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"ECB Monetary Policy and the German Economy, 1999-2023"

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Abstract

This report examines how conventional ECB monetary policy instruments transmit to the German economy over the 1999 to 2023 period, using a baseline OLS specification, local projections, and a Cholesky-identified VAR. Three findings emerge consistently. Shocks to the broad monetary aggregate M3 generate no systematic response in German prices, real activity, or equity returns. A positive EURIBOR shock depresses German equity returns sharply at medium horizons, in line with the asset price channel. The effect on inflation is weakly visible in the local projections but not robust to the structural setting, and the response of industrial production exhibits a persistent output puzzle. Conventional ECB instruments thus appear to transmit most reliably to financial markets, less reliably to inflation, and not measurably through the broad aggregate.

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Declaration of Word Count

Excluding figures and tables, this report contains 5,022 words, thus exceeding the given requirement of a minimum of 4,000 words.

List of Abbreviations

ADF	Augmented-Dickey-Fuller
AIC	Akaike Information Criterion
CPI	Consumer Price Index
DFR	Deposit Facility Rate
ECB	European Central Bank
ESCB	European System of Central Banks
EMU	Economic and Monetary Union
IPI	Industrial Production Index
LTRO	Long-Term Refinancing Operation
MLF	Marginal Lending Facility
MRO	Main Refinancing Operations
OLS	Ordinary Least Squares
VAR	Vector Autoregression

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1. Introduction

Empirical research on monetary policy has long been dominated by the US case. Important contributions identifying the effects of policy shocks, namely Christiano et al. (1999), Bernanke and Mihov (1998), Romer and Romer (2004), and more recently Gertler and Karadi (2015) all were developed and tested with Federal Reserve data. Nonetheless, since the launch of the Economic and Monetary Union (EMU), the euro area has attracted growing attention. Important papers include Peersman and Smets (2003), Boivin et al. (2008), and Jarociński and Karadi (2020). Still, country-specific evidence on how the conventional ECB instruments transmit to individual member economies remains comparatively thin. Given the relevant heterogeneity within the currency union, the same policy can produce substantially different effects among different member states.

Germany is a natural focal point. As the largest economy in the euro area and the institutional heir to the Bundesbank's price-stability tradition, German outcomes are often treated implicitly as a benchmark for ECB performance. However, the empirical link between conventional policy instruments and the German economy has rarely been the subject of dedicated study. Much of the existing work either aggregates over the euro area or concentrates on the unconventional measures introduced after 2008.

Therefore, this report addresses the research question: *How do conventional ECB monetary policy instruments affect German prices, real activity, and equity returns?* with said conventional policy instruments including the policy rate and the money supply, from 1999 to 2023.

The report is structured as follows: Chapter 2 outlines the institutional setting of the ECB and Chapter 3 develops the theoretical framework on conventional monetary instruments and transmission channels. Chapter 4 then describes the used data. Chapter 5 conducts the empirical analysis, combining a baseline OLS specification, local projections in the spirit of Jordà (2005), and a Cholesky-identified Vector Autoregression (VAR). Chapter 6 summarises the results and concludes.

2. The European Central Bank

The operations of monetary policy in Germany and the structure of the ECB cannot be fully understood without first considering the legacy of the Deutsche Bundesbank, the nation's former central bank. First established in 1957, the Bundesbank followed up on the federal structure of its predecessor, the Bank deutscher Länder, which had been set up in 1948 along the lines of the U.S. Federal Reserve System. From the start, the Bundesbank was legally independent of the federal government and focused on keeping prices stable. This really came from experiencing hyperinflation twice in the twentieth century. In December 1974, it became the first major central bank to set an explicit monetary target, first based on Central Bank Money and later on M3. Whilst the targets were missed rather frequently, they served as a credible anchor for inflation expectations and a transparent communication device (Mishkin, 1999; Issing, 2009). While many other central banks struggled with inflation in the 1970s and 1980s, the Bundesbank kept prices low. This success basically set the foundation that the European monetary union later built up on.

The legal foundations of the European Central Bank were laid by the Treaty of Maastricht in 1992. The European System of Central Banks (ESCB) and the ECB itself were established in June 1998, in preparation for the introduction of the euro as scriptural currency on 1 January 1999; euro cash followed in 2002. Decision-making within the Eurosystem is concentrated in two bodies. The Executive Board (Direktorium) consists of the President, the Vice-President, and four further members and is responsible for the implementation of monetary policy. The Governing Council (EZB-Rat) adds the governors of the euro-area NCBs and is the principal organ for setting policy. The General Council, which also includes the governors of NCBs from non-euro EU member states, primarily performs transitional and advisory functions.

The ECB's most important mandate, set out in Article 127 of the Treaty on the Functioning of the EU, is to keep prices stable. If that's not at risk, it should also support the EU's broader economic policies. On the operational side, price stability means a symmetric 2% inflation target over the medium term, measured by the Harmonised Index of Consumer Prices (HICP). This definition came out of the 2021 strategy review and replaced the older 'below, but close to, 2%' goal that had been around since 2003.

It was confirmed again in the 2025 strategy assessment (ECB, 2025). The 2025 review also downgraded forward guidance to a secondary instrument and built a stronger focus on structural risks into the framework, like geopolitical fragmentation, climate change, and demographics. The core toolkit, however, stayed the same: key interest rates, open market operations, minimum reserves, and asset purchases.

