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Inflation Risk in European Asset Markets: A Core-Energy Decomposition

Jessica PULFORD and Milja JOVANOVIC

Under the supervision of Prof. Evren ORS

President of the Jury: Prof. Irina ZVIADADZE

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Abstract

This thesis[1] applies the core-energy inflation decomposition of Fang, Liu and Roussanov (2025) to European asset markets, where the European Central Bank's (ECB) single monetary policy mandate and reliance on imported energy make for a structurally distinct setting. Our results mirror the U.S. evidence. We find that nominal bonds carry negative energy betas, energy commodity futures carry positive energy betas, and no asset class hedges core inflation. Six of eight country specifications yield a negative price of core inflation risk and all eight a positive price of energy inflation risk. No estimate achieves conventional statistical significance. We read this not as a failure of identification, but as a consequence of the ECB's mandate anchoring core inflation close to 2%. This compresses the variation in realised core shocks that identifying the premium requires. The pre-2020 sample lacks the core inflation variation that statistical identification requires, but the mechanism appears to operate.[2]

[1]Following HEC guidelines, we are hereby notifying that some paragraphs of this paper were proofread and rewritten for clarity using Large Language Models such as Claude and ChatGPT

[2]We thank Professor Evren Örs for his supervision and guidance throughout this project, and the members of the jury, including Professor Irina Zviadadze, for their time and attention.

Contents

1 Introduction

The relationship between asset returns and inflation is not uniform but decomposable. Fang, Liu and Roussanov (2025) show that separating headline inflation into its core and energy components resolves a long-standing puzzle in U.S. markets. By treating inflation as a single measure, we conflate two shocks with opposing asset pricing implications. Persistent core inflation, driven by sticky prices, carries a significantly negative price of risk; while volatile energy inflation carries a positive but insignificant price. Conventional real assets hedge against energy inflation but none hedge against core inflation. At the headline level, these opposing forces obscure each other. This produces the ambiguous and time-varying inflation relationships documented since Fama and Schwert (1977). This paper asks whether the same mechanism operates in European markets.

Whether the core-energy decomposition brings comparable clarity to European asset pricing is far from obvious due to the structural differences between the European and the U.S. setting. The European Central Bank imposes a single monetary policy across economies with heterogeneous inflation histories. It's mandate (European Central Bank, 2021b) focuses explicitly on the persistence and origin of core price pressures. Inflation is measured by the Harmonised Index of Consumer Prices (HICP), which excludes owner-occupied housing and produces a narrower core measure than the equivalent. Europe also imports approximately 88 per cent of its natural gas, making energy inflation structurally more sensitive to external supply shocks. These institutional differences may alter both the sign and magnitude of inflation risk premia. Prior work on European inflation risk has focused on headline measures and found evidence of structural shifts, but no prior study[1] applies the core-energy decomposition to European markets. This paper attempts to address that gap.

We study eighteen test assets across seven European sovereigns and the euro-area aggregate over 2001 Q1 to 2020 Q4. We use a vector autoregression to extract inflation shocks and the Fama-MacBeth procedure to estimate the prices of core and energy inflation risk, corroborated by factor-mimicking portfolios. The results are directionally consistent with the U.S. evidence. At the asset-class level, we find that nominal bonds carry negative energy betas and commodity futures positive ones and that no asset class robustly hedges core inflation. Six of the eight country specifications yield a negative estimated price of core inflation risk and all eight yield a positive price of energy inflation risk. The economic magnitudes are striking. Germany's annualised price of core inflation risk is approximately -4% per annum, within 0.1 percentage points of the Fang et al. (2025) estimate for the United States. None of the estimates, however, achieve conventional

[1] to our knowledge

statistical significance. We interpret this as a structural finding rather than a failure of identification. The ECB's success in anchoring core inflation over the 2001–2020 sample leaves too little variation in realised core shocks to establish the premium statistically. The near-absence of core inflation surprises is a consequence of the monetary regime, not evidence that the premium is absent.

This paper makes three contributions. It provides the first application of the Fang et al. (2025) core-energy decomposition to European markets. It shows that the direction and economic magnitude of inflation risk premia are broadly consistent with the U.S. evidence, suggesting the mechanism identified by Fang et al. (2025) is not specific to the U.S. setting. It also suggests that the ECB's price stability mandate is the binding constraint on European inflation risk identification. This structural feature should resolve as post-2020 data on the 2021–2023 inflation surge accumulates. Section 2 reviews the relevant literature and states our hypotheses. Section 3 describes the data and methodology. Section 4 presents the results. Section 5 concludes.

2 Literature review

2.1 The Inflation Hedging Puzzle

The conventional intuition is that equities, as claims on real assets, should provide some hedge against inflation. Yet empirical evidence contradicts this view. Fama and Schwert (1977) find, in a post-1953 U.S. sample, that stocks exhibit strong negative correlations to both expected and unexpected inflation, making them poor inflation hedges. Boudoukh and Richardson (1993) qualify this result by showing that stocks appear to be more effective hedges against inflation over longer horizons, suggesting the stock-inflation relationship may depend on investment horizon.

Fama (1981) offers the Proxy Effect as an explanation for the anomalous negative correlation between stock returns and inflation. Fama posits that stock returns and inflation are driven in opposite directions by market expectations of future real economic growth, thus the apparent negative relationship documented by Fama and Schwert (1977) is not causal; inflation merely proxies for deteriorating real activity which independently predicts low stock returns.

Subsequent asset-pricing evidence shifts the discussion from hedging to risk premia. Chen et al. (1986) offer evidence that inflation is a priced factor in the cross-section of stock returns and that the price of inflation risk is negative. Boons et al. (2020) extend this result by documenting that the sign of the inflation risk premium is time varying. In U.S.

markets, the sign shifted from negative to positive in the early 2000s. Consistent with this timing, the stock-bond correlation in U.S. markets also reversed sign in the early 2000s (Campbell et al. (2020); Baele et al. (2010)).

The literature establishes a central tension. Although theory suggests that equities should hedge inflation, empirical evidence in U.S. markets demonstrates their inflation exposure is negative and time-varying, while the broader relationships between inflation, stocks and bonds are varying as well.

2.2 Decomposing Inflation Risk: Core versus Energy

The later literature addresses this tension by arguing that the early literature treats inflation too coarsely. Ajello et al. (2020) decompose consumer prices into distinct factors: core, food and energy within a term-structure model. They demonstrate that these components have fundamentally different statistical properties. They find that core inflation shocks are more persistent and less volatile than food and energy shocks. Fang et al. (2025) adopt this decomposition to propose an explanation complementary to the Proxy Effect (Fama (1981)) for the surprising negative stocks-inflation correlation documented (Fama and Schwert (1977)), arguing that using a single aggregate measure of inflation conflates the distinct effects of different shocks.

Fang et al. (2025) find core inflation carries a significantly negative price of risk, while energy inflation carries a positive but insignificant price of risk. They find that real assets, conventionally seen as inflation hedges, exhibit positive energy betas and negative core betas. They perform well when energy prices surge, but are hurt by core inflation shocks, and none of the eight asset classes hedge against core inflation. This reflects the distinct economic nature of each shock. Core inflation, which is driven by sticky-prices, signals deteriorating long-run growth prospects and carries a negative risk premium (Kung (2015)). Energy inflation prices, by contrast, are highly flexible and procyclical. Bansal and Shaliastovich (2012) link the inflation premium to a negative correlation between expected inflation and long-term growth.

Fang et al. (2025) further attribute the early-2000s stock-bond correlation sign reversal, documented in U.S. markets (Campbell et al. (2020)), to the changing role of energy inflation. When core energy dominates, both stocks and bonds are hurt, producing positive comovement. As energy inflation became more volatile and procyclical post-2000s, stocks with a positive energy beta increasingly diverged from bonds with negative energy beta, reversing the correlation.

Decomposing inflation into core and energy thus resolves much of the earlier puzzle. Conventional real assets do not hedge inflation uniformly, they mainly protect against energy inflation shocks, while the significantly negative price of core inflation risk remains obscured at the headline level (Fang et al. (2025)). The remaining question is whether the same core-energy mechanism prices inflation risk in European markets. Although Fang et al. (2025) include international stock portfolios in their broader asset universe, they do not directly test whether the same core-energy mechanism prices inflation risk in European markets. This paper addresses that gap by applying their framework to a European markets.

2.3 Macroeconomic Regimes and Inflation Risk Premia

The relationship between stocks, bonds and inflation is not stable, but regime dependent. Campbell et al. (2020) document a structural break at 2001Q2 in U.S. markets, after which stocks and bonds changed from moving together to diverging (Campbell et al., 2020, p. 3). They also note that during this same break, the correlation between inflation and the output gap switched from negative to positive. Pflueger (2023) provides a structural explanation; that in the 1980s, volatile supply shocks and reactive monetary policy caused inflation to act as a stagflationary[1] drag on both equities and bonds, generating positive correlation (Pflueger, 2023, p. 28). By the 2000s, demand shocks dominated, inflation became procyclical and nominal bonds turned into safe assets that hedge equity risk.

Song (2017) similarly attributes the stock-bond correlation shift to a regime change in monetary policy and the cyclicality of inflation. The regime shift is also more broadly visible in cross-asset inflation exposures. Baele et al. (2010) show that aggregate inflation betas switched sign at the end of the 1990s. Therefore the classic findings on inflation hedging are inherently regime dependent.

At the stock-level, Katz et al. (2017) show that when inflation rises, equity investors adjust their long-run nominal discount rates sluggishly, causing real equity returns to fall while bond and currency returns are unaffected. Fang et al. (2025) demonstrate that this mechanism maps directly onto the slow-moving core component of headline inflation as its persistence creates a discount rate updating problem that depresses equity returns.

[1] Stagflation is defined as persistent inflation combined with stagnant consumer demand and relatively high unemployment. (Merriam-Webster (nd))

Conversely, volatile more transient energy shocks cannot be embedded into long-run nominal discount rates. Their model isolates this persistent inflation risk. Fang et al. (2025) confirms that core inflation mirrors the risk exposures and risk prices of sticky goods while energy mirrors flexible-price inflation. Critically, Fang et al. (2025) confirm that core inflation does not act as a proxy for macroeconomic risk factors such as consumption and unemployment growth rates. After controlling for such macroeconomic factors, they still find that the price of core inflation risk remains significant. Core and energy therefore represent independently priced risks rather than repackaged versions of broader economic conditions.

This decomposition resolves the apparent instability as the aggregate inflation measure conflates two components with distinct risk profiles. As energy inflation came to dominate headline volatility post-2000, only the energy betas show the structural shift. The regime-shift and sticky discount rate explanations are thus complementary rather than competing. The Fang et al. (2025) decomposition reconciles them structurally by demonstrating the time-varying behaviour of aggregate inflation reflects the changing volatility of the energy component. Meanwhile, the price of core inflation risk remains stable and negative throughout. Thus, the decomposition separates the time-varying energy effects from the stable core presence.

2.4 Inflation Exposure Across Asset Classes: Prior Evidence

The macro-regime shifts documented do not affect all asset classes equally; different assets load on core and energy inflation in distinct ways (Fang et al. (2025)). While Fang et al. (2025) study the eight asset classes, this paper focuses on equities, bonds and commodities.

Equities. Historically, inflation has carried a negative price of risk in the cross section of stock returns, demonstrating the poor inflation hedge of equities (Chen et al. (1986)). However, as documented by Boons et al. (2020), this inflation risk premium is time-varying, with its sign reversing in the early 2000s. Fang et al. (2025) clarifies that this instability is driven by the changing composition of headline inflation. Equities are severely negatively exposed to core inflation, because sticky core prices mean that core inflation shocks signal deteriorating real growth (Fang et al. (2025)). Conversely, equities act as partial hedges against energy inflation as energy demand is procyclical (Fang et al. (2025)). Therefore, we expect that equities will exhibit negative core inflation betas, positive energy inflation betas and an overall negative price of core inflation risk.

Bonds. For bonds, the classical view is that fixed nominal cash flows are eroded by inflation, resulting in a positive inflation risk premium that rises with duration (Ang et al. (2008)). Yet the severity of this penalty is dependent on the shock origin. Supply shocks create stagflation, making bonds riskier and positively correlated with equities; demand shocks drive consumption and output up, stock valuations rise and bond prices fall, causing stocks and bonds to diverge and bonds act as safe haven assets. Fang et al. (2025) refine this by showing bonds carry negative exposures to both core and energy inflation since fixed cashflows are eroded regardless of the source of the price increase. We therefore expect European sovereign bonds to exhibit negative betas to both core and energy components.

Commodities. Commodity futures have traditionally been considered the most reliable inflation hedge. Gorton and Rouwenhorst (2006) demonstrate that fully collateralised commodity futures have historically offered the same returns and Sharpe ratios as equities. However unlike equities, they have historically offered positive correlations with both unexpected and expected inflation. As commodity futures tend to rise with unexpected inflation when stocks and bonds fall, they have traditionally acted as effective diversifying assets throughout business cycles. Erb and Harvey (2005) caution that the effectiveness of commodity futures as inflation hedges is not uniform. Energy commodities exhibit significantly unexpected inflation betas, whereas non-energy commodities such as precious metals show little strong inflation hedging properties and even exhibit negative inflation betas (Erb and Harvey (2005, p. 20)). Additionally, Erb and Harvey (2005) note that the hedging effectiveness of commodities is tied to the futures curve's structure. They find that commodities whose prices tend to rise with inflation provide the strongest inflation hedges.

Fang et al. (2025) corroborate this heterogeneity with their decomposition framework and verify that commodities exhibit strong positive correlations with energy inflation but offer virtually zero protection against core inflation. We therefore expect European-traded commodities will exhibit significant positive betas to energy inflation and insignificant exposures to core inflation.

2.5 The European Setting: Institutional Differences and Research Gap

Whether these relationships hold in European markets is far from obvious, given that the existing evidence is drawn primarily from U.S. data. The euro area's institutional architecture, energy structure and inflation measurements differ meaningfully from the U.S. and these differences may alter both the magnitude and sign of core and energy risk premia.

Bekaert and Wang (2010) demonstrate that inflation risk is internationally priced, but that individually, countries' inflation dynamics differ substantially. Historically in European markets, both nominal bonds and equities fail as reliable inflation hedges. Bekaert and Wang (2010, p. 7) find that European equities exhibit a small positive inflation beta (+0.27) in contrast to the pronounced negative relationship in U.S. markets. The pricing of inflation risk in Europe has undergone distinct structural shifts. Following 1990, the EU experienced a steep, statistically significant decrease in equity unexpected inflation betas at the 1-year horizon (Bekaert and Wang (2010, p. 17)). Thus, the empirical findings based on U.S. data that aggregate inflation systematically hurts equities is not necessarily a universal truth. European markets price inflation risk differently.

Despite national deviations, European inflation has a coherent internal structure that supports aggregate cross-sectional testing. Ciccarelli and Mojon (2010, p. 526) found that a common global factor explains approximately 70% of national inflation variance. Additionally, they verify that the high degree of comovement is not simply a side effect of European fixed exchange rates or geographic proximity. The shared trends persist strongly even when isolating countries with floating exchange rates (Brière and Signori, 2012, p. 30). This unity makes Europe a meaningful setting in which to apply an aggregate inflation decomposition framework.

Europe nonetheless presents three key structural differences to the U.S. that make it a distinct testing environment. First, the institutional setting of the ECB imposes a single monetary policy across all member states. According to Article 127 of the TFEU, an identical nominal rate was applied to economies with differing inflation experiences (European Central Bank, 2021a, Art. 127). The ECB's mandate further commits to calibrate policy based on "origin, magnitude and persistence" of inflation deviation (European Central Bank, 2021b). This implies a stronger institutional reaction to persistent core inflation than is typical of the dual mandate of the Federal Reserve.

Second, inflation is measured differently in Europe. Historically, the HICP excludes owner-occupied housing, whereas U.S. CPI core is heavily influenced by the inclusion of owners' equivalent rent (European Central Bank, 2021b). The core inflation risk premium estimated by Fang et al. (2025) in the U.S. is based on a broader measure than the European equivalent, and this may be reflected in estimated core betas.

Third, Europe is substantially more dependent on imported energy than the U.S. Eurostat data confirms that 88% of the EU natural gas supply was derived from net imports in recent years European Union (2026, p. 1). Due to this dependency, European energy inflation is more exposed to geopolitical supply shocks. Therefore, we expect that energy inflation may act as a more disruptive pricing factor in European markets than in the Fang et al. (2025) sample.

To our knowledge, no prior study applies the core-energy decomposition framework of Fang et al. (2025) to European markets. This paper fills that gap, testing whether the mechanism that resolves the U.S. inflation hedging puzzle holds in a structurally distinct European setting.

