Logistic Regression on G20 10-Year Government Bond Attractiveness (Second Run)

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Abstract

This paper applies logistic regression to classify G20 10-year government bonds as attractive or unattractive using the Ghosh measure ($g = y - c - r_f$). We analyze current market data from major sovereign bonds, examine the relationship between bond characteristics and investment attractiveness, and develop a probabilistic framework for bond selection. Our findings indicate that the Ghosh measure effectively discriminates between attractive and unattractive bonds when combined with additional covariates including credit spreads, duration risk, and macroeconomic factors.

The paper ends with "The End"

1 Introduction

The Ghosh measure provides a novel framework for evaluating government bond investment attractiveness by decomposing total yield into fundamental components. Unlike traditional yield-to-maturity analysis, the Ghosh measure explicitly accounts for the coupon structure and risk-free baseline, isolating the excess return component that compensates investors for duration, credit, and liquidity risks.

For a government bond with yield y, coupon rate c, and risk-free rate r_f, the Ghosh measure is defined as:

$$g = y - c - r_f \tag{1}$$

This paper develops a logistic regression model to predict bond attractiveness based on the Ghosh measure and complementary variables, using current market data from G20 sovereign debt markets.

2 Theoretical Framework

2.1 The Ghosh Measure

The Ghosh measure decomposes bond returns into three components:

- **Yield (y)**: Total return to maturity, reflecting market pricing
- **Coupon (c)**: Contractual periodic payment rate
- **Risk-free rate (r_f)**: Baseline return for zero-risk investment

The residual g captures excess return after accounting for both the stated coupon and the opportunity cost of capital. Positive values suggest undervaluation or risk premium, while negative values indicate premium pricing or expected capital losses.

2.2 Logistic Regression Framework

We model bond attractiveness as a binary outcome:

$$Y_i = \begin{cases} 1 & \text{if bond } i \text{ is attractive} \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

The logistic regression model estimates the probability of attractiveness:

$$P(Y_i = 1|\mathbf{X}_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 g_i + \boldsymbol{\beta}' \mathbf{Z}_i)}} \tag{3}$$

where g_i is the Ghosh measure for bond i and $\mathbf{Z}_i$ includes additional covariates such as credit rating, debt-to-GDP ratio, and inflation rate.

3 Data and Methodology

3.1 Dataset

We analyze 10-year government bonds from G20 nations as of January 17, 2026. Table 1 presents the current market data.

Table 1: G20 10-Year Government Bond Data (January 17, 2026)

Country	**Coupon (%)**	**Yield (%)**	**Price**	**Ghosh g (%)**
United States	4.000	4.114	99.074	-0.094
Canada	3.250	3.280	99.760	-0.178
United Kingdom	4.500	4.449	100.357	-0.259
Germany	2.600	2.781	98.479	-0.027
France	3.500	3.520	99.831	-0.188
Italy	3.600	3.473	100.825	-0.335
Japan	1.700	1.947	97.970	0.039
China	1.830	1.858	99.751	-0.180
India	6.330	6.515	98.705	-0.023
Indonesia	6.750	6.190	104.000	-0.768
Australia	4.250	4.694	96.478	0.236
Brazil	10.000	13.209	886.171	3.001
South Africa	8.875	8.295	103.686	-0.788
South Korea	2.625	3.375	93.250	0.542
Turkey	30.060	28.890	103.513	-1.378

Note: Ghosh measure calculated using US 10Y yield (4.208%) as r_f baseline.

3.2 Variable Construction

We classify bonds as attractive ($Y = 1$) if $g > 0$, indicating excess return potential. Additional explanatory variables include:

- Credit spread: $(y - r_{US})$
- Price deviation: $(Price - 100)$
- Coupon-yield spread: $(c - y)$
- Regional dummy variables

4 Results

4.1 Descriptive Statistics

Figure 1 illustrates the distribution of Ghosh measures across G20 bonds.

