Gold Price Relationships Before and After the Global Financial Crisis

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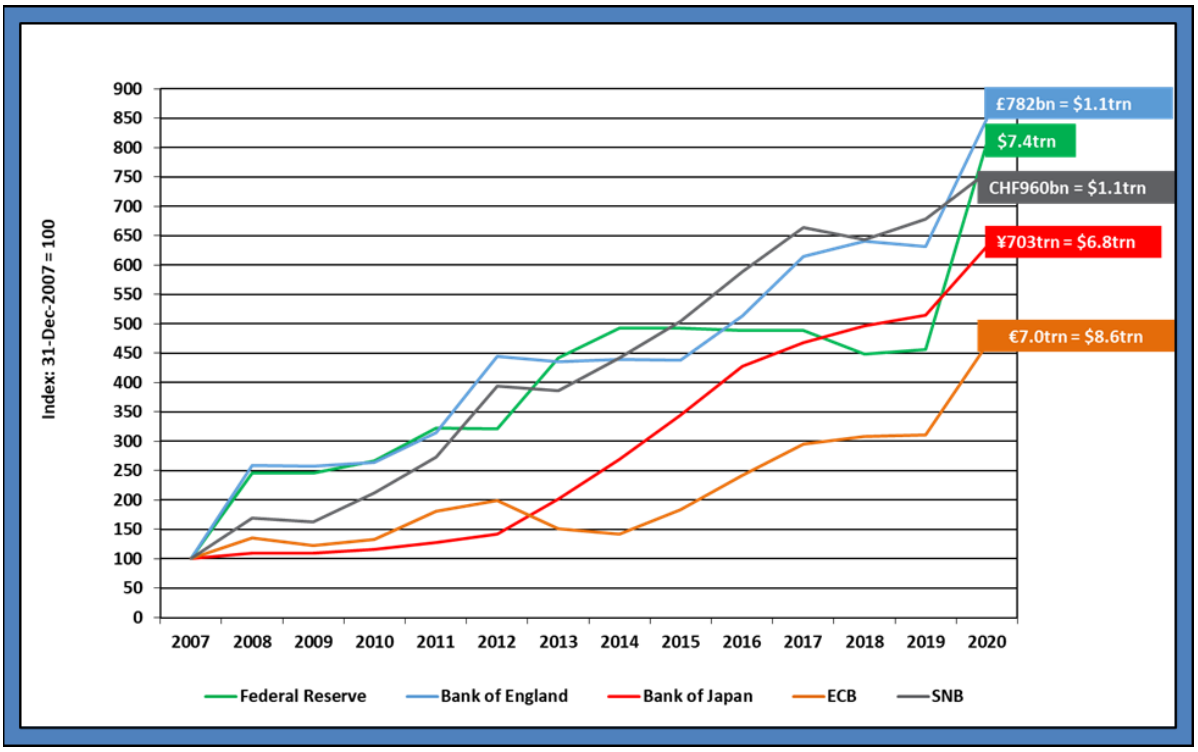
Introduction

A feature of financial markets over the past 12 years is that central banks around the world have engaged in a series of large-scale asset purchase programs. Policies that once would have been viewed as nothing more than theoretical textbook anomalies are now firmly established as a core part of central bankers' toolkits. The Federal Reserve's balance sheet has grown by about 8x since the onset of the Global Financial Crisis, as have the balance sheets of the Bank of England and the Swiss National Bank (SNB); the Bank of Japan's balance sheet has expanded over sixfold while the European Central Banks's (ECB's) has increased by a factor of nearly five. A natural question to ask is: what impact has this unusual central bank activity had on the market for gold?

Figure 1
Central Bank Balance Sheets Since the Global Financial Crisis



Sources: National Central Banks, EFG calculations.

What Drives the Gold Price?

Unlike most metals, gold is unusual in that it has relatively few practical uses. The majority of gold demand has historically been for jewelry and investment purposes. On average over the 10 years to end 2019, 51.3% of gold demand was for jewelry, 29.3% was for investment purposes and a further 11.3% originated from central banks and other institutions. Only 8.2% of gold demand was attributed to technological uses, comprised of electronics (6.3%), other industrial (1.3%) and dentistry (0.5%). Over the first three quarters of 2020, the investment share of total demand increased sharply to 55% as the shares attributable to demand for jewelry and from central banks dropped.