3 Methodology

3.1 The Data

3.1.1 The rate of inflation

We use the Harmonised Index of Consumer Prices observed from Eurostat to measure the rate of inflation. The HICP is the standard cross-country comparable price index for the European Economic Area, constructed under a common methodology so that the inflation rate of one country can be compared with that of another without adjustment for differences in basket weights or other conventions. The use of an inflation rate for consumption goods is appropriate under the assumption, made explicit by Fisher (1930, chap. 1) in his development of the theory and retained here, that the purpose of investment is eventual consumption. The rate of inflation for country i in quarter t, $\Delta_{i,t}$, is defined as the annualised log change of the all-items HICP index, evaluated at the last month of quarter t:

$$\Delta_{i,t} \;=\; 400 \cdot \left[\ln \mathrm{CPI}_{i,t} - \ln \mathrm{CPI}_{i,t-1}\right]. \tag{3.1}$$

While year-on-year inflation is the a more conventional reference object for commentary, we opt for quarter-on-quarter inflation to avoid the data being too smooth as we want to examine the short term shocks. Year-on-year would be too smooth at the quarterly horizon. We note that the as the Eurostat HICP index is not seasonally adjusted, there may be some cost to seasonal noise[1]

For each country and the Euro aggregate, we retrieve four HICP series. The headline series, COICOP code `CP00`, covers all items in the consumption basket. The core series, `TOT_X_NRG_FOOD`, excludes energy and food. The food and energy components are retrieved separately as `FOOD` and `NRG`. This decomposition follows standard Eurostat practice and facilitates the separation of inflation rates driven by underlying price pressures (core) from those driven by transient supply shocks (food and energy). The cross-sectional coverage comprises fifteen countries and the Euro Area aggregate (sixteen regions in total): Germany (DE), the United Kingdom (UK), France (FR), Italy (IT), Spain (ES), the Netherlands (NL), Belgium (BE), Austria (AT), Switzerland (CH), Denmark (DK), Finland (FI), Ireland (IE), Luxembourg (LU), Norway (NO), and Portugal (PT) and the Euro Area Aggregate (EA).

Our analysis sample is the period from 2001 Q1 through 2020 Q4, a total of eighty quarters. This start date is determined by the availability of the core HICP series, which begins at or shortly before 2001 for most of our countries. The end date is determined by the structural break in the European inflation process that began with the COVID-19 pandemic and was reinforced by the energy-price shock of 2022. Including the post-2020 observations would pool two regimes whose joint behavior would not be informative about the inflation-hedging properties of assets in a low-inflation environment.[2] This regime applies throughout our entire sample and the only one in which our full set of reference assets is consistently available.[3] The results are presented in Panel A of Table 1. Inflation rates and asset excess returns are reported in annualised percent throughout.

3.1.2 Returns on assets

The return on an asset is defined as the percentage change in the price of the asset from $t-1$ to t, augmented where relevant by the cash flow paid to the holder during the holding period. All are expressed relative to the price at $t-1$, with the exception of government bond returns, which are derived from yield dataing a duration approximation described below. All returns are computed from observed prices. Returns are reported in nominal terms unless explicitly labelled as excess returns, in which case the appropriate quarterly

[1]To address potential seasonality in quarterly inflation, we re-estimated the VAR augmented with Q1, Q2, and Q3 seasonal dummies in Section 4.6

[2]In Section 4 we discuss how looking at the second half of this structural break may reveal other findings.

[3]This is conceptually similar to the decision in Fama and Schwert (1977) to concentrate on January 1953 through July 1971 and exclude the 1971–1974 period of price controls, during which the CPI was unlikely to be a clean measure of the cost to consumers of obtaining goods and services.

risk-free rate has been subtracted. Throughout, returns are computed at quarterly frequency, with end-of-quarter observations for stock variables and quarterly aggregates for flow variables.

Government bonds. We collect government bond data for seven sovereigns. For Germany and the United Kingdom, daily yields at one-, three-, five-, and ten-year maturities are obtained from Bloomberg via the `GDBR` and `GUKG` ticker families. For France, Italy, Spain, the Netherlands, and Belgium, monthly ten-year long-term government bond yields are obtained from FRED (series `IRLTLT01[country]M156N`), which sources them from the OECD. The Bloomberg series are aggregated from daily to quarterly using the end-of-quarter observation; the FRED series, already monthly, are similarly sampled at the last month of the quarter. Holding-period returns on bonds are approximated from yield changesing the standard duration relation

$$r_t \approx \frac{y_{t-1}}{4} - D\,\Delta y_t, \tag{3.2}$$

where D is the modified duration, proxied by the time to maturity in years.[4] Excess returns on euro-denominated bonds are computed by subtracting the quarterly Euribor three-month rate; excess returns on UK gilts are computed by subtracting the quarterly GBP LIBOR three-month rate.

Risk-free rates. The Euribor three-month rate (Bloomberg ticker `EUR003M`) is obtained at daily frequency and aggregated to quarterly observation using the first observation of each quarter, on the convention that the risk-free rate relevant for the return realised over quarter t is the rate that prevailed at the start of the quarter. The annualised percent rate is divided by four to obtain a quarterly rate. The GBP LIBOR three-month rate is obtained from the ECB data portal (series `FM.M.GB.GBP.RT.MM.GBP3MFSR_` , GB Pound Sterling 3-month BBA LIBOR) at monthly frequency; the three monthly observations within each quarter are averaged to obtain a quarterly rate. The Euribor rate is applied as the risk-free rate for all euro-denominated assets: bond and equity returns for DE, FR, IT, ES, NL, BE and EA. The GBP LIBOR rate is applied to UK assets only. The choice of LIBOR rather than SONIA for the UK is because while SONIA is now the standard sterling benchmark, it only replaced LIBOR in this role from 2021, after the end of our sample. Throughout 2001–2020, GBP LIBOR was the conventional risk-free reference rate for sterling assets, and itse here is consistent with practice in the empirical literature

[4]This approximation treats the bond as a single zero-coupon claim and ignores convexity. It is satisfactory for the moderate yield changes observed in the sample but is less accurate at long maturities when yield changes are large. We retain the approximation rather than computing exact prices because the par-bond price function requires assumptions about coupon rates that vary across countries and over time; the duration approximation, while imperfect, is uniformly applied and preserves cross-country comparability.

for the same period.

Commodity futures. Front-month futures prices are obtained from Bloomberg at daily frequency for four contracts: West Texas Intermediate crude oil (`CO1`), Henry Hub natural gas (`NG1`), COMEX gold (`GC1`), and COMEX copper (`HG1`). Daily prices are aggregated to end-of-quarter observations, and returns are computed as simple percentage price changes. Futures returns are treated as already in excess form, such that a fully collateralised futures position requires no upfront capital outlay beyond margin, so the excess return over the risk-free rate is approximated by the price change itself. We do not adjust for the roll yield that would be incurred by a strategy maintaining constant exposure to the underlying commodity across delivery months. The returns reported here are therefore returns to the front contract rather than to a synthetic constant-maturity exposure. The four commodities cover the principal categories of the commodity complex: energy (crude oil and natural gas), precious metal (gold), and industrial metal (copper). Each was the most liquid front-month contract in its market over the sample period.

Equity. Equity returns are constructed from the Dow Jones Euro STOXX broad index, retrieved from the ECB Statistical Data Warehouse under the series:

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FM.M.U2.EUR.DS.EI.DJEURST.HSTA
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The index covers the euro-area aggregate (`U2`, which excludes the UK and other non-euro EU members) and is constructed by the ECB as the monthly average of daily closing prices, which is the only frequency available from the SDW. Monthly observations are aggregated to quarterly by taking the last monthly value of each quarter. Returns are computed as simple percentage changes and converted to excess returns by subtracting the quarterly Euribor three-month rate.

A single pan-European equity index is used rather than country-specific indices for two reasons. First, free institutional sources do not provide a consistent set of country-level equity indices for the full sample at a usable frequency; constructing country-level returns from commercial vendors would have introduced an additional source of heterogeneity (different index methodologies, dividend treatment, currency conventions) without a clear gain in resolution, given the strong factor structure of European equity returns at the quarterly frequency. Second, the DJ Euro STOXX broad index has wider coverage than the Euro STOXX 50 and is therefore a closer approximation to the market portfolio of the euro area. UK equity is excluded from the analysis as a comparable institutional series for the FTSE could not be sourced; this is a limitation of the UK results, which therefore rest on bond returns alone.

Summary of the assets chosen Our asset universe is narrow in places. We do not have bills at multiple maturities (Euribor and LIBOR three-month serve only as the risk-free rate, not as separate test assets), and we omit private residential real estate and labor income, neither of which is available on a comparable cross-country basis for our sample. On the other hand, we have commodities futures across four sectors, and we exploit the cross-section of seven European sovereigns. Six of the seven share a common currency and monetary authority, which provides additional power against the alternative that the inflation-hedge properties of government debt are specific to the United States.

3.2 Inflation shock extraction

In order to understand whether assets compensate investors for bearing inflation risk, it is necessary to measure the part of inflation that is a surprise as we expect that if investors expected inflation to be high, this would have been adjusted into their pricing in advance so there is no risk to be compensated for.
The raw inflation series $\Delta_{i,t}$ from equation (3.1) contains the predictable and unpredictable components. We use the following VAR system to extract the unexpected component in headline, core, food and energy inflationing the following VAR system:

$$Y_t = c + AY_{t-1} + \varepsilon_t \tag{3.3}$$

Similarly to Fang et al. (2025), Y_t includes the vector of headline, core, food and energy inflation as well as the risk free rate.

$$Y_{i,t} = \left(\Delta^{\text{head}}, \Delta^{\text{core}}, \Delta^{\text{food}}, \Delta^{\text{energy}}, r^f\right)'_{i,t}$$

The risk-free rate is `EURIBOR 3M` for EUR countries and the European Aggregate, and we use `LIBOR 3M` for the U.K. ε_t is the vector of innovations to Y_t which is the unpredictable component, given the information set at Y_{t-1}. Following Fang et al. (2025) we estimate a VAR(1) for each country separately as well as a Euro area aggregate. This gives a directly comparable aggregate to Fang et al. (2025)'s approach and country-level series which allows to study cross-country inflation heterogeneity. Figure 2 plots the time series of innovations to the four inflation variables and Table 2 shows the estimates of the VAR coefficients. Following Fang et al. (2025), we focus on reduced-form VAR innovations rather than structurally identified shocks. We therefore do not attribute unexpected inflation to specific structural causes such as productivity, demand, or policy shocks. We instead study the overall asset pricing implications of unexpected inflation regardless of its origin.

Fang et al. (2025) include the additional variables log P/D ratio and the output gap to run a 7-variable VAR, neither of which are included in our specifications. Sourcing data for the log P/D ratio and output gap for 15 European countries at the quarterly level was not feasible for the scope of this study.

3.3 Time-series inflation betas

Following the macroeconomic factor approach of Chen et al. (1986) and Fang et al. (2025), we estimate the inflation hedging properties of the eighteen test assets through the following regressions

$$r^e_{i,j,t} = \alpha_{i,j} + \beta^{headline}_{i,j} \varepsilon^{headline}_{t,j} + u_{i,j,t} \tag{3.4}$$

$$r^e_{i,j,t} = \alpha_{i,j} + \beta^{core}_{i,j} \varepsilon^{core}_{j,t} + \beta^{energy}_{i,j} \varepsilon^{energy}_{j,t} + u_{i,j,t} \tag{3.5}$$

where $r^e_{i,j,t}$ is the realised nominal return of asset i in quarter t in excess of the risk free rate for country j as specified in Paragraph 3.1.2. The shocks $\varepsilon^{energy}_{j,t}$, $\varepsilon^{core}_{j,t}$ and $\varepsilon^{headline}_{j,t}$ are the shocks for country j extracted from the VAR of equation (3.3). As with Fang et al. (2025), the Euribor 3M and GBP LIBOR 3M incorporate expected inflation, but do not reflect inflation surprises that occur within the quarter. As the excess returns on the left hand side of equation (3.4) and equation (3.5) remove the expected component, thus β captures only the sensitivity to the unexpected part. A perfect hedging asset should move one-to-one with inflation surprises with $\beta_{i,j} = 1$. Otherwise, $0 < \beta_{i,j} < 1$ is an imperfect hedge and $\beta_{i,j} < 0$ is a perverse inflation hedging asset.

We estimate equation (3.4) and equation (3.5) separately for each of the seven countries and the Euro Aggregate's shock series giving a set of inflation betas for each. This allows to examine whether inflation risk exposures differ across European countries. The results are reported in Tables 3-10.

3.4 The inflation risk premium

Having estimated the inflation-shock exposures of each test asset, we now examine whether these exposures are priced in the cross-section of average excess returns following the approach of Fang et al. (2025). Under a no-arbitrage restrictions for each specification, average excess returns should satisfy

$$\mathbb{E}\left[r^e_{i,j,t}\right] = \beta^{\text{headline}}_{i,j} \lambda^{\text{headline}}_j \tag{3.6}$$

$$\mathbb{E}\left[r^e_{i,j,t}\right] = \beta^{\text{core}}_{i,j} \lambda^{\text{core}}_j + \beta^{\text{energy}}_{i,j} \lambda^{\text{energy}}_j, \tag{3.7}$$

where λ_j^k denotes the price of inflation risk for factor k (core, energy or headline), implied by country j's inflation factors. We first estimate equation (3.6) using headline inflation as the sole pricing factor to see if headline inflation risk is significantly priced as a benchmark. We then turn to equation (3.7) as our main specification. equations (3.4) and (3.5) are estimated independently of each other, using the two-pass Fama-MacBeth cross-sectional regression (Fama and MacBeth, 1973). The first pass produces the betas from equations (3.4) and (3.5), the second pass regresses the time-series average excess returns of the eighteen test assets on the first-pass betas, with an intercept to allow for average mispricing not captured by the inflation factors. We report Shanken-corrected standard errors (Shanken, 1992) to account for the estimation error in the first-pass betas. The prices of risk are reported in Tables 11 and 12

3.5 Factor-mimicking portfolios

As Fang et al. (2025) explain in section 1.3.2, both core and energy inflation are macroeconomic factors which cannot be directly traded. Therefore, we examine factor-mimicking portfolios of these factors to complement the prices of inflation risk found in equations (3.6) and (3.7). A factor-mimicking portfolio (FMP) is a portfolio of traded assets constructed to maximally track an unobservable macroeconomic factor. It translates the inflation shock series extracted in Section 3.3 into a tradeable investment strategy, allowing the price of inflation risk to be estimated directly from portfolio returns as an alternative to the Fama-MacBeth procedure. We deviate from the method of constructing the factor-mimicking portfolios conducted in Fang et al. (2025), instead following the spirit of Lamont (2001). We construct the FMP weights as

$$w = \hat{\Sigma}^{-1}\widehat{\text{cov}}(r, \varepsilon^k), \tag{3.8}$$

where $\hat{\Sigma}$ is the estimated covariance matrix of asset returns and $\widehat{\text{cov}}(r, \varepsilon^k)$ is the vector of covariances between each asset's return and inflation factor k. We then normalise the weights to give a unit exposure to the factor via

$$w = w_{raw}/(w'_{raw}\widehat{\text{cov}}(r, \varepsilon^k)), \tag{3.9}$$

where $w_{raw} = \hat{\Sigma}^{-1}\widehat{\text{cov}}(r, \varepsilon^k)$. This ensures each portfolio has a unit exposure to factor k. By this construction, the normalised FMP has an expected return satisfying $E(w'r^e) = \lambda^k$. Thus, we can compare the mean FMP returns to the prices of inflation risks estimated in equations (3.6) and (3.7).

Fang et al. (2025) use the estimated betas from equations (3.4) and (3.5) to construct the

FMPs as the intermediate step to ask "which portfolio reproduces this factor given what we know about how assets load on it" following the construction of Kandel and Stambaugh (1989). This produces portfolios with unit exposure to each factor and orthogonality across factors by construction. We deviate from this and approach the FMP construction by asking "which portfolio moves most like the factor in the data, regardless of the beta structure". We do this deviation because with a smaller asset universe, the beta matrix would be estimated with considerable noise which would be amplified when inverting. By contrast, the Lamont (2001) construction that we follow, bypasses the beta matrix and projects directly onto the factor-return covariance structure. This produces more meaningful and interpretable results given our more limited asset universe. The returns of the factor mimicking portfolios are shown in Table 13. We discuss these results in 4.2.

4 Results and Observations

4.1 Descriptive Statistics

Before turning to the regression tests of inflation-hedging properties in Sections 4.3 and 4.4, we briefly summarise the statistical properties of the inflation series and the asset excess returns over the sample period. Table 1 reports the mean, standard deviation, and first-order autocorrelation of each inflation series (headline, core, food, and energy) for each country in our panel, together with the mean and standard deviation of the eighteen test-asset excess returns.

Inflation. Panel A.1 of Table 1 reports the mean, standard deviation and first-order autocorrelation of each inflation series. Panel A.2 of Table 1 reports the miniums and maximums. Two facts stand out. First, the unconditional means of headline, core, food, and energy inflation are broadly similar within each country. We see that typical values lie between one and two percent for headline and core, slightly higher for food, and generally higher for energy, though with greater cross-country variation. Switzerland is the outlier with near-zero average inflation across all four series, reflecting the well-known low-inflation regime of the Swiss franc area. Switzerland is retained for completeness but plays a limited role in subsequent results. Second, and in sharp contrast to the similarity of means, the four series differ substantially in their unconditional volatility. Core inflation is the least volatile component (of the food, core, energy decomposition) in the large majority of countries, with standard deviations ranging from 0.84% in Belgium to 4.22% in Spain. The only exceptions are Spain and Portugal, where food inflation is less volatile than core. Food inflation standard deviations range between 2.6% (Luxembourg) and 6.8% (Norway). Energy inflation is by far the most volatile, with standard deviations between 11% and 28%. This is between four and twenty times larger than the corresponding core standard deviations. For example, in Germany the standard deviations of core, food, and energy inflation are 2.57%, 4.08%, and 12.58%. Thus, headline inflation aggregates components whose volatilities differ by an order of magnitude. Any test of inflation hedging based on a single headline measure therefore risks attributing to aggregate inflation what is in fact driven by one specific component.

