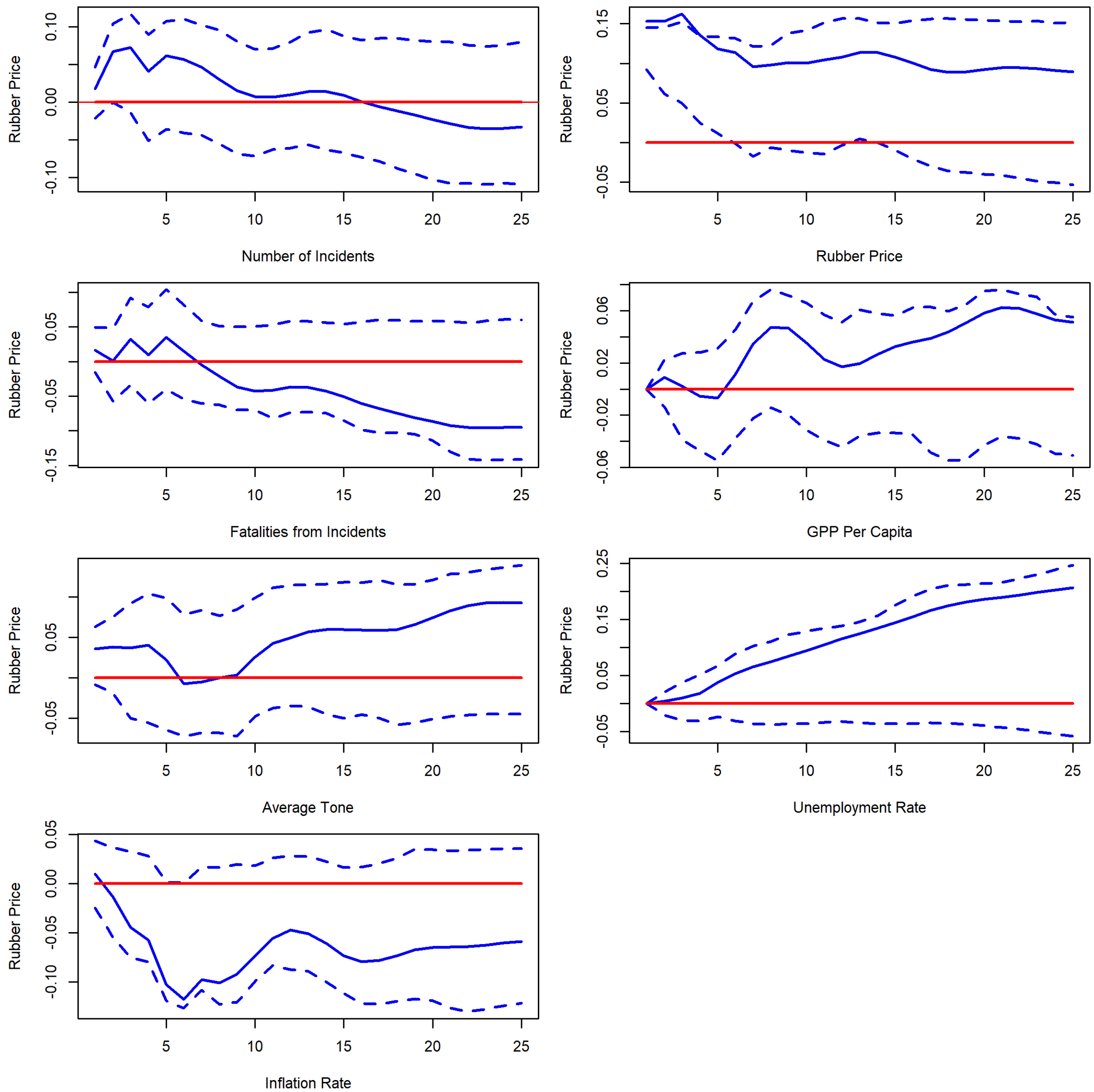

Figure 0-36: Impulse Response Function to Unemployment Rate - VECM Model - Pattani Province

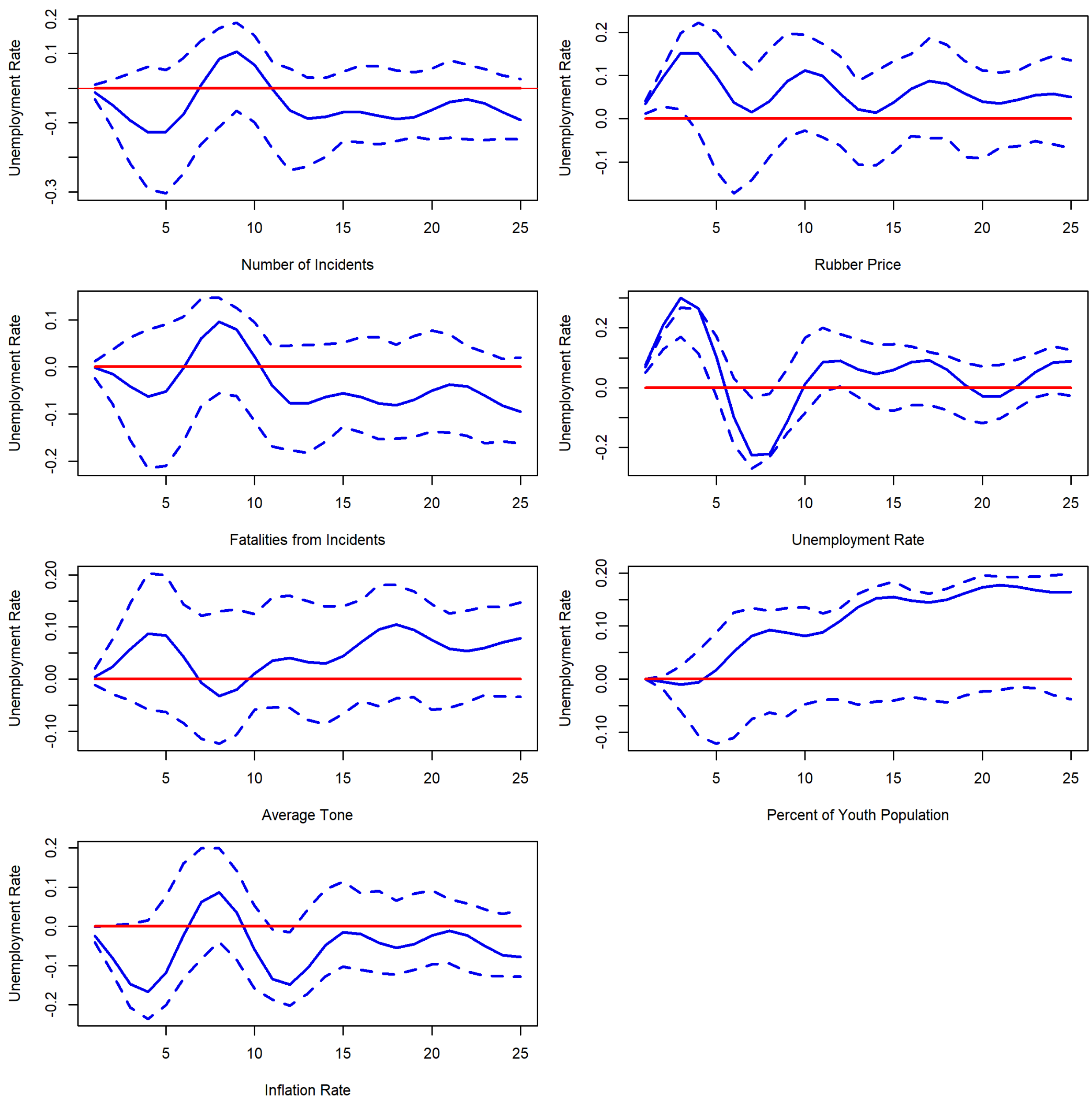

Figure 0-37: Impulse Response Function to Percent of Youth Population - VECM Model - Pattani Province

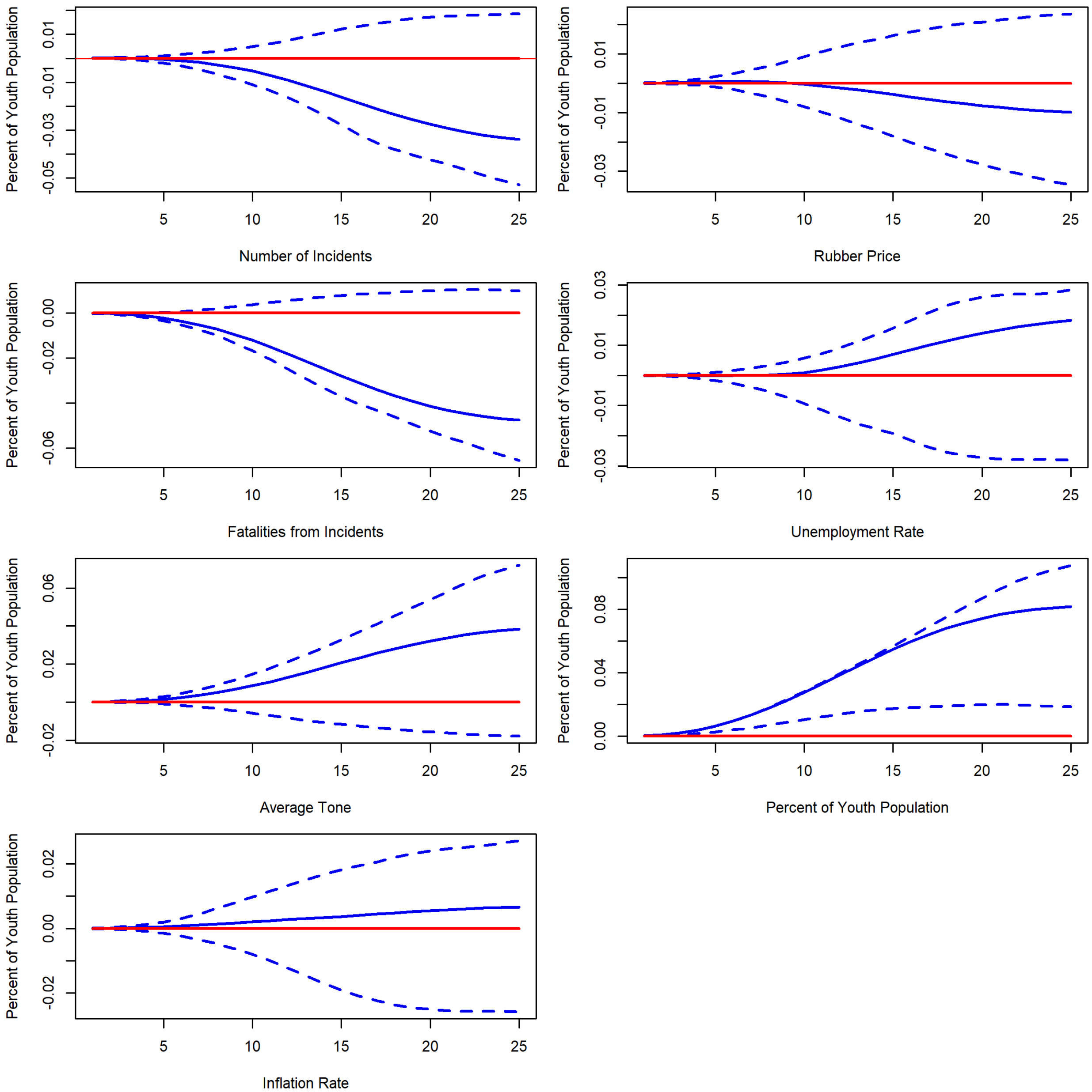

Figure 0-38: Impulse Response Function to Number of Incidents - VECM Model - Yala Province

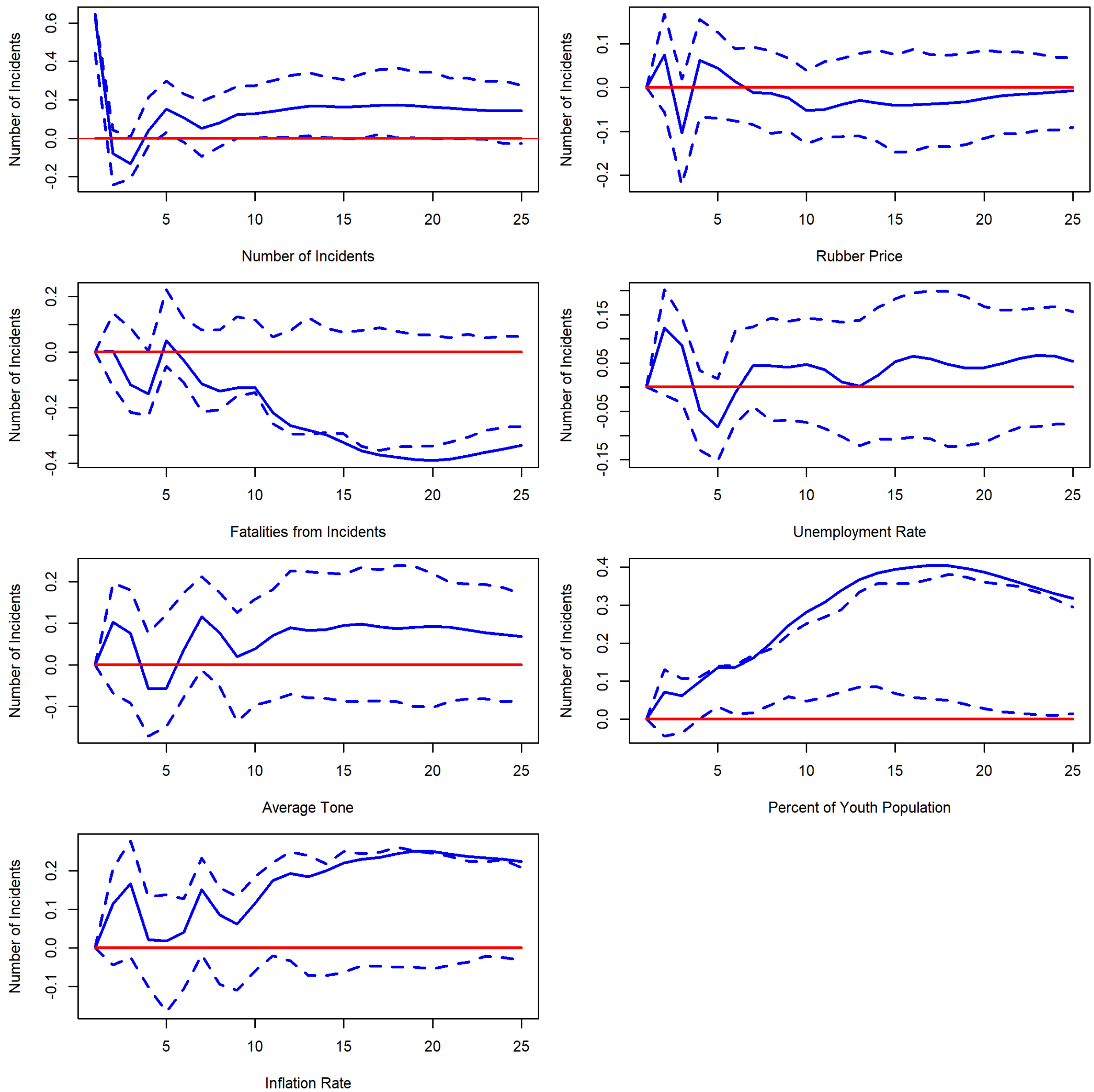

Figure 0-39: Impulse Response Function to Fatalities from Incidents - VECM Model - Yala Province

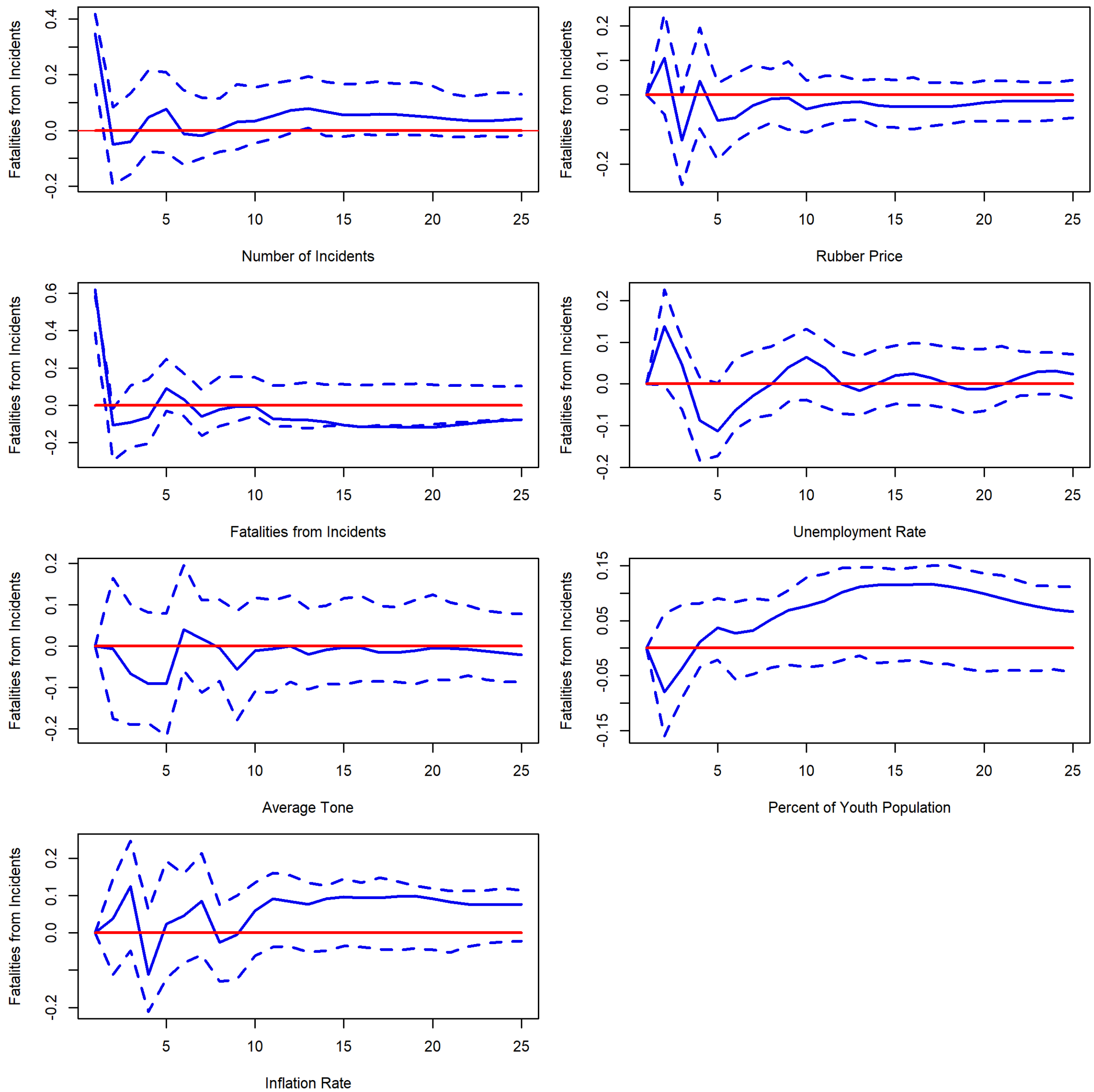

Figure 0-40: Impulse Response Function to Average Tone- VECM Model - Yala Province

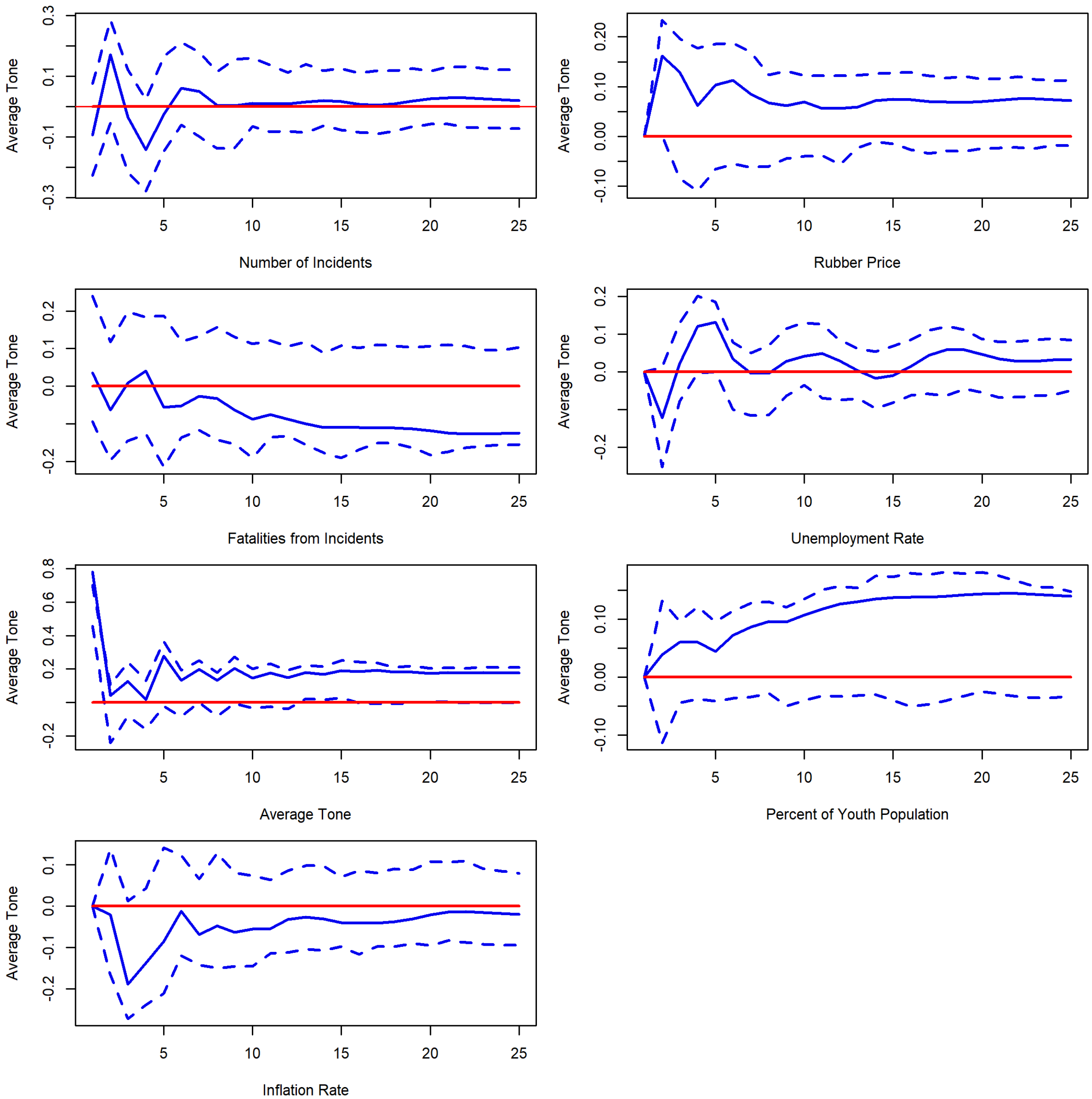

Figure 0-41: Impulse Response Function to Inflation Rate- VECM Model - Yala Province

