To: Professor Hanke
From: Elvis Han
Re: Money Mischief: Relationship between Money and Price Level
Date: March 3rd, 2024

Memorandum — Money Mischief: Relationship between Money and Price Level

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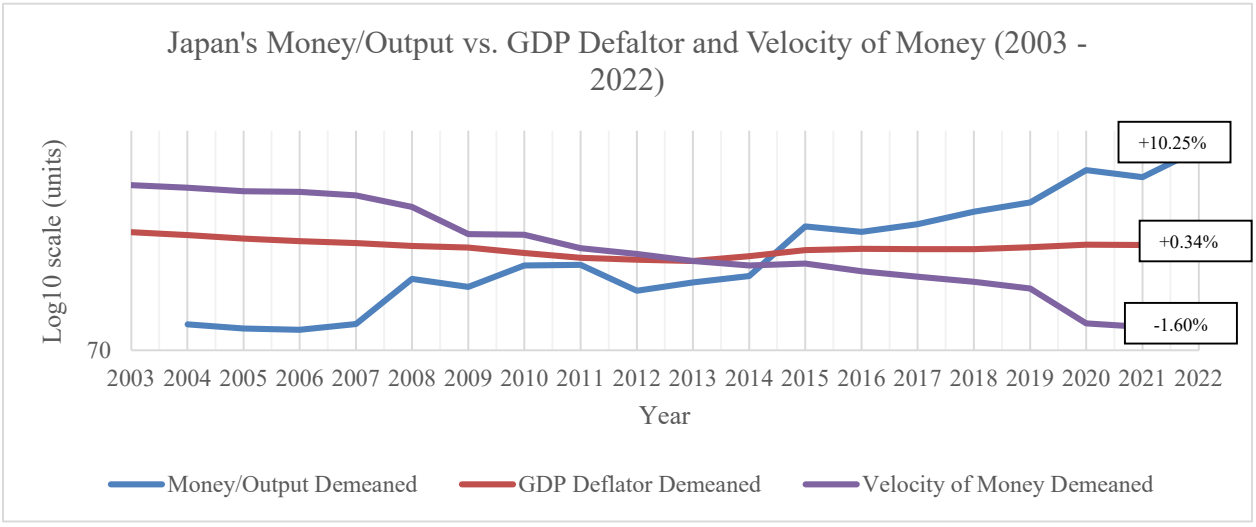
Dear Prof. Hanke,

Summary

This memo presents a replication of the figures presented in chapter 8 of *Money Mischief: Episodes in Monetary History* by Milton Friedman for Japan between 2003-2023.[1] Overall, Friedman maintains a monetarist claim via the Quantity Theory of Money (QTM) that a 1:1 increase in money supply leads to a proportional rise in prices. This analysis compares money/output (money per unit of GDP) against the GDP deflator (prices per unit of output) for Japan between 2003 and 2023. While Friedman's framework predicts that money and prices should move proportionally, Japan provides a counterexample. Results show that money/output initially trailed the GDP deflator before 2014 but rose well above it thereafter. Despite rapid monetary expansion, the GDP deflator remained largely flat over the two decades, indicating that increases in money supply did not translate into equivalent price increases. Through an event-study approach and a review of relevant literature, we suggest that Japan's persistently low velocity of money and liquidity traps are the key factors explaining this divergence.

Charts for Japan Inflation and Broad Money Expansion (2003-2022)

Figure 1: Japan's Money/Output, GDP Deflator, and Velocity of Money between 2003-2022



Source: The Bank of Japan (M2, nGDP) & The International Monetary Fund (Exchange Rate, GDP, GDP Deflator)
Calculations by Professor Steve H. Hanke

[1] Friedman, M. (1992). Money mischief: Episodes in monetary history. Harcourt Brace Jovanovich.

Methods and Calculations

The Money/Output series is calculated by dividing year-end money supply M2[2] and Real GDP.[3] For M2 and GDP deflator[4], we use December data for the corresponding year. rGDP in USD was converted into yen via the end-of-year December exchange rates[5] for each year of this study. All data (besides nominal GDP) are not seasonally adjusted to ensure that the actual relationship between money per output and price level is not skewed by the seasonal adjustment.