The first-order autocorrelations are generally modest in magnitude. Of the 64 series-country combinations, 46 fall within ± 0.2. The exceptions concentrate in core inflation, where Spain (-0.77), the Netherlands (-0.66), Italy (-0.53), and Switzerland (-0.52) exhibit strongly negative first-order autocorrelations, which we attribute to the quarter-to-quarter mean reversion induced by the seasonal pattern in the underlying monthly index. The general absence of strong serial dependence is the natural consequence of the quarter-on-quarter construction. As each observation is a single non-overlapping log-change, with no mechanical persistence carried in from the underlying data. The VAR specification of Section 3.2 then has the task of identifying whatever genuine predictability is present in the series.

Figure 1 plots the four inflation series for each country in our panel. The visual impression matches the moment-by-moment numbers. We see that core inflation is a smoothly evolving series in every country. Food inflation tracks core at lower frequencies but adds noticeable medium-frequency variation, while energy inflation is dominated by short-lived spikes, with two especially large episodes (2008–2009 and 2014–2016) possibly corresponding to the global oil-price collapses of those periods.

Inflation decomposition and component correlations. To assess the relative contribution of core, food, and energy to the variation in headline inflation, we regress headline inflation on the three components, country by country:

$$\Delta_{i,t}^{\text{head}} = c_i + w_i^{\text{core}} \Delta_{i,t}^{\text{core}} + w_i^{\text{food}} \Delta_{i,t}^{\text{food}} + w_i^{\text{energy}} \Delta_{i,t}^{\text{energy}} + u_{i,t}. \tag{4.1}$$

The estimated weights are the empirical analogs of the official COICOP basket weights, recovered from the time-series variation alone. Panel B of Table 1 reports these weights together with their t-statistics and the regression R^2. Across all fifteen countries and the euro-area aggregate, R^2 exceeds 0.97, indicating that the three components essentially span headline inflation once a constant is included. The estimated core weight ranges from 0.66 (Belgium) to 0.80 (United Kingdom), the food weight from 0.13 (Switzerland) to 0.24 (Luxembourg), and the energy weight from 0.07 (United Kingdom) to 0.12 (Luxembourg). Although core inflation dominates the basket weights, the much smaller energy weight is amplified by an order-of-magnitude larger standard deviation, so the large transitory spikes visible in the headline series in Figure 1 originate almost exclusively from the energy component.

Panel C of Table 1 reports the correlation structure of the four series within each country. The headline series is positively correlated with all three components in every country, as expected from (4.1). The correlation between core and energy inflation is the relevant object for our analysis, since these are the two components we treat as separate risk factors in subsequent sections.

The cross-country dispersion of this correlation is striking. In some countries core and energy inflation co-move positively. In the positive bucket we have the Netherlands with 0.43, Denmark 0.37, United Kingdom 0.35, while France, Luxembourg, Switzerland, Ireland, and Portugal fall in a positive but modest range of 0.09 to 0.16. In others, the correlation is essentially zero: Finland 0.05, Spain −0.06, Italy −0.08. In a third group the correlation is negative: Norway −0.18, Belgium −0.14, Austria −0.16, Germany −0.38 (the most negative in the panel). The euro-area aggregate sits in the negative group at −0.15. More generally, the cross-country heterogeneity in the core-energy relationship is the European analog of the well-known time-series fact that the inflation-asset-return relationship looks different in different decades for the United States (Campbell et al. (2020); Boons et al. (2020)). In our setting, the heterogeneity is across countries within a single time window rather than across time within a single country, but the implication is the same. Pooling headline inflation across heterogeneous regimes obscures the underlying signal.

Asset returns. Our test assets are quarterly excess returns on eighteen instruments: thirteen government bonds, four commodity futures (crude oil, natural gas, gold, and copper), and the DJ Euro STOXX equity index. Construction details are in Section 3.1.2. The lower block of Panel A.2 of Table 1 reports means and standard deviations of the eighteen test-asset excess returns. Three patterns are worth noting. First, average bond excess returns are increasing in maturity within each of the German and UK term structures, consistent with a positive term premium over the sample. German excess returns rise from 0.01% per quarter at the one-year maturity to 0.90% per quarter at the ten-year maturity. The corresponding UK excess returns are 0.00% and 0.77%. The associated standard deviations also rise with maturity, from 0.36% to 3.50% for Germany and from 0.53% to 3.90% for the UK, with the increase approximately linear in modified duration, as the duration approximation in Section 3.1.2 would predict. Second, the cross-section of ten-year sovereign excess returns reveals a clear core-periphery split. Average quarterly excess returns on ten-year bonds are clustered in the 0.9–1.1% range for Germany (0.90%), Netherlands (0.97%), France (0.98%), and Belgium (1.05%). Spain and Italy stand out at both 1.14%, with markedly higher standard deviations (4.31% and 4.92% versus 3.50% for Germany). The pattern is consistent with the sovereign-credit-risk premium that emerged during the 2010–2012 European sovereign debt crisis and that has remained a feature of the post-crisis term structure of euro-area bond yields (De Santis, 2012). Third, commodity and equity excess returns display the conventional ranking of mean returns and volatilities. Crude oil and copper have the highest mean quarterly excess returns (3.27% and 2.93% respectively); gold is intermediate (2.68% mean, 6.75% standard deviation); natural gas has the lowest mean (0.81%). The largest standard deviation belongs to natural gas (22.9%), followed by crude oil (20.4%) and copper (14.7%), and gold is the least volatile.

The Euro STOXX equity excess return averages only 0.15% per quarter over our sample, equivalent to approximately 0.6% annualised, with a quarterly standard deviation of 10.13%. This low equity premium is a real feature of European equity markets over 2001–2020. The sample spans the dot-com unwind, the 2008 financial crisis, the 2010–2012 sovereign debt crisis, and the subsequent low-growth low-inflation period, none of which were favourable for euro-area equity. The quarterly Sharpe ratio of the Euro STOXX excess return over our sample is approximately 0.015, materially below the long-run Sharpe ratio of broad equity over comparable periods.[1]

This low European equity premium is important context for the asset-pricing tests in Section 4.4, since the cross-sectional dispersion of average returns that the risk-price regressions exploit is materially smaller in our sample than it would be in a asset menu of comparable breadth.

4.2 VAR shock properties

Table 2 reports the equation-level R^2 and shock standard deviations for the headline, core, food, and energy equations in each of the fifteen countries and the euro-area aggregate. We note two clear patterns in Table 2. First, R^2 values are mostly modest across the four inflation equations, typically below 0.50 (61/64 equations), and often near zero. This is the expected consequence of the quarter-on-quarter construction. As most of the variation in $\Delta_{i,t}$ is unforecastable at the quarterly horizon, the VAR residual contains most of the action.[2] The core equation tends to have the highest R^2 in the cross-country panel, ranging from 0.01 (Austria) to 0.72 (Spain), but the energy equation tends to have the lowest, always below 0.15. Second, the standard deviation of the core innovation

[1] We do not include a precise comparison here as comparable figures vary by index, sample window, and frequency convention.

[2] We discuss the limitations of this in Section 4.6.

is uniformly much smaller than the standard deviation of the energy innovation. Core shock standard deviations range from 0.76 (France) to 3.50 (Portugal) while energy shock standard deviations range from 10.66 (Denmark) to 27.68 (Norway). The ratio of energy to core shock standard deviation is between roughly four and twenty across countries, preserving in the innovations the order-of-magnitude difference present in the raw series.

The compressed core shock dispersion has a clear macroeconomic interpretation. As anticipated in Section 2.5, the ECB's single price-stability mandate (European Central Bank, 2021a) anchors inflation expectations close to 2% across all member states. When a credible policy regime keeps the conditional mean of core inflation pinned to its target, the realised deviations are compressed. The euro-area aggregate core shock standard deviation of 1.22% is smaller than the comparable U.S. core dispersion documented in Fang et al. (2025), where the Federal Reserve's dual mandate tolerates a wider range of core outcomes and the 228-quarter U.S. sample spans the 1970s and 1980s high-inflation episodes that have no analog in our window. The empirical insignificance of $\hat{\lambda}^{\text{core}}$ reported in Section 4.4 should therefore be read as a feature of the institutional environment rather than a failure of identification.

The cross-country dispersion of core shock standard deviations broadly tracks macroeconomic stability over the sample period. The smallest core shocks belong to France (0.76), Belgium (0.80), Luxembourg (1.05), and Finland (1.10), core euro-area economies whose mean core inflation rates in Table 1 sit close to the ECB's 2% target. The largest belong to Portugal (3.50), Spain (2.24), and Ireland (2.18), three of the economies most directly affected by post-crisis austerity and real-wage adjustment (Schmitt-Grohé and Uribe, 2016). These three economies' mean core inflation rates in Table 1 substantially exceeded the ECB's 2% target across the sample. Germany (2.40) and the Netherlands (2.44) sit alongside the periphery, likely reflecting episodic national shocks within the sample.

Figure 2 plots the time series of the four inflation shocks for each country. The visual contrast between the core shock series (modest amplitude, broadly unstructured) and the spike-dominated energy shock series mirrors the contrast between the underlying inflation series in Figure 1.

4.3 Inflation hedging: Headline, core, and energy

Tables 3–10 report estimates of equations (3.4) and (3.5) for each of the eight specifications. Figure 3 plots the corresponding β^{core} and β^{energy} estimates with confidence intervals by specification. We mainly present the German specification as the primary benchmark. German Bunds serve as the structural risk-free reference for all euro-area sovereign pricing (De Santis, 2012). We found Germany's results are broadly representative of the patterns observed across all eight specifications. Where individual specifications diverge meaningfully, we note this explicitly.

Bonds have negative energy inflation betas across nearly every country. For the German specification in Table 3, the energy beta of the German ten-year bond is -0.10 ($t = -2.86$), and the energy betas of the UK, Italian, French, Spanish, Dutch, and Belgian ten-year bonds are all negative with t-statistics in absolute value at least 1.6, and exceeding 2.0 for 5/7 cases. The same negative-energy pattern holds in the other country and EA-aggregate specifications. This is consistent with the conventional view that fixed-income securities lose nominal value when inflation surprises occur, since their cash flows are nominally fixed.

Bonds' core inflation betas are predominantly negative on average but estimated imprecisely across most country specifications. In the German specification (Table 3), the core beta of the ten-year German bond is -0.14 ($t = -0.85$). The corresponding UK, French, Italian, Spanish, Dutch, and Belgian ten-year bond core betas are -0.03, -0.07, -0.26, -0.03, -0.14, and -0.09, with t-statistics in absolute value all below 1.1. Seven of the eight specifications follow the same predominantly negative pattern. The Netherlands specification (Table 8) is the exception as its core betas are predominantly positive across the bond cross-section, though equally imprecise. In no specification does any core beta achieve conventional statistical significance; the core inflation exposure of long-maturity bonds cannot be precisely identified in our sample. The signs are nearly all consistent with the energy results, as core inflation erodes the nominal value of fixed-income cash flows just as energy inflation does. The core betas are, however, estimated far less precisely. One mechanical reason is that the core inflation shock is smaller in standard deviation than the energy shock by a factor of roughly four to twenty (Table 2), so identifying the core beta requires the asset return to load strongly on a low-variance regressor; a second reason is the limited sample size (eighty quarters).

Commodity futures load more reliably on energy shocks than on core shocks across all specifications. Crude oil, natural gas, and copper carry positive and well identified energy betas in every specification; gold does not. Gold's energy betas are consistently near zero and statistically indistinguishable from zero throughout. In the German specification, the energy betas of crude oil and natural gas are 0.99 ($t = 5.78$) and 0.61 ($t = 2.86$); both are statistically reliable, and the oil beta in particular is one of the most precisely estimated coefficients in our entire regression panel. Core betas are sign-inconsistent and, with limited exceptions, statistically indistinguishable from zero. Crude oil is partially an exception as its core beta reaches significance in the French (t = 2.11), Italian (t = 2.28), and euro-area (t = 2.41) specifications, but this pattern does not extend to natural gas, gold, or copper. This is the closest analog in our results to the standard claim that commodities hedge inflation. Our findings suggest that commodities do hedge inflation, but specifically the energy component of inflation, and not the core component.

Equity exposures are weakly positive in core and energy, but not robustly identified. The Euro STOXX core beta is positive in seven of the eight specifications. The Netherlands is the only negative point estimate at -0.46. The t-statistics on β^{core} never exceed 1.5. The Euro STOXX energy beta is positive in all eight specifications, with t-statistics between 0.12 (United Kingdom) and 2.74 (Spain). The euro-area-aggregate energy beta is 0.24 with $t = 2.65$. However, compared with the bond and commodity results, the R^2 values for the Euro STOXX regression are low (ranging from 0.020 to 0.104 across specifications). The combination of a weak European equity premium over our sample (Section 4.1) and a single pan-European equity index, rather than a cross-section of industry or country portfolios, implies that the test has limited power to detect inflation-related variation in equity excess returns, and we interpret the equity results conservatively.

When we compare to the U.S. benchmark of Fang et al. (2025), the European results align with the U.S. evidence on the two asset classes where our cross-section has identifying power (bonds and commodities). Our results also reproduce Fang et al.'s headline conclusion on what investors cannot hedge. Fang et al. find that no long position in their eight U.S. asset classes hedges core inflation. Our European cross-section reaches the same broad conclusion, as with the exception of crude oil in the France, Italy, and Euro Area specifications, no asset carries a positive and statistically reliable core beta. The fixed-income mechanism explained by Fang et al., whereby that nominal cash flows are eroded by any inflation surprise regardless of its origin. The uniformly negative energy betas and predominantly negative core betas on European sovereigns are consistent with this mechanism, though the core estimates are considerably less precise.

On the commodities side, the near-mechanical commodity-energy relationship that Fang et al. document also emerges in our oil and natural-gas energy betas. When the test asset is the primary upstream driver of the energy price index being measured, the regression tends to deliver a strong positive loading. The oil beta of 0.99 ($t = 5.78$) and gas beta of 0.61 ($t = 2.86$) in the German specification are consistent with that argument. The macroeconomic implication for European investors is therefore the same as for their U.S. counterparts. Energy-inflation hedging is feasible through commodity-futures exposure, but the more persistent and economically meaningful core component (the component that signals deteriorating long-run growth prospects (Kung (2015); Fang et al. (2025))) is largely unhedgeable within the conventional asset menu available to European investors over our sample.

The hedging properties are reasonably stable across the choice of country whose inflation used as the shock source. The signs and rough magnitudes of bond energy betas, commodity energy betas, and the (small) equity inflation betas are similar across the German, French, Italian, Spanish, Dutch, Belgian, and euro-area aggregate specifications. The UK specification produces broadly similar but somewhat noisier estimates, although inflation shocks coming from a non-euro-area economy and the underlying inflation process being partly governed by a separate monetary policy regime. The t-statistics on the long-maturity continental bond energy betas are below those obtained from euro-area inflation sources. UK inflation shocks appear to be an imperfect proxy for the inflation shocks priced into euro-area sovereign bonds, but the differences are quantitative rather than qualitative.

Overall, the hedging-regression results in this section confirm two of three facts that the analogous literature has reported. First, nominal fixed-income securities have robustly negative energy betas and predominantly negative, though imprecisely estimated, core betas. Second, commodity futures, particularly crude oil, copper, and natural gas, have positive and well-identified energy-inflation betas; gold's energy beta is consistently small and insignificant. The third fact that the aggregate U.S. equity (Fang et al. (2025)) has a clearly negative core inflation beta, does not match our findings of the single European equity index over the 2001–2020 window. In our results, the Euro STOXX core beta is more often positive than negative across specifications, but in either direction it is too noisy to support a strong claim.

4.4 The inflation risk premium

Table 11 reports the Fama–MacBeth estimates of λ_i^{core}, $\lambda_i^{\text{energy}}$, and the second-stage intercept, together with their Shanken-corrected t-statistics and the cross-sectional R^2, for each of the eight specifications (seven country specifications plus the euro-area aggregate). Table 12 reports the same estimates of λ^{core} and λ^{energy} in annualised percent for easier economic interpretation. Figure 4 plots the time-varying Fama–MacBeth prices of risk and their sample averages for each specification. Figure 5 plots realised versus model-predicted average excess returns under each specification.

The estimated price of core inflation risk is statistically indistinguishable from zero in every specification, with the magnitude of the t-statistics ranging from 0.05 (Belgium and

Spain) to 0.87 (United Kingdom). However, six of the eight point estimates of λ^{core} are negative, including (in quarterly units) Germany (−0.99), the United Kingdom (−0.71), Italy (−0.42), and the euro-area aggregate (−0.71). France (+0.16) and the Netherlands (+0.29) are the only positive estimates. In annualised terms (Table 12), the Germany and euro-area estimates correspond to a negative price of core inflation risk of roughly −4% and −3% per annum, magnitudes that are economically meaningful (though imprecisely estimated) and are broadly in line with the negative price of core inflation risk that has been documented for the U.S. (Fang et al., 2025).

The estimated price of energy inflation risk is also statistically insignificant in every specification, with t-statistics between 0.43 (France) and 1.21 (Euro Area). The point estimates of λ^{energy} are positive in all eight specifications, ranging from 2.06 (France) to 4.65 (Euro Area) in quarterly units. The second-stage intercept is positive and statistically significant in every specification (point estimates between 0.84 and 1.05, with t-statistics between 2.79 and 4.11), indicating that the two inflation factors alone do not explain the level of average asset excess returns. The cross-sectional R^2 ranges from 0.45 (Netherlands) to 0.57 (Belgium), with six of the eight specifications above 0.48.

