Gold Demand Across Countries

Dirk G. Baur[*], Balagopal Gopalakrishnan[†], and Sanket Mohapatra[‡]

Abstract

This paper analyzes the demand for jewellery, bars & coins, and gold ETFs across high-income and middle-income countries. We employ a simultaneous equations model that allows a joint determination of the various categories of gold demand and find significant differences across gold demand categories and across countries. Jewellery and bars & coins demand are positively related in middle-income countries but unrelated in high-income countries. Jewellery demand is negatively related to gold prices in middle-income countries but not in high-income countries. Bars and coins demand positively reacts to global risk (VIX) in high-income countries but not in middle-income countries. The findings indicate that not all gold is equal and serves different purposes in different countries. Gold is generally more integrated with financial markets in high-income countries than in middle-income countries and jewellery is the least integrated among the three categories of gold demand.

Keywords: gold demand, jewellery, bars and coins, gold ETFs, financialization
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[*]UWA Business School, The University of Western Australia, 35 Stirling Highway, CRAWLEY WA 6009, Australia. Email: dirk.baur@uwa.edu.au

[†]Finance and Accounting department, Indian Institute of Management Kozhikode, Kerala, India, 673570. Email: balagopal@iimk.ac.in

[‡]Corresponding author. Economics department, Indian Institute of Management Ahmedabad, Gujarat, India, 380015. Email: sanketm@iima.ac.in

1. Introduction

While there has been substantive advancement in understanding the gold demand by institutional buyers such as central banks (Aizenman & Inoue, 2013; Baur, 2016; Gopalakrishnan & Mohapatra, 2018), there is a dearth of empirical studies on the components of gold demand at the country-level.

In recent years, the advent of gold ETFs created a new, financial, form of gold for investors and "consumers"[1], in addition to the traditional forms of physical gold investments in jewellery and bars & coins (Baur, 2013). Although gold ETFs are predominantly available in high-income countries, our analysis provides insights into the determinants of ETF demand and their relationship with conventional forms of gold investment. It also provides interesting lessons to middle-income countries where the adoption of gold ETFs is in a nascent stage.

We use a simultaneous equations model to examine the determinants of physical and "financial gold", i.e. exchange-traded funds (ETFs) on gold, across different types of countries and over time. The sample includes the largest gold consumers among high-income and middle-income countries.[2]

The consumption characteristics of various forms of gold have been largely ignored in the literature. We draw attention to this pertinent topic given the substantial increase in overall gold demand across countries since the global financial crisis in 2008 as shown in Figures 1 for all countries. Figures 2 and 3 display the demand trends for high-income countries and middle-income countries and show that the fall in jewellery demand is a high-income country phenomenon and not evident for middle-income countries.[3] The differences may be due to a lower popularity and availability of exchange-traded funds in middle-income countries with a stronger cultural role of jewellery, e.g., in India. The graphs also display a convergence of jewellery demand and bars and coins demand in

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[1]We use "consumers" in inverted commas because gold cannot be consumed in a common sense, i.e. that the consumption results in the disappearance of the good. Gold consumption is essentially gold investment.

[2]The countries in our sample account for more than 80 percent of global gold demand in 2018.

[3]Low-income countries, which are defined by the World Bank as having annual gross national income (GNI) per capita of less than $1,035, are not included in the analysis due to paucity of historical data on gold demand.

high-income countries which is in stark contrast to a positive trend of bars and coins demand and a relatively constant jewellery demand. The evolution of the gold demand suggests that jewellery and bars & coins are substitutes in high-income countries and complements in middle-income countries.

Our empirical analysis is based on a simultaneous equations model and identifies the following effects: (i) jewellery and bars & coins are unrelated in high-income countries, but positively related in middle-income countries, (ii) jewellery demand is negatively related to gold prices in middle-income countries, but there is no significant relationship in high-income countries, (iii) bars and coins demand positively reacts to global risk (VIX) in high-income countries but not in middle-income countries, (iv) bars and coins demand is positively related to inflation in middle-income countries, but not in high-income countries, (v) jewellery demand is negatively related to the level of financial development in high-income countries, but unrelated in middle-income countries, and (vi) demand for gold ETFs is positively related to global risk (VIX) in high-income countries, but not in middle-income countries.

The different findings across types of gold demand and across countries are remarkable and emphasize that jewellery is different than bars and coins and gold ETFs and also that gold plays very different roles in high-income countries than in middle-income countries. The results also suggest that gold investments are more costly in middle-income countries than in high-income countries given the prevalence of jewellery over other forms of gold.[4]

Jewellery appears to be the preferred gold product in middle-income countries due to cultural reasons in addition to a rise in purchasing power (see, for instance, World Gold Council (2017) for India), and less developed capital markets partly represented by underdeveloped gold ETF markets. Dichtl (2020) also discusses the unique drivers of gold demand, including cultural factors, that may lead to lower predictability of future excess returns on gold compared to equities.

In summary, gold types are treated differently across high-income and middle-income countries and react differently to specific factors such as gold prices and the VIX. For

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[4]We assume that the mark-ups and bid-ask spreads for jewellery products are considerably larger than for bars, coins and gold ETFs.

example, jewellery demand is negatively related to gold prices whereas bars and coins are positively related to gold prices. These differences suggest that investors buy jewellery when it is cheap but buy bars and coins when prices are high potentially following a price trend.

The insignificant relationship of jewellery with the VIX and the positive relationship of bars & coins with the VIX further support the different roles of jewellery and bars & coins for investors. Bars & coins may be more integrated with financial markets whereas jewellery appears segmented.

The rest of the paper is structured as follows. Section 2 describes the trends in gold demand, section 3 introduces the methodology and the data, section 4 presents and discusses the estimation results and section 5 summarizes the main findings and provides concluding remarks.

2. Trends in retail gold demand

In this section, we examine the trends in retail consumption of both physical and "financial" gold across high-income and middle-income countries. The annual consumption trends for each of these groups provide insights into the substitution and complementarity between various forms of gold demand. The trends are provided for high-income countries and middle-income separately due to differences in their level of financial development and the maturity of gold markets. For instance, gold ETF products, which constitute about 6 percent of average gold demand in high-income countries, are at a very nascent stage in middle-income countries. The trends are shown from the year 1996 until 2018.

2.1. Overall trends in gold demand

The trends in the various categories of gold demand in 30 high-income and middle-income countries over a 23 year period (1996-2018) are reported in Figure 1. The trends indicate largely a steady decline in the jewellery demand in the years prior to the global financial crisis. For instance, in the pre-crisis period, the highest average gold demand was in 1997

with 89.4 tonnes and declined to a low of 71.0 tonnes in 2006.[5]

However, during the global financial crisis, while we do not observe a significant increase in the jewellery demand, the demand of both bars & coins and gold backed ETFs had increased manifold. The consumption of bullion more than doubled year-on-year to 27 tonnes on average in 2008, while gold ETF flows doubled year-on-year to 41.2 tonnes in 2009. This surge in demand for bullion and gold ETFs during the financial crisis is consistent with gold's role as a safe haven.

In the post-crisis period, gold jewellery demand remained fairly steady during 2010-18, except for a sharp increase to 79.5 tonnes in 2013, a 26.2% increase compared to the level in 2012. This was potentially a result of the sharp price decline in commodities, accompanied by a reversal of capital flows from emerging market economies, due to the "taper tantrum" in 2013 caused by the US Federal Reserve's announcement to taper off its quantitative easing program (Reinhart, Reinhart, & Trebesch, 2016). In the subsequent years, average jewellery demand gradually declined to about 64 tonnes by 2018.

Bullion demand continued to rise in the post-crisis period, likely owing to investment motives. For instance, Emmrich and McGroarty (2013) show that including gold in investment portfolios is beneficial in terms of reduced portfolio volatility and higher returns, especially since 2007. While bullion demand rose 33.5% year-on-year in 2013, ETF flows turned sharply negative led by a steep fall in demand in high-income countries followed by a reversal in subsequent years.

2.2. Trends in high-income countries

The trends in the various categories of gold demand in 16 high-income countries are reported in Figure 2. There appears to be a secular decline in average jewellery demand over the sample period. Annual jewellery demand declined from 67.2 tonnes on average in 1997 to around 25.4 tonnes in 2018. This long-term decline in demand for jewellery is likely to be reflective of changes in tastes and preferences of retail consumers, as well as increasing availability of gold ETFs and other financial products to cater to the demand

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[5]Jewellery demand accounted for more than two-third of overall gold demand in the pre-crisis period (see also Shafiee and Topal (2010)).

for gold as an investment. An early study by Govett and Govett (1982) finds that investment and speculative motives were also major drivers of gold demand even in the 1980s.