Nominal GDP from the bank of Japan is released quarterly; this data was consolidated and published by the BOJ with data points corresponding to January 12 of each year. The velocity of money for each year in the relevant time span was calculated by dividing nominal GDP by the money supply. After taking the average of all velocities in the time span, velocity of money was divided by the time span's average velocity to reduce noise.

Money/output, the GDP deflator, and the velocity of money are plotted as percentages of their average value during the period 2002 and 2022. Since the graph is shown in logarithmic scale, the growth rate in percentage is represented by their slopes.

Historical & Theoretical Analysis

The following analyses are qualitative event-studies that explain fluctuations in money/output (the blue line).

- Summary: During this period, money/output expanded more rapidly than the GDP deflator up until 2014, after which the deflator remained largely flat for the next two decades. A sharp rise in money/output occurred between 2007 and 2008, followed by several fluctuations until 2012, when the ratio began a steady upward trend through 2022. After 2014, money/output consistently outpaced the GDP deflator, with two notable declines in 2015–2016 and 2020–2021.

- Historical Policy: Beginning in 2001, the Bank of Japan (BOJ) introduced quantitative easing, purchasing Japanese Government Bonds (JGBs) to inject liquidity and counter deflation until March 2006. During this period, the money/output curve flattened and stabilized. The global financial crisis of 2007–2008 then hit Japan's economy, prompting the BOJ to cut the policy interest rate from 0.75% to 0.3%, establish complementary deposit facilities, expand securities purchases, reintroduce U.S. dollar funding operations, and increase both the size and

[2] Bank of Japan (2002-2023). Bank of Japan's Time-Series Data Search: "M2 Monetary Stock." Retrieved 2024, February 25, from https://www.imf.org/external/datamapper/NGDPD@WEO/JPN?zoom=JPN&highlight=JPN

[3] International Monetary Fund (2002-2023). Japan: Gross Domestic Product. Retrieved 2024, February 25, from https://data.imf.org/regular.aspx?key=61545852 https://www.imf.org/external/datamapper/NGDPD@WEO/JPN?zoom=JPN&highlight=JPN

[4] International Monetary Fund (2002-2022). Japan: GDP Deflator. Retrieved 2024, February 25, from https://www.imf.org/external/np/fin/data/param_rms_mth.aspx

[5] International Monetary Fund (1994-2023). Exchange Rate Archives by Month. Retrieved 2024, February 2026 from https://www.imf.org/external/np/fin/data/param_rms_mth.aspx

frequency of commercial paper (CP) and repo purchases.[6] These liquidity operations, particularly the U.S. dollar funding measures and commercial paper purchases, were key drivers of the rise in money/output. The subsequent decline in 2011–2012 reflects fiscal spending on liability-sharing insurance schemes and joint government–private sector stimulus programs implemented after the 2011 earthquake and tsunami.[7] Following Shinzo Abe's election in 2012, his government launched *Abenomics*, an aggressive program built on three pillars: quantitative easing through large-scale asset purchases, fiscal stimulus, and structural reforms in labor and energy markets. These measures account for the steady rise in money/output from 2016 to 2020, when asset purchases reached nearly 70% of GDP and negative interest rates were introduced for the first time.[8] These policies were expanded at the onset of the pandemic (2020-2022).

- Theoretical Analysis: Money/output has expanded markedly over the past twenty years, driven by quantitative easing and repeated stimulus measures. Yet prices have remained flat, suggesting that the additional liquidity has not circulated through the economy. This points to a persistently low velocity of money, which we calculate and graph as the ratio of nominal GDP to the money supply. Below I explore a few explanations that contribute to this low velocity of money.