The institutional parallels with the Bundesbank tradition are hard to miss: independence, a primary mandate of price stability, and a federally organised executive. What is new is the international setting, which makes it more complicated to transmit a single policy stance across the very different economies of the currency union. That is the empirical question the following Chapters turn to.

3. Theoretical Framework

This Chapter lays out the theoretical groundwork for the empirical analysis in three steps: the conventional instruments of monetary policy, a comparison of rate-based and quantity-based steering, and the transmission channels through which policy reaches the real economy.

3.1 Conventional Monetary Policy Instruments

In conventional monetary economics, central bank instruments are usually grouped along two operational logics: interest rate targeting and money supply targeting (Poole, 1970). Under interest rate targeting, the central bank pins down a short-term money market rate and lets the quantity of base money adjust endogenously to whatever level is needed to clear the market at that rate. Under money supply targeting, the central bank instead fixes a target path for a monetary aggregate, typically M3, and lets the short-term rate adjust so that money demand meets that target. The Bundesbank pursued the second approach from late 1974 onwards for a broad monetary aggregate and stuck with it, with mixed accuracy but considerable credibility, until the handover to the ECB (Issing, 2009). The ECB inherited a watered-down version of this idea in the form of the so-called second pillar of its strategy, but its operational framework has from the start been firmly built around interest rate targeting.

In practice, the ECB sets three key policy rates (ECB, 2011). The Main Refinancing Operations (MRO) rate is the rate banks pay for the bulk of their weekly central bank

refinancing, conducted against eligible collateral. The Marginal Lending Facility (MLF) rate is the overnight ceiling at which banks can obtain emergency liquidity from their national central bank, and the Deposit Facility Rate (DFR) is the floor at which they earn interest on excess reserves held overnight at the Eurosystem. Together these three rates form the so-called interest rate corridor, within which the overnight unsecured money market rate (€STR, and EONIA before 2019) is supposed to fluctuate. After 2008, the large-scale provision of excess liquidity through the various asset purchase programmes pushed the system to the floor of the corridor, so that the DFR effectively became the binding steering rate while the MRO rate took on a more symbolic role (Bindseil, 2014).

The corridor itself is implemented through open market operations. Weekly MROs deliver the bulk of regular refinancing, while Longer-Term Refinancing Operations (LTROs), traditionally with a three-month maturity, provide more structural liquidity. Fine-tuning operations are deployed irregularly to absorb unexpected liquidity shocks, and structural operations adjust the longer-run liquidity position of the banking sector (ECB, 2011). The framework is rounded off by a minimum reserve requirement, currently set at 1% of selected short-term liabilities and unremunerated since September 2023, which stabilises banks' aggregate demand for central bank liquidity and makes the corridor easier to enforce (ECB, 2023).

3.2 Comparative Assessment

The two operational logics introduced above each come with a distinct set of advantages and drawbacks, and the ECB's commitment to interest rate targeting reflects a long debate rather than a foregone conclusion. The case for the rate-based approach rests primarily on precision and communicability. Short-term money market rates are the price that banks, firms, and households react to most directly, and a change in the policy rate translates into a relatively predictable shift in lending and deposit conditions across the financial system (Bindseil, 2014). A single rate decision is also far easier to communicate to the public than a multi-year growth corridor for an abstract monetary aggregate, which matters considerably for the management of inflation expectations (Blinder et al., 2008). The main weakness is that the approach loses traction once the policy rate approaches the effective lower bound. With nominal rates close to zero, further accommodation cannot be delivered through the standard

instrument (Eggertsson & Woodford, 2003), which is the situation the ECB faced for most of the time between 2014 and 2022 and which eventually motivated the move into unconventional policy.

Money supply targeting has the advantage of a direct conceptual link to the quantity theory of money, and the Bundesbank's record between 1974 and 1998 shows that even rather inaccurate target fulfilment can serve as a credible nominal anchor, as long as the institution itself is credible (Issing, 2009). The decisive problem in practice is the instability of money demand. Financial innovation, deregulation, and the rise of close substitutes for traditional bank deposits since the 1980s have made the relationship between monetary aggregates and nominal income increasingly noisy and structurally unstable (Estrella & Mishkin, 1997). This is the empirical counterpart of Goodhart's Law, the observation that once a particular monetary aggregate is elevated to the status of a target, the statistical regularities on which the targeting rule was built tend to deteriorate (Goodhart, 1984). The ECB acknowledged this development in its 2003 strategy review, when the prominent role of the M3 reference value was reduced (Issing, 2009) and made the shift official in the 2021 review by abandoning the two-pillar structure altogether (ECB, 2021).

3.3 Transmission Channels

A change in the policy rate does not affect the real economy directly, but works its way through several distinct channels that the literature has by now mapped out fairly comprehensively (Christiano et al., 1999; Boivin et al., 2008). The most familiar one is the interest rate channel, where a rise in the short-term rate translates into higher real borrowing costs and dampens interest sensitive components of aggregate demand, in particular investment. Operationally, this maps onto a leftward shift of the IS curve and, via the standard Phillips curve relationship, into downward pressure on inflation. A second channel runs through bank balance sheets and external finance premia. Tighter policy raises funding costs for banks and worsens the net worth of borrowers, both of which restrict the supply of credit beyond what the pure interest rate effect would predict, an amplification mechanism synthesised by Bernanke and Gertler (1995) as the credit channel. A last channel works through asset prices. Higher discount rates lower the present value of future cash flows, which in a textbook

dividend discount model translates one to one into lower equity valuations, and through Tobin's q into reduced investment incentives (Tobin, 1969). The exchange rate channel adds a further layer in an open economy: tighter euro area policy tends to appreciate the euro, which lowers import prices and reduces net exports. The expectations channel ties everything together, since most of the effects above operate through expected, rather than current, policy rates (Woodford, 2003).