The demand for bars & coins in the pre-financial crisis period until 2007 averaged about 5.6 tonnes, with a significant upward shift during the GFC to about 19 tonnes, a 6.4 fold increase from an average of 2.9 tonnes in the three years preceding the crisis. The shift suggests a surge in demand for bullion as a safe haven asset during the crisis. The data for gold ETFs, available from 2003 onwards, shows a sharp increase in demand particularly in the run-up to the GFC, rising from 22.7 tonnes in 2007 to 61.5 tonnes by 2009. This sharp increase is likely explained by the demand for safe haven assets and a preference of investors in high-income countries for "paper" gold during the crisis. The relative ease to trade and liquidity of the gold ETF market also likely contributed to the significant build-up of demand for these securities.

The behavior of gold ETFs during the GFC is similar to the increase in demand for bullion, with both likely driven by investment motives. This is accompanied by a continued fall in jewellery demand, possibly due to a fall in discretionary consumption and a substitution to gold ETFs. The subsequent decline in gold ETF demand in the immediate post-crisis years can be explained by the abatement of risk aversion. There was, however, a significant outflow from gold ETFs between 2012 and 2013 (from 24.2 tonnes in 2012 to -86.7 tonnes in 2013). This fall was likely a consequence of a sharp rise in US yields and significant correction of gold prices during the "taper tantrum" in 2013, resulting in a substitution away from gold ETFs.

2.3. Trends in middle-income countries

The average trends in the components of gold demand in 14 middle-income countries are reported in Figure 3. In contrast to a secular decline in jewellery demand for high-income countries, there is no such decline in demand in middle-income countries. Jewellery demand in middle-income countries was relatively stable averaging around 98 tonnes and rose from a trough in 2009 to a peak in 2012. During the taper tantrum that led to sharp

withdrawal of capital, jewellery demand rose sharply by 27.3% likely due to an increase in risk-aversion in middle-income countries.

The demand for bars & coins displays an increase over the 2000 to 2018 period. The demand for bullion experienced a steep increase during the global financial crisis to about 36 tonnes in 2008, a 33% increase as compared to the preceding year, likely explained by the role of gold as a safe haven. This observed increase is substantially higher compared to the 8.3% average annual increase seen in the preceding period from 1996 to 2007. The demand for bullion continued to rise further in the post-crisis period until 2012. The correction in gold prices in 2013 resulted in demand for bullion rising by 35.7% year-on-year to 82.7 tonnes in 2013. With abatement of risk aversion and a fall in gold prices, bullion demand fell to 46.2 tonnes during 2014-18.

Finally, unlike the popularity of gold ETFs in high-income countries, such products are at a nascent stage in middle-income countries as indicated by the significantly lower investment (averaging about 1 tonne during 2006-18) in gold ETFs. Given the trends observed in high-income countries and increasing acceptance of ETF products by investors, it is likely that demand for gold ETFs in middle-income countries will see a similar trajectory as observed for more developed countries.

3. Methodology and data

3.1. Simultaneous equation model of gold demand

The demand for various types of gold can affect each other. For instance, the demand for jewellery, which is usually for "consumption" motives[6], may increase simultaneously with the demand for bullion which is typically for investment motives. If simultaneity is not accounted for, the results may indicate that jewellery demand has a large effect on bullion demand and vice versa even if the true effect is weaker.

Gold demand categories may increase or decrease simultaneously if they are influenced by the same drivers. For example, in some countries with low levels of access

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[6]Since gold cannot be consumed similar to food or energy, gold consumption resembles investment rather than consumption.

to formal financial markets and high inflation, jewellery demand may be driven by investment demand leading to a simultaneous movement of jewellery and bars & coins demand. Similarly, bars & coins demand and gold ETF demand may both be driven by unobservable investment motives and thus move simultaneously.

Hence, it is appropriate to model the demand for each of these types in a simultaneous equation framework jointly and not separately. We model jewellery, bars & coins, and gold ETF demand in a three stage least squares (3SLS) approach, which allows all sources of gold demand to be endogenously determined. The 3SLS simultaneous equation modelling approach controls for the demand across these types of gold.[7] A similar simultaneous estimation approach has been employed in the finance literature (Bhagat & Black, 2001; Campello & Gao, 2017; Coles, Daniel, & Naveen, 2006).

To identify the effects of a simultaneous modelling of the three gold demand categories, we also estimate an equation-by-equation "reduced form" model. Such a model provides the isolated effects assuming that there are no other effects simultaneously affecting the demand for gold. For example, such a model would provide the effect of bars & coins demand on jewellery demand (and vice versa) but would not take into account the simultaneity in the determination of the two sources of gold demand. Such a separate estimation can overestimate the demand effects and this is indeed what we find.[8]

We approach the joint estimation in two different ways. First, we estimate the simultaneous determination of conventional forms of gold demand, i.e. jewellery and bullion demand. Second, we estimate the simultaneous equations model with all three forms of gold demand including ETF demand. The prevalence of gold ETF demand is more recent and the data is available only from 2003. Hence the estimation strategy provides an opportunity to understand the relationship between the physical forms of gold over a longer period, and their relationship with ETF for the period with availability of ETF flows data.

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[7]The 3SLS method has full-information characteristics and the estimates are considered to be consistent and more efficient compared to two-stage least squares (Zellner & Theil, 1992).

[8]The separate equation estimations for our baseline model is provided in Table A4. For example, the magnitude of the gold price coefficient is several times larger compared to the results of the 3SLS regression in Table 3. The corresponding single-equation regressions including ETFs is presented in Table A5.

3.2. Model of gold jewellery and bullion demand

In the first estimation, we control for the possible joint determination of demand for jewellery and bullion with the following system of equations.

$$Jewellery_{i,t} = \alpha_0 + \alpha_1 Bar\_coin_{i,t} + \alpha_2 Controls_t + \nu_i + \xi_{it} \qquad (1)$$

$$Bar\_coin_{i,t} = \beta_0 + \beta_1 Jewellery_{i,t} + \beta_2 Controls_t + \nu_i + \eta_{it} \qquad (2)$$

The dependent variables $Jewellery$ and Bar_coin, capture the jewellery and bullion demand of country i in year t, respectively. The control variables employed in all the equations include the logarithm of GDP (Log_GDP), a proxy for the level of financial development ($Pvtcredit\_GDP$), changes in the consumer price index (CPI) - inflation ($Inflation$), logarithm of real effective exchange rate (Log_REER), a measure of global risk (Log_VIX), and international gold prices in US dollars (Log_Gold_price). A higher level of GDP (Log_GDP) is likely to be associated with higher demand for all types of gold products. Gold has been shown to be a hedge against inflation in the short-run (see for instance, Van Hoang, Lahiani, & Heller, 2016), hence we control for $Inflation$. We also control for $Pvtcredit\_GDP$ as the demand for jewellery has been shown to be negatively associated with the size of credit markets relative to GDP (Starr & Tran, 2008).

The Chicago Board Options Exchange (CBOE) provides the implied volatility of the S&P 500 index options, commonly known as the volatility index (VIX). The measure is employed as a proxy for global risk. This measure captures periods of extreme risk where gold may act as a safe haven (Baur & Lucey, 2010). Demand for gold is likely to be negatively related to the gold price (Log_Gold_price). Since we are employing the US dollar price of gold, we control for real exchange rate (Log_REER) that could affect the purchasing power in local currency terms, and consequently, domestic demand for gold. When the local currency appreciates in real terms, gold becomes cheaper for domestic residents and thus demand is expected to increase.