  - **Japanese individuals possess a high propensity to save**. Although M2 has risen steadily, BOJ current account and reserve balances constitute most of the monetary base (Figure 2), suggesting that households are either hoarding cash or saving in banks. The former is more likely, given that negative interest rates would disincentivize bank savings. Figures 3–4 illustrate changes in the composition of the monetary base[9] (coins in circulation, bank notes in circulation, and reserve balances) as well as their growth rates. Notably, before 2012-2014, when money/output exceed GDP, coins and banknotes accounted for up to 85% of the total monetary base. This near one-to-one relationship between circulating cash and output highlights that monetary expansion was largely absorbed in physical currency rather than translating into higher prices, reinforcing the breakdown of Friedman's predicted 1:1 link between money supply and the price level.

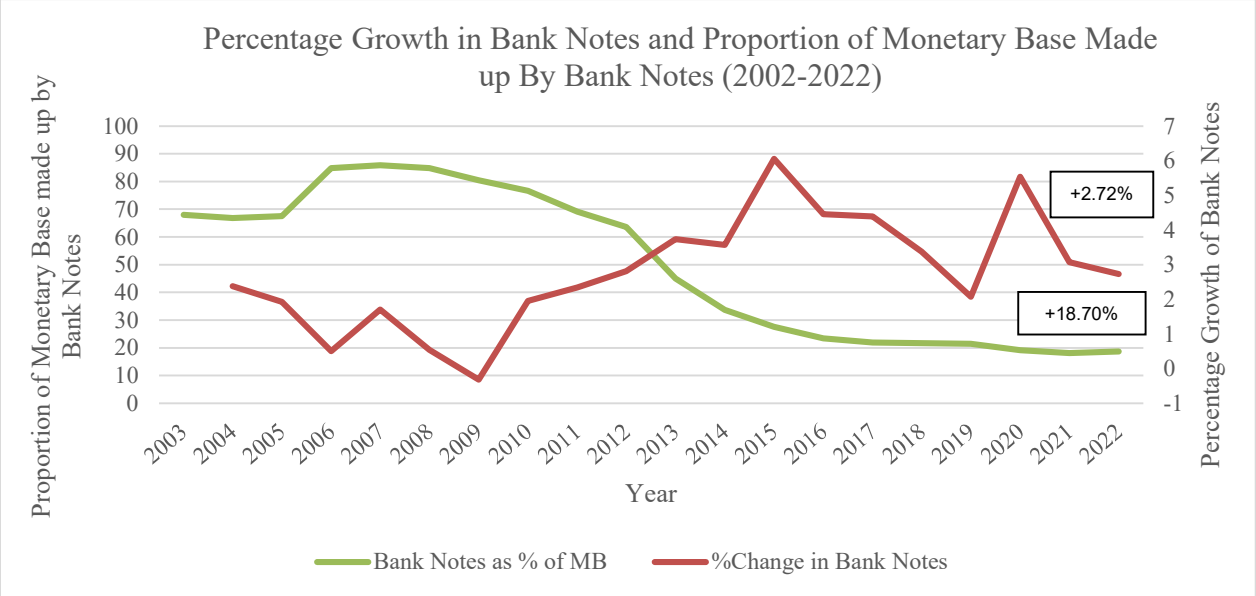
[6] Bank of Japan (2007-2010). The Bank of Japan's Policy Measures during the Financial Crisis. https://www.boj.or.jp/en/statistics/outline/note/notest31.htm

[7] Bank of Japan (2002-2023). Bank of Japan's Time-Series Data Search: "M2 Monetary Stock." Retrieved 2024, February 25, from https://www.imf.org/external/datamapper/NGDPD@WEO/JPN?zoom=JPN&highlight=JPN

[8] Council on Foreign Relations. (2018, March 23). *Abenomics and the Japanese economy*. Council on Foreign Relations. https://www.cfr.org/backgrounder/abenomics-and-japanese-economy

