# “G7, central banking, and U.S. Interest rates”


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# G7, central banking, and U.S. interest rates


## Abstract

Central banks globally are concerned over stagnant or declining consumer prices, with the Japanese economy of the 1990's and 2000's serving as a warning to the havoc deflation can cause. As such, G7 central banks are in a self-perpetuating cycle of accommodative monetary policy, with severe consequences for banks that alter course.

As the Federal Reserve's quantitative easing program ended, financial markets are fixated on how U.S. interest rates will react in the coming months and years. The authors present an inflation model estimated across the G7 countries that provides insight into the Federal Reserve's plans to increase short-term rates and the subsequent impact on long term interest rates over the foreseeable future.

This study develops a time-series/cross-section model to explain the rate of inflation across G7 economies as a function of significant economic variables. The nominal exchange rate, savings rate, debt-to-GDP ratio, current account balance, and GDP growth rate all have statistically significant coefficients to explain inflation, reflecting their impact on consumer prices. The model demonstrates the risks associated with the U.S. Federal Reserve tightening monetary policy while other advanced central banks do not follow suit and the ECB implements a €60 billion per month stimulus plan. For 2013 the model predicted U.S. inflation would be 1.6 percent, which compares favorably with the actual U.S. inflation rate of 1.5 percent.


**Keywords:** inflation, G7 economic policy.
**JEL Classification:** E31, E61.

## Introduction

As the U.S. economy exits an extraordinarily accommodative monetary environment, including a historically low Federal Funds target rate and purchases of long-term treasuries and asset-backed securities, the question is what is next? Predictions by economists and financial analysts vary. The Federal Reserve's Fed funds rate target has ranged between 0 and 0.25% for a considerable period of time through the end of the asset purchase program (U.S. Board of Governors of the Federal Reserve, 2014c, page 23).

The Federal Reserve's accommodative monetary policy since the financial crisis has succeeded in stabilizing the U.S. economy, keeping inflation at an acceptable level, and increasing the level of credit available for businesses and individuals. Other G7 countries have followed the United States' strategy. For Japan, Prime Minister Abe's government instituted a "three arrows" program – fiscal stimulus, monetary easing, and economic reform, and then proposed another stimulus program following his December reelection. The Bank of England is maintaining the bank rate at 0.5 percent and keeping the stock of purchased assets financed by the issuance of central bank reserves at £375 billion. The European Central Bank instituted negative interest rates for its deposit facility, reduced the interest rate for main refinancing operations to near zero, began purchasing asset-backed securities and covered bonds, and now has begun a €60 billion per month stimulus plan (European Central Bank, 2015).

A key driver for central banks in G7 countries has been to increase their respective jurisdiction's inflation rates to a moderate level – with 2 percent the predominate target. The G7 monetary policies are a zero-sum game. Maintaining more accommodative monetary policy in the United States than in Europe has, until very recently, had the effect of reducing the value of the dollar against the Euro and having the Euro Zone inflation rate trickle ever closer to a disinflation, or even deflationary, level. With economic indicators deteriorating, the ECB was forced to act aggressively with the monetary stimulus plan mentioned above – and the Euro has weakened accordingly. Japan has arguably employed the most aggressive monetary policy recently, when measuring asset purchases as a percent of GDP, has reduced the Yen to its lowest level in six years against the dollar, and increased annual core inflation above 1 percent.

Central Banks are in a self-perpetuating cycle, or in many ways a competition to have the most accommodative monetary policy. Financial markets have recently demonstrated what happens when there are expectations of one central bank tightening when others are not. The U.S. Dollar rose approximately 17.8 percent against the Yen and 13.2 percent against the Euro during the final two quarters of 2014 on expectations of tightening alone. With inflation remaining below its target level, the Fed will be apprehensive to raise rates quickly.

This study focuses on inflation and uses it to demonstrate that the Federal Reserve will be hesitant to raise U.S. short-term interest rates, and even if they do, it is unlikely to increase long-term interest rates

over the next 36 months, or even longer. Given that inflation is a primary driver for central bank policy, it is important to determine what drives inflation in a G7 country. Polgar and Walker (2014) explain the Japanese rate of inflation as a function of important economic variables and simulate Prime Minister Abe's "three arrows" economic policies, recommending significant depreciation of the yen-dollar exchange rate, an aggressive fiscal policy, and continued monetary easing to support the Bank of Japan target to reach 2 percent inflation.

This study develops an inflation model for the G7 countries and a lengthy annual time-series (1990-2012). The model recognizes the particular roles of a country's currency strength, international trade balances, debt, savings rate, and economic growth. Other variables are tested including foreign direct investment inflows, short- and long-term government bond yields, yield curve shape, changes in the labor force and unemployment, and money supply growth.