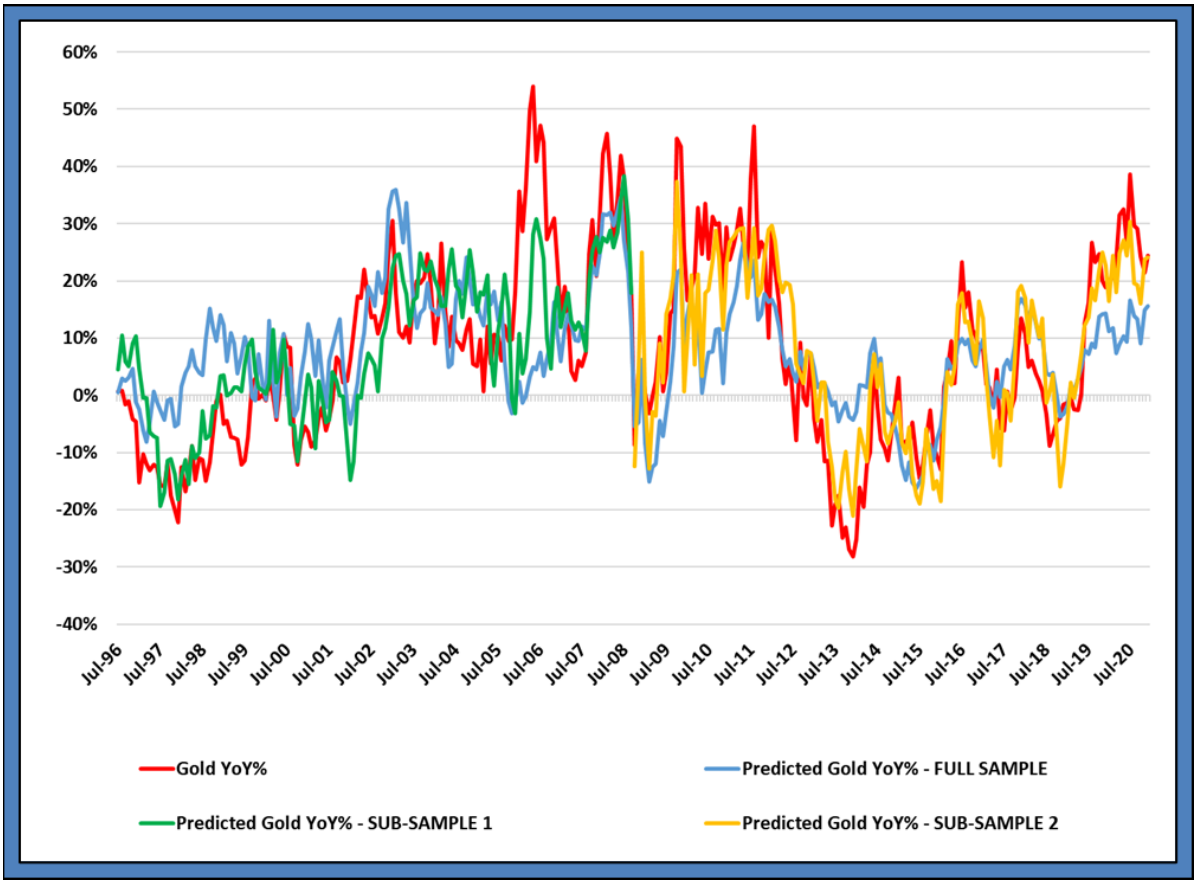
These different demand groups roughly coincide with the four factor groups the World Gold Council identifies as driving the gold market:

(i) Wealth and economic expansion
(ii) Market risk and uncertainty
(iii) Opportunity cost
(iv) Momentum and positioning.

