Bulletin of Business and Economics
ISSN - 2409 - 9368

EXPLORING COINTEGRATION BETWEEN GOLD PRICES AND INFLATION: AN EMPIRICAL ANALYSIS OF G-8 ECONOMIES

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ABSTRACT

The primary objective of this research is to explore whether there exists any meaningful relationship between domestic gold prices and expected rates of inflation, with a particular focus on the potential predictive capability of gold prices for such inflationary trends. The intricate relationship between gold prices and expected inflation is empirically investigated by considering the time-series data from Canada, France, Germany, Japan, Italy, Russia, the UK, and the US for the period 1990-2022. The primary data diagnostic tests revealed that the considered variables are non-stationary at the same level, prompting the application of an autoregressive distributed lag model, which identified a compelling and statistically significant linkage between domestic gold prices and anticipated inflation rates. The findings of the study can be attributed to the distinct ways in which inflation expectations materialize within these economies, potentially leading to a quicker convergence of mean-reverting inflation rates. The study concludes that gold prices can explain the anticipated inflation trends, thereby enhancing our understanding of the intricate interplay between these economic variables.

KEYWORDS: ARDL, Cointegration, Gold, G-8 Economies, Inflation

1. INTRODUCTION

The primary objective of central banks and their affiliated institutions is to accurately identify the drivers of inflation by giving significant attention to predictive factors. Among these predictors, factors such as demand and supply, exchange rates, and consumption patterns are of paramount importance. These elements serve as instruments to gauge the trajectory of an economy, whether it is trending upward or downward. By assessing the pace of economic activities, it becomes possible to infer the prevailing inflation rate (Blose, 2010). Recent studies (e.g., Ali, 2015; Fernando, 2017; Ali, 2018; Xu et al., 2021) have demonstrated that asset prices can serve as effective tools for forecasting inflation. Leveraging their inherent predictive characteristics, asset returns are employed to anticipate forthcoming inflation rates. Nonetheless, it is crucial to note that the predictive attributes of financial assets, as observed by Stock and Watson (2003), exhibit validity only within specific timeframes and certain nations, as other countries may not display similar correlations with financial assets. Among various financial assets, gold prices emerge as a preeminent gauge and forecaster of inflation rates. Gold, positioned within the realm of both goods and commodities, possesses an added layer of significance due to its hedging capabilities (Taylor, 1998). Governments frequently employ gold reserves as a hedge against surges in prices, solidifying its role as a designated financial asset with anti-inflationary and hedging purposes (Stock & Watson, 2003). It has progressively evolved into a primary predictor of inflation.

Gold, an enduring, lustrous, and chemically resistant metal, finds applications in diverse industries, including dentistry and manufacturing. Its profitable utility extends to gold plating, while its resilience over time differentiates it from other assets that tend to depreciate. Historical significance underscores its role in trade systems, where it served as a medium of exchange in lieu of gold coins. Even in today's era of paper money, gold reserves maintain their significance in backing currency production, as excessive money supply can trigger inflation (Fernando, 2017; Audi and Ali, 2023). Gold's investment appeal is augmented by its hedging attributes against both systematic and unsystematic risk. This includes mitigating risks stemming from broader economic shifts, social issues, currency crises, inflation, bearish stock market trends, and devaluation of currency against pegged counterparts (Blose, 2010). In the realm of economics, one of the foundational and extensively discussed concepts is inflation. The textbook definition of inflation, in its simplest form, is the increase in prices of various commodities. When demand outpaces supply, prices rise due to production inadequacies. Moreover, inefficient production processes can drive up production costs, leading to price increases. This, in turn, can erode the purchasing power of consumers as they struggle to attain goods at previously affordable levels. Conversely, deflation is the opposing concept, signifying a decline in commodity prices over a span of time. A related notion, disinflation, denotes a reduction in the rate of inflation while inflation still persists within an economy.

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Inflation perennially casts a shadow over investor enthusiasm within an economy, eroding the value of their investments. The impact of inflation on investors' profits can be substantial, encompassing not only the inflation rate itself but also the intersection of taxes and various economic factors. Consequently, the profitability of investments becomes intricately tied to the genuine worth of the product. The money invested today undergoes a transformation over time; its value a decade from now will inevitably differ. Profits accrued must be assessed in light of the prevailing cost of capital and the inflation rate, both of which play a pivotal role in shaping investment outcomes.

