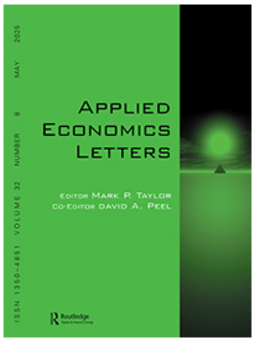
Currency-market devaluations: treating gold as a currency



Applied Economics Letters

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rael20

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APPLIED ECONOMICS LETTERS
2025, VOL. 32, NO. 8, 1192–1196
https://doi.org/10.1080/13504851.2024.2302876

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ABSTRACT
The currency market is a relative market, where one currency is priced in terms of another currency. As a consequence, currencies move relative to other currencies so that not all currencies can devalue at the same time. This creates a methodological challenge for measuring devaluations in the currency market as a whole, which may occur due to competitive devaluations, monetary policy coordination, contagion, or other reasons. For example, if there is a coordinated global reflationary policy, what measures the overall currency-market devaluation? In this paper, gold is treated as a currency to create a nominal anchor by which to measure currency-market devaluations, as all the other currencies can devalue relative to gold. In general, there have been three currency-market devaluations since the end of the Bretton Woods international monetary system: 89% between 1972 and 1980; 66% between 2005 and 2012; and 25% between 2019 and 2020.

KEYWORDS
Gold; exchange rates; currency-market devaluations; gold as a currency

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I. Introduction

Currency-market devaluations are devaluations of the currency market as a whole. The currency market is a relative market, where currencies move relative to other currencies. For example, a devaluation of a single currency is expected to reduce its *external* purchasing power relative to other currencies. As a consequence, all currencies cannot devalue at the same time. This creates a methodological challenge for measuring currency-market devaluations. The motivation of this paper is to measure currency-market devaluations by using gold as a common nominal anchor.

Currency-market devaluations occur due to competitive devaluations, monetary policy coordination, contagion, or some other reason. Competitive devaluations (currency wars), usually involve beggar-thy-neighbour policies to reduce the *external* purchasing power of one currency, with other currencies following suit: a devaluation spiral that is a race to the bottom in the hope of an exchange rate advantage (Betts and Devereux 2000; Corsetti et al. 2000). In contrast, monetary policy coordination attempts to limit excessive exchange rate fluctuations (Taylor 2013). Contagion occurs when a crisis in one currency affects other currencies (Eichengreen, Rose, and Wyplosz 1996).

Historically, gold has been a common nominal anchor for global currencies during both the pre-WWII *gold standard* and the post-WWII *gold-exchange standard* of the Bretton Woods international monetary system (Freedman and Laxton 2009). In the gold standard, there were many devaluations relative to gold. In the gold-exchange standard, the price of gold was fixed to the US dollar, where currencies could explicitly devalue relative to the US dollar and implicitly devalue relative to the price of gold. Since the end of the Bretton Woods international monetary system, the price of gold has moved freely and the use of gold as a common nominal anchor diminished. However, gold is still a popular instrument for hedging currency risk.

This paper contributes to the literature by treating gold as a currency inside the system of currencies, rather than as an outside commodity. This is achieved by assuming that the US dollar price of gold is a bilateral exchange rate. However, modelling bilateral exchange rates suffers from aggregation bias, which can be overcome by using *multilateral exchange rates* (Kunkler and MacDonald 2015). The multilateral exchange rates are priced in terms of the same *multicurrency numéraire*: an equally-weighted basket of currencies. Treating gold

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as a currency results in gold being included in the multicurrency numéraire. As a consequence, all the other currencies can devalue relative to gold. Since the end of the Bretton Woods international monetary system, three periods of currency-market devaluations have been found: 89% between 1972 and 1980; 66% between 2005 and 2012; and 25% between 2019 and 2020.

II. Materials and methods

A bilateral exchange rate is the price of a *fixed currency* in terms of a *variable* (*numéraire*) *currency*. Bilateral exchange rates are usually written in log terms to overcome Siegel's paradox (Taylor and Sarno, 2002). In log terms, for a system of N currencies, let $p_{i/j}(t)$ represent the ith/jth bilateral exchange rate at time t, where i is the *fixed* (ith) currency, j is the *variable* (jth) currency, $i, j = 1, \ldots, N$, and $t = 0, \ldots, T$.