4. Data

The empirical analysis utilizes six different monthly time series obtained from the FRED database, covering the sample period from January 1999 to December 2023. This window starts with the introduction of the euro as a currency and runs through the recent tightening cycle, which yields exactly 298 monthly observations.

The dependent variables capture different dimensions of macroeconomic activity that the German policy debate typically focuses on: prices, real activity, and financial markets. Inflation is measured by the German Consumer Price Index (DEUCPIALLMINMEI), real activity by the German Industrial Production Index (DEUPROINDMISMEI), and financial conditions by the OECD share price index for Germany (SPASTT01DEM661N). Industrial production is used as the activity measure rather than GDP because it is available at monthly frequency, which matches the policy variables and avoids interpolation. However, a drawback is that the services sector is thereby excluded. The monetary policy variables are the three month EURIBOR (IR3TIB01EZM156N) and euro area M3 (MABMM301EZM189S). EURIBOR is chosen over the official ECB administered rates (MRO, DFR, MLF) because it is a market rate determined in interbank trading and therefore reflects the effective cost of liquidity facing German banks rather than the formal corridor edges. M3 is the broad aggregate that the ECB itself referenced in its second pillar until 2003 and remains the standard quantity measure in euro area work; narrower aggregates such as M1 or M2 would understate financial innovation and capture only part of the deposit substitutes that the comparative discussion in Chapter 3.2 highlighted. A sixth series, the IMF Global Price Index of All Commodities (PALLFNFINDEXM), enters as a control variable. Its role becomes relevant in the structural estimation, where it absorbs the supply side shocks that would otherwise generate the price puzzle documented by Christiano et al. (1999).

All variables enter the analysis as monthly percentage changes, computed as $\left(\frac{x_t}{x_{t-1}} - 1\right) \times 100$, except for EURIBOR. The latter is kept in levels for the descriptive and OLS specifications and differenced once for the dynamic and structural specifications to address its persistent level behaviour. Stationarity properties are documented through standard ADF tests reported alongside the descriptive statistics. Table 1 summarises the variables and their key movements over the sample.

Variable	N	Mean	SD	Median	Min	Max
Interest_rate	298	1.567	1.780	1.199	-0.582	5.113
M3_growth	298	0.431	0.538	0.399	-1.809	2.663
CPI_growth	298	0.154	0.386	0.113	-1.031	1.981
IPI_growth	298	0.091	2.259	0.194	-21.398	11.636
Stock_return	298	0.282	4.848	0.954	-24.54	13.931
Comm_growt	298	0.546	4.462	1.046	-18.214	17.879

Table 1: Descriptive Statistics of Macroeconomic Variables (1999-2023)

EURIBOR ranges from -0.58 to 5.11 percent, with a median of 1.20, which captures both the pre-crisis high-rate environment and the prolonged negative-rate phase between 2014 and 2022. M3 growth averages 0.43 percent per month, equivalent to roughly 5.2 percent annualised, and is markedly less volatile than the real activity and asset price series. Industrial production growth and stock returns show the wide tails one would expect from monthly German data covering the global financial crisis and the COVID shock, with industrial production reaching a minimum of -21.4 percent in a single month. CPI growth is close to zero on average and tightly concentrated, consistent with the ECB's medium-term inflation objective being met on average over the sample.

Table 2 reports the unconditional correlation matrix. The pairwise correlations are modest, which is itself informative: at monthly frequency, the simple co-movement between policy variables and macroeconomic outcomes is weak, and any meaningful policy effects need to be identified through the dynamic and structural specifications introduced in the next Chapter.

	Interest_rate	M3_growth	CPI_growth	IPI_growth	Stock_return	Comm_growth
Interest_rate	1	0.165	-0.017	-0.02	-0.132	-0.037
M3_growth	0.165	1	0.098	-0.016	-0.045	-0.045
CPI_growth	-0.017	0.098	1	-0.016	0.001	0.24
IPI_growth	-0.02	-0.016	-0.016	1	0.207	0.281
Stock_return	-0.132	-0.045	0.001	0.207	1	0.266
Comm_growth	-0.037	-0.045	0.24	0.281	0.266	1

Table 2: Unconditional Correlation Matrix of Model Variables

Two patterns are still worth noting. EURIBOR and stock returns correlate negatively at -0.13, in line with the asset price channel discussed earlier, and industrial production and stock returns correlate positively at 0.21, consistent with equity markets pricing in real activity. The positive correlation between EURIBOR levels and M3 growth (0.17) is less intuitive at first sight but seems to reflect the comparison of a level with a growth rate rather than a structural relationship.