Consider an instance where an investor allocates $100 at a 3% rate of return for a year. Initially, the expected profit appears to be $3. However, this simplistic analysis overlooks the impact of inflation, which could be as high as 4%. Factoring in inflation, the investor could potentially incur a loss of $4, and the subsequent influence of taxes might further dampen the profitability of the capital gain. Consequently, the $100 invested today would acquire more value than the sum to be recouped after a year, a discrepancy attributed to the insulated nature of the present $100 against inflation's effects. It's important to note that discussing the inflation phenomenon shouldn't discourage savings or investments. On the contrary, investment remains a prudent choice, but augmenting the decision-making process with strategic considerations can potentiate returns among the plethora of investment avenues. A pivotal shift is moving from nominal rates to real rates, accounting for the corrosive impact of inflation on profits. Real estate, gold, and diamonds often serve as a refuge for investors due to their relatively inflation-resistant nature, safeguarding returns against the erosive power of inflation.

The surge in price levels extends its effect to appreciating the value of tangible assets such as gold, land, and homes, further rewarding the investor. Analytically astute investors take into account key metrics like the Consumer Price Index (CPI) and the Producer Price Index (PPI) to construct their investment strategies. Miscalculations can not only mitigate profits but also potentially trigger losses. Prudent investors must not rely solely on prevailing conditions; they must account for anticipated shifts in the inflation rate, a methodology that aids in estimating the rate of return while considering the associated costs incurred for profit realization. In summary, while inflation inherently poses challenges to investors, it also underscores the significance of informed decision-making. In the labyrinth of investment opportunities, a careful evaluation of real rates, inflation-resistant assets, and anticipated inflation movements empowers investors to make discerning choices that maximize profitability.

2. INFLATION HEDGE AND GOLD

Gold has long been embraced as a tool to mitigate the risks associated with inflation in economies. However, its effectiveness as an inflation hedge hinges on the establishment of a robust and enduring relationship between the two. While inflation and gold prices may not always move in lockstep, when they do, gold reveals its potential as a formidable hedge against inflation. A plethora of studies have illustrated the presence of co-integration between gold and inflation, affirming gold's role as a reliable safeguard against the erosive forces of inflation (Attié & Roache, 2009; Ali & Audi, 2016; Ali & Bibi, 2017). Investors eyeing gold as an investment option often do so with an awareness of its capacity to mitigate the impact of inflation. This dual nature positions gold as both a tactical hedge against inflation and a cornerstone of long-term strategic asset allocation strategies. Gold's resilience becomes even more evident during economic downturns when it consistently outperforms traditional financial assets, establishing itself as a stalwart in portfolios safeguarding against risk (Baur & Lucey, 2010).

For risk-averse investors, embracing a gold-centric investment strategy can yield substantial benefits. This precious metal serves as a robust bulwark against the perils of inflation, effectively neutralizing the corrosive effects of rising prices. It also effectively mitigates the systematic risk that often accompanies inflationary pressures, countering the destabilizing impact of inflation rates (Attié & Roache, 2009). Certain developed economies, including the United States, the United Kingdom, France, and Japan, have historically upheld the purchasing power of gold, reinforcing its status as a reliable inflation hedge (Baur & Lucey, 2010). Notably, amid the tumultuous backdrop of World War I, while the values of stocks and bonds dwindled in Germany, gold retained its purchasing power, emerging as a resilient investment option (Xu et al., 2021). Gold's distinctive attributes—portability, acceptability, and high liquidity—position it as a quintessential asset with universal appeal. Moreover, empirical studies underscore that gold's real returns exhibit limited correlation with conventional financial assets, accentuating its potential as a risk-diversifying entity. A gold-based portfolio consistently demonstrates superior returns when compared to portfolios predominantly invested in equities, exemplifying its capacity to amplify returns while mitigating risk (Attié & Roache, 2009).

3. DETERMINANTS OF GOLD PRICES

The existing literature on the determinants of gold prices unveils some crucial factors that significantly affect its price, enumerated as follows.

3.1. BANK INEFFICIENCY

When individuals perceive that traditional banking institutions are failing to offer attractive investment opportunities and are underperforming in their operations, they often seek alternative avenues to safeguard their wealth and generate returns. Gold bars become a preferred choice in this scenario due to their inherent liquidity and the ease with which they can be converted into paper currency. Moreover, gold's status as a hedge against economic uncertainties further bolsters its appeal as an investment vehicle. This surge in demand for gold leads to a heightened state of market dynamics where the imbalance between supply and demand exerts upward pressure on international gold prices. Investors flock to gold as a reliable store of value and a means to diversify their portfolios in the face of economic uncertainties (Blose, 2010).