The cross-section/time-series analysis exhibits a positive correlation between the inflation rate and both a country's savings rate and its debt-to-GDP ratio. There is a negative correlation between inflation and a country's current account balance and nominal exchange rate with the U.S. Dollar. The coefficient of economic growth is statistically significant for the G7 countries. GDP Growth is negatively correlated with inflation, which is explained from a theoretical perspective below.

The paper is structured as follows: Section 1 presents the determinants of inflation. Section 2 gives the data. While section 3 proposes inflation models. Conclusions from the model and consequences for U.S. monetary policy and U.S. interest rates, follow in final section.

## 1. Determinants of inflation

Gordon (2013, page 289) explained that sustained inflation requires a continuous increase in aggregate demand. He notes that inflation expectations and unexpected demand or supply shocks can influence the inflation rate. Krugman emphasizes three factors that impact a country's prices – excess demand for output and labor, inflationary expectations, and raw materials prices (Krugman and Obstfeld, 2009).

This study tests impacts of important economic variables on inflation across the G7 countries. There is a wealth of sophisticated literature that analyzes the effectiveness of monetary policy when interest rates and/or inflation are low and what many authors consider to be a liquidity trap. Among the major studies are ones by Bernanke and Reinhart (2004), Eggertsson (2010), Ito and Miskin (2006), Iwamura, Kudo, and Watanabe (2006), and Reifschneider and Williams (2000).

**1.1. Inflation and potential impacts on inflation.** Inflation for the G7 countries is calculated as year-on-year changes of end of period consumer prices, using data from the IMF's World Economic Outlook Database. Inflation rates are generally calculated in individual countries by constructing consumer price indices containing varying categories of goods and services produced and sold in the economy, and then tracking changes in the average prices of those categories. Various countries allocate different weights to the categories.

Expected inflation is included implicitly in the model since each potential impact on inflation is somewhat a function of expected inflation. Moreover, the potential explanatory variables are historical. Across the heterogeneous G7 countries, there would be high variation in the measurement and interpretation of expected inflation. To some extent expected inflation is dealt with in the error analysis in Table 3 in Appendix.

**Current account balance**: a larger current account surplus, which could indicate higher exports, could encourage price increases, higher wage demands, and inflation. A decreasing trade balance could indicate increasing domestic demand for goods, which can increase wage pressure and subsequently encourage inflation.

**Debt/GDP ratio**: a high debt-to-GDP ratio reduces resources available to the private sector, and crowds out private sector investment. With a high debt ratio, a government will face pressure to reduce expenditures to assuage bond investors' concerns. This reduces government demand for goods, making the labor market more reliant on the private sector. Alternatively, a higher debt-to-GDP ratio could indicate new fiscal stimulus, which can lead to greater aggregate demand, especially if there is slack in demand left by the private sector.

**Savings rate:** consumers who accumulate aggregate savings may be more likely to purchase expensive homes and luxury goods at inflated prices. As an alternative, more savings could reduce inflation in anticipation of higher taxes and weaker demand (lower consumption), which discourage price increases.

**Nominal exchange rate vs. U.S. dollar:** the value of a country's currency may have a significant impact on the global competitiveness of its exports and manufacturing sector. A weaker currency could lead to more domestic manufacturing jobs, which increases wage pressure and inflation.

**Money supply (M2):** the quantity theory of money dictates a positive correlation between a country's money supply and its inflation rate. The essence behind the monetary policy of many central banks that are continuing to grapple with slow growth following the global financial crisis is to reduce short-term interest rates to near zero and, in some cases, increase the money supply by purchasing long-term treasury securities and other assets, commonly referred to as "quantitative easing". While countries are still exiting the financial crisis, quantitative easing has not led to inflation, but central banks are vigilant about the likelihood of increasing prices.

**3-Month treasury bill and 10-year government bond:** these rates represent a country's short- and long-term borrowing costs. Bond yields typically maintain a positive correlation with inflation. As bond yields increase, investors transition away from safe assets towards more risky asset classes, which is a sign of an expanding economy.

**Yield curve: 10-year government bond rate minus 3-month treasury bill rate:** this difference between long and short rates represents the shape of the yield curve. A negative value is often interpreted to suggest a recession approximately 12 months into the future.

**FDI Inflows as a percentage of GDP:** an increase in Foreign Direct Investment (FDI) inflows can indicate an advantageous economic environment. As investors put money into the economy, prices of varying asset classes may rise and make it easier for businesses to obtain credit to expand. Over time, rising asset prices and available credit could lead to increasing wages, increased spending from strong consumer confidence, and rising prices.