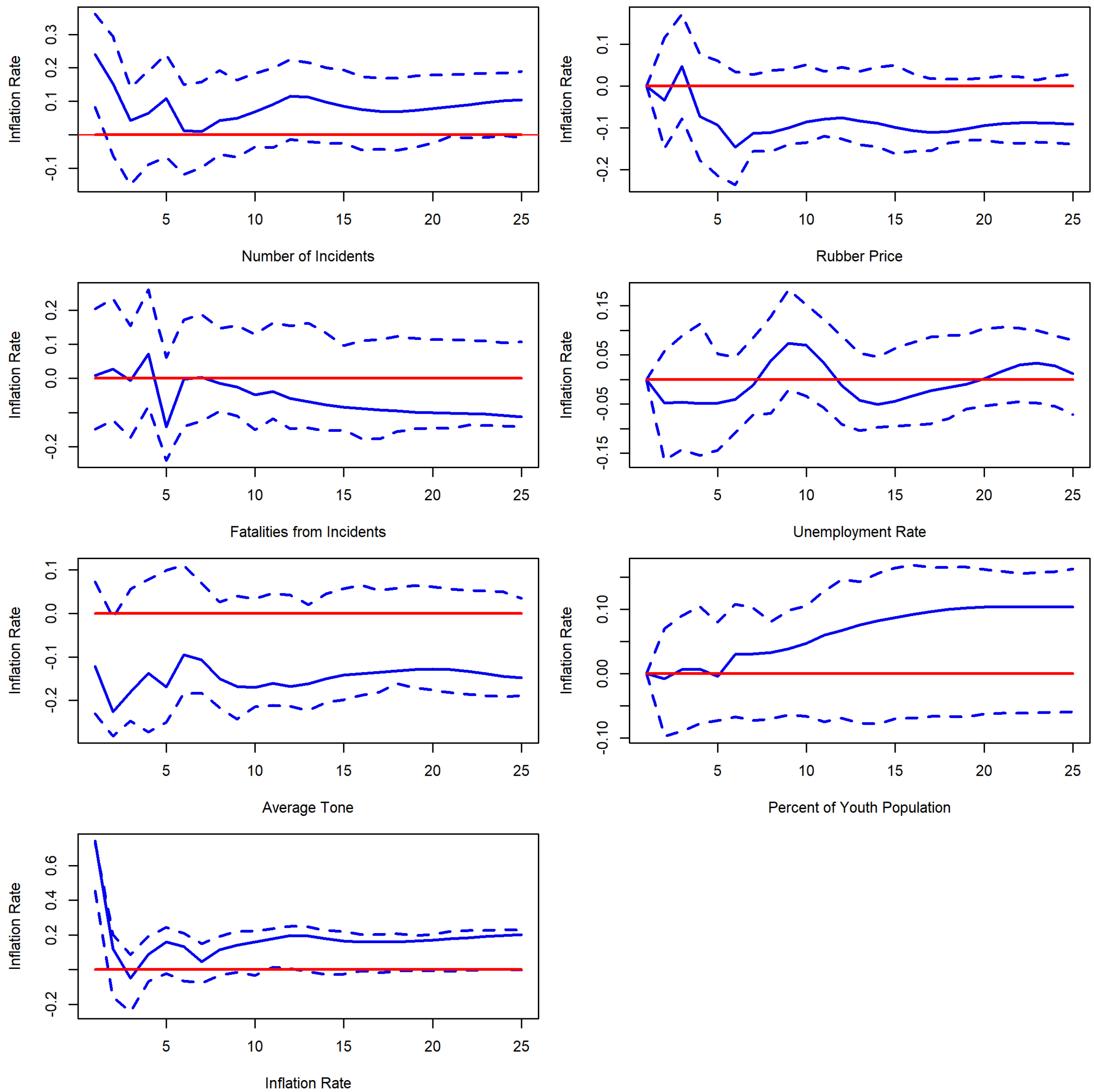

Figure 0-42: Impulse Response Function to Rubber Price- VECM Model - Yala Province

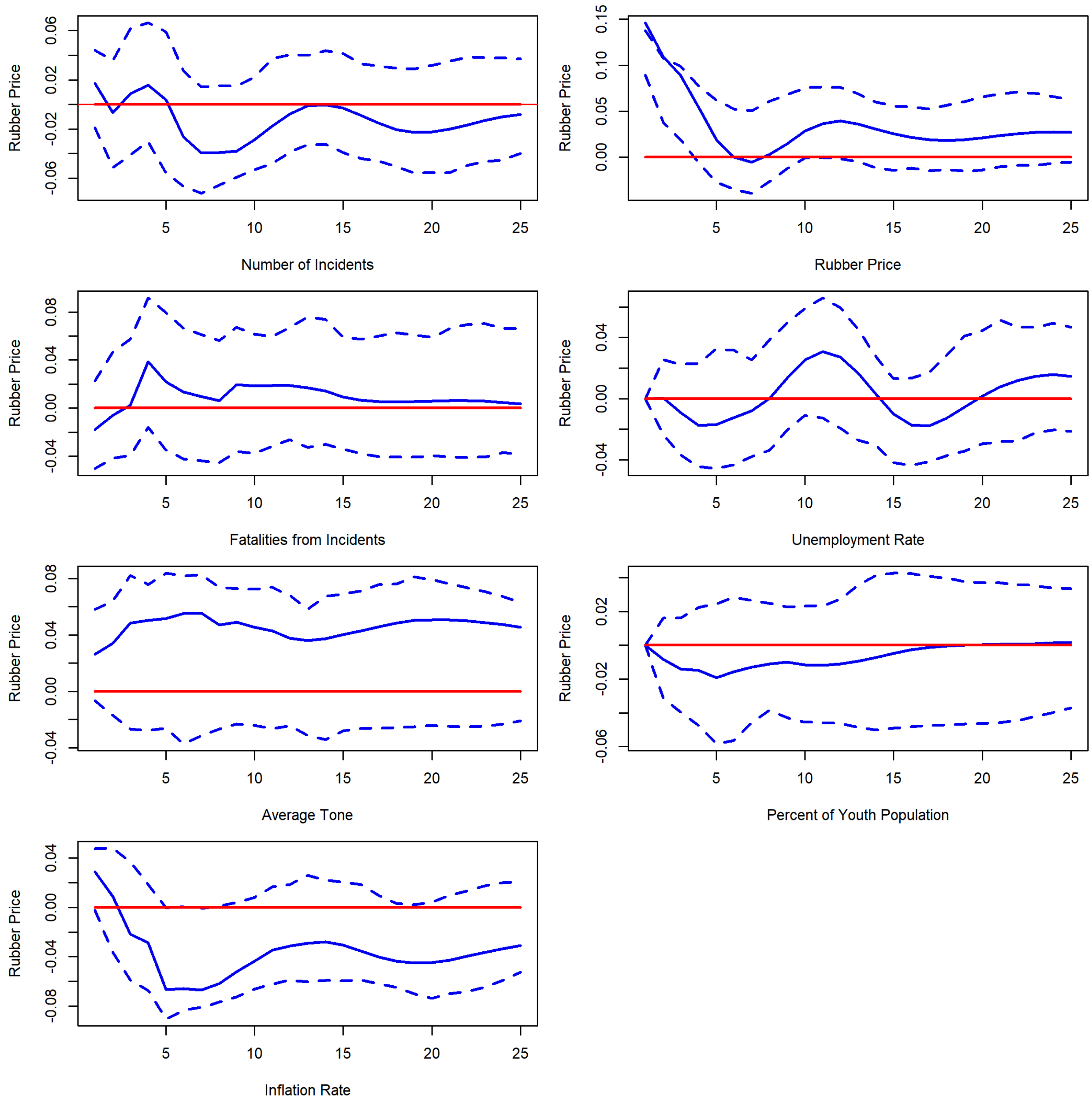

Figure 0-43: Impulse Response Function to Unemployment Rate - VECM Model - Yala Province

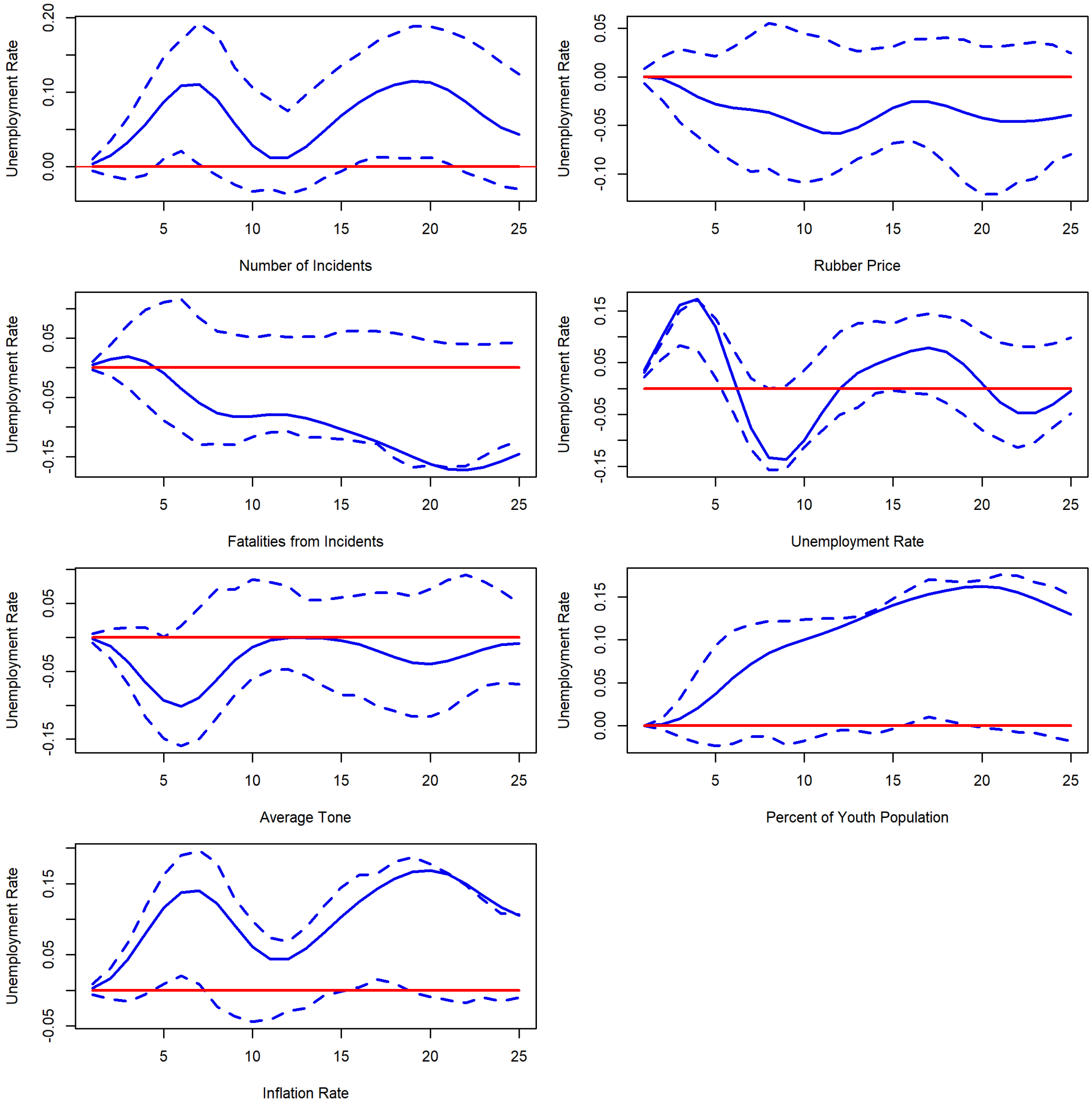

Figure 0-44: Impulse Response Function to Percent of Youth Population - VECM Model - Yala Province

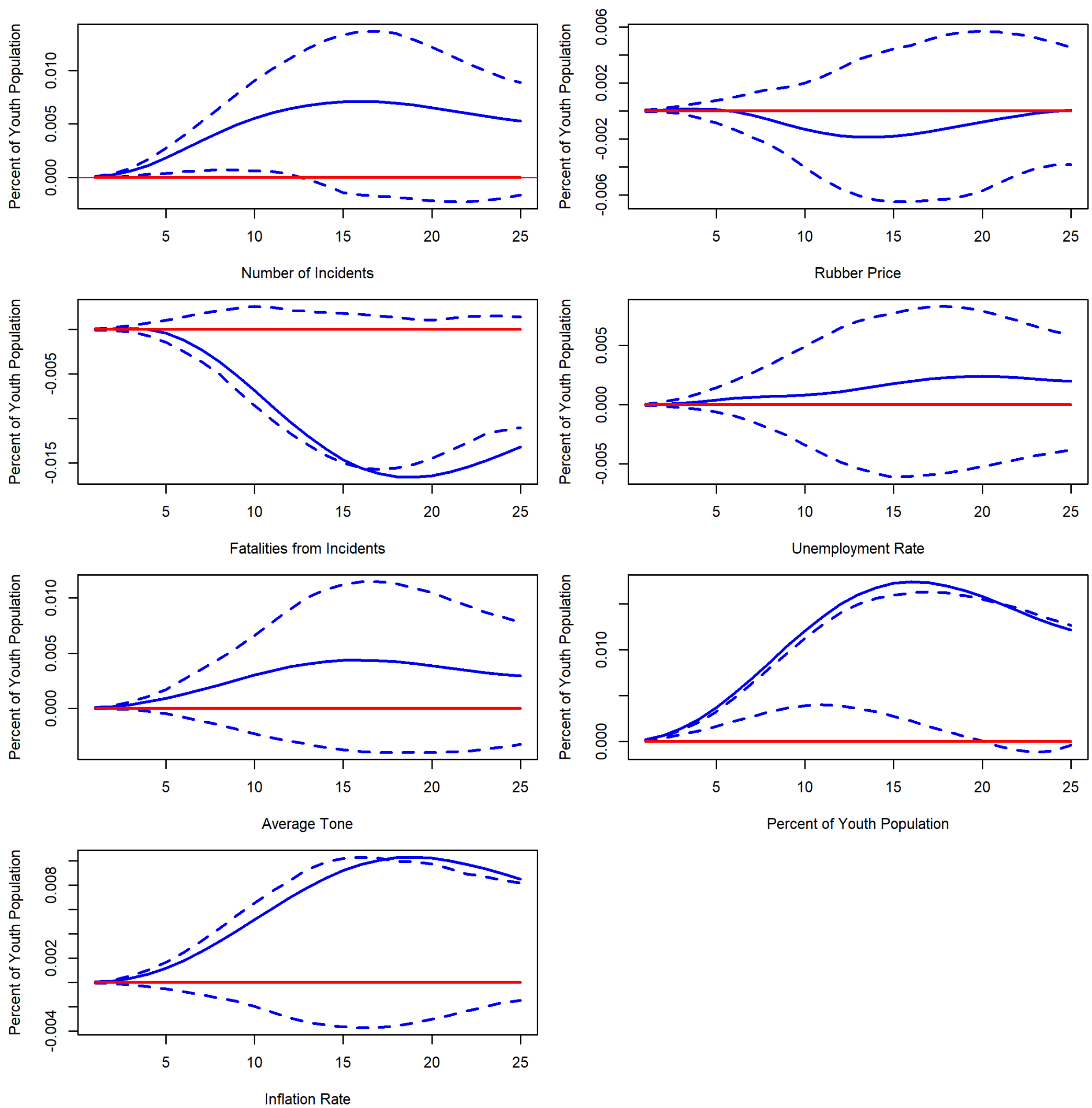

Figure 0-45: Impulse Response Function to Number of Incidents - VECM Model - Narathiwat Province

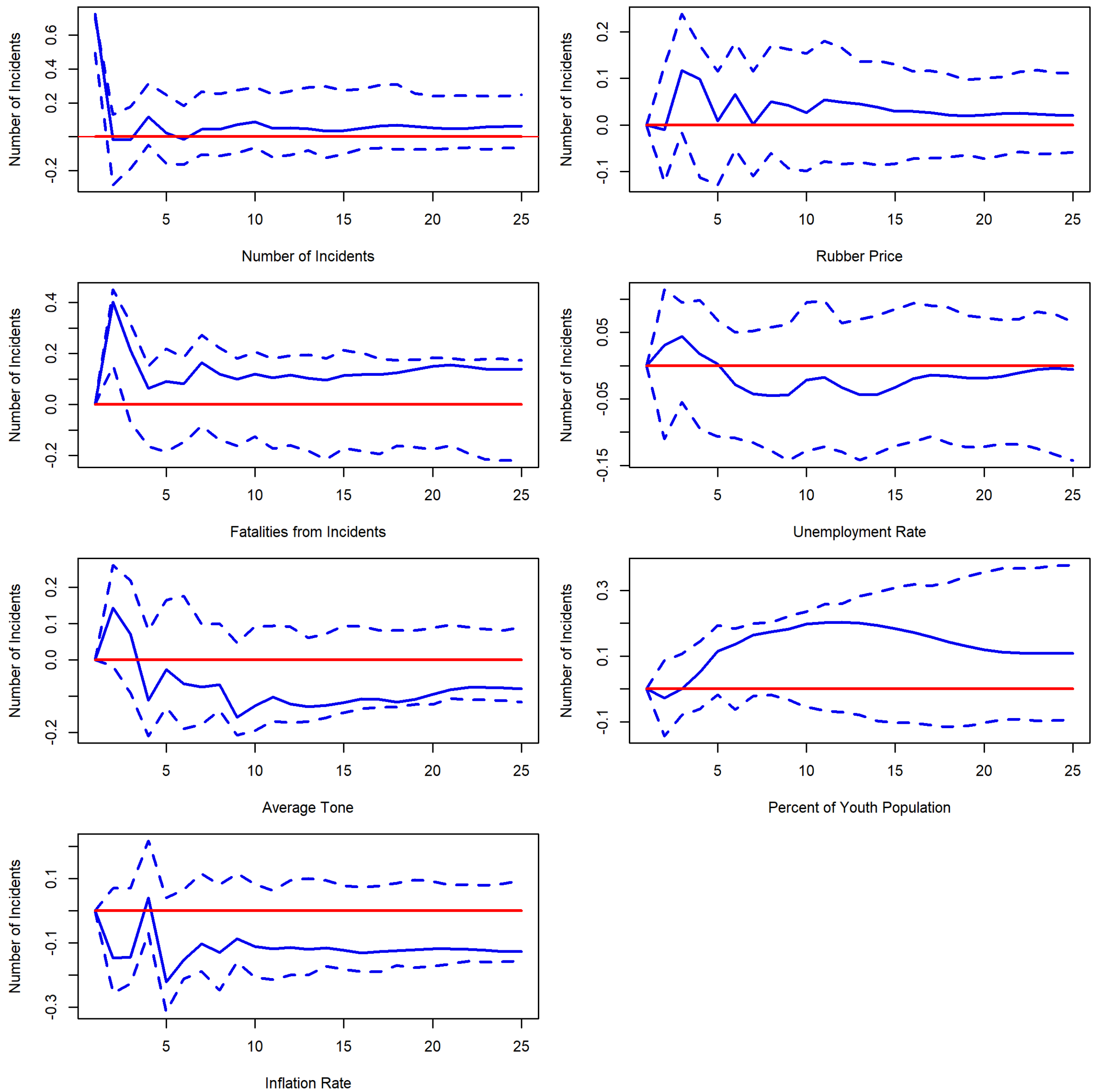

Figure 0-46: Impulse Response Function to Fatalities from Incidents - VECM Model - Narathiwat Province

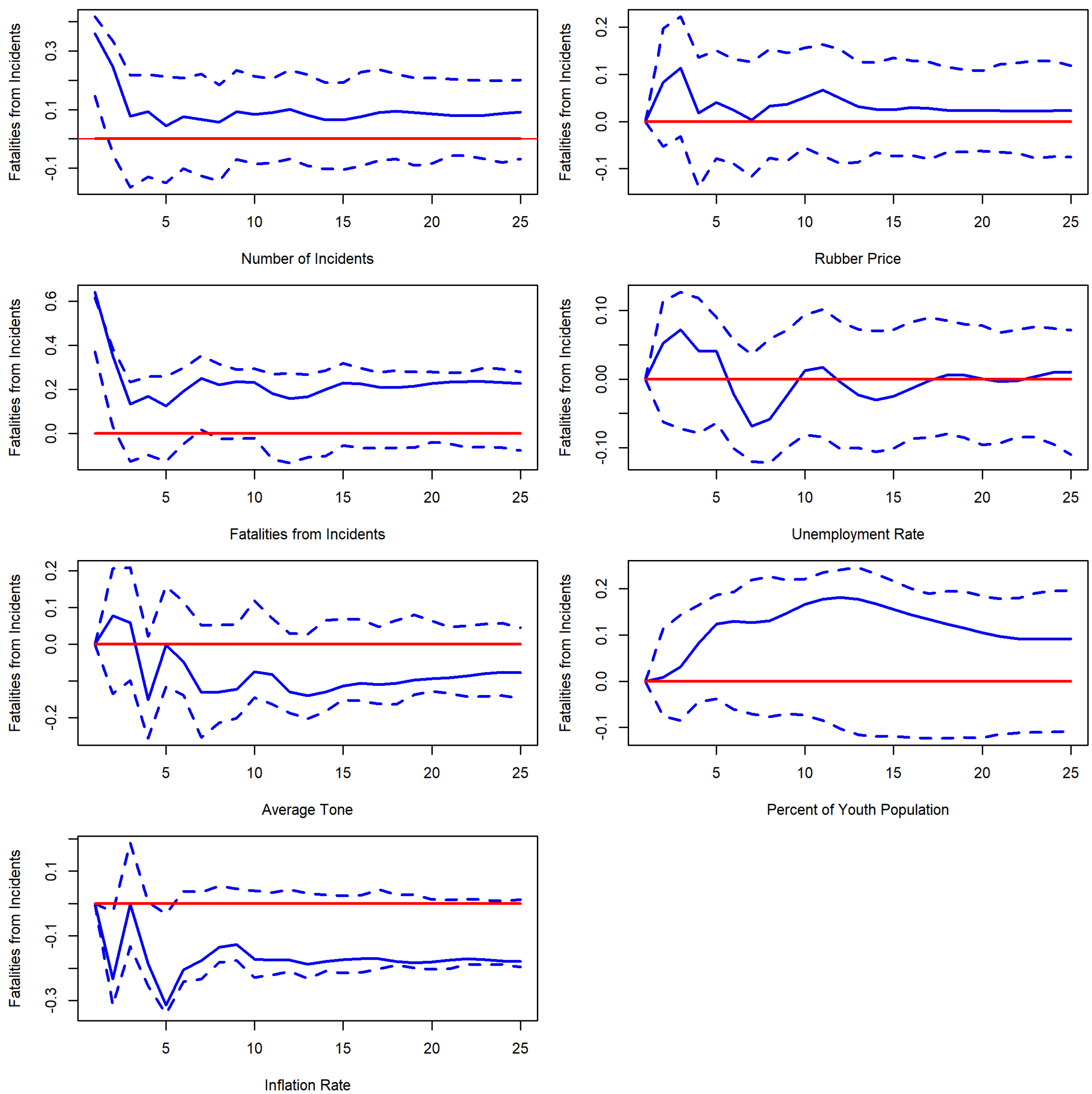

Figure 0-47: Impulse Response Function to Average Tone- VECM Model - Narathiwat Province