Two things follow from these estimates. First, we discuss whether the inflation-hedging properties documented in Section 4.3 carry a corresponding price of risk. The signs of the point estimates are consistent with the priors from Fang et al. (2025): a negative price of core inflation risk for the majority of country specifications and a uniformly positive price of energy inflation risk. Neither, however, is statistically distinguishable from zero in our sample. Second, the size of the second-stage intercept indicates that the average excess return on our cross-section reflects a large component common to all assets, captured by the intercept, alongside different exposures to inflation factors. Although the cross-sectional R^2 of 0.45–0.57 confirms that the inflation factors explain a meaningful share of the dispersion in average returns across assets, our cross-section is concentrated in sovereign bonds, which cluster at the lower end of the returns distribution, and the priced sources of risk that pin down the absolute level of average excess returns lie outside the two-factor inflation model.

We are cautious about over-interpreting these results. Eighty quarters is a short sample, and our cross-section of eighteen test assets is smaller than the 38-portfolio cross-section ussed in Fang et al. (2025). The estimated t-statistics on λ^{core} are consistent with a wide range of true values: we cannot reject $\lambda^{\text{core}} = 0$ in any of the eight specifications, but we also cannot reject negative values comparable in magnitude to those reported in the study. The most defensible reading of Tables 11 and 12 is therefore that the European sample does not contain the statistical power necessary to establish a price of core inflation risk separately from the common level of average excess returns. However, we find that the direction of the point estimates is suggestively consistent with the evidence (Fang et al., 2025). We find this particularly for the larger economies of Germany, the United Kingdom, and the euro-area aggregate, where the negative point estimates of λ^{core} are largest in absolute magnitude.

The asymmetric implications of these point estimates are worth making explicit. The negative λ^{core} in the German and euro-area specifications corresponds to an annualised compensation of approximately 4% and 3% for an asset carrying one unit of negative exposure to core inflation risk. Equivalently, investors who seek protection against an unexpected core inflation surprise (positive β^{core}) must forgo a comparable share of expected return per year. The positive λ^{energy} implies the opposite for the energy component: an asset with positive exposure to energy inflation surprises earns a positive expected return on average, so energy-inflation hedging appears not merely costless but potentially rewarded, though the estimates remain statistically imprecise. This is precisely the core-energy asymmetry that Fang et al. (2025) document for the U.S. Hedging against core inflation is costly while hedging against energy inflation is free or rewarded. Our point estimates reproduce it in European markets, with the caveat that neither side is statistically distinguishable from zero in our sample.

The statistical insignificance itself has an institutional reading. As discussed in Section 4.2, the ECB's single price-stability mandate (European Central Bank, 2021a) anchored realised European core inflation around its 2% target throughout 2001–2020. This will have compressed the variation in inflation shocks that the Fama–MacBeth procedure requires to separate λ^{core} from the common level of average excess returns. The point estimates above should therefore be read as a suggestive replication of the evidence in a regime where the identifying variation has been institutionally suppressed, rather than as an independent statistical confirmation.[3]

Figure 4 plots the time-varying prices of risk implied by quarter-by-quarter cross-sectional regressions, together with the time-series average λ for each country. The visual confirms the message of the tables: while the time-series average estimates lie in the regions discussed above, the realised λ_t series fluctuate widely around their means, particularly during the 2008–2009 and 2014–2016 episodes when energy shocks were largest.

[3] See Section 4.6 for further commentary

4.5 Factor-mimicking Portfolios

Section 3.5 introduced factor-mimicking portfolios as a tradeable alternative for evaluating the price of inflation risk. By construction, the mean return on each unit-exposure FMP is itself an estimate of the price of risk for the corresponding factor. Table 13 reports these mean returns, their t-statistics, and the tracking R^2 for the eight country specifications. Panel A reports the core and energy FMPs for the two-factor model; Panel B reports the headline FMP for the one-factor model.

The central result is that no FMP mean return is statistically distinguishable from zero in any specification. The largest absolute t-statistics are 1.57 for the French core FMP and -1.51 for the Belgian core FMP, both well below conventional significance thresholds. The headline FMP mean returns in Panel B are uniformly small, ranging from -0.11% to 0.34% annualised, and statistically insignificant (all $|t| < 1$). Together, Panels A and B confirm that FMP mean returns are statistically insignificant across all three inflation factors, consistent with the Fama-MacBeth $\hat{\lambda}$ estimates of Section 4.4.

The point estimates show meaningful cross-country dispersion in the core FMP and are remarkably uniform in the energy FMP. Six of the eight country specifications yield positive core FMP means. France (1.98% p.a.) and the Euro Area aggregate (0.37% p.a.) have the largest positive values; and the Netherlands (-0.14%) and Belgium (-2.19%) yield the only negative estimates. The energy FMP means are economically small in every specification, ranging from -0.01% (Italy and Netherlands) to 0.08% p.a. (United Kingdom). This near-zero pattern sits in some tension with the positive Fama-MacBeth energy price-of-risk estimates of Section 4.4. A possible explanation is that the Fama-MacBeth slope is driven disproportionately by crude oil and copper, which combine large positive energy betas with high average returns, rather than reflecting a broad systematic energy inflation risk premium that an FMP can isolate.

The tracking R^2 values reveal that the energy FMPs project onto their target shock more cleanly than the core FMPs. Energy R^2 values range from 0.331 (Italy) to 0.551 (Netherlands), while core R^2 values range from 0.150 (Belgium) to 0.333 (Netherlands). The hedging-regression results of Section 4.3 point in the same direction. The commodity futures, especially crude oil and natural gas, load strongly and significantly on energy inflation, providing a tractable spanning basis for the energy FMP. No asset class loads strongly on core inflation consistently across all specifications, so the core FMP weights are pulled across a noisier set of contributors, with a correspondingly weaker projection.

The FMP results (constructed via equations 3.8 and 3.9) corroborate the Fama–MacBeth estimates from an alternative angle, although the agreement between the two approaches is asymmetric across factors. The FM and FMP estimates agree in sign in six of eight specifications for the energy factor, but in only two specifications (France and Belgium) for the core factor. Both methods deliver statistically insignificant point estimates throughout, so this asymmetry plays out within the noise rather than at the rejection threshold, but it is informative about which factor European traded assets can recover.

The sign inconsistency on core is itself an informative European finding rather than a methodological inconvenience. In Fang et al. (2025), where the asset menu spans the core inflation factor cleanly, the core FMP returns recover the direction of the FM-implied λ^{core} across specifications. Our European FMPs do not. The projected portfolio returns disagree on the direction of λ^{core} with the FM estimates in six of eight specifications. This suggests that the asset menu available to European investors over 2001–2020 does not adequately span the core inflation factor. The FMP weights, projected onto a noisy core shock with little cross-asset dispersion in core exposure, end up reflecting idiosyncratic features of each country's covariance matrix rather than a systematic risk-return tradeoff. This outcome is only sharpened by the compressed core variation (Section 4.2) under the ECB's price-stability mandate. The contrast with the energy factor reinforces the point. The 6/8 sign agreement on energy (the two apparent exceptions, Italy and Netherlands, are effectively zero as well) reflects the European commodity-futures complex providing a tractable spanning basis for energy inflation (Section 4.3). Energy-inflation risk is recovered in the same direction by both methods because traded assets exist whose returns move with energy inflation almost mechanically. Core inflation has no consistent, reliable, tradeable proxy in our sample. The practical implication for European investors is the asymmetry already noted in Section 4.4. Energy-inflation risk is identifiable and tradeable; core-inflation risk is neither.

4.6 Robustness

We conduct three robustness checks to explore the validity of our results.

Food as a third pricing factor. First we rerun Section 3.4 under the alternate specification of including food inflation as a priced factor. The concern is that while Fang et al. (2025) do not include food inflation for the pricing as it sits between core-energy in its statistical properties, this may not hold in Europe. If food is priced, we might have biased the core and energy lambda estimates. The results confirm that food inflation is not a priced risk in our sample. The food-risk premium is insignificant for all countries and the signs of the estimates were inconsistent across countries. The core and energy risk premiums were largely unchanged in both sign and magnitude compared to the Section 3.4 specification.

No-constant Fama–MacBeth. We also verify that our decision to include a constant in the cross-sectional regression does not drive the λ estimates. We re-estimate the Fama–MacBeth procedure from Section 3.4 under the theoretically-motivated restriction $E[r_i^e] = \beta_i'\lambda$, which omits the constant. We examine if our results are significantly changed. The core risk premium remains negative in six of eight country specifications and statistically insignificant in all eight, and the energy premium remains uniformly positive. No specification crosses $|t| = 2$ for either factor. Our baseline results are therefore robust.

Alternate Factor-Mimicking Portfolio Construction. As justified in Section 3.5, we choose to deviate from the Fang et al. (2025) factor-mimicking portfolio construction due to our asset universe size. We nonetheless re-estimate the portfolio using the Fang et al. (2025) formulation to compare. Under both methods, the mean returns of the core and energy mimicking portfolios are statistically insignificant across all specifications. This is consistent with the λ estimates from Section 3.4. The tracking R^2 under the Fang et al. (2025) construction is approximately 5–10 times lower for core and approximately 2 times lower for energy, which confirms our deviation is justified and our results are robust.

Shanken correction factors. The Shanken correction factors presented in Tables 11–12 from Section 3.4 are modest across all specifications, ranging from 1.03 to 1.48 for the core and energy model and from 1.03 to 1.11 for the headline model. This confirms that the generated-regressor bias does not materially distort our standard errors.

VAR(4) specification. Finally, we examine whether the results are sensitive to the inclusion of the risk-free rate as a conditioning variable in Section 3.2. Our baseline conditions on r^f to orthogonalise inflation shocks to the monetary policy stance, following Fang et al. (2025). We re-estimate equation (3.3) without this conditioning and rerun Section 3.4. The core risk premium remains statistically insignificant across all eight specifications and the energy premium remains uniformly positive, with no specification crossing $|t| = 2$ for either factor. The proportion of specifications with a negative core lambda falls from six of eight to four of eight. Specification equation (3.3) improves shock identification by removing the monetary policy response from the inflation innovations. Our VAR(5) specification is therefore preferred.

Limitations. Our short sample window 2001 Q1–2020 Q4 reflects a structural feature of the European setting rather than a data gap we can resolve. The standardisation of European inflation statistics and the Euro introduction both occurred around 2000. This imposes a hard floor on the backwards extension. There is no pre-harmonisation equivalent for the Fang et al. (2025) 228-quarter U.S. sample in European data.[4] Thus, our 80-quarter window leaves the lambda estimation in Section 3.4 with wider confidence intervals than those in Fang et al. (2025). The statistical insignificance of $\hat{\lambda}^{\text{core}}$ throughout our results is an expected consequence of this constraint. A compounding factor is the near-absence of variation in European core inflation over our sample, likely due to the ECB's price-stability mandate (European Central Bank, 2021a). The identification of a core inflation risk premium requires dispersion in realised inflation shocks. So when those shocks are uniformly small, even a correctly-specified model will return imprecise estimates. The insignificance of our core results should be read not as evidence that the premium is absent, but as a consequence of limited identifying variation.

The European asset universe is also structurally narrower than the equivalent, giving our paper two fewer asset classes than Fang et al. (2025). Liquid pan-European REITs did not exist as a standardised asset class over our sample. Additionally, the absence of bilateral exchange rates within the euro area precludes currency portfolio strategies other than UK. At 18 test assets against Fang et al. (2025)'s 38, our cross-section offers less dispersion in inflation betas for the FM procedure in Section 3.4 to exploit. A further complication arises from applying a common Euribor rate across all euro-area countries. In practice, sovereign spreads embed country-specific credit risk that our inflation betas cannot cleanly separate from inflation exposure.

Further Study. Extending the sample to 2025 by using a euro-area-only panel (by excluding the U.K.) would capture the 2021–2023 European inflation surge, a period of substantially higher core inflation variability. This may provide the identifying variation our sample lacks. More broadly, the richer second half of Fang et al. (2025), encompassing time-varying inflation risk, the monetary policy channel, and a two-sector New Keynesian structural model, lies beyond the scope of this study and remains open for future work.

5 Conclusion

This paper set out to answer a straightforward question. Inflation and asset returns are clearly connected, but the connection has never looked consistent. Sometimes inflation appears to hurt equities and bonds, and sometimes it does not. Fang et al. (2025) offer an explanation. They argue that the instability comes from how inflation is measured. Headline inflation is really two different components bundled together, a slow-moving core component driven by sticky prices, and a volatile energy component driven by swings in

[4] That we have found in our extensive data search.

commodity prices. The two carry very different risks. Once they are separated, much of the old puzzle disappears. Their evidence comes from the United States. This paper addressed whether the same logic holds in Europe, a setting with a different monetary policy architecture, different methods for measuring inflation, and a much heavier dependence on imported energy.

The answer comes in two parts, because the two components behaved very differently in our data. The energy side is clear and works almost exactly as the prior evidence predicts. When energy inflation surprises European markets, government bonds lose value and energy commodity futures gain. We find this pattern across every country in our sample. Crude oil and natural gas load especially heavily on energy inflation, which is natural given that these contracts are themselves primary upstream drivers of the energy price index. Copper also loads significantly across all specifications. Gold is the exception, with an energy beta that is small and statistically weak throughout, a reminder that not all commodities hedge inflation alike. The practical message is encouraging for the European investor who wants to protect a portfolio against energy inflation. Our evidence suggests one can do so, because liquid assets exist that move with it.

Core inflation is more complex, and this is where our central finding lies. We estimate that core inflation carries a negative price of risk in Europe. This would mean investors are willing to give up returns to avoid it. The point estimates are economically large, around −4% per year for Germany and −3% for the euro area as a whole, figures that are remarkably close to those Fang et al. (2025) report for the United States. The economic story is thus that a core inflation surprise is bad news because sticky prices make it persistent, and persistent inflation tends to signal weaker growth ahead. Yet none of these estimates is statistically significant. The signs and magnitudes mostly point in one direction, but the statistical evidence is not strong enough to close the question. The same is true for equities, where the clearly negative core exposure documented for stocks does not replicate in our single European equity index; in fact the core betas are predominantly positive, though statistically insignificant. No asset in our sample offers reliable protection against core inflation.

It would be easy to read this as a disappointing result. We believe the opposite. The difficulty of measuring the core inflation premium is itself the finding. This has a clear economic explanation. Core inflation surprises are hard to study in Europe due to the low and stable core inflation across our sample, imposed by the ECB's policy. The core inflation in the HICP data is far more stable than in the longer U.S. sample of Fang et al. (2025), which reaches back into the high-inflation decades of the 1970s and 1980s. A risk premium can only be measured when the risk actually appears, and if core inflation almost never surprises anyone, even a well-designed study cannot pin down how much investors fear it. The premium is very probably there, since our point estimates suggest it and they agree with those of Fang et al. (2025), but variation needed to prove it was not present. We interpret the statistical weakness of our core results, not as a flaw in the study but as evidence of a successful monetary policy.

This study has its acknowledged limitations (Section 4.6). The sample is short, at eighty quarters, and cannot be extended backwards. The HICP was harmonised across European statistics offices from 1997, but the core sub-index for the Euro Area aggregate and Spain is unavailable before December 2000, imposing a hard floor on the sample start. The set of test assets is narrower than in the work we compare against, with no liquid pan-European property market and no tradeable exchange rates inside the euro area. As every euro area country shares a single short-term interest rate, some country-specific credit risk is mixed into our bond results in a way we cannot fully separate from inflation exposure. Within these limits, however, our results are robust to the choices we tested: adding food as a third inflation factor, removing the constant from the pricing regression, and changing how the inflation shocks are constructed all leave the picture unchanged. Further data from post-2020 may contain inflation surges that are more revealing for the core-energy inflation decomposition in Europe. During the inflation surge of 2021 to 2023, core inflation moved sharply and stayed well above target for an extended period. That episode contains exactly the kind of variation our sample lacked, and a study that extends the data through 2025, focused on the euro area and on this high-inflation period, could more precisely identify the core inflation premium.

To our knowledge, this study is the first to bring the core-energy decomposition to European markets. The results point in the same direction as Fang et al. (2025), with energy inflation emerging as the dominant, tradeable component and core inflation resisting clean identification. What the European context lacked was not a different methodology, but sufficient variation in the data. The stability of core inflation across our sample period, itself a consequence of ECB credibility, had the side effect of obscuring the premium we set out to measure. The post-2020 inflation episode has changed that, and future work extending the sample through 2025 will be better placed to answer the question our results could only indicate.