Variable	ADF_stat	p_value	Stationary
Interest_rate	-2.032	0.563	No
M3_growth	-4.19	0.01	Yes
CPI_growth	-5.583	0.01	Yes
IPI_growth	-6.698	0.01	Yes
Stock_return	-5.805	0.01	Yes
Comm_growth	-5.997	0.01	Yes

Table 3: Results of Augmented Dickey-Fuller (ADF) Tests for Stationarity

Augmented Dickey-Fuller tests confirm the stationarity properties presupposed by the empirical specifications below. All five growth-rate series (M3, CPI, IPI, stock returns, and commodity prices) reject the unit-root null at the one-percent level, as expected for variables already constructed in first log-differences. The EURIBOR level series, by contrast, fails to reject the null and is therefore treated as $I(1)$. This is consistent with the persistence visible in Figure 1, particularly the prolonged plateau near the zero lower bound between 2014 and 2022. Taking first differences resolves the issue: Δ EURIBOR is stationary at the one-percent level. Accordingly, the OLS specification in Chapter 5.2 retains EURIBOR in levels for transparency, while the local projections in Chapter 5.3 and the VAR in Chapter 5.4 use the differenced series. The full set of test statistics is reported in Table 3.

5. Empirical Analysis

This Chapter presents the empirical analysis in four steps of increasing identification ambition, beginning with a descriptive look at the policy variables, moving through a baseline OLS specification and a local projections approach to dynamic effects, and closing with a Cholesky-identified VAR.

5.1 Descriptive Analysis

Before turning to the formal models, it is useful to look at the two policy variables directly. Figure 1 plots the 3-month EURIBOR alongside the monthly growth rate of euro area M3 over the full sample period.

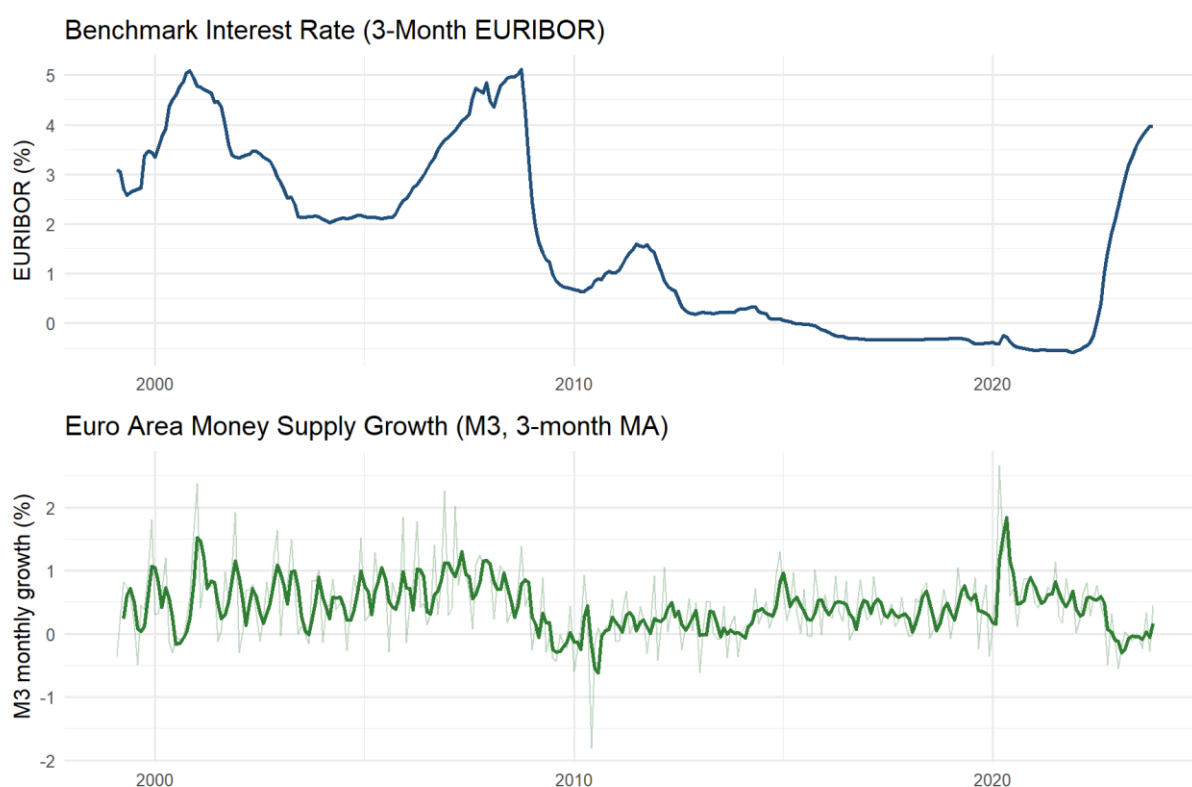


Figure 1: Time Series of Benchmark Interest Rate and Money Supply Growth

Two features stand out. The first is the structural break in the EURIBOR series around 2008. Before the global financial crisis, the rate moves between roughly 2 and 5 percent and tracks the ECB's tightening cycles in 2000 and 2006 to 2008. After 2008 it collapses, settles near zero, and remains negative for almost eight years between mid-2014 and mid-2022, before rising sharply to nearly 4 percent during the post-pandemic tightening cycle. The series is highly persistent throughout, with no tendency to revert

to a stable mean, which is consistent with the ADF results in Chapter 4 and motivates the use of first differences in the dynamic specifications below.

