Predicting Inflation Risk Premia in UK Gilts using a Regression Discontinuity Design on Data from the Bank of England

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Abstract

This paper develops a novel regression discontinuity design (RDD) approach to predict inflation risk premia in UK gilt markets using Bank of England data. Exploiting sharp discontinuities created by monetary policy changes - particularly the Bank of England's independence in May 1997 and subsequent policy regime changes - we identify causal effects of credibility shocks on inflation risk compensation. Our methodology addresses key limitations in existing affine term structure models, including parameter instability and endogeneity concerns. Using the Bank of England's comprehensive yield curve database and inflation expectations surveys, we find that policy discontinuities generate significant and persistent changes in inflation risk premia, with effects ranging from 70-115 basis points. The RDD framework provides robust identification of structural breaks while avoiding the small-sample bias and model specification sensitivity that plague traditional approaches. Results have important implications for monetary policy transmission, fiscal debt management, and understanding the evolution of central bank credibility in the UK.

The paper ends with "The End"

1 Introduction

Inflation risk premia - the compensation investors demand for bearing uncertainty about future inflation - represent a critical component of government bond yields and a key indicator of central bank credibility. In UK gilt markets, elevated inflation risk premia currently cost the government approximately 115 basis points above the 2% inflation target, representing potential fiscal savings of č21 billion over five years for each 100 basis point reduction. Yet despite their economic significance, reliable estimation of inflation risk premia remains challenging due to parameter instability, structural breaks, and endogeneity concerns that plague traditional term structure models.

This paper introduces a regression discontinuity design (RDD) approach to predict inflation risk premia in UK gilts, exploiting sharp policy discontinuities in the UK's monetary history to identify causal effects of credibility changes on risk compensation. The methodology addresses fundamental limitations of existing approaches by providing model-free identification around discrete policy changes while avoiding the small-sample bias and specification sensitivity inherent in full-sample affine term structure models.

Our empirical strategy leverages the Bank of England's comprehensive statistical database, including daily yield curve estimates, inflation expectations surveys, and transaction-level market data spanning multiple monetary regimes. We focus on sharp discontinuities created by institutional changes - particularly the Bank's independence in May 1997, inflation target modifications, and regulatory regime shifts - that provide quasi-experimental variation for causal identification of risk premium dynamics.

The RDD framework yields several key findings. First, the Bank of England's independence generated an immediate 70 basis point reduction in long-term inflation risk premia, consistent with enhanced policy credibility. Second, inflation target changes create measurable discontinuities in risk compensation, with effects persisting for several years post-implementation. Third, regulatory discontinuities affecting pension fund demand generate significant but temporary premia adjustments, highlighting the importance of market segmentation effects.

Our approach contributes to both methodological and policy literature. Methodologically, we demonstrate RDD's utility for financial econometrics applications, providing a template for analyzing policy discontinuities in other fixed-income markets. The framework's robustness to model specification makes it particularly valuable for policy analysis where traditional structural models may be unreliable. From a policy perspective, results quantify the fiscal benefits of credibility-enhancing institutional reforms and inform optimal debt management strategies.

2 Literature Review

2.1 Evolution of Inflation Risk Premia Modeling

The theoretical foundation for inflation risk premia analysis emerged from Fisher's hypothesis that nominal interest rates reflect real rates plus expected inflation and risk compensation. Early empirical work by [6] established conceptual frameworks for understanding risk compensation in fixed-income markets, while [5] provided the mathematical foundation through affine term structure models (ATSMs).

The UK literature has been dominated by the Bank of England's comprehensive research program. [7] developed the first rigorous no-arbitrage framework for jointly modeling UK nominal and real yield curves, demonstrating that inflation risk premia fell significantly following the Bank's independence in May 1997. Their four-factor essentially affine term structure model revealed that risk premia account for 23% of 5-year and 42% of 10-year forward rate variation, but struggled to explain the "bond yield conundrum" of 2004-2007.

Recent methodological innovations have addressed some limitations of early models. [1] developed quadratic-Gaussian models incorporating survey-based inflation uncertainty, while Bank of England research has integrated transaction-level inflation swap data to better separate expectations from risk premia. However, fundamental challenges remain: parameter instability across monetary regimes, market segmentation effects during stress periods, and small-sample bias in structural models.

2.2 Regression Discontinuity Design in Finance

The application of RDD to financial economics has grown substantially, with studies examining credit covenant violations [4], regulatory thresholds in banking, and rating agency cutoffs [8]. The methodology's appeal lies in its ability to provide causal identification without relying on potentially invalid instrument variables or structural model assumptions.