On their website the World Gold Council shows the results of a model that seeks to explain movements in the gold price according to these four factor groups. Whilst details of the model are not provided, it is

possible to perform a simple linear regression analysis that appears to broadly replicate the World Gold Council's model using monthly data from July 1996 to December 2020. For reference, the dependent variable is year-over-year percent changes in the gold price and the explanatory variables are year-over-year changes in the VIX index of implied volatility and the 10-year Treasury yield and year-over-year percent changes in the oil price, the trade weighted U.S. dollar and the U.S. Consumer Price Index (CPI inflation). Figure 2 shows how the model does a reasonable job at explaining changes in the gold price. For reference, the R^2 of the model is 36.8%.

Figure 2
YoY% Changes in the Gold Price: Predicted and Actual



Sources: Bloomberg, EViews, EFG calculations.

Figure 2 also shows the predicted values for two sub-sample models using the same dependent and explanatory variables. The first sub-sample runs from July 1996 to September 2008 and the second sub-sample starts in October 2008 and ends in December 2020. October 2008 was chosen because that was the month in which the U.S. Federal Reserve began its first quantitative easing program. July 1996 was chosen as the start date so that there are an equal number of observations before and after the suspected break point (which increases the power of the breakpoint test).

Several points are worth noting. First, the R^2 for the first sub-sample regression is 58.7%, a decent improvement over the whole sample regression. The second sub-sample R^2 jumps even more impressively to 75.4%. Furthermore, there are meaningful changes in the parameter estimates.

In the whole sample regression, the coefficients on CPI inflation and on changes in the VIX are not significant whereas the CPI inflation coefficient is significant in both sub-samples and the VIX coefficient is significant only in the second sub-sample. However, the coefficient on CPI inflation changes sign from positive in the first sub-sample to negative in the second sub-sample as does the coefficient on changes in the 10-year Treasury yield. And in the first sub-sample, the constant and the coefficient on percent changes in the oil price are insignificant whereas they are highly significant in the second sub-sample. Only the coefficient on the trade weighted dollar was significant with an unchanged sign in both sub-sample regressions. See Table A1 in the Appendix for more detail. So the relationship appears to have changed meaningfully before and after the Global Financial Crisis (GFC). A simple Chow test confirms that a structural break is present from October 2008 onwards (F statistic = 43.1).

A VAR Approach to Causality

Whilst a simple single equation linear approach to modeling the gold price is informative and intuitive in some respects, it assumes that the left-hand side variable is determined by the right-hand side variables. In reality the relationships between these variables are more complex with a high degree of interaction between them. For example, a commonly held market view is that the gold price is negatively correlated with the U.S. dollar. Whilst the simple linear approach does indeed seem to confirm that view, it says nothing about the direction of causality. Does the gold price lead the dollar or vice versa? Is the relationship two-way? What about interactions between and with the other variables? Using a simple linear approach may lead to erroneous conclusions being drawn.

One way to investigate the relationships between these variables is to use a Vector Autoregressive or VAR model. Following a similar approach to the simple linear model described above, VAR analysis was performed both on the full sample and the two sub-sample periods.

A convenient feature of VAR models is that they allow straightforward investigation of Granger causality. Table 1 shows the results for year-over-year percent changes in the gold price. The analysis illustrates how in the full sample it is only changes in the 10-year Treasury yield that weakly Granger cause percent changes in the gold price and in the first sub-sample there is no evidence of Granger causality from any of the variables to the gold price. However, there is evidence in the second sub-sample that percent changes in the gold price are Granger caused by the 10-year Treasury yield, the trade weighted dollar and inflation. This apparent shift in causal relationships supports the view that the behavior of the gold price and its relationship with other variables has changed meaningfully since the GFC.

Table 1
What Granger Causes YoY% Changes in the Gold Price?

		Dependent Variable: Gold Price YoY%		
		Full	Sub Sample 1	Sub Sample 2
Lagged Variables	Brent Oil Price YoY%	X	X	X
	10-Year Treasury yield Change over 12m	(✓)	X	✓
	Trade Weighted Dollar YoY%	X	X	(✓)
	CPI YoY%	X	X	✓
	VIX Change over 12m	X	X	X
✓ = statistically significant at 5%, (✓) = statistically significant at 10%, X = not statistically significant				

Sources: EViews, EFG calculations.

