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## Monetary Policy Spillovers to Polish Financial Markets

Wpływ zagranicznej polityki pieniężnej na rynki finansowe  
w Polsce

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### Abstract

This paper analyses the impact of monetary policy shocks from large advanced economies on Polish financial markets. I explore the spillovers from the US Federal Reserve's and European Central Bank's monetary policy decisions, differentiating between the effects of monetary policy and information shocks. The results suggest that the spillovers from US monetary policy are stronger and move Polish government and corporate bond yields, equity prices and the exchange rate significantly in the weeks following the announcement. At the same time, information shocks following monetary policy events in the euro area seem to have a significant effect on Polish financial markets. The findings may have interesting implications from the perspective of financial market functioning and policy-related financial market monitoring of a small open economy.

### Streszczenie

Artykuł analizuje wpływ nowych informacji, które dotyczą polityki pieniężnej w dużych gospodarkach rozwiniętych, na polskie rynki finansowe. Autorka bada międzynarodowe efekty polityki pieniężnej Systemu Rezerwy Federalnej Stanów Zjednoczonych i Europejskiego Banku Centralnego, dokonując rozróżnienia między efektami polityki pieniężnej a szokami informacyjnymi banku centralnego. Wyniki badania pokazują, że międzynarodowe efekty polityki pieniężnej Stanów Zjednoczonych są silniejsze i znacząco wpływają na stopy zwrotu polskich obligacji rządowych i przedsiębiorstw, ceny akcji i kurs walutowy w tygodniach po publikacji. Jednocześnie szoki informacyjne, do których dochodzi po publikacjach Europejskiego Banku Centralnego, również istotnie wpływają na polskie rynki finansowe. Wyniki te mogą mieć ciekawe konsekwencje w kontekście funkcjonowania i analizy rynków finansowych w małej gospodarce otwartej.

## Introduction

Monetary policy decisions by central banks in large advanced economies have a significant impact on global financial markets. In particular, for smaller markets, foreign monetary policy events may have large and lasting effects. The channels of such spillovers may be twofold. Central bank decisions may have a financial market effect as it constitutes news about the monetary policy stance and the expected evolution of interest rates. At the same time, it can impact the market as it also carries new information about the state of the economy, which is revealed through the policy announcement. Consequently, the size and nature of the shock transmission have important implications for the functioning of domestic markets and for policy-related market analysis and monitoring. This paper investigates the spillovers from the US Federal Reserve's and the European Central Bank's monetary policy decisions on Polish financial markets, differentiating between the effects of monetary policy and central bank information shocks. The results suggest that monetary policy in the United States strongly impacts the Polish financial market, in line with the literature claiming that it is a major driver of international market movements. At the same time, information effects originated in the largest economic area in the proximity of Poland also have relevant spillovers on the Polish financial market.

This work builds on the literature studying the international spillovers of monetary policy, including, for example, [Rey \[2016\]](#), [Dedola, Rivolta and Stracca \[2017\]](#), as well as [Miranda-Agrippino and Rey \[2020\]](#). These papers illustrate that US monetary policy is a powerful factor influencing international economic developments and financial market movements. A comparison between the strength of spillovers from US and euro area monetary policy decisions has been studied by [Ca' Zorzi et al. \[2021; 2020\]](#), [Chen et al. \[2017\]](#) and, in a broader advanced economy context, by [Kearns, Schrimpf and Xia \[2018\]](#). For example, [Ca' Zorzi et al. \[2020\]](#) show that Federal Reserve monetary policy shocks have a larger impact on international financial and real variables than ECB-originated shocks. For ECB-originated monetary policy spillovers, [Bluwstein and Canova \[2016\]](#) compare the relevance of several transmission channels and analyse various recipient country characteristics.

