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“Time Series Analysis on Macroeonomy in Japan”

Editor’s Introduction

Hiroshi Morita

I am pleased to introduce a special issue of the Journal of International Economic Studies, entitled “Time Series Analysis on Macroeonomy in Japan.” As an outcome of the research project “Analysis on Macroeconomic Structure in Japan” of the Institution of Comparative Economic Studies, this issue comprises three articles which tackle important macroeconomic problems using a sophisticated time-series empirical method. I believe that all the papers achieve the principal purpose of our project, which is to provide the readers with an understanding of empirical methods and insight into macroeconomic structure.

The first paper, entitled “Price and Wage Dynamics and Labor Market Conditions in Japan” written by Hiroshi Morita, examines the state-dependent relationship between labor market tightness and price-wage rigidities. In the phase of increasing inflationary pressure, it is often discussed whether the pass-through of such an increase in prices to nominal wages is sufficient and timely. Indeed, if this is case, real wages do not decline even in the inflationary phase and households should not suffer very much from inflation. However, amid the long-lasting deflation in Japan, the channel from prices to wages seems not to be functioning adequately, and thus real wages often decline in response to price increases stemming from external factors such as hikes in oil prices and commodity prices. The primary aim of this paper is to examine a transmission mechanism of structural shocks to prices and wages, and then reveal a source of insufficient pass-through between them. In the analysis, the Smooth Transition Vector Autoregressive (STVAR) model is employed to reveal the state-dependent effects of demand and supply shocks on prices and wages. The STVAR framework allows the dynamic responses of prices and wages to vary depending on the labor market tightness. Furthermore, this paper addresses the structural interpretation of the source of a state-dependency by conducting an impulse response matching technique based on the Dynamic Stochastic General Equilibrium (DSGE) model. From the methodological viewpoint, this paper combines two major methods in the macroeconomic analysis: the VAR model and the DSGE model, leading to a bridging of the gap between reduced-form analysis and structural interpretation. The results are summarized as follows. First, price and wage indexation in Japan is rather low. Second, as the labor market tightens, price becomes stickier, while wage becomes less sticky. Finally, the standard theoretical model can be used to sufficiently describe Japan’s economy at the period of labor market tightness. As the labor market loosens, however, the distance between the empirical and theoretical responses gradually grows.

The second paper, entitled “Macroeconomic Shocks and Firms’ Overseas Expansion: Evidence from the Factor-Augmented VAR Approach,” written by Shota Araki, Bin Ni, and Hiroshi Morita, analyzes the effects of macroeconomic variations, such as exchange rate and global GDP, on Japanese firms’ overseas expansion behaviors. Using a novel dataset of individual firm’s panel data, the authors examine how macroeconomic shocks affect the distribution of overseas subsidiaries of individual firms. The key technical contribution of this paper is to propose the Factor Augmented

VAR (FAVAR) model with Tobit specification. The FAVAR framework is utilized to capture the transmission effects of one macroeconomic shock to the activities of a group of firms in a single model, while Tobit specification can deal with a truncated number of oversea subsidiaries. Namely, the number of overseas subsidiaries for some firms might be zero in some period, but Tobit specification allows us to include such data samples in the analysis. By using the panel data of firms, the analysis can derive the implication of the effects of macroeconomic shock on the firms' distribution. The proposed method in this paper is a bridge connecting macro data and micro data. The results can be summarized as follows. First, the authors show that most firms increase overseas subsidiaries in response to the appreciation of the exchange rate. However, the results of forecast error variance decomposition show that, compared with the exchange rate, global GDP shocks play a more important role in the variation of Japanese firms' overseas expansion. Additionally, the results indicate that the variation of the exchange rate has only a temporary effect on overseas expansion behaviors.

The third paper, entitled "The NG-SVAR Model under the Pearson Family of Distributions: Implementation with R Packages" written by Tadashi Nakanishi, explains the pseudo-likelihood estimation method of the VAR model with structural shocks following a non-Gaussian distribution as well as a presentation of the R program for conducting the estimation. The paper applies independent component analysis, which is an unfamiliar method in the field of econometrics, being used mainly in engineering, to separate and estimate the structural error term of the structural VAR model from the inductive system error term. In the R software, the use of "fastICA" allows for estimation. The distribution of the separated and estimated structural error terms is then investigated using "PearsonMSC," which selects an approximate distribution of the estimated distribution from the Pearson family of distributions and estimates parameters that describe the shape of the distribution. Based on this information, a probability density function is constructed and estimated. In practice, this is not estimation but optimization and the optimization process can be implemented by using "optim." Although "optim" is used to obtain the contemporaneous matrix in the VAR model to be estimated by the pseudo-maximum likelihood method, initial values are needed to perform optimization. Therefore, the analysis uses the value obtained from the estimation method ("id.ngml"), which assumes the t-distribution and is a prior study of the pseudo-maximum likelihood method. The paper uses as initial values the values obtained from the value estimated by "id.ngml" plus a random number generated from a uniform distribution to set the initial value. By following these steps, a contemporaneous matrix can be estimated. The estimated matrix is used to draw the IRF and measure the policy effect of monetary policy.

Finally, I would like to express my deepest appreciation to the authors of this special issue for their cooperation. I am also very grateful to the members of my own research project.

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Price and Wage Dynamics and Labor Market Conditions in Japan

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Abstract

This study estimates structural parameters characterizing price and wage dynamics in Japan by accounting for labor market tightness. To reveal the state dependency of price and wage dynamics, we first estimate a smooth transition vector autoregressive model, in which the unemployment rate is regarded as a transition variable. Thereafter, the structural parameters in each state of the labor market are estimated using the impulse response matching technique. The results are summarized as follows. First, price and wage indexation in Japan is rather low. Second, as the labor market tightens, price becomes stickier, while wage becomes less sticky. Finally, the standard theoretical model can be used to sufficiently describe Japan's economy at the period of labor market tightness. As the labor market loosens, however, the distance between the empirical and theoretical responses gradually grows.

Keywords: price and wage dynamics, ST-VAR model, DSGE model

JEL classification: **C32, E24, E31, E52**

1. Introduction

The recent literature has been actively discussing whether inflation pressure from the economic stimulus policy implemented by the Abe Cabinet has sufficiently carried on nominal wages. Obviously, real wage declines in response to demand-stimulating policies, such as fiscal and monetary policies, particularly if the response of nominal wage is less than that of price. In this case, evaluations of such policies may deem resultant benefits inadequate. From an academic viewpoint, it is important to investigate the relationship between price and wage. As is widely known, both variables have a mutual linkage through the New Keynesian Phillips Curve (NKPC) and New Keynesian Wage Phillips Curve (NKWPC) in the dynamic stochastic general equilibrium (DSGE) model. Analyzing the dynamic relationship between price and wage, therefore, can reveal not only the effectiveness of economic policies but also the structure of the real economy.

This study explores the state dependency of price and wage dynamics in a labor market situation and attempts to understand the source and pattern of variation in price and wage dynamics in Japan. To accomplish these objectives, we adopt the smooth transition vector autoregressive (STVAR) model and impulse response matching technique. The STVAR model is a vector version of the smooth transition autoregressive (STAR) model developed by Granger and Terasvirta (1993), and has recently been used in Auerbach and Gorodnichenko (2012). The model allows the coefficients

and variance-covariance structure to smoothly vary by the value of a transition variable, and thus it is suitable for our analysis, which sheds light on the state dependency of price and wage dynamics. However, the results from the VAR model cannot be used to further discuss the structure of an economy (i.e., what causes a variation of dynamics in price and wage). Thus, we perform a structural estimation using impulse response matching, as proposed by Christiano et al. (2011). By estimating the DSGE model, the structural parameters in each state of the labor market are revealed, allowing us to identify the causes underpinning the changes in price and wage dynamics.

More precisely, our analysis is implemented as follows. First, we estimate the STVAR model, in which the unemployment rate is regarded as a transition variable. This first-step exercise gives us reduced-form results for the relationship between price and wage dynamics and labor market tightness. We examine the effects of supply and demand shocks on price and real wage based on long-run restrictions. Thereafter, the structural parameters are estimated to minimize the distance between the empirical and theoretical responses using the impulse response matching technique. These estimations are implemented using the Bayesian method.

The literature contains numerous studies that analyze the NKPC and NKWPC in Japan. These previous studies are categorized into two strands of approaches: one that estimates the NKPC and NKWPC as part of the DSGE model (Iiboshi et al., 2006, Sugo and Ueda, 2008) and the other does so separately (Fuchi and Watanabe, 2002, Koga and Nishizaki, 2006, Muto and Shintani, 2014). The approach in this study follows the former in that the DSGE model is completely estimated. However, this study may have certain advantages. First, a time variation of structural parameters cannot be estimated using an ordinary method to estimate the DSGE model. Although some recent studies (Farmer et al., 2011, Liu et al., 2011, Iiboshi, 2015) have estimated the Markov-switching (MS) DSGE model, this model cannot be successfully adopted if the sample size in a specific state is extremely small. On the contrary, the impulse response-matching technique can estimate the structural parameters in the DSGE model, even with a small sample size, as our method regards the impulse response functions (IRFs) as data. Compared with the latter, our estimation is desirable at the point of directly estimating the structural parameters. The coefficients in the separate estimation are formulated as a mixture of structural parameters, including price and wage stickiness and the inverse of Frisch labor elasticity. In addition, the components lying outside of the NKPC and NKWPC (e.g., a stance of monetary authority) are ignored.

This study's results are briefly summarized as follows. First, the state dependency of price and wage dynamics is observed. In particular, the response of real wage to demand shock shows a sign switch depending on labor market tightness. Second, as the labor market tightens, price becomes stickier, while wage becomes less sticky. Third, the standard DSGE model can sufficiently replicate the dynamics of the real economy when the labor market is tight. However, as the labor market loosens, the dynamics of the real economy deviates from the prediction of the theoretical model.

The remainder of this paper is organized as follows. Section 2 explains the STVAR model and reports the reduced-form empirical results. In Section 3, we construct the NK-type DSGE model, which is estimated using the Bayesian impulse response matching technique. Section 4 documents the estimation of the DSGE model using the impulse response-matching and then presents the estimates of the structural parameters. Section 5 provides concluding remarks.

2. VAR analysis

2.1. Smoothed transition VAR model

To reveal the variations in price and wage dynamics, depending on labor market tightness, we estimate the STVAR model in which unemployment rate is regarded as a transition variable. The

STVAR model is specified as follows:

$$Y_t = c(t) + \{1 - F(z_{t-1})\}B_0(L)Y_{t-1} + F(z_{t-1})B_1(L)Y_{t-1} + u_t \quad (1)$$

$$u_t \sim N(0, \Sigma_t) \quad (2)$$

$$\Sigma_t = \Sigma_0\{1 - F(z_{t-1})\} + \Sigma_1 F(z_{t-1}) \quad (3)$$

$$F(z_t) = \frac{\exp(-\gamma z_t)}{1 + \exp(-\gamma z_t)}, \gamma > 0 \quad (4)$$

where $c(t)$ is defined to include all the deterministic components of data, $B_i(L)$, $i = 0,1$ is a polynomial in the lag operator, and Σ_i, $i = 0,1$ denotes the variance–covariance matrix of the reduced-form residuals, u_t. $F(z)$, formulated as in equation (4), denotes the transition function with z as a transition variable, which allows the model to smoothly change according to the transition variable value.

As stated in Auerbach and Gorodnichenko (2012), the principal advantage of using the STVAR model, as compared to separately estimating the structural VAR (SVAR) model for each regime, is the utilization of all sample information to estimate a particular regime in which few observations are included. In addition, we also emphasize several advantages relative to the MSVAR and time-varying parameters (TVP) VAR models. Since the coefficients and variance-covariance matrix in the STVAR model smoothly vary by state, we can specify the model at the arbitrary points among the discrete states. For concreteness, we analyze the dynamics of Y_t at the mid-point of the two states by setting $F(z)$=0.5, and this cannot be done using the MSVAR model, wherein the states are perfectly separated. It is difficult to consider that the economy is divided into perfect discrete states, and thus, the STVAR model is more suitable to represent the real economy compared with the MSVAR model. On the other hand, the TVPVAR model describes continuous variations of the estimation model. However, it cannot explicitly answer what causes the time variation of the coefficients and covariance structure. In contrast, the STVAR model relates a transition variable to the variation of parameters in the model, and thus, we obtain the reason underpinning changes in the model throughout the sample period. For example, this study can reveal the relationship between price and wage stickiness and the unemployment rate, allowing for a more sophisticated micro-foundation for the theoretical model; however, this point remains beyond the focus of this study. In short, the STVAR model elucidates the state dependency of the model associated with the variable in which we are interested.

2.2. Identification of structural shocks

Based on the STVAR model mentioned above, we identify labor productivity and monetary policy shocks as supply and demand shocks using the long-run restriction. To achieve the identification of structural shocks and the estimation of structural parameters in the theoretical model, constructed in Section 3, our VAR model comprises the log first difference of real wage (w_t), price (p_t), and monetary base (m_t).[1] Real wage is a proxy of labor productivity. For simplicity, represented by the SVAR model and not the STVAR model, our 3-variables VAR system can be written in the form of a structural vector moving average as follows:

1 The source and construction of data are explained in detail in Section 2.3.

$$\begin{bmatrix} \Delta w_t \\ \Delta p_t \\ \Delta m_t \end{bmatrix} = \begin{bmatrix} C_{11}(L) & C_{12}(L) & C_{13}(L) \\ C_{21}(L) & C_{22}(L) & C_{23}(L) \\ C_{31}(L) & C_{32}(L) & C_{33}(L) \end{bmatrix} \begin{bmatrix} e_t^a \\ e_t^m \\ e_t^{non} \end{bmatrix} \tag{5}$$

where $C(L)$ is a polynomial in the lag operator. The innovations e_t^a, e_t^m, and e_t^{non}, respectively, denote labor productivity shock, monetary policy shock, and non-specified shock; these shocks are assumed to be mutually orthogonal. Following the seminal work of Blanchard and Quah (1989), we impose the restriction that only labor productivity shock has a permanent effect on real wage, that is, $C_{12}(1)=0$ and $C_{13}(1)=0$.[2] Moreover, we allow the labor productivity and monetary policy shocks to have a long-run effect on prices. In other words, a non-specified shock, which is considered as a mixture of all temporary shocks, is assumed to have no long-run effects on prices, that is, $C_{23}(1)=0$. This is based on the theoretical prediction that a monetary policy measure, such as a temporary increase in the growth rate of money or decrease in the short-term interest rate, permanently shifts price level, although it has no permanent effect on inflation rate.

2.3. Data and specification

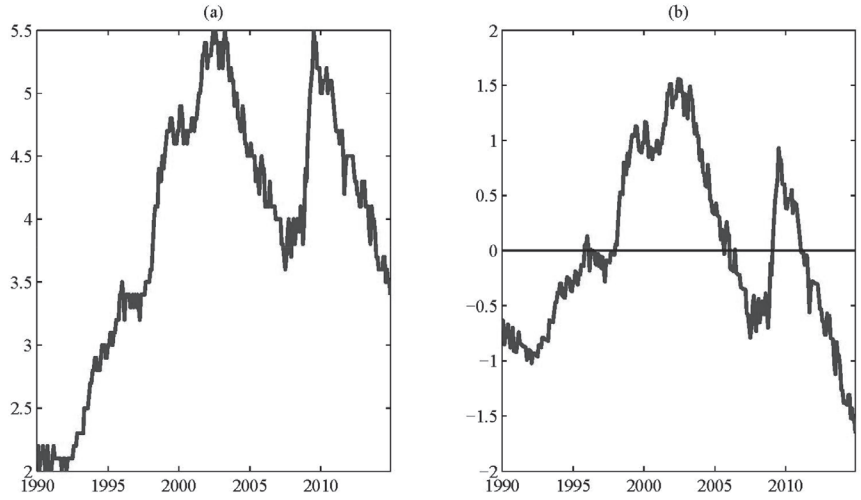
We employ monthly real wage, price, and monetary base data for 1990M1–2014M12. The series of hourly real wage is constructed as follows. First, we obtain the seasonally adjusted series of real wage indices (establishments with five employees or more and total cash earnings) and total hours worked indices (establishments with five employees or more) from the Monthly Labor Survey (Ministry of Health, Labour and Welfare). Second, each index is translated into a real value using the value of the base year. Finally, we calculate hourly real wage by dividing real wage by total hours worked. For price, the series of non-seasonally adjusted Consumer Price Index (CPI) (all items, less fresh food) is downloaded from the CPI (Ministry of Internal Affairs and Communications). We first subtract 1.4% in 1997 and 2.0% in 2014 from the year-on-year inflation rate to eliminate the effects of an increase in consumption tax.[3] Then, we recalculate the level series and perform seasonal adjustments using X-12 ARIMA. The seasonally adjusted series of the monetary base (with adjusted reserve requirement rate change) is collected from the Bank of Japan.

For transition variable z, we use the unemployment rate published in the Labour Force Survey (Ministry of Internal Affairs and Communications). As shown in Figure 1(a), the original series for the unemployment rate has an upward trend in our sample period, and thus we de-trend it by regressing on a constant and linear trend (Figure 1(b)). Furthermore, the data for period t-1 is used to take account of the possibility that labor market tightness cannot be contemporaneously reflected in wage negotiation.

2 Francis and Ramey (2005) also adopt the long-run restriction associated with real wage.

3 These values are based on a trial calculation by the Bank of Japan.

Figure 1: Unemployment rate



Note: Figure 1(a) and 1(b) denote the original series of and the detrended series of unemployment rate, respectively. The original data is obtained from Labor Force Survey. For the detrended series, the linear trend and constant term are excluded from the original series.

In the VAR model, all variables are included in the form of the first difference of the natural logarithm, and a constant term and linear trend are contained as a deterministic component. In addition, the lag length is set as two. This is because the principal aim of the VAR analysis in this study is to obtain the impulse responses necessary to estimate the DSGE model using the impulse response matching technique. Accordingly, we choose two lags as a lag length that can at least capture the dynamics of a system.

2.4. Estimation procedure

The estimation of the STVAR model is implemented using the Bayesian Markov Chain Monte Carlo (MCMC) method, particularly the random-walk Metropolis-Hastings (MH) algorithm. Basically, we follow Auerbach and Gorodnichenko (2012). Let $\tilde{Y}=\{Y_t\}_{t=1}^{T}$ be the sequence of Y_t and $\Theta=[\gamma, \Sigma_0,\Sigma_1, c(t), B_0(L), B_1(L)]$ be the parameters in which we are interested. The posterior log-likelihood for the model is then specified as follows:

$$\ln L\left(\Theta \mid \tilde{Y}\right) = const - \frac{1}{2}\sum_{t=1}^{T} \ln|\Sigma_t| - \frac{1}{2}\sum_{t=1}^{T} u_t'\Sigma_t^{-1}u_t \qquad (6)$$

where $u_t=Y_t-c(t)-\{1-F(z_{t-1})\}\ B_0\ (L)\ Y_{t-1}-F(z_{t-1})\ B_1(L)Y_{t-1}$. Given the above, the estimation procedure of a random-walk MH algorithm is summarized as follows:

1. Derive the posterior mode $\widehat{\Theta}$ to maximize $\ln L(\Theta \mid \tilde{Y})$.
2. Set the initial value $\Theta_0 = \widehat{\Theta}$, and $n = 1$.
3. Draw $\Theta_n^{(\text{proposal})}$ from the following random-walk model:

$$\Theta_n^{(\text{proposal})} = \Theta_{n-1} + \nu_t, \nu_t \sim N(0, cH),$$

4. Calculate the acceptance rate q using $\Theta_n^{\text{proposal}}$ and Θ_{n-1} as follows:

$$q = \min\left[\frac{f\left(\Theta_n^{(\text{proposal})} \mid \tilde{Y}\right)}{f\left(\Theta_{n-1} \mid \tilde{Y}\right)}, 1\right].$$

5. Accept $\Theta_n^{(\text{proposal})}$ with probability q and reject it with probability $1 - q$. Set $\Theta_n = \Theta_n^{(\text{proposal})}$ when accepted and $\Theta_n = \Theta_{n-1}$ when rejected.
6. Set $n = n + 1$ and return to Step 3 until the number of iterations reaches N times.