**Labor force:** changes in the total labor force can impact competition for jobs, which influences wages and consumer prices. A declining labor force can indicate an aging population, which is more reliant on social welfare programs. This can lead to inefficiencies in how resources are allocated in a country, leading to a drop in productivity, wages, and prices.

**Unemployment rate:** wages are a driver of aggregate demand and a country's inflation rate. A low unemployment rate can indicate excess demand for labor, which could increase wages and thus inflation.

**GDP growth rate:** traditional economic theory suggests a positive correlation between GDP Growth and inflation. Growth leads to more jobs and higher wages, which in turn will lead to inflation. But alternatively, there can be a negative correlation between GDP growth and inflation. Gordon discusses that the rate of inflation can accelerate or decelerate due to shifts in aggregate demand or aggregate supply (Gordon, page 289). A shift in aggregate supply, or a supply shock, would constitute a change in an important commodity, such as an unexpected rise in the price of oil. Gordon attributes the low cost of energy, a drop in the price of computers, and a reduction in imports prices to low inflation in the U.S. during rapid economic expansion in the late 1990's (Gordon, page 326).

## 2. Data

Annual data from the IMF's International Financial Statistics, the World Bank Global Financial Database, and country central banks are employed to develop models for 1990-2012 for inflation (I), as a function of the current trade balance (CURR), the ratio of debt-to-GDP (DEBTR), the nominal exchange rate against the U.S. dollar (EXR), the savings rate (SAVR), and the GDP growth rate (GDPG). The definitions and characteristics of the variables are provided in Table 1.

Annual rather than quarterly data are employed to avoid quarterly seasonality across the G7 countries. Binary variables representing countries' distinct seasons would exhaust many degrees of freedom. 1990 is selected as the initial year for the empirical models since German reunification began in 1989, the USSR dissolved in 1991, much of Eastern and Central Europe began their transitions to market-based economies in the early 1990s, and the Japanese economy entered its first lost decade in 1991. This study demonstrates the variables that impact inflation in the current economic environment.

## 3. Inflation models

*Estimation:* the cross-section/time-series model for the G7 countries ($j = 1,\ldots,7$) across the 23 years ($t = 1990,\ldots, 2012$) can be expressed as:

$$I_{jt} = f(X_{jt}) + e_{jt}, \quad (1)$$

where $X_{jt}$ is a vector of independent variables and $e_{jt}$ are the error terms that explain inflation, $I_{jt.}$ Pooling is ideally suited for this analysis because neither seven countries nor 23 annual observations would be sufficient for a sophisticated analysis without mixing them (Dielman, 1989).

*Primary models.* The null hypothesis is that inflation ($I$) for the G7 countries across 23 years can be explained as a function of a small number of variables. The hypothesized independent variables are presented in Table 1; models 100 and 101 trace the development of the primary model – model 102. model 100: Savings Rate (SAVR), Nominal Exchange Rate (EXR) model 101: GDP Growth Rate (GDPG), Savings Rate (SAVR), Nominal Exchange Rate (EXR) model 102: GDP Growth Rate (GDPG), Savings Rate (SAVR), Nominal Exchange Rate (EXR), Current Account Balance (CURR), Debt-to-GDP Ratio (DEBTR).

Model 100 explains inflation on the basis of one domestic and one international rate: the domestic savings rate and the international exchange rate; each coefficient is statistically significant at the five percent level. Model 101 includes the GDP growth rate in addition to the first two rates; the coefficient of GDP growth is statistically significant with a *t*-statistic of -2.53, *R*-squared of 75.4 percent, and Durbin-Watson statistic of 1.53.

Model 102 builds on the previous two models plus the explanatory capacity of debt-to-GDP and the current account balance. All of the variables in model 102 have statistically significant coefficients at the 0.10 level or better. In model 102, 76 percent of the variation in inflation is explained by five variables. The *F*-statistic is (12.41), and much of the autocorrelation is removed (Durbin-Watson statistic = 1.60, which is inconclusive for positive autocorrelation).

Model 102 projects greater inflation with (1) a higher rate of savings, as a precursor to expected higher taxes, (2) a larger fiscal debt ratio and (3) a depreciating currency relative to the dollar. With elastic demand, prices rise more rapidly than aggregate consumer and business demand may decline, resulting in inflation. A negative current trade balance (with greater resource imports) encourages inflation. Increasing GDP growth could occur at the expense of wages for unskilled workers – who are replaced by technological advances or off shore of jobs – keeping inflation depressed in a developed economy. The significant, positive coefficient of the nominal exchange rate suggests that as a country's currency depreciates, its exports are more competitive, increasing employment and wages.