Equation 1 and Equation 2 for the conventional forms of gold demand are estimated

for the 1996-2018 period. In all our estimations, we control for country-specific unobserved heterogeneity (ν_i) that can influence gold demand using country fixed effects in the panel regressions. The first and second lags of *Jewellery* and *Bar_coin* are used as the instruments in the 3SLS estimations. More specifically, in Equation 1 for jewellery demand as the dependent variable, the bars & coins demand is the endogenous explanatory variable and is instrumented using two lags of bars & coins. Similarly, in Equation 2 for bars & coins demand, the endogenous variable jewellery is instrumented by two lags of jewellery.[9]

3.3. Model with ETF demand

In order to estimate whether there is a substitution between electronic forms of gold demand and the physical forms, we employ a simultaneous equation model to estimate the joint determination of jewellery, bullion, and ETF flows. The estimation equations are as follows:

$$Jewellery_{i,t} = \alpha_0 + \alpha_1 Bar\_coin_{i,t} + \alpha_2 ETF_{i,t} \\ + \alpha_3 Controls_t + \nu_i + \xi_{it} \tag{3}$$

$$Bar\_coin_{i,t} = \beta_0 + \beta_1 Jewellery_{i,t} + \beta_2 ETF_{i,t} \\ + \beta_3 Controls_t + \nu_i + \eta_{it} \tag{4}$$

$$ETF_{i,t} = \gamma_0 + \gamma_1 Bar\_coin_{i,t} + \gamma_2 Jewellery_{i,t} \\ + \gamma_3 Controls_t + \nu_i + \zeta_{it} \tag{5}$$

The dependent variables *Jewellery*, *Bar_coin*, and *ETF*, capture the jewellery, bullion, and gold ETF demand of country i in year t, respectively. The control variables are the same as in Section 3.2. Equation 3-Equation 5 are estimated for the 2003-2018 period for which ETF flows data is available. Similar to the specification shown earlier, the estimations with ETF demand also control for country fixed effects in the panel regressions. The first and second lags of *Jewellery*, *Bar_coin*, and *ETF* are used as the instruments

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[9]The specification of lagged values as instruments is similar to Coles et al. (2006).

in the 3SLS estimations. Similar to earlier, in Equation 5 for gold ETF demand as the dependent variable, jewellery and bars & coins are the endogenous explanatory variables. These endogenous variables are instrumented using two lags of jewellery and bars & coins, respectively.

3.4. Data

We use cross-country data on gold demand obtained from the World Gold Council database for 30 high-income and middle-income countries (see Table A1). The database provides information on gold demand for both physical and electronic gold. As the focus of our study is on demand for gold by retail and institutional investors, gold purchases of central banks is excluded from the analysis. The sample period is from 1996 to 2018. Given the paucity of data on gold ETFs prior to 2003, our gold ETF sample period is from 2003 until 2018. Overall, we have observations from 30 countries for which we have consistent data for this period. The sample consists of 16 high-income and 14 middle-income countries. All country-level variables are obtained from the World Bank's World development indicators and the FRED database of the St. Louis Federal Reserve. The description of each of these variables are provided in Table 1.

The average jewellery demand is 78.3 tonnes for all countries, 47.6 tonnes for the high-income countries and 111.7 tonnes for the middle-income countries. Similarly, the average bars & coins demand for the full sample is 25.7 tonnes, of which the average in high-income countries is 14.4 tonnes, and 38.0 tonnes for middle-income countries. While the average gold ETF flows for the high-income countries is 20.2 tonnes, they are significantly smaller at 0.9 tonnes for the middle-income countries. The detailed summary statistics of each of the variables employed in our study is shown in Table 2. Pairwise correlations between the variables employed in the study are shown in Table A2.

The average GDP for the high-income countries is 960 billion USD and for the middle-income countries is 476 billion USD (in PPP terms in 2017 international dollars). Middle-income countries have higher rates of inflation (8.8% vis-à-vis 2.0%), have higher average annual real effective exchange rates (103.54 vis-à-vis 101.49), and lower private credit as

a share of GDP (59.39% vis-à-vis 116.87%).

The bivariate relationship between various forms of physical gold demand and their relationship to gold prices and global risk is shown in Figure A1 and Figure A2 for high-income countries and middle-income countries, respectively. The results suggest that there is a positive association between bullion and jewellery demand for both sets of countries. There is a negative relationship between jewellery and gold price in the high-income countries, however, we do not observe any relationship in the middle-income countries. Bullion demand is positively associated with the gold price for the high-income and middle-income countries, suggesting investment motives in that form of gold. In high-income countries, demand for gold in bullion and ETF is slightly positive related to the measure of global risk, however, we do not observe such a relationship in middle-income countries. While the bivariate relationships are indicative, they do not control for a variety of other factors that could affect gold demand nor do they account for the relationships between various forms of gold demand. A systematic multivariate analysis of the simultaneous determination of the physical and electronic gold demand is performed in the next section.

The panel stationarity tests for the main variables employed in the study is shown in Table A3. We do not find any evidence of non-stationarity based on the Fisher unit root test for panel data.

4. Findings and discussion

4.1. Jewellery and Bars & Coins Demand

We implement the simultaneous equation models with the two physical forms of gold demand for all countries, high-income countries, and middle-income countries separately. The results for the baseline estimations in Equation 1 and Equation 2 are reported in Table 3. The results of the simultaneous equation model for the full sample are shown in columns (1)-(2), for the high-income countries in columns (3)-(4), and for middle-income countries in columns (5)-(6). The dependent variable in columns (1), (3) and (5) is the

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aggregate jewellery demand (*Jewellery*). In columns (2), (4) and (6) the dependent variable is the aggregate gold demand in bars and coins (*Bar_coin*).

We find that the retail gold jewellery demand tends to rise with an increase in bars and coins demand (column (1)), and vice versa (column (2)) for the full sample period 1996-2018. This effect is driven by middle-income countries, where the jewellery demand is partly associated with investment motives, similar to bars & coins demand (column (5)). When there is an increase in bars and coins demand because of an investment motive, this also positively affects jewellery demand. Jewellery is also purchased for social occasions such as weddings and festivals (e.g., in India), in addition to investment motives, whereas bars and coins are generally for investment purposes only (Gülseven & Ekici, 2016; Narayanan, Gopalakrishnan, & Sahay, 2020). We do not find any relationship between jewellery and bullion demand for high-income countries (columns (3)-(4)), indicating a possible separation between the investment motives and consumption motives in high-income countries.

The level of a country's GDP positively affects jewellery demand (*Jewellery*) and bars and coins demand (*Bar_coin*) for the full sample (columns (1) and (2)). This positive relationship is consistent with greater purchasing capacity at the country-level driving demand for gold. The magnitude of the coefficient suggests that for a 10% increase in the overall GDP of a country, jewellery demand increases by 1.46 tonnes and bars and coins demand increases by 1.13 tonnes.[10] A similar magnitude is observed for middle-income countries, although the effect is statistically insignificant. This suggests that the effect for the all-country sample is likely due to a variation in gold demand across the high-income and middle-income countries.

The gold price adversely affects jewellery demand as expected in the full sample. A 10% increase in the gold price is associated with reduced demand for gold jewellery of about 0.74 tonnes in the full sample (column (1)), about 0.9% of the sample mean, and a reduction of 1.4 tonnes in the middle-income countries (column (4)), which is about 1.3%

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[10]The coefficient is capturing the semi-elasticity of jewellery demand with respect to GDP ($\frac{\partial Jewellery}{\partial Log\_GDP}$). Hence, the coefficient is divided by 100 for the interpretation as a response of jewellery demand in tonnes to a 1 percentage point increase in GDP.

of the sample mean.[11] The findings suggests that the jewellery demand of consumers is sensitive to international gold price changes, after controlling for real exchange rates that could affect prices in the domestic currency. However, the gold price seems to positively affect bars and coins demand, although the effect is statistically significant only in middle-income countries (column (6)).

Reaffirming the role of gold as a safe haven asset in high-income countries (Baur & Lucey, 2010; Baur & McDermott, 2010), we find that the demand for bars and coins is higher during times of heightened global risk and uncertainty. A 10% increase in the VIX index is associated with an increase in the demand for bars and coins by 0.89 tonnes for the full sample, and 1.25 tonnes for high-income countries (see columns (2) and (4)). The effect of the VIX for middle-income countries is not significant. The increase in the demand is about 3.5% and 9.1% of the sample mean for the full sample and high-income countries, respectively, suggesting a relatively strong safe haven effect in high-income countries.

Inflation is positively associated with both jewellery and bars & coins demand, albeit statistically insignificant in some specifications. A 1 percentage point increase in inflation is associated with an increase of 0.22 tonnes in bars and coins demand for the full sample and 0.3 tonnes for middle-income countries. This suggests that gold bars and coins act as an inflation hedge, particularly in the middle-income countries where inflation tends to be higher on average compared to high-income countries. It is possible that the insufficient access to alternative financial products can influence the demand for gold in the form of bars and coins as an inflation-hedge, particularly in the middle-income countries. Inflation is also positively associated with jewellery demand in high-income countries, with both likely related to improvements in overall demand conditions. Overall financial development ($Pvtcredit\_GDP$) is negatively related to jewellery demand in high-income and unrelated in middle-income countries. The availability of other financial products in high-income countries with a more developed financial sector seems to dissuade investment in gold jewellery.

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[11]A semi-elasticity interpretation applies to the coefficient for Log_Gold_price, similar to that described earlier for Log_GDP.