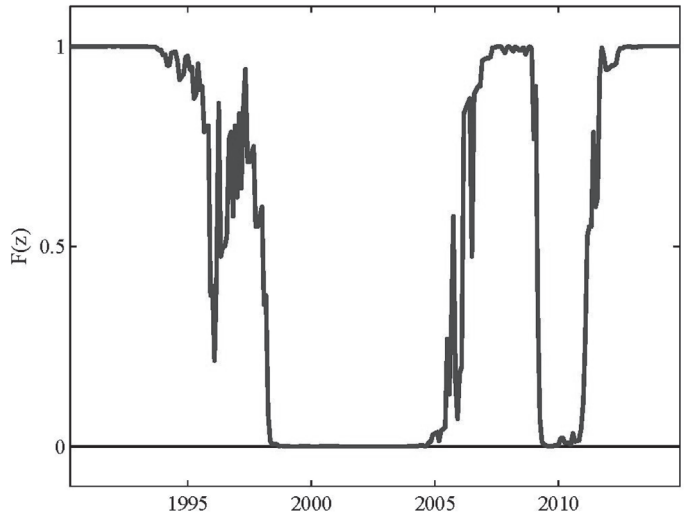
In the actual estimation, we randomly generate only Θ'=[γ, *chol*(Σ_0), *chol*(Σ_1)] because, given Θ', the lag polynomials [B_0 (*L*), B_1 (*L*)] can be estimated with weighted least squares to maximize ln *L*(Θ | $\tilde{Y}$). Moreover, this simplification saves the time necessary for convergence.

In this study, *N* is set to be 120,000 and the first N_0 = 20,000 samples are discarded as a burn-in. To ensure the stationarity of the VAR system, the unit circle is selected only for draws within which the roots of the lag polynomials [B_0 (L), B_1 (0)] are present. With respect to the priors, the gamma distribution is associated with γ. In the benchmark, we set the mean and standard deviation of the prior to 10 and 0.1.

2.5. Impulse response function

Figure 2 shows the estimated transition probability, *F*(*z*), and indicates that the higher the transition probability, the more the labor market tightness. The figure also allows us to understand labor market transition in Japan. As shown, the degree of tightness in the labor market is still high just after the economic bubble burst in the early 1990s, but it gradually declines. The state then falls *F*(*z*) = 0 (i.e., low tightness state) perfectly from the second half of the 1990s to the first half of the 2000s. Thereafter, the labor supply and demand situation improve by benefiting from the economic recovery in the 2000s. However, after the temporary economic deterioration by the Lehman shock, it tightens again because of the Great East Japan earthquake and the economic stimulus policy implemented by Prime Minister Shinzo Abe, or the so-called "Abenomics."

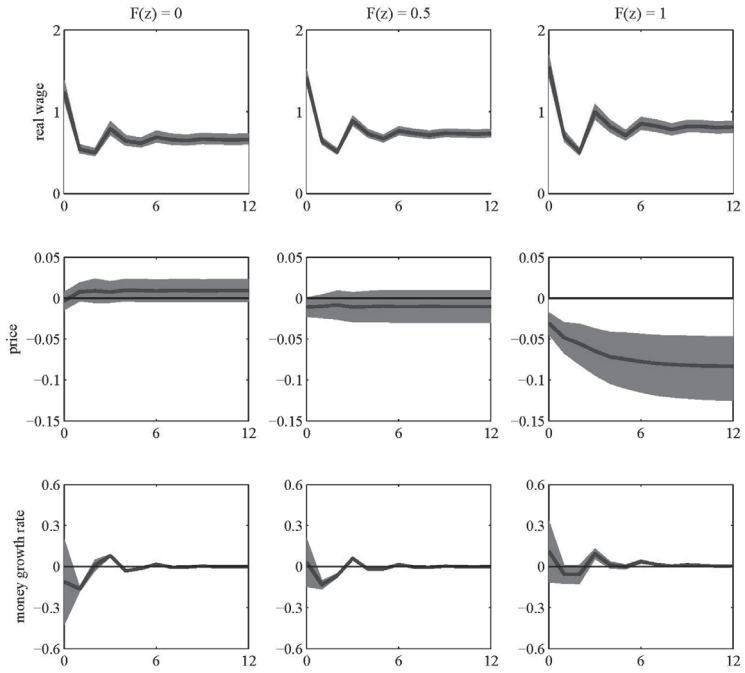
Figure 2: Estimated transition probability



Figures 3 and 4 depict the IRFs to supply and demand shocks at the state of $F(z)$=0,0.5, and 1. The solid lines and shaded areas denote the median of sampled IRFs and 90% Bayesian credible intervals. At first glance, we observe that the signs of several responses switch depending on labor market tightness. The most notable is a response of real wage to demand shock, where the response changes from negative to positive as the labor market tightens. This result indicates the possibility that the structure of price and wage dynamics, that is, the structural parameters of a real economy, alters according to labor market tightness.

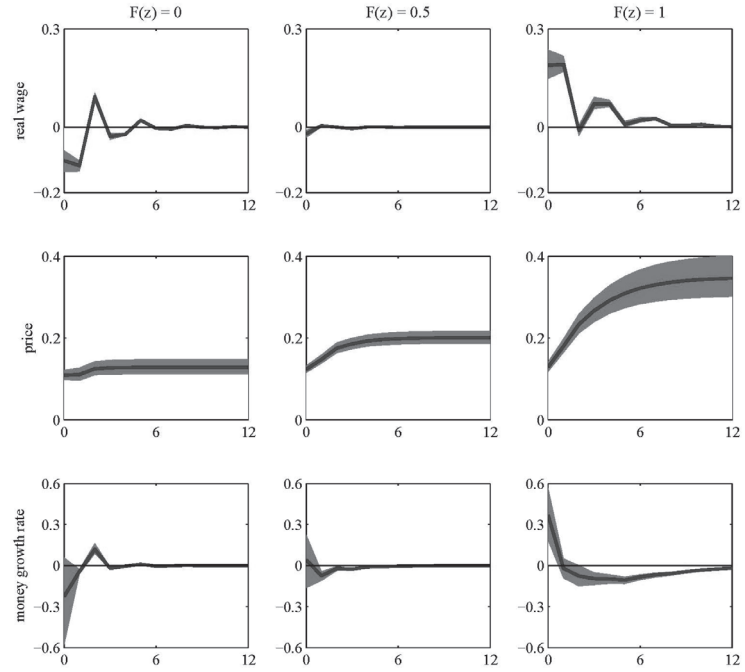
In addition, we also recognize that the sign of some responses at $F(z)$=0 is opposite to a normal prediction of the standard theoretical model. For instance, the most prominent one is a positive (but insignificant) response of price to supply shock, as shown in the middle-left chart of Figure 3. A negative response of money growth rate to both shocks also seems to be counterintuitive because the standard model, generally, presumes that both shocks stimulate consumption and, as a result, increase money demand. Consequently, as mentioned in Section 4, the calculated IRFs at $F(z)$=0 using the DSGE model do not effectively trace the VAR model. On the other hand, the responses at $F(z)$=1 are consistent with the usual expectation: a permanent labor productivity shock reduces price, while a monetary policy shock increases price and money growth rate. Furthermore, we find that a positive demand (monetary policy) shock increases real wage and price levels. The responses at $F(z)$=0.5 are in the center of the two extreme cases. The impact of responses seems weak compared with $F(z)$=0 and $F(z)$=1, especially in the responses of prices to supply shock and real wage to demand shock. Below, we estimate the value of structural parameters for each state via the impulse response matching technique using the IRFs obtained in this section.

Figure 3: Responses of variables to supply shock



Note: Solid lines and shaded areas indicate the median responses and 90% credible intervals, respectively.

Figure 4: Responses of variables to demand shock



Note: Solid lines and shaded areas indicate the median responses and 90% credible intervals, respectively.

3. Theoretical model

To interpret the (reduced-form) empirical results obtained from the VAR analysis in a structural manner, we estimate the DSGE model using the impulse response matching technique. This section presents the simple NK model employed in the Bayesian estimation.

The NK model in this study comprises Calvo-type (1983) sticky prices and wages, price and wage indexation, consumption habit, money growth rate, and no capital.[4] To capture the situation in which the Bank of Japan has been setting the policy rate to be almost zero and adopting quantitative easing (QE) after the second half of the 1990s, we employ a money growth rule as a monetary policy rule instead of the Taylor rule. Since the focus of this study is to ascertain the state dependency of price and wage dynamics, price and wage indexation is incorporated into the model. Furthermore, the stochastic process of permanent technology and transitory monetary policy shocks is introduced as a counterpart of supply and demand shocks in the VAR analysis.

3.1. Households

The economy consists of a unit mass of identical households indexed by $i \in [0,1]$. The utility maximization problem of each household can be written as follows:

$$\max U = E_0 \sum_{t=0}^{\infty} \left[\frac{\left\{ c_{t(i)} - h c_{t-1}(i) \right\}^{1-\gamma}}{1-\gamma} + \frac{m_t(i)^{1-\mu}}{1-\mu} - \frac{n_t(i)^{1+\phi}}{1+\phi} \right] \tag{7}$$

subject to

$$c_t(i) + m_t(i) + b_t(i) = \frac{W_t(i)}{P_t} n_t(i) + \frac{m_{t-1}(i)}{\Pi_t} + \frac{R_{t-1}}{\Pi_t} b_{t-1}(i) + d_t(i) \tag{8}$$

where the uppercase and lowercase letters denote nominal and real variables. The household obtains positive utility from consumption c, and real money holdings m and a negative utility from hours worked n. In return, the budget constraint represents that a household allocates the sum of real labor income $\frac{W_t(i)}{P_t} n_t(i)$; inflation-adjusted money holding $\frac{m_t}{\Pi_t}$; inflation-adjusted total sum of bond and its interest payment $\frac{R_{t-1}}{\Pi_t} b_{t-1}(i)$; and real dividends d_t to consumption, money holdings, and bond. Here, P, Π, and R denote aggregate price, inflation rate, and gross nominal interest rate, respectively. Based on this optimal problem, each household chooses the optimal level of consumption and money holdings.

3.2. Labor market and wage setting

To introduce wage stickiness, we assume a continuum of differentiated labor input indexed by $l \in [0,1]$. Furthermore, it is assumed that there exist labor unions corresponding to each differentiated

4 Watanabe (2009) emphasizes the importance of the consumption habit in Japan.

labor input, and each union sets their wage rate. As adopted in Schmitt-Grohe and Uribe (2006), each household member is assumed to provide each possible type of labor input. In other words, each household belongs to every labor union. This assumption rules out the possibility that each household receives different labor income in equilibrium without adopting a contingent claim. In addition, as adopted in Gaíl et al. (2007), labor supply is assumed to be determined by labor demand (not by the optimal choice of households), given a wage fixed by the labor union.

A perfectly competitive labor-bundler firm bundles differentiated labor input $n_t(l)$ into effective labor denoted by n_t as follows:

$$n_t = \left[\int_0^1 n_t(l)^{\frac{\varepsilon_w - 1}{\varepsilon_w}} dl\right]^{\frac{\varepsilon_w}{\varepsilon_w - 1}} \tag{9}$$

where ε_w denotes the elasticity of substitution among labor inputs. As a result of the labor bundler's optimal problem, the demand function for each differentiated labor input is expressed as

$$n_t(l) = \left(\frac{W_t(l)}{W_t}\right)^{-\varepsilon_w} n_t \tag{10}$$

Then, aggregate nominal wage is equal to

$$W_t = \left[\int_0^1 W_t(l)^{1-\varepsilon_w} dl\right]^{\frac{1}{1-\varepsilon_w}} \tag{11}$$

Given the demand function for labor input l, the labor union sets its nominal wage $W_t(l)$ to maximize the lifetime utility of each household. Under the Calvo-type (1983) wage stickiness, it is assumed that the fraction $1-\rho_w$ of labor unions can reset the optimal nominal wage $W_t^*(l)$ in each period. The rest of the labor unions, which do not obtain an opportunity to re-optimize their nominal wage, sets $W_t(l)$ according to

$$W_t(l) = \left(\frac{P_{t-1}}{P_{t-2}}\right)^{\gamma_w} W_{t-1}(l) \tag{12}$$

where γ_w is a degree of wage indexation. The optimal problem for wage union l can then be written as

$$\max_{W_t^*(l)} E_t \sum_{s=0}^{\infty} \rho_w^s \Lambda_{t,t+s} \left[\frac{\{c_{t+s}(l) - hc_{t+s-1}(l)\}^{1-\gamma}}{1-\gamma} + \frac{m_{t+s}(l)^{1-\mu}}{1-\mu} - \frac{n_{t+s}(l)^{1+\phi}}{1+\phi}\right] \tag{13}$$

subject to

$$c_{t+s}(l) + m_{t+s}(l) + b_{t+S}(l) = \int_0^1 \frac{\left(\frac{P_{t+s-1}}{P_{t-1}}\right)^{\gamma_w} W_t^*(l)}{P_{t+s}} n_{t+S}(l)\, dl + \frac{m_{t+s-1}(l)}{\Pi_{t+s}} + \frac{R_{t+s-1}}{\Pi_{t+s}} b_{t-1}(l) + d_{t+s}(l) \tag{14}$$

and

$$n_{t+s}(l) = \left\{ \frac{\left(\frac{P_{t+s-1}}{P_{t-1}}\right)^{\gamma_w} W_t^*(l)}{W_{t+s}} \right\}^{-\varepsilon_w} n_{t+s} \tag{15}$$

where $\Lambda_{t,t+S} = \beta^s \left(\frac{c_{t+s}}{c_t}\right)^{-1}$ denotes the stochastic discount factor. From equations (11) and (12), the law of motion of aggregate wages can be given as

$$W_t = \left[(1-\rho_w) W_t^{*1-\varepsilon_w} + \rho_w \left\{ \left(\frac{P_{t-1}}{P_{t-2}}\right)^{\gamma_w} W_{t-1} \right\}^{1-\varepsilon_w} \right]^{\frac{1}{1-\varepsilon_w}} \tag{16}$$

3.3. Firm

The production sector comprises two types of firms: monopolistically competitive firms that produce differentiated intermediate goods and perfectively competitive firms that produce single final goods using intermediate goods as input. Each intermediate goods firm indexed by $j \in [0,1]$ produces an intermediate good $y_t(j)$, and its production function is simply assumed to be a linear function:

$$y_t(j) = a_t n_t(j) \tag{17}$$

where a_t denotes the total factor productivity (TFP), which is exogenously given. As a result of the profit maximization problem for intermediate goods firms, we simply obtain real marginal cost mc_t as follows:

$$mc_t = \frac{w_t}{a_t}. \tag{18}$$

On the other hand, the final goods firms transform intermediate goods to final goods using the following Dixit–Stiglitz-type production function:

$$y_t = \left[\int_0^1 y_t(j)^{\frac{\varepsilon_p - 1}{\varepsilon_p}} dl\right]^{\frac{\varepsilon_p}{\varepsilon_p - 1}} \tag{19}$$

where ε_p is the elasticity of substitution across each type of intermediate goods. Then, the demand function for intermediate goods is obtained as

$$y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\varepsilon_p} y_t \tag{20}$$

and the final goods pricing rule is written as

$$P_t = \left[\int_0^1 P_t(j)^{1-\varepsilon_p} dj\right]^{\frac{1}{1-\varepsilon_p}} \tag{21}$$

3.4. Price setting

As with wage setting, intermediate goods firms set their prices according to the Calvo (1983) mechanism with price indexation. For any given period t, the fraction $1-\rho_p$ of intermediate goods firms can revise their prices to the optimal price level $P_t^*(j)$, whereas the fraction ρ_p does not have the opportunity to reset their price and set their prices as

$$P_t(j) = \left(\frac{P_{t-1}}{P_{t-2}}\right)^{\gamma_p} P_{t-1}(j) \tag{22}$$

where γ_p indicates a degree of price indexation. The optimal price $P_t^*(j)$ is determined by solving the problem:

$$\max_{P_t^*(j)} E_t \sum_{s=0}^{\infty} \rho_p^s \Lambda_{t,t+s} \left[\left(\frac{P_{t+s-1}}{P_{t-1}}\right)^{\gamma_p} P_t^*(j) y_{t+s}(j) - P_{t+s} y_{t+s}(j) mc_{t+s}(j)\right] \tag{23}$$

subject to

$$y_{t+s}(j) = \left(\frac{\left(\frac{P_{t+s-1}}{P_{t-1}}\right)^{\gamma_p} P_t^*(j)}{P_{t+s}}\right)^{-\varepsilon_w} y_{t+s}. \tag{24}$$

As in wage setting, the law of motion of aggregate prices can be written as

$$P_t = \left[(1-\rho_p) P_t^{*1-\varepsilon_p} + \rho_p \left\{ \left(\frac{P_{t-1}}{P_{t-2}} \right)^{\gamma_p} P_{t-1} \right\}^{1-\varepsilon_p} \right]^{\frac{1}{1-\varepsilon_p}}. \quad (25)$$

3.5. Rest of the model

With respect to the monetary policy, we assume that the monetary authority adopts the money growth rule as follows:

$$M_t = exp\{\nu_t\} M_{t-1} \Leftrightarrow m_t = exp\{\nu_t\} \frac{m_{t-1}}{\Pi_t}. \quad (26)$$

Here, ν_t denotes the money growth rate, which depends on its own lags and inflation rate, such as

$$\hat{\nu}_t = \rho_m \hat{\nu}_{t-1} - \psi_p \hat{\pi}_t + \varepsilon_t^m \quad (27)$$

where a hat means a log deviation from a steady state value, and ε_t^m is a monetary policy shock that follows an i.i.d. normal distribution. On the other hand, the stochastic process of TFP is assumed to follow the random-walk process:

$$\ln a_t = \ln a_{t-1} + \varepsilon_t^a \quad (28)$$

Finally, the market clearing condition in this study is given by

$$y_t = c_t \quad (29)$$

because our model ignores the government sector.