3.2. RISK DIVERSIFIER AND RISK FREE

Modern-day investors meticulously assess multiple factors before committing their capital to any investment vehicle. Virtually all investment instruments are susceptible to the erosive effects of inflation, which gradually erode their real returns and overall profitability. If the rate of return fails to adequately compensate for the combined impact of inflation and market risk, investors tend to seek refuge in risk-free assets. Consequently, the heightened demand for gold ensues, invariably driving up its market price. This phenomenon underscores gold's enduring appeal as a store of value and a hedge against economic uncertainties, as it tends to retain its purchasing power over time (Goodhart & Hofmann, 2001).

3.3. DE-STABILIZED AND WAR STATE

Countries frequently affected by conflict, such as war-torn nations, introduce an intense fear of account freezes, causing a sudden loss of liquidity. Moreover, large-scale national crises, such as floods and irregular economic trends, can inject uncertainty into an economy. This heightened state of uncertainty often prompts risk-averse individuals to swiftly convert their liquid assets into gold, which is universally regarded as the most reliable medium of exchange. Consequently, this surge in demand exerts upward pressure on gold prices, shaping market dynamics. While various studies have delved into the indicators of inflation, some prominent researchers have not positioned gold prices as the primary gauge of inflation.

Stock and Watson (1999) have argued that different indicators perform distinctively depending on the economic climate. For instance, some researchers have noted that during the 1980s, gold prices were not particularly effective in predicting inflation. Thus, it can be surmised that the utility of gold prices as a predictor of inflation can vary across different eras. Indeed, researchers have presented divergent views on the relationship between gold prices and inflation rates. Blose (2010) and Taylor (1998) have identified a significant relationship between inflation rates and gold prices. In contrast, Baur and Lucey (2010) have reported a lack of a significant relationship between gold prices and inflation rates, emphasizing the complexity of this relationship.

4. LITERATURE REVIEW

The financial and economic literature encompasses numerous studies exploring the various roles gold plays within the economy. The literature review can be categorized into two primary groups: the theoretical perspective and the empirical perspective.

4.1. THEORETICAL VIEWPOINT

The relationship between inflation and asset prices is multifaceted, with various theoretical perspectives shedding light on this connection. One prominent theory, rooted in Marxian economics, pertains to the adoption of fiat money and its impact on asset prices. This theory posits that the actual value of a commodity can exert upward pressure on the price levels of other commodities, a phenomenon generally associated with inflation (Marx, 1867). However, the relationship between asset prices and inflation is a subject of debate, with both supporting and opposing arguments. Tobin's q theory, for instance, argues that an increase in asset prices can enhance the profitability of capital, thereby stimulating investment growth, and subsequently leading to increased demand and inflation (Mishkin, 1990; Ali & Audi, 2018). This wealth effect, stemming from asset price appreciation, not only boosts private consumption but also augments borrowing capacity, potentially fueling inflation (Ali & Rehman, 2017; Goodhart & Hofmann, 2001). Conversely, classical economic thought distinguishes between these variables, recognizing that asset prices are inherently volatile and susceptible to shifts in investor sentiment, often disconnected from underlying economic fundamentals. Consequently, deriving precise and timely insights from changes in asset prices proves challenging (Bernanke & Gertler, 2000). The literature on inflation hedging emphasizes that certain assets have the ability to protect investors from the erosive effects of inflation within an economy. For example, Fisher's hypothesis (1930) explores the role of stock market securities in hedging against inflation, proposing a one-to-one relationship between expected nominal stock returns and interest rates. Similar inflation-hedging characteristics can be found in real estate and durable goods, where the present value of their rents represents their market value when used as investment assets. As inflation increases, property owners often raise rents to counter its effects, effectively safeguarding their investments (Feldstein, 1983).

Foreign currency can also serve as an inflation hedge, particularly through the concept of dollarization. This occurs when a country's residents utilize foreign currency, either alongside or in lieu of the domestic currency, as a store of value, medium of exchange, and/or unit of account during periods of domestic economic uncertainty. This practice provides a safeguard against inflation (De Gregorio, 2012). Gold, a timeless symbol of wealth, has historically served as a defensive commodity during times of economic uncertainty, making it a favored hedge against inflation (Baur & Lucey, 2010).

4.2. EMPIRICAL VIEWPOINT

The first group of studies (e.g., Dooley et al., 1995) investigates how macroeconomic factors impact gold prices. They delve into this aspect by employing linear cointegration tests proposed by Engle and Granger (1987) and nonlinear threshold cointegration as suggested by Enders and Siklos (2001). Their findings suggest that during low momentum periods, gold may not serve as an effective inflation hedge in both the USA and Japan. However, during high momentum times, gold can be a valuable hedge against inflation in the USA and partially in Japan. The second group of literature delves into the predictive aspects of gold prices. Researchers in this group seek to understand the factors influencing variations in gold prices. Notable studies in this category include Diba and Grossman (1984) and Pindyck (1993). They have examined the influencing factors behind gold price fluctuations.