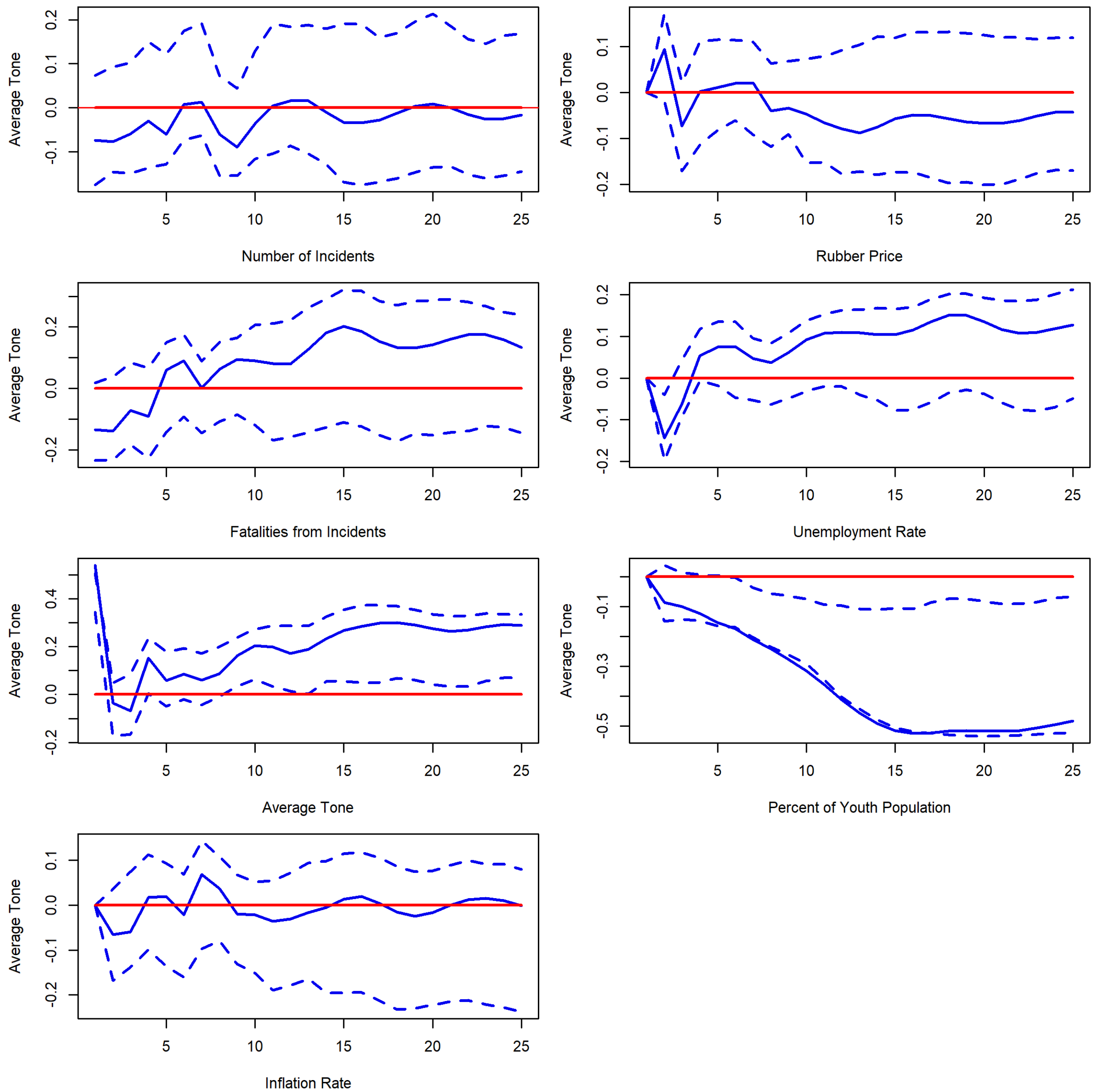

Figure 0-48: Impulse Response Function to Inflation Rate- VECM Model - Narathiwat Province

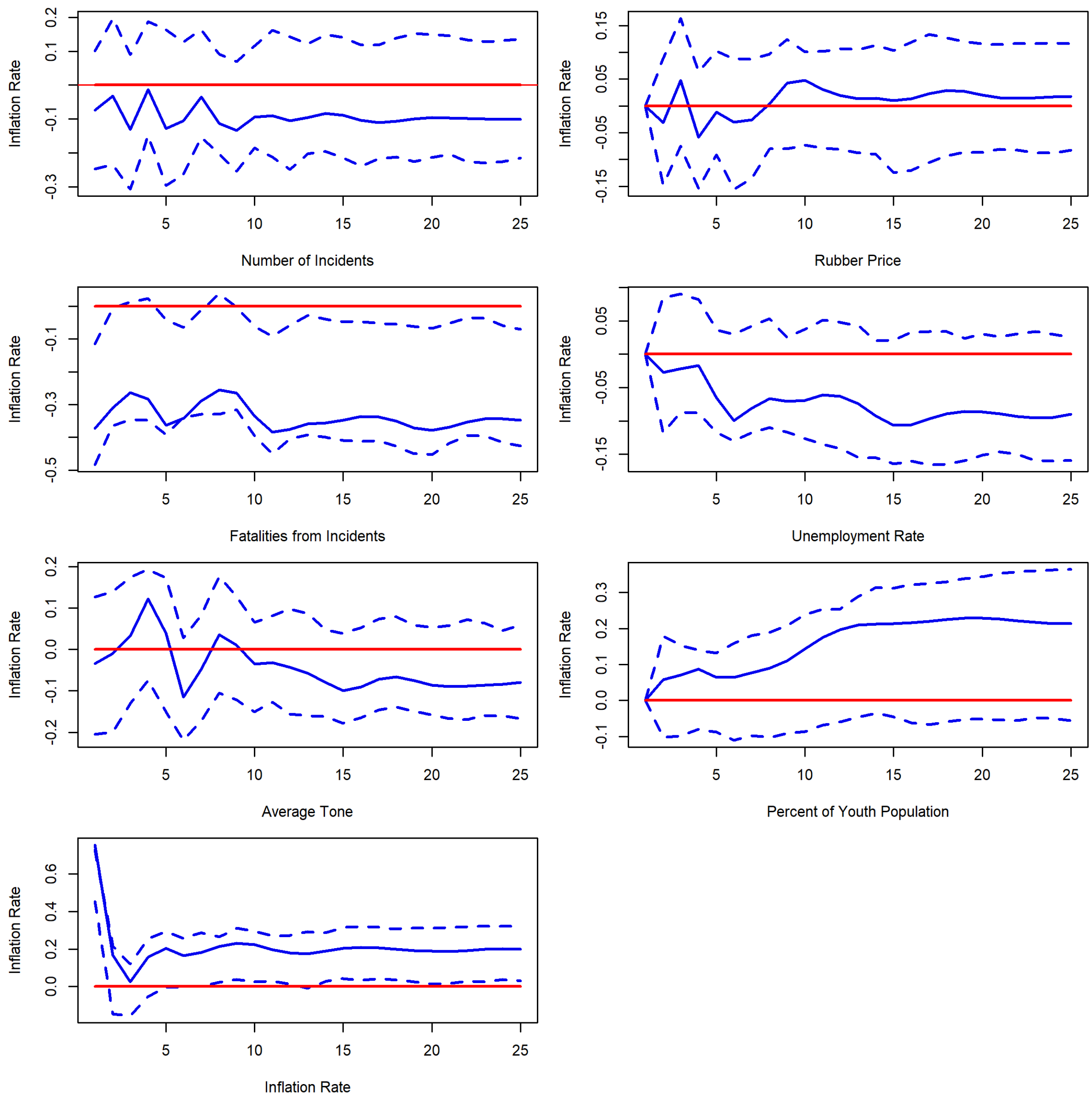

Figure 0-49: Impulse Response Function to Rubber Price- VECM Model - Narathiwat Province

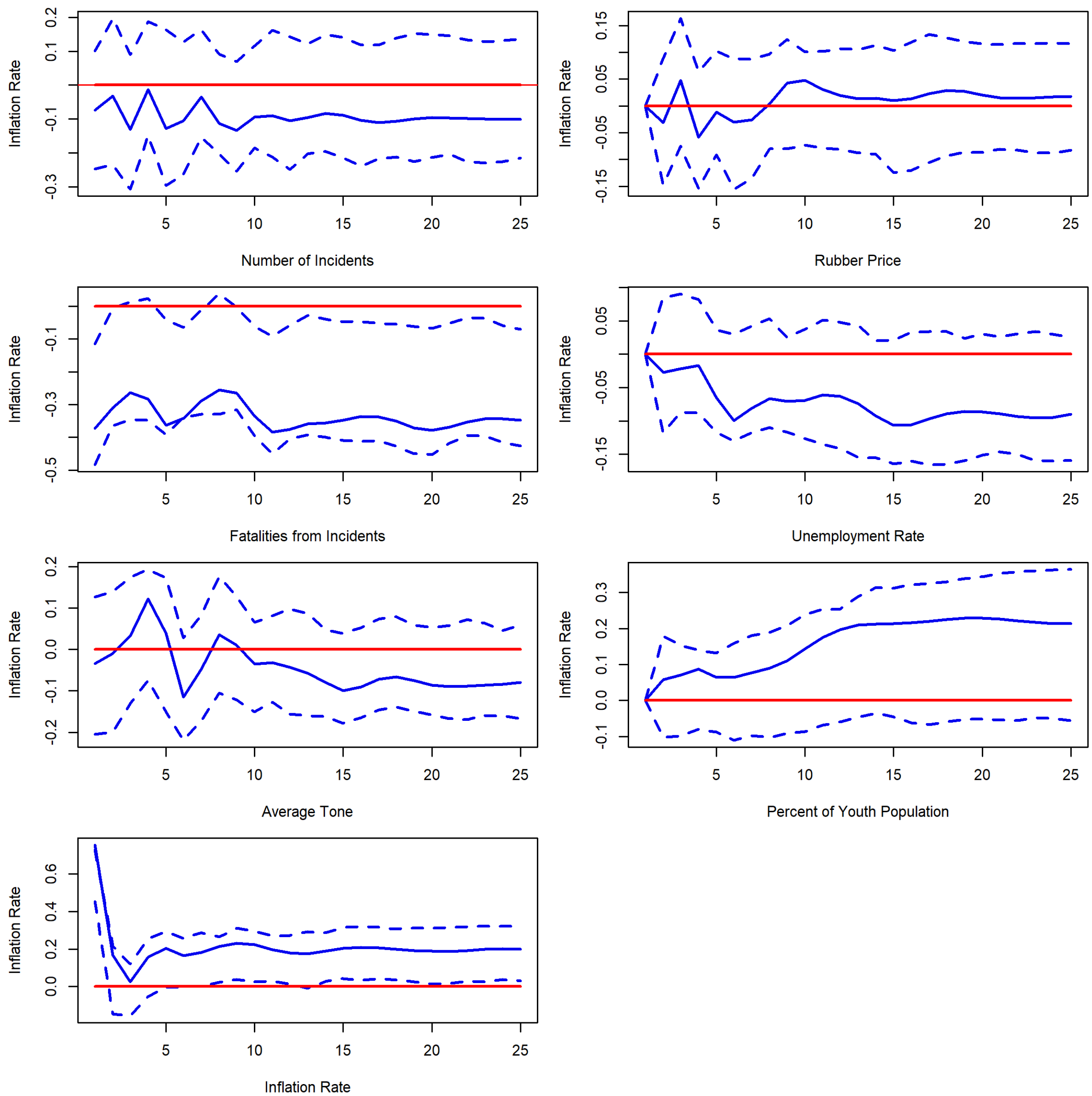

Figure 0-50: Impulse Response Function to Unemployment Rate - VECM Model - Narathiwat Province

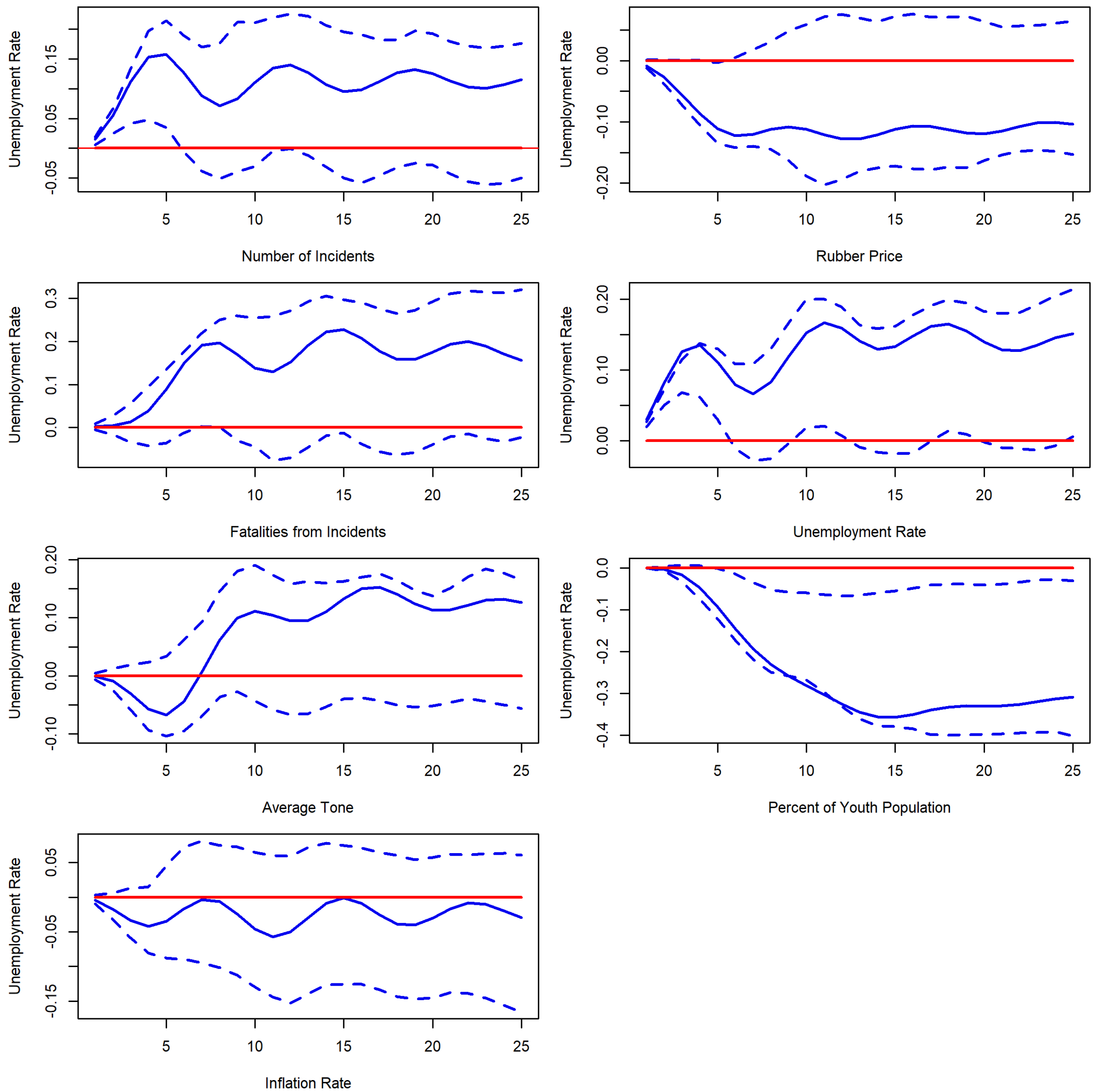

Figure 0-51: Impulse Response Function to Percent Of Youth Population - VECM Model - Narathiwat Province

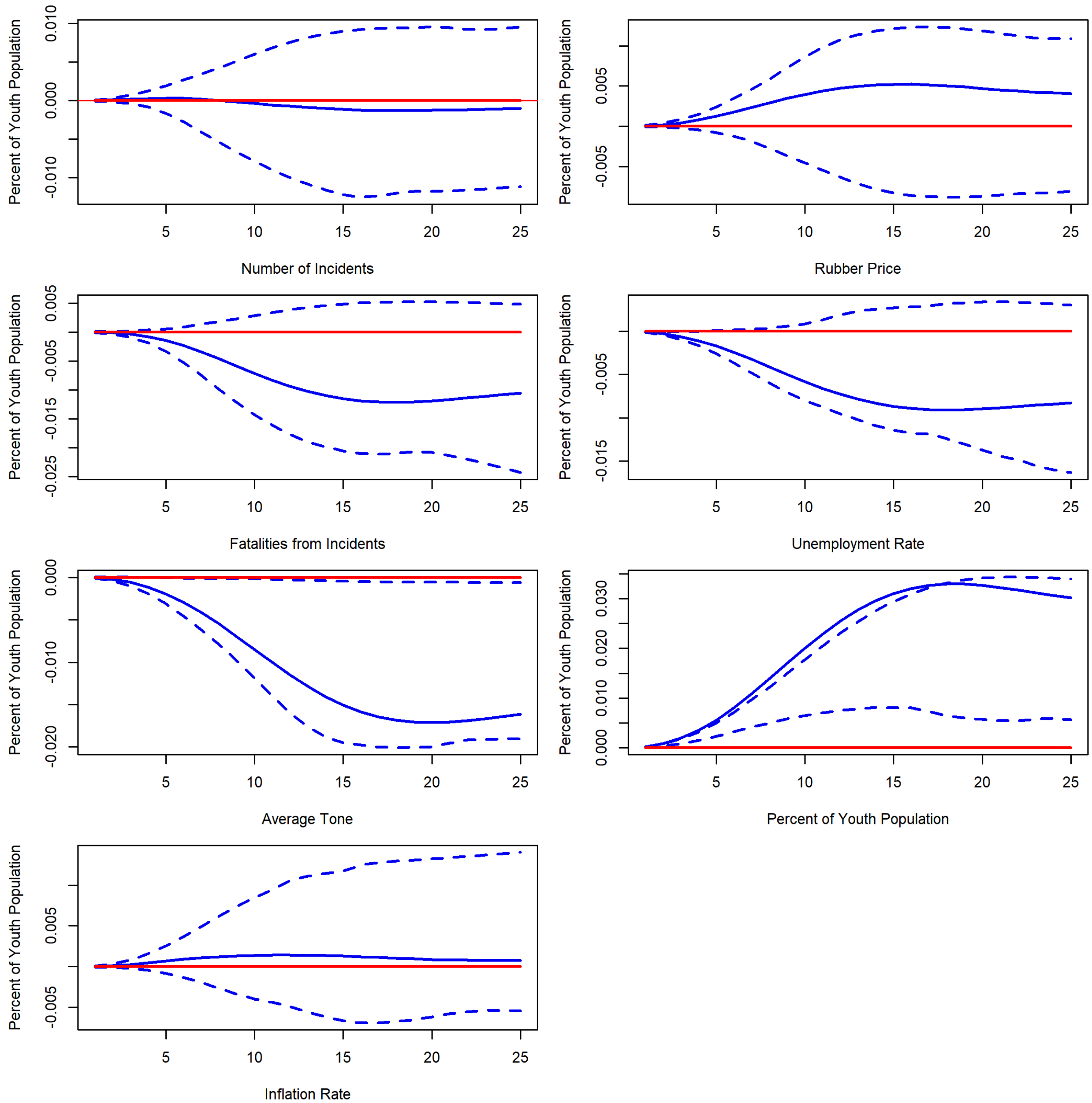

Figure 0-52: Causality Test with Convergent Cross Mapping against Number of Incidents - Pattani Province