The second feature is the relative stability of M3 growth. Despite the dramatic regime shifts on the rate side, the broad aggregate continues to expand at roughly half a percent per month across most of the sample, with a brief contraction during the financial crisis and a more sustained one in 2023. The disconnect between a policy rate pinned at its floor and a quantity aggregate growing at its historical pace is a counterpart of the conceptual point in Chapter 3.2: rate-based steering loses traction at the effective lower bound (Eggertsson & Woodford, 2003). It also implies that the relationship between the two policy variables is not stable across the sample, so any model imposing a single linear specification over the full window is best read as describing an average response across very different policy regimes, a point we return to when interpreting the impulse responses in Chapter 5.4.

5.2 Baseline OLS

The most direct way to look for monetary policy effects is to regress each macroeconomic outcome on the two policy variables in the same period. Table 4 reports the resulting estimates for inflation, industrial production, and stock returns, with Newey-West standard errors that allow for arbitrary serial correlation up to twelve months.

OLS Baseline (Newey-West HAC SEs) -- contemporaneous correlations			
	Dependent variable:		
	CPI Growth (1)	IPI Growth (2)	Stock Returns (3)
M3 Growth (Euro Area)	0.074* (0.041)	-0.054 (0.369)	-0.217 (0.726)
EURIBOR	-0.007 (0.014)	-0.023 (0.074)	-0.348 (0.216)
Constant	0.134*** (0.037)	0.149 (0.132)	0.921** (0.399)
Observations	298	298	298
R2	0.011	0.001	0.018
Adjusted R2	0.004	-0.006	0.011
Residual Std. Error (df = 295)	0.385	2.266	4.820
F Statistic (df = 2; 295)	1.591	0.082	2.696*
Note: *p<0.1; **p<0.05; ***p<0.01			

Table 4: Baseline OLS Regressions (Contemporaneous Effects)

Figures 2 to 4 visualise the same relationships through pairwise scatter plots, with M3 growth and EURIBOR plotted separately against each dependent variable.

The most striking feature of the table is the near-absence of measurable effects. Adjusted R^2 lies between -0.006 and 0.011 across all three specifications, so the two policy variables jointly explain essentially none of the monthly variation in German prices, real activity, or equity returns. The EURIBOR coefficient is statistically indistinguishable from zero in every column, and even the M3 coefficient reaches conventional significance only in the inflation regression, and only at the ten-percent level. The scatter plots in Figures 2 to 4 reinforce this impression: the fitted lines are nearly flat throughout, and the confidence bands are wide enough to accommodate slopes of either sign in five of the six panels. The single exception, the negative slope in the EURIBOR-to-stock-returns panel of Figure 4, is at least sign-consistent with the asset price channel discussed in Chapter 3.3, but the coefficient still falls short of significance when using heteroskedasticity- and autocorrelation-robust standard errors.



Figure 2: Scatter Plots - Contemporaneous Effects on Inflation (CPI)

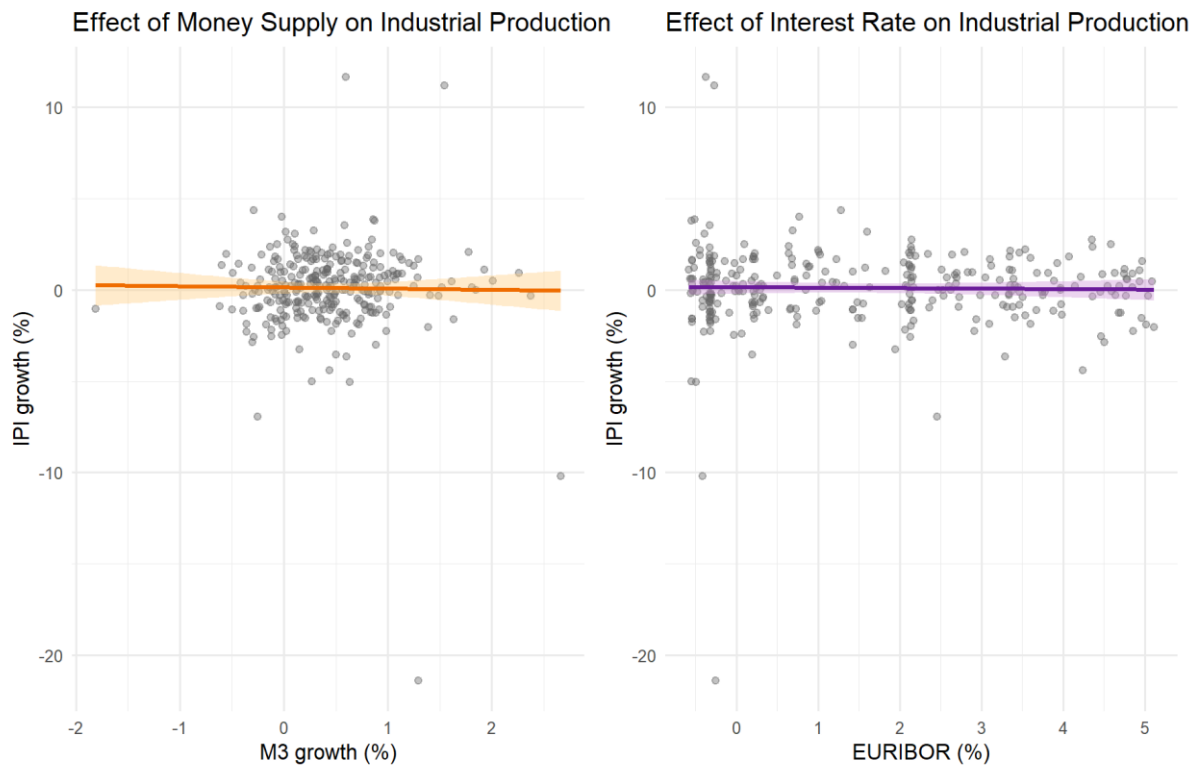


Figure 3: Scatter Plots - Contemporaneous Effects on Industrial Production (IPI)