It's also interesting to look at other relationships to see if percent changes in the gold price Granger cause any of the other variables. This information is summarized in Table 2.

Table 2
What is Granger Caused by YoY% Changes in the Gold Price?

		Dependent Variable				
Lagged Variable: Gold Price YoY%		Brent Oil Price YoY%	10-Year Treasury Yield Change over 12m	Trade Weighted Dollar YoY%	CPI YoY%	VIX Change over 12m
	Full Sample	X	X	X	(✓)	X
	Sub-sample 1	(✓)	X	✓	X	X
	Sub-sample 2	X	✓	X	(✓)	X
✓ = statistically significant at 5%, (✓) = statistically significant at 10%, X = not statistically significant						

Sources: EViews, EFG calculations.

The results here are also revealing and supportive of the view that the relationships have changed since the GFC. In the full sample analysis percent changes in the gold price weakly Granger cause inflation whereas in the first sub-sample percent changes in the gold price Granger cause only percent changes in the price of Brent oil and the trade weighted dollar. In the second sub-sample the results change yet again: percent changes in the gold price Granger cause only changes in the 10-year Treasury yield and inflation.

If we consider the second sub-sample relationship as the one that best describes the current environment, it suggests that there is bi-directional Granger causality between percent changes in the gold price and changes in the 10-year Treasury yield and inflation, whilst there is weaker evidence that percent changes in the gold price are Granger caused by percent changes in the trade weighted dollar.

Impulse Responses

A separate feature of VAR models is that they allow investigation of what would happen to the system if a variable were to experience an unexpected shock. As with the Granger causality analysis, the focus will remain on the behavior of gold and for the sake of brevity results are discussed solely for the second sub-sample. A full set of charts showing the impulse response functions for both sub-samples is provided in the Appendix.

Of the five impulse response functions related to the impact on gold of an unexpected change in one of the other variables, only two are significant. These are shown in Figures 3a and 3b. For the other variables – percent changes in the price of Brent oil, inflation and the change in the VIX index – the responses are not meaningful.

Figure 3a

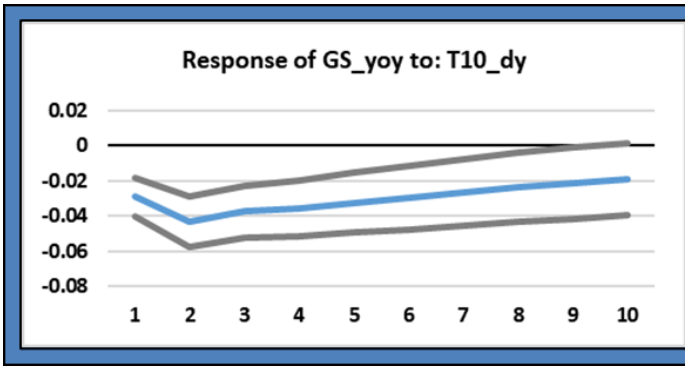
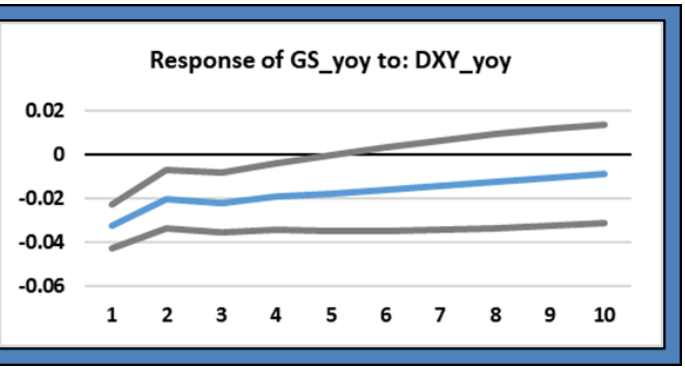


Figure 3b



Sources: EViews, EFG calculations.