In contrast, the US dollar price of gold is the price of gold in terms of the US dollar (*numéraire*). In log terms, let $p_{XAU/USD}(t)$ represent the US dollar price of gold at time t, where $t = 0, \ldots, T$. More generally, let $p_{XAU/j}(t)$ represent the price of gold in terms of the jth currency at time t, where $j = 1, \ldots, N$ and $t = 0, \ldots, T$.

In this paper, gold is treated as a currency by assuming that the US dollar price of gold is a bilateral exchange rate. However, modelling the relationship between currencies using bilateral exchange rates suffers from aggregation bias, which can be overcome by using multilateral exchange rates (Kunkler and MacDonald 2015). For example, each bilateral exchange rate can be decomposed by:

$$p_{i/j}(t) = p_i(t) - p_j(t) \tag{1}$$

where $i, j = 1, \ldots, N$; $t = 0, \ldots, T$; $p_{i/j}(t)$ is the ith/jth bilateral exchange rate; $p_i(t)$ is the ith (fixed currency) multilateral exchange rate; and $p_j(t)$ is the jth (variable currency) multilateral exchange rate (Kunkler and MacDonald 2015).

Each multilateral exchange rate is priced relative to the same *multicurrency numéraire* (an equally-weighted basket of the N currencies) by:

$$p_i(t) = \frac{1}{N}\sum_{j=1}^{N} p_{i/j}(t) \tag{2}$$

where $i = 1, \ldots, N$; $t = 0, \ldots, T$; $p_i(t)$ is the ith multilateral exchange rate; and $p_{i/j}(t)$ is the ith/jth bilateral exchange rate. For example, the multilateral exchange rate for gold $p_{XAU}(t)$ is calculated by:

$$p_{XAU}(t) = \frac{1}{N}\sum_{j=1}^{N} p_{XAU/j}(t) \tag{3}$$

where $p_{XAU/j}(t)$ is the price of gold in terms of the jth currency: the XAU/jth bilateral exchange rate.

Assuming that there are no arbitrage opportunities, the N multilateral exchange rates in Equation (2) are related by:

$$\sum_{i=1}^{N} p_i(t) = 0 \tag{4}$$

where $t = 0, \ldots, T$; and $p_i(t)$ is the ith multilateral exchange rate (Kunkler and MacDonald 2015). The no-arbitrage condition also applies to the log returns by:

$$\sum_{i=1}^{N} \Delta p_i(t) = 0 \tag{5}$$

where $t = 1, \ldots, T$; and $\Delta p_i(t) = p_i(t) - p_i(t-1)$ is the log return of the ith multilateral exchange rate. The no-arbitrage condition in Equation (5) highlights the relative nature of the currency market, where all currencies cannot appreciate (depreciate) at the same time. The log returns of the N multilateral exchange rates are centred at zero.

In summary, treating gold as a currency is advantageous because it provides a method to measure currency-market devaluations. The currency market as a whole can depreciate relative to the gold multilateral exchange rate. For example, Equation (5) can be rearranged to give:

$$\Delta p_{XAU}(t) = -\sum_{i=1}^{N} I(i \neq XAU)\Delta p_i(t) \tag{6}$$

where $t = 0, \ldots, T$; $\Delta p_{XAU}(t)$ is the log return of the gold multilateral exchange rate; $\Delta p_i(t)$ is the log return of the ith multilateral exchange rate; and $I(i \neq XAU)$ is an indicator function that is equal to one when the ith currency is not equal to gold and zero otherwise.

III. Results and discussion

The monthly data sample consists of the US dollar price of gold and six US dollar bilateral exchange rates, sourced from Bloomberg between the 31st of Decemeber 1971 and the 31st of Decemeber 2021. The currencies are: Gold (XAU), the US dollar (USD), the Japanese yen (JPY), the Eurozone euro (EUR), the Swiss franc (CHF), the British pound (GBP), the Canadian dollar (CAD), and the Australian dollar (AUD). Table 1 reports the descriptive statistics for the log returns of the multilateral exchange rates and the log returns of the gold bilateral exchange rates priced in terms of the other currencies.

The movements in the gold multilateral exchange rate are negatively correlated with the movements in the multilateral exchange rates for all other currencies, with an average of −0.298 (see column $\rho_{XAU,i}$ in Table 1). In contrast, the price of gold in terms of the ith currency is negatively correlated with the ith currency, with an average of −0.635 (see column $\rho_{XAU/i,i}$ in Table 1).