Figure 4: Scatter Plots - Contemporaneous Effects on Stock Returns

This weak picture is exactly what one would expect from a contemporaneous reduced-form regression, and it is the central reason why the OLS coefficients cannot be read causally. The ECB does not set rates randomly; it sets them in response to current and expected macroeconomic conditions. When inflation is high, the ECB tightens, which mechanically biases the contemporaneous correlation between EURIBOR and CPI growth toward zero, masking the structural effect of a rate hike on prices. The same reverse-causality logic applies to industrial production, where the ECB cuts rates in downturns and raises them in booms. Without an explicit identification strategy, the OLS coefficients therefore conflate the policy effect with the central bank's reaction function (Bernanke & Mihov, 1998). A second reason for the weak fit is that monetary policy is known to operate with long and variable lags of twelve to twenty-four months (Friedman, 1961), which a same-month specification by construction cannot capture. The OLS results thus serve as a negative benchmark: they document precisely the kind of weak and ambiguous correlations that motivate the dynamic and structural specifications in the next Chapters.

5.3 Dynamic Effects

The OLS results establish that contemporaneous correlations are too weak to identify monetary transmission. A plausible next step is to allow the response to unfold over time. Local Projections in the spirit of Jordà (2005) do this by estimating a separate regression for each horizon h , in which the dependent variable is shifted h periods into the future and regressed on the contemporaneous policy shock and a set of controls. The key advantage over a VAR is that misspecification at a given horizon does not propagate to other horizons, which makes the impulse response estimates more robust to the kind of small-sample problems typical of monthly macro data. A second advantage is conceptual transparency: each coefficient has a direct interpretation as the partial effect of the shock on the outcome h months ahead, holding the lagged information set fixed.

The specification follows standard practice. Each regression uses the contemporaneous policy variables together with the global commodity price index as forward-looking control for supply shocks, and twelve lags of all six variables in the system as conditioning information. The lag length is selected by the Akaike Information Criterion (AIC) within the range of six to twelve months, which is the

standard window for monthly euro area data. Inference is based on Newey-West standard errors with a horizon-dependent lag of $\max(h,1)$, reflecting the fact that Local Projection residuals are autocorrelated up to order h by construction. EURIBOR enters in first differences for the reasons set out in Chapter 4: the level series is non-stationary and dominated by a single low-frequency regime shift around 2008, which would otherwise drive the regression mechanically. Figure 5 reports the resulting impulse responses for inflation and industrial production over a 24-month horizon, and for stock returns over 12 months, since asset prices are expected to incorporate monetary policy news contemporaneously rather than with the longer lags relevant for real activity and prices (Fama, 1970).

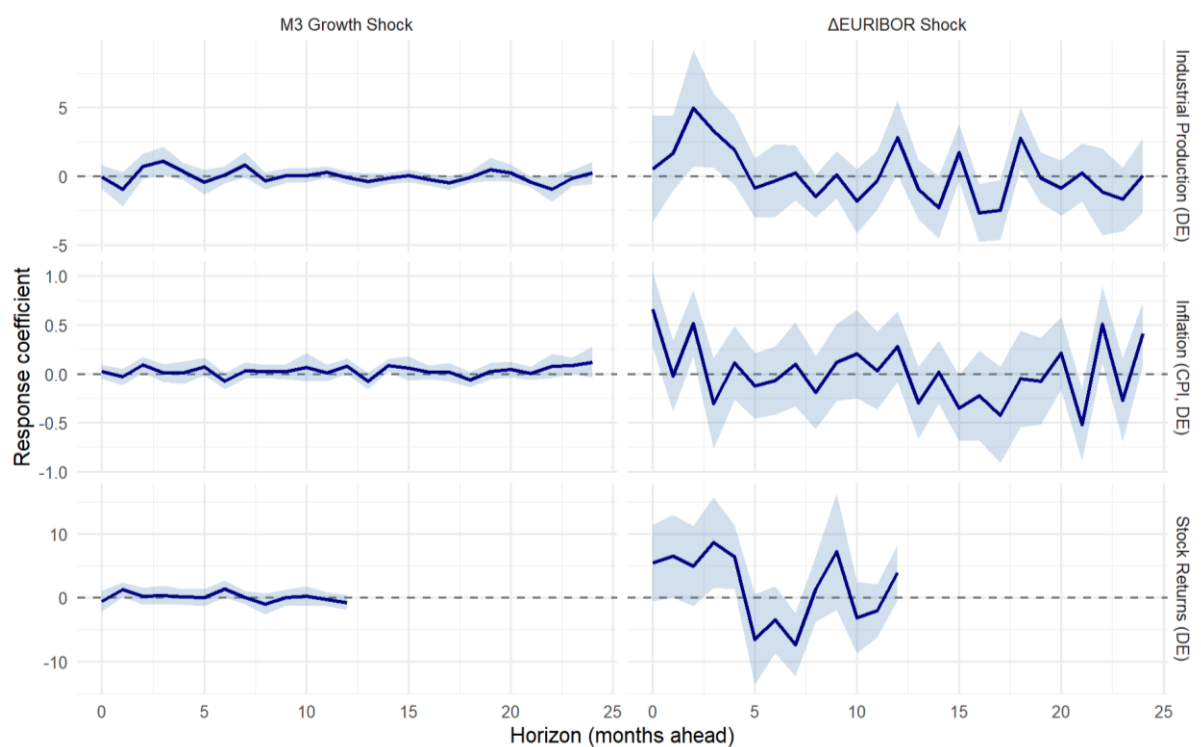


Figure 5: Dynamic Effects of Monetary Policy Shocks (Jordà Local Projections)