Stock and Watson (2003) conducted research on Forecasting Output and Inflation, examining the ability of asset prices to predict inflation and real economic growth. They analyzed quarterly data for 40 years across G-7 countries, albeit with some data gaps for specific countries. The study considered various indicators, including default spreads, term spreads, interest rates, and non-financial indicators. Their findings suggested that asset prices have limited predictive power for inflation and real growth over different time horizons, and no single asset price consistently worked across all countries.

5. DATA AND METHODOLOGY

Gold prices are expected to incorporate inflation expectations and potentially lead to inflation. To explore this phenomenon, we conducted an investigation across eight countries: Canada, France, Germany, Japan, Italy, Russia, the United Kingdom, and the United States of America, spanning 33 years from 1990 to 2022. The gold price data used in this study was sourced from the World Gold Council and denominated in U.S. dollars per ounce. We standardized this by converting prices to 10 grams (1 ounce = 28.35 grams). Inflation rates were calculated using the Consumer Price Index for all the countries involved, while exchange rates and Consumer Price Index values were obtained from the IMF International Financial Statistics database. Our research is based on secondary data compiled from these eight countries, utilizing a dataset spanning 33 years to facilitate a comprehensive analysis. The following sections outline the statistical techniques employed in our research.

In our investigation, we adopted the Auto Regressive Distributed Lag (ARDL) approach to discern the significance of the relationship between dependent and independent variables. ARDL encompasses a suite of techniques designed for modeling and analyzing multiple variables, with a primary focus on understanding the association between one dependent variable and one or more independent variables. Regression analysis, a pivotal component of ARDL, provides insights into how variations in the dependent variable are linked to changes in one independent variable while keeping the other independent variables constant.

5.1. THE MODEL

The main objective is to extract information regarding future inflation from gold prices. We define the inflation rate as the annualized percentage change in the Consumer Price Index (P) over a *k*-period.

Equation 1

$$\pi_t = [\log P_t - \log P_{t-k}] \times 1200/k \ ,$$

By using monthly data, we try to explain movements in inflation for periods ranging from 1990 to 2022. We can decompose the *k*-period inflation rate into nominal and real rates of return on a financial asset as follows.

Equation 2

$$\pi_t = R_t - r_t$$

Investors typically seek a nominal rate of return on any asset that adequately compensates for the erosive impact of inflation on their purchasing power. In Equation (2), R_t can be interpreted as the nominal *k*-period annualized rate of return on gold, while r_t represents the real *k*-period rate of return. To gauge the effectiveness of gold as a hedge against inflation, it is imperative for investors to consider the rate of return on gold expressed in terms of their domestic currency. Since the price of gold is determined in global markets and quoted in U.S. dollars, a crucial step involves multiplying the price of gold by the prevailing exchange rate before computing its rate of return. In this context, we introduce two distinct terms: R^D_t to signify the domestic rate of return on gold, and R_t reserved for denoting the U.S. dollar rate of return on gold. With *G* representing the price of gold per ounce in U.S. dollars and *E* symbolizing the exchange rate between the domestic currency and the U.S. dollar, we can define the international (U.S.) and domestic annualized *k*-period rates of return on gold as follows:

Equation 3

$$R_t^D = [\log(G_t \times E_t) - \log(G_{t-k} \times E_{t-k})] \times 1200/k$$

Equation (3) can alternatively be written as

Equation 4

$$R_t^D = [\log G_t - \log G_{t-k}] \times 1200/k + [\log E_t - \log E_{t-k}] \times 1200/k \text{ , or}$$

$$R_t^D = R_t + \dot{E}_t$$

Where E_t is the annualized *k*-period percentage change in the exchange rate. To establish whether the *k*-period rate of return on gold contains information about realized inflation over the next *k* periods, we have estimated the following equation for the United States (Equation 5):

Equation 5

$$\pi_t = \alpha + \beta R_{t-k} + \varepsilon_t$$

Equation 6

$$\pi_t^D = \alpha + \beta R_{t-k}^D + \varepsilon_t$$

For the remaining countries, Equation 6 will be applied. Within these equations, *Et* represents an error term designed to account for inflation fluctuations not accounted for by the incorporated variables. In this analytical framework, when individuals anticipate an impending rise in inflation, their inclination is to mitigate the potential loss of purchasing power. They achieve this by elevating their demand for gold, subsequently boosting both the price and the rate of return on gold. Consequently, our expectations for Beta in Equation 5 and Equation 6 lean towards a positive value.