4.2.   Gold ETF Demand

Next, we implement the simultaneous equations model for three forms of gold demand, two physical forms of gold demand and gold-backed exchange traded funds (ETF) demand. The estimation is conducted for a shorter period from 2003 to 2018 separately for all countries, for high-income countries and for middle-income countries. The shorter time period and inclusion of only the country-year observations for which ETF data is available reduces the sample considerably to about a third of the original sample. The estimation results based on the equations Equation 3 - Equation 5 are reported in Table 4. The estimates for the all-country sample are shown in columns (1)-(3), for high-income countries in columns (4)-(6) and for middle-income countries in columns (7)-(9). The dependent variable in columns (1), (4) and (7) is the aggregate jewellery demand (*Jewellery*). In columns (2), (5) and (8), the dependent variable is the aggregate demand for bars and coins (*Bar_coin*), and in columns (3), (6) and (9), the dependent variable is the aggregate gold ETF demand (*ETF*).

The results for jewellery and bars & coins are different compared to the results presented above due to the inclusion of gold ETF demand and due to the shorter sample from 2003. For the all country sample, jewellery positively affects bars and coins demand and ETF demand but not vice versa. For high-income countries, jewellery and bars & coins are not influenced by any of the other gold demand categories and only ETF demand is positively influenced by both jewellery demand and bars and coins demand. For middle-income countries, jewellery demand positively influences bars and coins demand but not vice versa and there are no other significant effects among the three demand categories.

Similar to the results reported earlier, the global risk (VIX) index positively affects gold bars & coins and gold ETF demand in high-income countries, but none of the three types of gold in middle-income countries. The VIX also has a negative effect on jewellery demand which emphasizes the different roles of types of gold in periods of heightened risk and uncertainty.

Inflation has a positive influence on jewellery and on bars and coins demand both

in high-income and in middle-income countries but the coefficients are statistically insignificant for bars and coins in high-income countries and for jewellery in middle-income countries.

The asymmetry in the effects, e.g., that jewellery positively affects ETFs but not vice versa deserves further discussion. The effects are symmetric in an OLS framework which does not account for the simultaneity of the effects (see Table A5). Only when the simultaneity of the effects is accounted for within a 3SLS framework, the results become asymmetric and reveal that jewellery demand is not affected by bars and coins demand or ETF demand but that jewellery demand positively affects ETF demand and bars and coins demand.

An economic explanation for this finding is that there are conditions when jewellery and bars & coins demand is so strong or weak that it also affects ETF demand, but that there are no conditions in which ETF demand is so strong or weak that it affects the other gold demand categories. It seems that ETF demand is dependent on the other gold types but the other gold types are independent of ETF demand.

The econometric explanation for the asymmetry may be rooted in the relatively high persistence of jewellery demand and bars and coins demand. The comparatively low persistence of ETF demand is reflected in the larger influence of the regressor variables relative to jewellery demand and bars and coins demand. The persistence plays an important role in the 3SLS since the lags are used as instruments. The different degrees of persistence explain the different estimation results for the 3SLS compared with the OLS method.

Another reason for the asymmetry is that the control variables explain substantially more of the variation of the jewellery demand and bars and coins demand equations than of the ETF demand equation.

5. Summary and Conclusion

Gold is influenced by a variety of factors. Both the supply and the demand of gold are global, come from a large set of countries and are influenced by the global price of gold and drivers such as expected inflation and investor sentiment.

This paper focuses on three types of gold demand - demand for jewellery, demand for bars and coins, and demand for gold-backed exchange-traded funds - from 30 countries, 16 high-income countries and 14 middle-income countries. The gold demand includes retail and institutional demand but excludes central bank demand.

The econometric analysis shows that the factors that determine the demand for each of the three types of gold differ both across types and across countries. For example, jewellery demand is negatively affected by gold prices and immune to global risk changes, whereas bars and coins are positively affected by gold prices and not immune to global risk changes. The factors also depend on the origin of the demand, i.e. high-income countries display different demand characteristics than middle-income countries. The results also show that bars and coins demand is more consistent with gold being a financial asset whereas jewellery demand is consistent with a normal (consumption) good, i.e. a good whose demand falls with rising prices and increases with falling prices. This feature of jewellery may explain why jewellery demand is also labelled gold consumption despite the fact that gold cannot be consumed in the sense that the consumption of gold makes it disappear.

The larger demand for jewellery in middle-income countries than in high-income countries further suggests that middle-income investors likely pay a higher price for gold than high-income investors on average. This is due to the fact that jewellery is generally more costly to buy and sell than bars and coins or gold ETFs. The differences between high-income and middle-income countries are also reflected in the fact that jewellery and bars & coins are unrelated and segmented in high-income countries and positively related and thus not segmented in middle-income countries. More specifically, it seems that changes in the demand for jewellery (bars and coins) do not affect demand for bars and coins (jewellery) in high-income countries but the two demand types positively affect each other in

middle-income countries.

These results are based on an analysis of two forms of gold. When gold ETFs are added to the analysis, it emerges that jewellery demand and bars and coins demand positively affect the demand for ETFs in high-income countries but not in middle-income countries and that ETFs play no significant role for the demand of jewellery or bars and coins. However, ETF demand is significantly influenced by jewellery and bars & coins demand.

Our analysis of gold demand across 30 countries provides important information about the role of gold for different income-levels and for the usage of gold. It answers the question whether gold is used as an investment and thus influenced by global risk factors or whether it is rather used as a store of value and thus mostly unrelated to global risk factors. The results demonstrate that gold demand is different across types of gold and across different income levels of investors and "consumers".

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Figure 1: **Trends in gold demand: All countries**
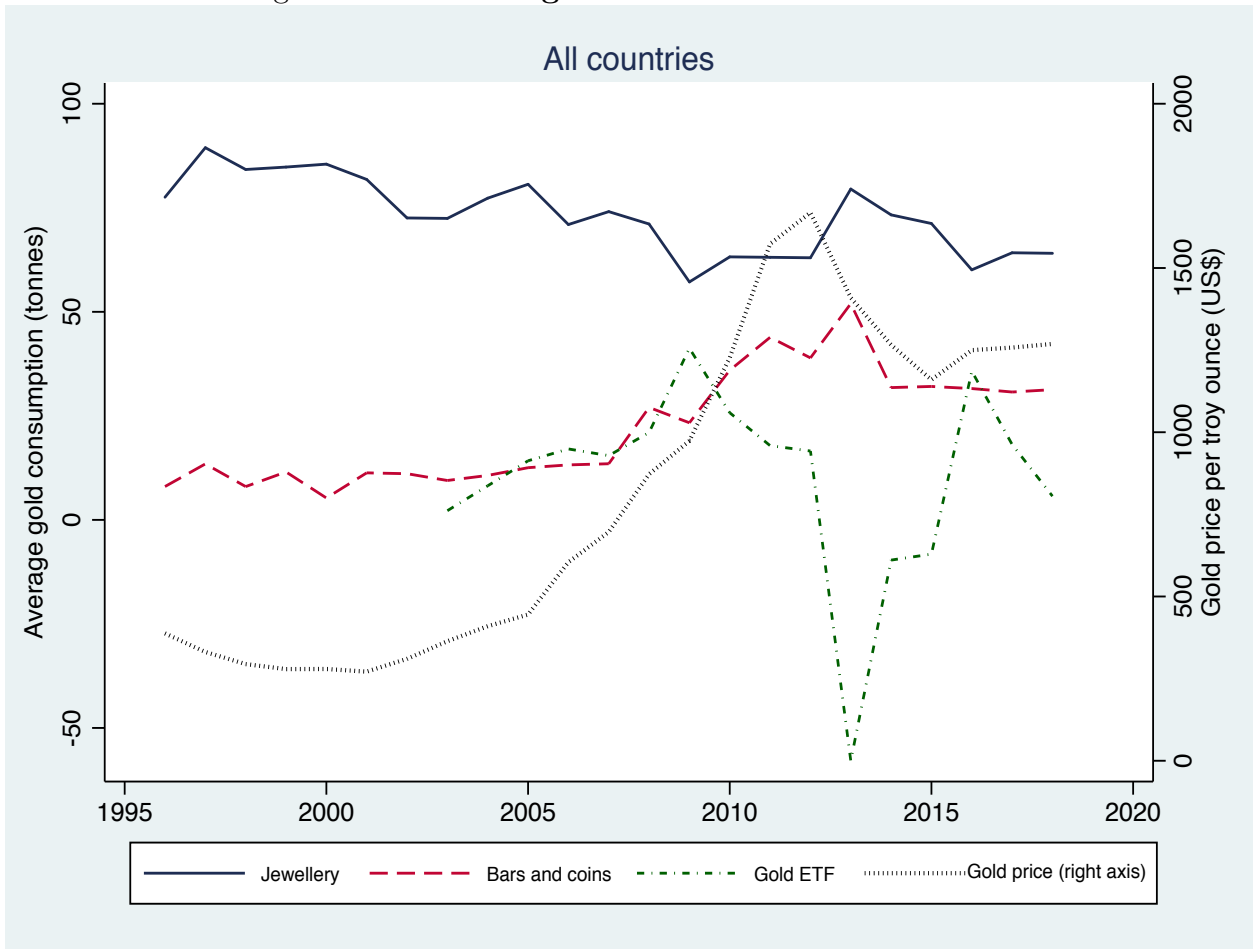
The figure shows the trends of the average gold demand for each channel across all countries. The gold price in US dollars is shown in the right axis.