Three findings are notable. First, M3 shocks generate no systematic response in any of the three target variables. Point estimates swing around zero across all horizons, and confidence bands comfortably contain both signs throughout. This is consistent with the post-1980s breakdown of money demand stability discussed in Chapter 3.2 and confirms that broad monetary aggregates carry little independent information about the stance of euro area policy. Second, the response of inflation to a Δ EURIBOR shock is weakly negative between roughly five and eighteen months ahead, with point

estimates of around -0.2 to -0.4 percentage points and confidence bands that exclude zero at several individual horizons. This is the only response in the system that is both signed correctly from the perspective of the interest rate channel and reasonably persistent, and it represents the central piece of positive evidence in this report. Third, the response of industrial production to a $\Delta\text{EURIBOR}$ shock is positive and statistically significant for the first three months, which is the wrong sign from a textbook perspective: a contractionary monetary shock should depress, not stimulate, real activity. The most plausible explanation is that the recursive identification has not fully purged the endogenous component of the policy variable, a point we develop further in Chapter 5.4. Stock returns show the analogous pattern, with a counter-intuitive positive response on impact followed by the theoretically expected sharp decline between months five and eight.

Taken together, the local projections reveal what the OLS specification could not: monetary policy does affect the German economy with a delay, and the inflation response aligns with the textbook interest rate channel. At the same time, the persistent output puzzle at short horizons signals that the identification strategy based on $\Delta\text{EURIBOR}$ alone is not fully satisfactory. The following Chapter therefore embeds the same variables in a Cholesky-identified VAR, which provides a complete dynamic system and an alternative test of the same underlying transmission mechanisms.

5.4 Structural Identification

The local projections deliver horizon-wise responses but estimate each one in isolation. A vector autoregression closes this gap by treating the six variables as a complete dynamic system and recovering the impulse responses from a single set of estimated coefficients (Sims, 1980). The identification challenge then reduces to choosing how the contemporaneous innovations are mapped into structural shocks. The most widely used solution in the monetary policy literature is the recursive Cholesky scheme of Christiano, Eichenbaum and Evans (1999), which orders the variables by the speed at which they are assumed to react within the month. The ordering used here is $\text{Commodity} \rightarrow \text{IPI} \rightarrow \text{CPI} \rightarrow \Delta\text{EURIBOR} \rightarrow \text{M3} \rightarrow \text{Stock}$. Commodity prices come first because they are determined in deep global markets and forward-looking by construction, so that any contemporaneous co-movement with the policy variable is more naturally read as the ECB responding to commodity-driven

inflation expectations than the reverse. Industrial production and inflation precede the policy variable on the standard assumption that real and nominal aggregates do not respond to a rate change within the same month. M3 is placed after the policy rate because broad aggregate movements reflect liquidity demand by banks and households that adjusts quickly to a rate decision, and stock returns are ordered last because financial markets price all other innovations contemporaneously. The lag length is selected by AIC within the range of six to twelve months and yields a VAR(12) specification, which is consistent with the Local Projection setup. The maximum modulus of the companion-matrix roots is below one, confirming stability, and the impulse responses reported in Figure 6 are constructed with 90 percent bootstrap confidence bands based on 500 replications.

