TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Business and Economics Finance and Financial Services

ARE CRYPTOCURRENCIES THE NEW GOLD?

A VOLATILITY BASED ANALYSIS

Tony Klein, Hien Pham-Thu, Thomas Walther

tony.klein@tu-dresden.de

Workshop: Crypto-Currencies in a Digital Economy

Berlin, November 17, 2017

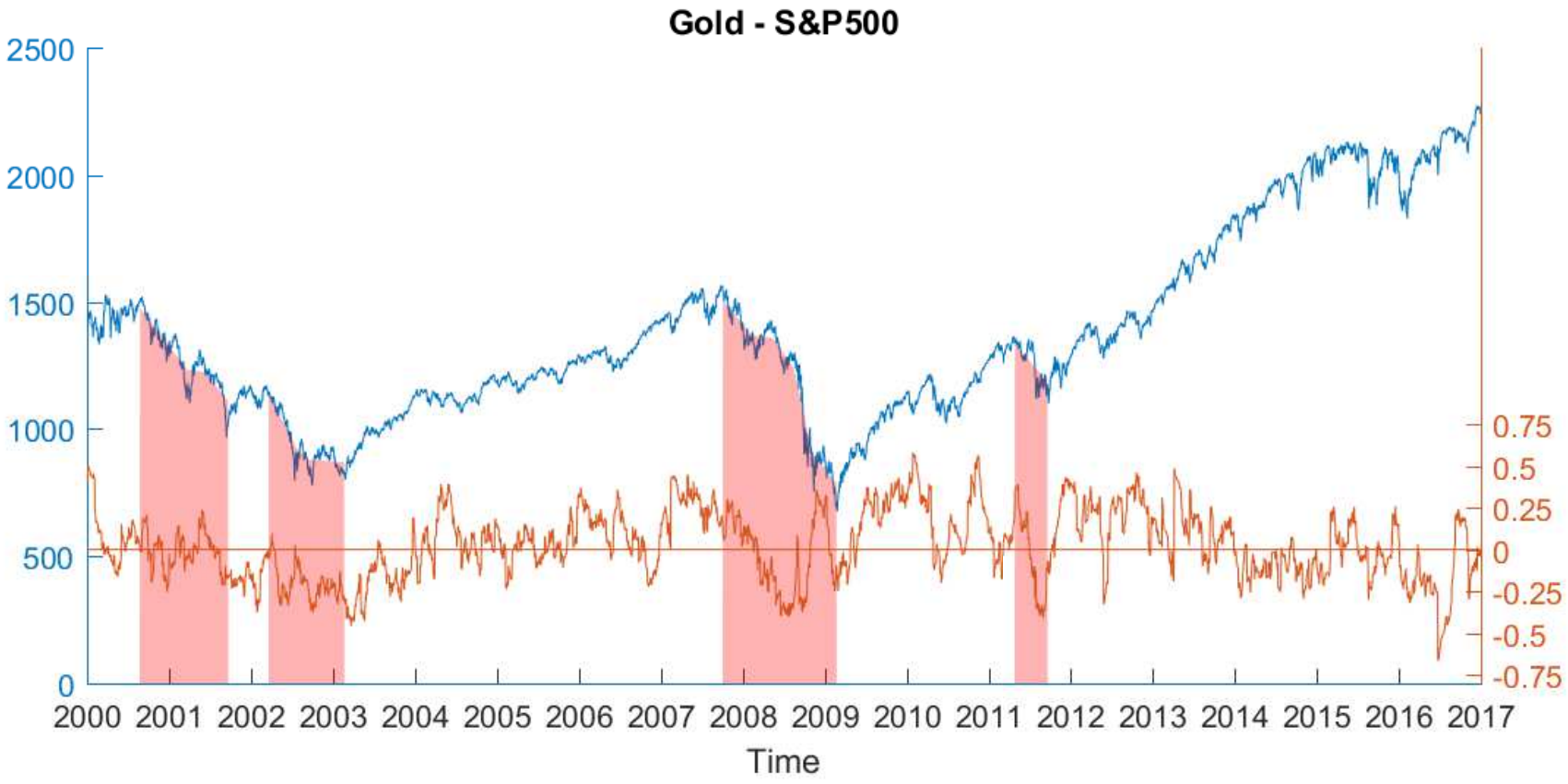

Figure: Gold-S&P500 dynamic correlation, Adjusted-DCC (orange) and index points (blue), market turmoil (red) identified by linear trend analysis; figure taken from Klein (2017).