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Table 1: Descriptive statistics of inflation and asset excess returns

Panel A.1: Inflation summary statistics by country and component

	Headline			Core			Food			Energy		
Country	Mean	SD	ρ_1	Mean	SD	ρ_1	Mean	SD	ρ_1	Mean	SD	ρ_1
DE	1.38	2.09	-0.01	1.10	2.57	-0.19	2.14	4.08	-0.05	2.38	12.58	-0.05
UK	2.00	2.02	0.06	1.65	1.50	-0.27	2.58	3.91	0.21	3.68	13.42	0.08
FR	1.48	1.85	0.08	1.16	0.97	-0.05	2.16	3.65	0.05	2.59	13.69	0.03
IT	1.61	2.18	-0.11	1.50	2.46	-0.53	2.04	2.86	0.10	1.77	11.51	0.22
ES	1.84	3.59	-0.35	1.56	4.22	-0.77	2.49	2.66	0.23	2.51	17.80	-0.05
NL	1.80	4.04	-0.48	1.60	3.96	-0.66	2.11	4.28	0.09	2.99	14.22	-0.20
BE	1.81	2.24	0.12	1.56	0.84	-0.06	2.44	4.22	-0.03	2.42	17.17	0.21
AT	1.85	1.76	0.06	1.81	1.53	-0.07	2.31	3.80	-0.00	1.63	14.38	0.02
CH	0.21	2.15	-0.10	0.13	1.87	-0.52	0.28	3.88	0.09	1.23	17.81	0.12
DK	1.38	2.44	-0.14	1.23	1.83	-0.31	1.83	4.17	0.07	1.70	11.12	-0.10
FI	1.50	2.26	0.04	1.28	1.24	0.06	1.92	5.23	0.14	2.89	17.28	-0.06
IE	1.26	2.85	0.28	1.17	2.56	0.38	0.98	3.58	0.44	2.88	15.30	-0.06
LU	1.98	3.24	-0.02	1.75	1.19	-0.17	3.07	2.61	-0.00	1.92	22.47	-0.04
NO	1.91	2.68	-0.09	1.68	1.70	0.08	1.89	6.79	-0.29	4.20	27.68	-0.05
PT	1.63	3.52	-0.06	1.39	3.98	-0.28	1.65	3.76	0.20	3.02	13.12	0.04
EA	1.57	1.77	0.11	1.31	1.49	-0.39	2.18	2.79	0.15	2.40	12.78	0.04

Quarter-on-quarter HICP inflation rates, annualised: $\Delta_{i,t} = 400 \cdot [\ln \text{CPI}_{i,t} - \ln \text{CPI}_{i,t-1}]$, where $\text{CPI}_{i,t}$ is the HICP at the last month of quarter t. Sample: 2001 Q1–2020 Q4 (80 quarters; Switzerland: 2005 Q1–2020 Q4). ρ_1 is the first-order autocorrelation. EA denotes the euro-area aggregate HICP. All series in annualised percent.

Table 1: (continued)

Panel A.2: Test-asset excess returns

Asset	Mean	SD	Min	Max	N
Government bonds					
DE 1Y	0.010	0.363	-1.15	1.27	80
DE 3Y	0.191	1.226	-3.56	4.80	80
DE 5Y	0.404	1.953	-5.46	6.87	80
DE 10Y	0.904	3.497	-7.43	11.75	80
UK 1Y	0.004	0.533	-1.54	3.12	80
UK 3Y	0.205	1.424	-4.38	6.58	80
UK 5Y	0.405	2.200	-6.92	8.75	80
UK 10Y	0.773	3.895	-8.21	14.25	80
FR 10Y	0.977	3.413	-7.28	8.37	80
IT 10Y	1.142	4.918	-9.61	19.00	80
ES 10Y	1.136	4.305	-13.10	9.23	80
NL 10Y	0.968	3.347	-7.79	9.90	80
BE 10Y	1.050	3.451	-8.16	8.95	80
Commodity futures					
Crude Oil	3.268	20.393	-65.55	80.96	80
Natural Gas	0.811	22.913	-48.59	99.41	80
Gold	2.677	6.748	-23.27	16.41	80
Copper	2.934	14.741	-51.02	40.58	80
Equity					
Euro STOXX	0.151	10.126	-28.64	22.41	80

Quarterly excess returns in percent. Government bond returns are derived from yieldsing the duration approximation $r_t \approx y_{t-1}/4 - D\,\Delta y_t$; bonds are denominated in EUR (DE, FR, IT, ES, NL, BE) or GBP (UK), with the corresponding 3-month interbank rate as the risk-free benchmark. Commodity returns are simple percentage changes in front-month futures prices, treated as already in excess form. The Euro STOXX excess return is the broad index return in excess of Euribor 3M.

Table 1: (continued)

Panel B: Headline inflation decomposition

Country	w^{core}	w^{food}	w^{energy}	R^2
DE	0.719 (44.5)	0.151 (15.4)	0.117 (34.1)	0.974
UK	0.804 (39.0)	0.172 (22.5)	0.069 (29.4)	0.984
FR	0.697 (76.9)	0.203 (85.0)	0.090 (153.8)	0.999
IT	0.708 (52.1)	0.194 (16.6)	0.087 (31.0)	0.984
ES	0.670 (119.4)	0.226 (25.3)	0.108 (86.1)	0.997
NL	0.730 (150.3)	0.170 (41.1)	0.099 (77.3)	0.999
BE	0.655 (24.4)	0.212 (39.6)	0.107 (86.7)	0.994
AT	0.763 (83.7)	0.158 (43.6)	0.086 (90.2)	0.996
CH	0.748 (50.1)	0.129 (17.8)	0.074 (46.7)	0.990
DK	0.699 (48.7)	0.197 (32.4)	0.106 (45.0)	0.993
FI	0.696 (46.0)	0.217 (60.3)	0.081 (78.1)	0.995
IE	0.687 (41.5)	0.221 (18.8)	0.094 (41.3)	0.989
LU	0.660 (26.7)	0.240 (20.8)	0.122 (92.0)	0.994
NO	0.766 (27.2)	0.189 (27.0)	0.086 (49.5)	0.977
PT	0.689 (94.0)	0.232 (29.3)	0.098 (44.3)	0.995
EA	0.718 (79.7)	0.192 (39.7)	0.099 (95.5)	0.996

OLS estimates of $\Delta^{\text{head}}_{i,t} = c_i + w^{\text{core}}_i \Delta^{\text{core}}_{i,t} + w^{\text{food}}_i \Delta^{\text{food}}_{i,t} + w^{\text{energy}}_i \Delta^{\text{energy}}_{i,t} + u_{i,t}$, one regression per country. t-statistics in parentheses. R^2 is the coefficient of determination of the regression with constant.

Table 1: (continued)

Panel C: Inflation component correlations

	Headline with			Core with		Food with
Country	core	food	energy	food	energy	energy
DE	0.600	0.432	0.453	-0.066	-0.375	0.280
UK	0.790	0.506	0.747	0.104	0.345	0.242
FR	0.625	0.639	0.769	0.417	0.138	0.126
IT	0.826	0.503	0.420	0.254	-0.083	0.097
ES	0.814	0.499	0.506	0.346	-0.062	0.109
NL	0.931	0.521	0.689	0.378	0.426	0.202
BE	0.282	0.596	0.836	0.373	-0.140	0.126
AT	0.626	0.483	0.593	0.214	-0.159	-0.001
CH	0.729	0.321	0.719	0.015	0.119	0.128
DK	0.793	0.613	0.768	0.274	0.367	0.276
FI	0.579	0.694	0.686	0.333	0.045	0.101
IE	0.831	0.653	0.584	0.572	0.109	0.044
LU	0.420	0.476	0.942	0.206	0.162	0.273
NO	0.325	0.351	0.732	0.008	-0.183	-0.147
PT	0.878	0.527	0.490	0.255	0.092	0.216
EA	0.565	0.581	0.676	0.242	-0.154	0.188

Pairwise Pearson correlations of headline, core, food, and energy inflation within each country.

Table 2: VAR-based inflation shocks: equation-level R^2 and shock standard deviations

	Headline		Core		Food		Energy	
Country	R^2	σ_ε	R^2	σ_ε	R^2	σ_ε	R^2	σ_ε
DE	0.029	2.071	0.114	2.398	0.055	3.905	0.091	12.050
UK	0.201	1.790	0.221	1.294	0.141	3.609	0.141	12.329
FR	0.111	1.753	0.385	0.763	0.133	3.324	0.023	13.444
IT	0.495	1.558	0.514	1.725	0.314	2.361	0.082	11.078
ES	0.413	2.762	0.722	2.242	0.174	2.417	0.034	17.497
NL	0.467	2.793	0.595	2.442	0.072	3.868	0.108	13.111
BE	0.062	2.181	0.105	0.804	0.057	4.099	0.117	16.180
AT	0.028	1.747	0.011	1.531	0.107	3.522	0.028	14.071
CH	0.139	2.007	0.358	1.509	0.047	3.776	0.020	17.771
DK	0.234	2.139	0.350	1.477	0.023	4.069	0.092	10.660
FI	0.175	2.046	0.167	1.098	0.148	4.822	0.060	16.838
IE	0.276	2.442	0.271	2.181	0.295	2.962	0.040	14.820
LU	0.056	3.146	0.207	1.052	0.370	2.088	0.044	21.824
NO	0.024	2.600	0.076	1.576	0.128	6.369	0.007	27.682
PT	0.183	3.191	0.237	3.499	0.073	3.463	0.004	13.158
EA	0.200	1.597	0.335	1.216	0.197	2.428	0.084	12.295

Country-by-country VAR(1) on the vector $Y_{i,t} = (\Delta^{\text{head}}, \Delta^{\text{core}}, \Delta^{\text{food}}, \Delta^{\text{energy}}, r^f)'_{i,t}$, where the inflation series are quarter-on-quarter annualised rates and r^f is the country's three-month interbank rate. For each inflation equation, R^2 is the in-sample coefficient of determination and σ_ε is the residual standard deviation in annualised percent. The risk-free-rate equation is included in the VAR but not reported here. EA denotes the euro-area aggregate. Sample: 2001 Q1–2020 Q4 (80 quarters; Switzerland: 2005 Q1–2020 Q4).

Figure 1: Inflation series

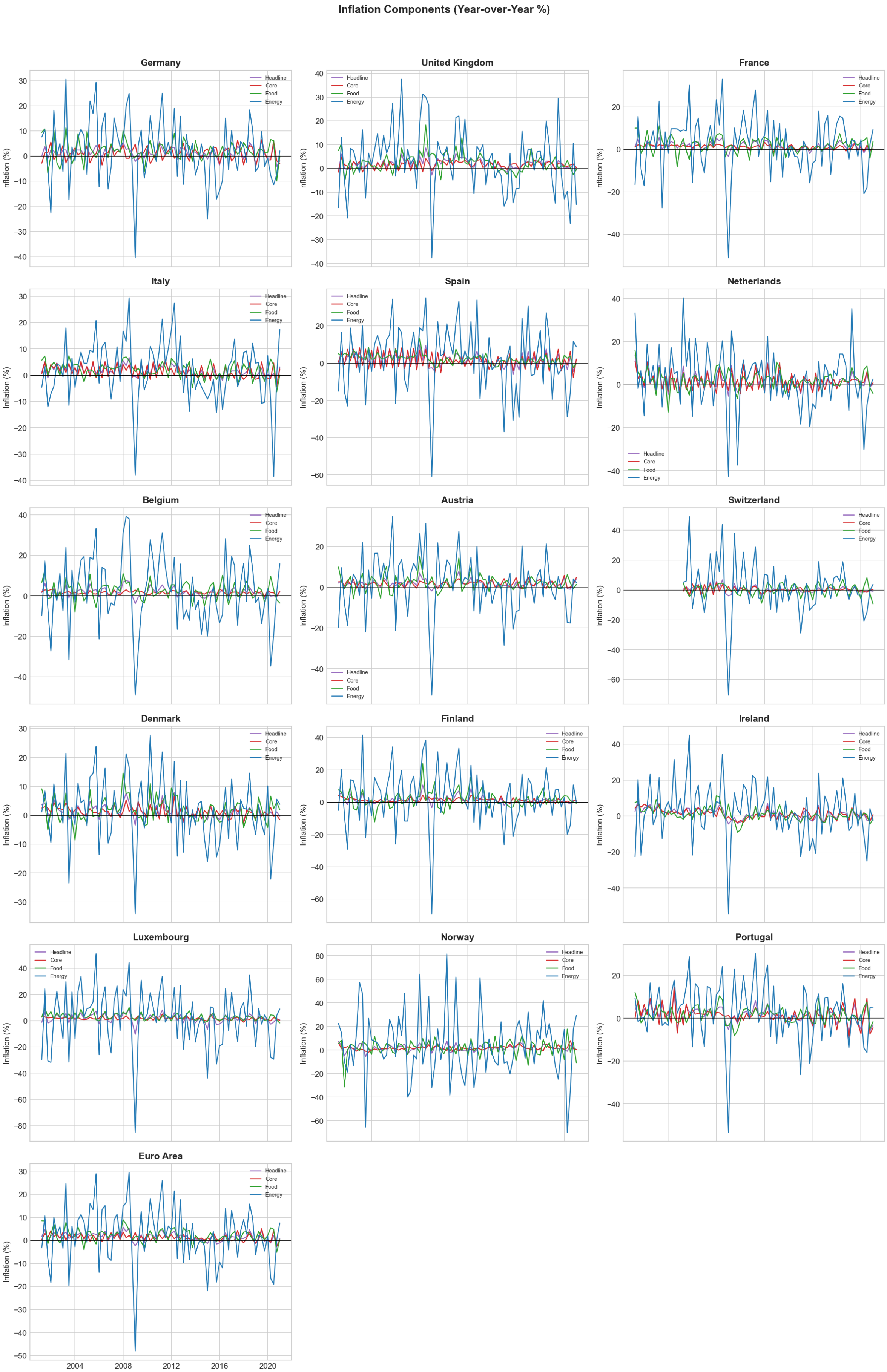


Figure 2: VAR-Extracted Inflation Shocks

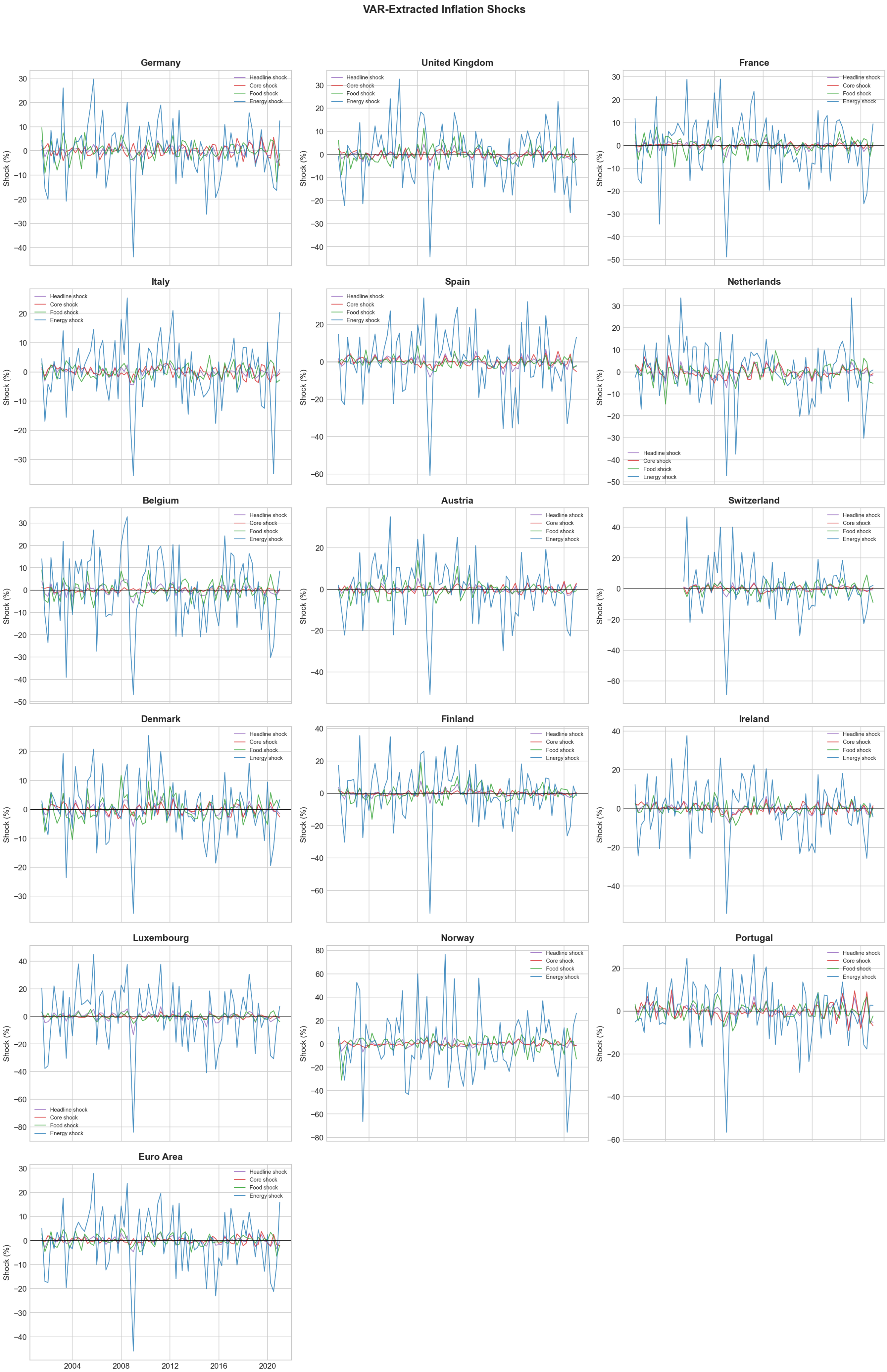


Table 3: Inflation-hedging betas, shocks from Germany (DE)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.00	-0.24	-0.01	-2.81	0.006	0.16	0.099
DE 3Y	-0.01	-0.15	-0.03	-2.84	0.185	1.39	0.103
DE 5Y	-0.03	-0.35	-0.05	-2.85	0.399	1.88	0.100
DE 10Y	-0.14	-0.85	-0.10	-2.86	0.896	2.35	0.097
UK 1Y	-0.00	-0.09	-0.02	-4.30	0.002	0.04	0.212
UK 3Y	-0.03	-0.42	-0.05	-3.72	0.197	1.32	0.160
UK 5Y	-0.02	-0.17	-0.07	-3.47	0.396	1.70	0.147
UK 10Y	-0.03	-0.16	-0.13	-3.72	0.773	1.89	0.165
FR 10Y	-0.07	-0.42	-0.09	-2.81	0.963	2.59	0.097
IT 10Y	-0.26	-1.06	-0.10	-1.99	1.133	2.06	0.052
ES 10Y	-0.03	-0.15	-0.07	-1.60	1.128	2.33	0.035
NL 10Y	-0.14	-0.87	-0.09	-2.91	0.954	2.62	0.100
BE 10Y	-0.09	-0.51	-0.08	-2.36	1.036	2.71	0.069
Commodity futures							
Crude oil	1.62	1.88	0.99	5.78	3.263	1.67	0.305
Natural gas	1.15	1.07	0.61	2.86	1.437	0.59	0.098
Gold	0.41	1.23	0.08	1.15	2.784	3.68	0.027
Copper	-0.33	-0.48	0.43	3.10	3.090	1.98	0.137
Equity							
Euro STOXX	0.53	1.05	0.16	1.63	0.311	0.28	0.037

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta^{\text{core}}_j \varepsilon^{\text{core}}_{DE,t} + \beta^{\text{energy}}_j \varepsilon^{\text{energy}}_{DE,t} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the Germany specification. Sample: 2001 Q1–2020 Q4.