*Tests of alternative issues.* Model 102 is an effective basis to test other potential factors that may explain aspects of G7 country inflation. Models 103-109 provide tests for coefficients of seven additional potential determinants of inflation. These variables were tested since well-established theories of inflation might include unemployment and changes in the labor force, the growth of the money supply, yields on government securities, and foreign direct investment.

model 103: Foreign direct investment inflows as a percent of GDP.
model 104: Changes in the labor force.
model 105: Growth in the money supply.
model 106: Unemployment rate.
model 107: Yields on 10-year government bonds.
model 108: Yields on 3-month treasury bills.
model 109: Yield curve shape (10-year Bond Yield minus 3-month *T*-Bill Yield).

The results for these seven tests can be summarized very simply. None of the factors delineated in models 103-109 has a statistically significant coefficient at any meaningful level or a significant impact on inflation across the G7 countries without reducing the importance of other variables. Some of the excluded variables that would represent other established theories are highly correlated with included variables. For example, the growth of the money supply for Germany and the exchange rate for Germany have a correlation coefficient of 0.54 and the growth of the money supply for UK and the savings ratio for the UK have a correlation coefficient of 0.55.

The coefficients for foreign direct investment inflows, money supply growth, and the unemployment rate each have a *t*-statistic below 1.0. The coefficient for the change in the size of the labor force has a *t*-statistic of 1.41, indicating that increasing the number of workers can have a weak, positive impact on inflation. The coefficients for both the 10-year Treasury bond yield (*t*-statistic of 4.09) and 3-month *T*-bill (*t*-statistic of 1.98) are individually statistically significant; however, each variable appears to be correlated with the nominal exchange rate, resulting in an insignificant coefficient for the nominal exchange rate. Long ago Fisher showed the interaction between interest rates and inflation and over the past couple years central banks in emerging market nations – such as India and Turkey – have increased interest rates to help maintain the value of their currencies, again demonstrating the relationship (Candemir and Parkinson, 2014).

The results are fairly robust. The means and medians for inflation are quite similar for all of G7 countries. For all but Japan, the standard deviation of inflation is well below the mean. The standard deviations of the explanatory variables for Japan are approximately one-third of the means, except for GDP growth, which reflects the lost decade. To some extent, the error analysis below also reflects on the robustness of the results.

*Error analysis.* Across the 161 observations for years and countries, $e_{jt} = I_{jt} - f(X_{jt})$ is assumed to satisfy the usual least squares assumption with a zero mean; $E(e_{jt}) = 0$ so that expected inflation $I_{jt}^* = f(X_{jt})$. For country $k$ ($k$ = 1,…, 7), however, the assumption that $E(e_{kt}) = 0$ needs to be explored.

Figure 3 provides inflation ($I_{kt}$), expected inflation ($I_{kt}^*$), errors ($e_{kt}$), and errors as a percentage of inflation ($100e_{kt}/I_{kt}$). The estimated mean error, $E(e) = -0.0027$, across the 23 years and seven countries, is well below the mean error attributed to any single country. Germany has the smallest mean error of 0.05. Virtually the same result is observed for the percentage error/Inflation ratio. This reflects the power of the cross-section/time-series analysis in developing model 102. The assumption that:

$E(e_{jt}) \approx 0$ appears to be satisfied for $j$ = 1,…, 7 and $t$ = 1990,…, 2012.

## Conclusions

The inflation model developed in this study provides insight into why U.S. economic policy has remained accommodative and why long-term U.S. interest rates are not likely to rise very much, even if short-term rates are increased by the Federal Reserve as currently predicted. With 2013 data for the explanatory variables in the model, U.S. inflation would have been predicted to be 1.6 percent, which compares favorably with the actual U.S. 2013 inflation rate of 1.5 percent measured by the consumer price index and the core inflation rate of 1.7 percent (US Bureau of Labor Statistics, 2014). These rates did not cause the Federal Reserve to change interest rate policies substantially.

Expansionary monetary policy is needed to prevent the U.S. dollar from rising too quickly, which should reduce the level of inflation well below the target level. The importance of accommodative U.S. monetary policy is exacerbated by continued discourse in the U.S. Congress for tighter fiscal policy, meaning the country will not receive the fiscal stimulus needed to jolt consumer prices. Further, reductions in commodity and oil prices are suppressing energy prices while increases in U.S. oil production have reduced imports and the current account deficit – and with it inflationary pressure.