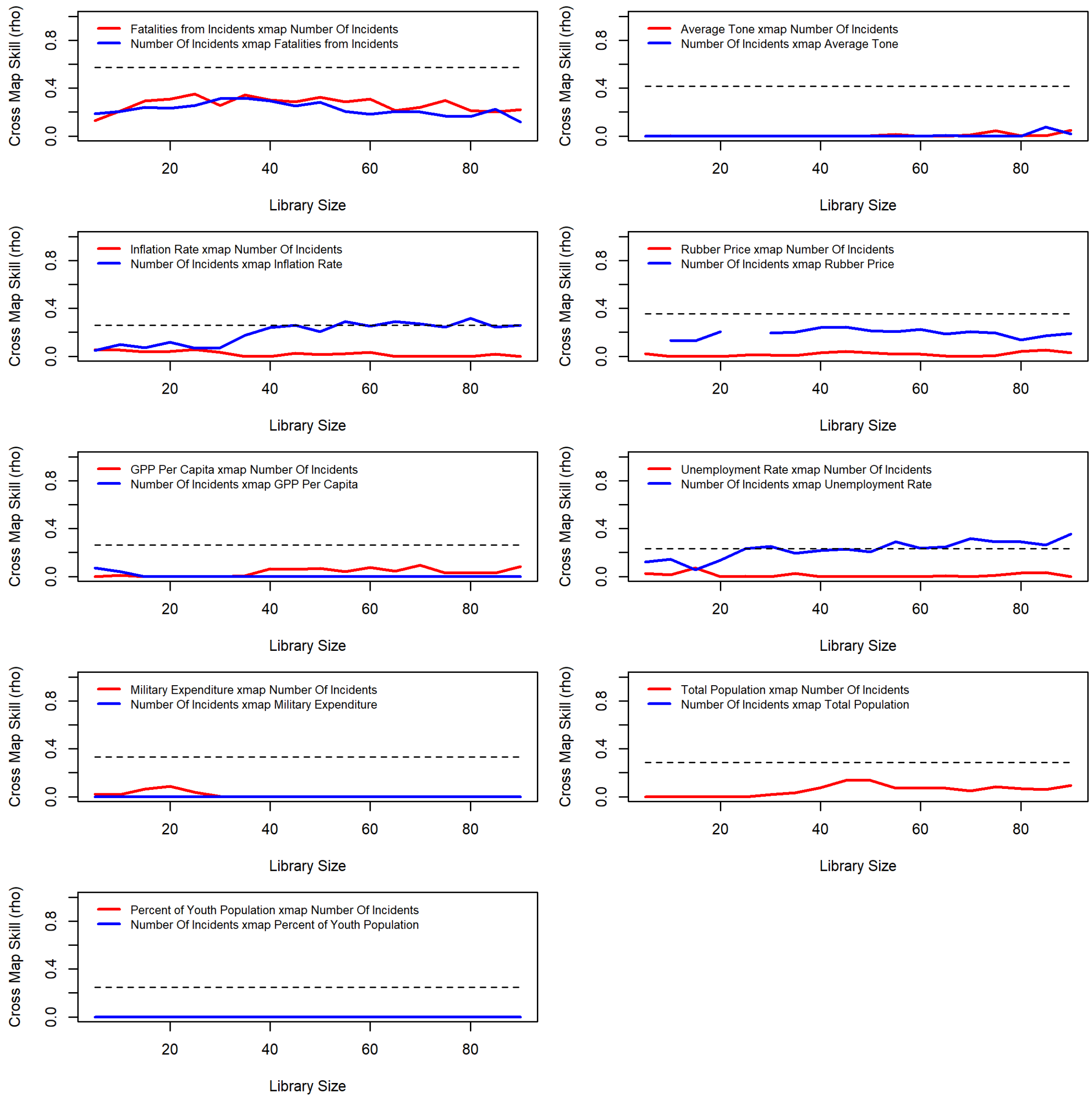

Figure 0-53: Causality Test with Convergent Cross Mapping against Fatalities from Incidents - Pattani Province

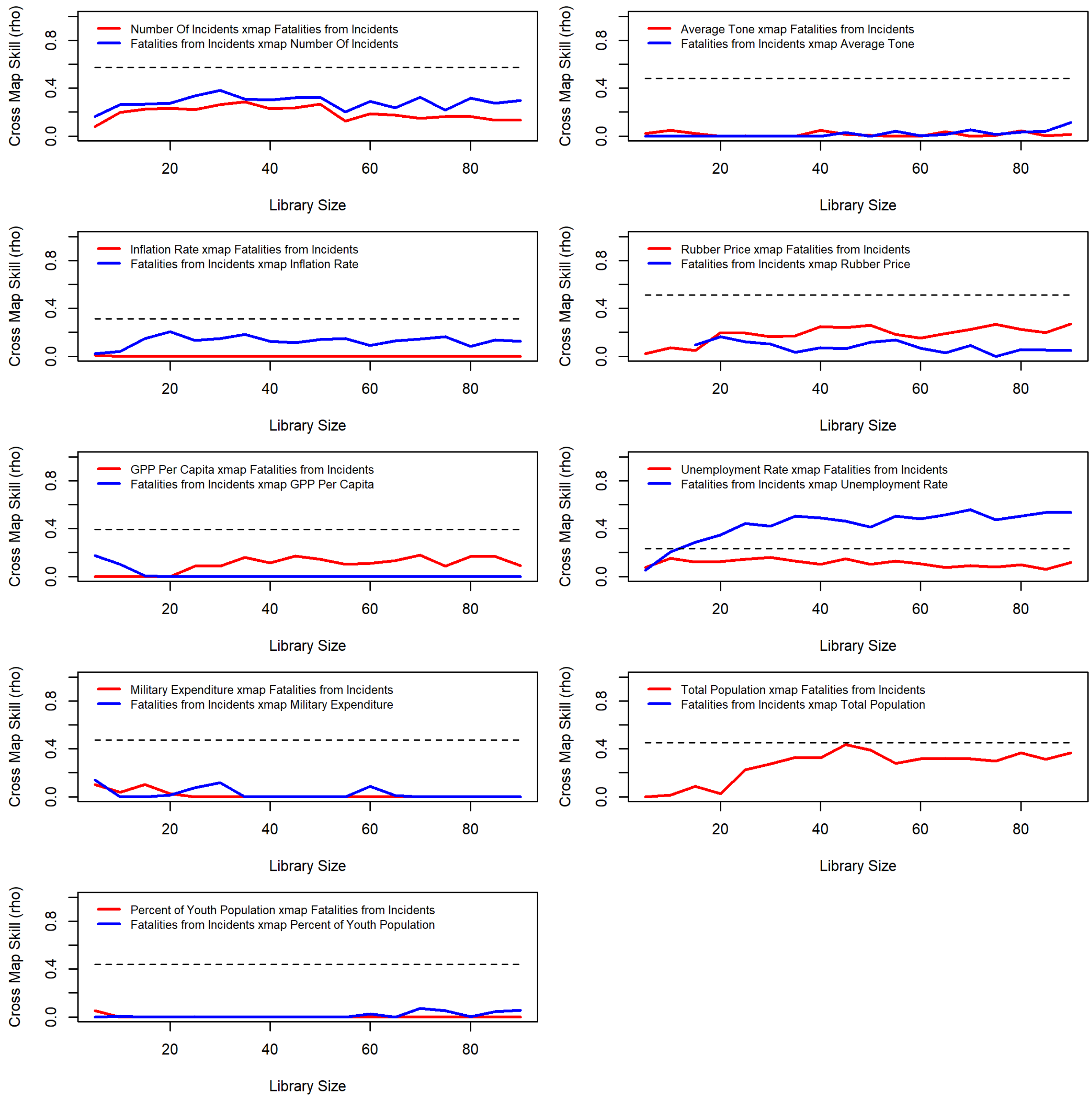

Figure 0-54: Causality Test with Convergent Cross Mapping against Average Tone- VECM Model - Pattani Province

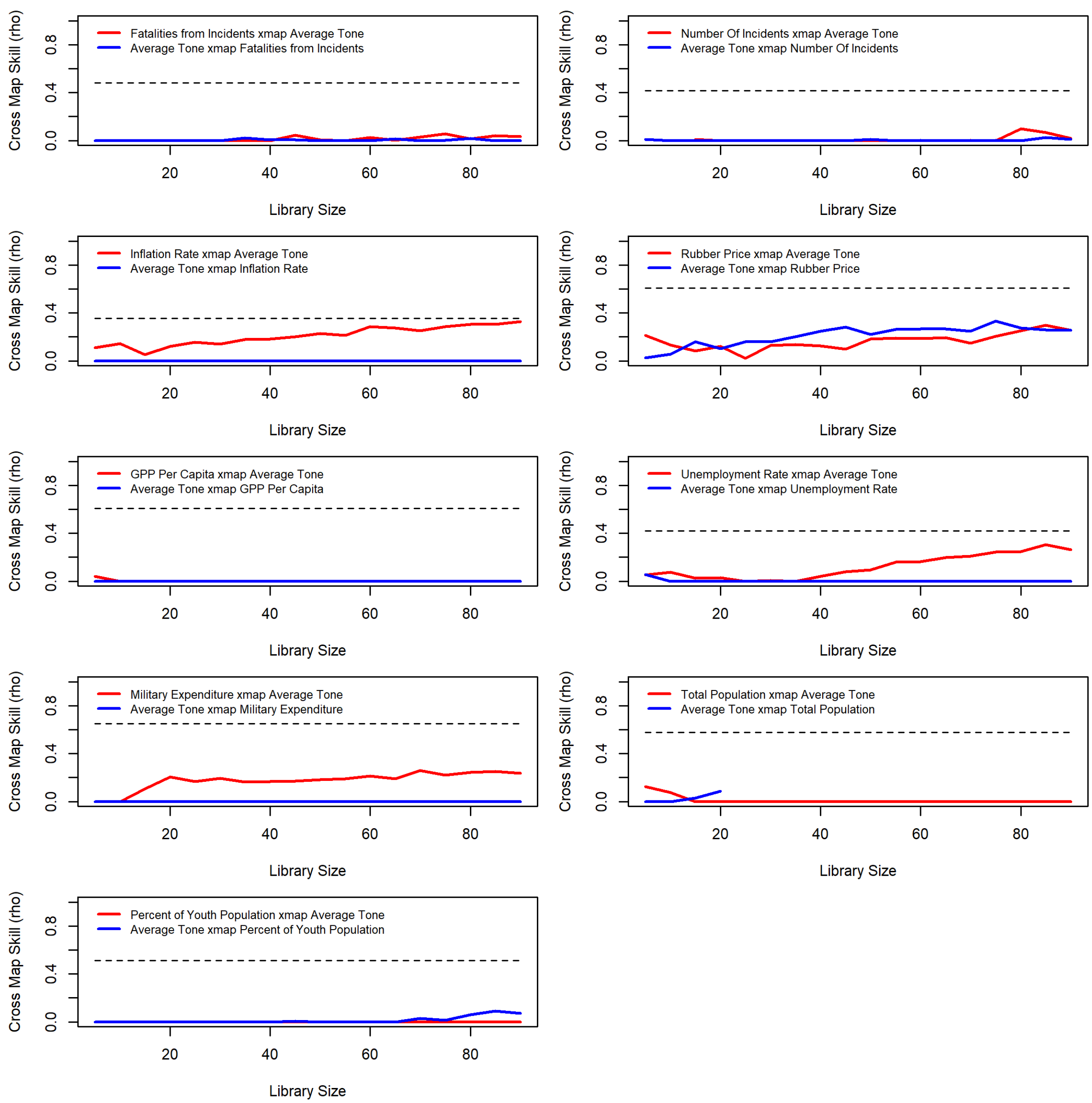

Figure 0-55: Causality Test with Convergent Cross Mapping against Inflation Rate - Pattani Province

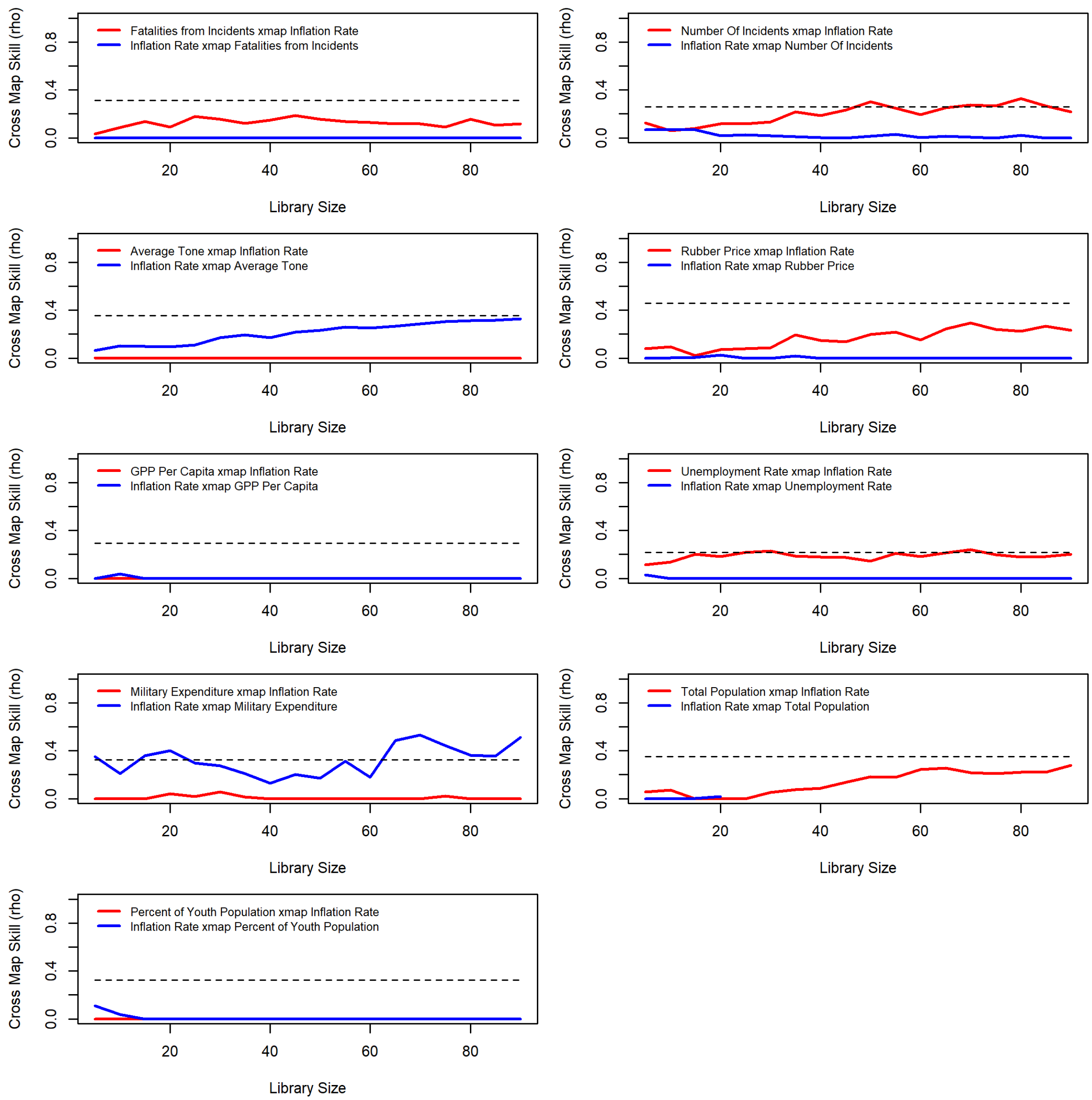

Figure 0-56: Causality Test with Convergent Cross Mapping against Rubber Price - Pattani Province

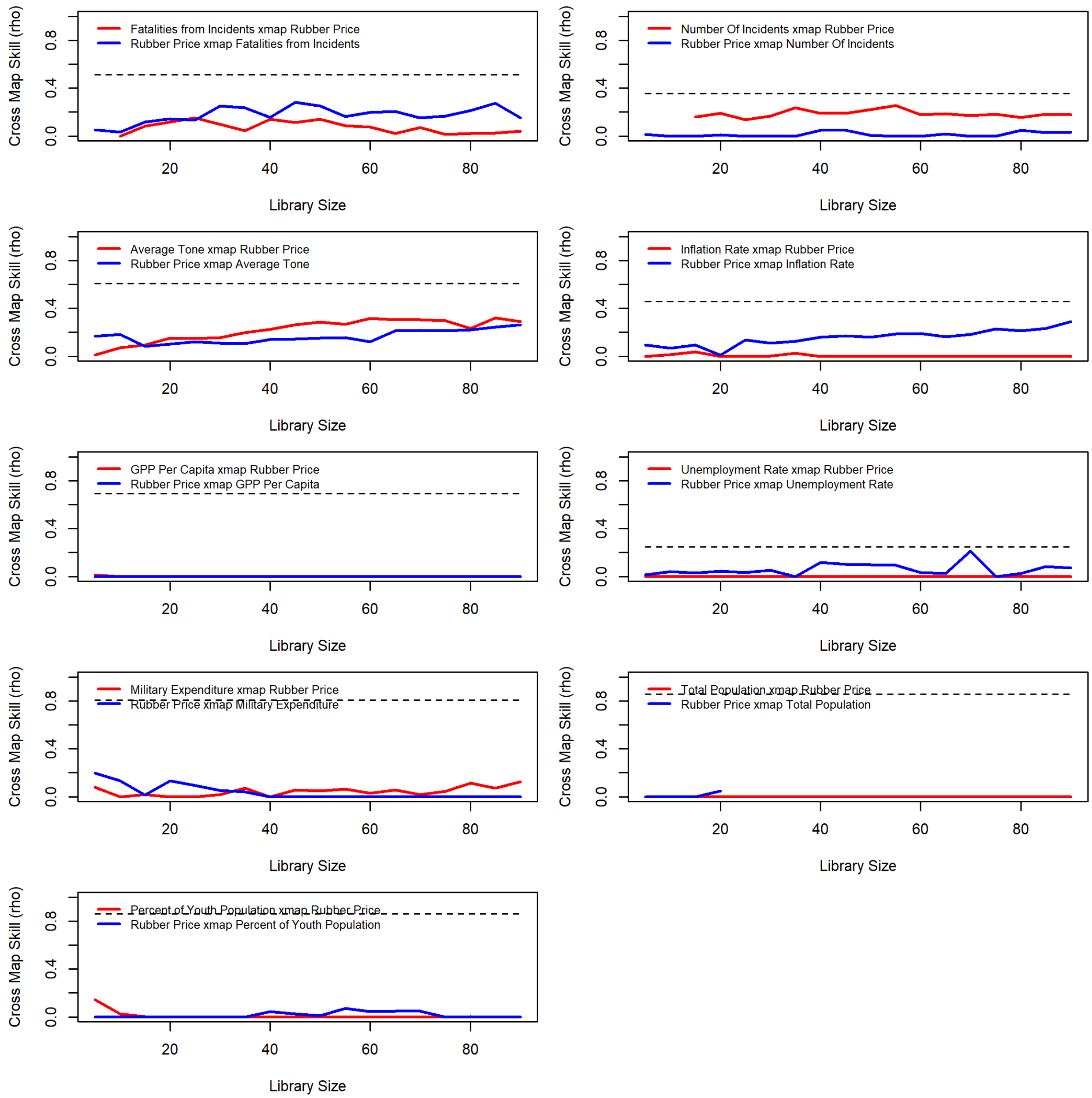

Figure 0-57: Causality Test with Convergent Cross Mapping against GPP per Capita - Pattani Province

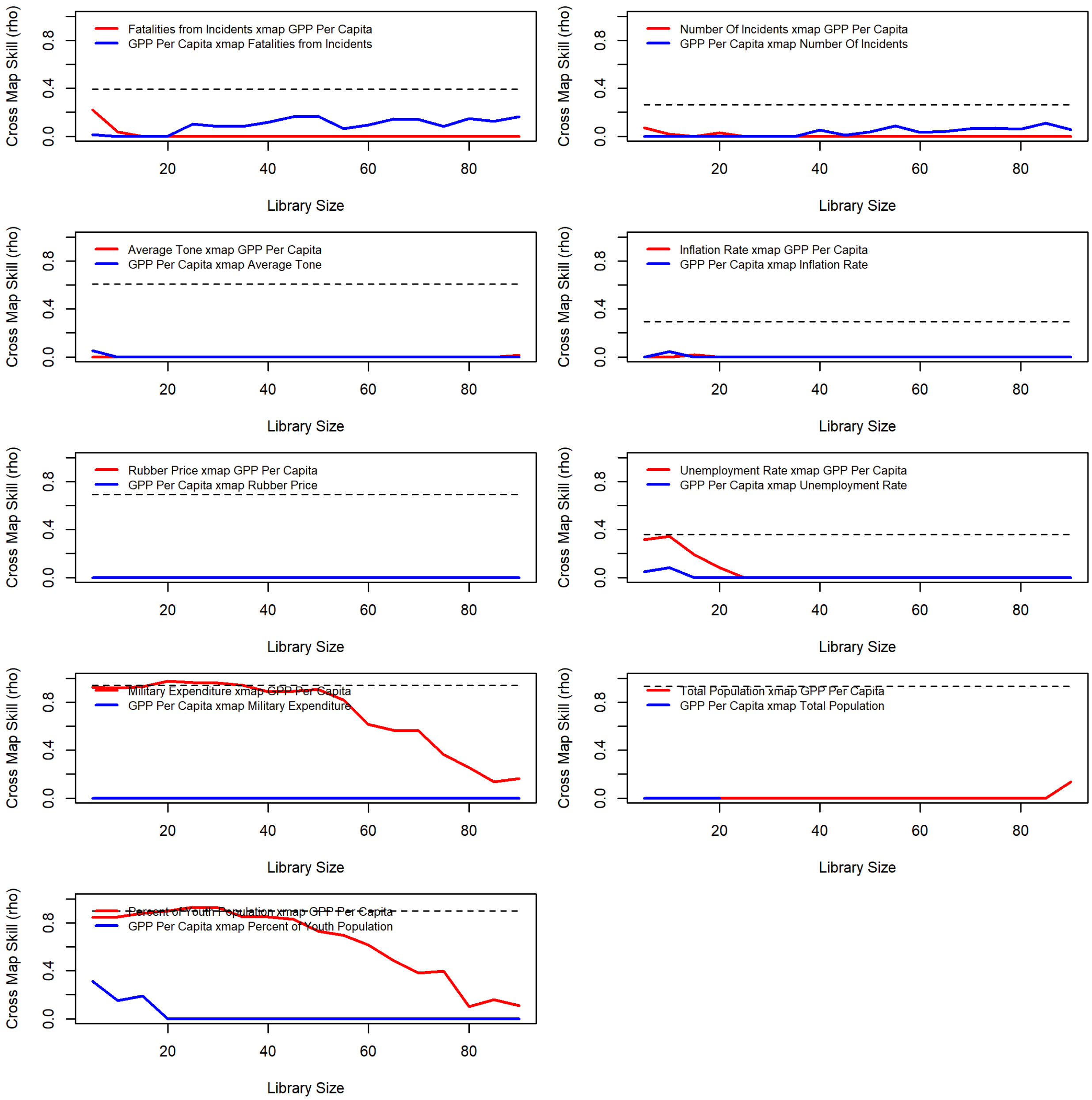

Figure 0-58: Causality Test with Convergent Cross Mapping against Unemployment Rate - Pattani Province