Figure 2: **Trends in gold demand: High-income countries**
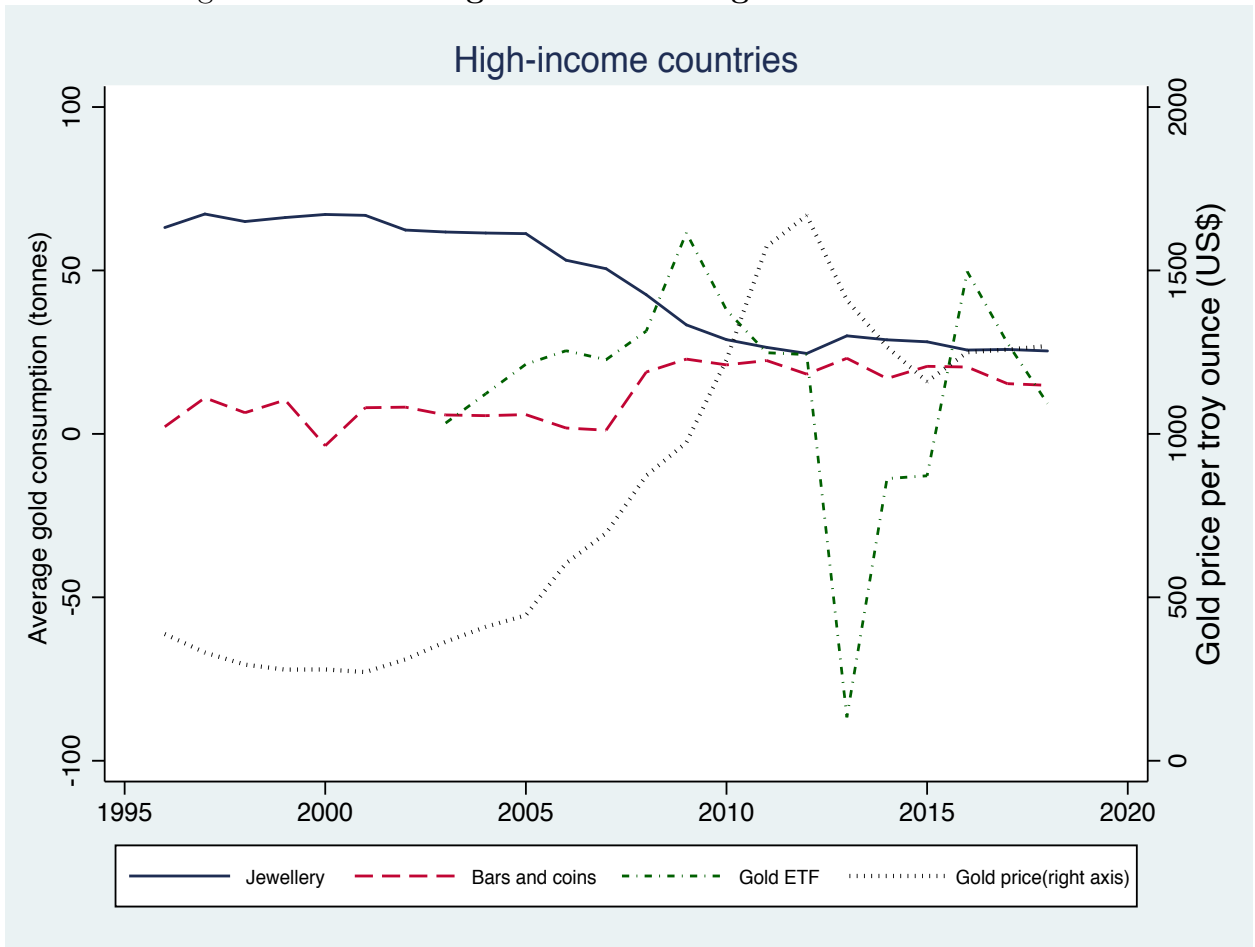
The figure shows the trends of the average gold demand for each channel across the high income countries. The gold price in US dollars is shown in the right axis.

Figure 3: **Trends in gold demand: Middle-income countries**
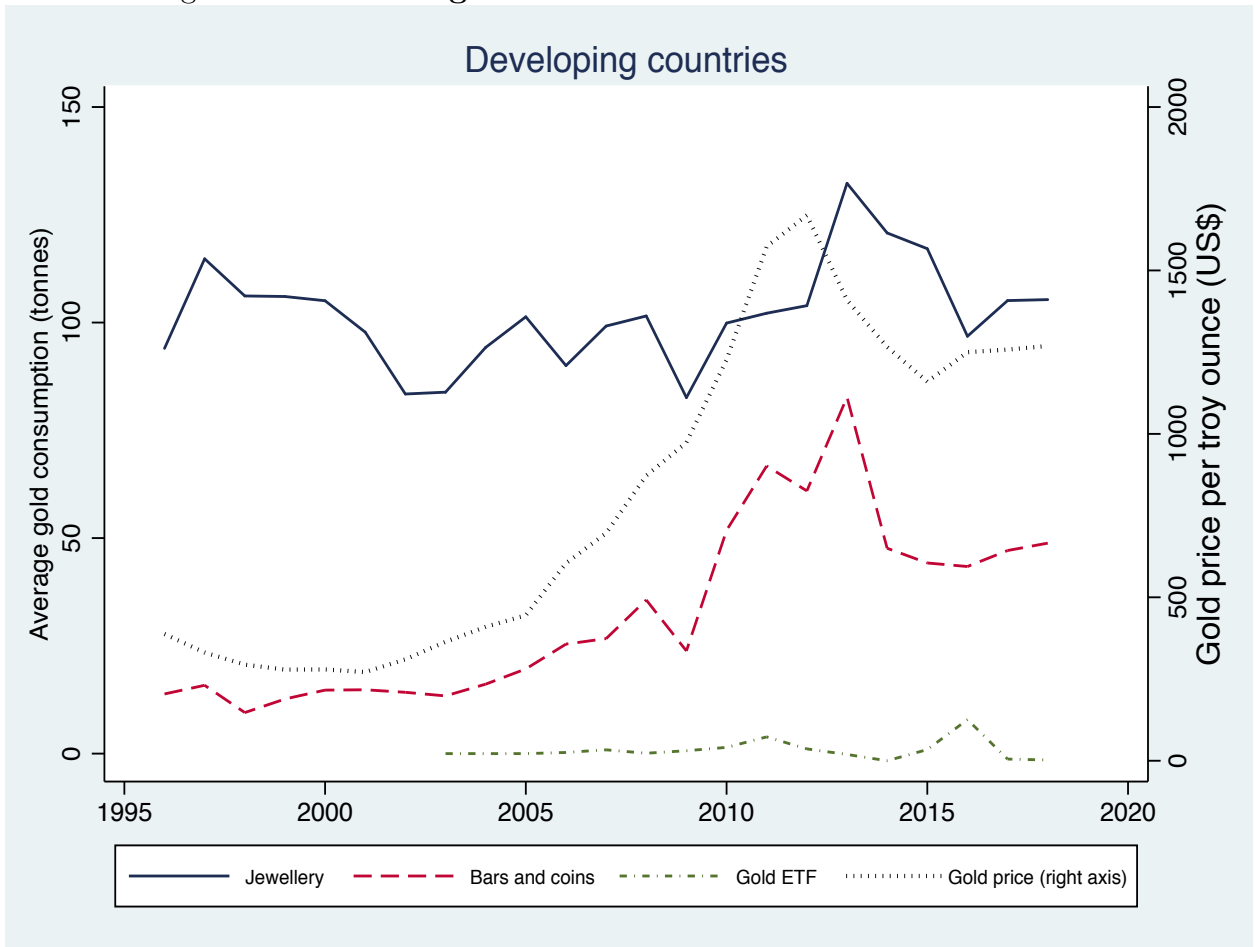
The figure shows the trends of the average gold demand for each channel across the middle-income countries. The gold price in US dollars is shown in the right axis.