An ancillary reason for continued low long-term U.S. interest rates is that yields in the U.S. are above those of many industrialized countries, including those deemed not as credit-worthy, such as Spain. As such, investors looking to purchase safe assets, and more specifically government bonds, will likely purchase U.S. treasuries before those of other nations. This result is seen in U.S. bond price increases despite improving economic indicators and financial market expectations for monetary tightening. If the Federal Reserve did raise short-term interest rates, the result would be a flattening of the yield curve, as long-term yields will remain depressed despite short-term yields rising.

The Federal Reserve is in a tight bind, one it most certainly recognizes. U.S. employment figures are improving, with the unemployment rate dropping to 5.8 percent in December 2014, and non-farms payroll figures consistently above 200,000 new jobs per month. Traditionally, the employment market indicators would probably lead the Federal Reserve to tighten policy. But real wages have remained low, suppressing consumer demand. And most importantly, with other major central banks undergoing loose accommodative policy, a hawkish Federal Reserve will drive up the value of the U.S. Dollar to levels that will drop inflation and derail a somewhat fragile economic recovery. As such, expect minimal action from the Federal Reserve with short-term interest rates, and no rise in long-term interest rates over the medium-term.

## References


1. Bank of England. Press Release. "Bank of England maintains Bank Rate at 0.5% and the size of the Asset Purchase Programme at £375 billion", April 10, 2014.
2. Bank of Japan. Press Release. "Statement on Monetary Policy", April 8, 2014.
3. Bernanke, Ben and Vincent R. Reinhart (2004). "Conducting Monetary Policy at Very Low Short-Term Interest Rates", *The American Economic Review*, pp. 94, pp. 85-90.
4. Dielman, Terry E. (1989). *Pooled Cross-Sectional and Time Series Data Analysis*. Marcel Dekker, Inc.
5. Durbin, J. and G.S. Watson (1971). "Testing for Serial Correlation in Least Squares Regression III", *Biometrica*, 58. pp. 1-42.
6. *The Economist* (2014). "Economic and Financial Indicators", October 11, page 100.
7. *Economist Intelligence Unit* (2014). Country Reports. February.
8. Eggertsson, Gauti B. (2010). "What Fiscal Policy Is Effective at Zero Interest Rates?" NBER Macroeconomic Annual.
9. Eggertsson, Gauti B. and Paul Krugman (2012). "Debt, Deleveraging, and the Liquidity Trap", *Quarterly Journal of Economics*, 127, pp. 1469-1513.
10. European Central Bank (2013). "Introductory Statement by Mario Draghi", President of the European Central Bank, November 7.
11. European Central Bank (2015). Press Release, "ECB Announces Expanded Asset Purchase Programme", January 22.
12. Eviews Illustrated for Version 8. (2013). Irvine CAIHS Global Inc., Chapters 104-412.
13. Federal Reserve Bank of St. Louis. FRED2.
14. Fisher, Irving (1930). *The Theory of Interest*, Macmillan, New York City.
15. Forni, Mario, Marc Hallin, Marco Lippi and Luerezia Reichlin (2003). "Do Financial Variables Help Forecasting Inflation and Real Activity in the Euro Area?" *Journal of Monetary Economics*, 50, pp. 1243-1255.
16. Gordon, Robert (2013). *Macroeconomics: 12th Edition*. Pearson Series in Economics.
17. International Monetary Fund (2013). MF, World Economic Outlook Database, available at: www.imf.org.
18. International Monetary Fund (2013). *International Financial Statistics*, available at: www.imf.org.
19. Ito, Takatoshi and Frederic S. Miskin (2006). "Two Decades of Japanese Monetary Policy and the Deflation Problem", in *Monetary Policy Under Very Low Inflation in the Pacific Rim*, and Takatoshi Iwamura, Mitsuru, Takeshi Kudo, and Tsutomu Watanabe. 2006. "Monetary and Fiscal Policy in a Liquidity Trap: The Japanese Experience,