Outline

1. What is a Safe-Haven and why Gold?
2. Methodology
3. Data
4. Results & Concluding Remarks

01 What is a Safe-Haven?

On a classification of assets during market pressure...

- Baur & Lucey (2010) distinguish three asset types in view of portfolio loss reduction

(1) *Hedge*
uncorrelated/negatively correlated on average

(2) *Diversifier*
positively correlated on average

(3) *Safe-Haven*
negatively correlated in distressed markets
$\Longrightarrow$ emphasis on temporal property

01 Gold as a Safe-Haven

- precious metals, in particular Gold, are considered safe-haven investments
- demand and prices rise during bearish environments
- *flight-to-quality* phenomenon (Hammoudeh et al., 2010)
- Sensoy (2013) and Chkili (2016) identify Gold as safe-haven for BRICS countries
- weak safe-haven, inferior to VIX in Hood & Malik (2013)
- dissipating safe-haven properties on recent data (Klein, 2017)

How about Cryptocurrencies or crypto-indices such as CRIX?

- Comparison of volatility behavior
- Correlation analysis
- Cryptocurrencies as portfolio components

Literature on investment strategies is growing...

- Dyhrberg (2016): Bitcoins hedge for stock markets, short-term hedge in FX markets (data up to 05/2015)
- Bouri et al. (2017b): Bitcoins are diversifier and weak hedge (data up to 12/2015)
- Bouri et al. (2017a): Bitcoins hedge global uncertainty (data up to 10/2016)

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02 Methodical Approaches

Volatility Modeling

- idiosyncratic volatility modeled with GARCH-type processes accounting for properties such as
  - volatility clustering
  - long memory (persistence of vola shocks)
  - asymmetric vola response

$$
\begin{aligned}
y_t &= \mu_t + \varepsilon_t, \\
\varepsilon_t &= z_t \sqrt{h_t}, \quad \text{with } z_t \sim \text{St-}t(\nu) \text{ i.i.d.}, \\
h_t &= \text{Var}\left(y_t | \mathcal{F}_{t-1}\right)
\end{aligned}
\tag{1}
$$

Model	Definition
GARCH(1,1)	$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}^2$
FIGARCH(1,d_ν,1)	$h_t = \omega_\nu + (1 - \beta_\nu L - (1 - \phi_\nu L)^{d_\nu})\varepsilon_t^2 + \beta_\nu h_{t-1}$
APARCH(1,1)	$h_t^{\delta_\nu/2} = \omega_\nu + \alpha_\nu(\lvert\varepsilon_{t-1}\rvert - \gamma_\nu\varepsilon_{t-1})^{\delta_\nu} + \beta_\nu h_{t-1}^{\delta_\nu/2}$
FIAPARCH(1,d_ν,1)	$h_t^{\delta_\nu/2} = \omega_\nu + (1 - \beta_\nu L - (1 - \phi_\nu L)(1 - L)^{d_\nu})(\lvert\varepsilon_t\rvert - \gamma_\nu\varepsilon_t)^{\delta_\nu} + \beta_\nu h_{t-1}^{\delta_\nu/2}$

Table: Univariate conditional variance model. Non-negativity and stationarity conditions are found in Bollerslev & Mikkelsen (1996), Ding et al. (1993), or Tse (1998).