Figure 1 displays the cumulative log returns of the eight multilateral exchange rates and Figure 2 displays the log returns of the eight multilateral exchange rates, together with the cross-sectional standard deviation.

Over the 50 year period, the annualized expected return of the gold multilateral exchange rate (μ_{XAU})

Table 1. Descriptive statistics.

	μ_i	$\mu_{XAU/i}$	σ_i	$\sigma_{XAU/i}$	$\rho_{XAU,i}$	$\rho_{XAU/i,i}$
XAU	6.10%		15.15%		1.000***	
USD	−1.37%	7.47%	6.86%	19.11%	−0.427***	−0.697***
JPY	0.64%	5.46%	8.66%	19.12%	−0.234***	−0.638***
EUR	−0.10%	6.20%	6.33%	18.03%	−0.289***	−0.594***
CHF	1.54%	4.56%	7.22%	17.88%	−0.175***	−0.552***
GBP	−2.63%	8.73%	7.13%	19.11%	−0.392***	−0.684***
CAD	−1.83%	7.93%	6.70%	18.50%	−0.334***	−0.636***
AUD	−2.35%	8.45%	8.76%	19.20%	−0.235***	−0.642***

Notes: Table 1 reports the descriptive statistics for the log returns of the multilateral exchange rates (μ_i, σ_i, and $\rho_{XAU,i}$) and the log returns of the gold bilateral exchange rates priced in terms of the other currencies ($\mu_{XAU/i}$, $\sigma_{XAU/i}$, and $\rho_{XAU/i,i}$). Significance levels for the correlations are denoted by * for 10%, ** for 5%, and *** for 1%.

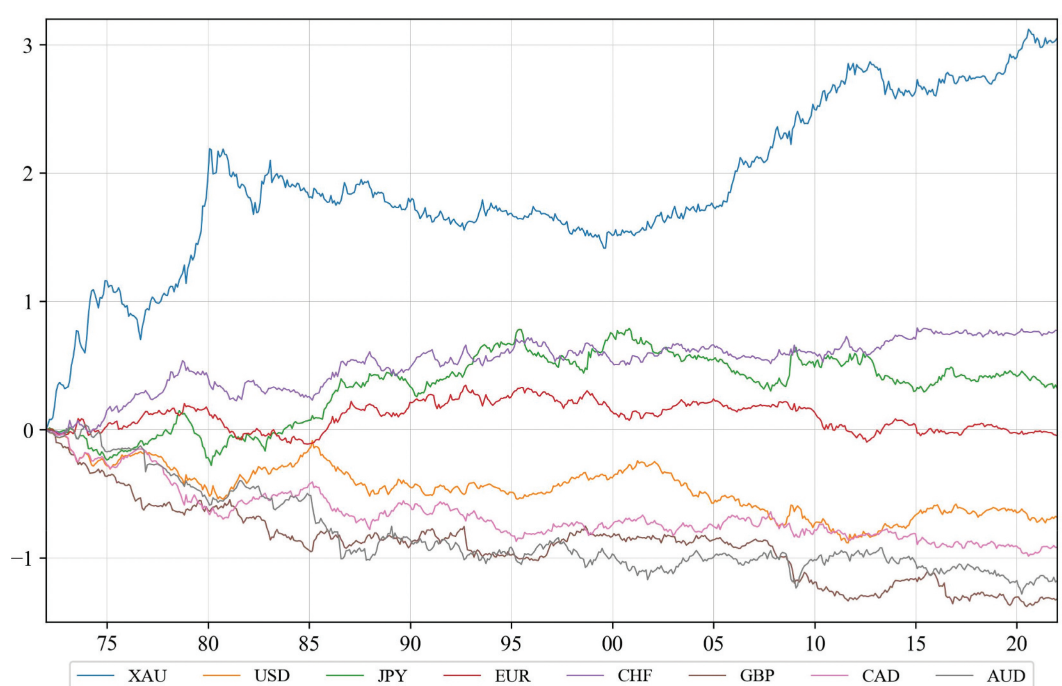

Figure 1. Multilateral exchange rates. Notes: Figure 1 displays the cumulative log returns of the multilateral exchange rates.