Table 3: (continued)

Panel B: One-factor specification (headline shock)

	β^{headline}		α		
Asset	est.	t	est.	t	R^2
Government bonds					
DE 1Y	-0.05	-2.46	0.006	0.15	0.073
DE 3Y	-0.15	-2.27	0.185	1.37	0.063
DE 5Y	-0.25	-2.42	0.399	1.86	0.071
DE 10Y	-0.50	-2.71	0.896	2.35	0.087
UK 1Y	-0.08	-2.90	0.002	0.04	0.098
UK 3Y	-0.22	-2.91	0.197	1.28	0.099
UK 5Y	-0.29	-2.52	0.395	1.64	0.076
UK 10Y	-0.51	-2.48	0.773	1.81	0.074
FR 10Y	-0.40	-2.17	0.963	2.55	0.058
IT 10Y	-0.44	-1.64	1.133	2.06	0.034
ES 10Y	-0.26	-1.08	1.128	2.32	0.015
NL 10Y	-0.44	-2.50	0.954	2.60	0.075
BE 10Y	-0.35	-1.86	1.036	2.70	0.043
Commodity futures					
Crude oil	4.12	4.01	3.263	1.54	0.173
Natural gas	1.83	1.51	1.437	0.58	0.029
Gold	0.46	1.26	2.784	3.69	0.020
Copper	0.90	1.11	3.090	1.86	0.016
Equity					
Euro STOXX	1.20	2.23	0.311	0.28	0.061

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{head}} \varepsilon^{\text{head}}_{DE,t} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Table 4: Inflation-hedging betas, shocks from United Kingdom (UK)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.01	-0.40	-0.01	-2.28	0.006	0.15	0.080
DE 3Y	-0.00	-0.01	-0.03	-2.35	0.185	1.37	0.075
DE 5Y	-0.07	-0.42	-0.04	-2.12	0.399	1.85	0.071
DE 10Y	-0.41	-1.30	-0.06	-1.90	0.896	2.34	0.091
UK 1Y	0.03	0.61	-0.02	-3.65	0.002	0.04	0.152
UK 3Y	-0.00	-0.02	-0.04	-3.00	0.197	1.28	0.117
UK 5Y	-0.12	-0.59	-0.05	-2.64	0.396	1.66	0.108
UK 10Y	-0.28	-0.82	-0.10	-2.74	0.773	1.85	0.123
FR 10Y	-0.21	-0.70	-0.07	-2.11	0.963	2.57	0.079
IT 10Y	-0.17	-0.38	-0.07	-1.46	1.133	2.05	0.037
ES 10Y	-0.32	-0.81	-0.04	-0.91	1.128	2.32	0.028
NL 10Y	-0.17	-0.55	-0.06	-1.88	0.954	2.57	0.061
BE 10Y	-0.06	-0.19	-0.07	-1.98	1.036	2.70	0.058
Commodity futures							
Crude oil	-0.82	-0.45	0.51	2.65	3.263	1.46	0.087
Natural gas	0.47	0.24	0.55	2.66	1.437	0.59	0.099
Gold	0.40	0.65	0.05	0.70	2.784	3.66	0.017
Copper	-1.27	-0.97	0.38	2.77	3.090	1.93	0.092
Equity							
Euro STOXX	1.06	1.14	0.01	0.12	0.311	0.27	0.020

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta^{\text{core}}_j \varepsilon^{\text{core}}_{UK,t} + \beta^{\text{energy}}_j \varepsilon^{\text{energy}}_{UK,t} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the United Kingdom specification. Sample: 2001 Q1–2020 Q4.

Table 4: (continued)

Panel B: One-factor specification (headline shock)

	β^{headline}		α		
Asset	est.	t	est.	t	R^2
Government bonds					
DE 1Y	-0.07	-2.98	0.006	0.16	0.103
DE 3Y	-0.18	-2.40	0.185	1.37	0.070
DE 5Y	-0.33	-2.73	0.399	1.88	0.088
DE 10Y	-0.72	-3.43	0.896	2.42	0.133
UK 1Y	-0.10	-3.00	0.002	0.04	0.105
UK 3Y	-0.28	-3.33	0.197	1.30	0.126
UK 5Y	-0.45	-3.40	0.395	1.69	0.130
UK 10Y	-0.81	-3.51	0.773	1.87	0.138
FR 10Y	-0.69	-3.38	0.963	2.66	0.129
IT 10Y	-0.62	-2.01	1.133	2.08	0.050
ES 10Y	-0.61	-2.29	1.128	2.38	0.064
NL 10Y	-0.60	-2.95	0.954	2.64	0.101
BE 10Y	-0.60	-2.84	1.036	2.77	0.095
Commodity futures					
Crude oil	2.92	2.31	3.263	1.45	0.065
Natural gas	2.46	1.76	1.437	0.58	0.039
Gold	0.62	1.48	2.784	3.71	0.028
Copper	1.61	1.75	3.090	1.88	0.038
Equity					
Euro STOXX	0.70	1.10	0.311	0.27	0.016

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{head}} \varepsilon_{UK,t}^{\text{head}} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Table 5: Inflation-hedging betas, shocks from France (FR)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.06	-1.18	-0.01	-3.44	0.006	0.16	0.171
DE 3Y	-0.05	-0.28	-0.03	-3.48	0.185	1.43	0.148
DE 5Y	-0.04	-0.16	-0.05	-3.41	0.399	1.92	0.141
DE 10Y	-0.25	-0.49	-0.09	-3.05	0.896	2.39	0.123
UK 1Y	-0.07	-0.98	-0.02	-4.25	0.002	0.04	0.223
UK 3Y	-0.19	-0.95	-0.04	-3.81	0.197	1.34	0.190
UK 5Y	-0.28	-0.90	-0.07	-3.74	0.396	1.74	0.183
UK 10Y	-0.22	-0.40	-0.12	-3.69	0.773	1.89	0.166
FR 10Y	-0.23	-0.47	-0.10	-3.53	0.963	2.68	0.156
IT 10Y	0.01	0.01	-0.07	-1.69	1.133	2.05	0.038
ES 10Y	-0.42	-0.64	-0.06	-1.49	1.128	2.33	0.040
NL 10Y	-0.30	-0.61	-0.08	-2.93	0.954	2.65	0.118
BE 10Y	-0.19	-0.38	-0.08	-2.84	1.036	2.77	0.106
Commodity futures							
Crude oil	5.54	2.11	0.72	4.84	3.263	1.68	0.307
Natural gas	0.88	0.27	0.51	2.77	1.437	0.59	0.100
Gold	0.29	0.28	0.07	1.19	2.784	3.67	0.022
Copper	1.50	0.71	0.37	3.07	3.090	1.97	0.130
Equity							
Euro STOXX	1.52	1.02	0.16	1.93	0.311	0.28	0.072

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{core}} \varepsilon^{\text{core}}_{FR,t} + \beta_j^{\text{energy}} \varepsilon^{\text{energy}}_{FR,t} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the France specification. Sample: 2001 Q1–2020 Q4.

Table 5: (continued)

Panel B: One-factor specification (headline shock)

	β^{headline}		α		
Asset	est.	t	est.	t	R^2
Government bonds					
DE 1Y	-0.09	-4.50	0.006	0.17	0.208
DE 3Y	-0.29	-3.98	0.185	1.46	0.171
DE 5Y	-0.46	-3.90	0.399	1.96	0.165
DE 10Y	-0.79	-3.74	0.896	2.45	0.154
UK 1Y	-0.16	-5.28	0.002	0.04	0.266
UK 3Y	-0.40	-4.95	0.197	1.39	0.242
UK 5Y	-0.59	-4.67	0.395	1.79	0.221
UK 10Y	-0.95	-4.13	0.773	1.92	0.182
FR 10Y	-0.82	-4.03	0.963	2.73	0.174
IT 10Y	-0.53	-1.69	1.133	2.06	0.036
ES 10Y	-0.62	-2.29	1.128	2.38	0.064
NL 10Y	-0.73	-3.62	0.954	2.71	0.145
BE 10Y	-0.72	-3.42	1.036	2.83	0.132
Commodity futures					
Crude oil	6.07	5.33	3.263	1.64	0.269
Natural gas	2.56	1.80	1.437	0.58	0.040
Gold	0.47	1.07	2.784	3.68	0.015
Copper	2.84	3.15	3.090	1.96	0.114
Equity					
Euro STOXX	1.46	2.31	0.311	0.28	0.065

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta^{\text{head}}_j \varepsilon^{\text{head}}_{FR,t} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Table 6: Inflation-hedging betas, shocks from Italy (IT)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.02	-1.00	-0.01	-3.80	0.006	0.16	0.165
DE 3Y	-0.01	-0.10	-0.04	-3.64	0.185	1.43	0.148
DE 5Y	-0.01	-0.12	-0.07	-3.65	0.399	1.93	0.149
DE 10Y	-0.16	-0.73	-0.12	-3.60	0.896	2.42	0.148
UK 1Y	-0.03	-0.86	-0.02	-4.47	0.002	0.04	0.211
UK 3Y	-0.05	-0.58	-0.06	-4.68	0.197	1.37	0.224
UK 5Y	-0.09	-0.68	-0.09	-4.40	0.396	1.76	0.204
UK 10Y	-0.20	-0.84	-0.15	-4.01	0.773	1.91	0.177
FR 10Y	-0.02	-0.11	-0.13	-4.04	0.963	2.71	0.177
IT 10Y	-0.51	-1.62	-0.11	-2.31	1.133	2.11	0.090
ES 10Y	-0.35	-1.27	-0.11	-2.57	1.128	2.40	0.093
NL 10Y	-0.15	-0.73	-0.11	-3.55	0.954	2.69	0.144
BE 10Y	-0.07	-0.33	-0.11	-3.30	1.036	2.80	0.126
Commodity futures							
Crude oil	2.87	2.28	0.60	3.06	3.263	1.52	0.153
Natural gas	2.66	1.85	0.38	1.72	1.437	0.59	0.073
Gold	-0.16	-0.35	0.02	0.30	2.784	3.64	0.003
Copper	0.52	0.55	0.38	2.62	3.090	1.92	0.085
Equity							
Euro STOXX	0.41	0.63	0.20	1.93	0.311	0.28	0.050

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{core}} \varepsilon_{IT,t}^{\text{core}} + \beta_j^{\text{energy}} \varepsilon_{IT,t}^{\text{energy}} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the Italy specification. Sample: 2001 Q1–2020 Q4.

Table 6: (continued)

Panel B: One-factor specification (headline shock)

	β^{headline}		α		
Asset	est.	t	est.	t	R^2
Government bonds					
DE 1Y	-0.08	-3.42	0.006	0.16	0.132
DE 3Y	-0.23	-2.71	0.185	1.39	0.087
DE 5Y	-0.37	-2.68	0.399	1.88	0.086
DE 10Y	-0.72	-2.97	0.896	2.38	0.103
UK 1Y	-0.14	-3.85	0.002	0.04	0.161
UK 3Y	-0.35	-3.64	0.197	1.32	0.147
UK 5Y	-0.52	-3.46	0.395	1.70	0.134
UK 10Y	-0.84	-3.10	0.773	1.85	0.111
FR 10Y	-0.73	-3.07	0.963	2.63	0.109
IT 10Y	-1.09	-3.21	1.133	2.15	0.118
ES 10Y	-0.87	-2.87	1.128	2.42	0.097
NL 10Y	-0.70	-2.98	0.954	2.64	0.103
BE 10Y	-0.65	-2.66	1.036	2.76	0.084
Commodity futures					
Crude oil	5.32	3.87	3.263	1.53	0.163
Natural gas	3.09	1.93	1.437	0.58	0.046
Gold	-0.03	-0.06	2.784	3.66	0.000
Copper	2.40	2.29	3.090	1.91	0.064
Equity					
Euro STOXX	1.60	2.23	0.311	0.28	0.061

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{head}} \varepsilon^{\text{head}}_{IT,t} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Table 7: Inflation-hedging betas, shocks from Spain (ES)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.02	-1.03	-0.01	-3.56	0.006	0.16	0.162
DE 3Y	-0.03	-0.48	-0.03	-3.54	0.185	1.43	0.149
DE 5Y	-0.02	-0.24	-0.04	-3.59	0.399	1.93	0.149
DE 10Y	-0.06	-0.36	-0.08	-3.81	0.896	2.45	0.166
UK 1Y	-0.02	-0.95	-0.01	-4.54	0.002	0.04	0.230
UK 3Y	-0.07	-1.03	-0.04	-4.21	0.197	1.36	0.208
UK 5Y	-0.10	-1.00	-0.06	-4.37	0.396	1.77	0.219
UK 10Y	-0.08	-0.46	-0.11	-4.73	0.773	1.98	0.235
FR 10Y	-0.05	-0.31	-0.08	-3.77	0.963	2.69	0.162
IT 10Y	-0.28	-1.13	-0.07	-2.07	1.133	2.09	0.074
ES 10Y	-0.17	-0.78	-0.07	-2.52	1.128	2.39	0.089
NL 10Y	-0.20	-1.24	-0.07	-3.68	0.954	2.74	0.176
BE 10Y	-0.08	-0.49	-0.06	-2.76	1.036	2.76	0.098
Commodity futures							
Crude oil	1.41	1.70	0.69	6.47	3.263	1.78	0.386
Natural gas	0.14	0.13	0.49	3.60	1.437	0.61	0.148
Gold	0.17	0.49	0.01	0.27	2.784	3.64	0.004
Copper	-0.13	-0.18	0.34	3.86	3.090	2.01	0.165
Equity							
Euro STOXX	0.42	0.85	0.17	2.74	0.311	0.29	0.104

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{core}}\varepsilon^{\text{core}}_{ES,t} + \beta_j^{\text{energy}}\varepsilon^{\text{energy}}_{ES,t} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the Spain specification. Sample: 2001 Q1–2020 Q4.

Table 7: (continued)

Panel B: One-factor specification (headline shock)

	β^{headline}		α		
Asset	est.	t	est.	t	R^2
Government bonds					
DE 1Y	-0.05	-3.36	0.006	0.16	0.128
DE 3Y	-0.14	-2.98	0.185	1.40	0.103
DE 5Y	-0.22	-2.93	0.399	1.89	0.100
DE 10Y	-0.45	-3.31	0.896	2.40	0.124
UK 1Y	-0.08	-3.74	0.002	0.04	0.154
UK 3Y	-0.21	-3.78	0.197	1.32	0.157
UK 5Y	-0.33	-3.91	0.395	1.73	0.166
UK 10Y	-0.56	-3.74	0.773	1.89	0.153
FR 10Y	-0.45	-3.44	0.963	2.66	0.133
IT 10Y	-0.52	-2.69	1.133	2.12	0.086
ES 10Y	-0.47	-2.78	1.128	2.41	0.091
NL 10Y	-0.50	-3.99	0.954	2.75	0.171
BE 10Y	-0.38	-2.79	1.036	2.77	0.092
Commodity futures					
Crude oil	4.15	5.91	3.263	1.69	0.312
Natural gas	2.38	2.70	1.437	0.59	0.086
Gold	0.21	0.75	2.784	3.67	0.007
Copper	1.50	2.57	3.090	1.93	0.079
Equity					
Euro STOXX	1.05	2.64	0.311	0.28	0.083

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{head}} \varepsilon^{\text{head}}_{ES,t} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Table 8: Inflation-hedging betas, shocks from Netherlands (NL)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.01	-0.51	-0.01	-2.20	0.006	0.15	0.077
DE 3Y	-0.03	-0.49	-0.03	-2.38	0.185	1.38	0.088
DE 5Y	-0.00	-0.01	-0.04	-2.46	0.399	1.86	0.081
DE 10Y	0.07	0.44	-0.08	-2.69	0.896	2.34	0.089
UK 1Y	-0.02	-0.86	-0.02	-4.23	0.002	0.04	0.233
UK 3Y	0.00	0.07	-0.05	-4.24	0.197	1.35	0.205
UK 5Y	0.01	0.07	-0.07	-4.02	0.396	1.74	0.189
UK 10Y	-0.09	-0.51	-0.12	-3.64	0.773	1.90	0.175
FR 10Y	0.11	0.68	-0.10	-3.24	0.963	2.63	0.122
IT 10Y	0.36	1.54	-0.11	-2.46	1.133	2.10	0.081
ES 10Y	0.11	0.53	-0.10	-2.70	1.128	2.39	0.089
NL 10Y	0.05	0.33	-0.09	-3.15	0.954	2.65	0.120
BE 10Y	0.18	1.08	-0.09	-2.98	1.036	2.77	0.105
Commodity futures							
Crude oil	-0.19	-0.22	0.91	5.92	3.263	1.71	0.333
Natural gas	-0.58	-0.54	0.41	2.07	1.437	0.58	0.053
Gold	-0.38	-1.16	-0.01	-0.16	2.784	3.67	0.021
Copper	-0.19	-0.28	0.38	2.94	3.090	1.94	0.107
Equity							
Euro STOXX	-0.46	-0.95	0.16	1.79	0.311	0.28	0.043

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta^{\text{core}}_j \varepsilon^{\text{core}}_{NL,t} + \beta^{\text{energy}}_j \varepsilon^{\text{energy}}_{NL,t} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the Netherlands specification. Sample: 2001 Q1–2020 Q4.