Table 1: **Variable definition and data sources**

Variable	Definition and construction	Data source
Jewellery	Jewellery demand in tonnes of a country	World Gold Council
Bar_coin	Bars and coins demand in tonnes of a country	World Gold Council
ETF	Gold ETF flows in tonnes of a country	World Gold Council
Log_GDP	Logarithm of gross domestic product, PPP terms (constant 2017 international dollars)	World Bank WDI
Pvtcredit_GDP	Private credit scaled by the GDP of a country	World Bank WDI
Inflation	Consumer price index (CPI) inflation	World Bank WDI
Log_REER	Logarithm of the real effective exchange rate of a country	World Bank WDI
Log_Gold_price	Logarithm of international gold price in US dollars	FRED database of the St. Louis Federal Reserve
Log_VIX	Logarithm of the implied volatility of the S&P 500 index options	FRED database of the St. Louis Federal Reserve

Table 2: **Gold demand - Summary Statistics**

Jewellery, bars & coins and ETFs are aggregates at the country-year level.

Variable	Obs.	Mean	Std_dev	Min	Max	P10	P25	P50	P75	P90
All countries										
Jewellery	585	78.30	137.90	0.00	661.66	7.06	15.31	30.08	64.00	188.08
Bar_coin	585	25.67	52.98	-38.90	304.20	0.00	1.00	5.20	26.00	87.20
ETF	195	13.27	47.98	-101.20	229.71	-0.75	0.00	0.00	2.65	59.12
Log_GDP	585	27.26	1.36	24.45	30.38	25.63	26.20	27.12	28.35	28.99
Pvtcredit_GDP	585	89.36	53.86	15.04	214.30	25.52	37.72	87.52	133.31	166.75
Inflation	585	5.25	8.17	-15.18	54.29	-0.38	1.11	3.06	7.53	14.09
Log_REER	585	4.63	0.16	4.17	5.10	4.45	4.55	4.61	4.70	4.84
Log_Gold_price	585	6.55	0.64	5.60	7.42	5.63	5.90	6.77	7.14	7.25
Log_VIX	585	2.96	0.30	2.41	3.49	2.55	2.74	2.88	3.19	3.31
High-income countries										
Jewellery	305	47.65	69.91	0.00	389.26	0.00	12.00	23.00	54.74	112.50
Bar_coin	305	14.36	31.38	-38.90	142.40	-1.50	0.00	4.00	14.10	61.20
ETF	125	20.20	58.70	-101.20	229.71	-0.29	0.00	0.15	20.73	76.42
Log_GDP	305	27.59	1.38	24.98	30.38	25.72	26.46	27.69	28.59	29.39
Pvtcredit_GDP	305	116.87	49.20	21.51	214.30	50.93	83.41	107.93	158.83	183.18
Inflation	305	2.00	5.26	-15.18	22.36	-1.38	0.29	1.61	2.69	5.96
Log_REER	305	4.62	0.13	4.20	5.02	4.45	4.56	4.61	4.69	4.82
Log_Gold_price	305	6.57	0.64	5.60	7.42	5.63	5.90	6.77	7.14	7.25
Log_VIX	305	2.95	0.30	2.41	3.49	2.55	2.74	2.88	3.19	3.45
Middle-income countries										
Jewellery	280	111.69	179.81	0.00	661.66	11.05	19.05	39.95	78.92	466.67
Bar_coin	280	37.99	67.16	-38.90	304.20	0.00	2.00	9.05	41.80	106.80
ETF	70	0.90	6.10	-7.28	43.75	-2.70	-0.06	0.00	0.01	2.26
Log_GDP	280	26.89	1.23	24.45	30.02	25.39	25.96	26.85	27.76	28.46
Pvtcredit_GDP	280	59.39	41.31	15.04	166.50	19.88	27.32	44.72	95.94	124.73
Inflation	280	8.78	9.25	-5.99	54.29	1.61	3.69	6.68	10.40	19.24
Log_REER	280	4.64	0.18	4.17	5.10	4.45	4.54	4.61	4.72	4.90
Log_Gold_price	280	6.53	0.65	5.60	7.42	5.63	5.80	6.77	7.14	7.25
Log_VIX	280	2.96	0.30	2.41	3.49	2.55	2.74	2.88	3.19	3.31

Table 3: **Gold demand through various channels**

The dependent variable in columns (1), (3) and (5) is the jewellery demand ($Jewellery_t$), and in columns (2), (4) and (6) is the gold demand in bars and coins (Bar_coin_t). The first and second lags of $Jewellery$ and Bar_coin are used as the instruments in the 3SLS estimations. Standard errors are shown in parenthesis. ***, ** and * indicate significance at the 1%, 5% and 10% respectively.

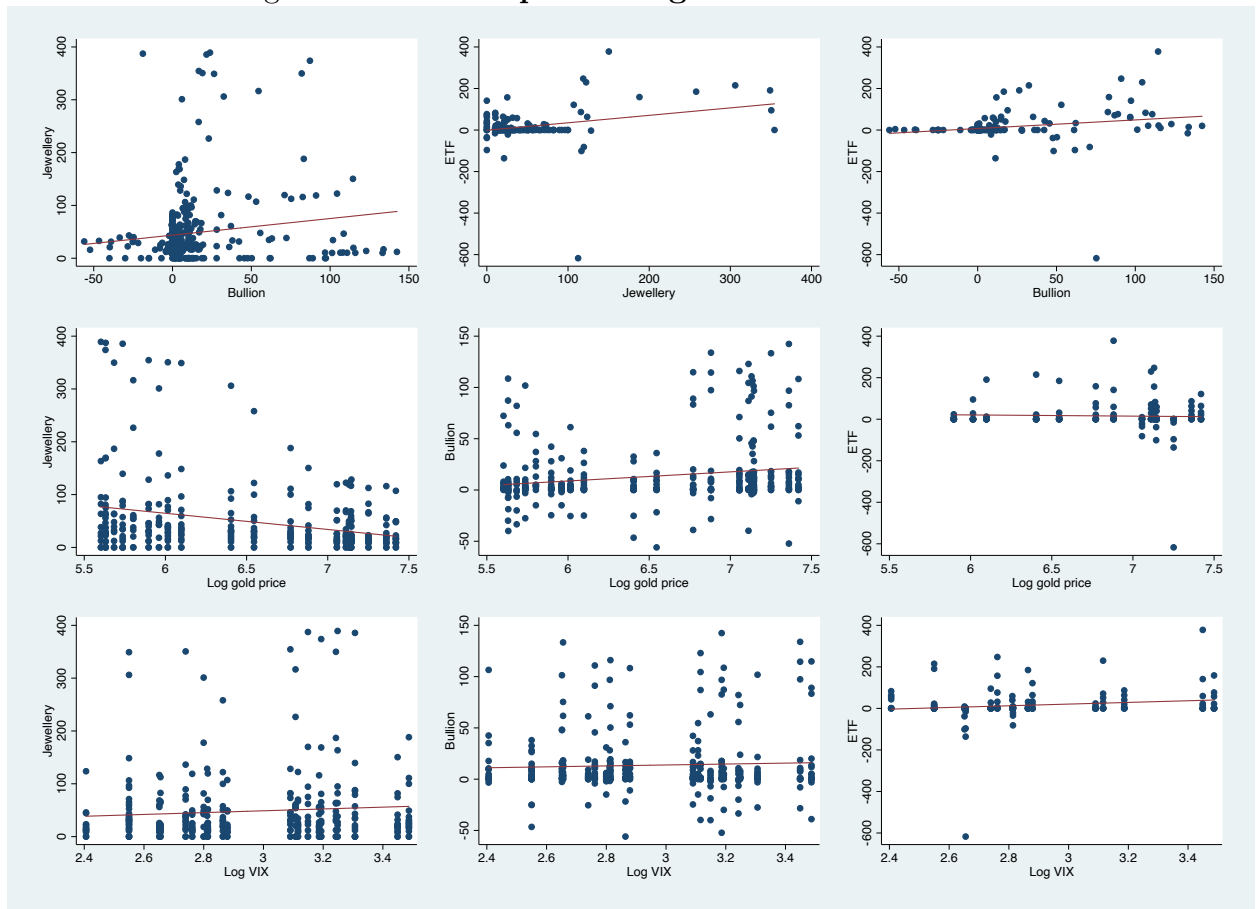|	All countries		High-income countries		Middle-income countries	
	(1)	(2)	(3)	(4)	(5)	(6)
$Jewellery_t$		0.044**		-0.041		0.083**
		(0.022)		(0.029)		(0.040)
Bar_coin_t	0.087**		0.001		0.268***	
	(0.043)		(0.036)		(0.089)	
Log_GDP_t	14.629**	11.292*	3.651	6.178	18.442	6.041
	(7.361)	(6.017)	(6.022)	(8.832)	(12.582)	(9.006)
$Pvtcredit\_GDP_t$	-0.127**	-0.037	-0.073**	0.014	-0.168	-0.063
	(0.054)	(0.044)	(0.035)	(0.050)	(0.108)	(0.077)
$Inflation_t$	0.214	0.204*	0.219*	0.138	0.184	0.301*
	(0.140)	(0.114)	(0.116)	(0.168)	(0.225)	(0.154)
Log_REER_t	11.016	7.422	2.301	12.808	14.161	7.164
	(8.216)	(6.651)	(7.381)	(10.656)	(12.805)	(8.983)
$Log\_Gold\_price_t$	-7.371***	3.037	-2.749	0.686	-13.731**	7.001*
	(2.786)	(2.301)	(1.843)	(2.716)	(5.718)	(4.094)
Log_VIX_t	-5.228	8.932***	-2.85	12.521***	-6.183	2.973
	(3.208)	(2.575)	(2.123)	(3.018)	(6.023)	(4.184)
$Jewellery_{t-1}$	0.864***		1.224***		0.742***	
	(0.041)		(0.055)		(0.062)	
$Jewellery_{t-2}$	-0.003		-0.299***		0.009	
	(0.039)		(0.054)		(0.054)	
Bar_coin_{t-1}		0.727***		0.625***		0.735***
		(0.040)		(0.053)		(0.064)
Bar_coin_{t-2}		0.061		0.095*		0.021
		(0.039)		(0.050)		(0.059)
$Constant$	-356.050**	-377.272**	-71.7	-258.588	-464.889	-259.791
	(181.324)	(147.121)	(146.984)	(215.132)	(337.440)	(240.121)
$Country\text{-}year\ obs.$	585	585	305	305	280	280
$Country\ fixed\ effects$	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.978	0.902	0.981	0.796	0.979	0.928