6. FINDINGS AND DATA ANALYSIS

Our study encompassed eight countries, with the central objective of assessing whether current gold prices could serve as a reliable predictor of future inflation trends. These countries include Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States of America. Given the nature of our data as a time series, specific analyses were necessary to reach conclusive findings. These analyses were conducted in accordance with the specific requirements of our study and were structured as follows: Our analytical approach was divided into two distinct time periods. The initial phase involved the utilization of a 6-month timeframe, where returns were computed based on a 6-month moving average. Subsequently, the second phase employed a 1-year timeframe, computing returns based on a 1-year moving average.

The initial step in our analysis involved assessing the stationarity of the data. To accomplish this, we employed the Augmented Dickey-Fuller (ADF) test, which is a widely recognized method for evaluating stationarity in time series data. The Augmented Dickey-Fuller (ADF) unit root test served as a pivotal tool in our analysis. This test is employed to ascertain the stationarity of data. Specifically, if the ADF test rejects the null hypothesis of a unit root in the data, it indicates that the time series data is stationary, thereby challenging the random walk hypothesis. The formula for the Augmented Dickey-Fuller (ADF) unit root test is as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t$$

During our analysis, the initial step involved assessing the stationarity of the data for each country. Stationary data exhibits a constant mean and variance, while non-stationary data lacks a consistent mean and exhibits time-specific variance. For Canada, the Augmented Dickey-Fuller (ADF) test yielded stationary results with t-statistics of -9.22 and a probability of 0.000, suggesting stationarity at first difference with trend and intercept. Similarly, the Canadian inflation series showed stationarity with t-statistics of -6.48 and a probability of 0.000, but at the stationary level and intercept. Given these differing levels of stationarity in both variables, the Johansen-Juselius (JJ) Co-Integration test was not applicable, leading us to employ the Autoregressive Distributed Lag (ARDL) approach.

Moving on to France, the Gold data exhibited stationarity with t-statistics of -5.53 and a probability value of 0.0003, indicating stationarity at the level with trend and intercept. France's inflation series also showed stationarity with t-statistics of -8.17 and a probability of 0.000, signifying stationarity at the first difference with intercept. Since both series demonstrated stationarity at different levels, the ARDL approach was adopted for further analysis. In Germany, the Gold data displayed stationarity with t-statistics of -8.11 and a probability value of 0.000 at the first difference without trend and intercept.

Conversely, Germany's inflation series exhibited stationarity with t-statistics of -4.06 and a p-value of 0.0029, but only at the level with an intercept. Again, with varying levels of stationarity in the two series, the ARDL approach was chosen. For Italy, the Gold series data showed stationarity with t-statistics of -7.19 and a probability of 0.000 at the first difference with trend and intercept. Italy's inflation series had a t-statistics of -6.34 and a probability of 0.00, demonstrating stationarity at the first difference without an intercept and trend. Given the differing models for both series, the ARDL approach was pursued. Japan's Gold series analysis resulted in t-statistics of -4.34 and a probability of 0.0081, indicating stationarity at the first level with trend and intercept. Japan's inflation data, on the other hand, showed t-statistics of -3.896 and a probability of 0.0003, signifying stationarity at the first difference without a trend and intercept.

In Russia, the Gold series exhibited t-statistics of -6.099 and a p-value of 0.000, demonstrating stationarity at the first level with an intercept. Russia's inflation series showed stationarity with t-statistics of -3.89 and a p-value of 0.025 at the level with trend and intercept. Once again, due to the differing order of stationarity, the ARDL method was chosen. Moving to the United Kingdom, the Gold series analysis revealed t-statistics of -8.05 and a p-value of 0.000, suggesting stationarity at the first difference with an intercept and trend. Similarly, the UK's inflation series displayed t-statistics of -4.3065 and a p-value of 0.0015, indicating stationarity at the first difference level with an intercept.

Finally, for the United States, the Gold series analysis yielded a t-statistic of -8.876 and a p-value of 0.000, indicating stationarity at the first difference with intercept and trend. The inflation series for the US showed a t-statistic of -4.78 and a p-value of 0.0004, demonstrating stationarity at the level with intercept. Due to the differing order of stationarity in both variables for the United States, the Autoregressive Distributed Lag (ARDL) approach was applied.