1999-2004", in *Monetary Policy Under Very Low Inflation in the Pacific Rim*, Takatoshi Ito and Andrew K. Rose, eds., June 25-27, University of Chicago Press. Chicago.
20. Kmenta, Jan (1986). *Elements of Econometrics*, 2nd. ed. Macmillan Publishing Company. New York.
21. Krugman, Paul (2013). "Monetary Policy in a Liquidity Trap", *New York Times*. April 11.
22. Krugman, Paul and Maurice Obstfeld (2009). *International Economics: Theory & Policy*. 8th ed. Pearson: Addison Wesley.
23. National Bureau of Economic Research (2013). "Business Cycle Expansions and Contractions", November 3, available at: http://www.nber.org.cycles.html.
24. Polgar, Gregory T. and David A. Walker (2014). "Will Japan's Three Arrows Policy Hit Its Target?" presented to the 12th Annual International Conference on Finance, Athens, Greece. May 2014.
25. Reifschneider, David and John C. Williams. (2000). "Three Lessons for Monetary Policy in a Low-Inflation Era". *Journal of Money, Credit, and Banking*, 32, pp. 936-966.
26. U.S. Board of Governors of the Federal Reserve System (2014a). Federal Reserve Board Press Release. March 31, 2014.
27. U.S. Board of Governors of the Federal Reserve System (2014b). Federal Reserve Board Press Release, September 17, 2014.
28. U.S. Board of Governors of the Federal Reserve System, (2014c). "Minutes of the Federal Open Market Committee", December 16-17.
29. U.S. Department of Treasury, Office of International Affairs (2013). "Report to Congress on International Economic and Exchange Rate Policies", October 30, 3013.
30. U.S. Bureau of Labor Statistics, available at: www.bls.gov/cpi/tables/htm.
31. White, H. (1980). "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity", *Econometrica*, pp. 817-838.
32. World Bank. Country Data, available at: www.wb.org.
33. *Wall Street Journal* (2009). "Euro-Zone Inflation Unexpectedly Weakened to Lowest Rate Since", March 31, 2014.
34. *Wall Street Journal* (2014). "Exports Boost Euro-Zone Trade Surplus", April 15.
35. *Wall Street Journal* (2014). "Turkey Raises Rates Sharply to Bolster Currency", January 28.
36. *Wall Street Journal.* Market Data Center.

Table 1. Characteristics of data and variable definitions

| Canada characteristics of data | | | | | |
|---|---|---|---|---|---|
| | Mean | Median | Standart deviation | Maximum | Minimum |
| Inflation rate | 2.08 | 2.05 | 1.13 | 4.92 | 0.04 |
| Debt to GDP ratio | 84.16 | 82.66 | 10.54 | 101.72 | 66.52 |
| Nominal exchange rate | 1.27 | 1.27 | 0.19 | 1.59 | 0.99 |
| Savings ratio | 20.26 | 20.93 | 3.50 | 25.13 | 12.94 |
| Current account balance | -0.81 | -0.86 | 2.27 | 2.51 | -3.79 |
| GDP growth rate | 2.28 | 2.53 | 1.97 | 5.21 | -2.71 |
| France characteristics of data | | | | | |
| Inflation rate | 1.87 | 1.77 | 0.69 | 3.21 | 0.27 |
| Debt to GDP ratio | 60.88 | 59.40 | 14.42 | 90.23 | 35.21 |
| Nominal exchange rate | 2.63 | 1.00 | 2.30 | 5.99 | 0.68 |
| Savings ratio | 19.57 | 19.52 | 1.32 | 21.96 | 17.52 |
| Current account balance | 0.25 | 0.47 | 1.50 | 3.15 | -2.19 |
| GDP growth rate | 1.55 | 1.84 | 1.50 | 3.68 | -3.15 |
| Germany characteristics of data | | | | | |
| Inflation rate | 1.97 | 1.85 | 1.01 | 4.22 | 0.22 |
| Debt to GDP ratio | 61.32 | 60.75 | 12.27 | 82.44 | 39.54 |
| Nominal exchange rate | 1.13 | 1.00 | 0.40 | 1.79 | 0.68 |
| Savings ratio | 22.32 | 22.29 | 1.95 | 26.71 | 19.74 |
| Current account balance | 2.22 | 1.89 | 3.42 | 7.45 | -1.73 |
| GDP growth rate | 1.69 | 1.66 | 2.24 | 5.72 | -5.09 |
| Italy characteristics of data | | | | | |
| Inflation rate | 3.21 | 2.58 | 1.80 | 9.31 | 1.10 |
| Debt to GDP ratio | 111.04 | 108.58 | 8.50 | 126.98 | 94.26 |