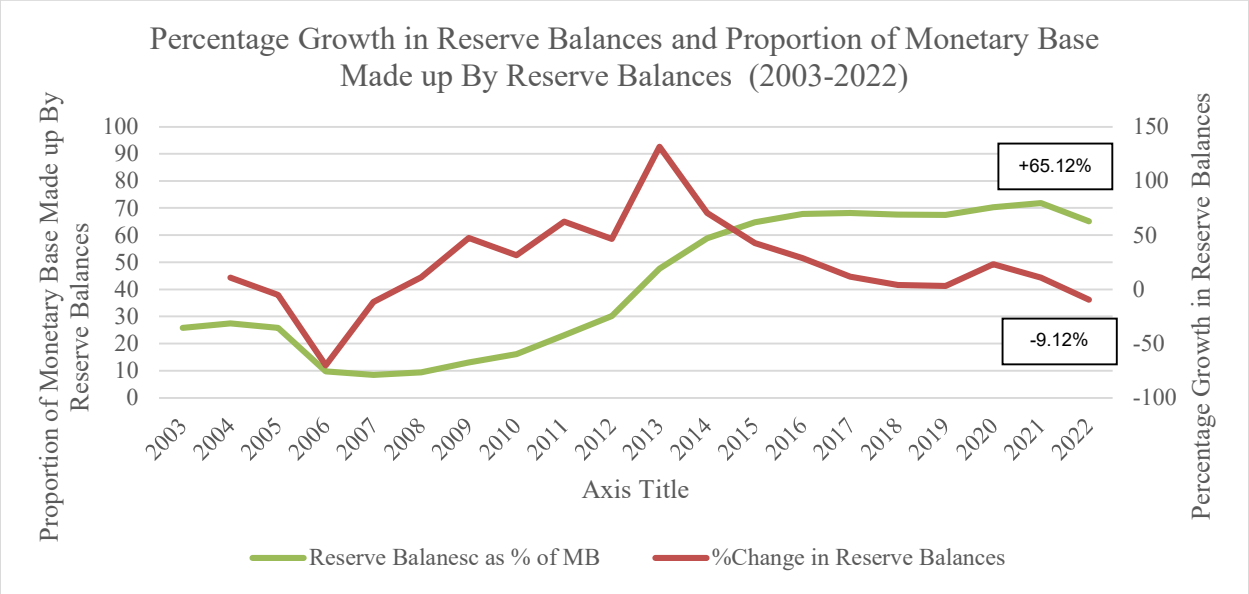
[9] Bank of Japan. (2024). Monetary base. Retrieved from http://www.boj.or.jp/en/statistcs/boj/other/mb/index.htm

Figure 2: Proportion of Bank Notes in MB and Percentage Growth in Bank Notes 2003-2022



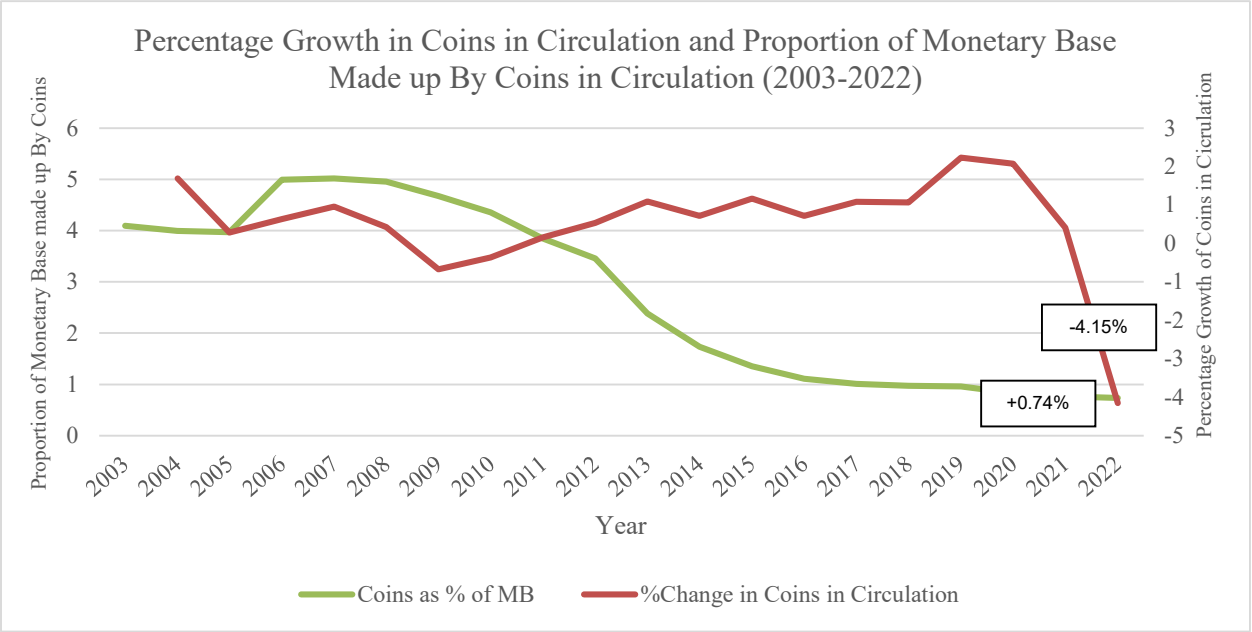
Source: The Bank of Japan
Calculations by Professor Steve H. Hanke