Correlation Modeling with BEKK

Baba-Engle-Kraft-Kroner (BEKK-MGARCH) model of (Engle & Kroner, 1995) in diagonal specification

$$
\begin{aligned}
\mathbf{H}_t &= \mathbf{C}_0^\top \mathbf{C}_0 + \mathbf{A}_1^\top \epsilon_{t-1}\epsilon_{t-1}^\top \mathbf{A}_1 + \mathbf{G}_1^\top \mathbf{H}_{t-1}\mathbf{G}_1 \\
&= \begin{bmatrix} c_{11} & 0 \\ c_{12} & c_{22} \end{bmatrix} \begin{bmatrix} c_{11} & c_{12} \\ 0 & c_{22} \end{bmatrix} \\
&\quad + \text{diag}\left[a_{11}, a_{22}\right]^\top \begin{bmatrix} \epsilon_{1,t-1}^2 & \epsilon_{1,t-1}\epsilon_{2,t-1} \\ \epsilon_{1,t-1}\epsilon_{2,t-1} & \epsilon_{2,t-1}^2 \end{bmatrix} \text{diag}\left[a_{11}, a_{22}\right] \\
&\quad + \text{diag}\left[g_{11}, g_{22}\right]^\top \mathbf{H}_{t-1} \text{diag}\left[g_{11}, g_{22}\right]
\end{aligned}
$$

with

$$
\mathbf{R}_t = \text{diag}\left[\sqrt{h_{11,t}}, \sqrt{h_{22,t}}\right]^{-1} \mathbf{H}_t \text{diag}\left[\sqrt{h_{11,t}}, \sqrt{h_{22,t}}\right]^{-1}
$$

Components of the minimum variance portfolio

$$\min_{\omega_t} \quad \omega_t^{'} \mathbf{H}_t \omega_t$$

$$s.t. \quad \omega_t^{'} 1 = 1$$

(without liquidity constraints)

03 Data

- cryptocurrencies: CRIX index, Bitcoin price in USD
- indeces: S&P500, S&P1200 Global Technology Index
- precious metals: Gold spot and futures, Silver spot
- FX rates