Table 4: **Gold demand through various channels including Gold ETFs**

The dependent variable in columns (1), (4) and (7) is the jewellery demand ($Jewellery_t$), in columns (2), (5) and (8) is the gold demand in bars and coins (Bar_coin_t), and in columns (3), (6) and (9) is the gold-backed exchange traded funds flows in a country in a year (ETF_t). The first and second lags of $Jewellery$, Bar_coin, and ETF are used as the instruments in the 3SLS estimations. Standard errors are shown in parenthesis. ***, ** and '*' indicate significance at the 1%, 5% and 10% respectively.

	All countries			High-income countries			Middle-income countries		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Jewellery_t$		0.130**	0.188*		-0.042	0.761***		0.787*	-0.200
		(0.061)	(0.100)		(0.092)	(0.172)		(0.414)	(0.233)
Bar_coin_t	0.117		-0.007	0.012		0.835***	0.445		0.383
	(0.086)		(0.147)	(0.056)		(0.282)	(0.491)		(0.386)
ETF_t	-0.078	0.067		-0.004	0.054		-0.266	-2.096	
	(0.099)	(0.103)		(0.039)	(0.086)		(1.795)	(3.433)	
Log_GDP_t	4.803	-7.001	6.345	5.571	28.565	8.247	60.258	-160.874**	42.045
	(16.507)	(16.196)	(26.628)	(12.546)	(25.860)	(75.627)	(89.421)	(75.926)	(51.056)
$Pvtcredit\_GDP_t$	-0.045	0.026	0.017	0.029	-0.089	-0.174	-0.837	2.049*	-0.297
	(0.119)	(0.115)	(0.191)	(0.045)	(0.094)	(0.264)	(0.961)	(1.180)	(0.502)
$Inflation_t$	1.049**	0.989**	-0.570	0.520***	0.253	-1.409	0.557	3.654**	-0.94
	(0.515)	(0.500)	(0.824)	(0.186)	(0.385)	(1.109)	(3.315)	(1.768)	(1.192)
Log_REER_t	34.108	12.309	-72.238*	4.845	-19.367	-57.464	85.617	-46.987	14.674
	(26.022)	(25.643)	(40.175)	(9.829)	(21.073)	(58.259)	(65.311)	(95.006)	(22.776)
$Log\_Gold\_price_t$	-2.092	18.197***	-11.089	-1.584	4.445	-10.727	-26.793	83.471**	-34.659
	(7.498)	(6.446)	(12.098)	(2.638)	(5.167)	(15.781)	(52.615)	(32.861)	(33.373)
Log_VIX_t	-8.536	10.121*	23.992***	-4.792**	16.003***	21.953*	-3.358	-11.917	9.803
	(5.905)	(5.759)	(8.743)	(2.288)	(4.957)	(13.297)	(18.815)	(17.037)	(7.437)
$Jewellery_{t-1}$	0.553***			1.170***			0.341*		
	(0.064)			(0.075)			(0.181)		
$Jewellery_{t-2}$	0.241***			-0.332***			0.231		
	(0.067)			(0.077)			(0.169)		
Bar_coin_{t-1}		0.605***			0.622***			0.067	
		(0.073)			(0.123)			(0.283)	
Bar_coin_{t-2}		0.002			-0.105			-0.173	
		(0.075)			(0.108)			(0.230)	
ETF_{t-1}			0.386***			0.262***			-0.246
			(0.072)			(0.086)			(0.416)
ETF_{t-2}			-0.069			-0.068			-0.816
			(0.072)			(0.083)			(0.528)
$Constant$	-237.095	-39.21	160.58	-139.629	-731.071	10.841	-1722.257	3950.552*	-1017.477
	(423.784)	(415.250)	(682.692)	(319.561)	(651.325)	(1926.056)	(2219.693)	(2062.770)	(1254.717)
$Country$-$year$ $obs.$	195	195	195	125	125	125	70	70	70
$Country$ $fixed$ $effects$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.987	0.930	0.467	0.985	0.895	0.518	0.989	0.929	-0.657

A.   Appendix

Figure A1: **Scatter plots - High income countries**

The figure shows the scatter plots for high-income countries.

Figure A2: **Scatter plots - Middle-income countries**
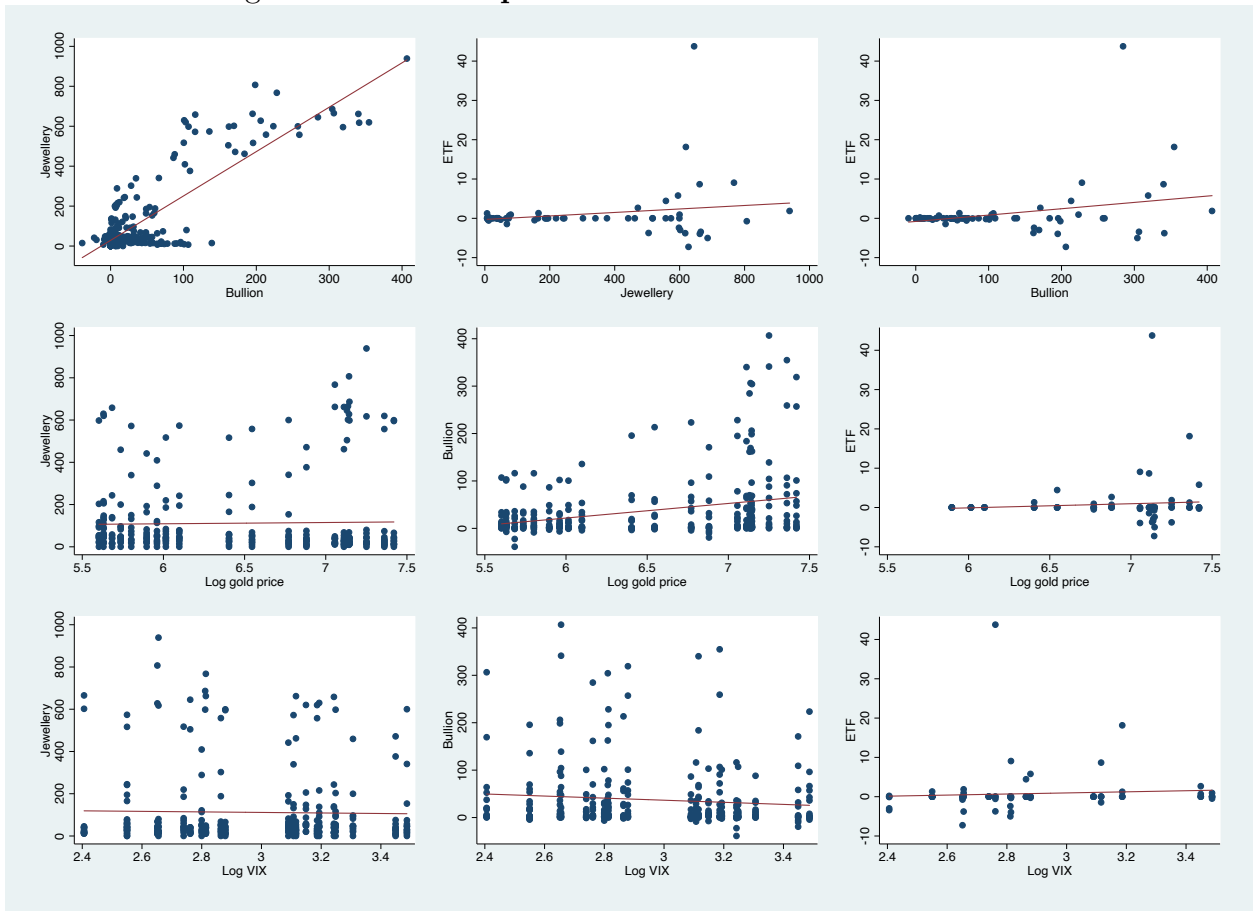
The figure shows the scatter plots for middle-income countries.

