Is a Markov Switching Model using Genetic Algorithm probabilities appropriate in determining Bitcoin price regimes?

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Research Proposal

In this paper we propose Bitcoin's exchange rate follows a regime changing structure. Engel and Hamilton (1989, 1990, 1994), among others have suggested exchange rates can be forecasted using a Markov Switching Model. Following their work we construct a MSM assuming two price regimes, a high period - typified by an exponential rise in value, and a low period - typified by low value, both with high volatility. In our paper we shall consider 3 markov models, each in which the two price regimes are normally distributed. The models differ in only how the probabilities enter in the transition matrix. In the first case, our base case of comparison, we consider constant probabilities, found using maximum likelihood, as in Hamilton (1990). In the second case we consider time-varying probabilities as in Diebold, Lee and Weinbach (1994). In the third case we propose time varying probabilities evolving by genetic algorithm.

To elaborate our Genetic Algorithm, we begin by constructing a a binary string (gene) of chromosomes equaling 0 if this predicting variable (chromosome) suggests state will be the same next period, and 1 if it suggests a change in regime. Taking the average of the gene returns our probabilities. Composing our $x_k, k = 1, 2, \ldots, K$ predicting variables are: exogenous variables unique to predicting bitcoin price that others have used such as market sentiment, hash rate, gold, and a stock market index; exogenous variables that are used in predicting exchange rates of fiat currencies such as differentials in inflation and interest rates, current account deficits, public debt, terms of trade, political stability and economic performance; finally we include the class of endogenous variables constructed from patterns such as the triangle pattern, and head-and-shoulder pattern as suggested by Shah and Zhang (2014).

In all three cases we split our sample into three subsets, ordered as a training period, in-sample forecast period (validation period), and out-of-sample forecast period (testing period). We start time $t = 0$ at the beginning of the validation period, using the time before as historical data needed to start predictions at time $t = 0$, in the validation period we use maximum likelihood to find our unknown parameters, in case 1 these are: $\theta_H = (\mu_0, \sigma_0^2, \mu_1, \sigma_1^2, \beta_{00}, \beta_{10}, \rho)$, in the second case these are: $\theta_T = (\mu_0, \sigma_0^2, \mu_1, \sigma_1^2, \beta_{00}, \beta_{01}, \beta_{10}, \beta_{11}, \rho)$, and in the third case these are: $\theta_G = (\mu_0, \sigma_0^2, \mu_1, \sigma_1^2, \omega_{01}, \omega_{02}, \omega_{11}, \omega_{12}, \ldots, \omega_{sk}\rho)$ where ω_{sk} indicates the weight of the $k-th$ variable in the probability of staying in state $s = \{0, 1\}$. We further propose the time-varying weights of the variables can help us glean which variables are influential in the determining of regimes (and hence price) through the time-periods.

We have Bitcoin data on *every* trade on the Coinbase exchange for USD from December 1st 2014 till March 27th 2018, and every trade on Coincheck for JPY from October 31st 2014 till March 27th 2018. We will likely have to aggregate this to minute or daily data. Besides these the most difficult data to obtain will be the Market sentiment data, which we will derive from Twitter. The rest of the data mentioned will come from various sources.

References

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