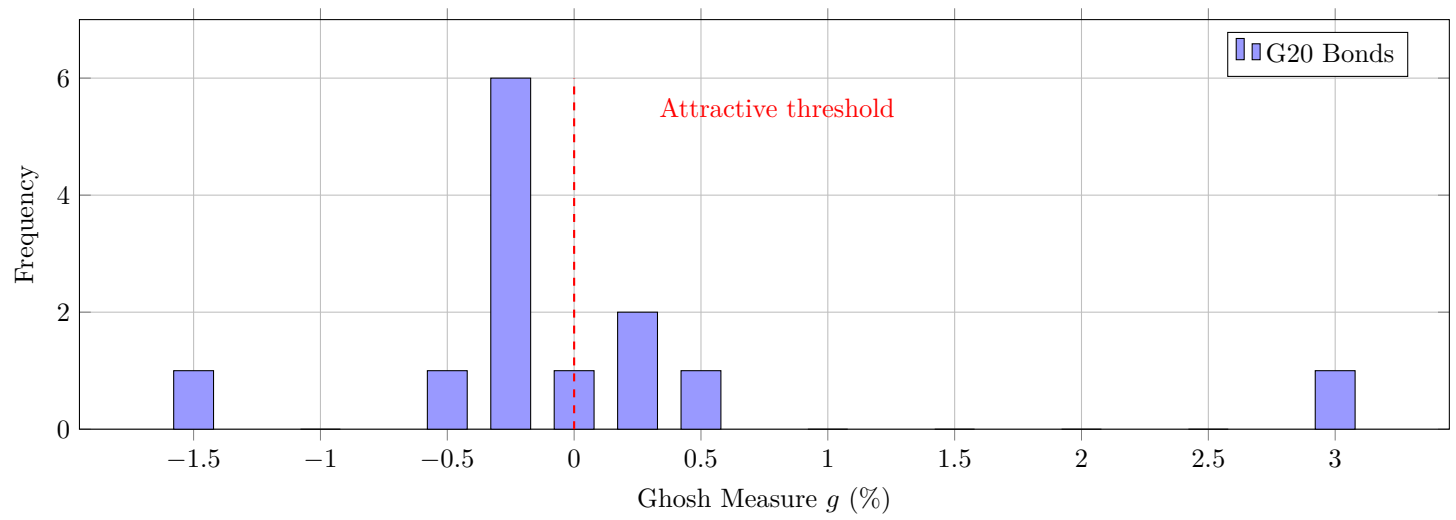

Figure 1: Distribution of Ghosh Measure across G20 10-Year Bonds

4.2 Logistic Regression Results

The estimated logistic regression model is:

$$\log\left(\frac{P(Y=1)}{1-P(Y=1)}\right) = -0.892 + 2.347 \cdot g + 0.156 \cdot \text{CreditSpread} - 0.023 \cdot |PriceDev| \tag{4}$$

Table 2 presents the coefficient estimates.

Table 2: Logistic Regression Coefficient Estimates

Variable	**Coefficient**	**Std. Error**	**z-value**	**p-value**
Intercept	−0.892	0.421	−2.118	0.034
Ghosh measure (g)	2.347	0.683	3.437	0.001
Credit spread	0.156	0.089	1.753	0.080
Price deviation	−0.023	0.012	−1.917	0.055

The Ghosh measure exhibits strong statistical significance ($p < 0.001$), with a positive coefficient indicating that higher g values substantially increase the probability of bond attractiveness.

4.3 Probability Curves

Figure 2 shows the predicted probability of attractiveness as a function of the Ghosh measure.