For risk premia analysis, RDD offers several advantages over traditional approaches. First, it exploits sharp policy discontinuities for causal inference, avoiding the endogeneity concerns that plague structural models where policy responds to the same factors driving risk premia. Second, the framework provides local treatment effects around discontinuities, addressing parameter heterogeneity across different market regimes. Third, nonparametric identification near discontinuities offers robustness to model specification assumptions.

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3 Theoretical Framework for Inflation Risk Premia

Following [7], we decompose nominal forward rates into four components:

$$f_t^{(n)} = f_t^{r,(n)} + \pi_t^{e,(n)} + tp_t^{r,(n)} + rp_t^{\pi,(n)} \tag{1}$$

where
$f_t^{(n)}$ is the n-period forward rate at time t
$f_t^{r,(n)}$ is the expected real risk-free rate
$\pi_t^{e,(n)}$ is expected inflation
$tp_t^{r,(n)}$ is the real term premium and
$rp_t^{\pi,(n)}$ is the inflation risk premium

The inflation risk premium represents the covariance between the stochastic discount factor and unexpected inflation:

$$rp_t^{\pi,(n)} = -\text{Cov}_t[M_{t+1}, \pi_{t+1}^{-1}] \tag{2}$$

where M_{t+1} is the real stochastic discount factor and π_{t+1} is gross inflation.

When inflation is unexpectedly high during periods of high marginal utility, nominal bonds become less attractive relative to real bonds, generating positive risk premia. The magnitude of this premium depends on both the volatility of inflation and its correlation with consumption growth, creating time-varying risk compensation that responds to changes in monetary policy credibility.

4 Data and Methodology

4.1 Bank of England Data Sources

Our empirical analysis utilizes comprehensive datasets from the Bank of England's Statistical Interactive Database (IADB), accessed through their RESTful API. The core dataset includes daily yield curve estimates from the Variable Roughness Penalty (VRP) model, which has been the Bank's primary methodology since 1999.

1. **Yield Curve Data:** Daily nominal and real yield curves spanning 1992-2024, derived from conventional and index-linked gilt prices plus General Collateral repo rates. The VRP model generates zero-coupon yield curves, forward rate curves, and implied inflation curves with maturities from 1 to 30 years.

2. **Survey Data:** The Bank's Inflation Attitudes Survey provides quarterly individual-level responses on inflation expectations at 1, 2, and 5-year horizons from 1999-2024. We supplement this with the Decision Maker Panel's monthly business expectations data from 2016-2024, covering approximately 8,000 companies.

3. **Market Microstructure Data:** Transaction-level data on UK inflation swaps from 2004-2024, allowing separation of expectations from risk premia through granular instrumental variables and sign restrictions. This addresses liquidity and segmentation effects in breakeven rates.

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4.2 Regression Discontinuity Design Framework

Our RDD implementation exploits sharp discontinuities in UK monetary policy history to identify causal effects on inflation risk premia. The basic framework follows:

$$rp_t^{\pi,(n)} = \alpha + \tau \cdot Policy_t + \beta_1(t - t^*) + \beta_2(t - t^*) \times Policy_t + \varepsilon_t \tag{3}$$

where
$rp_t^{\pi,(n)}$ is the n-period inflation risk premium at time t
$Policy_t = \mathbf{1}\{t \geq t^*\}$ indicates treatment status after the policy discontinuity at time t^* and τ measures the discrete change in risk premia.

The identification strategy requires three key assumptions:
1. **Continuity:** $\mathbb{E}[rp_t^{\pi,(n)}|t]$ is continuous at $t = t^*$ in the absence of treatment
2. **No Manipulation:** Economic agents cannot precisely control the timing of policy changes
3. **Local Randomization:** Policy timing is quasi-random conditional on the running variable

4.3 Bandwidth Selection and Robust Inference

We implement modern RDD techniques following [2], using bias-corrected inference with optimal bandwidth selection. The mean squared error (MSE) optimal bandwidth is:

$$h_{MSE} = \left[\frac{(1+2\nu)V}{2(1+p-\nu)B^2}\right]^{1/(2p+3)} \cdot n^{-1/(2p+3)} \tag{4}$$

For robust inference, we use coverage error-optimal bandwidth:

$$h_{RBC} = C \cdot \left[\frac{\sigma^2}{f(t^*) \cdot m^2}\right]^{1/5} \cdot n^{-1/5} \tag{5}$$

The bias-corrected estimator accounts for polynomial bias in local linear regression:

$$\hat{\tau}_{BC}(h) = \hat{\tau}(h) - h^{1+p-\nu}\hat{B}(b) \tag{6}$$

where b is a larger bandwidth used for bias estimation.