Table 1 (cont.) Characteristics of data and variable definitions

| Canada characteristics of data | | | | | |
|---|---|---|---|---|---|
| | Mean | Median | Standart deviation | Maximum | Minimum |
| Nominal exchange rate | 592.39 | 1.00 | 766.79 | 1759.19 | 0.68 |
| Savings ratio | 19.98 | 20.31 | 1.86 | 22.76 | 16.44 |
| Current account balance | -0.48 | -0.74 | 1.92 | 3.05 | -3.51 |
| GDP growth rate | 0.87 | 1.45 | 1.92 | 3.65 | -5.49 |
| Japan characteristics of data | | | | | |
| Inflation rate | 0.32 | 0.35 | 1.28 | 3.54 | -1.98 |
| Debt to GDP ratio | 146.14 | 153.64 | 55.63 | 238.03 | 66.49 |
| Nominal exchange rate | 109.56 | 114.00 | 15.99 | 134.40 | 77.72 |
| Savings ratio | 27.73 | 27.32 | 3.59 | 33.83 | 21.61 |
| Current account balance | 2.74 | 2.83 | 0.91 | 4.87 | 1.01 |
| GDP growth rate | 1.14 | 1.60 | 2.25 | 5.57 | -5.53 |
| U.K. characteristics of data | | | | | |
| Inflation rate | 2.67 | 2.13 | 1.76 | 7.77 | 0.86 |
| Debt to GDP ratio | 47.77 | 42.76 | 16.19 | 88.81 | 30.99 |
| Nominal exchange rate | 0.61 | 0.62 | 0.06 | 0.69 | 0.50 |
| Savings ratio | 15.20 | 15.38 | 1.63 | 18.09 | 10.86 |
| Current account balance | -1.78 | -1.65 | 0.99 | -0.11 | -3.79 |
| GDP Growth rate | 2.20 | 2.94 | 2.27 | 4.95 | -5.17 |
| U.S. characteristics of data | | | | | |
| Inflation rate | 2.66 | 2.71 | 1.06 | 5.76 | 0.71 |
| Debt to GDP ratio | 69.38 | 65.62 | 13.76 | 102.73 | 53.00 |
| Nominal exchange rate | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 |
| Savings ratio | 18.04 | 17.85 | 1.86 | 21.26 | 14.37 |
| Current account balance | -3.00 | -2.95 | 1.65 | 0.05 | -5.76 |
| GDP growth rate | 2.51 | 2.75 | 1.79 | 4.85 | -2.80 |

**Variable definitions:**

**Current account balance (CURR):** Current account is all transactions other than those in financial and capital items. Source IMF, World Economic Outlook Database, October 2013.

**Debt-to-GDP ratio (DEBTR):** Gross debt consists of all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future. Sources IMF, World Economic Outlook Database, October 2013; http://www.reinhartandrogoff.com.

**Nominal exchange rate (EXR):** National Currency per U.S. Dollar, end of period. Source IMF, International Financial Statistics.

**GDP growth rate (GDPG):** Annual percentages of constant price GDP are year-on-year changes. Sources IMF, World Economic Outlook Database, October 2013; Worldwide Inflation Data.

**Inflation rate (I):** Annual percentages of end of period consumer prices are year-on-year changes. Source IMF, World Economic Outlook Database, October 2013.

**Savings ratio (SAVR):** Expressed as a ratio of gross national savings in current local currency and GDP in current local currency. Source IMF, World Economic Outlook Database, October 2013.

**Unemployment rate (U):** Unemployment rate can be defined by either the national definition, the ILO harmonized definition, or the OECD harmonized definition. Source IMF, World Economic Outlook Database, October 2013.

**Labor force (LF):** Total labor force comprises people ages 15 and older who meet the International Labor Organization definition of the economically active population. Source World Bank.

**Foreign direct investment (FDI):** Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. Source World Bank.

**Money supply (M2):** Average annual growth rate in money and quasi money. Sources: World Bank, IMF International Financial Statistics, Global Financial Database, Bank of Canada. Statistics for Germany and France in 1999 were averaged from 1998 and 2000 figures.

**3-Month treasury bill (T3B):** Annual End of Period Yield of 3-Month Treasury Bill. Source: Global Financial Database; United States is Secondary Market Rate Discount Basis. Source: Federal Reserve Board.

**10-Year government bond (T10YR):** Annual End of Period Yield of 10-Year Government Bond. Source: Global Financial Database.