$\Longrightarrow$ data range 2014-07-31 to 2017-06-30, $n = 757$

- focus on S&P500, Gold, CRIX, Bitcoin

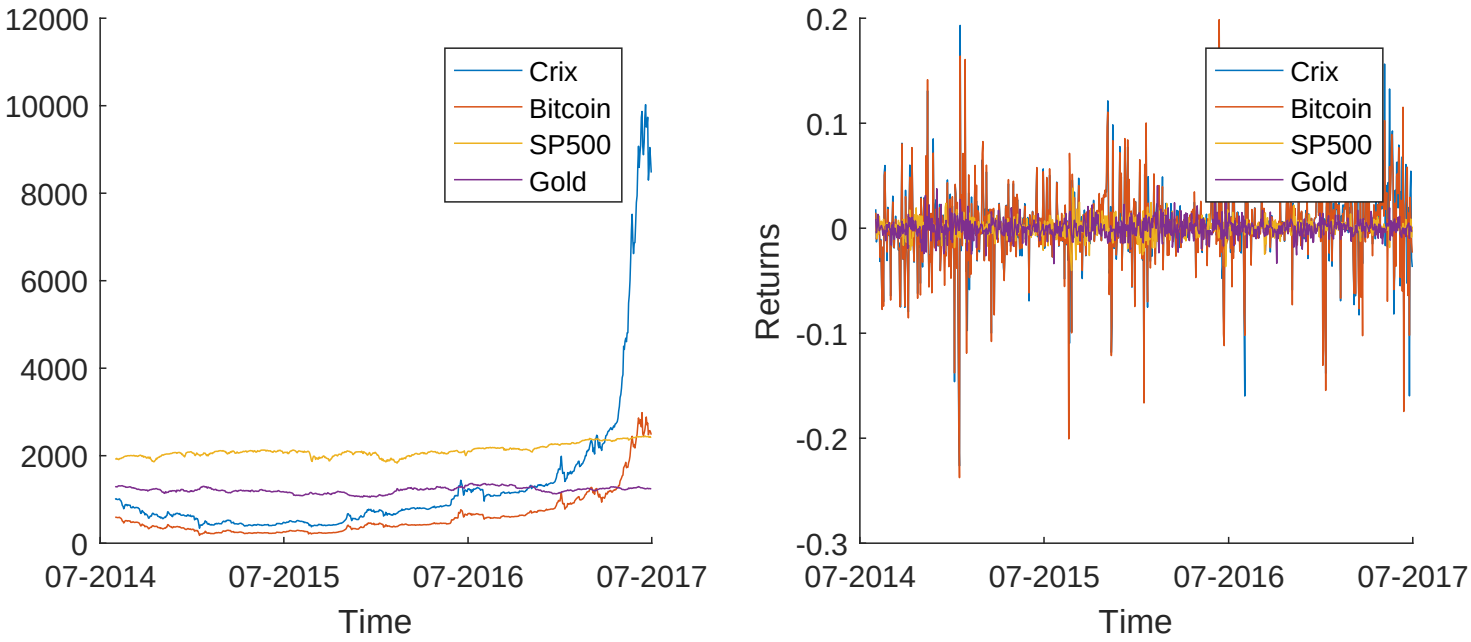


Figure: Price and log-return structure of CRIX, Bitcoin, S&P 500, and Gold.

04 Results

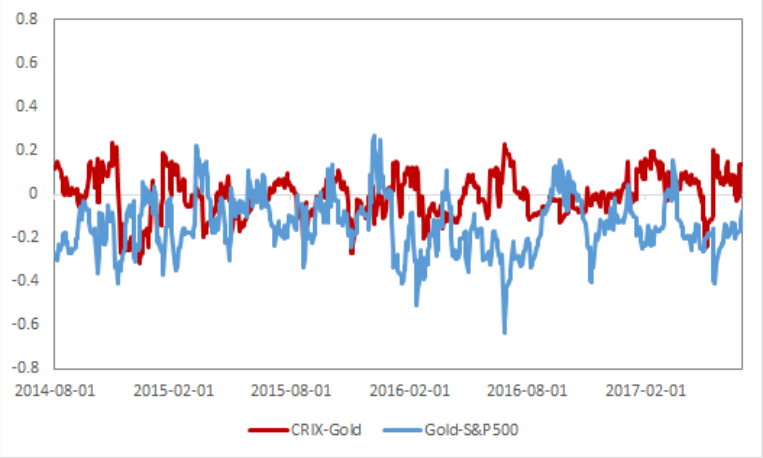
Univariate volatility models

- Gold with strong asymmetric response ($\gamma \approx -0.3000$ in APARCH and FIAPARCH)

$\Longrightarrow$ positive returns increase volatility

- similar behavior for Bitcoin ($\gamma = -0.2100$), CRIX ($\gamma = -0.1700$)
- CRIX/Bitcoin also feature an elevated shock persistence (FIAPARCH best LL/BIC)
- uncond. volatility elevated by factor 10-20 for CRIX/Bitcoin

Results of BEKK



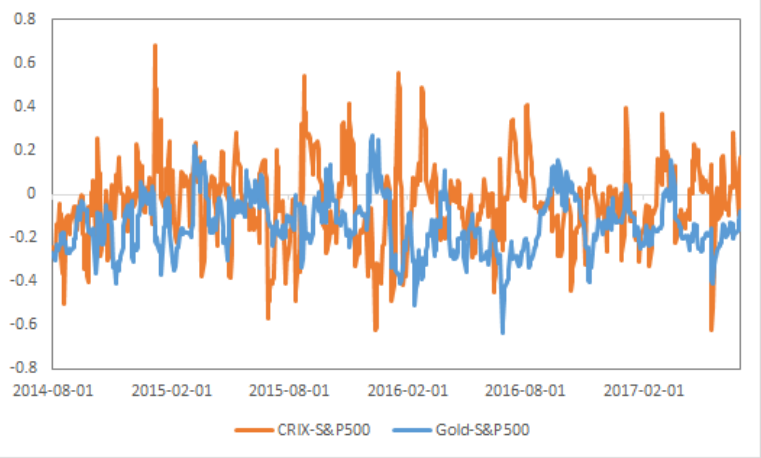


Figure: Correlations calculated from BEKK-MGARCH.