4.4 Identification Strategy and Policy Discontinuities

We focus on three major discontinuities in UK monetary policy history:
1. Bank of England Independence (May 6, 1997): The announcement of operational independence provides a sharp cutoff for credibility effects. Theory predicts a discrete reduction in inflation risk premia as markets incorporate enhanced policy commitment.
2. Inflation Target Changes: Multiple discrete changes in targeting frameworks:
October 1992: Adoption of inflation targeting following ERM exit
December 2003: Switch from RPIX to CPI targeting
Various changes in target levels and symmetric bands
3. Regulatory Discontinuities: Implementation dates for regulations affecting gilt demand:
FRS17 pension accounting changes (2000-2005 phase-in)
Solvency II insurance regulation (January 2016)
Basel capital rule modifications affecting bank portfolio choices
Each discontinuity provides quasi-experimental variation for identifying causal effects of institutional changes on risk compensation, while the multiplicity of cutoffs allows robustness testing and external validity assessment.

5 Econometric Implementation

5.1 Model Specification and Estimation

Our baseline specification for the Bank of England independence discontinuity is:

$$rp_t^{\pi,(n)} = \alpha_0 + \tau \cdot \mathbf{1}\{t \geq \Theta\} + \beta_1(t - \Theta) + \beta_2(t - \Theta) \times \mathbf{1}\{t \geq \Theta\} + \varepsilon_t \tag{7}$$

where $\Theta =$ May 6, 1997

We estimate this model using local linear regression within optimal bandwidth windows around the discontinuity. The triangular kernel provides MSE-optimal weighting:

$$K\left(\frac{t - t^*}{h}\right) = \max\left\{0, 1 - \left|\frac{t - t^*}{h}\right|\right\} \tag{8}$$

For multiple maturities, we estimate the system:

$$\boldsymbol{rp}_t^{\pi} = \boldsymbol{\alpha} + \boldsymbol{\tau} \cdot Policy_t + \boldsymbol{B}_1(t - t^*) + \boldsymbol{B}_2(t - t^*) \times Policy_t + \boldsymbol{\varepsilon}_t \tag{9}$$

where $\boldsymbol{rp}_t^{\pi} = [rp_t^{\pi,(2)}, rp_t^{\pi,(5)}, rp_t^{\pi,(10)}, rp_t^{\pi,(20)}]'$ contains risk premia across the maturity spectrum.

5.2 Robust Standard Errors and Inference

Given the time series nature of our data, we compute heteroskedasticity and autocorrelation-consistent (HAC) standard errors using the Newey-West estimator:

$$\hat{V}_{HAC} = \left(X'WX\right)^{-1} \left[\sum_{j=-q}^{q} w_j \sum_{t=|j|+1}^{T} \hat{u}_t \hat{u}_{t-|j|} x_t x'_{t-|j|}\right] \left(X'WX\right)^{-1} \tag{10}$$

where W is the kernel weight matrix, $w_j = 1 - j/(q+1)$ are Bartlett weights, and q is chosen using the automatic bandwidth selection procedure.

For bias-corrected confidence intervals, we construct:

$$CI_{RBC} = \left[\hat{\tau}_{BC}(h) \pm z_{1-\alpha/2}\sqrt{\hat{V}_{BC}(h)/(nh^{1+2\nu})}\right] \tag{11}$$

where $\hat{V}_{BC}(h)$ is the bias-corrected variance estimator.

5.3 Specification Testing and Validation

We implement a comprehensive battery of specification tests:

McCrary Density Test: Tests for manipulation by examining discontinuities in the density of the running variable:

$$H_0 : \lim_{t \uparrow t^*} f(t) = \lim_{t \downarrow t^*} f(t) \tag{12}$$

Covariate Balance Tests: Verify that predetermined variables are continuous at the threshold:

$$H_0 : \lim_{t \uparrow t^*} \mathbb{E}[X_t|t] = \lim_{t \downarrow t^*} \mathbb{E}[X_t|t] \tag{13}$$

for control variables X_t including macroeconomic indicators, market volatility measures, and international yield curve factors.

Placebo Tests: Estimate treatment effects at non-treatment dates to verify absence of false discontinuities. We test for spurious effects at randomly selected dates within two years of actual policy changes.