3.6. Log-linearized de-trended equilibrium conditions

To eliminate a stochastic trend and ensure model stationarity, we divide real variables c_t, y_t, and W_t / P_t by the productivity a_t. Let $\tilde{x}_t$ indicate the log deviations of a stationary variable from its steady states. The log-linearized de-trended equilibrium conditions in our model are summarized as the following nine equations:

$$\frac{1}{1+h} E_t \tilde{c}_{t+1} + \frac{1-h}{\gamma(1+h)} E_t \hat{\pi}_{t+1} - \frac{1-h}{\gamma(1+h)} \hat{r}_t - \frac{h}{1-h} \hat{a}_t = \tilde{c}_t - \frac{h}{1+h} \tilde{c}_{t-1} - \frac{h}{1-h} \hat{a}_{t-1} \quad (30)$$

$$\frac{\beta}{1+\beta\gamma_p} E_t \hat{\pi}_{t+1} = \hat{\pi}_t - \frac{\gamma_p}{1+\beta\gamma_p} \hat{\pi}_{t-1} - \frac{(1-\rho_p)(1-\rho_p\beta)}{\rho_p(1+\beta\gamma_p)} \tilde{w}_t \quad (31)$$

$$\Gamma\beta E_t\tilde{w}_{t+1} + \Gamma\beta E_t\,\hat{\pi}_{t+1} + \Gamma\kappa_w\phi\hat{n}_t + \left(\Gamma\beta + \frac{\Gamma\kappa_w\gamma}{1-h} - 1\right)\hat{a}_t$$

$$= \tilde{w}_t - \left(\frac{\Gamma\kappa_w\gamma}{1-h}\right)\tilde{c}_t + \Gamma(1+\beta\gamma_w)\hat{\pi}_t - \Gamma\,\tilde{w}_{t-1} + \left(\frac{\Gamma\kappa_w\gamma h}{1-h}\right)\tilde{c}_{t-1} \tag{32}$$

$$- \Gamma\gamma_w\hat{\pi}_{t-1} - \Gamma\left(1 - \frac{\kappa_w\gamma h}{1-h}\right)\hat{a}_{t-1}$$

$$\tilde{y}_t = \tilde{c}_t \tag{33}$$

$$\tilde{y}_t - \hat{n}_t = 0 \tag{34}$$

$$\mu\hat{m}_t + \frac{1}{\mathrm{R}-1}\hat{r}_t = \frac{\gamma}{1-h}\tilde{c}_t - \frac{h\gamma}{1-h}\tilde{c}_{t-1} + \frac{\gamma}{1-h}\hat{a}_t - \frac{h\gamma}{1-h}\hat{a}_{t-1} \tag{35}$$

$$\hat{m}_t - \hat{v}_t = \hat{m}_{t-1} - E_t\hat{\pi}_{t+1} \tag{36}$$

$$\hat{v}_t = \rho_m\hat{v}_{t-1} - \psi_p\hat{\pi}_t + \varepsilon_t^m \tag{37}$$

$$\hat{a}_t = \hat{a}_{t-1} + \varepsilon_t^a \tag{38}$$

where $\Gamma=\rho_w/(1+\beta\rho_w^2)$ and $\kappa_w=(1-\beta\rho_w)(1-\rho_w)/\rho_w$.

4. Structural estimation

4.1. Methodology

The presented DSGE model is estimated using the Bayesian minimum distance technique (i.e., impulse response matching), as adopted in Altig et al. (2011), Christiano et al. (2011), and Hofmann et al. (2012). More specifically, the structural parameters in the DSGE model are derived to minimize the distance between the IRFs obtained from the VAR and DSGE models. Since we estimate the VAR model using the Bayesian method, there is no estimated point at which we can match the IRFs, calculated using the DSGE model. Hence, we regard the median of the sampled IRFs, shown in Figure 3 and 4, as reference points to minimize the distance from the theoretical responses.

Following the description of Christiano et al. (2011), let $\hat{\Psi}$ be the stacked vector of the sampled IRFs, which has a dimension of 12 (number of horizons) times 2 (number of shocks) times 3 (number of variables). For the number of observations T, the standard asymptotic theory says that

$$\sqrt{T}\left(\hat{\psi} - \psi(\theta_0)\right) \sim N\left(0, W(\theta_0, \zeta_0)\right) \tag{39}$$

where θ_0 indicates the true values of the parameters and ζ_0 denotes those of the parameters of shocks that are in the model. As noted in Christiano et al. (2011), ζ_0 does not formally appear in this analysis. Given the above, the asymptotic distribution of $\hat{\Psi}$ can be written as

$$\hat{\psi} \sim N\big(\psi(\theta_0), V(\theta_0, \zeta_0, T)\big), \tag{40}$$

where

$$V(\theta_0, \zeta_0, T) \equiv \frac{W(\theta_0, \zeta_0)}{T}. \tag{41}$$

Subsequently, we regard $\hat{\Psi}$ as data, and then the approximate likelihood of the data $\hat{\Psi}$ as a function of θ can be written as

$$f\big(\hat{\psi} \mid \theta\big) = \left(\frac{1}{2\pi}\right)^{\frac{N}{2}} \mid V(\theta_0, \zeta_0, T) \mid^{-\frac{1}{2}} \times exp\left[-\frac{1}{2}\left(\hat{\psi} - \psi(\theta_0)\right)' V(\theta_0, \zeta_0, T)^{-1} \left(\hat{\psi} - \psi(\theta_0)\right)\right], \tag{42}$$

where N denotes the number of elements in $\hat{\Psi}$. With respect to the matrix V, its estimator $\hat{V}$ is set to depend on the second moments of the sample impulse response function. More precisely, we use the matrix that has on its diagonal the diagonal elements of

$$\bar{V} = \frac{1}{M}\sum_{i=1}^{M}(\psi_i - \bar{\psi})(\psi_i - \bar{\psi})' \tag{43}$$

as $\hat{V}$ based on Christiano et al. (2011). Here, $\overline{\Psi}$ is a median of the sampled IRFs and M is the number of samples. Given the likelihood of $\hat{\Psi}$, as represented in (43), the Bayesian posterior distribution of θ conditioned on $\hat{\Psi}$ and $\hat{V}$ is specified by

$$f\big(\theta \mid \hat{\psi}\big) = \frac{f\big(\hat{\psi} \mid \theta\big)p(\theta)}{f\big(\hat{\psi}\big)} \tag{44}$$

where $p(\theta)$ indicates the priors for θ, and $f(\hat{\Psi})$ denotes a marginal density of $\hat{\Psi}$. Based on equation (44), we estimate the structural parameters in the DSGE model using a random-walk MH algorithm, as explained in Section 2.4.

4.2. Results

Table 1 reports the priors and posteriors of the estimated parameters for the states of $F(z)$=0, $F(z)$=0.5, and $F(z)$=1. The other parameters are fixed as follows. The discount factor is set as β= 0.999 because the interest rate in the sample period is markedly low due to the zero-interest rate

policy and QE.[5] The preference parameters are chosen as γ=1.5, μ=1, and ϕ=1. The values of the fixed parameters and priors depend on previous studies.

From the result of Table 1, we first observe a drastic variation of structural parameters according to the labor market state. For example, the price stickiness parameter changes from 0.01 at $F(z)$=0 to 0.67 at $F(z)$=1, while the wage stickiness parameter changes from 0.32 to 0.01.[6] These variations suggest the necessity of considering the relationship between price and wage dynamics and labor market tightness. Accordingly, this result indicates the possibility that the labor market condition affects the price and wage decision. In return, the indexations of price and wage are estimated as considerably small and stable through all the states, and this is consistent with Muto and Shintani's (2014) results.[7] Compared with the estimated results for the United States, as reported by Hofmann et al. (2012), this degree of price and wage indexation in Japan is substantially modest. This finding (i.e., the indexation in Japan is smaller than that in the United States) also conforms to the claims in Kuroda and Yamamoto (2007) and Muto and Shintani (2014).

Subsequently, we focus on the state dependency of price and wage stickiness. As mentioned above, price stickiness tends to be high as the labor market becomes tight. For the price stickiness, if we regard the period of $F(z)$=1 as an economic boom, this result implies that it is unlikely that the price will rise in response to an increase in demand resulting from economic recovery. On the contrary, it seems to be easy to downwardly adjust a price to a decrease in demand when $F(z)$=0. This result accords with the Japanese economy's experience in the "lost two decades," that is, long-lasting deflation. On the other hand, wage is stickier when the labor supply and demand situation is loose. This is also consistent with a phenomenon called the downward rigidity of wage, as indicated in Kuroda and Yamamoto (2007).

Finally, we mention the parameters in the monetary policy rule. One can confirm that the monetary authority takes an active stance at $F(z)$=0, in which the sample from the second half of the 1990s to the 2000s is mainly included. Accordingly, reflecting the adoption of the QE policy, the monetary policy at the time was more persistent and aggressive to deflation.

5 Under β=0.999, the net nominal interest rate is assumed to equal 0.01.

6 The estimates of price and wage stickiness in this study are somewhat small compared with the results reported in previous studies (Iiboshi et al., 2006, Sugo and Ueda, 2008). It can be considered that this difference emanates from the variation in the sample period. The sample period in the extant literature is restricted to the late 1990s to avoid the period of zero lower bound on nominal interest rate. In fact, the estimated result in Muto and Shintani (2014), who adopted 1980–2013 as the sample period, is similar to ours.

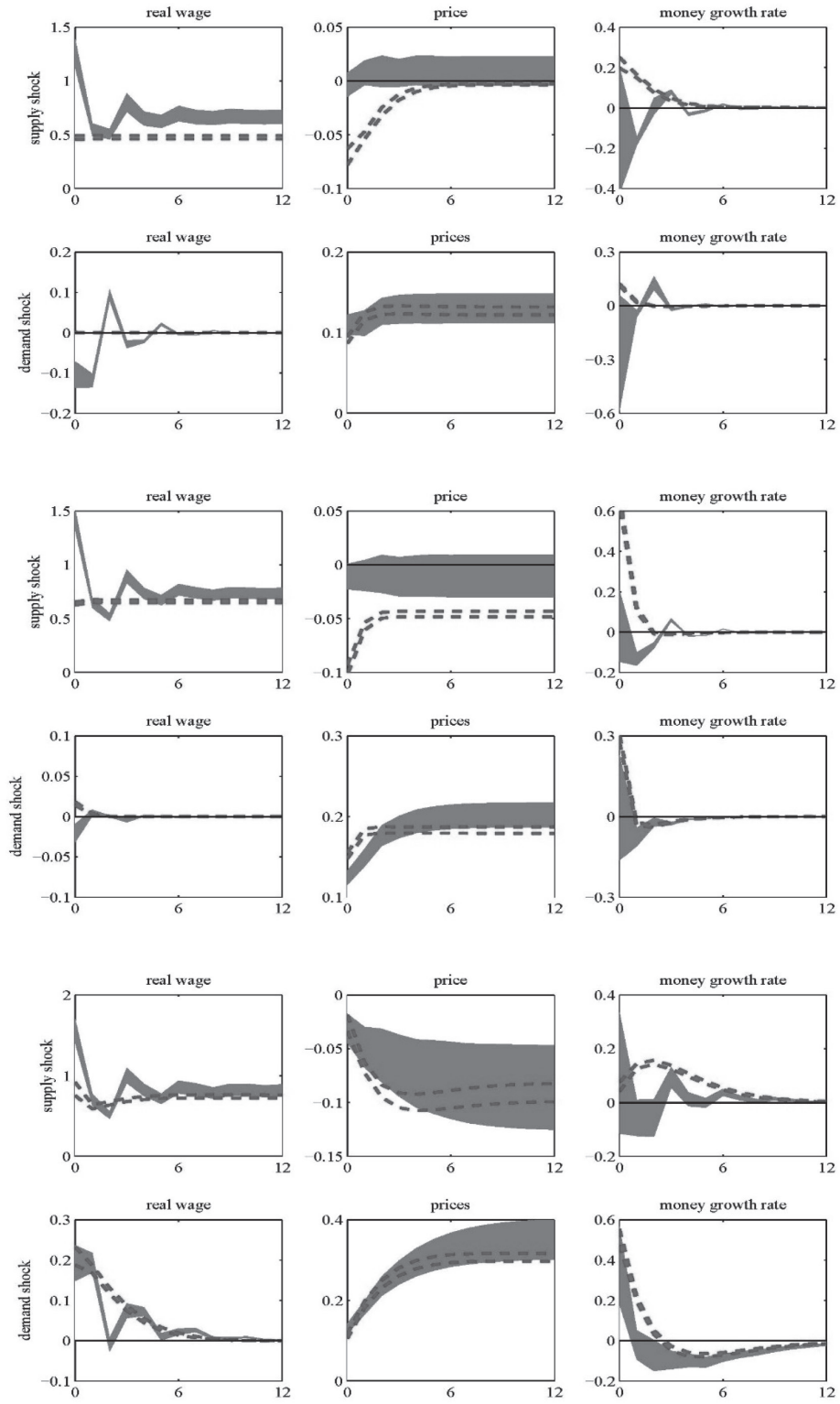
7 Although the median values of price indexation at $F(z)$=0 and wage indexation at $F(z)$=1 seem to be large, the credible intervals associated with these parameters are significantly wide. Hence, we consider these values as largely insignificant.

Table 1: Prior and posterior estimates of the DSGE model

		Prior		Posterior		
				$F(z)=0$	$F(z)=0.5$	$F(z)=1$
		Density	Mean	Median	Median	Median
		[bounds]	(Std. dev.)	[5%, 95%]	[5%, 95%]	[5%, 95%]
γ_p	Price indexation	Beta	0.5	0.30	0.02	0.01
		[0,1]	(0.2)	[0.03, 0.85]	[0.00, 0.06]	[0.00, 0.04]
γ_w	Wage indexation	Beta	0.5	0.02	0.02	0.22
		[0,1]	(0.2)	[0.00, 0.09]	[0.00, 0.06]	[0.02, 0.77]
ρ_p	Price Stickiness	Beta	0.75	0.01	0.10	0.67
		[0, 0.99]	(0.15)	[0.00, 0.34]	[0.09, 0.12]	[0.66, 0.69]
ρ_w	Wage Stickiness	Beta	0.75	0.32	0.16	0.10
		[0, 0.99]	(0.15)	[0.31, 0.34]	[0.15, 0.17]	[0.04, 0.19]
h	Consumption habit	Beta	0.7	0.57	0.12	0.59
		[0, 1]	(0.1)	[0.53, 0.59]	[0.08, 0.16]	[0.54, 0.63]
ρ_m	Persist. of MP shock	Beta	0.7	0.99	0.58	0.75
		[0, 0.99]	(0.2)	[0.98, 0.99]	[0.57, 0.60]	[0.72, 0.78]
ψ_p	MP rule	Gamma	0.5	3.18	6.80	2.23
		[0, ∞]	(0.1)	[2.91, 3.46]	[6.35, 7.30]	[2.03, 2.47]
σ_s	Std. dev. Tech. shock	Inv. Gamma	1	0.48	0.66	0.74
		[0, ∞]	(0.5)	[0.46, 0.50]	[0.64, 0.68]	[0.72, 0.76]
σ_d	Std. dev. Dem. shock	Inv. Gamma	1	0.41	1.32	0.76
		[0, ∞]	(0.5)	[0.37, 0.44]	[1.24, 1.42]	[0.69, 0.84]

Figure 5 shows the 90 percentiles of the IRFs of the DSGE model and those from the VAR analysis. The red dotted lines and shaded areas indicate the credible intervals corresponding to the DSGE and VAR models, respectively. As can be seen from Figure 5(c), the IRFs obtained from the DSGE model correspond fairly well with those from the VAR model at $F(z)$=1. However, as the labor market loosens, the deviation between theoretical and empirical responses gradually spreads. At $F(z)$=0, the theoretical responses almost completely fail to trace the empirical response, except for the response of price to demand shock. This finding indicates the possibility that it may be difficult to describe the Japanese economy from the second half of the 1990s to the first half of the 2000s using the standard DSGE model. In other words, the Japanese economy in this period is a unique situation not to be explained by the standard DSGE model. Therefore, we will have to investigate Japan-specific factors that cause the real economy to become estranged from the theoretical prediction. Unfortunately, this is beyond the focus of this study and thus, we hope to address this in the future.

Figure 5: Impulse responses of VAR and DSGE model for $F(z)$=0,0.5,and 1.



5. Conclusion

In this study, we analyzed price and wage dynamics in Japan by accounting for the labor market. Combining the reduced-form results derived from the STVAR model and the structural analysis using impulse response matching technique, we estimated the structural parameters in the Japanese economy based on labor market tightness. The main findings are summarized as follows.

First and most importantly, price and wage dynamics change according to labor market tightness. The sign of several IRFs in reduced-form analysis switches as the labor market tightens, and thus, the structural parameters characterizing price and wage dynamics also show a drastic variation. Second, it is found that price becomes stickier, while wage becomes less sticky as the labor market becomes tight. The former is consistent with the historical fact that it is difficult for firms to raise price in response to an increase in demand, even in an economic boom. On the other hand, the latter is in accord with the downward rigidity of wage, which is often mentioned in Japan. Related to price and wage rigidity, it also turns out that the indexation in price and wage in Japan is quite modest. Third, the standard DSGE model fairly replicates the dynamics of the Japanese economy when the labor market is tight. However, as the labor market loosens, its explanatory power to describe the real economy seems to gradually dampen.

Nevertheless, this study has certain limitations. As stated above, it reveals the state dependency of price and wage dynamics; however, the theoretical model that we estimate captures the differences in the dynamics that exogenously stem from the labor market situation. Therefore, in an extension of this study, we will attempt to construct a theoretical model in which the price and wage decision is endogenously determined based on labor market tightness. Enhancing the ability of the DSGE model to explain the real economy will allow us to better understand the structure of the Japanese economy.

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Macroeconomic Shocks and Firms' Overseas Expansion: Evidence from the Factor-Augmented VAR Approach*

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Abstract

This paper analyzes the effects of macroeconomic variations, such as exchange rate and global GDP, on Japanese firms' overseas expansion behaviors. Particularly, we examine how macroeconomic shocks affect the number of overseas subsidiaries of individual firms under the framework of the factor-augmented VAR (FAVAR) model. Moreover, we combine the Tobit and FAVAR models to incorporate firms that own no overseas subsidiaries into our empirical analysis. The results can be summarized as follows. First, we show that most firms increase overseas subsidiaries in response to the appreciation of the exchange rate. However, the results of forecast error variance decomposition show that, compared with the exchange rate, global GDP shocks play a more important role in the variation of Japanese firms' overseas expansion. Additionally, our results indicate that the variation of the exchange rate has only a temporary effect on overseas expansion behaviors.

Keywords: exchange rate, overseas affiliate, factor-augmented VAR model, Tobit model

JEL classification: **F31, F44, C32**

1. Introduction

The causality between the variation of the exchange rate and foreign direct investment (FDI) flows has been verified by many existing studies. A large stream of empirical studies has focused on the first and second moments of the exchange rate, that is, how the depreciation or devaluation of the host country's currency is associated with FDI inflows into the country or how exchange rate volatility would affect FDI inflows.

Several studies have empirically examined the effects of the exchange rate on FDI (Froot and Stein 1991; Klein and Rosengren 1994; Blonigen 1997; Bayoumi and Lipworth 1998; Goldberg and Klein 1998; Ito 2000; Sazanami and Wong 1997; Sazanami et al. 2003; Kiyota and Urata 2004). However, among the few studies that focused on the impacts of exchange rate volatility, the findings are mixed. For instance, Cushman (1985 and 1988) and Goldberg and Kolstad (1995) find a positive impact of exchange rate volatility on FDI, while Urata and Kawai (2000) and Bénassy-Quéré, Fontagné and Lahrèche-Révil (2001) find a negative impact.