**Yield curve:** 10-Year Government Bond Yield minus 3-Months Treasury Bill Yield (T10YR-T3B).

Table 2. Regression models – dependent variable = inflation

| Model | Intercept | Savings ratio (SAVR) | Debt ratio (DEBTR) | Current account balance (CURR) | Nominal exchange rate (EXR) | Alternative variable | Adj. $R^2$ / *F*-statistic/ D-W |
|---|---|---|---|---|---|---|---|
| 100 | 0.565 | 0.072 | N/A | N/A | 0.001 | N/A | 0.74 |
| | 0.82 | 2.14* | | | 2.81** | | 12.42*** 1.41 |
| 101 | 0.183 | 0.104 | N/A | N/A | 0.001 | GDPG | 0.75 |
| | 0.26 | 2.94** | | | 2.86** | -0.153 -2.53* | 12.73*** 1.53 |
| 102 | -3.620 | 0.243 | 0.012 | -0.127 | 0.001 | GDPG | 0.76 |
| | -1.78+ | 3.20** | 1.73+ | -2.26* | 2.30* | -0.198 -3.07** | 12.41*** 1.60 |
| 103 | 0.526 | 0.071 | N/A | N/A | 0.001 | FDI inflows | 0.74 |
| | 0.76 | 2.10* | | | 2.75** | 0.037 0.71 | 11.99*** 1.40 |
| 104 | -0.990 | 0.074 | N/A | N/A | 0.001 | Labor force | 0.75 |
| | -0.76 | 2.20* | | | 2.57* | 0.000 1.41 | 12.18*** 1.42 |
| 105 | 0.568 0.82 | 0.072 2.11* | N/A | N/A | 0.001 2.79** | M2 0.001 0.12 | 0.74 11.93*** 1.41 |
| 106 | 0.563 0.51 | 0.072 1.83+ | N/A | N/A | 0.001 2.71** | U 0.000 0.00 | 0.74 11.93*** 1.41 |
| 107 | -1.613 -1.92+ | 0.095 2.96** | N/A | N/A | 0.000 0.91 | T10YR 0.352 4.09*** | 0.77 14.01*** 1.46 |
| 108 | 0.061 0.08 | 0.076 2.29* | N/A | N/A | 0.000 1.53 | T3B 0.122 1.98* | 0.75 12.42*** 1.40 |
| 109 | 0.490 0.59 | 0.074 2.20* | N/A | N/A | 0.000 2.94** | Yield curve = T10YR-T3B 0.070 0.88 | 0.74 12.03*** 1.42 |

Note: ***significant at the .001 level; **significant at the .01 level; *significant at the .05 level; + significant at the .10 level. The second number in each cell represents the coefficient's *t*-statistic or *F*-statistic for adjusted *R*-squared. The third number in the last column represents the Durbin-Watson statistic.

Table 3. Error analysis

| | Inflation | Expected Inflation | Error | % Error inflation |
|---|---|---|---|---|
| Canada | | | | |
| Mean | 2.08 | 1.96 | 0.1201 | -0.014 |
| Median | 2.05 | 1.94 | 0.1090 | 0.006 |
| Stand.dev. | 1.13 | 0.57 | 1.2928 | 0.57 |
| France | | | | |
| Mean | 1.87 | 1.53 | 0.3388 | 0.000 |
| Median | 1.77 | 1.53 | 0.5290 | 0.003 |
| Stand .dev. | 0.69 | 0.39 | 0.7825 | 0.008 |
| Germany | | | | |

Table 3 (cont.) Error analysis

| | Inflation | Expected Inflation | Error | % Error Inflation |
|---|---|---|---|---|
| Mean | 1.97 | 1.93 | 0.0460 | -0.005 |
| median | 1.85 | 1.86 | -0.1435 | -0.001 |
| Stand .dev. | 1.01 | 0.34 | 1.0975 | 0.018 |
| Italy | | | | |
| mean | 3.21 | 3.05 | 0.1649 | -0.002 |
| median | 2.58 | 2.69 | 0.0302 | 0.000 |
| Stand .dev. | 1.80 | 0.81 | 1.7139 | 0.006 |
| Japan | | | | |
| mean | 0.32 | 4.41 | -4.0912 | 0.022 |
| median | 0.35 | 4.38 | -4.0151 | -0.002 |
| Stand .dev. | 1.28 | 0.39 | 1.3080 | 0.088 |
| U.K. | | | | |
| mean | 2.67 | 0.44 | 2.2274 | 0.008 |
| median | 2.13 | 0.33 | 1.9357 | 0.009 |
| Stand .dev. | 1.76 | 0.40 | 1.6018 | 0.002 |
| U.S. | | | | |
| mean | 2.66 | 1.48 | 1.1748 | 0.003 |
| median | 2.71 | 1.52 | 1.3161 | 0.005 |
| Stand .dev. | 1.06 | 0.31 | 1.1455 | 0.005 |
| G7 | | | | |
| mean | 2.11 | 2.11 | -0.0027 | 0.0018 |
| median | 2.13 | 1.86 | 0.1090 | 0.003 |
| Stand .dev. | 1.28 | 0.48 | 1.2853 | 0.04 |