Table 8: (continued)

Panel B: One-factor specification (headline shock)

	β^{headline}		α		
Asset	est.	t	est.	t	R^2
Government bonds					
DE 1Y	-0.03	-2.26	0.006	0.15	0.062
DE 3Y	-0.10	-2.09	0.185	1.36	0.054
DE 5Y	-0.13	-1.63	0.399	1.82	0.034
DE 10Y	-0.20	-1.41	0.896	2.28	0.025
UK 1Y	-0.07	-3.42	0.002	0.04	0.132
UK 3Y	-0.15	-2.65	0.197	1.27	0.084
UK 5Y	-0.21	-2.43	0.395	1.64	0.071
UK 10Y	-0.40	-2.62	0.773	1.82	0.082
FR 10Y	-0.24	-1.73	0.963	2.53	0.037
IT 10Y	-0.10	-0.49	1.133	2.03	0.003
ES 10Y	-0.28	-1.60	1.128	2.34	0.032
NL 10Y	-0.26	-1.94	0.954	2.56	0.047
BE 10Y	-0.17	-1.22	1.036	2.66	0.019
Commodity futures					
Crude oil	2.61	3.33	3.263	1.50	0.126
Natural gas	0.48	0.53	1.437	0.57	0.004
Gold	-0.34	-1.25	2.784	3.69	0.020
Copper	0.79	1.32	3.090	1.87	0.022
Equity					
Euro STOXX	0.02	0.05	0.311	0.27	0.000

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{head}} \varepsilon_{NL,t}^{\text{head}} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Table 9: Inflation-hedging betas, shocks from Belgium (BE)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.08	-1.75	-0.01	-3.68	0.006	0.16	0.165
DE 3Y	-0.26	-1.56	-0.03	-3.17	0.185	1.41	0.129
DE 5Y	-0.39	-1.48	-0.04	-3.03	0.399	1.90	0.119
DE 10Y	-0.69	-1.42	-0.06	-2.71	0.896	2.35	0.099
UK 1Y	-0.03	-0.45	-0.01	-3.86	0.002	0.04	0.164
UK 3Y	-0.18	-0.93	-0.03	-3.12	0.197	1.28	0.116
UK 5Y	-0.26	-0.88	-0.05	-3.09	0.396	1.67	0.113
UK 10Y	-0.47	-0.88	-0.09	-3.29	0.773	1.85	0.126
FR 10Y	-0.83	-1.82	-0.08	-3.36	0.963	2.66	0.146
IT 10Y	-1.01	-1.45	-0.05	-1.50	1.133	2.06	0.047
ES 10Y	-0.74	-1.22	-0.06	-1.99	1.128	2.36	0.059
NL 10Y	-0.69	-1.51	-0.07	-2.86	0.954	2.63	0.110
BE 10Y	-0.60	-1.26	-0.06	-2.65	1.036	2.75	0.093
Commodity futures							
Crude oil	2.28	0.90	0.66	5.21	3.263	1.63	0.264
Natural gas	-1.75	-0.57	0.40	2.60	1.437	0.59	0.092
Gold	-0.33	-0.35	0.07	1.39	2.784	3.69	0.029
Copper	0.37	0.19	0.33	3.36	3.090	1.97	0.130
Equity							
Euro STOXX	0.52	0.36	0.09	1.29	0.311	0.27	0.022

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{core}} \varepsilon^{\text{core}}_{BE,t} + \beta_j^{\text{energy}} \varepsilon^{\text{energy}}_{BE,t} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the Belgium specification. Sample: 2001 Q1–2020 Q4.

Table 9: (continued)

Panel B: One-factor specification (headline shock)

	β^{headline}		α		
Asset	est.	t	est.	t	R^2
Government bonds					
DE 1Y	-0.07	-3.91	0.006	0.16	0.166
DE 3Y	-0.20	-3.28	0.185	1.41	0.123
DE 5Y	-0.30	-3.08	0.399	1.90	0.110
DE 10Y	-0.50	-2.89	0.896	2.37	0.098
UK 1Y	-0.11	-4.19	0.002	0.04	0.186
UK 3Y	-0.24	-3.52	0.197	1.31	0.138
UK 5Y	-0.36	-3.34	0.395	1.69	0.127
UK 10Y	-0.63	-3.29	0.773	1.86	0.123
FR 10Y	-0.64	-3.87	0.963	2.71	0.163
IT 10Y	-0.51	-2.02	1.133	2.08	0.050
ES 10Y	-0.53	-2.42	1.128	2.39	0.071
NL 10Y	-0.55	-3.37	0.954	2.68	0.129
BE 10Y	-0.56	-3.30	1.036	2.82	0.124
Commodity futures					
Crude oil	4.29	4.50	3.263	1.58	0.208
Natural gas	1.22	1.05	1.437	0.57	0.014
Gold	0.38	1.09	2.784	3.68	0.015
Copper	1.76	2.36	3.090	1.91	0.067
Equity					
Euro STOXX	0.51	0.98	0.311	0.27	0.012

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta_j^{\text{head}} \varepsilon^{\text{head}}_{BE,t} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Table 10: Inflation-hedging betas, shocks from Euro Area (EA)

Panel A: Two-factor specification (core and energy shocks)

	β^{core}		β^{energy}		α		
Asset	est.	t	est.	t	est.	t	R^2
Government bonds							
DE 1Y	-0.04	-1.40	-0.01	-3.64	0.006	0.16	0.157
DE 3Y	-0.08	-0.76	-0.04	-3.53	0.185	1.42	0.142
DE 5Y	-0.16	-0.92	-0.06	-3.53	0.399	1.92	0.143
DE 10Y	-0.42	-1.37	-0.11	-3.49	0.896	2.42	0.146
UK 1Y	-0.03	-0.66	-0.02	-4.92	0.002	0.04	0.241
UK 3Y	-0.12	-1.01	-0.05	-4.50	0.197	1.36	0.212
UK 5Y	-0.17	-0.89	-0.08	-4.30	0.396	1.75	0.197
UK 10Y	-0.29	-0.88	-0.14	-4.35	0.773	1.93	0.200
FR 10Y	-0.15	-0.49	-0.11	-3.60	0.963	2.66	0.146
IT 10Y	-0.43	-0.93	-0.09	-1.99	1.133	2.07	0.055
ES 10Y	-0.21	-0.53	-0.08	-1.94	1.128	2.34	0.048
NL 10Y	-0.36	-1.21	-0.10	-3.38	0.954	2.67	0.136
BE 10Y	-0.13	-0.42	-0.09	-2.87	1.036	2.76	0.098
Commodity futures							
Crude oil	3.76	2.41	0.98	6.31	3.263	1.74	0.358
Natural gas	2.63	1.32	0.60	3.02	1.437	0.60	0.116
Gold	0.31	0.49	0.06	0.99	2.784	3.66	0.014
Copper	0.00	0.00	0.49	3.87	3.090	2.01	0.167
Equity							
Euro STOXX	1.34	1.47	0.24	2.65	0.311	0.29	0.099

Panel A: OLS estimates of $r^e_{j,t} = \alpha_j + \beta^{\text{core}}_j \varepsilon^{\text{core}}_{EA,t} + \beta^{\text{energy}}_j \varepsilon^{\text{energy}}_{EA,t} + u_{j,t}$. Inflation shocks are extracted from the VAR of Table 2, the Euro Area specification. Sample: 2001 Q1–2020 Q4.

Table 10: (continued)

Panel B: One-factor specification (headline shock)

Asset	β^{headline} est.	β^{headline} t	α est.	α t	R^2
Government bonds					
DE 1Y	-0.10	-4.12	0.006	0.16	0.181
DE 3Y	-0.30	-3.64	0.185	1.43	0.147
DE 5Y	-0.47	-3.67	0.399	1.94	0.149
DE 10Y	-0.86	-3.74	0.896	2.44	0.153
UK 1Y	-0.16	-4.59	0.002	0.04	0.215
UK 3Y	-0.40	-4.41	0.197	1.36	0.202
UK 5Y	-0.57	-3.99	0.395	1.73	0.172
UK 10Y	-0.99	-3.89	0.773	1.90	0.164
FR 10Y	-0.78	-3.40	0.963	2.66	0.130
IT 10Y	-0.68	-1.98	1.133	2.07	0.049
ES 10Y	-0.58	-1.93	1.128	2.35	0.046
NL 10Y	-0.77	-3.43	0.954	2.69	0.133
BE 10Y	-0.65	-2.75	1.036	2.76	0.089
Commodity futures					
Crude oil	6.94	5.63	3.263	1.67	0.291
Natural gas	3.40	2.20	1.437	0.58	0.059
Gold	0.43	0.90	2.784	3.68	0.010
Copper	2.90	2.90	3.090	1.95	0.098
Equity					
Euro STOXX	2.02	2.96	0.311	0.29	0.102

Panel B: OLS estimates of $r^e_{j,t} = \alpha_j + \beta^{\text{head}}_j \varepsilon^{\text{head}}_{EA,t} + u_{j,t}$, where the headline inflation shock is the residual from the headline equation of the country VAR. Headline inflation aggregates the core, food, and energy components weighted by their COICOP basket shares.

Figure 3: Inflation Betas

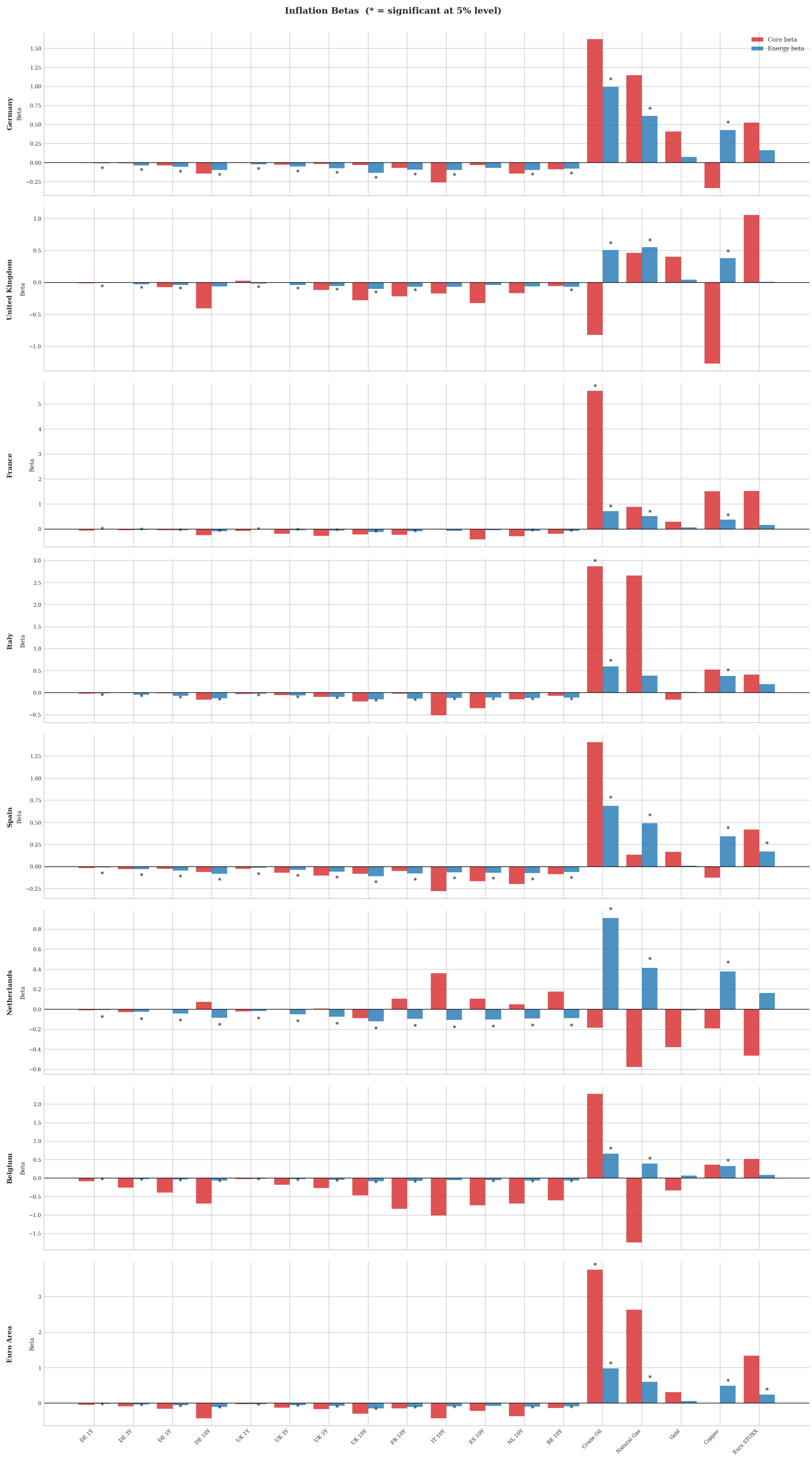


Table 11: Fama–MacBeth estimates of the price of inflation risk

Panel A: Two-factor specification (core and energy shocks)

	λ^{core}		λ^{energy}		λ_0		
Shocks from	est.	t	est.	t	est.	t	$\bar{R}^2$
Germany	-0.994	-0.78	3.690	1.20	0.910	3.78	0.482
United Kingdom	-0.708	-0.87	2.927	0.71	0.837	3.03	0.472
France	0.160	0.23	2.059	0.43	0.870	3.48	0.541
Italy	-0.419	-0.38	4.637	0.95	1.047	3.60	0.561
Spain	-0.073	-0.05	3.006	0.80	0.891	4.11	0.488
Netherlands	0.287	0.19	2.651	1.06	0.930	4.04	0.448
Belgium	-0.036	-0.05	3.621	0.92	0.859	2.79	0.571
Euro Area	-0.708	-0.83	4.649	1.21	0.909	3.49	0.502

Panel A: Two-pass Fama–MacBeth estimates of the price of inflation risk in the two-factor specification. The first-pass betas are the country-specific β^{core} and β^{energy} from Panel A of Tables 3–10. The second-pass cross-sectional regression of time-series average excess returns on the first-pass betas (with intercept) yields λ^{core}, λ^{energy}, and λ_0. The t-statistics are Shanken-corrected. $\bar{R}^2$ is the cross-sectional coefficient of determination. $N = 18$ test assets in each specification; $T = 80$ quarters. EA denotes the euro-area aggregate.

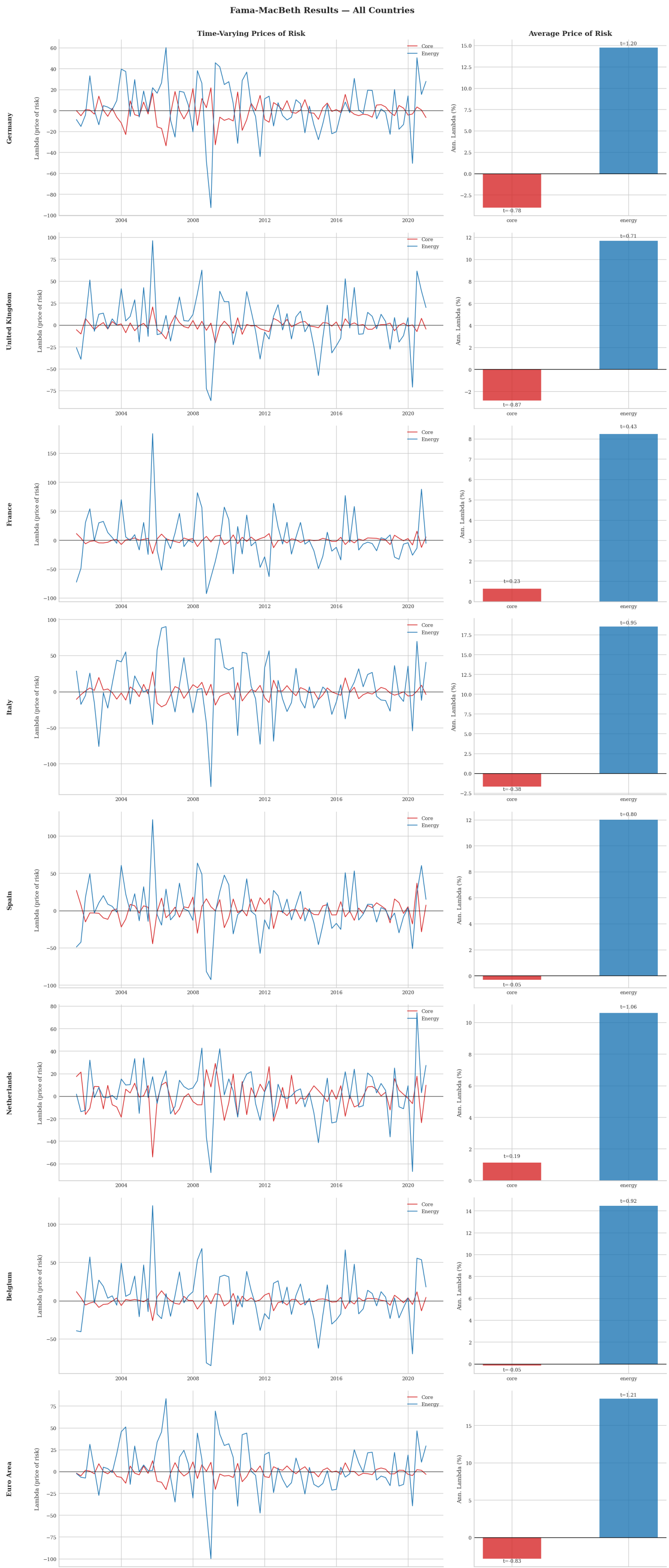
Table 11: (continued)

Panel B: One-factor specification (headline shock)

	$\lambda^{\text{headline}}$		λ_0		
Shocks from	est.	t	est.	t	$\bar{R}^2$
Germany	0.546	0.94	0.915	3.88	0.346
United Kingdom	0.595	0.94	0.978	3.66	0.359
France	0.388	1.03	0.918	3.84	0.358
Italy	0.366	0.90	0.950	3.88	0.361
Spain	0.514	0.94	0.912	3.99	0.362
Netherlands	0.931	0.99	0.990	3.53	0.322
Belgium	0.593	1.07	0.955	3.66	0.351
Euro Area	0.324	0.98	0.902	3.93	0.359

Panel B: Two-pass Fama–MacBeth estimates of the price of inflation risk in the one-factor (headline) specification. The first-pass betas are the country-specific β^{headline} from Panel B of Tables 3–10. The cross-sectional R^2 is markedly lower than the two-factor counterpart in Panel A, reflecting the loss of information from collapsing core and energy into a single inflation factor.