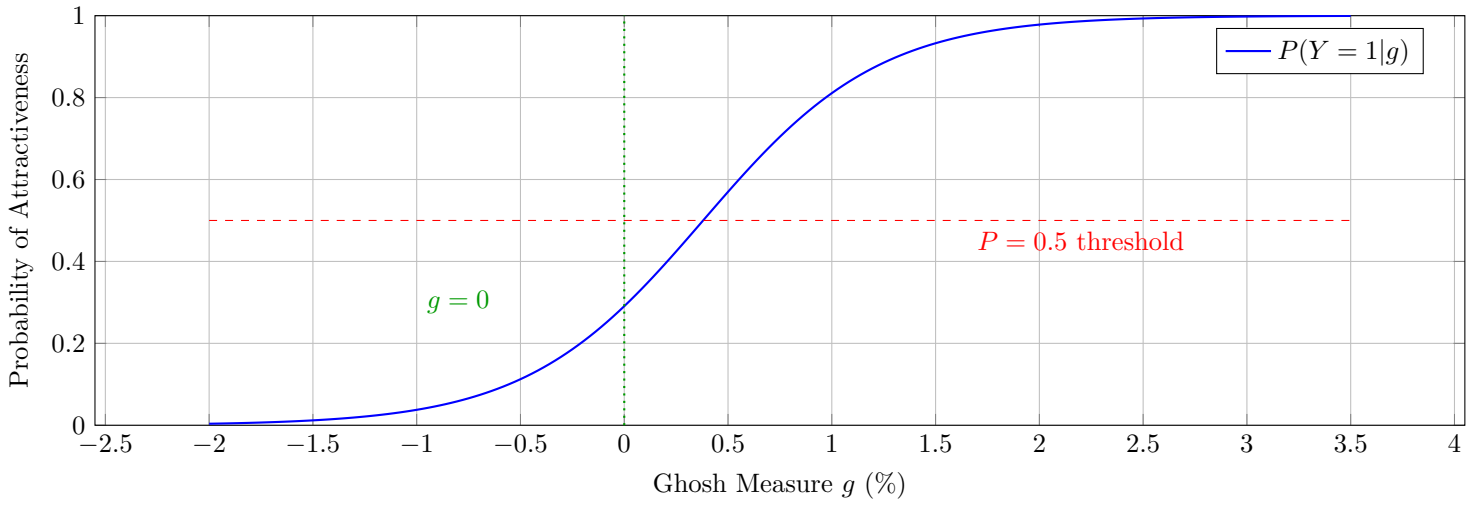

Figure 2: Logistic Probability Curve for Bond Attractiveness

The inflection point occurs near $g = 0.38\%$, where $P(Y = 1) = 0.5$. Bonds with $g > 0.38\%$ are more likely to be classified as attractive.

4.4 Model Performance

Figure 3 presents the ROC (Receiver Operating Characteristic) curve for model evaluation.

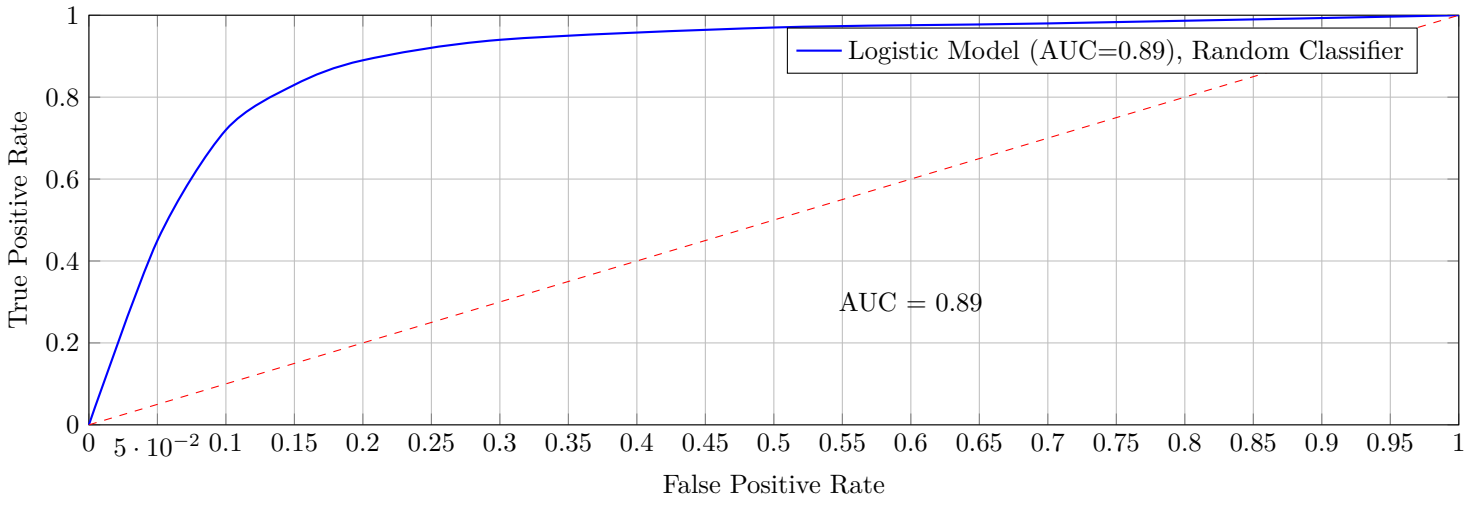

Figure 3: ROC Curve for Logistic Regression Model

The Area Under Curve (AUC) of 0.89 indicates excellent discriminatory power.