Table A1: **Country list**

The list of countries in our sample is shown in the table.

High-income countries	Middle-income countries
Austria	Brazil
Canada	China
France	Egypt
Germany	Indonesia
Hongkong	India
Italy	Iran
Japan	Sri Lanka
Kuwait	Mexico
Saudi Arabia	Malaysia
South Korea	Pakistan
Spain	Russia
Singapore	Thailand
Switzerland	Turkey
United Arab Emirates	Vietnam
UK	
USA	

Table A2: **Correlation - All countries**

The table shows the pairwise correlation of the variables. Jewellery, bars & coins and ETFs are aggregates at the country-year level

	$Jewellery$	Bar_coin	ETF	Log_GDP	$Pvtcredit\_GDP$	$Inflation$	Log_REER	Log_Gold_price	Log_VIX
$Jewellery$	1.00								
Bar_coin	0.74	1.00							
ETF	0.04	0.07	1.00						
Log_GDP	0.36	0.30	0.30	1.00					
$Pvtcredit\_GDP$	-0.04	0.05	0.27	0.41	1.00				
$Inflation$	0.03	0.00	-0.06	-0.21	-0.45	1.00			
Log_REER	0.11	0.18	-0.06	-0.13	0.11	-0.18	1.00		
Log_Gold_price	-0.07	0.22	0.00	0.18	0.14	-0.13	0.14	1.00	
Log_VIX	0.02	-0.04	0.12	-0.10	-0.06	0.07	-0.01	-0.31	1.00

Table A3: **Panel unit root tests**

The table shows the results of the Fisher's panel unit root test with a drift term for all panel variables in the estimation. The null hypothesis is that there is unit root in the panel of observations. The inverse chi-square statistic is indicated in the table along with the corresponding p-value in the brackets. ***, ** and * denotes the p-values at 1%, 5% and 10% significance respectively.

	Fisher's panel stationarity test
Variable	With intercept (All countries)
$Jewellery$	213.739***
	(0.000)
Bar_coin	257.939***
	(0.000)
ETF	140.769***
	(0.000)
Log_GDP	109.253***
	(0.000)
$Pvtcredit\_GDP$	109.839***
	(0.000)
$Inflation$	393.819***
	(0.000)
Log_REER	168.597***
	(0.000)

Table A4: **Gold demand through various channels - OLS**

The dependent variable in columns (1), (3) and (5) is the jewellery demand ($Jewellery_t$), and in columns (2), (4) and (6) is the gold demand in bars and coins (Bar_coin_t). Robust standard errors are shown in parenthesis. ***, ** and * indicate significance at the 1%, 5% and 10% respectively.

	All countries		High-income countries		Middle-income countries	
	(1)	(2)	(3)	(4)	(5)	(6)
$Jewellery_t$		0.337**		-0.102		0.464***
		(0.125)		(0.087)		(0.036)
Bar_coin_t	0.748**		-0.202		1.146***	
	(0.338)		(0.233)		(0.290)	
Log_GDP_t	94.725**	20.080	55.155	-8.066	74.454*	9.932
	(44.986)	(17.173)	(51.056)	(26.903)	(37.748)	(15.771)
$Pvtcredit\_GDP_t$	-0.107	0.057	-0.003	0.049	-0.216	0.182
	(0.223)	(0.153)	(0.201)	(0.220)	(0.246)	(0.178)
$Inflation_t$	0.418*	0.196	0.788*	0.218	-0.018	0.389
	(0.243)	(0.202)	(0.375)	(0.133)	(0.339)	(0.318)
Log_REER_t	34.674	19.756	63.435	47.456*	23.915	9.936
	(27.090)	(17.404)	(46.064)	(27.030)	(31.617)	(18.248)
$Log\_Gold\_price_t$	-56.692***	17.131	-39.023*	8.390	-60.225***	22.742*
	(19.105)	(10.812)	(19.795)	(18.222)	(17.934)	(10.592)
Log_VIX_t	5.658	8.799**	10.576	11.505*	6.813	1.993
	(4.887)	(3.883)	(8.781)	(5.666)	(7.405)	(4.490)
Constant	-2321.010*	-783.890*	-1540.338	-72.866	-1658.722	-495.713
	(1162.254)	(451.130)	(1299.717)	(618.568)	(942.219)	(368.087)
Country-year obs.	585	585	305	305	280	280
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adj_R^2	0.430	0.449	0.318	0.095	0.643	0.711

Table A5: **Gold demand through various channels including Gold ETFs - OLS**

The dependent variable in columns (1), (4) and (7) is the jewellery demand ($Jewellery_t$), in columns (2), (5) and (8) is the gold demand in bars and coins (Bar_coin_t), and in columns (3), (6) and (9) is the exchange traded funds (ETF) flows in a country in a year (ETF_t). Robust standard errors are shown in parenthesis. ***, ** and * indicate significance at the 1%, 5% and 10% respectively.

	All countries			High-income countries			Middle-income countries		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Jewellery_t$		0.450***	0.145		-0.145	0.792***		0.596***	-0.009
		(0.121)	(0.140)		(0.110)	(0.148)		(0.046)	(0.011)
Bar_coin_t	0.764***		0.081	-0.200		0.610	1.178***		0.041*
	(0.213)		(0.085)	(0.254)		(0.379)	(0.085)		(0.018)
ETF_t	0.118	0.039		0.196**	0.109***		-0.267	0.628	
	(0.069)	(0.046)		(0.065)	(0.029)		(0.360)	(0.549)	
Log_GDP_t	107.809**	-6.502	13.834	73.670*	31.393	15.674	199.941***	-126.599***	-1.775
	(47.365)	(47.497)	(20.200)	(33.535)	(35.970)	(92.536)	(36.214)	(15.171)	(2.960)
$Pvtcredit\_GDP_t$	0.087	-0.044	0.077	0.409**	-0.141	-0.18	-1.855**	1.448***	0.095
	(0.342)	(0.314)	(0.188)	(0.174)	(0.194)	(0.124)	(0.625)	(0.266)	(0.089)
$Inflation_t$	0.883	0.678	-0.647	1.515***	0.427***	-1.452**	-3.205*	3.727*	0.037
	(0.578)	(0.677)	(0.411)	(0.381)	(0.126)	(0.518)	(1.324)	(1.622)	(0.192)
Log_REER_t	172.137**	-9.393	-96.981**	23.267	-21.411	-96.919	181.511**	-24.087	6.217
	(59.190)	(31.606)	(43.283)	(36.134)	(39.529)	(62.920)	(52.578)	(37.247)	(11.114)
$Log\_gold\_price_t$	-67.650***	51.343***	-17.84	-37.525**	16.631	-7.387	-116.888**	82.093**	-4.918
	(17.195)	(14.544)	(11.667)	(14.869)	(15.709)	(17.387)	(31.086)	(22.083)	(3.493)
Log_VIX_t	-1.785	3.646	27.997*	-0.341	11.783	28.808*	20.606	-17.991	3.226*
	(7.221)	(8.746)	(14.936)	(3.990)	(9.526)	(13.961)	(16.405)	(14.232)	(1.432)
$Constant$	-3283.710**	-137.857	88.475	-1941.754**	-892.432	-30.737	-5305.975***	2896.954***	34.832
	(1268.713)	(1288.027)	(583.822)	(821.989)	(851.921)	(2374.770)	(1030.443)	(277.326)	(44.813)
Country-year obs.	195	195	195	125	125	125	70	70	70
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj_R^2	0.584	0.539	0.064	0.418	0.255	0.215	0.846	0.851	0.029