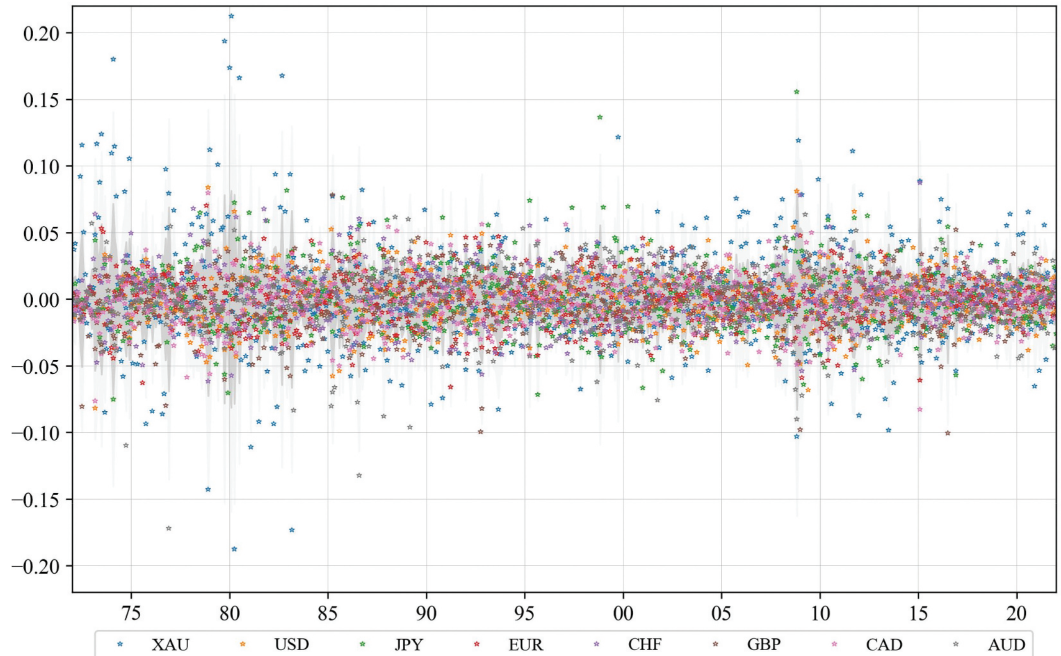

Figure 2. Movements in the multilateral exchange rates. Notes: Figure 2 displays the log returns of the multilateral exchange rates. The dark grey band represents 1.00 times the cross-sectional standard deviation and the light grey band represents 1.96 times the cross-sectional standard deviation.

Table 2. Currency-market devaluations.

	Log return	Nominal return	Std. deviation
Whole period	−3.0543	−95.28%	8.27%
1972 to 1980	−2.1706	−88.59%	10.23%
Mid-2005 to 2012	−1.0889	−66.34%	8.68%
2019 to 2020	−0.2882	−25.04%	6.05%

Notes: Table 2 reports the devaluations of the three episodes, together with the whole period, as well as the average cross-sectional annualized standard deviation.

is 6.10% in log terms (6.29% in nominal terms). Thus, the currency market devalues at an annualized rate of 6.10% in log terms (5.92% in nominal terms) relative to the gold multilateral exchange rate. However, annual currency-market devaluations are not constant, with three episodes of large devaluations. Table 2 reports the devaluations of the three episodes, together with the whole period, as well as the annualized average of the cross-sectional standard deviations.

In nominal terms, the currency market devalued −88.59% with an average cross-sectional annualized standard deviation of 10.23% in the first episode from 1972 to mid-1980, which started at the end of the Bretton Woods international monetary system and included the two oil-price shocks of the 1970s. The currency market devalued −66.34% with an average cross-sectional standard deviation of 8.68% in the second episode from mid-2005 to 2012, which started near the beginning of the global financial crisis in mid-2005 and ended during the later stages of the European sovereign debt crisis in 2012. The currency market devalued −25.04% with an average cross-sectional standard deviation of 6.05% in the third episode from 2019 to 2020, which occurred during the Covid pandemic. The average cross-sectional standard deviation is 8.27% for the whole data sample. Thus, explanations of the large deviations are not solely associated with extreme periods of currency market fluctuations. The interested reader is referred to Beckmann et al. (2015) for more sophisticated models of the volatility relationship between gold and currencies.

IV. Conclusion

Most central banks view gold as a safe-haven asset during times of global turbulence (Aizenman and Inoue 2013). Treating gold as a currency allows policy makers and investors to measure currency-market devaluations.

Disclosure statement

No potential conflict of interest was reported by the author.

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