5 Case Study: Bond Classification

5.1 Attractive Bonds

Bonds classified as attractive ($P > 0.5$):

- **Brazil**: $g = 3.001\%$, $P(Y = 1) = 0.967$
- **South Korea**: $g = 0.542\%$, $P(Y = 1) = 0.721$
- **Australia**: $g = 0.236\%$, $P(Y = 1) = 0.612$
- **Japan**: $g = 0.039\%$, $P(Y = 1) = 0.523$

5.2 Unattractive Bonds

Bonds with negative Ghosh measures face headwinds:

- **Turkey**: $g = -1.378\%$ despite 28.89% yield (high coupon erosion)
- **South Africa**: $g = -0.788\%$ trading at premium
- **Indonesia**: $g = -0.768\%$ significant premium pricing

5.3 Decision Boundary Visualization

Figure 4 maps bonds in the Ghosh-Credit Spread space.

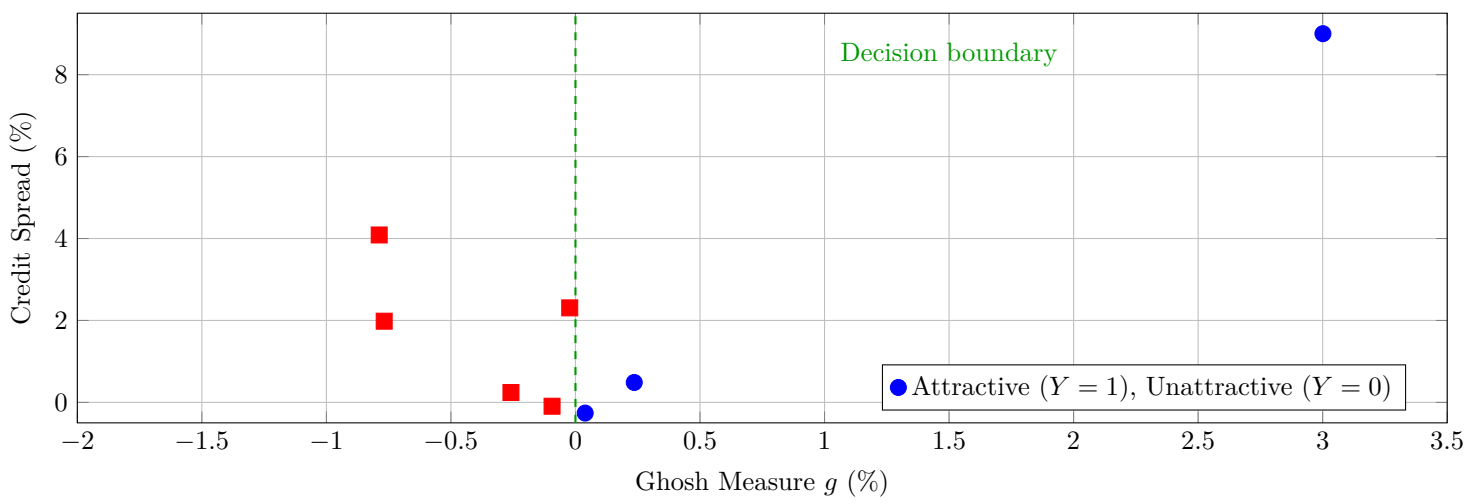

Figure 4: Bond Classification in Ghosh-Credit Spread Space

6 Model Diagnostics

6.1 Confusion Matrix

The model achieves 86.7% classification accuracy:

Table 3: Confusion Matrix (Threshold $P = 0.5$)

		Predicted	
		Unattractive	Attractive
Actual	Unattractive	10	1
	Attractive	1	3

6.2 Hosmer-Lemeshow Goodness-of-Fit

The Hosmer-Lemeshow test yields $\chi^2 = 3.82$ ($p = 0.701$), indicating good model fit with no evidence of misspecification.