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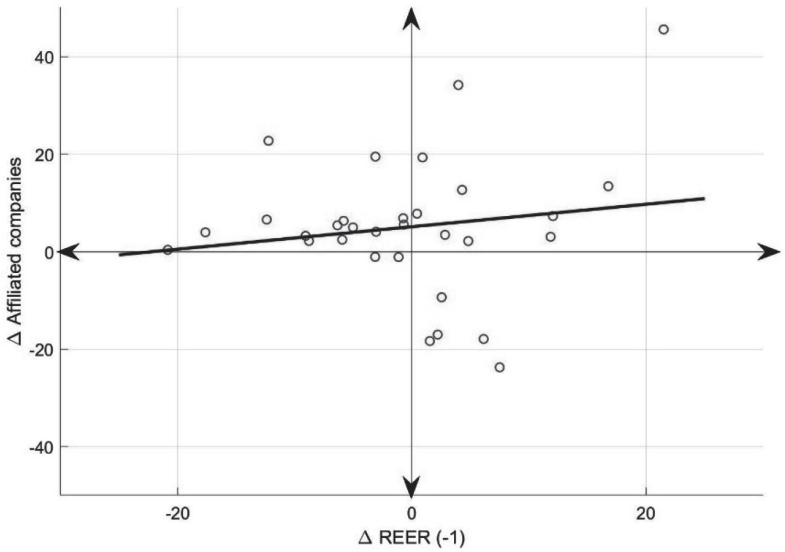
There are at least two reasons for the mixed results concerning the impacts of exchange rate volatility on FDI. One reason is the aggregation problem, as suggested by Kiyota and Urata (2004). [1] Most previous studies use aggregated national- or industry-level data without further breakdowns. However, as shown by Froot and Stein (1991) and Sazanami et al. (2003), the analysis of national-level data may result in ambiguous results because exchange rate volatilities among industries may offset one another. Similarly, industry-level data may also be too aggregated. As Melitz and Redding (2014) indicate, there is only a limited number of firms within an industry or area that choose to be engaged in FDI. Therefore, the aggregated index cannot differentiate the heterogeneity of FDI firms from that of non-FDI firms. To better capture the impact of the exchange rate on firms' decision making for overseas investments, we combine firm-level data from the Toyo Keizai's Overseas Japanese companies' database with financial information from Nikkei Needs Financial Quest, while also controlling for other macroeconomic factors.

Figure 1: Correlation between the number of Japanese firms' overseas affiliates and the real effective exchange rate (authors' calculation based on the Basic Survey on Overseas Business Activities).



Further, we use the number of foreign affiliates owned by individual Japanese firms as a proxy for FDI. [2] From Figure 1, the relationship between the number of Japanese firms' overseas affiliates and real effective exchange rate (REER) seems positive. Although firm-level data can help overcome the heterogeneity issue, when we use these data, all firms in the sample will be faced with the same exchange rate at a certain time point. This approach will complicate our identification because the impact of the exchange rate on FDI will be contaminated by other macroeconomic factors. Using firms' historical export/import data, previous studies attempt to derive the ease with which firms can react to exchange rate variations and then control for it as a proxy of firm heterogeneity so that the

1 Kiyota and Urata (2004) use industry-level outward FDI data on Japan for analysis.

2 It has been argued that the revenue-weighted index of each overseas affiliate would be a more reasonable proxy; however, we do not have access to information on affiliates. We will consider analyzing this issue in future studies.

impact of the exchange rate can be singled out (e.g., Klein et al. 2003; Moser et al. 2010; Nucci and Pozzolo 2010).

Analogous to these studies, we apply the FAVAR model proposed by Bernanke et al. (2005). Specifically, we extract one unobserved factor from the number of overseas affiliates of each manufacturing firm and then estimate the VAR model that builds on this single factor and additional macroeconomic variables. By applying this method, we can clarify the dynamic relationship between the factor and macro variables, as well as that between the factor and the number of an individual firm's overseas affiliates. Furthermore, unlike previous studies on the static relationship between exchange rate volatility and one-time FDI, this paper attempts to capture the dynamic variations in the number of overseas affiliates after macroeconomic shocks occur through the lens of the VAR model. One practical caveat is that, when we focus on the number of overseas affiliates, the firms that have no affiliates will be dropped from the sample. To deal with this truncation problem, we use the Tobit model nested within the FAVAR setting. In other words, for firms that have zero overseas affiliates, we assume that firms that have a potentially negative number of affiliates also exist (and are unobservable) and estimate this potential number. To the best of our knowledge, this study is a pioneer in exploring the impact of macroeconomic variation on individual firms' outward FDI decisions, while also extending the conventional FAVAR model by its combination with the Tobit model.

The findings can be summarized as follows. First, the appreciation of the exchange rate leads to an increasing number of overseas affiliates of the firms. However, the impact of the exchange rate on FDI is temporary. Second, after we control for other macroeconomic factors, we show that world GDP has a more long-lasting and profound influence on firms' decisions for outward FDI.

In view of the above, this study is related to two literature streams. The first one lies in the context of labor economics, specifically, the question of whether the hollowing out phenomenon did arise in Japan and to what extent we can relate it to the appreciation of Japanese currency. The second one derives from macroeconomic modeling and shows how firms' decision making evolves over time under the impact of exchange rate volatility. The former literature stream focuses on economic intuition, whereas the latter tends to approach the issue from a more technical perspective. However, both point in the same direction regarding the impact of the exchange rate variation. Therefore, clarifying this theoretical puzzle will have significant policy implications for other nations as well.

The remainder of the paper is organized as follows. The next section introduces the background to why we use FAVAR model. Section 3 presents the estimation strategy and data used for this study. Section 4 shows the results and Section 5 concludes the paper.

2. Background to the application of the FAVAR model

The FAVAR model was originally proposed by Bernanke et al. (2005) to cope with the problem of sparse information sets in typical VAR analyses. Building on the dynamic factor model, developed by Stock and Watson (2002), the relatively small set of factors extracted from the large dataset, and the variables of interest (e.g., the Federal Fund rate) composes the system of the FAVAR model, and thus it is free from the degrees-of-freedom limitation despite including large amounts of information. Bernanke et al. (2005) document three advantages of using the FAVAR model with a large series dataset. First, the FAVAR model reflects the information possessed by economic agents better than the standard VAR model and thus mitigates the possibility of contaminating policy innovations. Second, it excludes arbitrariness, which occurs for the choice of a time series, including in the VAR system. Finally, we can examine the responses of a number of variables in the system to structural

innovations at the same time, which cannot be done in the standard VAR model because the inclusion of variables is limited by the degrees of freedom.

Our analysis mainly relies on the third point. As noted above, the FAVAR model allows us to identify the influence of macroeconomic shocks, such as the variations in the exchange rate and the business cycle worldwide, on the behaviors of numerous firms comprehensively and simultaneously. Therefore, we apply the FAVAR model in our analysis.

3. Methodology and data

3-1. Factor-Augmented VAR model with censored variable

The details of the empirical strategy are as follows. First, we define F_t as an $m\times1$ vector that represents unobserved factors. [3] $X_t^* = (x_{1t}^*, \cdots, x_{n(t)t}^*)'$ is an $n(t)\times1$ vector of the latent number of firm i's overseas affiliates in year t, denoted by x_{it}^*. As shown in equation (1), we assume F_t has a dynamic impact on X_t^*. As some firms might go bankrupt at some time point during the analysis period, these observations will be dropped from the sample, meaning we can only estimate $n(t)$ based on unbalanced panel data.

$$X_t^* = \Lambda F_t + z_{t-1}'\beta + e_t,\ e_t \sim N(0, R). \tag{1}$$

In equation (1), z_{t-1} is an $l\times n(t)$ vector that includes the observed exogenous variables that might affect X_t^* other than F_t. R is a matrix with the diagonal elements $e_t = (e_{1t}, \cdots, e_{n(t)t})'$. Λ is called factor loading and represents an $n(t)\times m$ vector that shows the relationship between extracted factors and the number of each firm's overseas affiliates. Furthermore, as indicated in equation (2), we define x_{it} as x_{it}^* if the threshold value is above 0 and x_{it} =0 otherwise. In practice, a Tobit model can better capture this mechanism.

$$x_{it} = \begin{cases} x_{it}^* \text{ if } x_{it}^* > 0 \\ 0 \text{ if } x_{it}^* \le 0 \end{cases}. \tag{2}$$

Next, we define Y_t as a $k\times1$ vector that includes the observed macroeconomic variables. The dynamics between F_t and Y_t can be described using the following VAR model:

$$\begin{bmatrix} F_t \\ Y_t \end{bmatrix} = \Phi \begin{bmatrix} F_{t-1} \\ Y_{t-1} \end{bmatrix} + u_t, \qquad u_t \sim N(0, Q). \tag{3}$$

In equation (3), Φ is the coefficient matrix, whereas Q represents the variance-covariance matrix of error term u_t. To clarify how exogenous factors affect firms' overseas investment behavior, we define Y_t as a 2×1 vector that includes world GDP and REER at time t. In contrast to the conventional VAR model that only includes observable endogenous variables Y_t , the current specification adds unobserved F_t to the estimation system, and we call equation (3) the factor-augmented VAR model.

We conduct the analysis outlined above using firm-level micro data. Since we can identify the

3 Throughout the text, we alternatively use "factor shock" to indicate F_t.

channel through which Y_t affects F_t and the relationship between F_t and x_{it}^* is captured by Λ, we can then derive the extent to which the shock in Y_t affects x_{it}^*. By doing so, we can quantify individual firms' reactions to the macroeconomic shock, especially in terms of the exchange rate.

3-2. MCMC estimation

The FAVAR model mentioned above is estimated by the Bayesian Markov Chain Monte Carlo (MCMC) method via the Gibbs sampler. To do so, we construct the state-space model, where equation (3) is regarded as the state-equation and equation (1)', which is the transformation of (1), as the observation equation:

$$\begin{bmatrix} X_t^* \\ Y_t \end{bmatrix} = \begin{bmatrix} \Lambda & 0 \\ 0 & I_k \end{bmatrix} \begin{bmatrix} F_t \\ Y_t \end{bmatrix} + \begin{bmatrix} z_{t-1}' \\ 0_{k\times l} \end{bmatrix} \beta + \begin{bmatrix} e_t \\ 0 \end{bmatrix}. \qquad (1)'$$

In this system, Y_t is also treated as the latent variable, as well as F_t. Since our model comprises several parameters and the latent variables denoted by Θ, where $\Theta = \Lambda, \beta, \Phi, R, Q, \{F_t\}_{t=1}^T, \{X_t^*\}_{t=1}^T$, the posterior distribution is too complicated to calculate analytically and, thus, the MCMC method is suitable for estimation. Given observed data $y = \{Y_t\}_{t=1}^T, \{z_t\}_{t=1}^T$ and prior density functions $\pi(\Theta)$, the samples from the posterior distribution $\pi(\Theta \mid y)$ are obtained as follows:

1. Set initial values of $\Lambda^{(0)}$, $\beta^{(0)}$, $\Phi^{(0)}$, $R^{(0)}$, $Q^{(0)}$, $\{F_t\}_{t=1}^{T\ (0)}$, $\{X_t^*\}_{t=1}^{T\ (0)}$, and $j = 1$.

2. Draw $\{F_t\}_{t=1}^{T\ (j)}$ from $\pi\left(\{F_t\}_{t=1}^T \mid \Lambda^{(j-1)}, \beta^{(j-1)}, \Phi^{(j-1)}, R^{(j-1)}, Q^{(j-1)}, \{X_t^*\}_{t=1}^{T\ (j-1)}, y\right)$.

3. Draw $\Lambda^{(j)}$ and $\beta^{(j)}$ from $\pi\left(\Lambda, \beta \mid \{F_t\}_{t=1}^{T\ (j)}, \{X_t^*\}_{t=1}^{T\ (j-1)}, R^{(j-1)}, y\right)$.

4. Draw $R^{(j)}$ from $\pi\left(R \mid \{F_t\}_{t=1}^{T\ (j)}, \{X_t^*\}_{t=1}^{T\ (j-1)}, \Lambda^{(j)}, \beta^{(j)}, y\right)$.

5. Draw $x_{it}^{*\ (j)}$ in $\{X_t^*\}_{t=1}^{T\ (j)}$ from $\pi\left(x_{it}^* \mid \{F_t\}_{t=1}^{T\ (j)}, \Lambda^{(j)}, \beta^{(j)}, R^{(j)}, \{z_t\}_{t=1}^T\right)$ truncated between $-\infty$ and 0.

6. Draw $\Phi^{(j)}$ from $\pi\left(\Phi \mid \{F_t\}_{t=1}^{T\ (j)}, Q^{(j-1)}, y\right)$.

7. Draw $Q^{(j)}$ from $\pi\left(Q \mid \{F_t\}_{t=1}^{T\ (j)}, \Phi^{(j)}, y\right)$.

8. Return to step 2 until N iterations have been completed.

For the above process, N is set at 25,000, but the initial 5,000 samples are discarded as burn-in. In the following, we briefly explain the process of sampling for each step. In step 2, we employ the Kalman filter and Kalman smoother to our state-space specification to sample the latent factor

$\{F_t\}_{t=1}^T$. To draw Λ and β simultaneously in step 3, equation (1) is transformed as:

$$X_t^* = [F_t \times I_n \quad z_{t-1}'] \begin{bmatrix} \Lambda \\ \beta \end{bmatrix} + e_t.$$

Specifically, the equation can be expressed as:

$$\begin{bmatrix} x_{1t}^* \\ x_{2t}^* \\ \vdots \\ x_{nt}^* \end{bmatrix} = \begin{bmatrix} F_t & 0 & \cdots & 0 & z_{1,t-1}^1 & \cdots & z_{1,t-1}^l \\ 0 & F_t & \ddots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \cdots & \ddots & 0 & \vdots & \vdots & \vdots \\ 0 & \cdots & 0 & F_t & z_{n,t-1}^1 & \cdots & z_{n,t-1}^l \end{bmatrix} \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \vdots \\ \lambda_n \\ \beta_1 \\ \vdots \\ \beta_l \end{bmatrix} + e_t.$$

As mentioned above, our model is estimated using the Bayesian method, such that λ_1 is normalized to be 1 to identify the latent factor uniquely.[4] Thus, the system for estimation in this study is given by

$$\begin{bmatrix} x_{1t}^* - F_t \\ x_{2t}^* \\ \vdots \\ x_{nt}^* \end{bmatrix} = \begin{bmatrix} 0 & \cdots & 0 & z_{1,t-1}^1 & \cdots & z_{1,t-1}^l \\ F_t & \ddots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \ddots & 0 & \vdots & \vdots & \vdots \\ 0 & \cdots & F_t & z_{n,t-1}^1 & \cdots & z_{n,t-1}^l \end{bmatrix} \begin{bmatrix} \lambda_2 \\ \vdots \\ \lambda_n \\ \beta_1 \\ \vdots \\ \beta_l \end{bmatrix} + e_t.$$

Here, let us denote $\tilde{\Lambda} = [\lambda_2, \cdots, \lambda_n, \beta_1, \cdots, \beta_l]'$ and

$$\tilde{F}_t = \begin{bmatrix} 0 & \cdots & 0 & z_{1,t-1}^1 & \cdots & z_{1,t-1}^l \\ F_t & \ddots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \ddots & 0 & \vdots & \vdots & \vdots \\ 0 & \cdots & F_t & z_{n,t-1}^1 & \cdots & z_{n,t-1}^l \end{bmatrix},$$

and then assume $\tilde{\Lambda} \sim N(h_0, H_0)$ for the prior of $\tilde{\Lambda}$. The posterior distribution of $\tilde{\Lambda}$ is obtained as:

$$\tilde{\Lambda} \mid \{F_t\}_{t=1}^T, \{X_t^*\}_{t=1}^T, R, \{z_t\}_{t=1}^T \sim N(h_1, H_1),$$

where $h_1 = H_1\left(H_0^{-1}h_0 + \sum_{t=1}^T \tilde{F}_t' R^{-1} X_t^*\right)$ and $H_1^{-1} = H_0^{-1} + \sum_{t=1}^T \tilde{F}_t' R^{-1} \tilde{F}_t$.. In step 4, under the

4 This restriction for identifying the latent factor is adopted by Bernanke et al. (2005) and Belviso and Milani (2006).

prior distribution of $R_{ii}^{-1} \sim Gamma\left(\frac{w_0}{2}, \frac{w_0 S_0}{2}\right)$, where R_{ii} is the (i,i) element of R, the random sample of R_{ii}^{-1} is drawn from

$$R_{ii}^{-1} \mid \{F_t\}_{t=1}^{T}, \{X_t^*\}_{t=1}^{T}, \Lambda, \{z_t\}_{t=1}^{T} \sim Gamma\left(\frac{w_1}{2}, \frac{w_1 S_1}{2}\right),$$

where $w_1 = w_0 + T$, $w_1 S_1 = w_0 S_0 + \sum_{t=1}^{T} e_{it}^2$, and $e_{it} = x_{it}^* - \tilde{F}_{it}\tilde{\Lambda}$.

Since x_{it}^* follows a normal distribution of mean $\lambda_i F_t + z_{i,t-1}' \beta$ and variance R_{ii}, as shown in equation (1), for the observations that are $x_{it}=0$, latent variable x_{it}^* is generated from:

$$x_{it}^* \sim TN_{(-\infty,0]}\left(\lambda_i F_t + z_{i,t-1}'\beta, R_{ii}\right).$$

As for Φ and Q in steps 6 and 7, we regard the sampling result of $\{F_t\}_{t=1}^{T}$ as data and set the normal distribution and Wishart distribution for the prior of Φ and Q^{-1} as follows:

$$\Phi \sim N(b_0, B_0), \qquad Q^{-1} \sim W(v_0, V_0).$$

Then, the conditional posterior density functions for Φ and Q^{-1} are, respectively:

$$\Phi \mid \{F_t\}_{t=1}^{T}, \{Y_t\}_{t=1}^{T}, Q \sim N(b_1, B_1),$$
$$Q^{-1} \sim W(v_1, V_1).$$

Here, $b_1 = B_1\left(B_0^{-1} b_0 + \sum_{t=2}^{T} \hat{F}_{t-1} Q^{-1} \hat{F}_t\right)$, $B_1^{-1} = B_0^{-1} + \sum_{t=2}^{T} \hat{F}_{t-1} Q^{-1} \hat{F}_{t-1}$, $v_1 = v_0 + T - 1$, and $V_1^{-1} = V_0^{-1} + \sum_{t=2}^{T}\left(\hat{F}_t - \Phi \hat{F}_{t-1}\right)\left(\hat{F}_t - \Phi \hat{F}_{t-1}\right)'$, where $\hat{F}_t = [F_t, Y_t]'$.

3-3. Data

Firm-level FDI data (1999–2014)[5] are taken from Toyo Keizai's Kaigai Sinshutsu Kigyo Soran, consisting of green-field and acquisition (20% or higher equity acquisitions) investments. We focus on manufacturing firms listed on either the first or the second section of the Tokyo Stock Exchange. We also limit our estimation to firms that have observations for at least eight years. In other words, we omit firms that have too many missing values or do not have enough observations because of bankruptcy during the estimation period. Finally, 715 firms were used for analysis.

5 Since the one-period lag is included in the VAR model, the data used in practice range from 2000 to 2014.

First, we extract the unobserved factors based on the variation of these firms' overseas affiliates. Second, as for explanatory variables z_{t-1} in equation (1), overseas export revenue/total revenue, R&D expenditure/total revenue, capital investment/total revenue, and liabilities/assets are used. These data are all obtained from Nikkei's Needs Financial Quest. The information on REER is taken from the website of the Bank of Japan, whereas the world GDP comes from Constant GDP per capita for the World, constructed by the Federal Reserve Bank of St. Louis.