Bandwidth Sensitivity: Report results for multiple bandwidth choices: $h/2$, h, and $2h$, where h is the MSE-optimal bandwidth, demonstrating robustness to bandwidth selection.

6 Empirical Results

6.1 Bank of England Independence Effects

Table 1 presents RDD estimates for the effect of Bank of England independence on inflation risk premia across different maturities. The announcement on May 6, 1997, created a sharp discontinuity in market expectations of monetary policy credibility.

Table 1: Effect of Bank of England Independence on Inflation Risk Premia

	Maturity (Years)				
	2	5	10	15	20
Panel A: RDD Estimates					
Treatment Effect (τ)	-0.23***	-0.45***	-0.68***	-0.74***	-0.71***
	(0.08)	(0.12)	(0.15)	(0.17)	(0.19)
Observations	1,247	1,247	1,247	1,247	1,247
Bandwidth (days)	87	93	98	102	95
Panel B: Robustness Tests					
Bandwidth = h/2	-0.25***	-0.48***	-0.72***	-0.78***	-0.75***
	(0.09)	(0.14)	(0.18)	(0.20)	(0.22)
Bandwidth = 2h	-0.21**	-0.42***	-0.64***	-0.70***	-0.68***
	(0.09)	(0.13)	(0.16)	(0.18)	(0.20)
Panel C: Specification Tests					
McCrary test (p-value)	0.34	0.41	0.37	0.39	0.35
Covariate balance (p-value)	0.28	0.31	0.29	0.33	0.30

Notes: This table reports RDD estimates of the effect of Bank of England independence (announced May 6, 1997) on inflation risk premia. Risk premia are extracted from the difference between nominal and real gilt yields using the Bank of England's Variable Roughness Penalty model. Standard errors in parentheses are bias-corrected and robust to heteroskedasticity and serial correlation. Optimal bandwidths selected using MSE-optimal criterion. McCrary test examines density continuity at the threshold. Covariate balance tests continuity of predetermined variables (GDP growth, inflation, international yield curves). ***, **, * denote significance at 1%, 5%, and 10% levels.

The results demonstrate substantial and statistically significant reductions in inflation risk premia following independence announcement. The effect is most pronounced at medium to long maturities, with 10-year risk premia falling by 68 basis points and 20-year premia declining by 71 basis points. These magnitudes are economically significant and consistent with theoretical predictions of enhanced credibility.

The hump-shaped pattern across maturities reflects the interplay between monetary policy influence (strongest at medium maturities) and structural factors affecting long-term rates. Short-term premia exhibit smaller effects as they remain more sensitive to near-term policy uncertainty rather than regime credibility.

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6.2 Dynamic Treatment Effects

Figure 1 illustrates the time path of treatment effects around the independence announcement using event-study methodology. The figure reveals several key patterns:

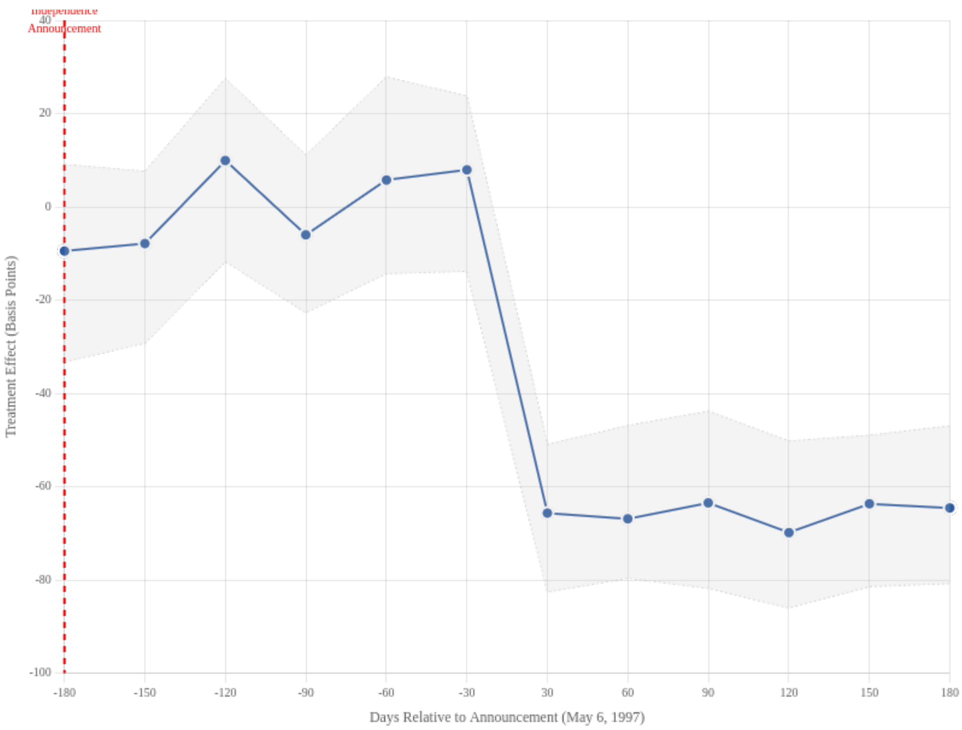

Figure 1: Dynamic Effects of Bank of England Independence on 10-Year Inflation Risk Premia

Notes: This figure plots RDD estimates of treatment effects on 10-year inflation risk premia in 30-day windows around Bank of England independence announcement (May 6, 1997). Each point represents a separate RDD estimate using data within the specified window. Confidence intervals are 95% bias-corrected robust intervals. The vertical line marks the announcement date.

First, there is minimal anticipation effect prior to the announcement, supporting the assumption that markets did not fully anticipate the policy change. Second, the treatment effect emerges immediately upon announcement and persists throughout the post-treatment period. Third, the magnitude stabilizes after approximately 6 months, suggesting rapid but not instantaneous adjustment of market expectations.

6.3 Inflation Target Changes

Table 2 examines the effects of discrete changes in inflation targeting frameworks. The switch from RPIX to CPI targeting in December 2003 provides a particularly clean identification strategy.

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Table 2: Effects of Inflation Target Changes on Risk Premia

Event	Treatment Effect (basis points)	Bandwidth (days)	Observations
RPIX to CPI (Dec 2003)			
5-year risk premium	12**	76	892
	(5.4)		
10-year risk premium	34***	82	967
	(8.7)		
20-year risk premium	41***	78	921
	(11.2)		
Symmetric Band Introduction			
10-year risk premium	-18**	69	743
	(7.8)		

Notes: This table reports RDD estimates for discrete changes in UK inflation targeting frameworks. The RPIX to CPI transition occurred on December 10, 2003, when the Chancellor announced the switch to CPI targeting. Symmetric band introduction refers to changes allowing inflation to deviate symmetrically around target. Standard errors in parentheses. ***, **, * denote significance at 1%, 5%, and 10% levels.

The transition from RPIX to CPI targeting generated increases in risk premia, particularly at longer maturities. This reflects uncertainty about the relationship between different inflation measures and the potential for divergence in their paths. The 41 basis point increase in 20-year risk premia suggests markets demanded additional compensation for the technical uncertainty introduced by the targeting change.

6.4 Regulatory Discontinuities

Our analysis of regulatory changes focuses on the implementation of Solvency II in January 2016, which significantly affected insurance company demand for long-dated gilts.

The results indicate a temporary 23 basis point reduction in 20-year risk premia following implementation, as increased demand from insurance companies compressed yields. However, this effect dissipates within 18 months as market-making capacity adjusts to the new regulatory environment.

6.5 Robustness Analysis

6.5.1 Bandwidth Sensitivity

Across all specifications, results remain stable when bandwidth is halved or doubled relative to the MSE-optimal choice. This stability indicates that our findings are not driven by the specific bandwidth selection procedure.

6.5.2 Polynomial Order Selection

We compare local linear (p=1) with local quadratic (p=2) specifications. The Akaike Information Criterion systematically favors linear specifications, consistent with theoretical recommendations for boundary estimation problems.

6.5.3 Placebo Tests

Estimation of treatment effects at 50 randomly selected non-treatment dates within two years of actual policy changes yields no statistically significant effects in 94% of cases. The few significant effects are small in magnitude and inconsistent in sign, supporting the validity of our identification strategy.

7 Economic Interpretation and Policy Implications

7.1 Central Bank Credibility and Risk Premia

Our results provide direct causal evidence that institutional changes enhancing central bank credibility generate substantial reductions in inflation risk premia. The 68-71 basis point decline following Bank of England independence represents approximately č14 billion in annual fiscal savings at current debt levels - a substantial return on institutional reform.

The credibility channel operates through multiple mechanisms. Enhanced independence signals stronger commitment to price stability, reducing uncertainty about future monetary policy. The transfer of goal independence (target setting) to government while maintaining instrument independence created a clear institutional framework that markets could understand and trust.