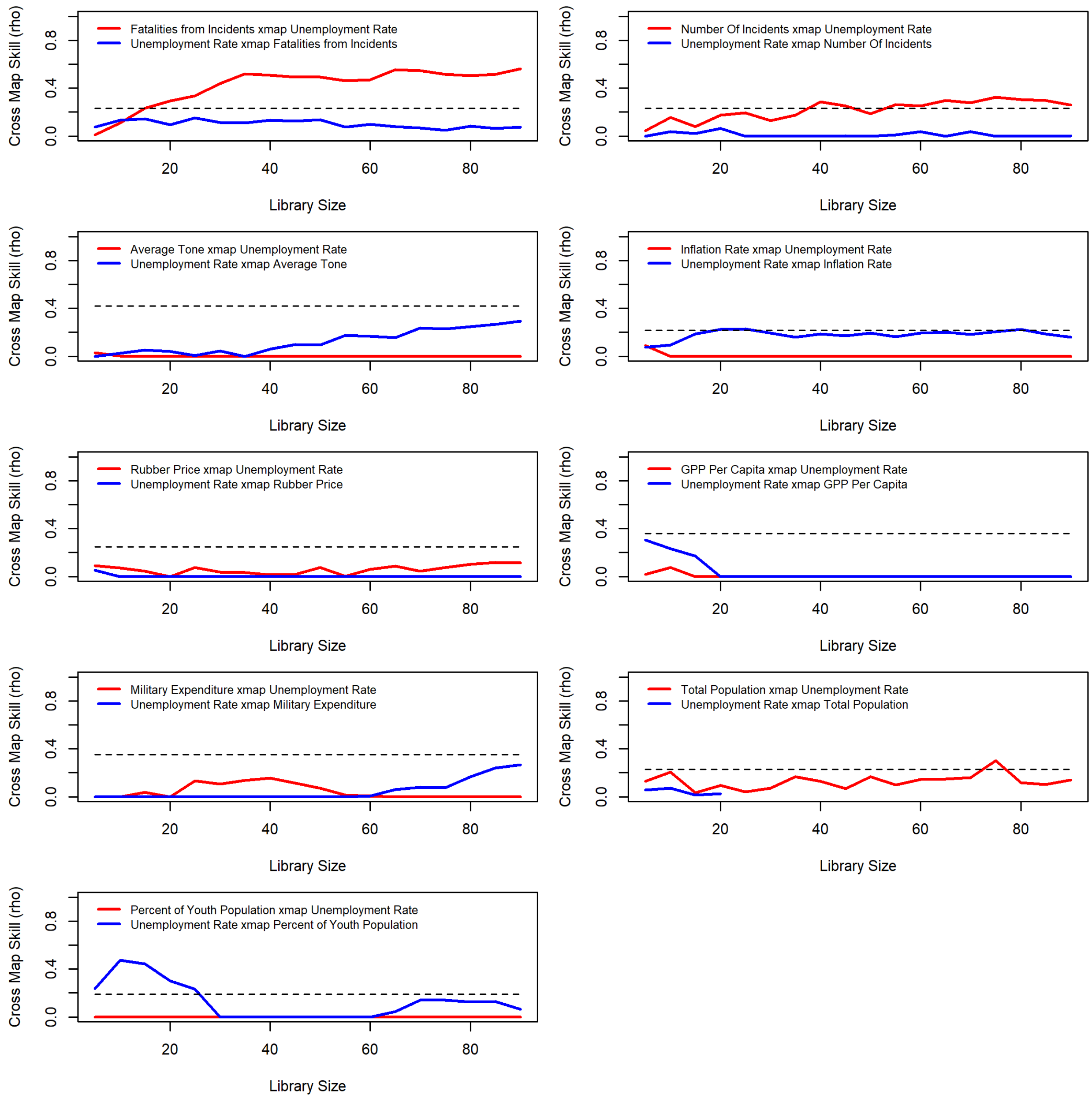

Figure 0-59: Causality Test with Convergent Cross Mapping against Military Expenditure - Pattani Province

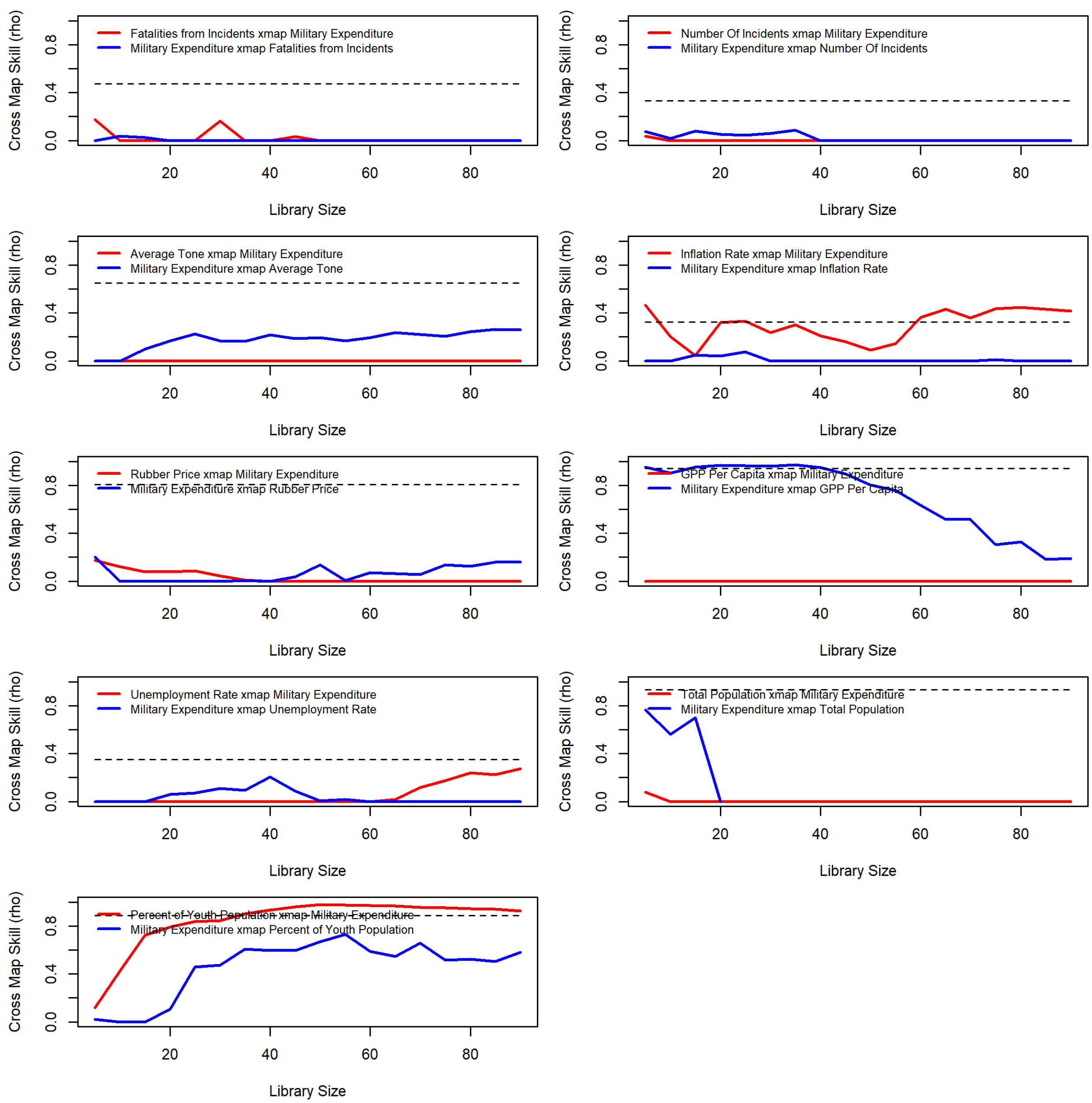

Figure 0-60: Causality Test with Convergent Cross Mapping against Total Population - Pattani Province

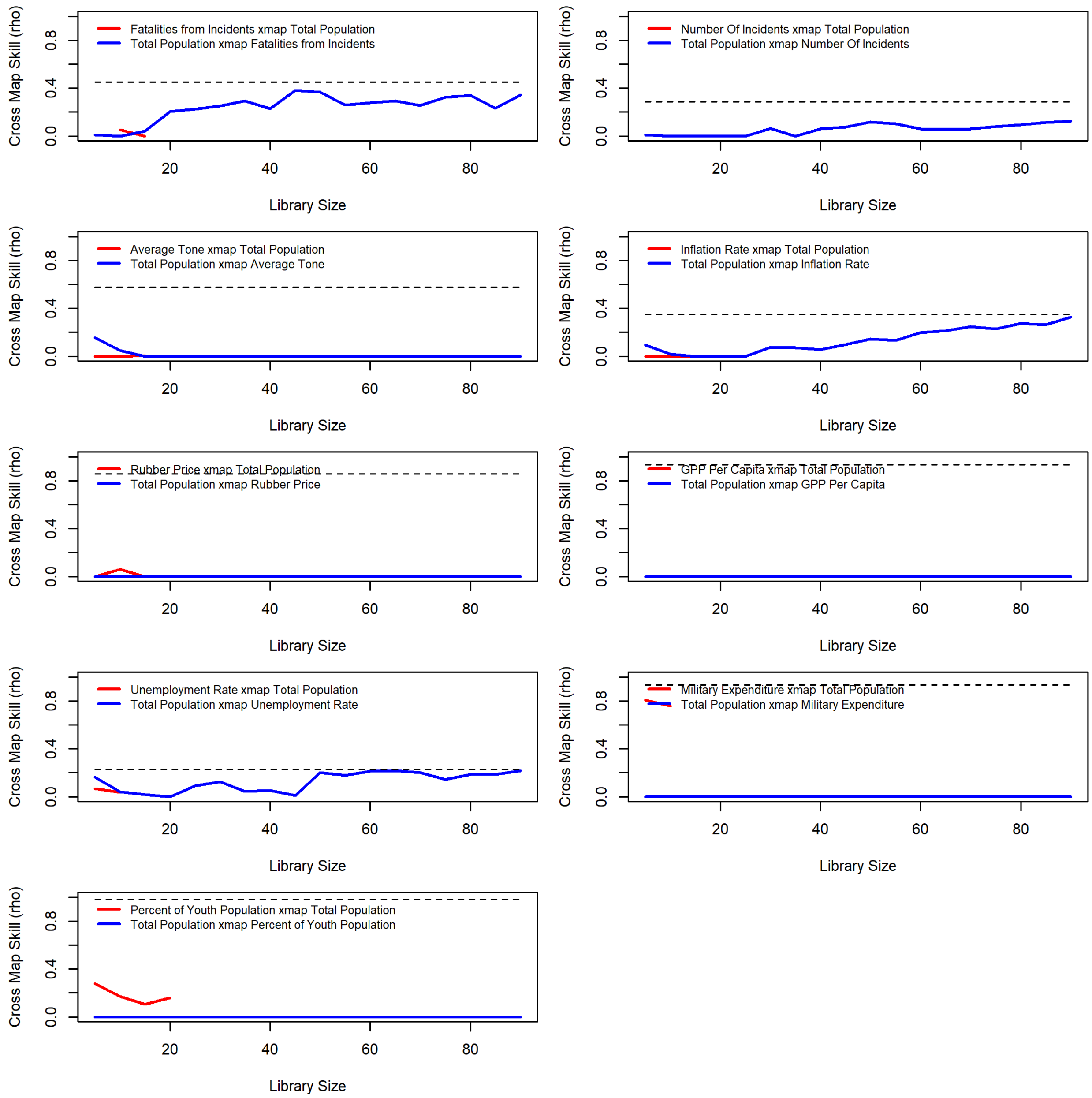

Figure 0-61: Causality Test with Convergent Cross Mapping against Percent Of Youth Population - Pattani Province

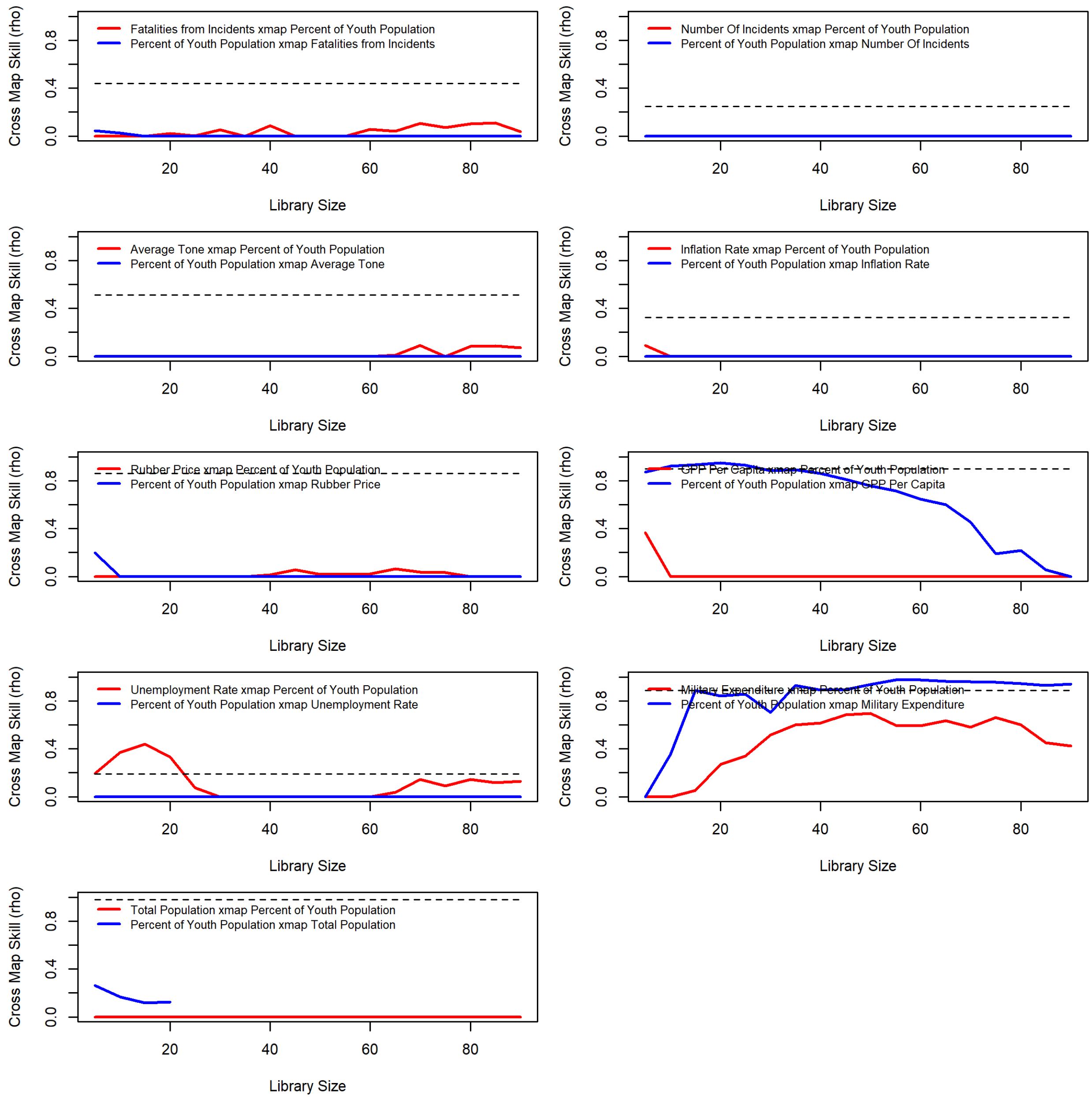

Figure 0-62: Causality Test with Convergent Cross Mapping against Number of Incidents - Yala Province

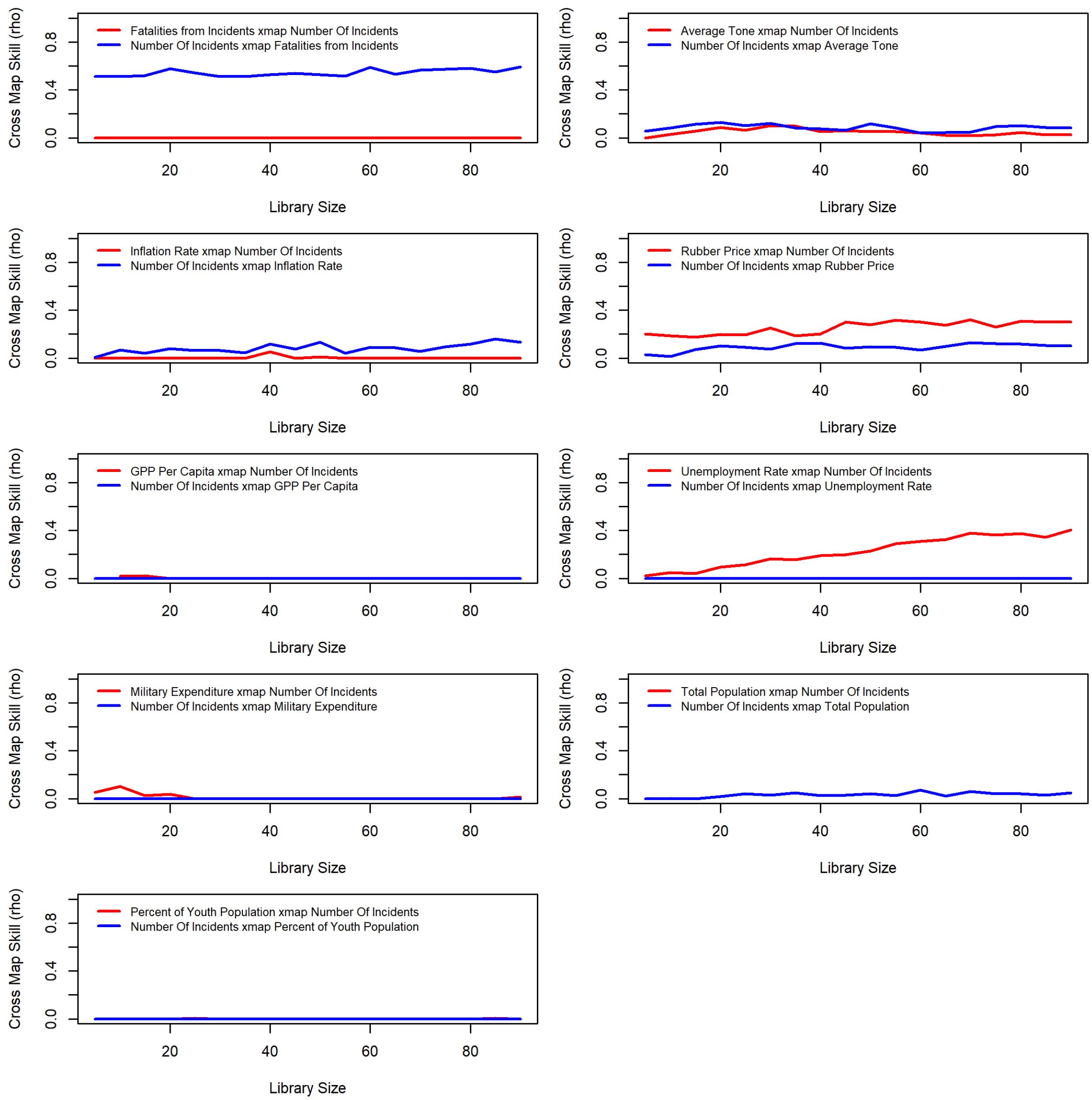

Figure 0-63: Causality Test with Convergent Cross Mapping against Fatalities from Incidents - Yala Province

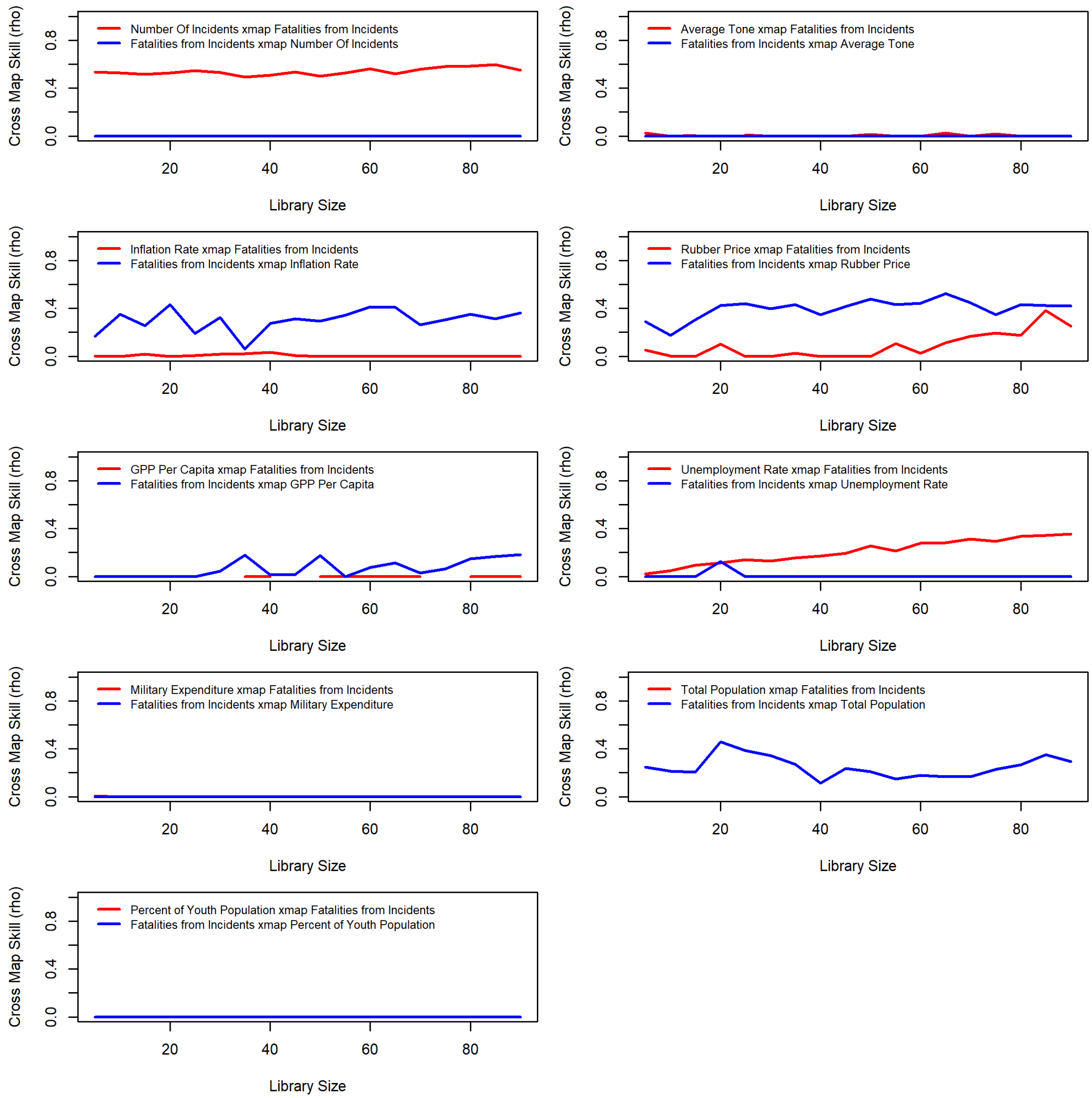

Figure 0-64: Causality Test with Convergent Cross Mapping against Average Tone - Yala Province