It is worth noticing the identification of the VAR model. The number of overseas affiliates in year t is based on the value in October, REER is the average value from January to December, and world GDP is the flow value aggregated from January to December. Because of the deviation in the timing of observations, the order of the variables used in the VAR model of equation (3) is as follows: factors, world GDP, and REER. By applying the recursive formulation of the Cholesky factorization, we can identify the structural shock.[6]

Concerning the specification of the VAR model, the lag length of our system is set as one year, and all variables are included at this level. Furthermore, in equation (1), we control for firm-level fixed effects and, in equation (3), we add the constant term. Because the estimated coefficients will be interpreted as elasticity, it is reasonable for the variables to take logarithm values. While this will work for REER and world GDP, since the number of overseas affiliates have zero values, which makes it impossible to take the logarithm, we apply the inverse hyperbolic sine transformation to solve the problem. [7]

Finally, for the prior distribution of parameters, we assume that $\tilde{\Lambda}=[\Lambda' \beta']'$ and Φ follow the normal distribution, the inverse of R_{ii} follows the Gamma distribution, and the inverse matrix of Q is subject to the Wishart distribution.

$$\begin{aligned} \widetilde{\Lambda} &\sim N(0, I), \\ \Phi &\sim N(0, I), \\ R_{ii}^{-1} &\sim Gamma\left(\frac{40}{2}, \frac{40 \times (0.001)^2}{2}\right), \\ Q^{-1} &\sim W(100, I \times 100). \end{aligned} \tag{4}$$

4. Estimation results

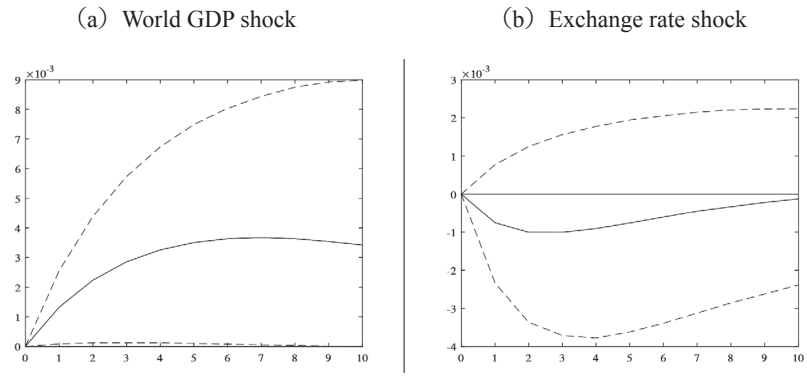
4-1. Factors' impulse response function and variance decomposition

Figure 2 shows the impulse response function of the factors (for the number of overseas affiliates) with respect to the world GDP (a) and the exchange rate (b). The impulse responses to a one standard deviation macroeconomic shocks are included—the blue solid line indicates the median response based on all sampled responses, whereas the red dotted line indicates the 68% confidence intervals.

6 The financial data are all based on observations during the accounting period in March.

7 The inverse hyperbolic sine transformation of a certain x is defined as $\ln(x+(x^2+1)^{1/2})$.

Figure 2: Impulse response function of factors with respect to world GDP and exchange rate shocks.



Notes: Figures 2(a) and 2(b) show the responses of the overseas affiliate factor to world GDP and exchange rate shocks, respectively. The solid blue line indicates the average responses of the sample responses, whereas the red dotted line indicates 68% confidence intervals.

From the results, the world GDP has a positive impact on the factors of overseas affiliates and it is significant for 68% confidence intervals. In the meantime, the responses to the exchange rate shock are confirmed not to be significant. By the median response, the factors of the overseas affiliates show a continuous response to the world GDP shock, whereas the response to the exchange rate converges to zero.

Furthermore, to confirm the scale of each shock's influence on the factors, we use Table 1 to summarize the results of the variance decomposition by shocks. Variance decomposition is the methodology that quantifies the impact of each macroeconomic shock on the unpredictable volatility of the variables included in the VAR system. Table 1 shows the relative contributions of each shock on the factor one, two, and five years ahead, respectively, in terms of the average square of the error term. Since this study conducts a Bayesian estimation based on the MCMC method, we calculate the variance decomposition for each group of sampling observations and show the average value, together with the 68% confidence intervals.

Table 1: Variance decomposition by shocks

	Factor shock	World GDP shock	Exchange rate shock
1 year later	98.6 [97.4, 99.8]	0.7 [0.0, 1.5]	0.7 [0.0, 1.3]
2 years later	96.5 [93.5, 99.4]	2.0 [0.1, 4.1]	1.5 [0.1, 3.0]
5 years later	89.7 [81.0, 98.1]	7.1 [0.4, 14.2]	3.2 [0.2, 6.5]
10 years later	81.0 [64.4, 96.5]	14.5 [0.8, 30.0]	4.4 [0.3, 8.8]

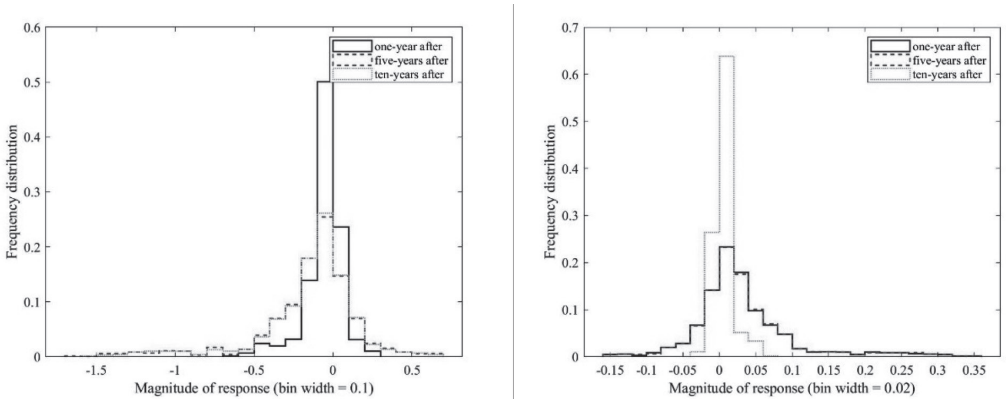
Notes: The values show the contribution of each shock to the volatility of the dependent variable, while the values between parentheses indicate the 68% confidence intervals.

From Table 1, the variation of the number of overseas affiliates can be mostly explained by the factor shock. This is due to the fact that we adopt the recursive constraint based on the Cholesky decomposition. In other words, because the factor shock under the recursive constraint is the only one that affects the change in the number of overseas affiliates when the shock occurs, its impact is larger than that of the other shocks. One thing that worth noticing is that, in the second and third columns, the world GDP shock has a larger long-term impact on the dependent variable than the exchange rate does. In comparison to the exchange rate, the impact of the world GDP shock is twice as large after five years and three times as large after 10 years. In this way, for the determinants of individual firms' overseas investment, rather than exchange rate, the world GDP plays an even more important role. This is in accordance with the results of the impulse response shown in Figure 2.

4-2. Response to the number of overseas affiliates

Hitherto, we have verified the impacts of world GDP and exchange rate on the decision making for overseas investment by Japanese firms in general. To take this a step further, we can calculate Λ in equation (1) and thus identify the macroeconomic shocks' impact on each individual firm. That is, using the FAVAR model, it is possible to systematically estimate the impact on the 715 firms by respectively combining equations (1)' and (3). However, due to space constraints, we only show the histogram based on 715 firms' impulse response function in Figure 3.

Figure 3: Individual firms' responses



Notes: The horizontal axis shows the response, while the vertical axis indicates the ratio of firms within each interval.

Figures 3(a) and 3(b) are the histograms of the impulse response functions for world GDP and exchange rate, respectively. The horizontal axis shows the response, while the vertical axis indicates the ratio of firms within each interval. In Figure 3(a), the interval is 0.1, whereas it is 0.02 in Figure 3(b). The histograms are based on the median value of each firm's response. The blue solid line indicates the distribution of the responses one year after the shock. The red and green dotted lines are for five and 10 years, respectively.

First, in Figure 3(a), the blue line shows that the peak of the histogram is near zero and nearly half of the firms do not have any responses. However, after five years, the firms that increase and decrease their number of overseas affiliates diverge. Furthermore, the shapes of the responses after

five and 10 years are similar, which means that the influence of the shock is durable. In Figure 2(a), the factor of the overseas affiliates shows a positive response to the world GDP shock. However, when we look at individual firms' responses, the histogram skews to the left, which means that there are more firms that decrease their number of overseas affiliates after a positive world GDP shock. The result is opposite to our intuition, and to better understand the mechanism behind it, we assume it is necessary to divide the samples and conduct more detailed analyses.[8]

On the other hand, one year after the exchange rate shock, the distribution tail of the responses becomes wider, which means that firms react at a relatively early stage once they are affected by the shock. While in the short run, more than half of the firms increase their overseas affiliates in response to an increase in exchange rate, the peak of the histogram is near zero after 10 years, showing that the impact of the exchange rate shock on firms' overseas investment decisions might be temporary.

5. Conclusions

This study analyzes the dynamic relationship between macroeconomic shocks such as exchange rate and individual firms' overseas investment decision in terms of the number overseas affiliates. Specifically, we extract one unobserved factor from the number of overseas affiliates of each manufacturing firm and then estimate a VAR model that builds on this single factor and macroeconomic variables. Specifically, we embed a Tobit model in the FAVAR context and apply firm-level micro data while controlling for year fixed effects. By using a VAR model for time series analysis, we can capture not only the static relationship between macroeconomic variables and firm behavior, but also how economic shocks dynamically affect firms' responses. This is the major contribution of this study.

By analyzing impulse response and variance decomposition based on the factors extracted from the number of Japanese firms' overseas affiliates, we verify that both the exchange rate and world GDP variation affect firms' decisions to invest abroad. When there is an increase in the exchange rate, most firms will increase their number of overseas affiliates; however, the impact of the world's GDP is even larger. Additionally, in contrast to the fact that the impact of the exchange rate on firms' overseas investment is temporary, the world GDP has a continuous influence on firms' decisions in terms of their outward FDI. By far the largest number of studies has focused on the determinants of inward FDI, as FDI is an important channel through which a host country can improve its technology, as well as resource allocation efficiency. By contrast, in this paper, we attempt to lay the micro-level foundation for quantifying the influence that macroeconomic factors have on individual firms' outward FDI. The new insights from the supply side will have tremendous policy implications for future study.

However, the current study has its limitations. As outlined in the previous section, the result on the influence that world GDP has on firms' reactions is the opposite of our expectations, which needs further justification. We might divide the destinations by different patterns or regions. Furthermore, structural shocks, such as financial policy and risk premium, can also change the exchange rate; however, the current Cholesky factorization under recursive constraint does not consider these factors. To mitigate such problems, we will apply a similar FAVAR model with sign restrictions, as used by Ahmadi and Uhlig (2009). In this case, a theoretical model to describe the mechanism of

8 For example, when the economic situation improves in developing countries, firms will shut down several foreign affiliates in advanced countries and open new affiliates in those developing nations. In this paper, such behavior is regarded as decreasing overseas affiliates, such that it is necessary to divide the sample by region and conduct further analyses in future studies.

firms' overseas investments will be proposed in future studies and more endogenous variables will be included in our VAR model.

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The NG-SVAR Model under the Pearson Family of Distributions: Implementation with R Packages*

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Abstract

In traditional econometric analysis, Structural Error Terms (SETs) of Structural Vector Autoregressive (SVAR) models are assumed to follow a normal distribution. However, in actual data analysis, SETs follow non-Gaussian distributions in more than a few cases. We have not found normally distributed data in the SETs of models constructed from data (mainly CPI, MB, Nikkei225, real effective exchange rate, 10-year Japanese Government Bond interest rate, etc.) that we have treated in our empirical studies. These experiences made us realize the need to develop a non-Gaussian Structural Vector Autoregressive (NG-SVAR) model. This paper omits the theoretical content, simulation results, etc., and details the procedure for applying Maekawa et al. [11] to the empirical analysis using the R program.

Keywords: Monetary policy, VAR model, non-Gaussian distribution

JEL classification: **E52, C32**

1. Introduction

We consider estimation problems in SVAR models in which disturbances have non-Gaussian distribution. We call this model the NG-SVAR model. Since the estimation problem of this model is closely related to the Independent Component Analysis (ICA) developed in machine learning and signal processing, we apply the theory of ICA to our estimation problem. However, since we do not know the true non-Gaussian distribution in practice, we cannot construct the exact log likelihood function. The pseudo log likelihood approach proposed in Maekawa et al. [11] and 'id.ngml' assuming *t*-distribution are known to have consistent estimators and asymptotic normality as the sample size increases from a semiparametric statistics standpoint. See Amari [1], Amari et al. [2, 3] for details. For recent studies of NG-SVAR models, see Lanne et al. [8]; Maekawa [9, 10]; Maekawa et al. [11]; Shimizu et al. [13].

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Consider the NG-SVAR model consisting of k variables with p-lags as in equation (1). The NG-SVAR model is written as:

$$y_t = By_t + B_1 y_{t-1} + \cdots + B_p y_{t-p} + \varepsilon_t \tag{1}$$

$t = 1, \cdots, T$

where $y_t = (y_{1t}, \cdots, y_{kt})'$ is a vector of $k \times 1$ observed values at time t for k variables, and $\varepsilon_t = (\varepsilon_{1t}, \cdots, \varepsilon_{kt})'$ is a vector of $k \times 1$ that is assumed to follow a non-Gaussian distribution under fairly general assumptions. Furthermore, the t-distribution was used to derive an exact log likelihood function and derived asymptotic properties of the maximum likelihood estimator (MLE) in the model.

Rewriting the equation (1), it can be written as:

$$(I - B_0)y_t = B_1 y_{t-1} + \cdots + B_p y_{t-p} + \varepsilon_t \tag{2}$$

By defining $B_0^{-1} = (I\text{-}B_0)^{-1}$ (note that the diagonal element is 1), the reduced form of Eq. (2) becomes

$$\begin{aligned} y_t &= B_0^{-1}B_1\, y_{t-1} + \cdots + B_0^{-1}B_p y_{t-p} + B_0^{-1}\varepsilon_t \\ &= A_1\, y_{t-1} + \cdots + A_p y_{t-p} + u_t \end{aligned} \tag{3}$$

where $A_i = B_0^{-1}\, A_i$, $i = 1, \cdots, p$.

$$u_t = B_0^{-1}\varepsilon_t \tag{4}$$

Typically, A_i is assumed to satisfy the stability condition

$$\begin{aligned} \mathrm{detA(z)} \overset{\text{def}}{=} \det\left(I_T - A_1 z - \cdots - A_p z^p\right) \neq 0, \\ |z| \leq 1 (z \in \mathbb{C}). \end{aligned}$$

Our aim is to estimate B_0^{-1} without knowing the Probability Density Function (PDF) of the true PDF of non-Gaussian ε_t. Maekawa et al. [11] proposed the following method.

(1) Obtain reduced form residuals u_t from the reduced form.
(2) Decompose u_t into the two parts $\hat{B}_0^{-1}$ and $\hat{\varepsilon}_t$ by equation (4) using an ICA algorithm.
(3) Find the most suitably fitted PDF for ε_t from the Pearson family of distributions, which contains a wide range of distributions.
(4) Use the fitted PDF as a pseudo PDF for ε_t
(5) Using a pseudo PDF, construct a pseudo log likelihood function and estimate $\hat{B}_0^{-1}$.

In this paper, the above methods are presented using the R program.

2. Estimate VAR analysis

The variables used in the model presented as an example in this paper are real Gross Domestic Product (GDP), Consumer Price Index (CPI) excluding fresh food and energy prices, Monetary Base (MB), 10-year Japanese Government Bond interest rate, and Nikkei225. The lag of the VAR model was set to 2 based on the results of an investigation of the optimal lag using the information criterion. The R program 'VARselect' calculates Akaike's Information Criteria (AIC), the Hannan-Quinn criterion (HQ), Schwarz Criterion (SC) and the Final Prediction Error criterion (FPE). The estimated results of optimal lags of the VAR model are shown in Table 1. In this paper, the optimal lag was selected with reference to HQ and SC. Stationarity of the VAR model was checked using the Augmented Dickey-Fuller (ADF) test. The results were non-stationary. Therefore, the first-order difference was taken. Some of the results of the ADF test after taking the first-order difference are shown in Table 2. Since this model was found to be a stationary process, we estimate a VAR model. The estimated reduced form residuals are shown in Figure 1.

```
> v1 <- vars::VAR( data.selected , p=2 )# estimate VAR(2)
> X <- residuals(v1) # residuals obtained
> plot(ts(X))
```

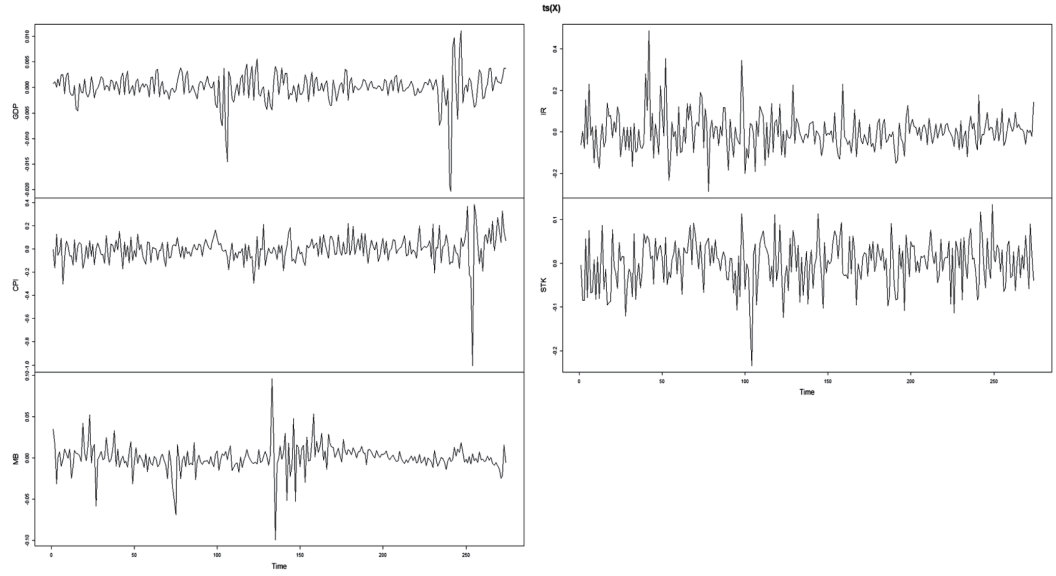
Table 1. Selection of optimal lags of the VAR model

selection						
AIC(n)	HQ(n)	SC(n)	FPE(n)			
12	2	2	10			
criteria						
	1	2	3	4	5	6
AIC(n)	3.40E+01	3.44E+01	3.45E+01	3.45E+01	3.46E+01	3.46E+01
HQ(n)	3.38E+01	3.41E+01	3.41E+01	3.40E+01	3.39E+01	3.37E+01
SC(n)	3.36E+01	3.37E+01	3.34E+01	3.31E+01	3.28E+01	3.25E+01
FPE(n)	1.71E-15	1.12E-15	1.01E-15	1.01E-15	9.72E-16	9.80E-16
	7	8	9	10	11	12
AIC(n)	3.45E+01	3.45E+01	3.46E+01	3.47E+01	3.47E+01	3.47E+01
HQ(n)	3.35E+01	3.33E+01	3.33E+01	3.33E+01	3.31E+01	3.31E+01
SC(n)	3.20E+01	3.17E+01	3.15E+01	3.12E+01	3.09E+01	3.06E+01
FPE(n)	1.07E-15	1.10E-15	9.86E-16	8.71E-16	9.19E-16	8.73E-16

Table 2. Result of the ADF test

Augmented Dickey-Fuller Test	
Dickey-Fuller	-6.8114
Lag order	2
p-value	0.01
alternative hypothesis: stationary	

Figure 1. Reduced form residuals



3. 'fastICA'

The relationship between the ICA model and the VAR model is briefly described. Equation (5) is a general ICA model.

$$x = As \tag{5}$$

x in equation (5) is known as an "observed signal" and corresponds to u_t in equation (4). A in equation (5) is called a "mixing matrix" and corresponds to B_0^{-1} in equation (4). s in equation (5) is called a "source signal" and corresponds to ε_t in equation (4).