- uncorrelated on average ($\hat{\rho} \approx 0$)
- regular spikes with min/max of up to $-0.6/0.6$

Portfolio Perspect

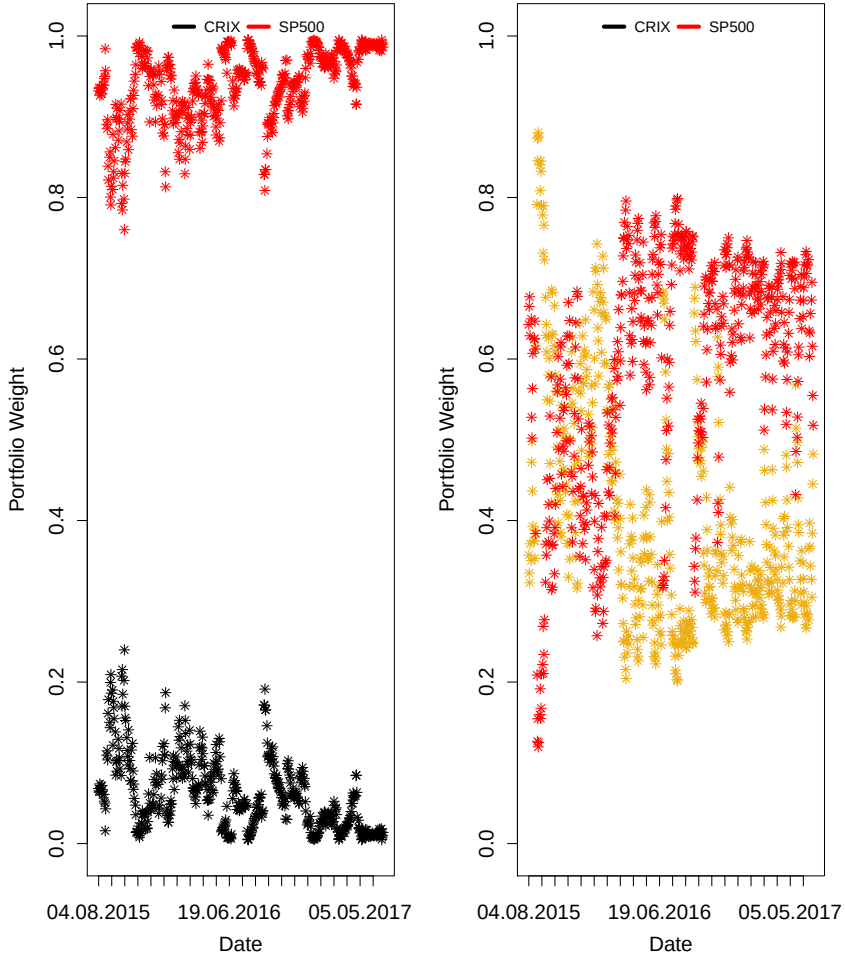


Figure: Portfolio weights calculated via minimum variance portfolio optimisation for PF1 (CRIX and S&P500) and PF2 (Gold and S&P500).

04 Concluding Remarks

- no verification of safe-haven status as no stressed situation occurred
- variance properties of CRIX/Bitcoin different from Gold as classical safe-haven
- correlation shows strong coupling for a few consecutive trading days, zero on average
- data base of daily returns not sufficient (yet)
- CRIX/Bitcoin as portfolio component yield little variance reduction

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