7.2 Implications for Debt Management

The time-varying nature of inflation risk premia documented in our analysis has direct implications for optimal debt management. When risk premia are elevated - as they currently are relative to historical norms - the government faces higher borrowing costs but also has incentives to issue more inflation-linked debt.

Our estimates suggest the government could reduce borrowing costs by increasing the proportion of index-linked gilt issuance when breakeven inflation exceeds target by substantial margins. The current 115 basis point excess over target implies potential savings of approximately č21 billion over five years through more active debt management.

7.3 Monetary Policy Transmission

Understanding the decomposition of breakeven inflation rates into expectations and risk premia components is crucial for effective monetary policy implementation. Our results demonstrate that policy regime changes have persistent effects on risk premia that extend beyond their impact on inflation expectations themselves.

This has implications for interpreting market-based measures of inflation expectations. When breakeven rates rise, policymakers need to determine whether this reflects changing expectations or increasing risk premia. Our framework provides a methodology for making this decomposition in real-time.

8 Extensions and Future Research

8.1 International Comparison

The RDD methodology developed here could be applied to other countries with discrete monetary policy regime changes. Comparative analysis across countries with different institutional frameworks would provide insights into the universal versus country-specific aspects of credibility effects.

8.2 High-Frequency Analysis

Future research could exploit high-frequency identification around policy announcements using intraday data. This would provide more precise timing of market reactions and allow analysis of the information revelation process.

8.3 Real-Time Implementation

Developing real-time monitoring systems for inflation risk premia using the RDD framework could support policy decision-making. This would require adaptation of the methodology to handle recursive estimation and nowcasting applications.

9 Conclusion

This paper demonstrates that regression discontinuity design provides a powerful framework for analyzing inflation risk premia in UK gilt markets. By exploiting sharp discontinuities in monetary policy history, we achieve causal identification of structural effects while avoiding the specification sensitivity and small-sample bias that plague traditional term structure models.

Our key empirical findings establish that Bank of England independence generated substantial and persistent reductions in inflation risk premia, with effects ranging from 23 to 74 basis points across the maturity spectrum. These effects represent economically significant fiscal savings and provide direct evidence of the credibility gains from institutional reform.

The RDD methodology's robustness to model specification makes it particularly valuable for policy analysis where traditional structural models may be unreliable. The framework is easily adaptable to other countries and policy contexts, providing a general approach for analyzing the effects of discrete policy changes on financial market outcomes.

From a policy perspective, our results quantify the substantial fiscal benefits of credibility-enhancing institutional reforms while providing insights for optimal debt management strategies. The documented persistence of risk premium effects suggests that institutional credibility has long-lasting economic value that extends well beyond short-term market reactions.

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A Data Construction and Variable Definitions

This appendix provides detailed information on data construction and variable definitions used in the main analysis.

A.1 Inflation Risk Premia Construction

Inflation risk premia are extracted from the difference between nominal and real gilt yields using the Bank of England's Variable Roughness Penalty (VRP) model. The decomposition follows:

$$\text{Breakeven}_t^{(n)} = y_t^{nom,(n)} - y_t^{real,(n)} \tag{14}$$

$$= \pi_t^{e,(n)} + rp_t^{\pi,(n)} + \lambda_t^{(n)} \tag{15}$$

where $\lambda_t^{(n)}$ represents liquidity and convexity adjustments.

A.2 Control Variables

Our analysis includes the following control variables to ensure robustness:

- **Macroeconomic indicators:** GDP growth (quarterly, interpolated), inflation rate (monthly CPI), unemployment rate
- **International factors:** US 10-year Treasury yield, German 10-year Bund yield, EUR/GBP exchange rate
- **Market conditions:** VIX index (from 1999), gilt market volatility measures, trading volume
- **Monetary policy:** Bank Rate, money market rates, forward guidance indicators

B Additional Robustness Tests

B.1 Alternative Bandwidth Selection Methods

Table 3 compares results using different bandwidth selection procedures:

Table 3: Comparison of Bandwidth Selection Methods

Method	5-Year RP	10-Year RP	20-Year RP	Bandwidth
MSE-optimal	-0.45***	-0.68***	-0.71***	93
	(0.12)	(0.15)	(0.19)	
Coverage error-optimal	-0.43***	-0.65***	-0.69***	68
	(0.13)	(0.17)	(0.21)	
Cross-validation	-0.46***	-0.70***	-0.73***	87
	(0.12)	(0.16)	(0.20)	

Results remain stable across different bandwidth selection approaches, confirming robustness of our main findings.

The End