Note: GS_yoy = YoY% change in the gold price, T10_dy = YoY change in the 10-year Treasury yield, DXY_yoy = YoY% change in the trade weighted dollar.

Figure 3a illustrates how a sudden move (one standard deviation) higher (lower) in the 10-year Treasury yield would be expected to result in an immediate decline (increase) in the year-over-year percent change in the gold price, the effect of which peaks one month after the initial shock. Figure 3b illustrates how a sudden move higher (lower) in the trade weighted dollar would also be expected to result in an immediate decline (increase) in the year-over-year percent change in the gold price, the effect of which declines immediately after the initial shock.[1] These results are perhaps not surprising given the Granger causality discussed above. For reference, the impulse response functions of gold to the other variables in the first sub-sample are all statistically insignificant from 0 apart from the trade weighted dollar for which the response is similar to but weaker than in the second sub-sample.

Conclusions

The purpose of this article was to investigate the behavior of the gold price to see if its relationships with other variables have changed in the post-GFC environment. A standard linear regression approach suggests that a structural break occurred during the GFC - perhaps as a result of semi-permanent changes in the operation of monetary policies around the world - following which the relationship between gold and the other variables appears to have changed meaningfully. However, such a modeling approach may not be appropriate.

Further insights are provided by a VAR analysis that allows for more sophisticated interactions between the variables. The results of this analysis are also consistent with a structural break having occurred during the GFC, as evidenced by significant changes in Granger causality test results. Those tests and the accompanying impulse response functions indicate that year-over-year percent changes in the gold price respond negatively to unexpected changes in the 10-year Treasury yield and percent changes in the trade weighted dollar. However, these relationships are bi-directional: it is inappropriate to assume that causality runs in one direction only, as is the case with the linear model. What is perhaps more surprising and contrary to widely held market wisdom is that no statistical relationship has been found between percent changes in the gold price and changes in the VIX index.

More generally, market participants often make assertions about the relationship between the gold price and the variables used in the analysis presented in this report. This article seeks to deepen and formalize our understanding of those relationships, taking into consideration the dramatic shift in monetary policy operation that has taken place since the GFC.

Appendix

Table A1
Ordinary Least Squares (OLS) Regression Results

	FULL SAMPLE		SUB-SAMPLE 1		SUB-SAMPLE 2	
	Coefficient	t statistic	Coefficient	t statistic	Coefficient	t statistic
BRENT_YOY	0.125	3.748	-0.034	-1.055	0.410	9.256
T10_DY	-0.074	-6.015	0.042	2.743	-0.195	-17.693
DXY_YOY	-0.866	-8.239	-1.289	-11.403	-0.917	-7.852
CPIYOY	0.001	0.067	0.080	6.792	-0.064	-6.025
VIX_DY	0.000	-0.208	-0.001	-0.424	0.002	2.642
C	0.053	2.695	-0.130	-4.312	0.149	8.186

Table A2
Granger Causality Results: Full Sample
Null: lagged coefficients do not Granger cause the dependent variable
Values in cells are probabilities of not rejecting the Null based on Chi-sq test statistics

		FULL SAMPLE Dependent Variable					
		GS_YOY	BRENT_YOY	T10_DY	DXY_YOY	CPIYOY	VIX_DY
Lagged Variables	GS_YOY		0.484	0.565	0.433	0.094	0.697
	BRENT_YOY	0.468		0.250	0.154	0.000	0.134
	T10_DY	0.072	0.017		0.204	0.053	0.817
	DXY_YOY	0.391	0.041	0.717		0.123	0.535
	CPIYOY	0.353	0.111	0.155	0.142		0.002
	VIX_DY	0.515	0.054	0.039	0.457	0.003	

Table A3
Granger Causality Results: Sub-sample 1
Null: lagged coefficients do not Granger cause the dependent variable
Values in cells are probabilities of not rejecting the Null based on Chi-sq test statistics