Comparing equations (4) and (5) shows that the structures are similar. Hence, we can apply the theory and algorithm in ICA to estimate the SVAR model.

The reduced form of the SVAR model is estimated to obtain $\hat{u}_t$. Inputting the induced form residuals into "fastICA" provides SETs that are separated and estimated by the ICA algorithm. This process provides a good estimation because it performs whitening even in the presence of correlations. However, the ICA method cannot be applied when two or more u_t are normally distributed.

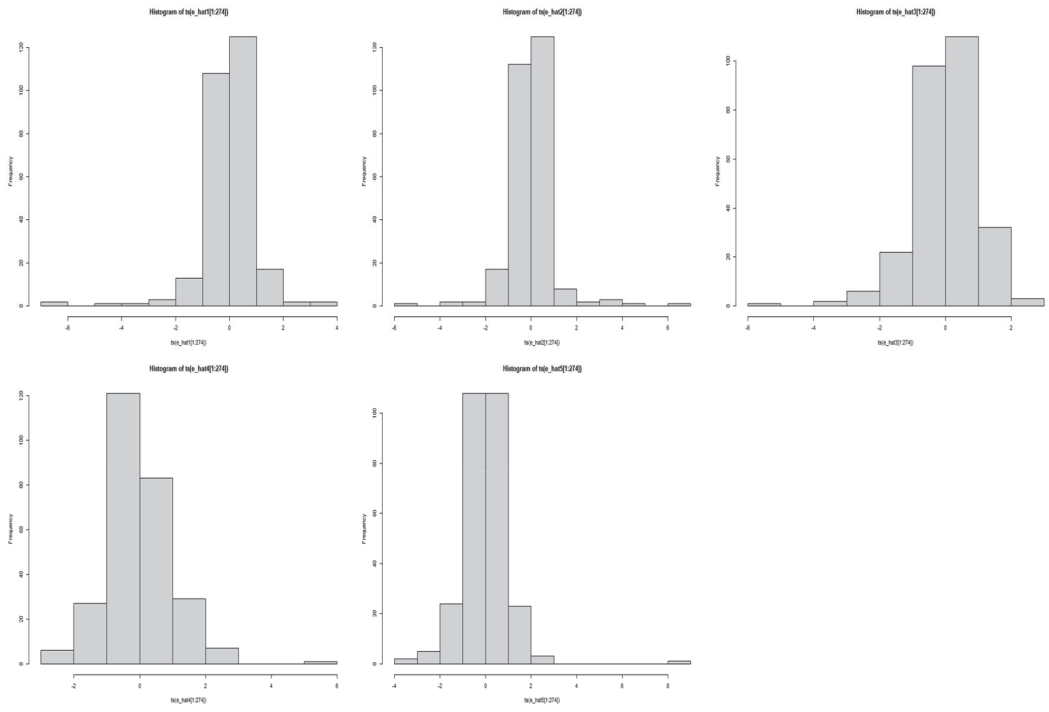
>b <- fastICA(X, 5, alg.typ = "parallel", fun = "logcosh", alpha = 1,method = "C", row.norm >= FALSE, maxit = 200,tol = 0.0001, verbose = TRUE)

The 'X' in the code is the estimated reduced form residuals. The estimated results are stored in 'b'. The $\hat{\varepsilon}_t$, which is separated and estimated from the induced system residuals, can be viewed inside by entering b$s. Also, 'b$X' is called pre-processed data, and the input induction system residuals can be viewed. The correlation matrix of $\hat{\varepsilon}_t$ (Table 3) shows that each value is small and uncorrelated. The distribution of each structural error term is shown in Figure 2. For more information on ICA theory, see Hyvärinen et al. [7] and Moneta et al. [12].

Table 3. Correlation matrix of $\hat{\varepsilon}_t$

1.000000E+00	7.703835E-15	2.277426E-16	-4.207289E-15	3.415022E-15
7.703835E-15	1.000000E+00	2.769406E-16	1.070747E-16	5.048078E-16
2.277426E-16	2.769406E-16	1.000000E+00	-2.565982E-16	-1.095701E-16
-4.207289E-15	1.070747E-16	-2.565982E-16	1.000000E+00	-1.924934E-17
3.415022E-15	5.048078E-16	-1.095701E-16	-1.924934E-17	1.000000E+00

Figure 2. Histograms of distribution of each $\hat{\varepsilon}_t$



In the next section, the approximate distribution of each estimated structural error term is selected from the Pearson distribution family.

4. 'PearsonMSC'

The approximate distribution of $\hat{\varepsilon}_t$ obtained from the above results is selected by 'pearsonMSC' in the R package 'PearsonDS'. As an example, use 'pearonMSC' to select an approximate distribution for $\hat{\varepsilon}_{1t}$.

>result1<-pearsonMSC(e_hat1)

Using the above R code, the approximate distribution of $\hat{\varepsilon}_{1t}$ can be selected from the Pearson family of distributions. The information criteria used in this process are Maximum Likelihood (ML), AIC, corrected AIC, Bayes Information Criterion (BIC), and Hannan-Quinn criterion (HQC). From each information criterion, the optimal Pearson distribution type and some parameters are obtained. The analyst must choose which information criteria to use. In this paper, AIC will be employed. The results for the approximate distribution of $\hat{\varepsilon}_{1t}$ are shown in Tables 4 and 5. Pearson distribution type 4 was chosen as the approximate distribution of $\hat{\varepsilon}_{1t}$. However, the parameters of the distribution when fitted to a distribution other than the optimal distribution are also obtained.

Table 4. Selection of type of Pearson distribution of $\hat{\varepsilon}_{1t}$

MSCs				
	0	1	2	3
ML	777.5783	749.3435	777.5851	2135.874
AIC	781.5783	757.3435	783.5851	2141.874
AICs	781.6226	757.4922	783.674	2141.963
BIC	788.8046	771.796	794.4245	2152.713
HQC	784.4787	763.1444	787.9358	2146.224
	4	5	6	7
ML	646.3415	740.8067	741.2063	649.3327
AIC	654.3415	746.8067	749.2063	655.3327
AICs	654.4902	746.8956	749.355	655.4216
BIC	668.794	757.6461	763.6588	666.1721
HQC	660.1424	751.1573	755.0071	659.6833
Log-Likelihood				
	0	1	2	3
	-3.89E+02	-2.75E+02	-388.7926	-1067.9369
	4	5	6	7
	-323.1708	-370.4033	-370.6031	-324.6663

Table 5. Selection of type of Pearson distribution and parameters of $\hat{\varepsilon}_{1t}$

Fitted Distributions					
	mean	SD			
Type 0	1.45E-17	1.00E+00			
	a	b	location	scale	
Type 1	72889.74434	37.04834	-11654.12752	11660.04866	
	a	location	scale		
Type 2	147868.3289	-543.9983	1087.9966		
	shape	location	scale		
Type 3	0.4394017	3.6792755	-1.5690128		
	m	nu	location	scale	
Type 4	1.9688366	0.4601418	0.2350211	0.9395913	
	shape	location	scale		
Type 5	115.81485	10.09428	-1158.78507		
	a	b	location	scale	
Type 6	244.383856	123.808464	8.527508	-4.284872	
	DF	location	scale		
Type 7	3.37881989	0.06671337	0.56239978		
	Type	m	nu	location	scale
Best$ML	4	1.9688366	0.4601418	0.2350211	0.9395913
Best$AIC	4	1.9688366	0.4601418	0.2350211	0.9395913
	Type	m	nu	location	scale
Best$AICs	4	1.9688366	0.4601418	0.2350211	0.9395913
	Type	df	location	scale	
Best$BIC	7	3.37881989	0.06671337	0.56239978	
Best$HQC	7	3.37881989	0.06671337	0.56239978	

In this paper, rather than using all of the selected approximate distributions and parameters for each distribution, we use the average of the parameters that represent the most frequently adopted distribution types and their shapes among the selected approximate distributions. In the future, the R program will need to be modified with a view to using the type of approximate distribution and its parameters for each error term. In this example, the average values of each parameter were used, but the median value could also be used. Three Pearson distribution type 4 and two Pearson distribution type 7 were selected for this analysis. The average values for each parameter of the selected Pearson

distribution type 4 are as follows.

>params4 <- cbind(3.122808967, 0.2509609, 0.091948133, 1.6145176)

We use pseudo-PDF to construct a pseudo log likelihood function of B_0^{-1} . We introduce PDFs for Pearson family of distribution types 4 and 7. See Figures 3 and 4 for the R codes of the respective Pearson distributions.

Pearson type 4 :

$$f(x) = \frac{\left|\frac{\Gamma\left(m+\frac{\nu}{2}i\right)}{\Gamma(m)}\right|^2}{\alpha B(m-\frac{1}{2},\frac{1}{2})}\left[1+\left(\frac{x-\lambda}{a}\right)^2\right]^{-m} e^{-\nu arctan\left(\frac{x-\lambda}{\alpha}\right)}.$$

For $a > 0, m > \frac{1}{2}, \nu \neq 0$ ($\nu = 0$ *corresponds to Pearson type VII*).

Pearson type 7:

$$f(x) = \frac{\Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi}\Gamma\left(\frac{n}{2}\right)}\left(1+\frac{\left(\frac{x-\lambda}{s}\right)^2}{n}\right)^{-\frac{n+1}{2}}.$$

The Pearson type 7 distribution has *n* degrees of freedom, location parameter λ, and scale parameter *s*. This distribution reduces to the student's *t*-distribution when s=1 and λ=0.

Figure 3. The R code of the log-Likelihood function of Pearson type 4

```
> #### log-Likelihood_function_P4 ####
>
> Lik_P4 <- function(theta,x){
+     T <- nrow(x) #5
+     Tl<-ncol(x)  #272
+
+     params <- params4
+     m <- 3.122808967#as.numeric(params[1])
+     nu <- 0.2509609#as.numeric(params[2])
+     L <- 0.091948133#as.numeric(params[3]) # location,lambda
+     s <- 1.6145176#as.numeric(params[4]) # scale
+
+     B <- matrix(B ,P,P)
+
+     B0 <- solve(B)    ###
+     LM <- matrix(NA,P,Tl)
+     lt <- matrix(NA, ncol = 1, nrow = Tl)
+     Ip <- diag(P)
+
+     for (tl in 1:Tl) {
+
+       pdfl <- abs(lngamma_complex(m+nu*1i/2)/gamma(m))^2 /( s*beta(m-1/2,1/2) )
+       for (k in 1:P) {
+         zl <- Ip[k,]%*%B0%*%(x[,tl]) #-m)
+         LM[k,tl] <- log(pdfl) -m*log(1+((zl-L)/s )^2)-nu*atan((zl-L)/s)
+       }
+
+      lt[tl,1] <-   sum(LM[,tl])  - log(abs(det(solve(B0)))) - 4*log(s)
+
+     }
+     -sum(lt)/Tl
+ }
```

Figure 4. The R code of the log-Likelihood function of Pearson type 7

```
> #### log-Likelihood_function_P7 ####
>
>      Lik_P7 <- function(theta,x){
+     T <- nrow(x)
+     Tl<-ncol(x)
+     params <- params7
+     n <- as.numeric(params[1]) # df
+     m <- as.numeric(params[2]) # location
+     s <- as.numeric(params[3]) # scale
+
+     B0 <- solve(B)    ###
+     L <- matrix(NA,5,Tl)
+     lt <- matrix(NA, ncol = 1, nrow = Tl)
+     Ip <- diag(P)
+
+
+     for (tl in 1:Tl) {
+
+         pdf1 <- gamma((n+1)/2)/(sqrt(pi*n)*gamma(n/2))
+         pdf3 <- matrix(0,1,P)
+       for (k in 1:P) {
+         zl <- Ip[k,]%*%B0%*%(x[,tl]-m)
+         pdf3[1,k] <- (   1+(((zl)/s)^2)/n  )^(-(n+1)/2)
+         L[k,tl] <- log(pdf1)-((n+1)/2)*log(1+(((zl)/s)^2)/n)
+        }
+
+
+      lt[tl,1] <-   sum(L[,tl])  - log(abs(det(solve(B0)))) - 4*log(s)
+
+     }
+     -sum(lt)/Tl
+ }
```

5. 'id.ngml'

'id.ngml' is a program in R that constructs a likelihood function assuming the *t*-distribution as the distribution of ε_t and performs a maximum likelihood estimation. Maekawa [10] states that the results of Monte Carlo experiments under various non-Gaussian distribution assumptions show that the pseudo-maximum likelihood estimation and tests based on the *t*-distribution are not bad. When an approximate probability density function is obtained from $\hat{\varepsilon}_t$, the *t*-distribution and distributions close to it are often selected. When the true distribution is unknown, the *t*-distribution is flexible as an approximation to the various non-Gaussian distributions that tend to appear in data analysis. It is also easy to use, with a wide variety of options available to meet the various requirements of the analyst.

'id.ngml' is optimized using the reduced form residuals obtained from the VAR estimation. Here, the residuals obtained from the previously estimated VAR (2) are given and estimated. The estimation results are shown in Table 6.

Table 6. Result of using 'id.ngml'

Identification Results					
Method: Non-Gaussian maximum likelihood					
Sample size	274				
Log-Likelihood	3014.7				
AIC	-5859.5				
Estimated degree of freedom	2.2389	8.2239	2.4554	2.1875	4.6149
Standard errors of estimated degrees of freedom	0.6035	3.5046	1.3439	0.0570	1.5236
Estimated B Matrix					
(unique decomposition of the covariance matrix)					
	GDP	CPI	MB	IR	STK
GDP	0.0047	-8.76E-05	-0.0002	-9.05E-05	-0.0002
CPI	0.0114	1.03E-01	0.0041	1.46E-02	0.0024
MB	-0.0008	-7.26E-04	0.0185	-3.32E-03	-0.0022
IR	0.0089	-3.46E-03	-0.0011	2.08E-01	-0.0034
STK	0.0223	5.12E-04	0.0085	4.71E-02	0.0518
Estimated standardized B matrix					
	GDP	CPI	MB	IR	STK
GDP	1	-0.0009	-0.0082	-0.0004	-0.0004
CPI	2.3990	1		0.0701	0.0455
MB	-0.1727	-0.0070	1	-0.0160	-0.0419
IR	1.8819	-0.0034	-0.0593	1	-0.0647
STK	4.7036	0.0050	0.4603	0.2268	1
Standard errors of standardized B matrix					
	GDP	CPI	MB	IR	STK
GDP	0	0.0018	0.0105	0.0021	0.0036
CPI	2.6299	0	0.3804	0.0791	0.1616
MB	0.2108	0.0052	0	0.0077	0.0162
IR	2.6575	0.0453	0.3723	0	0.1570
STK	1.4174	0.0336	0.2722	0.0550	0
Estimated scale of the standardized B	0.0047	0.1028	0.0185	0.2077	0.0518
Standard errors of the scale	0.0053	0.0054	0.0196	0.0258	0.0047

6. The Estimation of $\hat{B}_0^{-1}$

To obtain $\hat{B}_0^{-1}$ using the pseudo maximum likelihood method proposed by Maekawa et al. [11], an initial value is needed. As the initial value, we use $\hat{B}_0^{-1}$ estimated by 'id.ngml' plus a small random number. For the initial value, a random number generated from the standard normal distribution and reduced to 1/50 is added. By using the nonlinear optimization function "optim", the pseudo-MLE of $\hat{B}_0^{-1}$ is calculated by the pseudo log likelihood function. The optimized results are shown in Figure 5.

Figure 5. The result of our method

```
> #################
>  Type <- 4
> #################
>  theta0 <- B_init+matrix(c(rnorm(25,0,1)/50),5,5)
>   opt.4 <- optim(theta0,x=x, Lik_P4,gr=NULL, method = "SANN" ,control =  list(maxit=1000))
> opt.4
$par
         [,1]      [,2]       [,3]       [,4]        [,5]
GDP 11.285511  5.658008   3.019215   4.873097  -3.3294485
CPI -2.533674  3.762072  -4.142705   4.000766 -12.9785103
MB   6.274275  3.193518 -11.838179  -4.178564  -0.4918123
IR   6.260704 -7.619496  -2.004511 -11.405401  -5.3570617
STK  4.298211  2.624215   5.510252   4.152795   2.4079151

$value
[1] 1.543774

$counts
function gradient
    1000       NA

$convergence
[1] 0

$message
NULL
```

This method is primarily intended to accurately measure $\hat{B}_0^{-1}$. The reason for this is to estimate the IRF, and the A_i and $\hat{B}_0^{-1}$ matrices are used in calculating the IRF. Therefore, $\hat{B}_0^{-1}$ must be estimated accurately. This method has been shown, based on the results of Monte Carlo experiments, to yield values close to the true value. For details of the results of the Monte Carlo experiment, see Maekawa et al. [11].

7. Conclusion

In this paper, we have described the method of implementation of the pseudo-maximum likelihood method proposed by Maekawa et al. [11] in R. At present, the most frequently selected approximate distributions from the Pearson family of distributions and their average values are adopted, and a pseudo log likelihood function is constructed from the PDF of the approximate distributions for optimization. In the future, we would like to modify the program so that optimization is performed using the distribution of each SET and its average value.

In economic analysis, some data, such as GDP, are only available in quarterly data. A possible solution to such problems is the application of the Mixed Data Sampling (MIDAS) model. Therefore, we would like to consider developing a model that assumes non-normality in the MIDAS model.

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Ways to Conserve the Land Title of the Orang Rimba, Hunter-Gatherers of Jambi, Indonesia

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Abstract

Since the 1980's, the Orang Rimba, hunter-gatherers of Jambi Province, Indonesia, have been in a dire situation due to displacement and land dispossession accompanying oil palm plantation and timber plantation development. The Communal Land Rights recognized by Indonesia's Basic Agrarian Law of 1960 were designed with sedentary agrarian communities in mind. Consequently, the government has shown reluctance to extend these rights to the nomadic Orang Rimba.

This article discusses the difficulty of preserving Orang Rimba land rights, even in the post-Suharto Reform Era that commenced in 1998. Although during the COVID-19 pandemic, 80 percent of Orang Rimba were officially issued Indonesian Residential Identity cards (KTP) inscribed with their indigenous beliefs, uncertainties remain. Specifically in question is whether the Land for Agrarian Reform Policy of the Joko Widodo administration will effectively protect communities predominantly maintaining a semi-nomadic lifestyle, such as the Orang Rimba.

1. Introduction, Impact of the Rights of Indigenous People on Indonesia

In September 2007, the UN General Assembly adopted the Declaration on the Rights of Indigenous Peoples. However, there was opposition from some countries to the right to self-determination and the corresponding obligation to obtain FPIC (Free, Prior, Informed Consent) for decisions and policies affecting indigenous peoples. Indonesia voted in favor of the resolution, but shortly thereafter, Muhammad Anshor, then Ambassador to the UN, criticized the lack of a strict definition of indigenous peoples in the Declaration, and announced that Indonesia would pursue her own policy regarding indigenous peoples.[1]

In fact, however, the concept of Indigenous People, a term which has been defined in a series of incremental changes since the 1970s (Osakada, 2017, pp.57-62), has provided substantial grounding for NGO movements supporting land disputes. The English term, "indigenous people," is often used in Indonesia, but the Indonesian equivalent has been extensively debated. Eventually, the term *Masyarakat Adat* [2] (indigenous society) was settled on, but a complex political struggle occurred in the process leading up to this decision.

Sandra Moniaga, who observed the process of the founding of AMAN (The Indigenous Peoples'

1 United Nations, General Assembly Adopts Declaration on Rights of Indigenous People, 13 September 2007.

2 Adat (Customary Practice and Law) is a system of general social norms in each ethnic community, governing customs such as land use, marriage regulations, and inheritance.