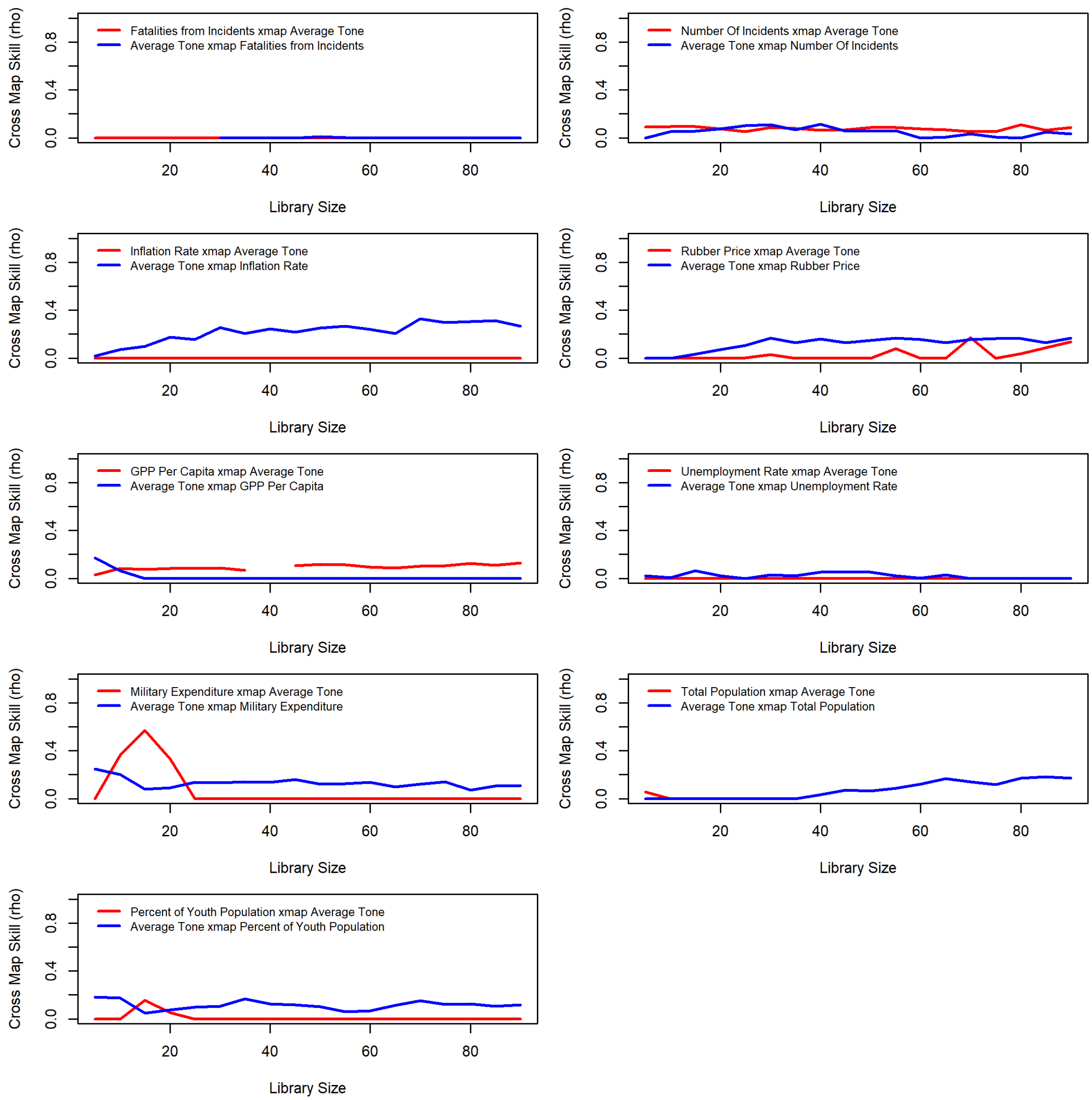

Figure 0-65: Causality Test with Convergent Cross Mapping against Inflation Rate - Yala Province

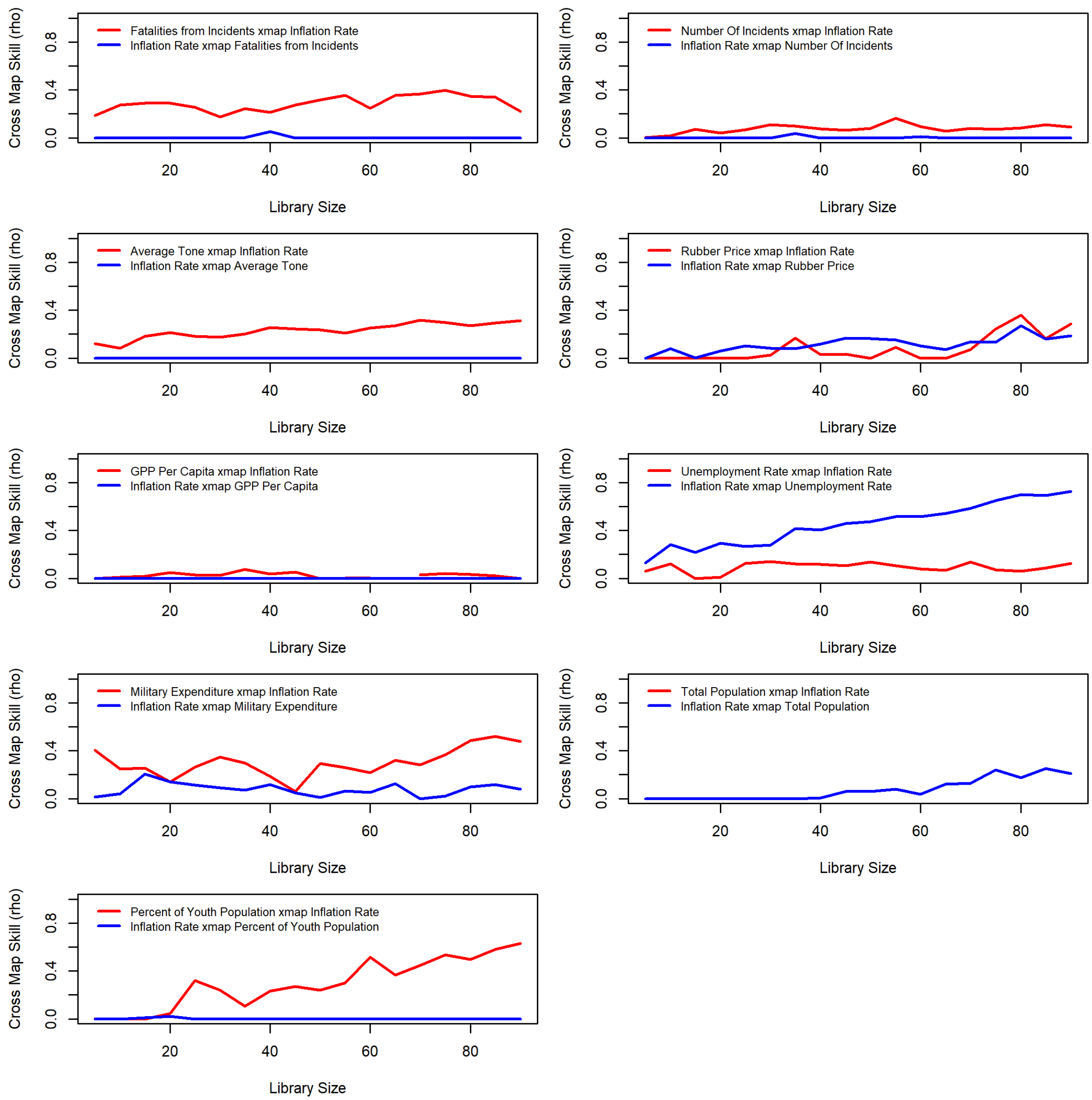

Figure 0-66: Causality Test with Convergent Cross Mapping against Rubber Price - Yala Province

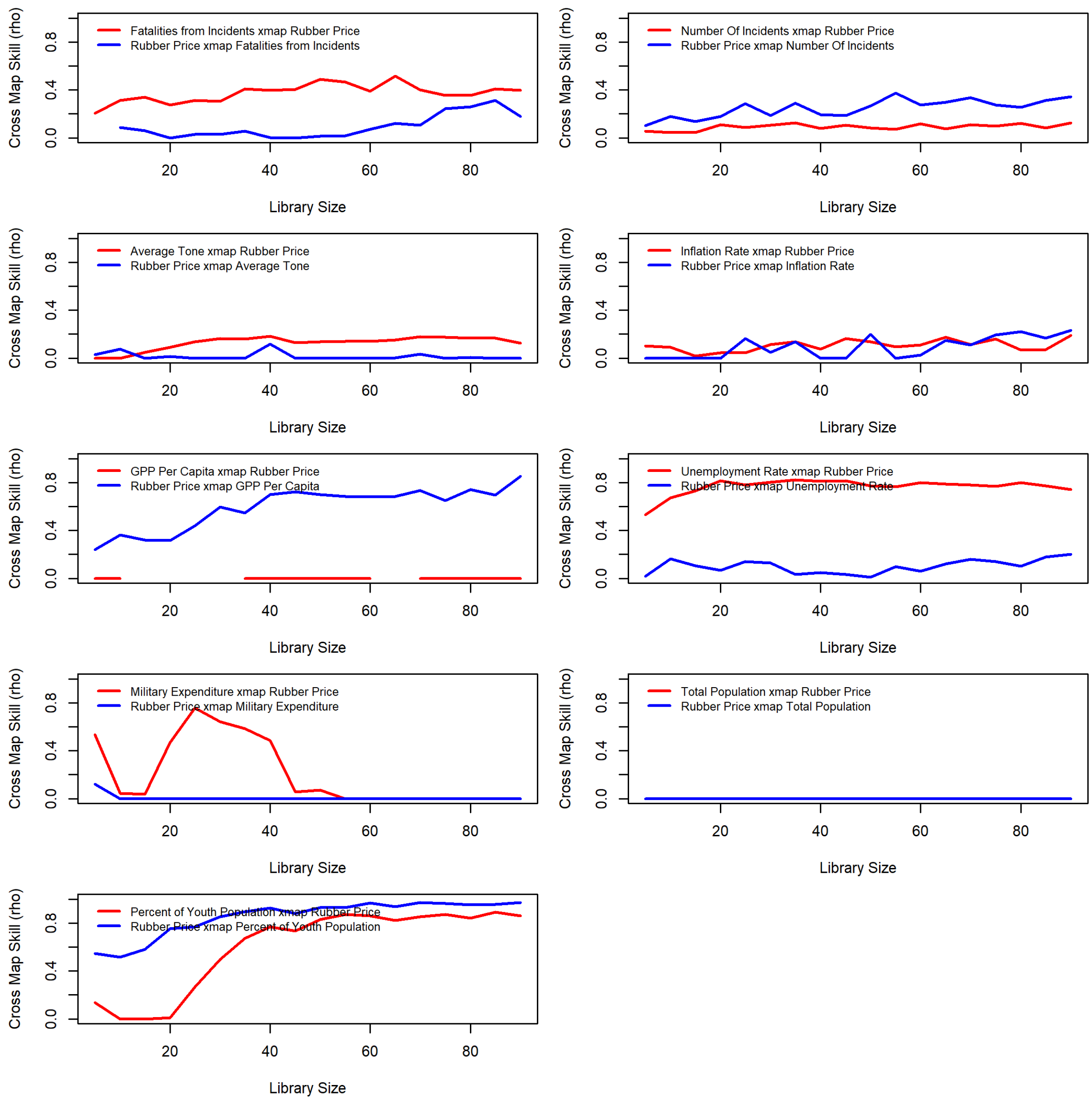

Figure 0-67: Causality Test with Convergent Cross Mapping against GPP per Capita - Yala Province

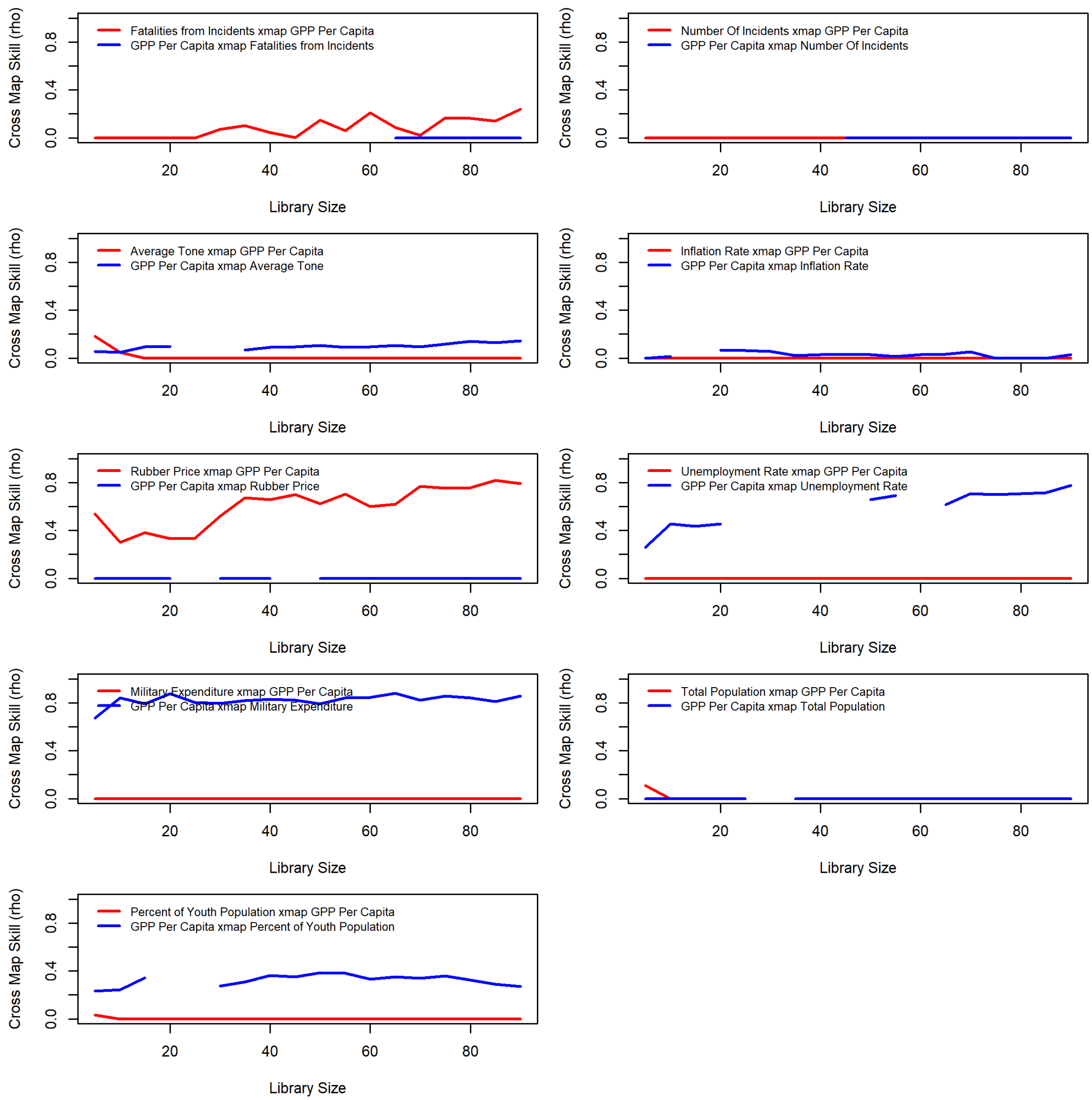

Figure 0-68: Causality Test with Convergent Cross Mapping against Unemployment Rate - Yala Province

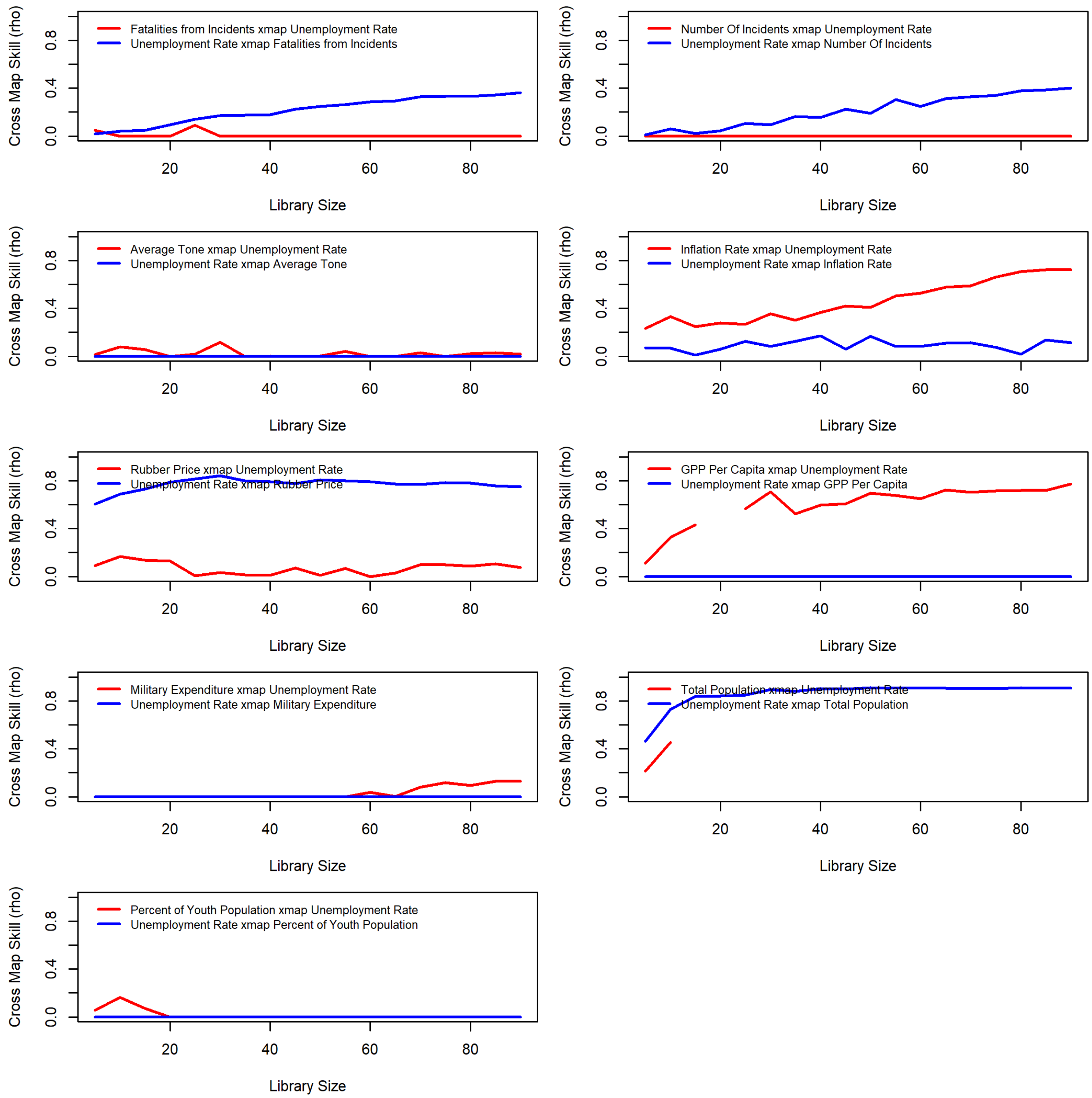

Figure 0-69: Causality Test with Convergent Cross Mapping against Military Expenditure - Yala Province

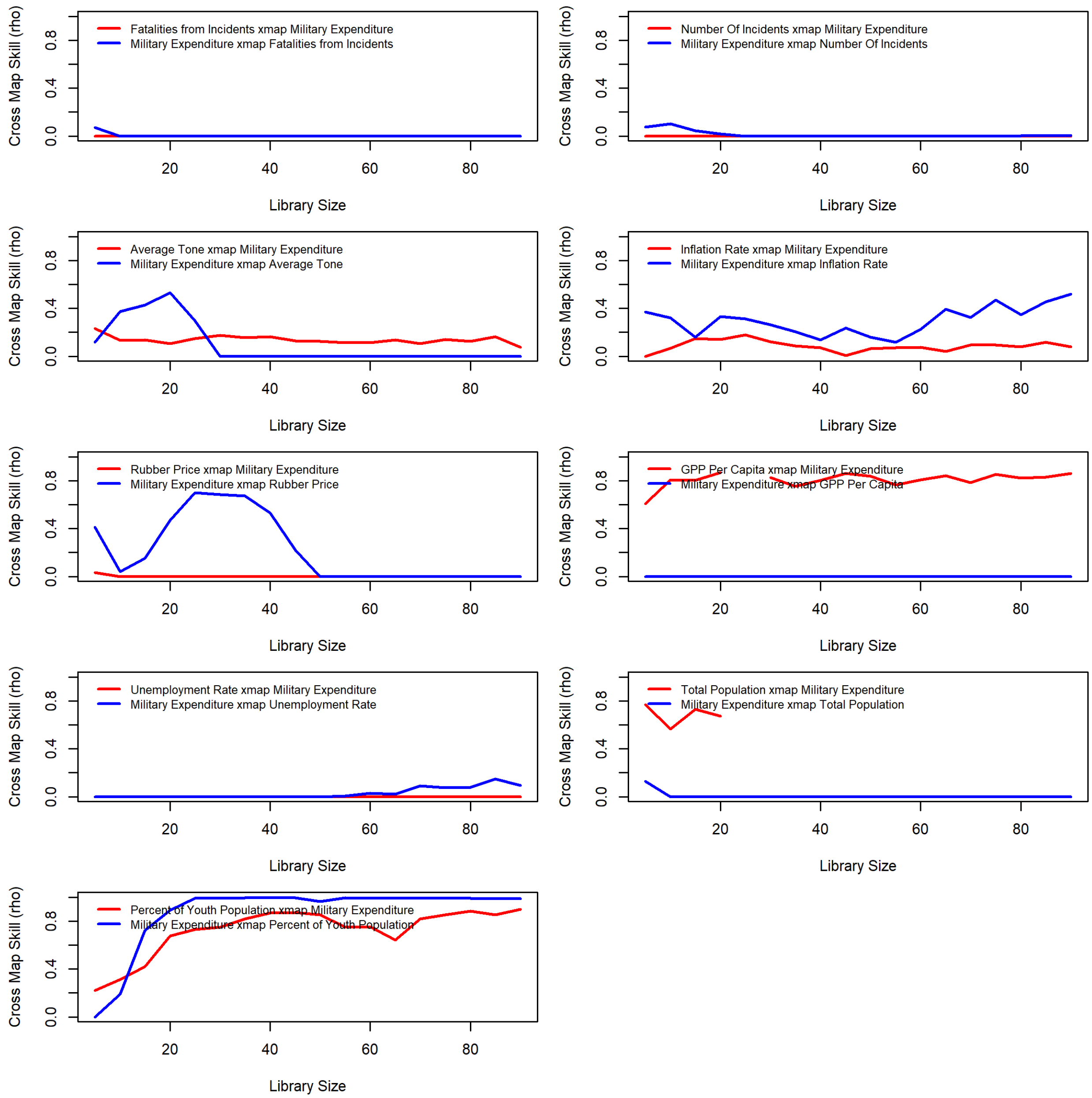

Figure 0-70: Causality Test with Convergent Cross Mapping against Total Population - Yala Province

