**Appendix**

**Correlation analysis**

**Table S1. C**ovariance analysis for gold and S&P 500 daily returns in financial crisis subsample (2008-2009).

|  |  |  |  |
| --- | --- | --- | --- |
| Covariance Analysis: Ordinary | | |  |
| Date: 05/24/20 Time: 22:47 | | |  |
| Sample: 9/22/2008 3/20/2009 | | |  |
| Included observations: 117 | | |  |
| Balanced sample (listwise missing value deletion) | | | |
|  |  |  |  |
|  |  |  |  |
| Correlation | |  |  |
| t-Statistic | |  |  |
| Probability | |  |  |
| Observations | SP500\_DLOG | GOLD\_DLOG |  |
| SP500\_DLOG | 1.000000 |  |  |
|  | ----- |  |  |
|  | ----- |  |  |
|  | 117 |  |  |
|  |  |  |  |
| GOLD\_DLOG | -0.068167 | 1.000000 |  |
|  | -0.732719 | ----- |  |
|  | 0.4652 | ----- |  |
|  | 117 | 117 |  |
|  |  |  |  |
|  |  |  |  |

\* Significant at 5% level (p<0.05).

**Table S2. C**ovariance analysis of gold and S&P 500 daily returns in COVID-19 subsample (2019-2020).

|  |  |  |  |
| --- | --- | --- | --- |
| Covariance Analysis: Ordinary | | |  |
| Date: 05/21/20 Time: 12:39 | | |  |
| Sample: 12/23/2019 5/19/2020 | | |  |
| Included observations: 89 | | |  |
| Balanced sample (listwise missing value deletion) | | | |
|  |  |  |  |
|  |  |  |  |
| Correlation | |  |  |
| t-Statistic | |  |  |
| Probability | |  |  |
| Observations | GOLD\_DLOG | SP500\_DLOG |  |
| GOLD\_DLOG | 0.000207 |  |  |
|  | 1.000000 |  |  |
|  | ----- |  |  |
|  | ----- |  |  |
|  | 89 |  |  |
|  |  |  |  |
| SP500\_DLOG | 0.000244 | 0.001084 |  |
|  | 0.515097 | 1.000000 |  |
|  | 5.605325 | ----- |  |
|  | 0.0000**\*** | ----- |  |
|  | 89 | 89 |  |
|  |  |  |  |
|  |  |  |  |

\* Significant at 5% level (p<0.05).

**Regression output**

Financial crisis: September 2008 to March 2009

**Table S3.** Regression output of financial crisis subsample: Oct 2008- March 2009.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent Variable: GOLD\_DLOG | | | |  |
| Method: Least Squares | | |  |  |
| Date: 05/24/20 Time: 22:31 | | | |  |
| Sample: 9/22/2008 3/20/2009 | | | |  |
| Included observations: 117 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | -0.000299 | 0.002257 | -0.132359 | 0.8949 |
| SP500\_DLOG | -0.045307 | 0.061834 | -0.732719 | 0.4652 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.004647 | Mean dependent var | | -0.000124 |
| Adjusted R-squared | -0.004008 | S.D. dependent var | | 0.024233 |
| S.E. of regression | 0.024282 | Akaike info criterion | | -4.581241 |
| Sum squared resid | 0.067804 | Schwarz criterion | | -4.534025 |
| Log likelihood | 270.0026 | Hannan-Quinn criter. | | -4.562072 |
| F-statistic | 0.536877 | Durbin-Watson stat | | 2.117752 |
| Prob(F-statistic) | 0.465221 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |



**Figure S1.** Plottedfitted **r**esiduals of regression for financial crisis subsample (2008-2009).

**Table S4.** Quandt-Andrews unknown breakpoint test

|  |  |  |  |
| --- | --- | --- | --- |
| Quandt-Andrews unknown breakpoint test | | | |
| Null Hypothesis: No breakpoints within 15% trimmed data | | | |
| Varying regressors: All equation variables | | | |
| Equation Sample: 9/22/2008 3/20/2009 | | | |
| Test Sample: 10/16/2008 2/25/2009 | | | |
| Number of breaks compared: 82 | | | |
|  |  |  |  |
|  |  |  |  |
| Statistic | Value |  | Prob. |
|  |  |  |  |
|  |  |  |  |
| Maximum LR F-statistic (10/20/2008) | 5.935979 |  | 0.0439 |
| Maximum Wald F-statistic (10/20/2008) | 11.87196 |  | 0.0439 |
|  |  |  |  |
| Exp LR F-statistic | 1.287964 |  | 0.0969 |
| Exp Wald F-statistic | 3.406127 |  | 0.0404 |
|  |  |  |  |
| Ave LR F-statistic | 1.522421 |  | 0.1708 |
| Ave Wald F-statistic | 3.044842 |  | 0.1708 |
|  |  |  |  |
|  |  |  |  |
| Note: probabilities calculated using Hansen's (1997) method | | | |
| WARNING: estimation sample is non-continuous (probabilities | | | |
| calculated assuming a continuous sample) | | | |

**Table S5.** Regression output of reduced financial crisis subsample: Sep-Oct 2008.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent Variable: GOLD\_DLOG | | | |  |
| Method: Least Squares | | |  |  |
| Date: 05/24/20 Time: 22:36 | | | |  |
| Sample: 9/22/2008 10/20/2008 | | | |  |
| Included observations: 21 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | -0.007735 | 0.006005 | -1.288120 | 0.2132 |
| SP500\_DLOG | -0.303586 | 0.120831 | -2.512485 | 0.0212 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.249385 | Mean dependent var | | -0.004238 |
| Adjusted R-squared | 0.209879 | S.D. dependent var | | 0.030116 |
| S.E. of regression | 0.026769 | Akaike info criterion | | -4.312727 |
| Sum squared resid | 0.013615 | Schwarz criterion | | -4.213249 |
| Log likelihood | 47.28363 | Hannan-Quinn criter. | | -4.291138 |
| F-statistic | 6.312579 | Durbin-Watson stat | | 2.537897 |
| Prob(F-statistic) | 0.021175 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Table S6.** Regression output of reduced financial crisis subsample: Oct 2008-Mar 2009.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent Variable: GOLD\_DLOG | | | |  |
| Method: Least Squares | | |  |  |
| Date: 05/24/20 Time: 23:44 | | | |  |
| Sample: 11/20/2008 3/20/2009 | | | |  |
| Included observations: 74 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 0.001601 | 0.002526 | 0.633754 | 0.5282 |
| SP500\_DLOG | 0.167556 | 0.086824 | 1.929831 | 0.0576 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.049182 | Mean dependent var | | 0.001580 |
| Adjusted R-squared | 0.035976 | S.D. dependent var | | 0.022133 |
| S.E. of regression | 0.021731 | Akaike info criterion | | -4.793479 |
| Sum squared resid | 0.034002 | Schwarz criterion | | -4.731207 |
| Log likelihood | 179.3587 | Hannan-Quinn criter. | | -4.768638 |
| F-statistic | 3.724248 | Durbin-Watson stat | | 2.041141 |
| Prob(F-statistic) | 0.057568 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |





**Figure S2.** Histograms confirming the normality of gold and S&P 500 returns in reduced financial crisis subsample (Sep-Oct 2008).

COVID-19 pandemic: December 2019 to May 2020

**Table S7.** Regression output of COVID-19 pandemic subsample.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent Variable: GOLD\_DLOG | | | |  |
| Method: Least Squares | | |  |  |
| Date: 05/24/20 Time: 22:52 | | | |  |
| Sample (adjusted): 12/23/2019 5/19/2020 | | | |  |
| Included observations: 89 after adjustments | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 0.001393 | 0.001325 | 1.051184 | 0.2961 |
| SP500\_DLOG | 0.225371 | 0.040207 | 5.605325 | 0.0000 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.265325 | Mean dependent var | | 0.001022 |
| Adjusted R-squared | 0.256880 | S.D. dependent var | | 0.014485 |
| S.E. of regression | 0.012486 | Akaike info criterion | | -5.906133 |
| Sum squared resid | 0.013564 | Schwarz criterion | | -5.850209 |
| Log likelihood | 264.8229 | Hannan-Quinn criter. | | -5.883592 |
| F-statistic | 31.41967 | Durbin-Watson stat | | 1.860022 |
| Prob(F-statistic) | 0.000000 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |



**Figure S3.** Fitted **r**esiduals of COVID-19 subsample (2019-2020) regression analysis.