		SUB SAMPLE 1 Dependent Variable					
		GS_YOY	BRENT_YOY	T10_DY	DXY_YOY	CPIYOY	VIX_DY
Lagged Variables	GS_YOY		0.059	0.351	0.002	0.271	0.569
	BRENT_YOY	0.159		0.306	0.491	0.000	0.023
	T10_DY	0.945	0.002		0.439	0.055	0.773
	DXY_YOY	0.456	0.045	0.136		0.474	0.266
	CPIYOY	0.128	0.000	0.285	0.001		0.045
	VIX_DY	0.605	0.097	0.255	0.739	0.704	

Table A4
Granger Causality Results: Sub-sample 2
Null: lagged coefficients do not Granger cause the dependent variable
Values in cells are probabilities of not rejecting the Null based on Chi-sq test statistics

		SUB SAMPLE 2 Dependent Variable					
		GS_YOY	BRENT_YOY	T10_DY	DXY_YOY	CPIYOY	VIX_DY
Lagged Variables	GS_YOY		0.716	0.034	0.495	0.072	0.182
	BRENT_YOY	0.620		0.102	0.735	0.000	0.117
	T10_DY	0.005	0.967		0.414	0.049	0.363
	DXY_YOY	0.056	0.021	0.041		0.004	0.641
	CPIYOY	0.025	0.068	0.035	0.195		0.040
	VIX_DY	0.985	0.004	0.601	0.436	0.087	

Charts A1-10
Impulse Response Functions for Year-over-Year Percent Changes in the Gold Price

Sub-sample 1

Chart A-1

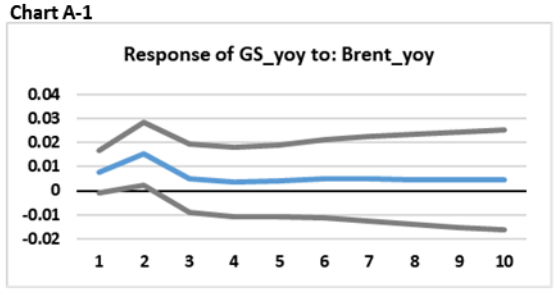


Chart A-2

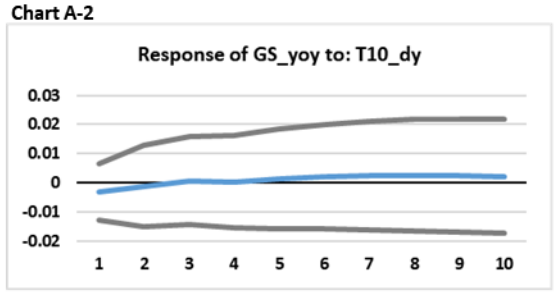


Chart A-3

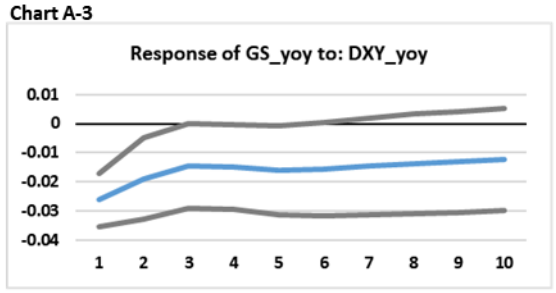


Chart A-4

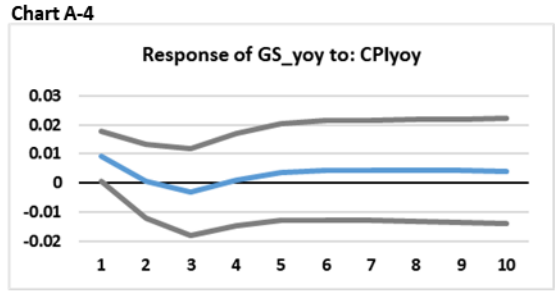
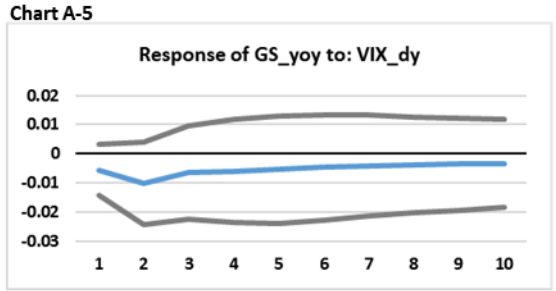