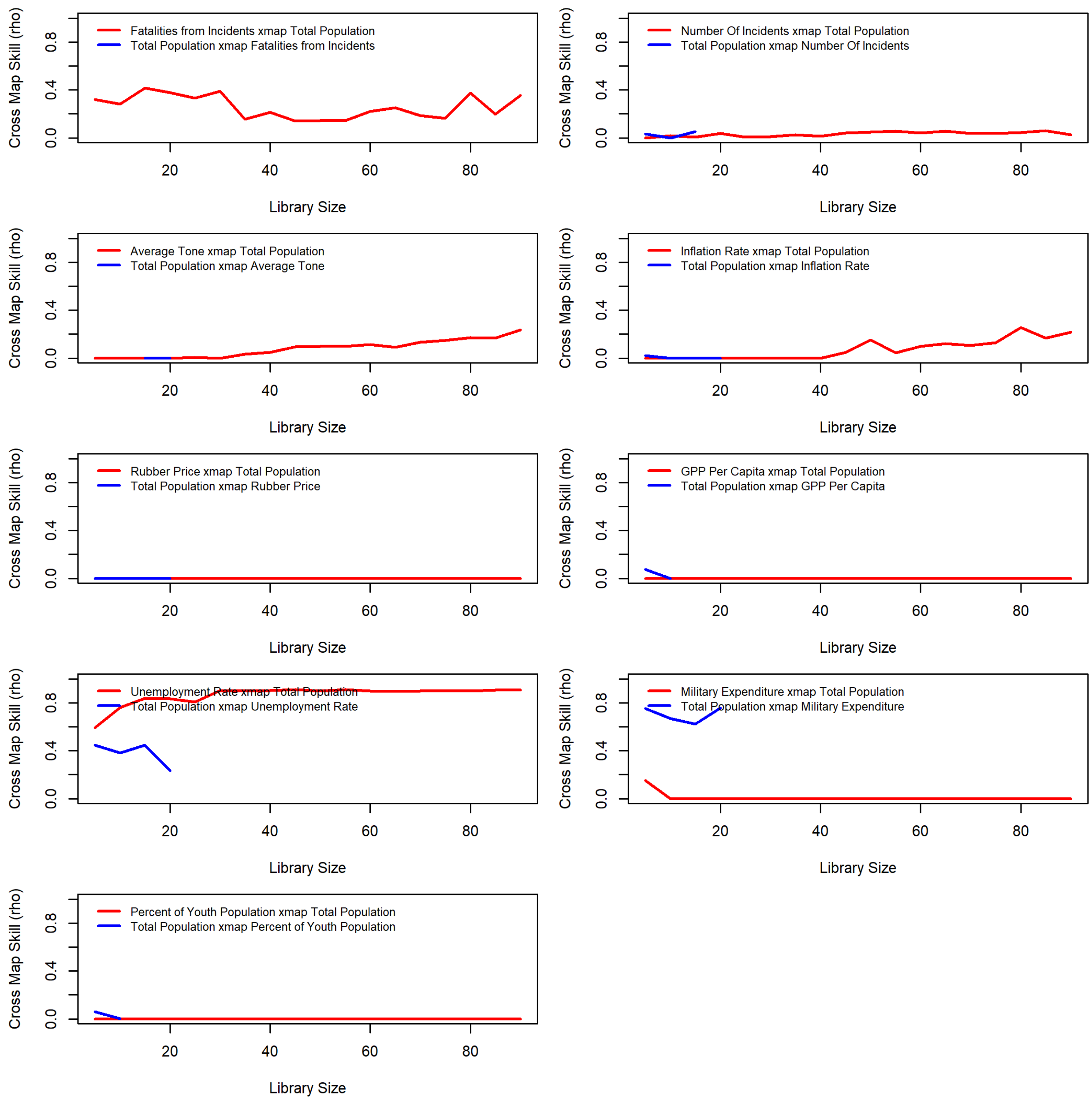

Figure 0-71: Causality Test with Convergent Cross Mapping against Percent Of Youth Population - Yala Province

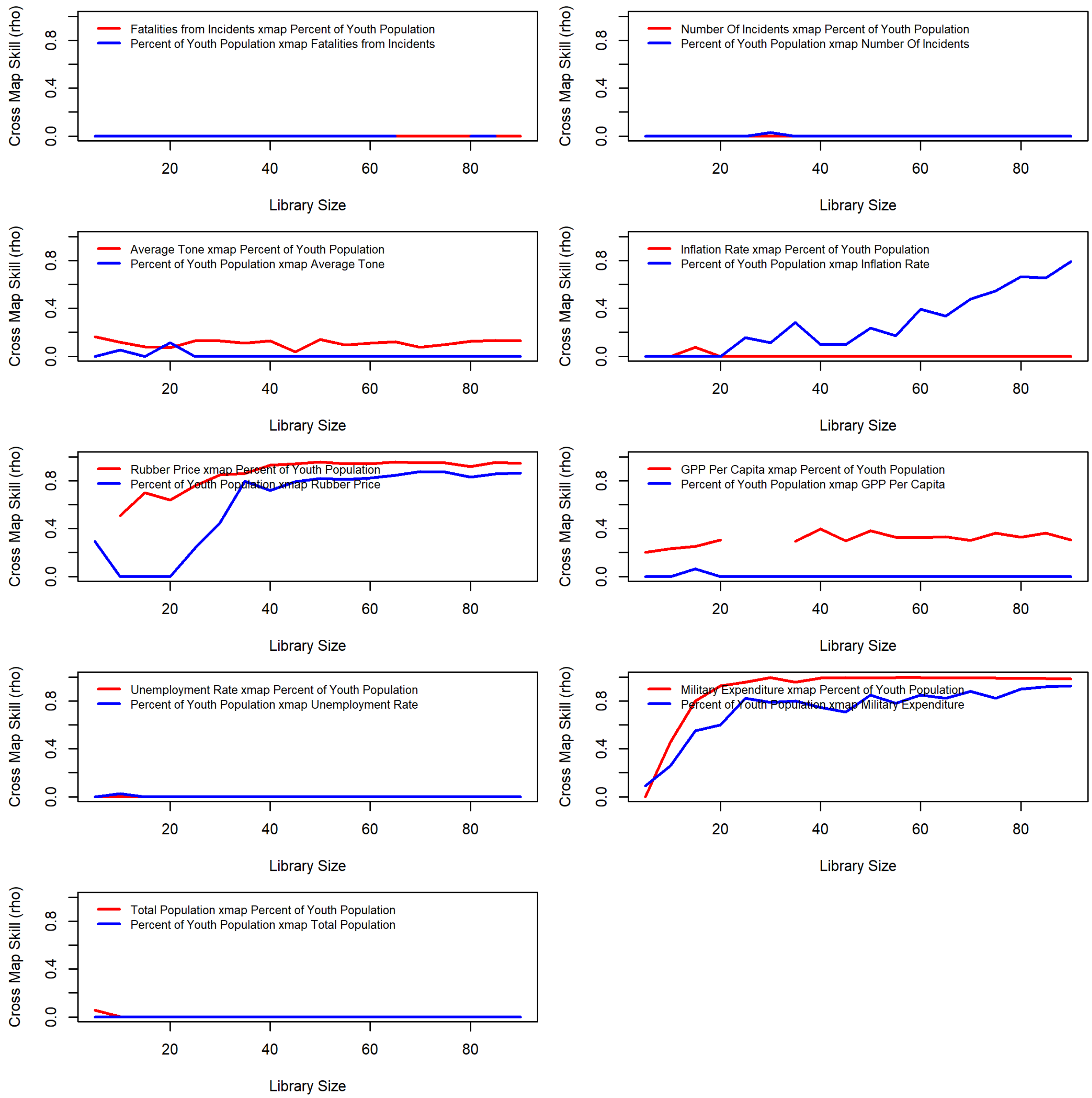

Figure 0-72: Causality Test with Convergent Cross Mapping against Number of Incidents - Narathiwat Province

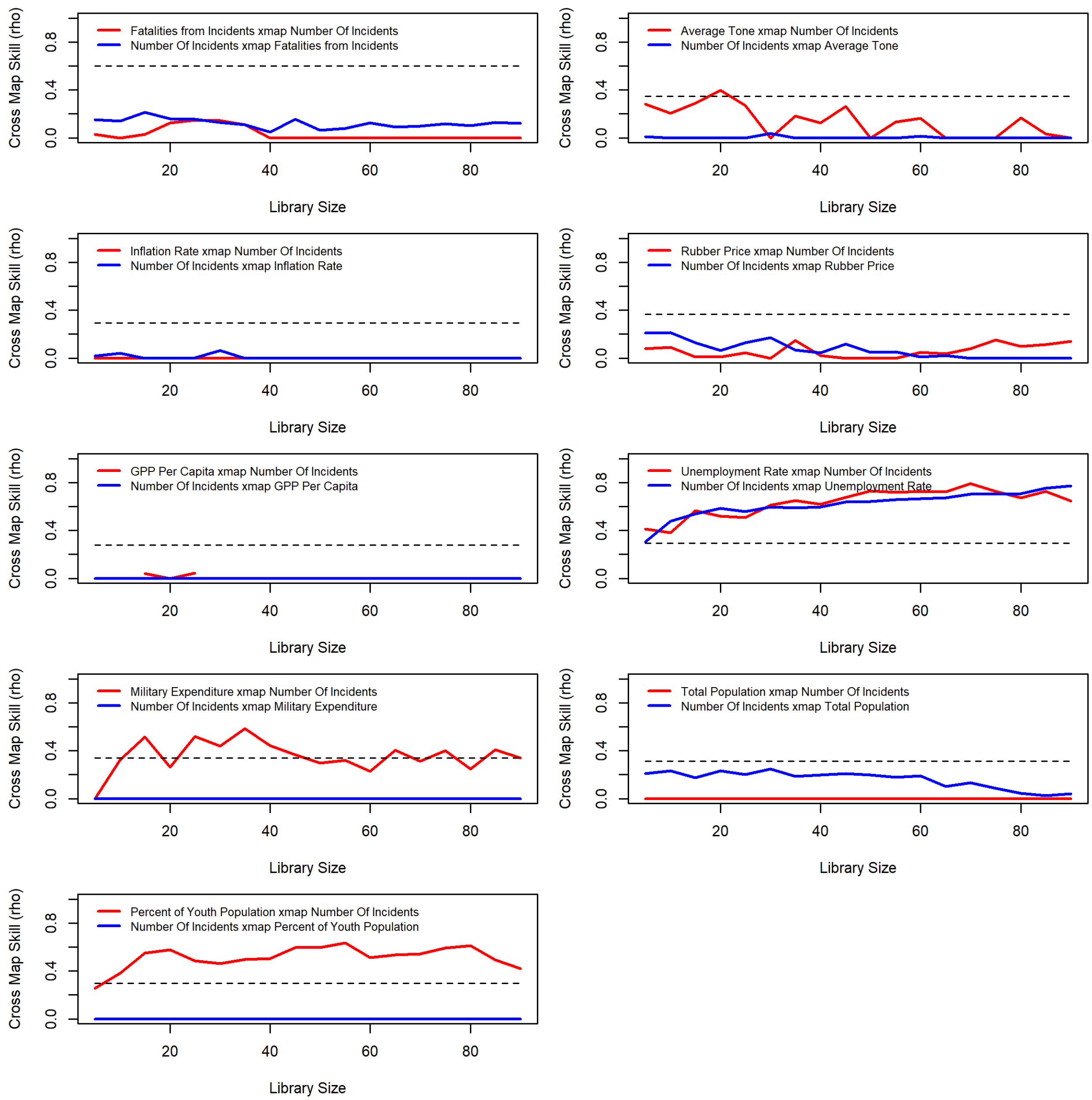

Figure 0-73: Causality Test with Convergent Cross Mapping against Fatalities from Incidents - Narathiwat Province

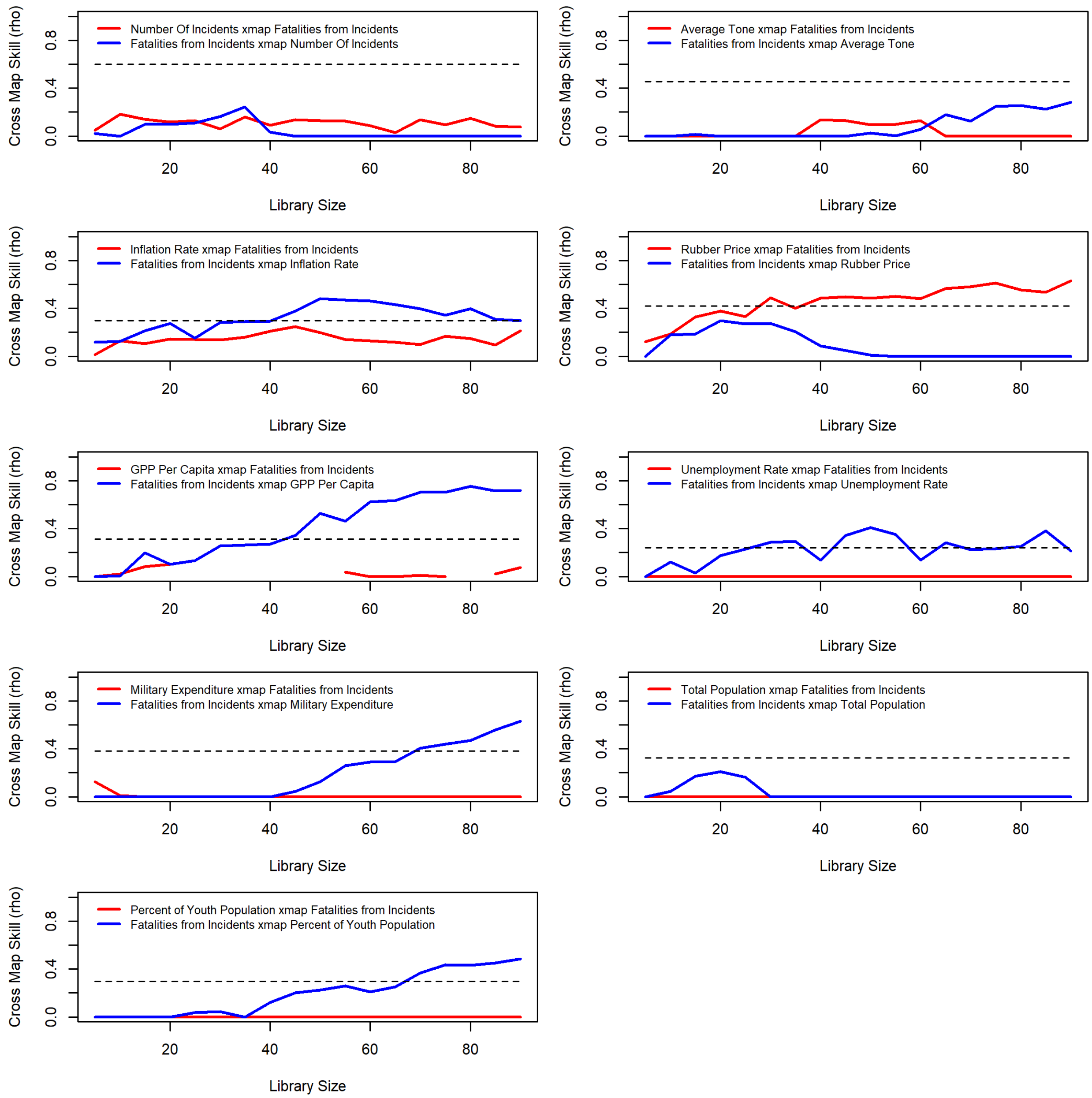

Figure 0-74: Causality Test with Convergent Cross Mapping against Average Tone - Narathiwat Province

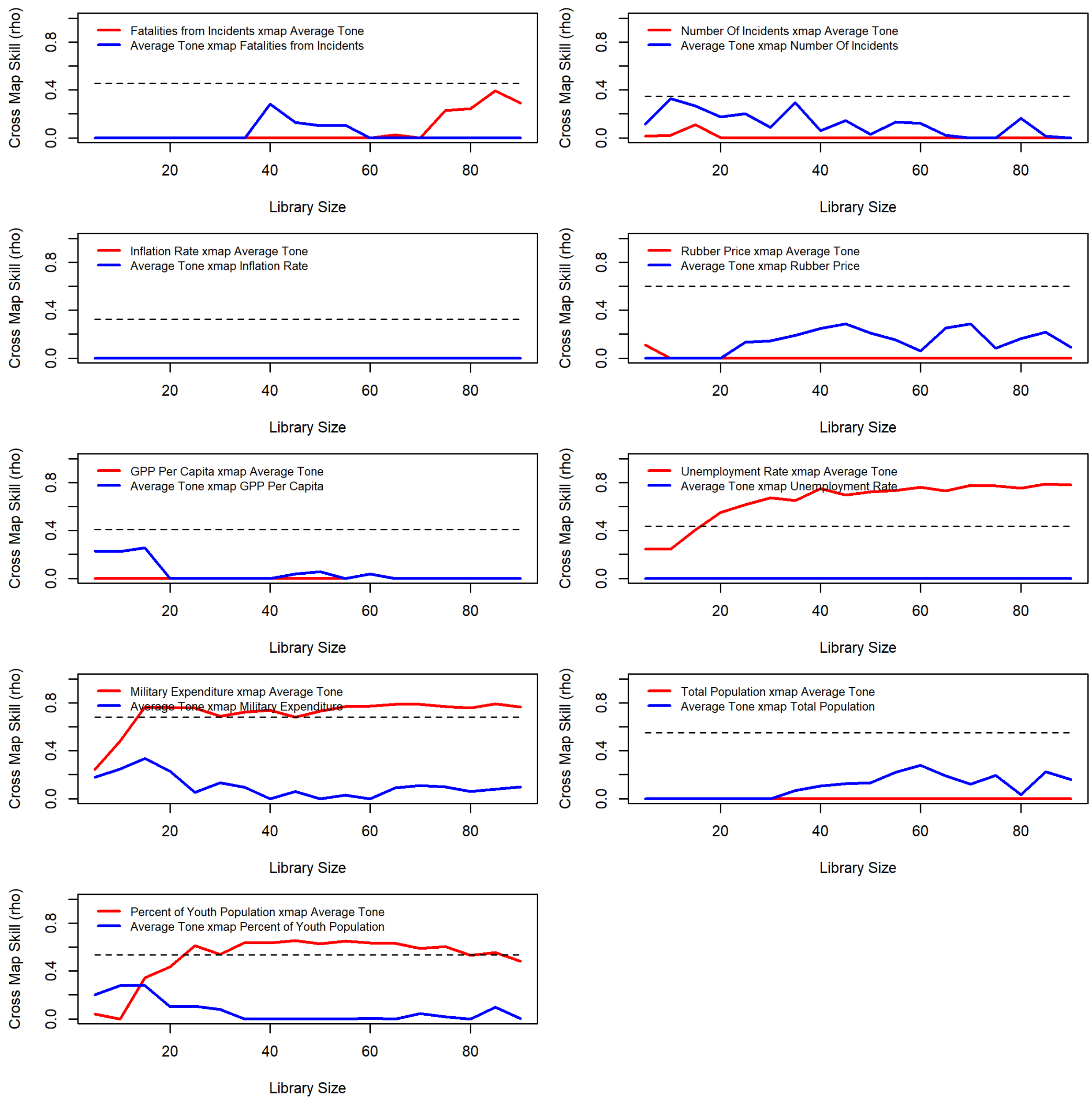

Figure 0-75: Causality Test with Convergent Cross Mapping against Inflation Rate - Narathiwat Province