Table 1: Augmented Dickey-Fuller Test

COUNTRY		CALCULATED VALUES	TABULATED VALUES		
			1%	5%	10%
CANADA	Ca_G	-9.218527	-4.20500	-3.52660	-3.19461
	Ca_I	-5.627080	-3.600987	-2.935001	-2.605836
FRANCE	Fr_G	-5.531840	-4.198503	-3.523623	-3.192902
	Fr_I	-8.172324	-3.605593	-2.936942	-2.606857
GERMANY	Gr_G	-8.113501	-2.624057	-1.949319	-1.611711
	Gr_I	-4.059696	-3.600987	-2.935001	-2.605836
ITALY	IT_G	-7.187639	-4.205004	-3.526609	-3.194611
	IT_I	-6.342372	-2.624057	-1.949319	-1.611711
JAPAN	Ja_G	-4.340970	-4.252879	-3.548490	-3.207094
	Ja_I	-3.896373	-2.622585	-1.949097	-1.611824
RUSSIA	Ru_G	-6.099135	-3.615588	-2.941145	-2.609066
	Ru_I	-3.887494	-4.296729	-3.568379	-3.218382
UK	UK_G	-8.045474	-4.205004	-3.526609	-3.194611
	UK_I	-4.306470	-3.605593	-2.936942	-2.606857
USA	US_G	-8.876592	-4.205004	-3.526609	-3.194611
	US_I	-4.779119	-3.600987	-2.935001	-2.605836

In Canada, the initial step of Autoregressive Distributed Lag (ARDL) estimates reveals that the dependent variable is significantly affected by its own lagged term, supported by a p-value of 0.00 and a t-ratio of 12.27. However, the independent variable, which is inflation, does not exhibit a significant influence. Moving to France, ARDL estimates demonstrate that the dependent variable is also significantly influenced by its lagged term with a p-value of 0.00 and a t-ratio of 14.21. In this case, the independent variable, inflation, exerts a significant effect with a p-value of 0.022 and a t-ratio of 2.38.

Table 2

COUNTRY	Dependent Variable	Regressor	ESTIMATION FROM 1990H1 TO 2022H2		
			Coefficient	S.E	T.Ratio[Prob]
CANADA	CA_1	CA_I(-1)	.78900	.78900	12.2656[.000]
		CA_G	.015082	.012382	1.2181[.230]
FRANCE	FR_I	FR_I(-1)	.84857	.059699	14.2141[.000]
		FR_G	.018701	.018701	2.3754[.022]
GERMANY	GR_1	GR_I(-1)	.84616	.087581	9.6615[.000
		GR_G	.0048662	.013542	.35934[.721]
ITALY	IT_I	IT_I(-1)	.88177	.065938	13.3729[.000
		IT_G	.0041359	.0046500	.88944[.379
JAPAN	JA_I	JA_I(-1)	.70673	.091677	7.7090[.000]
		JA_G	.0065246	.0078912	.82681[.413]
RUSSIA	RU_I	RU_I(-1)	.47628	.12523	3.8033[.000]
		RU_G	.065067	.29087	.22370[.824]
UK	UK_I	UK_I(-1)	.85668	.033860	25.3009[.000]
		UK_G	.017851	.0060485	2.9512[.005]
USA	US_I	US_I(-1)	.86920	.058402	14.8830[.000]
		US_G	.024233	.011029	2.1972[.034]

In Germany, the first step of the ARDL reveals a significant impact of the lagged term of the dependent variable, with a p-value of 0.00 and a t-ratio of 9.67. However, the independent variable, inflation, does not exert a significant effect. Similarly, in Italy, there is a significant influence of the lagged term of the dependent variable, with a p-value of 0.00 and a t-ratio of 13.37, but the independent variable, inflation, does not display a significant impact. Turning to Japan, the initial step of the ARDL indicates a significant effect of the lagged term of the dependent variable, with a p-value of 0.00 and a t-ratio of 7.709. However, the independent variable, inflation, does not have a significant effect.

Russia's ARDL estimates illustrate a significant influence of the lagged term of the dependent variable, with a p-value of 0.00 and a t-ratio of 3.80. However, similar to other countries, the independent variable, inflation, lacks a significant impact. Shifting to the United Kingdom, the first step of ARDL estimates shows a substantial effect of the lagged term of the dependent variable, with a p-value of 0.00 and a t-ratio of 25.301. In this case, the independent variable, inflation, does exhibit a significant influence, supported by a p-value of 2.951. Finally, for the United States, ARDL estimates reveal a significant effect of the lagged term of the dependent variable, with a p-value of 0.034 and a t-ratio of 14.88, while the independent variable, inflation, does not yield a significant impact.

Starting with Canada, the analyzed data does not reveal significant long-term dynamics, as supported by p-values of 0.199 and a ratio of 1.305. However, in France, the data suggests substantial long-term dynamics, with p-values of 2.182 and a ratio of 0.035, indicating a lasting relationship between the regressor, gold, and inflation rates over time. Conversely, in Germany, Italy, Japan, and Russia, no significant long-term dynamics are observed, as evidenced by p-values of 0.705 (Germany), 0.183 (Italy), 0.466 (Japan), and 0.821 (Russia), along with their respective ratios. Shifting to the United Kingdom and the United States, the data reveals notable long-term dynamics, supported by p-values of 0.004 (United Kingdom) and 0.051 (United States), accompanied by ratios of 3.019 and 2.016, respectively.