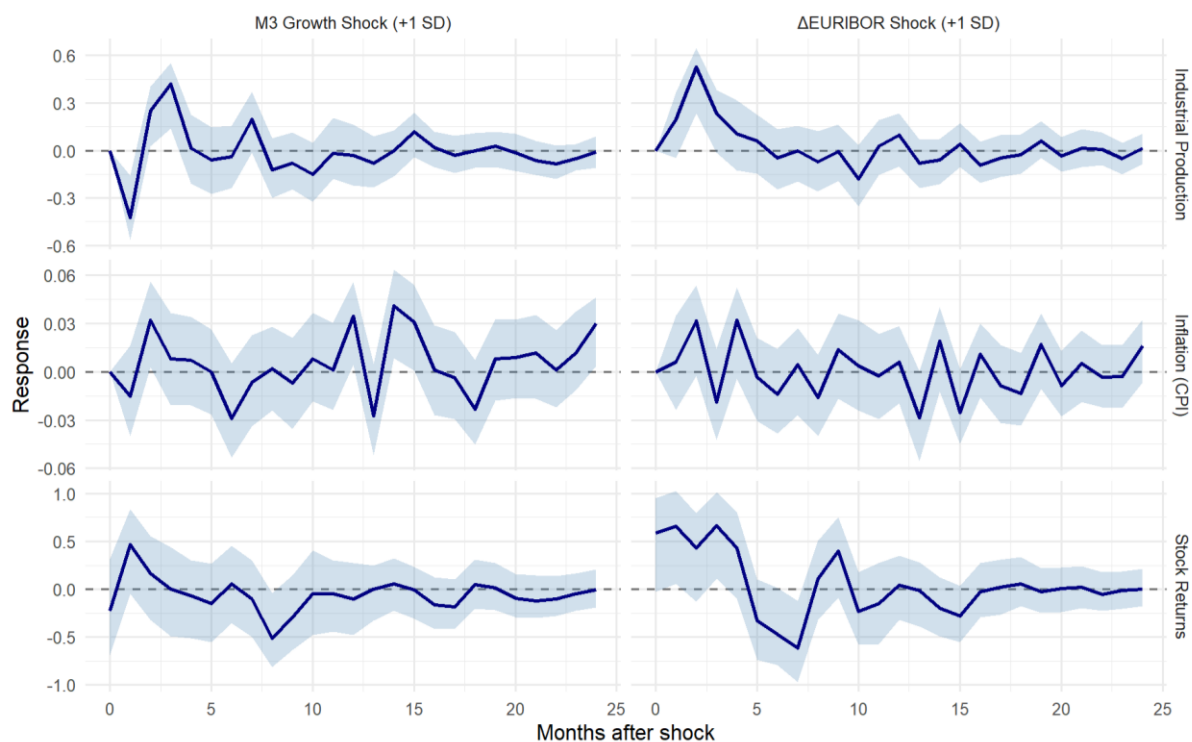


Figure 6: Structural Impulse Response Functions (Cholesky-Identified VAR Model)

The structural results largely equal the Local Projections but show two new patterns. First, M3 shocks again generate no systematic response in any target variable, with point estimates close to zero and confidence bands that span both signs across all 24 horizons. The structural setting therefore confirms what the Local Projections already suggested and what the comparative discussion in Chapter 3.2 anticipated: the broad aggregate carries no independent information about the stance of euro area policy.

Second, the response of industrial production to a $\Delta\text{EURIBOR}$ shock is again positive and statistically significant for the first three months. The persistence of this output puzzle across both methods, despite the inclusion of commodity prices as forward-looking control, is informative. This indicates that the recursive identification still loads the policy innovation with contemporaneous business-cycle information that cannot be removed by the within-month timing assumption. Third, the cleanest structural signal in the system is the response of stock returns to a $\Delta\text{EURIBOR}$ shock, which turns sharply negative between months five and eight, with confidence bands that exclude zero at several individual horizons. This is consistent with the asset price channel discussed in Chapter 3.3 and represents the only response in which the Cholesky identification produces a theory-consistent effect.

The two methods therefore tell a coherent story. Where the local projections and the VAR agree, the underlying mechanism is most plausibly identified: M3 shocks are uninformative, the asset price channel operates with the expected sign and timing, and the contractionary effect on inflation is at best modest and short-lived. Where they disagree or both fail, namely in the response of real activity to a $\Delta\text{EURIBOR}$ shock, the most plausible reading is not that monetary policy does not depress output, but that recursive identification on monthly data is not powerful enough to recover this response in the presence of a strong endogenous component in the policy rate. Disentangling the two would require either an external instrument such as high-frequency surprises around ECB announcements (Jarociński & Karadi, 2020) or a non-recursive identification scheme based on sign restrictions, both of which fall outside the scope of this report and are returned to in the conclusion.

6. Conclusion

This report has examined how conventional ECB monetary policy instruments transmit to the German economy over the 1999 to 2023 period, using a baseline OLS specification, local projections, and a Cholesky-identified VAR. Three findings emerge consistently across the dynamic and structural specifications. M3 shocks generate no systematic response in German prices, real activity, or equity returns, which confirms that the broad monetary aggregate carries little independent information about the stance of euro area policy and is consistent with the post-1980s breakdown of money

demand stability (Estrella & Mishkin, 1997). The asset price channel operates as theory predicts: a positive $\Delta\text{EURIBOR}$ shock depresses German equity returns sharply between months five and eight in both specifications. The contractionary effect on inflation is weakly visible in the local projections but not robust to the structural setting, and the response of industrial production exhibits a persistent output puzzle. Three points should be noted. Both methods still leave business cycle information in the $\Delta\text{EURIBOR}$ innovation. The recursive timing assumptions are just not enough to separate the two cleanly. This is likely what drives the output puzzle. The zero lower bound period dominates a substantial share of the identifying variation, since EURIBOR remained negative for almost eight years between 2014 and 2022. And by pooling pre-crisis, zero lower bound and tightening episodes into a single specification, the estimated responses describe an average effect across very different policy regimes rather than a regime-specific transmission mechanism.

Each of these limitations points to a natural extension. High-frequency identification using policy surprises around ECB announcements (Jarociński & Karadi, 2020) would isolate the unexpected component of policy decisions. State-dependent local projections would allow the transmission to differ across regimes. Comparing the German responses with analogous specifications for the southern member states would directly address the policy-relevant question of whether conventional ECB instruments produce uniform or asymmetric effects across the currency union.

The conventional ECB toolkit affects German outcomes mainly through asset prices, less reliably through inflation, and not measurably through the broad monetary aggregate. For an economy whose central bank legacy is built on a price-stability mandate, the evidence that conventional instruments transmit most reliably to equity markets rather than to the price level is a finding worth taking seriously.

7. References

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