Figure 4



Fama-MacBeth Results — All Countries
Time-Varying Prices of Risk
Average Price of Risk
Germany
United Kingdom
France
Italy
Spain
Netherlands
Belgium
Euro Area
Lambda (price of risk)
Ann. Lambda (%)
Core
Energy
core
energy
t=1.20
t=-0.78
t=0.71
t=-0.87
t=0.43
t=0.23
t=0.95
t=-0.38
t=0.80
t=-0.05
t=1.06
t=0.19
t=0.92
t=-0.05
t=1.21
t=-0.83

Table 12: Price of inflation risk: headline summary (annualised)

Panel A: Two-factor specification

	λ^{core} (% p.a.)		λ^{energy} (% p.a.)		
Shocks from	est.	t	est.	t	$\bar{R}^2$
Germany	-3.98	-0.78	14.76	1.20	0.482
United Kingdom	-2.83	-0.87	11.71	0.71	0.472
France	0.64	0.23	8.24	0.43	0.541
Italy	-1.68	-0.38	18.55	0.95	0.561
Spain	-0.29	-0.05	12.02	0.80	0.488
Netherlands	1.15	0.19	10.61	1.06	0.448
Belgium	-0.14	-0.05	14.48	0.92	0.571
Euro Area	-2.83	-0.83	18.60	1.21	0.502

Panel A: Annualised two-factor Fama–MacBeth price-of-risk estimates from Panel A of Table 11. Estimates are reported in percent per annum (the quarterly estimates in Table 11 multiplied by 4); t-statistics are unchanged. $\bar{R}^2$ is the cross-sectional coefficient of determination from the second-pass regression. Sample: 2001 Q1–2020 Q4 (80 quarters); $N = 18$ test assets. EA denotes the euro-area aggregate.

Table 12: (continued)

Panel B: One-factor (headline) specification

	$\lambda^{\text{headline}}$ (% p.a.)		
Shocks from	est.	t	$\bar{R}^2$
Germany	2.18	0.94	0.346
United Kingdom	2.38	0.94	0.359
France	1.55	1.03	0.358
Italy	1.46	0.90	0.361
Spain	2.06	0.94	0.362
Netherlands	3.72	0.99	0.322
Belgium	2.37	1.07	0.351
Euro Area	1.30	0.98	0.359

Panel B: Annualised one-factor Fama–MacBeth price-of-risk estimates from Panel B of Table 11. $\bar{R}^2$ values are lower than in Panel A because the headline factor pools the differentially-priced core and energy components into a single regressor.

Table 13: Factor-mimicking portfolio returns

Panel A: Two-factor specification (core and energy FMPs)

	Core FMP			Energy FMP		
Shocks from	mean (% p.a.)	t	R^2	mean (% p.a.)	t	R^2
Germany	0.12	0.35	0.291	0.06	1.00	0.437
United Kingdom	0.18	0.27	0.281	0.08	1.21	0.340
France	1.98	1.57	0.218	0.05	1.00	0.466
Italy	0.24	0.53	0.321	-0.01	-0.15	0.331
Spain	0.28	0.78	0.314	0.01	0.40	0.524
Netherlands	-0.14	-0.45	0.333	-0.01	-0.13	0.551
Belgium	-2.19	-1.51	0.150	0.05	1.17	0.455
Euro Area	0.37	0.53	0.286	0.05	0.91	0.459

Panel A: Mean returns of the factor-mimicking portfolios for the core and energy inflation shocks. For each country specification, the FMP weights are obtained by regressing the inflation shock on the eighteen test-asset excess returns; the mean return of the resulting portfolio is the FMP-implied price of risk for that factor. Mean returns are reported in annualised percent. t-statistics are computed from the time series of FMP returns. R^2 is the first-pass regression's coefficient of determination.

Table 13: (continued)

Panel B: One-factor (headline) specification

Shocks from	mean (% p.a.)	t	R^2
Germany	0.30	0.85	0.390
United Kingdom	0.31	0.72	0.347
France	0.30	0.79	0.465
Italy	0.09	0.19	0.387
Spain	0.13	0.55	0.510
Netherlands	-0.11	-0.45	0.469
Belgium	0.17	0.54	0.445
Euro Area	0.34	0.79	0.443

Panel B: Mean return of the factor-mimicking portfolio for the headline inflation shock. The FMP weights are obtained by regressing the headline shock on the eighteen test-asset excess returns; mean return is reported in annualised percent.

Figure 5

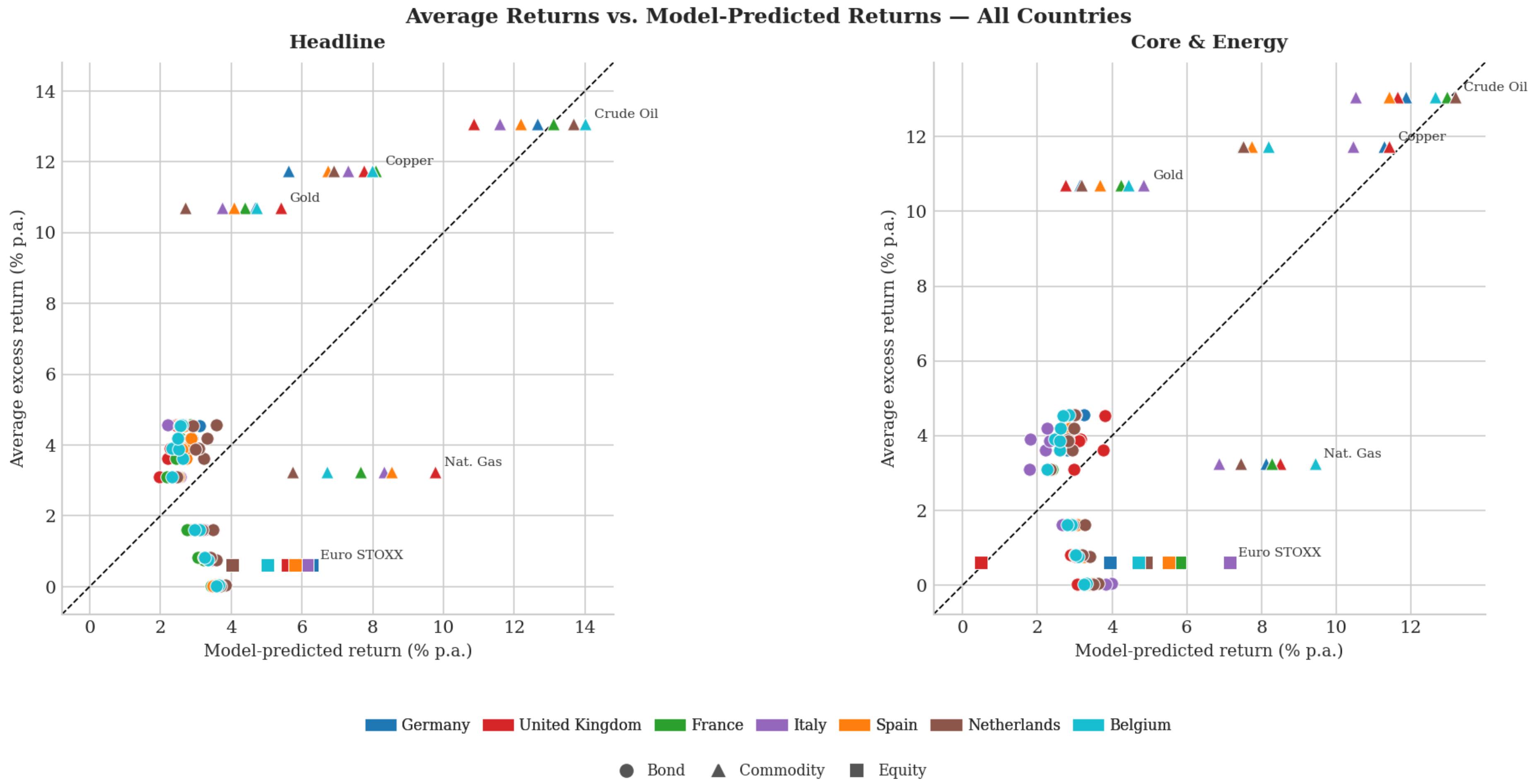

Average Returns vs. Model-Predicted Returns — All Countries
Headline
Core & Energy
Average excess return (% p.a.)
Model-predicted return (% p.a.)
Crude Oil
Copper
Gold
Nat. Gas
Euro STOXX
Germany
United Kingdom
France
Italy
Spain
Netherlands
Belgium
Bond
Commodity
Equity

Figure 6

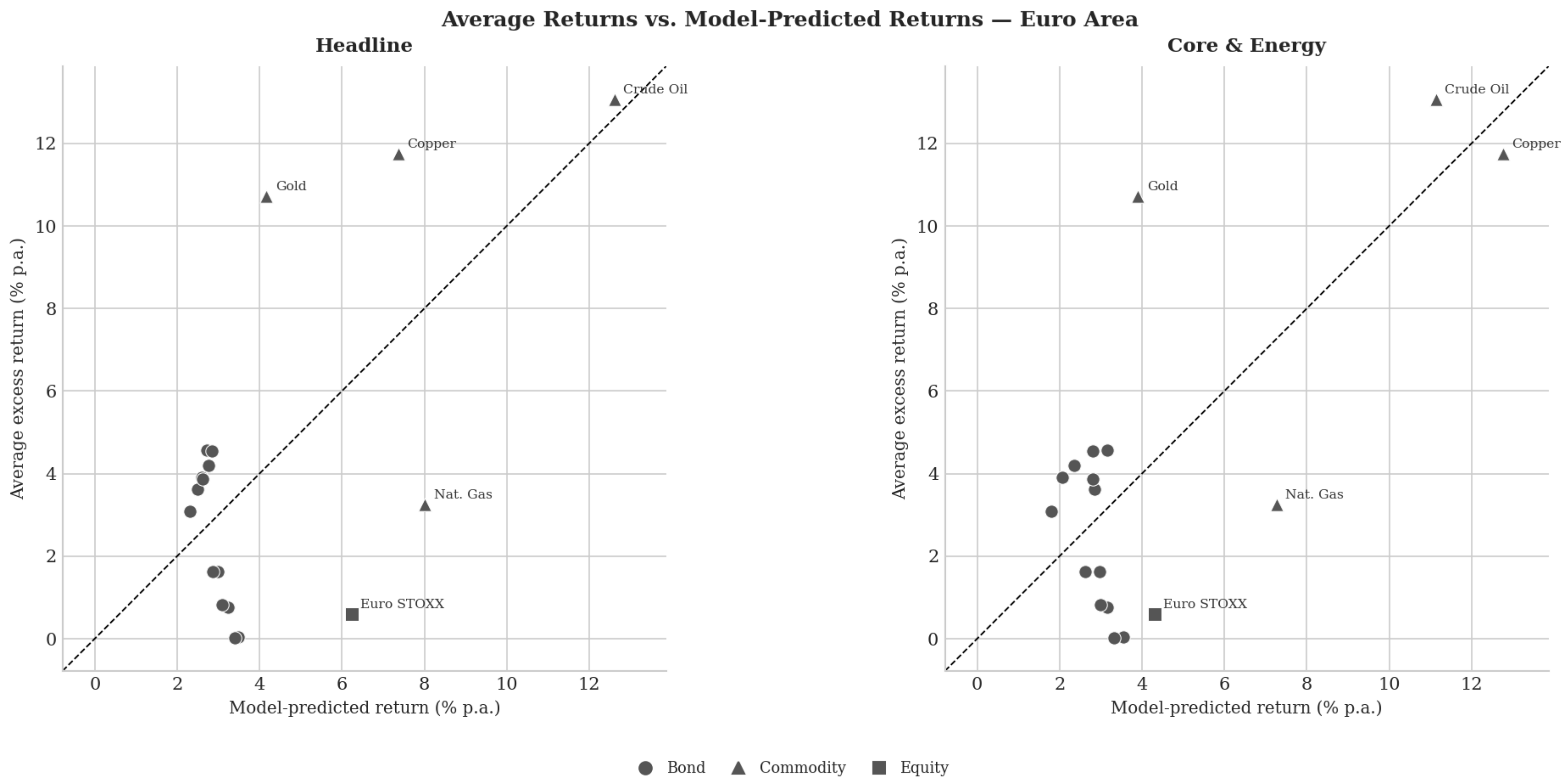
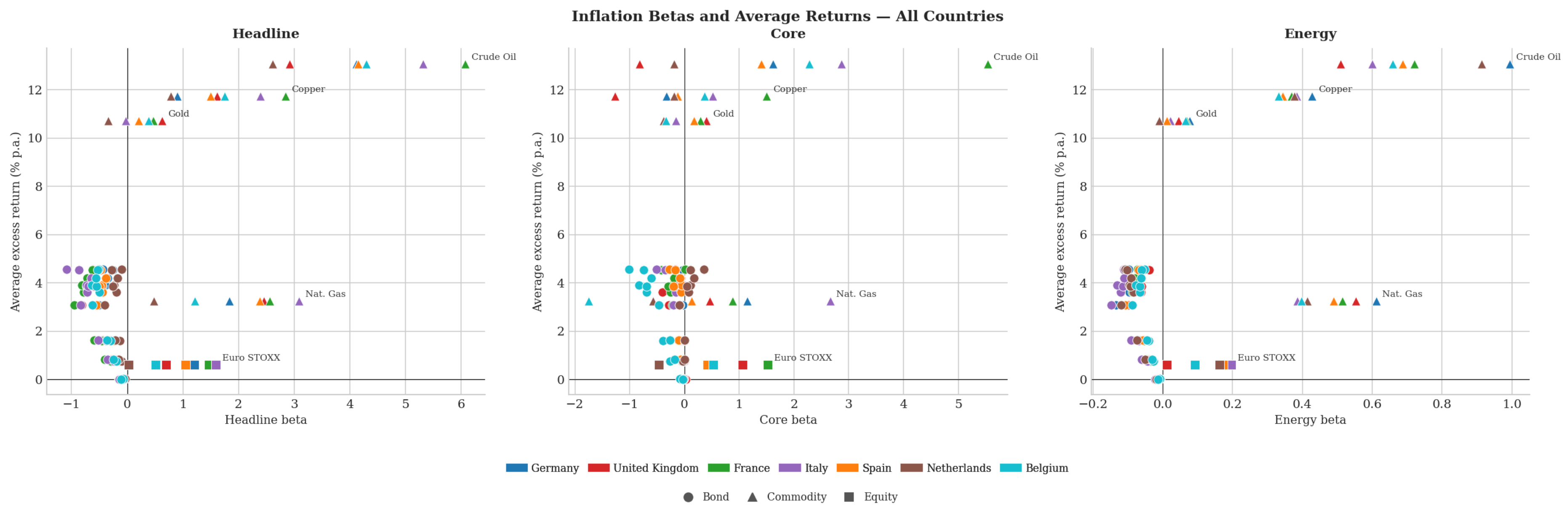

Average Returns vs. Model-Predicted Returns — Euro Area
Headline
Core & Energy
Crude Oil
Copper
Gold
Nat. Gas
Euro STOXX
Average excess return (% p.a.)
Model-predicted return (% p.a.)
Bond
Commodity
Equity

Figure 7



Inflation Betas and Average Returns — All Countries
Headline
Core
Energy
Average excess return (% p.a.)
Headline beta
Core beta
Energy beta
Crude Oil
Copper
Gold
Nat. Gas
Euro STOXX
Germany
United Kingdom
France
Italy
Spain
Netherlands
Belgium
Bond
Commodity
Equity

Figure 8


Inflation Betas and Average Returns — Euro Area
Headline
Core
Energy
Average excess return (% p.a.)
Headline beta
Core beta
Energy beta
Crude Oil
Copper
Gold
Nat. Gas
Euro STOXX
Bond
Commodity
Equity