Table 3

COUNTRY	Dependent Variable	Regressor	Estimated Long-Run Coefficients T.Ratio[Prob]
CANADA	CA_1	CA_G	1.3052[.199]
FRANCE	FR_I	FR_G	2.1820[.035]
GERMANY	GR_1	GR_G	.38182[.705]
ITALY	IT_I	IT_G	1.3535[.183]
JAPAN	JA_I	JA_G	.73637[.466]
RUSSIA	RU_I	RU_G	.22799[.821]
UK	UK_I	UK_G	3.0198[.004]
USA	US_I	US_G	2.0160[.051]

The ECM analysis reveals distinctive findings for each country. In Canada, it suggests the presence of short-term dynamics, as indicated by a low p-value of 0.002, signifying that lag values have a significant short-term effect on the Canadian economy. Similarly, France exhibits short-term dynamics, with a p-value of 0.015, implying that lag values influence the French economy in the short term. Conversely, in Germany, the analysis indicates an absence of short-term dynamics, supported by a p-value of 0.08, despite negative coefficients and t-values, indicating that lag values do not significantly affect the German economy in the short term. Italy, too, lacks short-term dynamics, with a p-value of 0.002, suggesting that lag values do not exert a short-term impact on the Italian economy.

In Japan, short-term dynamics are evident, with a p-value of 0.003, highlighting the influence of lag values in the short term. Russia also exhibits short-term dynamics, reflected in a low p-value of 0.000, indicating that lag values have a pronounced short-term effect on the Russian economy. The United Kingdom demonstrates short-term dynamics with a strikingly low p-value of 0.000, emphasizing the impact of lag values in the short term. Finally, the United States exhibits short-term dynamics, supported by a p-value of 0.031, signifying the significance of lag values on the U.S. economy in the short term.

In our analysis of various countries, the initial step of Autoregressive distributed lagged estimates consistently reveals that the dependent variable is influenced by its own lagged term, demonstrating statistical significance with p-values of 0.00 across all countries. However, the independent variable, which represents gold, does not exert a significant effect on the dependent variable, which represents inflation, in all cases except for Russia. In Russia, the independent variable does have a notable impact on inflation, supported by a p-value of 0.05 and a t-statistic of 2.045. Notably, the United Kingdom also exhibits a significant effect of the independent variable Gold on inflation, with a p-value of 0.023 and a t-statistic of 2.48. In contrast, for the remaining countries, including Canada, France, Germany, Italy, Japan, and the United States, the independent variable gold does not significantly affect inflation.

Table 4

COUNTRY	Dependent Variable	Regressor	Error Correction Representation T.Ratio[Prob]
CANADA	dCA_1	dCA_G	1.2181[.230]
		ecm(-1)	-3.2802[.002]
FRANCE	dFR_I	dFR_G	2.3754[.022]
		ecm(-1)	-2.5366[.015]
GERMANY	dGR_1	dGR_G	.35934[.721]
		ecm(-1)	-1.7565[.087]
ITALY	dIT_I	dIT_G	.88944[.379]
		ecm(-1)	-1.7930[.081]
JAPAN	dJA_I	dJA_G	.82681[.413
		ecm(-1)	-3.1989[.003]
RUSSIA	dRU_I	dRU_G	.22370[.824]
		ecm(-1)	-4.1820[.000]
UK	dUK_I	dUK_G	2.9512[.005]
		ecm(-1)	-4.2327[.000]
USA	dUS_I	dUS_G	2.1972[.034]
		ecm(-1)	-2.2396[.031]

Table 5

COUNTRY	Dependent Variable	Regressor	Estimation from 1991h1 to 2022h2		
			Coefficient	S.E	T.Ratio[Prob]
CANADA	CA_1	CA_I(-1)	.65177	.13420	4.8568[.000]
		CA_G	.027330	.025155	1.0865[.292]
FRANCE	FR_I	FR_I(-1)	.77076	.10449	7.3765[.000]
		FR_G	.026725	.014340	1.8637[.079]
GERMANY	GR_1	GR_I(-1)	.77899	.16756	4.6491[.000]
		GR_G	.0093070	.026563	.35038[.730]
ITALY	IT_I	IT_I(-1)	.72418	.13804	5.2461[.000]
		IT_G	.012651	.010044	1.2595[.224]
JAPAN	JA_I	JA_I(-1)	.43973	.17247	2.5496[.020]
		JA_G	.0037582	.014409	.26082[.797]
RUSSIA	RU_I	RU_I(-1)			
		RU_G	.81367	.39791	2.0448[.055]
UK	UK_I	UK_I(-1)	.73648	.074215	9.9235[.000]
		UK_G	.031872	.012869	2.4767[.023]
USA	US_I	US_I(-1)	.79725	.10521	7.5777[.000]
		US_G	.034041	.020092	1.6943[.107]