Chart A-5



Sub-sample 2

Chart A-6

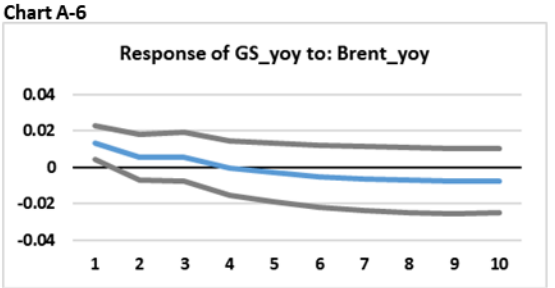


Chart A-7

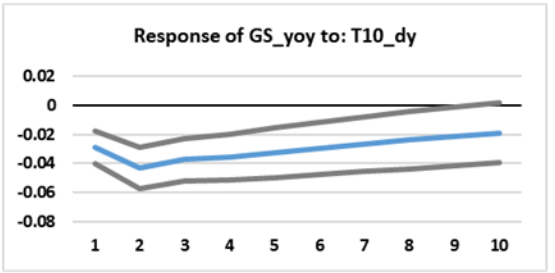


Chart A-8

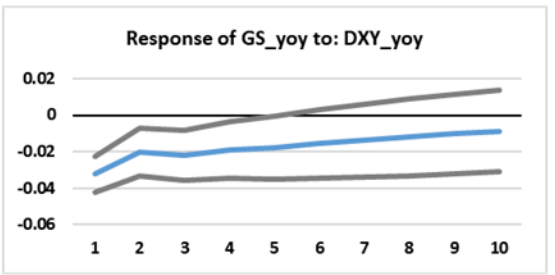


Chart A-9

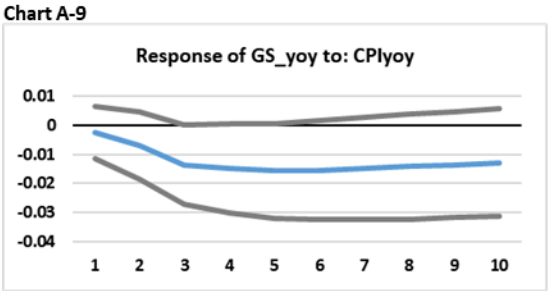
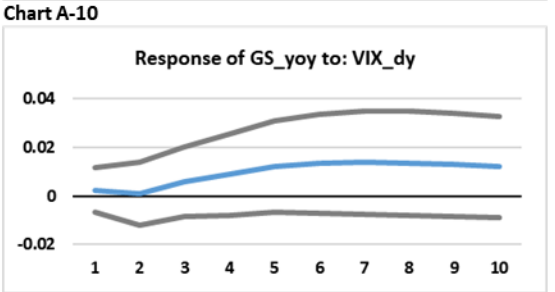


Chart A-10



Endnote

1 Intuitively, these two responses may be connected since a stronger dollar is supported by a wider yield spread of U.S. government bonds over those issued by other countries. Analysis shows that while changes in the trade weighted dollar Granger cause changes in the 10-year Treasury yield the opposite is not true.

Author Biography

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Dr. Daniel Murray is Deputy Chief Investment Officer and Global Head of Research at EFG Asset Management, U.K. He was previously employed as a Director of Strategy at Russell Investments, before which he worked as a portfolio manager at Merrill Lynch Investment Managers. He began his career at Smithers & Co. Ltd. He has broad investment experience, having worked as an economist, strategist, asset allocator and portfolio manager with exposure to a wide range of markets, instruments and investment styles. He has been a CFA charter holder since 2003. Daniel has a B.Sc. Hons Degree in Economics, an M.Sc. in Econometrics and Mathematical Economics and a Ph.D. in Economics. He is a previous winner of the CFA U.K. Wincott Prize and is Chair of the Board of CFA U.K. Dr. Murray had last contributed an article to the *GCARD* on "Geopolitical Risk and Commodities."