Figure 3: Proportion of Reserve Balances in MB and Percentage Growth in Reserve Balances 2003-2022



Source: The Bank of Japan
Calculations by Professor Steve H. Hanke

Figure 4: Proportion of Coins in MB and Percentage Growth in Coins 2003-2022



Source: The Bank of Japan
Calculations by Professor Steve H. Hanke

- **Negative interest rates contribute to liquidity traps that disincentivize consumer spending.** Negative interest rate policies and large-scale asset purchases were intended to reduce long-term rates and spur investment through lending. Instead, they contributed to a liquidity trap in which households preferred cash holdings, reflecting doubts about non-cash assets and concerns over economic downturns. Nao Sudo's "Accounting for the Decline in the Velocity of Money in the Japanese Economy," reinforces this view. Using a cash-in-advance model with liquidity shocks, Sudo shows that during the late-1990s banking crisis and the 2008 recession, households' expectations of future liquidity needs drove the decline in money velocity. Anticipating higher liquidity requirements for future transactions, households increased precautionary cash holdings in the present, effectively hoarding money to be spent later.[10]

- **The weak presence of financial markets in Japan contribute to low velocity of money**. Small businesses and retail transactions remain heavily cash-based (Figure 4), in contrast to the widespread use of electronic payments in other advanced economies. This reliance on cash, coupled with weak consumer confidence, reinforces deflationary expectations and delays investment, suppressing demand and keeping prices down.

[10] Sudo, N. (2011). Accounting for the Decline in the Velocity of Money in the Japanese Economy. *Institute for Monetary and Economic Studies, Bank of Japan. IMES Discussion Paper Series (2011-E-16).*

- Japan's aging population reduces the size of its goods and service consuming workforce. Population growth and labor force growth are key inputs in the Solow Growth model's projected steady-state growth rate. As the labor force shrinks, the steady-state growth rate declines accordingly. Sudo's analysis further illustrates this dynamic, showing impulse responses of prices, money velocity, and interest rates following shocks to money stock, discount rate, and population growth.

Conclusion

In replicating Friedman's *Money Mischief* figures for Japan, we find that the monetarist claim of a proportional link between money supply and prices does not hold. Despite large-scale monetary expansion, Japan's GDP deflator has remained largely flat, underscoring the limits of a purely quantity-theory view. Our event-study analysis and supporting literature suggest that structural features, including liquidity traps, cash-dominant markets, and demographic shifts, sustain a low velocity of money that breaks the expected money–price relationship. Together, these findings highlight the importance of context-specific factors in shaping monetary outcomes, offering Japan as a critical counterexample to Friedman's framework.

Elvis Han

March 3, 2024

Baltimore, MD

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Sudo, N. (2011). Accounting for the Decline in the Velocity of Money in the Japanese Economy. *Institute for Monetary and Economic Studies, Bank of Japan. IMES Discussion Paper Series (2011-E-16).*