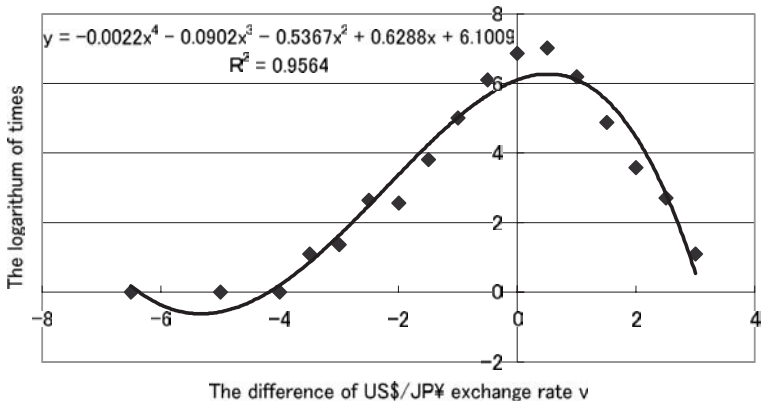

Fig. 7. We show the logarithmic histogram of the differenced time series and its typical regression with the graph of a polynomial of degree 4.

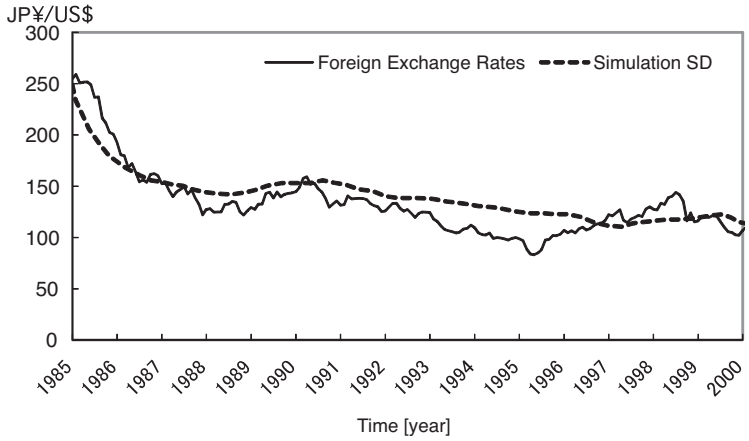

Fig. 8. We compare the central rate time series and the time series generated by the numerical simulation.

which are not probability density functions but movement of the variable. We can compare the solutions with the time series data and verify the reducing method to construct the SDE.

5.1 Numerical simulations of our mathematical model

We proposed a construction method of the mathematical model on time series data with Markov property and obtained a SDE as a mathematical model. To be concrete, we applied the method to the differenced time series data of the central rate $\{\tilde{v}_t\}_{t\in K}$ and constructed a mathematical model (9) of $\{\tilde{v}_t\}_{t\in K}$. In this section, we calculate the numerical simulation on Eq. (9) and evaluate the SDE obtained for the description of the JP¥/US$ exchange rate time series in Subsection 4.3. The SDE cannot describe the central rates but the difference of them; therefore it is necessary to integrate with a time valuable for the description. We reproduce the central rate with the integration.

The initial condition –1.12 was given by the normalized difference of the time series data of the central rate. We used pseudo random number series obtained by the linear congruential method (Lehmer, 1951). Series of the pseudo random numbers whose domain was [0, 1) were standardized respectively because of the standard deviation on the Gaussian white noise. We introduced these series into the white noise terms on the difference equation that we rewrote Eq. (9) into. We calculated the difference equation with the Runnge-Kutta-Gill formula by the time step 1. We transformed values on the time series obtained with this method in accordance of the inverse transformation of Eq. (6). Thus, we regenerate the differenced time series of the central rates $\{\hat{v}_t\}_{t\in K}$ and integrated them on each time step to compare the time series data of the central rate. That is, we regressed variations of the central rate with use of the following series:

$$\hat{\varsigma}_{j+1} = \varsigma_{1985.11.1} + \sum_{i=1985.11.1}^{j} \hat{v}_i \quad (j = 1985.11.1 - 2001.1.30). \tag{10}$$

We show this time series obtained with the method proposed in this paper and time series of the central rate (Fig. 8). We compare these series and evaluate the NSDE (9) in the next section.

5.2 Evaluation for the mathematical model

In the previous researches, the time series on the central rate were described by the multiple regressions with economic variables. We compare these previous regression models with the SDE (9) here.

Their coefficient of determination R^2 is about 0.72 with-