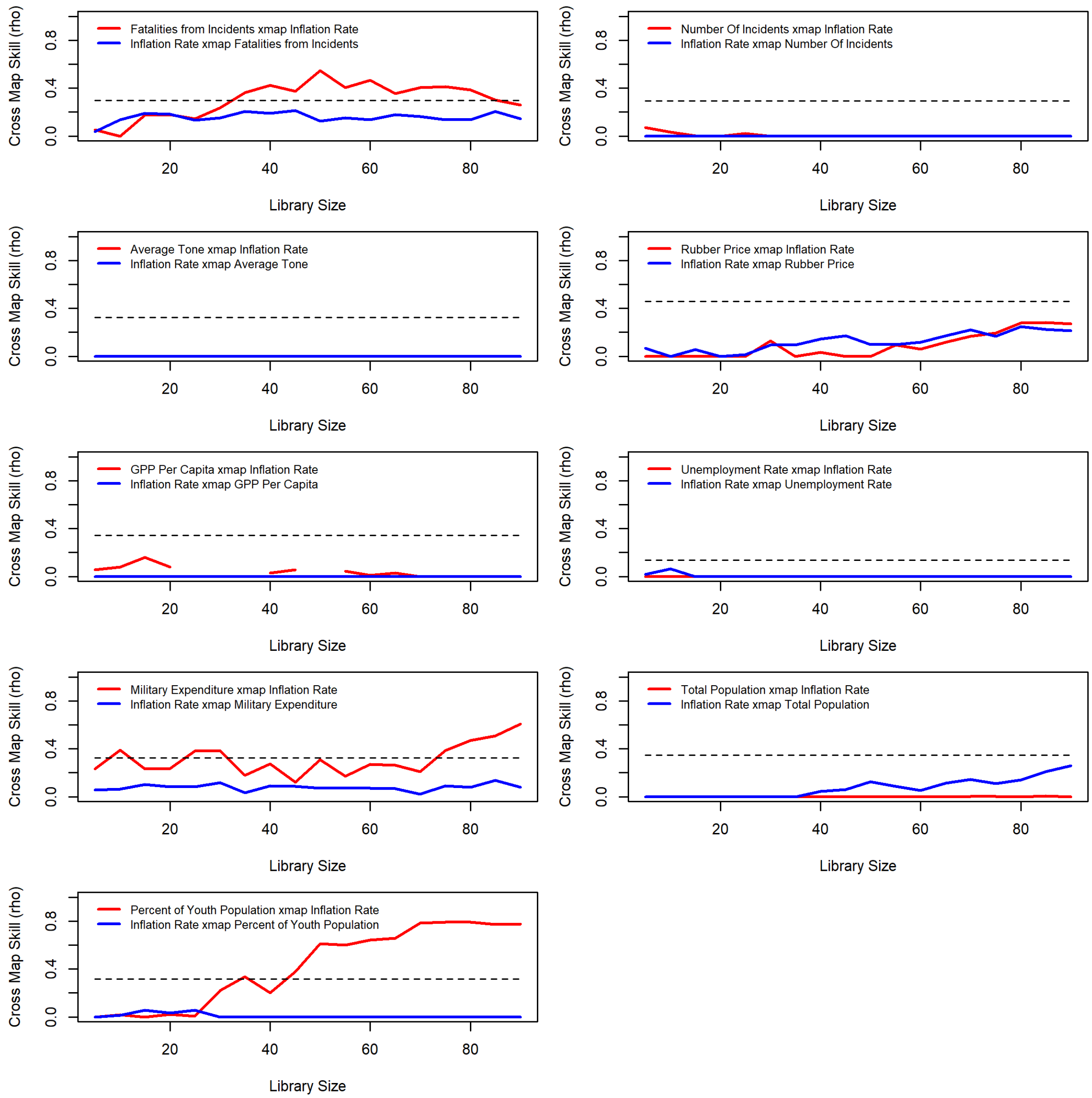

Figure 0-76: Causality Test with Convergent Cross Mapping against Rubber Price - Narathiwat Province

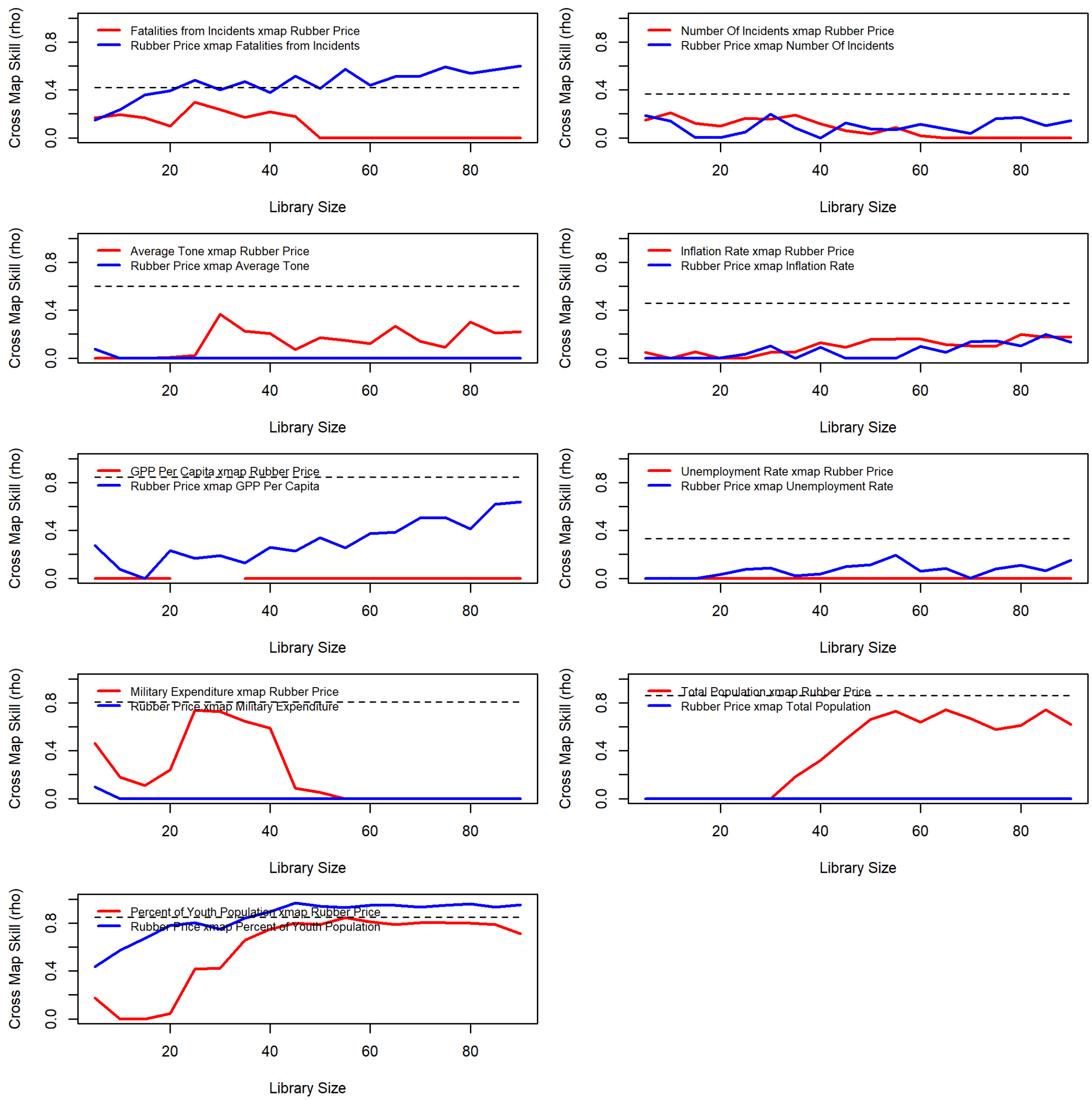

Figure 0-77: Causality Test with Convergent Cross Mapping against GPP per Capita - Narathiwat Province

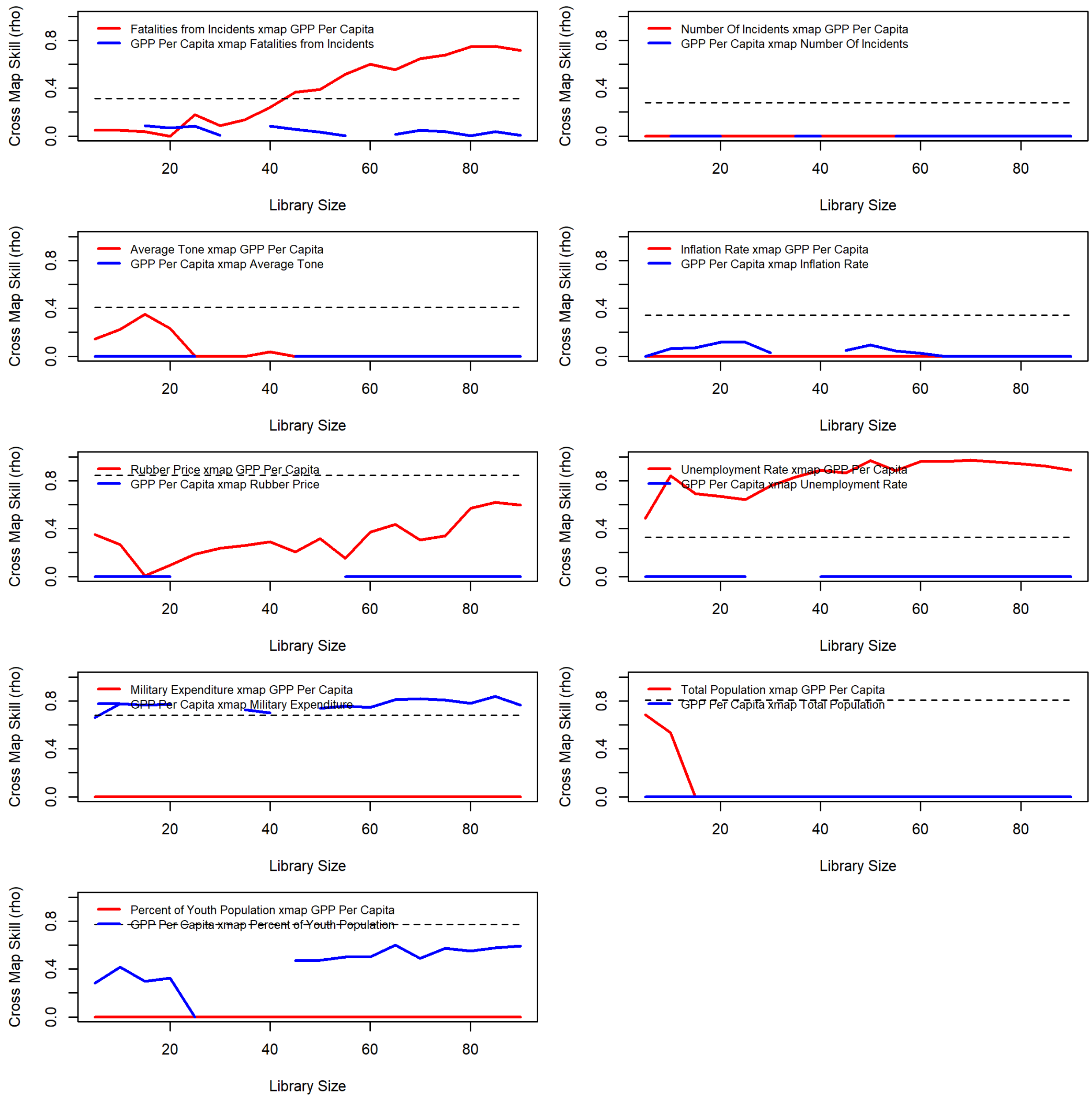

Figure 0-78: Causality Test with Convergent Cross Mapping against Unemployment Rate - Narathiwat Province

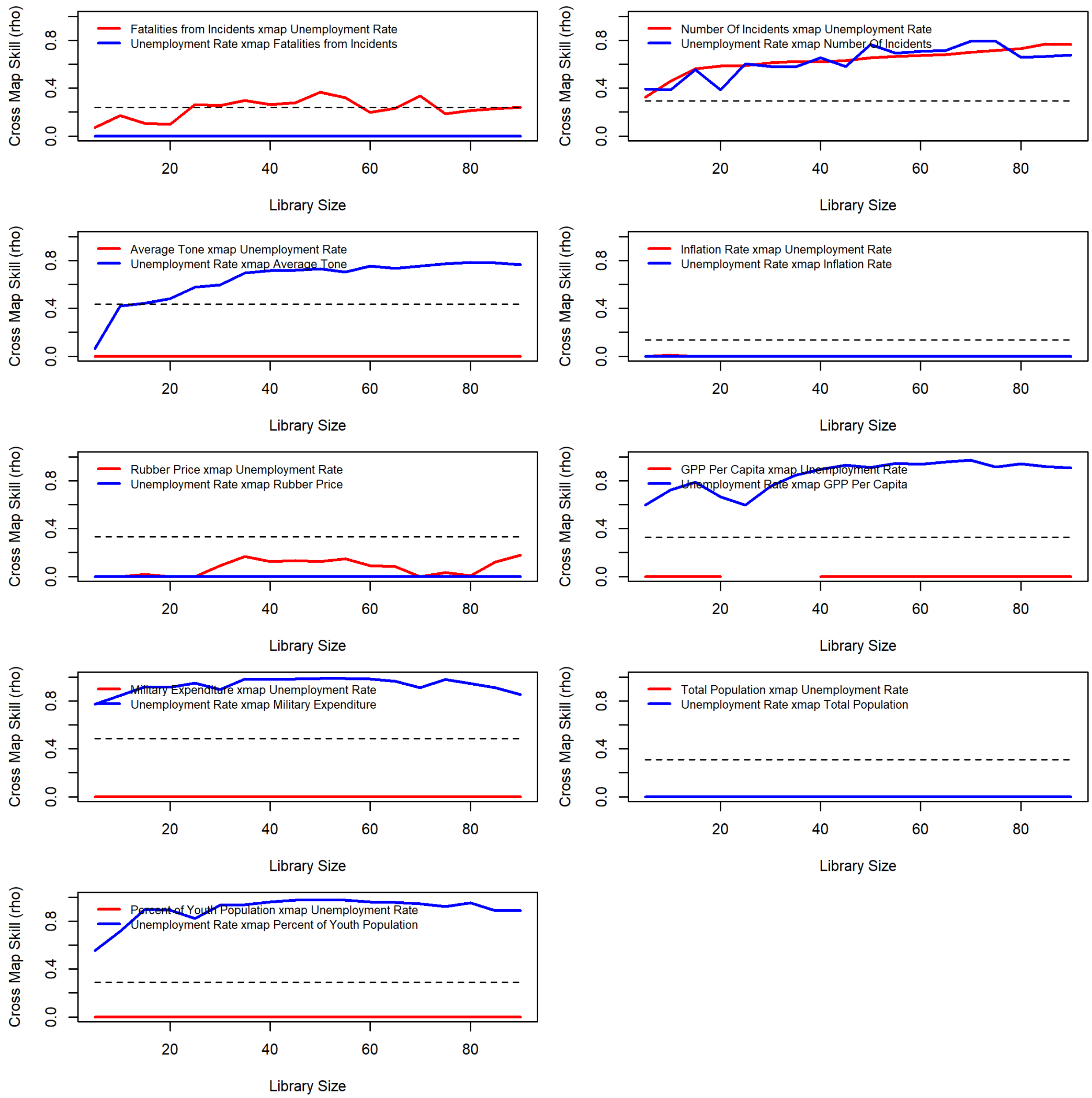

Figure 0-79: Causality Test with Convergent Cross Mapping against Military Expenditure - Narathiwat Province

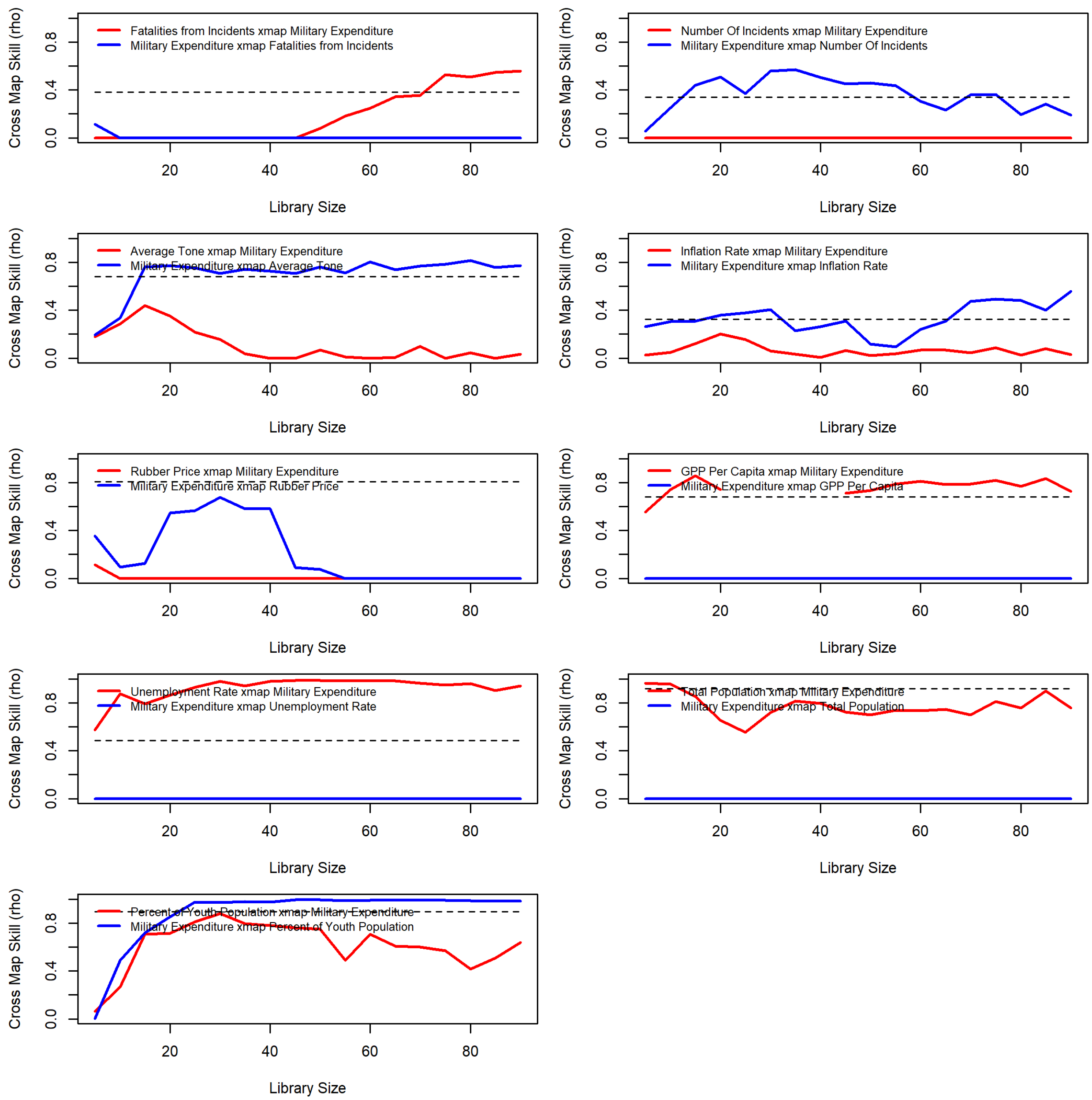

Figure 0-80: Causality Test with Convergent Cross Mapping against Total Population - Narathiwat Province

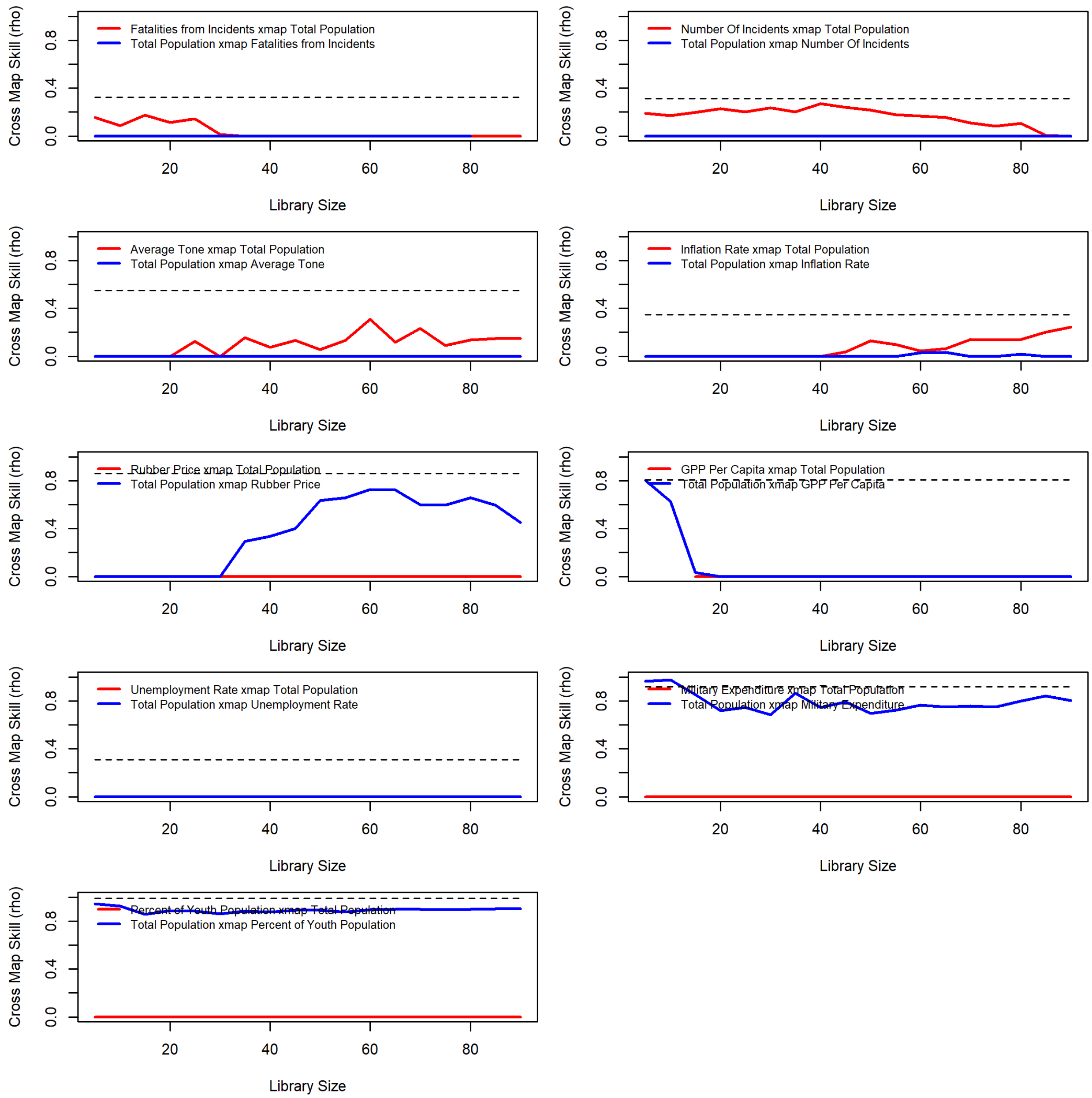

Figure 0-81: Causality Test with Convergent Cross Mapping against Percent Of Youth Population - Narathiwat Province