In our analysis of these countries, the assessment of long-term dynamics varies. For Canada, France, Germany, Japan, and the United States, there is no substantial evidence of long-term dynamics, as indicated by relatively high p-values and lower ratios. However, Italy, Russia, and the United Kingdom exhibit distinct long-term dynamics. In Italy, the data suggests a significant long-term relationship, supported by a p-value of 0.031 and a ratio of 2.345. Similarly, Russia displays long-term dynamics with a p-value of 0.05 and a ratio of 2.045. The United Kingdom also shows notable long-term dynamics with a p-value of 0.016 and a ratio of 2.67. These findings illustrate varying degrees of long-term relationships between gold prices and inflation in the examined countries.

Our examination of short-term dynamics reveals varying outcomes across the studied countries. In Canada and France, short-term dynamics are evident, supported by low p-values (0.002 and 0.042, respectively) and negative coefficients along with corresponding negative t-values, indicating that lag values have a short-term impact on their respective economies. Conversely, Germany exhibits no substantial short-term dynamics, as the p-value is relatively high at 0.204, although the coefficients and t-values are negative. Italy similarly lacks short-term dynamics, with a p-value of 0.06. In contrast, Japan displays short-term dynamics, backed by a low p-value of 0.004 and negative coefficients and t-values. Russia, on the other hand, does not exhibit significant short-term dynamics, as lagging does not significantly affect the dependent period. The United Kingdom showcases short-term dynamics (p-value of 0.002), as does the United States, despite its slightly higher p-value of 0.07. These findings highlight the differential short-term effects of gold prices on inflation across these economies.

Table 6

COUNTRY	Dependent Variable	Regressor	Estimated Long-Run Coefficients T.Ratio[Prob]
CANADA	CA_1	CA_G	1.245[.227]
FRANCE	FR_I	FR_G	1.820[.085]
GERMANY	GR_1	GR_G	.387[.703]
ITALY	IT_I	IT_G	2.345[.031]
JAPAN	JA_I	JA_G	.251[.805]
RUSSIA	RU_I	RU_G	2.045[.055]
UK	UK_I	UK_G	2.668[.016]
USA	US_I	US_G	1.648[.117]

Table 7

COUNTRY	Dependent Variable	Regressor	Error Correction Representation
CANADA	CA_1	CA_G	1.087[.292]
		ecm(-1)	-2.595[.018]
FRANCE	FR_I	FR_G	1.864[.079]
		ecm(-1)	-2.194[.042]
GERMANY	GR_1	GR_G	.350[.730]
		ecm(-1)	-1.319[.204]
ITALY	IT_I	IT_G	1.260[.224]
		ecm(-1)	-1.998[.061]
JAPAN	JA_I	JA_G	.2608[.797]
		ecm(-1)	-3.249[.004]
RUSSIA	RU_I	RU_G	2.045[.056]
		ecm(-1)	*NONE*
UK	UK_I	UK_G	2.477[.023]
		ecm(-1)	-3.551[.002]
USA	US_I	US_G	1.694[.107]
		ecm(-1)	-1.927[.070]

7. CONCLUSION

The primary objective of this study was to examine whether there exists a significant relationship between domestic gold prices and anticipated inflation rates, with a particular focus on their long-term association. The ARDL approach served as the primary analytical method, yielding the quantitative results of the study. When analyzing data, most countries did not exhibit direct significant effects from gold prices on inflation, except for the United Kingdom, which displayed a short-term relationship. France demonstrated a long-term relationship with gold prices and inflation, remaining unresponsive in the long run, whereas Germany showed only a short-term relationship. Shifting to one-year average returns altered the results, with the United Kingdom and Russia now experiencing lagged independent variables, signifying an impact over a longer time frame. Italy, Russia, and the United Kingdom demonstrated significant long-term relationships. Germany remained largely unaffected by gold prices in the short run. The findings indicate that the relationship between gold prices and inflation rates is influenced by the time frame. In sum, we can conclude that gold prices and inflation rates are related, but the nature and strength of this relationship vary over time and across different countries. Consequently, this study suggests that gold prices can serve as a predictor of future inflation, contingent on specific economic scenarios and contextual factors.

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