Alliance of Nusantara[3]) wrote; "In 1993, a meeting in South Sulawesi decided upon the words, *Masyarakat Adat* for referring to indigenous peoples. Suharto's authoritarian regime fell in 1998. This provided greater political space for civil organizations to operate. In 2003 nearly 1,000 local and regional indigenous organizations were allied with AMAN." (Moniaga, 2008, pp.281-83).

Lucas & Warren, known for their study of land conflicts in Indonesia, explained the political context of the term, "indigenous people" as follows (Lucas & Warren, 2003, p.100).

> The term was regarded as unacceptable by the Indonesian government because of its politically awkward connotations in international law and because all but the small percentage of mainly ethnic Chinese Indonesians could be regarded as "indigenous." "Indigenous minorities" is nevertheless an appropriate means of distinguishing these marginalized groups from the largest Javanese ethnic group that has dominated Indonesia's political and cultural landscape since independence. As indigenous rights became a global human rights issue, this discourse was imported and increasingly began to influence representations of the cultural minorities referred to collectively as the *adat* peoples (*masyarakat adat*) of Indonesia.

On the other hand, the Indonesian government continues to use *Masyarakat Hukum Adat* (Customary Law Community), a descendent of the *Adat-Recht* Gemeinscaft concept of *adat* (Customary Practice and Law) during the Dutch colonial period.[4]

Article 3 of the Basic Agrarian Law of 1960 (abbreviated BAL below), despite the intention to create a unified Indonesian law system after independence, defines the Customary Law Community, the essence of which is not separable from the existence of Communal Land Rights (*Hak Ulayat*). However, the Communal Land Rights granted by the BAL were denied to the people living inside the Forest Area (*Kawasan Hutan*) defined by the Basic Forestry Law of 1967, Article 17.[5] The Forest Area, as defined by the Ministry of Forestry, covers 70% of the total area of Indonesia, and was the driving force behind the development policy that followed (Bedner, 2016, p.70).

Law No. 39 Year 1999 - Concerning Human Rights - Article 6 stipulates:

(1) In the interest of upholding human rights, the differences and needs of indigenous peoples must be taken into consideration and protected by the law, the public and the Government.

(2) The cultural identity of indigenous peoples, including indigenous land rights, must be upheld, in accordance with the development of the times. The difference between the original Indonesian text and the English translation is that here, "Customary Law Community" is consistently used for "*Masyarakat Hukum Adat*," not "*Masyarakat Adat*."

Although the term, *Masyarakat Adat*, is used in some Indonesian laws,[6] its use is discouraged by legislative bodies. Administratively, "Customary Law Community" (*Masyarakat Hukum Adat*) is preferred. *Masyarakat Hukum Adat* and *Masyarakat Adat* are very different in their connotations. The concept and use of the English term, "Customary Law Community" has its roots in the colonial

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3 AMAN is the abbreviation of Aliansi Masyarakat Adat Nusantara. *Nusantara* is an elegant old Javanese term to describe the Indonesian Archipelago.

4 Reviewing the long history of Dutch Colonial Studies in Indonesia, Franz and Keebet Benda-Beckmann, remarked; "*Tanah ulayat* (communal land) has not received sufficient attention by Vollenhoven and subsequent Dutch common law scholars. Since the beginning of the 20th century, the perception of *ulayat* has changed among residents, administrators, and researchers, and since the beginning of the reform era after 1998, *tanah ulayat* has been advocated by residents who advocate the restoration of suppressed rights, but this is not in line with what customary law researchers and administrators believe." (Von Benda-Beckmann and Von Benda-Beckmann, 2011, pp.167-188).

5 Undang-undang No. 5 Tahun 1967 Tentang Ketentuan-Ketentuan Pokok Kehutanan.

6 For example, Law on the Management of Coastal Areas and Small Islands (No 27/2007).

period, originating from late 19th and early 20th century conditions when colonizers exploited the "unique" culture of indigenous peoples through indirect rule. In contrast, *Masyarakat Adat* (Indigenous Society) implies both the victims of Suharto's Development Policy, and expresses resistance to discrimination (Arizona & Cahyadi, 2013, pp.52-55).

This article clarifies the precarious situation of the Orang Rimba, formerly hunter-gatherers of Jambi Province, Indonesia. Development policies initiated in the 1980's have led to the near-extinction of the forests that sustained them.[7] Due to the facts mentioned above, their legal status is complicated. Internationally they are recognized as indigenous and domestically, termed *Masyarakat Adat* by NGO organizations. Yet, they are not categorized as *Masyarakat Hukum Adat* under the stringent criteria of the Indonesian administration. In analyzing the difficulty of guaranteeing their land rights, the author highlights shifts occurring during the COVID-19 pandemic and contemplates potential futures facing these communities.

2. Leadership and the Land of the Orang Rimba

The number of Orang Rimba (People in the Forest) was estimated to be 3,650 in 2008 for the entire province of Jambi, according to a census conducted in collaboration with the Department of Statistics and KKI WARSI in 2013.[8] Of these, 1,775 people lived in the Bukit Duabelas National Park (abbreviated BDNP below) area,[9] which is exactly the geographical center of the Orang Rimba lands.

The Residential ID Card,[10] which all Indonesian citizens are required to carry at all times, has not been issued to Orang Rimba, and they have not traditionally been treated as Indonesian citizens. According to the electronic version of the Antara News,[11] "The Jambi Provincial Demographic Office announced that "the demographics of the Orang Rimba will be included in the 2020 population statistics as well as the 2010 population statistics." Regardless of how they are represented in demographic statistics, the fact remains that they were not accorded the rights of normal Indonesian citizens prior to receiving ID cards during the COVID-19 pandemic. This issue will be explored in more detail below.

Sager, who submitted his doctoral dissertation on Orang Rimba rituals and beliefs to ANU, describes the inland inhabitants of Jambi as follows. "The traditional economies of upstream peoples combined horticulture, foraging, and the gathering of forest products for trade. Over the last several centuries, the upstream regions have received significant numbers of migrants from the matrilineal Minangkabau people. Since the early 1980s, the upstream regions have been flooded by peasants from Java who have come with the Indonesian government's transmigration program and primarily work in attached palm oil plantations (Sager, 2008, p.3)."

Orang Rimba societies are federations under a *Tumenggung* (senior leader). There are thirteen *Tumenggung* around BDNP, three in Tebo Province, and one in Bungo Province. *Tumenggung* are leaders of a group of hunter-gatherer Orang Rimba who share *Jelajah* (an area of foraging and hunting) with fluid boundaries. Leadership is not merit based or assigned to a superior individual (Bigman), but is passed down through family lineage (Nakashima, 2021, p. 91).

According to Sager, their nomadism primarily occurs following the death of a group member

7 According to the statistics mentioned in the internet news platform, Mongabay, September 3, 2021, the forest of Jambi Province in 1990 was 2,771 ha, but the area drastically dropped to 900 ha in 2019.

8 See KKI WARSI, *Sejarah Pendirian*.

9 Taman Nasional Bukit Duabelas, *Tumenggung* Suku Anak Dalam di Kawasan BDNP.

10 KTP, Kartu Tanda Penduduk.

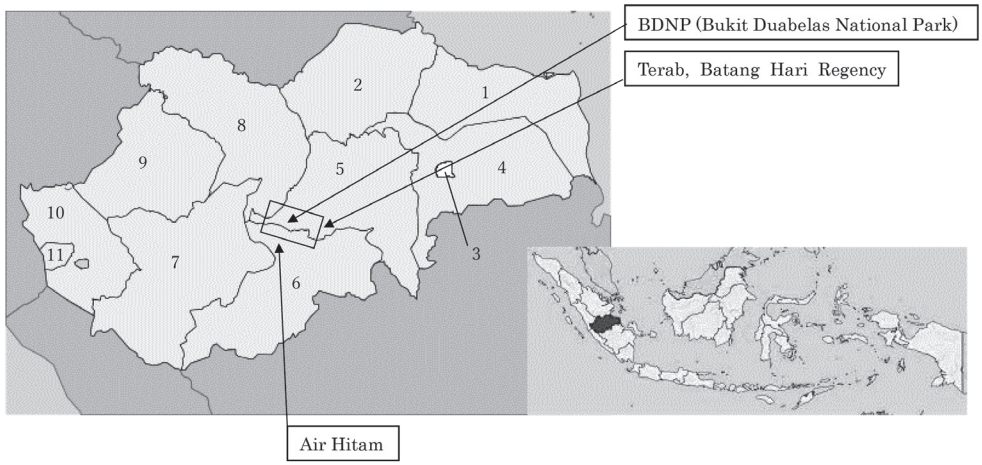
11 Antara News, 19 September 2019. The Census is held every ten years by BPS (Central Agency on Statistics).

but can also occur or be extended due to mere preference for the lifestyle. It is traditionally combined with hunting, trapping, fishing, damming and poisoning rivers, and collection of forest products for trade (Sager, 2008, p.7).

Elkholy, who conducted field work in Tebo Regency, said; "*remayow* is a term replete with meaning, as it signifies a condition of living that the Orang Rimba hold sacred; one that is embodied in the practice of moving through the forest and living off the land through hunting and gathering. The notion of *remayow* also serves as a euphemism for individual and collective authority and a state of ontological purity (*murni*) (Elkholy, 2016, p.105)."

Prasetijo, a lecturer at Diponegoro University, divides the Orang Rimba into three types according to their degree of sedentarization; (1) Not sedentary, (2) Semi-sedentary, staying in both the forests and villages, and (3) Sedentary, and typifies the characteristics of each, using fourteen indicators. Indicators influencing this include religion, practice of rituals and taboos, housing, attitudes toward settlement, attitudes toward policies, degree of assimilation and access to public facilities (Prasetijo, 2017, 267-68). The Orang Rimba people discussed in this article belong to type (2). They live on the fringe of BDNP.

Map of Jambi Province



Cities and Regencies

1 Tanjung Jabung Timur
2 Tanjung Jabung Barat
3 Jambi
4 Muaro Jambi
5 Batang Hari
6 Sarolangun
7 Merangin
8 Tebo
9 Bungo
10 Keinci
11 Sungai Penuh

3. Land Grabs by Oil Palm Plantations

SAL Operations and Resistance

The Transmigration Policy of the 1970s and 1980s brought large numbers of migrants from Java to Jambi Province. They settled in the vicinity of BDNP, in Hitam Hulu and Air Hitam, quickly clearing the surrounding forests. This was followed by oil palm development and further forest

depletion.

SAL (PT Sari Aditya Loka) began operations in 1988. SAL is a subsidy of Astra Group, an Indonesian multi-national conglomerate. SAL is composed of two companies, SAL1 and SAL2, which together own 33,867 ha of plantations.[12] The author was witness to the following testimony of how the Orang Rimba lost their living environment through a series of measures.[13]

> The land was our *Jelajah* until SAL came. At that time, there were not many *Tumenggung*, and many *Depati* (leaders under the *Tumenggung*) were assisting *Tummenggung*. Then, the population grew, and the group branched out. We have thirteen *Tumenggung* now. However, in the 1980s, the government suddenly announced, "This land will become SAL land." The government suddenly demanded that we vacate the land because it was going to become SAL land. We were evicted from our land without any compensation. There was no memorandum of understanding or sales contract of any kind.

The following is a summary of a WARSI report entitled, "Conflict Settlements between PT SAL and the Orang Rimba."[14] There are 505 Orang Rimba people in 130 households in eleven locations around SAL plantations.[15] The trees are essential to the birth and naming of the Orang Rimba. This custom used to be central to Orang Rimba life, but no longer exists. Some Orang Rimba live in government-supplied barracks, and some live in tents on the plantation.[16] Conflicts with oil palm plantations have resulted in the deaths of fourteen Orang Rimba in the last fifteen years. Their livelihood depends on gathering snakes, lizards, rubber nuts/fallen oil palm/pinang nuts, stink beans such as *jengkol*,[17] and other food sources that are not used by the villagers.[18] Problems arise when what is a means of earning a living for them is seen as theft by the big plantation and *plasma* (smallholder) farmers.

The main causes of trouble are categorized as: (1) stealing from villagers' plantations and oil palm orchards, (2) entering plantations and smallholders' plantations to hunt and cause trouble with guards and villagers, and (3) picking up *brondolan* (oil palm nuts that have fallen in the plantations) and selling them to middlemen. The Orang Rimba who have lost their forest habitat typically have no skills or knowledge outside of hunting and gathering, with the concept of land ownership being foreign to them. Their only recourse for survival is to enter the plantations to hunt game and collect *brondoran* to sell. Tragically, encounters with plantation security guards or *plasma* (smallholder) farmers, result in their being forcibly expelled and in extreme cases, fatal violence.[19] Many of these incidents are resolved through "customary law," to avoid police involvement, which culminates in the Orang Rimba being given only meager compensation.

In 2000, the BDNP was established by expanding a previously protected area. The whole area of BDNP is only 60,500 ha. Nevertheless, the government seems to assume that the establishment

12 PT. Sari Aditya Loka 1, Company Profile.

13 Interviews conducted on August 20 and 21, 2019.

14 Peluang Solusi Konflik Orang Rimba dengan PT SAL, Pekat IB Sumbar, Year Not Mentioned, Unpublished Paper.

15 The latest data by PT SAL shows that there are 217 house heads or 898 people who had been suffering damage from the operation of PT SAL (Personal communication from WARSI).

16 Of the five people interviewed, two live in tents and three live in government-provided barracks.

17 The plant belongs to the legume family and has a strange odor. It is a popular ingredient in Indonesian cuisine.

18 They hunt crocodiles about once a month. They shoot sleeping crocodiles at night and eat the meat. According to the WARSI's report, the crocodile penis is also included, but as an energizer.

19 Such troubles increased during the COVID-19 pandemic, because Orang Rimba faced food shortages. Mongabay, an internet news platform, reported the serious trouble of some Orang Rimba people with PT SAL in Merangin regency on May 19, 2020.

of the BDNP has solved all the Orang Rimba problems. On the contrary, the land designated as BDNP was previously industrially forested, and there is very little good (diverse) forest there. Approximately 900 Orang Rimba live in the park, but many Orang Rimba live outside the park, and the issue of how to protect the rights of both groups has not been addressed at all. Merely providing small barracks to the Orang Rimba who have lost their forests and means of survival, is not a solution.

Orang Rimba Demanding Land Return

In the 2000s, people started insisting that SAL return their land, but SAL stated no more than that it would improve the welfare of the people through CSR. The Orang Rimba demanded that (1) No extension of SAL's HGU (Commercial Use Rights) (35 years, valid until 2030) would be made and that: (2) As part of SAL's CSR, each household should be given 2 ha of land in an accessible area and receive livelihood compensation. The corporation refused these requests.

However, things have changed dramatically since that time. Article 7.1.c of the 2018 Presidential Decree No. 86 on Agrarian Reform stipulates that "the project concessionaire must return at least 20% of the state land (the land on which the project concession was issued) to the original owners upon renewal or termination of the project concession."[20] On the basis of this so-called TORA (Land for Agrarian Reform) policy, the Orang Rimba are demanding that 20% of the 5,479 ha of SAL1's core plantations, or 1,095 ha of land, be returned to them. This is because the living areas of each of the five groups the author interviewed are within SAL1's core plantations (Nakashima, 2021,100-102).

These claims of lost land rights are also beginning to be considered by an Orang Rimba group living in another area, Terab, Batang Hari Regency.[21] In fact, 167 Orang Rimba households under four *Tumenggung* reside in and around BDNP. The estate of the PT Wana Perintis rubber plantation used to be in the *Jelajah* of those Orang Rimba people. As the land clearing was not done by Wana Perintis, these Orang Rimba people were given the right to engage in Social Forestry[22] there. This decision was made by the Ministry of Environment and Forestry to avoid conflict. Through engaging in partnership (*kemitraan*) Social Forestry, Orang Rimba households now earn 500,000-1,500,000 rupiah per month.[23]

They also have been experiencing tensions with the oil palm plantation BKS (PT Bahana Karya Semesta). In June 2016, there was a major conflict with BKS when BKS security guards took physical action against the protesters. As a result, two people were injured and a car, five motorcycles, and 1,000 pieces of clothing were burned. The corporation has since discussed compensation for the damage and future countermeasures, but no progress has been made in negotiations other than compensation for the two injured individuals (Nakashima, 2021, pp. 102-103).[24]

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20 Peraturan Presiden Republik Indonesia Nomor 86, Tahun 2018 Tentang Reforma Agraria.

21 Batin 24 County, Batang Hari Regency.

22 Social Forestry was legislated in 2016 by the Regulation of the Minister of Environment and Forestry No. 83

23 According to the information from Mr Rudi Syaf, it is the women who are involved in rubber cultivation. Most of the men are engaging in hunting and collecting. The exchange rate at the time made this equivalent to approximately US$50.

24 On this incident, I interviewed persons locally on August 26, 2019. They have Sialang trees for wild honey collection in BDNP and the cash income raised from their honey collection is significant. A leader said, "We just collected one ton of honey; with two *Sialang* trees, we could harvest one ton of honey and had a cash income of 40 million rupiah (US $4,000)." *Sialang* is a tree in which bees build their nest.

4. Institutional Efforts to Improve the Orang Rimba's Situation

Legal Status of the Orang Rimba

It is difficult to locate the exact legal status of Orang Rimba in the current Indonesian legal system. It has not been the subject of remedies in the various laws aimed at resolving land issues during the reform era. To resolve land disputes which frequently occurred after Suharto's resignation in 1998, a decision was made by the National Land Agency Head, Ministry of Agrarian Affairs. No. 3.[25] Article 2(2) of the Agrarian Affairs Act stipulates the following requirements for the recognition of a Customary Law Community (*Masyarakat Hukum Adat*): a) the existence of people who recognize the existence of a shared customary law system, b) the existence of a specific Communal Land (*tanah ulayat*) where the people live, and c) the existence of communal land operated, managed, and used by the people. Bedner, a professor at Leiden University, explains that certification requires a study by an external third party (a university or research institution) (Bedner, 2016, 72).

Article 97 of the 2014 Law of The Republic of Indonesia, Number 6, concerning Village,[26] lists the following three requirements for recognizing a customary law community: a. its unity of Customary Law Community and traditional rights still actually exist, whether they shall be territorial, genealogical, or functional; b. its unity of Customary Law Community and traditional rights are deemed in accordance with the development of society; and c. its unity of Customary Law Community and traditional rights in accordance with the principles of the Republic of Indonesia. In other words, what is key in defining a community is that the *Masyarakat Hukum Adat* members reside in a certain area, have their own *adat* and the *adat* is being successfully managed. It is assumed that communities cooperate with the development policies of the Indonesian government.

Currently, two customary law communities (*Masyarakat Hukum Adat*) are recognized in Jambi Province.[27] Both are located in remote areas and are very small communities that meet the criteria above. Although this recognition imposes restrictions on their ability to buy and sell communal lands, it can be a means to combat development and illegal settlement.[28] However, as discussed below, these criteria cannot remedy the current situation of the Orang Rimba (Nakashima, 2021, p.105).

WARSI Support

WARSI began supporting the Orang Rimba around 1997. Their action was focused on teaching three subjects: reading, writing and counting. WARSI has a local office on the southwestern border of the BDNP. There, more than a dozen children (ages 7-8 to 15-16, all boys) belonging to the *Tumenggung Nggrip* group live and study with the staff. They can study in WARSI facilities, or they can go to elementary school and receive an institutional education. Alternatively, they can study in the BDNP when WARSI staff come through.[29]

However, there is still a tendency among some Orang Rimba to reject these activities. For them, the outside world is considered harmful to the Orang Rimba and they need to keep as much distance from it as possible. Diseases and misfortunes in their community are considered to be the result of

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25 Peraturan Menteri Negara Agraria / Kepala Badan Pertanahan Nasional Nomor 5 Tahun 1999 Tentang Pedoman Penelesaian Masalah Hak Ulayat Masyarakat Hukum Adat.