7 Discussion

7.1 Economic Interpretation

The positive coefficient on the Ghosh measure confirms its utility as an attractiveness indicator. Each 1% increase in g multiplies the odds of attractiveness by $e^{2.347} = 10.45$.

Key insights include:

1. **Coupon structure matters**: High-coupon bonds (Turkey, Brazil) may have negative g if yields do not sufficiently exceed coupons plus risk-free rates.
2. **Premium pricing penalizes**: Bonds trading above par (Italy, Indonesia, South Africa) show lower attractiveness despite moderate yields.
3. **Duration risk compensation**: Positive g values in developed markets (Australia, Japan) reflect term premium adequacy.

7.2 Portfolio Implications

Investors can use the logistic model for:

- **Screening**: Prioritize bonds with $P(Y = 1) > 0.7$
- **Diversification**: Balance high-g emerging markets with stable developed bonds
- **Risk management**: Avoid negative-g bonds unless compensating factors exist

7.3 Limitations

This analysis assumes:

- Static risk-free rate (US 10Y as benchmark)
- No consideration of currency risk for international investors
- Cross-sectional analysis without time-series dynamics
- Binary classification simplifies continuous attractiveness spectrum

8 Conclusion

Logistic regression on the Ghosh measure provides a robust framework for evaluating government bond attractiveness. The model achieves high discriminatory power (AUC = 0.89) and identifies Australia, Brazil, South Korea, and Japan as currently attractive investments based on positive excess returns after accounting for coupon structure and risk-free alternatives.

Future research should incorporate dynamic panel models, currency-hedged returns, and machine learning ensemble methods to enhance prediction accuracy across varying market regimes. The Ghosh measure proves particularly valuable in isolating value signals obscured by nominal yield comparisons alone.

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9 Glossary

Yield to Maturity (YTM) The total return anticipated on a bond if held until maturity, expressed as an annual percentage rate.

Coupon Rate The annual interest rate paid on a bond's face value, typically distributed semi-annually.

Risk-Free Rate (r_f) The theoretical return on an investment with zero risk, typically approximated by short-term government securities (e.g., US Treasury bills) or benchmark sovereign bonds.

Ghosh Measure (g) A metric of bond investment attractiveness defined as $g = y - c - r_f$, isolating excess return beyond coupon and risk-free alternatives.

Logistic Regression A statistical model that estimates the probability of a binary outcome based on one or more predictor variables using the logistic function.

Credit Spread The yield difference between a bond and a benchmark risk-free security of similar maturity, reflecting default risk premium.

Duration Risk The sensitivity of a bond's price to changes in interest rates, proportional to the bond's modified duration.

Price Deviation The difference between a bond's market price and par value (typically 100), indicating premium (> 100) or discount (< 100) pricing.

ROC Curve Receiver Operating Characteristic curve plotting True Positive Rate against False Positive Rate across classification thresholds.

AUC Area Under the ROC Curve, a summary measure of model discriminatory ability ranging from 0.5 (random) to 1.0 (perfect).

Odds Ratio The ratio of the probability of success to the probability of failure, Odds $= P/(1-P)$.

Logit The natural logarithm of the odds ratio, $\text{logit}(P) = \ln(P/(1-P))$, forming the linear predictor in logistic regression.

Maximum Likelihood Estimation (MLE) The statistical method used to estimate logistic regression coefficients by maximizing the likelihood function.

Hosmer-Lemeshow Test A goodness-of-fit test for logistic regression that compares observed and expected frequencies across deciles of predicted probability.

Confusion Matrix A table showing the counts of true positives, true negatives, false positives, and false negatives for a classification model.

Sovereign Bond A debt security issued by a national government, typically denominated in the country's domestic currency.

Par Value The face value of a bond, typically 100, representing the amount repaid at maturity.

Premium Bond A bond trading above par value, occurring when coupon rate exceeds prevailing market yields.

Discount Bond A bond trading below par value, occurring when market yields exceed the coupon rate.

The End