26 https://www.pbatlas.net/uploads/7/0/6/1/70619115/law_6__2014_.pdf

27 One is Datuk Sinaro Putih, Bungo Regency, which was recognized in 2006, and the other is Serampus, Murangin Regency, which was recognized in 2016.

28 Villagers' opinion in a Serampus survey.

29 I visited this place on August 21, 2018, and talked to the staff of WARSI (Nakashima, 2021, p.109).

these negative influences from the outside world.[30] Institutional education is also thought of in this way, and there are still some groups that keep their relationship with the outside world to a minimum.[31] The forest dwellers still observe strict food taboos, an indicator of their differentiation from the outside population. Specifically, to prevent contamination from the *Orang Terang* (the outside peoples), they forbid foods made from farmed animals, such as chickens, eggs, goats, cows and their milk, etc. This "prohibition" is called *Patang'on* (Prasetijo, 2017, p.273).

At the same time, some Orang Rimba are seeking to adapt to the outside world. If their children wish to continue their studies further in secondary school, the decision regarding this will be made through negotiations among parents, leaders and WARSI representatives. Such children may receive government support, and some have already become police officers and military personnel. WARSI also provides FM radio broadcasts for the Orang Rimba living in the BDNP fringe area, conveying important news, providing other necessary information, introducing people of interest, and playing popular *Dandut* (an Indonesian song genre).[32]

The majority of the *Tumenggung Nggrip* group still lives in the BDNP, while 17 families live outside of the forest in tents; 40 families live in government-provided houses near where WARSI's local office is located. "Even if we are provided with houses, we have no food. There is not enough forest in the surrounding area for us, Orang Rimba, to survive. We cannot hunt the game we need to survive. There are not enough wild animals, especially wild pigs (*Babi Hutan*)," they complain.

Placing Hope in Social Forestry with Wild Rubber

Indonesia classifies natural rubber into two types: *Karet Alam* (wild rubber) and *Karet Sintetis* (cultivation rubber). The latter nomenclature is derived from the scientific name, *hevea brasiliensis*, for the species brought from Brazil. The most productive variety is the excellent cultivation rubber, *Karet Unggul*. It becomes harvestable 5 to 7 years after planting and reaches its maximum yield between the 15th and 20th years. The yield is more than five times higher than that of wild rubber, but it requires intensive management, depletes the soil and must be replanted after 20 years (Nakashima, 2021, pp. 113-114).

Some Orang Rimba hope that instead of the excellent cultivation rubber (*Karet Unggul*) being planted by companies, wild rubber (*Karet Alam*) planting, which is supportive of the community, will be allowed.[33] This shift is essential for them since fruit and wild rubber can coexist. Although the monoculture plantation system forces people to obey company regulations, some Orang Rimba have planted fruit among the cultivation *Karet Unggul* rubber trees despite plantation companies banning the practice (ibid, p. 113).

In the last chapter of *Stories of Rubber (Gomu Monogatari, 1984)*, the author Tsurutaro Nakagawa states, "In the early 1980s, the demand ratio for artificial to natural rubber was two to one, but as natural rubber (hevea brasiliensis) generates less heat during vibration, it has been in demand for tires for heavy trucks, large buses, and airplanes. In addition, the price of synthetic rubber is

30 During the COVID-19 pandemic, they practiced a custom called *besasandingon*, or social distancing from the plague.

31 The parents of Orang Rimba who managed to permit WARSI educational activities wanted education to take place far away from their residence. This is because they are afraid of being possessed by the external demon, *Natong Luar* (Manurung, 2007, p.306).

32 KKI WARSI, Sidia Dan Benor FM Radionya Orang Rimba.

33 I interviewed *Tummenggung Tarib*, a prominent leader of Orang Rimba, in August 2018. He told me that cultivation of *Karet Alam* enhances ecosystem diversity. Although it is true that *Karet Unggu*l produces greater quantities of rubber product than *Karet Alam*, the latter can thrive for up to a century, he continued, and can allow for the coexistence of fruits and wild animals. On the contrary, he stressed that *Karet Unggul* trees last only 20 years, and have a detrimental effect on the soil and environment (Nakashima, 2021, p.123-124).

rising due to soaring petroleum prices, and it is no longer possible to use petroleum, without restraint, to produce synthetic rubber as in the past" (Nakagawa, 1984, pp.213-215). However, Nakagawa was not aware that natural rubber could be further classified into wild rubber and cultivation rubber.

The Ministry of Agriculture of Indonesia expresses the following view on the difference between the properties of wild and cultivation rubber: "Wild rubber is gaining popularity in developed countries due to its superiority over cultivation rubber in terms of heat generation during vibration. In fact, the demand for wild rubber has increased in recent years, as tires for vans, trucks, buses, and other vehicles have been found to perform better when composed of 45-55% wild rubber."[34]

The book, *Everything about Rubber* (*Panduan Lengkap Karet,* 2008), describes the difference between the properties of wild rubber (*Karet Alam*, abbreviated KA) and cultivation rubber (*Karet Sintetis*, abbreviated KS) as follows. KS has a much higher utilization value than KA. KS is more resistant to chemicals. KS has not experienced any difficulties in transportation or supply during the past century. KA, on the other hand, has advantages over KS, such as perfect elasticity, easy processing, high fluidity and heat resistance. It is also less prone to cracking than KS. However, KS has higher resistance to chemicals and more stable prices. There has never been a shortage in product delivery or supply of KS. These advantageous characteristics are not true of KA, which has inconsistent prices and supplies which sometimes fluctuate widely. Despite these disadvantages, some producers prefer KA" (Tim Penulis PS, 2008, pp.17-18).

In addition to engaging in Social Forestry on 114 hectares of the PT Wana Perintis rubber plantation, the people of Terab, Batang Hari Regency have been cultivating their own rubber estates in which fruits such as mango, jack fruit and durian are planted among wild rubber trees.[35] Although it is probable that both the government and the company are aware of this situation, they have chosen not to pursue any tangible measures in response. Their reluctance may stem from a motive to evade negative publicity. At present, Social Forestry regulations strictly prohibit changing designated land use, but it is necessary to firmly emphasize to companies and government authorities that there is a growing demand for wild rubber based on its characteristics, and that this demand will also lead to the preservation of tropical forests as well as that of the Orang Rimba living environment.

Sokola Rimba

Butet Manurung's book, *Sokola Rimba* (2007), which describes the formal education of Orang Rimba and their reactions to it, received great international acclaim and she was awarded the Magsaysay Award in 2014. In 2013, Indonesian director, Riri Riza, made a film based on this book, which was also highly acclaimed.[36] Butet Manurung worked for WARSI's educational activities (1999-2003) before leaving WARSI and founding Sekola Rimba/The Jungle School in 2003,[37] an NGO that works not only with the Orang Rimba but also with the Dani people in Papua. Within Sekola Rimba/The Jungle School is KMB, an organization of the Orang Rimba for the Orang Rimba. More specifically, it is an organization that supports the 533 members of *Tumenggung Jelitai* who reside upstream of the Makekal River in BDNP.[38]

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34 Kementrian Pertaian, Keungulan Karet Alam dibandinga Karet Sintetis, 23-September-2013.

35 Personal communication from Mr. Rudi Syaf.

36 *Sokola Rimba: The Jungle School* (Miles Film) won awards at various international film festivals and the Audience Award at the 2014 Fukuoka Film Festival.

37 The Indonesian word Sekolah Rimba (Forest School) is "Sokola Rimba" in the Orang Rimba language.

38 Data of the Orang Rimba Upstream of the River Makekal, 2016 (KMB, Data Penduduk Orang Rimba Makekal Hulu, Maret 2016) based on statistics. The author was able to interview more than a dozen Orang Rimba youth on August 24, 2018, at the KMB office in the city of Bangko, the capital of the province of Murangin regency.

The major goal of KMB activity is to establish a 6,500-ha portion of the *Tumenggung Jelitai* group's *Jelajah* in BDNP as a Customary Law Forest (*Hutan Adat*). Their goal is to preserve it "as a place of ritual and worship for the Orang Rimba." Cutting trees will not be allowed, potato cultivation and rubber plantations will not be permitted, but hunting and rattan/honey gathering will be allowed. If successful, they hope to be officially recognized by the President, and at the same time, by the local government.

In 2012, the Indonesian Ministry of Forestry segmented the BDNP into seven zones for conservation purposes. This division faced criticism for not accurately reflecting the land usage of the *Tumenggung Jelitai* group who have resided there for generations. In September of 2018, a revision in the BDNP zoning was declared,[39] motivated by several factors: (1) The Orang Rimba communities had already established their presence before the inception of BDNP zoning, (2) the current zoning has few religious zones, and (3) restrictions on economic activities were imposed within the traditional zones. This commitment signifies the BDNP's commitment to honoring the traditional land-use practices of the Orang Rimba (Nakashima, 2021, p.116). As a result, KMB's objective to secure a place of ritual and worship for the Orang Rimba is drawing closer to realization.

Butet Manurung founded the Sokola Rimba organization with the belief that addressing the pressing challenges faced by the Orang Rimba required a unique approach, one that, while aligned with the nationwide organization AMAN, diverged in its methods and activities. Similarly, based on his experience in interviewing KMB members, this author felt that it would be difficult for the Orang Rimba to have an equal relationship with AMAN, both in terms of Indonesian language literacy skills and education level. KMB is an attempt to build an Orang Rimba-led rights movement (Nakashima, 2021, pp.115-118).[40]

Sedentarization and ID Cards

Since the colonial period, the central government has consistently implemented Orang Rimba sedentarization policies with little success. Today, the Orang Rimba are accepting some forms of sedentarization because the forest is already gone and the traditional way of life is no longer possible.[41] However, although buildings have been erected, they are seldom used. The forest dwellers are not familiar with the idea of settlement, and the buildings themselves, such as barracks, are so inferior that many Orang Rimba return to the forest after a short period of attempting to inhabit them. Most importantly, the lack of forest in the vicinity of the buildings renders the residences almost completely unappealing (Nakashima, 2021, p.118).

On October 30, 2015, President Joko Widodo (Jokowi) visited Air Hitam County, Sarolangun Regency, and was greeted by several hundred Orang Rimba. After speaking with residents living in tents within oil palm plantations, the President met with four proactive *Tumenggung*. President Jokowi was the first president to visit Orang Rimba lands, but no further progress was made. President Jokowi's visit was commendable in that it demonstrated the administration's commitment to indigenous peoples, but no significant outcomes transpired other than a promise to build housing to promote resettlement.[42] What was expected of him was not the provision of housing to promote resettlement, but a statement from a broader perspective on how to guarantee the indigenous rights

39 Taman Nasional Bukit Duabelas, *Zonasi Taman Nasional Bukit Duabelas*.

40 WARSI is critical of this KMB activity. It says that KMB only helps one particular group and does little for other Orang Rimba.

41 Sager remarked: "Before 1960, most of the area had forest cover. By 1980, 73% had forest cover, and by 1990, when the World Bank ended its support for the transmigration program, the figure had again dropped to just over 50%" (Sager, 2008,p.13).

42 Detiknews, Berikut Kronologi Pertemuan Presiden Jokowi dengan Suku Anak Dalam, 2 November 2015.

and land rights of the Orang Rimba. This was not forthcoming.

After an interview at the park administration office in Sarolangun Regency, the author was told that some *Tumenggung* are allowed to have Indigenous Beliefs listed in the religion section of their ID card. However, there was no legal basis for this at the time, and it was understood to be a local response. A landmark ruling was issued in 2017. "Indonesia's Constitutional Court has announced that it will allow 'Indigenous Beliefs' (*Aliran Kepercayaan*)[43] to be inscribed in the faith section of the ID Card."[44] Responding to this constitutional decision, President Jokowi ordered the administrators of state and local governments to honor the decision.[45] Notwithstanding this move from the central government and growing criticism throughout Indonesia of ongoing political repression of religious minorities in Muslim-majority Indonesia, the administrators of state and local governments are still unwilling to accept the ruling.[46]

On May 28, 2021, Suara.com reported on the Orang Rimba response to the death of a 70-year-old woman at a market in Sarolangun Regency. The woman had suddenly fallen, and died in the market. Witnesses of the unexpected event were taken aback, speculating that the coronavirus had infiltrated their region. Immediately, the *Tumenggung Nggrip* group residing at a nearby barracks decided to withdraw into the jungle to protect themselves from the perceived threat. In their cultural context this is known as *besasandingon*, a social distancing strategy. They maintained distances of several meters from each other. This proved effective against potential COVID-19 transmission, but led to food scarcity.[47] Following this incident, other Orang Rimba groups also adopted this custom. The Indonesian government became aware of their difficulties and assisted them with cash, food and medical services including vaccinations at community health centers. WARSI supported the government in issuing ID cards to Orang Rimba, and currently it is estimated that 80 percent possess them. Their recorded faith was officially recognized as *Aliran Kepercayaan*.[48]

5. Concluding Remarks

Communal Land Rights granted to each ethnic group in Indonesia under BAL were greatly restricted by the Basic Forestry Law of 1967. However, Law No. 41 Concerning Forestry, Part II, Section (1) stipulates that "forests shall be divided into state forests and rights forests according to their status," and Section (2) stipulates that "state forests shall constitute Customary Law Forests" (*Hutan Adat*). AMAN appealed the inconsistency of this provision to the Constitutional Court, which ruled on May 16, 2013, by Constitutional Court Decision No. 35 (hereinafter referred to as MK35) that customary forests are not state-owned forests. Customary forests are forests within indigenous lands that exist provided the forests and the indigenous communities that recognize their existence continue to exist.

MK 35 considers the Customary Law Community to be the "bearer of rights" and the subject of law in customary lands. It is hoped that this ruling will contribute solutions to the issues of

43 This refers to several syncretistic religions with characteristics of Javanese mysticism but means "other religions." "Other" refers to ones not among the six recognized religions.

44 It admits that to deny other religions than the six religions (Islam, Catholicism, Protestantism, Hinduism, Buddhism and Confucianism) listed in Law No. 23 of 2006 concerning People Administration is anti-constitutional. Kompas. Com (online), MK: Kolom Agama di KTP dan KK Dapat Ditulis "Penghayat Kepercayaan", 7 November 2017.

45 *Beritagar.id., KTP untuk penghayat kepercayaan sesuai pilkada.*

46 VOA (Voice of America), Indonesian Groups Call for Minority Religious Protections, Sep. 14, 2018

47 Suara.com, (2021). Antara News reported that 22,854 people were infected with COVID-19, and 511 people died of it in Jambi Province at that time (Antara News 2021).

48 Personal communication from Mr. Rudi Syaf. See the news of LIPUTAN 6 on March 12, 2021, concerning issuing ID cards to Orang Rimba.

indigenous societies in the future. While some are pleased with this decision out of hand, Siscawati lays out the problems that exist in this decision (Siscawati, 2014, p.13). It is problematic, for example, that AMAN, which filed the case, pointed out the inconsistencies in the definition of Customary Law Community in the 1999 Forestry Law, but refused to request a review of it. It would be premature to expect that the rights of indigenous communities will be significantly protected by this Constitutional Court decision, as none of the indigenous communities, such as the Orang Rimba keep written records to confirm their rights.

Defining communal land rights among the Orang Rimba, who are/were migratory hunter-gatherers rather than sedentary agriculturalists, is a difficult task. They did not occupy the land even in a collective manner but were people who moved around in *Jelajah* (an area of foraging and hunting) and lived on the periphery of the current SAL plantation just prior to the arrival of the SAL corporation. It is not clear how long they lived there. Whenever there was a death in their family group, they would fold up their tents, move for several months, and look for a new place to live. This was possible in the days when the forests were rich, but now that the land has been encroached upon by oil palm plantations, industrial plantations and migrants, it is difficult for the Orang Rimba to continue this way of life.

It is difficult at this point to recognize the entire population of Orang Rimba scattered in four regencies of Jambi as one Customary Law Community. It may be possible if authority is given to the governor of the province, rather than to the regencies. Alternatively, if this were done under the authority of the President, it would be more likely to have an effect. However, the idea of establishing an all-Orang Rimba Customary Law Community is not currently being considered.

Indonesia has only endorsed the UN resolution recognizing the rights of indigenous peoples and has not actively pursued policies that would push for the expansion of indigenous rights in domestic law.[49] The government's recommendation for recognition of *Masyarakat Hukum Adat* is not a remedy for the current situation of the Orang Rimba, as it requires (1) territoriality, (2) the existence of autonomous customary law, and (3) a permanent management entity. Working from the foundation of the Jokowi Administration's Land for Agrarian Reform policy (TORA), it might be possible that the Orang Rimba, who have conventionally lived in the vicinity of SAL corporation operations and had a portion of their land confiscated by these operations, be given 5 ha of land per household to cultivate wild rubber and other crops.

On October 26, 2021, the Sarolangun Regency government announced that for the first time, the governor of Sarolangun Regency issued 105 TORA certifications to the indigenous inhabitants of Desa Spintun, Sarolangun Regency in Jambi. Furthermore, they confirmed plans to extend the TORA certification to additional areas within the Regency. Antara News also highlighted that in 2023, the Ministry of Forestry in Jambi intends to broaden the scope of the TORA program.[50]

Interestingly, the recipients of these certificates were not the Orang Rimba, but rather, the Batin Sembilan people. Both groups are commonly referred to as SAD (Suku Anak Dalam), which translates to "peoples in outback." Historically, the Batin Sembilan people were involved in upland rice cultivation, and those awarded the certificates had been residents of the area, engaging in

49 Regrettably, the 2023 IWGIA report reads: "Throughout 2022, Indigenous Peoples in Indonesia demonstrated their resilience to the political pressure and policies that were increasingly moving away from the agenda of recognizing and protecting Indigenous Peoples. The fact that recognition has been confirmed in the Constitution does not necessarily mean that the State is carrying out its mandate to establish the Indigenous Peoples Law. After a long process of more than a decade, the Indigenous Peoples Bill remains simply a bill in Parliament. By the end of 2022, the Indigenous Peoples Bill had again failed to be adopted into law, as in previous years. In the midst of this situation, there have recently been a number of discriminatory laws and regulations enacted that have placed Indigenous Peoples in an increasingly threatened position."

50 Pemerintah Kabupaten Sarolangun (2021), and Antara Jambi (2022).

swidden rice cultivation long before the arrival of SAL. To date, no Orang Rimba has received a TORA certificate, and there is no clear indication that they will in the foreseeable future.[51]

The TORA program, under the Joko Widodo administration, seems to offer significant opportunities for indigenous populations. However, it appears to show a preference for completely sedentary peoples, sidelining the Orang Rimba who, while settled, still aspire to maintain a semi-nomadic way of life. Given the divide between the Orang Rimba and governmental policy, it remains crucial to explore strategies that safeguard the land rights of the Orang Rimba.

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Abbreviations and Indonesian Words

Adat	Customary Practice and Law
AMAN	Aliansi Masyrakat Adat Nusantara (Nusantara Association of Customary Law Society)
BDNP	Bukit Duabelas National Park
Hak Ulayat	Communal Land Rights
Jelajah	Area of Foraging and Hunting
Masyarakat Adat	Indigenous (*Adat*) Society
Masyarakat Hukum Adat	Customary Law Community
Tanah Ulayat	Communal Land
Tumenggung	Senior Leader of a Nomadic Group of Orang Rimba
WARSI / KKI WARSI	The Indonesian Conservation Community

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