In a broader comparison among countries, [Kearns, Schrimpf and Xia \[2018\]](#) show that the largest spillovers originate from the United States, but also that the magnitude of spillovers is strongly related to the financial openness of a country. In a study focusing on three selected emerging market economies, [Gajewski et al. \[2019\]](#) explore monetary policy spillovers from the United States and the euro area to domestic bank lending in Poland, arguing that FX liquidity mismatches might affect the vulnerability of a financial system to foreign spillovers.<sup>1</sup> For Polish financial markets, [Goczek and Mycielska \[2017\]](#) show that the Polish interest rates adjust to changes in interest rates in the euro area,<sup>2</sup> while [Janus \[2020\]](#) finds relatively modest volatility spillovers, defined as increases in conditional correlations, between euro area monetary policy decisions, also including unconventional policy measures, and Polish macro-financial variables.<sup>3</sup>

In some recent studies on the international spillovers of monetary policy, the differentiation between monetary policy and central bank information shocks has been accounted for, as introduced in [Jarociński and Karadi \[2020\]](#), and discussed, for example, in [Andrade and Ferroni \[2021\]](#), [Cieslak and Schrimpf \[2019\]](#), [Kerssenfischer \[2019\]](#) as well as [Nakamura and Steinsson \[2018\]](#).<sup>44</sup> This paper contributes to the existing liter-

<sup>1</sup> In a related study, [Moder \[2021\]](#) analyses the interest rate pass-through of euro area monetary policy to retail rates outside the euro area, showing that a significant share of retail rates in euroised countries of Central, Eastern and South-Eastern Europe are linked to the euro area shadow rate, which significantly impacts the transmission rate.

<sup>2</sup> A related finding is documented for several non-euro area EU countries in [Goczek and Partyka \[2019\]](#), [Horvath and Voslarova \[2017\]](#), [Potjagailo \[2017\]](#), and [Benecka, Fadejeva and Feldkircher \[2018\]](#) document spillovers from ECB policy to macro variables, while [Hajek and Horvath \[2018\]](#) also include spillovers from the Fed in this context. In examples of comprehensive cross-country studies on macro spillovers from US monetary policy, [Iacoviello and Navarro \[2019\]](#), as well as [Georgiadis \[2016\]](#) and [Maćkowiak \[2007\]](#), document that these spillovers are sizeable and describe country characteristics that affect the magnitude of spillovers.

<sup>3</sup> In a related study focusing on unconventional monetary policy spillovers, [Apostolou and Beirne \[2019\]](#) find that EME stock and bond markets are susceptible to volatility spillovers from changes in the size of the Federal Reserve's and ECB's balance sheets.

<sup>4</sup> The existence of asymmetric information between the Federal Reserve and the public was documented earlier, for example in [Romer and Romer \[2000\]](#).

ature on monetary policy spillovers by exploring the market impact, following Federal Reserve and ECB policy decisions, for an example of a small open economy in the proximity of the euro area, while also accounting for the difference between pure monetary policy and central bank information shocks.

This paper analyses the size and nature of monetary policy spillovers to Polish financial markets with local projections, which is the approach introduced by [Jorda \[2005\]](#). I use pure monetary policy and information shock series as identified in a Bayesian structural vector autoregression by [Jarociński and Karadi \[2020\]](#) for the United States and the euro area. The model in their paper includes financial market variables and identifies their developments within a high-frequency window after central bank announcements. The shocks are identified employing sign restrictions, and assuming that tightening monetary policy shocks move interest rates up while suppressing equity market prices within a half-hour window around FOMC announcements. Such shocks lead to a contraction in output and the price level, and a tightening of financial conditions. Positive central bank information shocks move interest rates as well as equity prices up, while also leading to a higher price level and real activity, as well as looser financial conditions. To assess the international spillovers of these two shocks, I use series provided by [Jarociński and Karadi \[2020\]](#) in local projections where the dependent variables are Polish government bond yields, corporate spreads, equity prices and the exchange rate. The impact of monetary policy and information shocks from the two advanced economy central banks is identified over a horizon of several weeks following the shock.

The results suggest that spillovers from US monetary policy are stronger than those from the euro area, and move Polish government and corporate bond yields, equity prices and the exchange rate significantly in the weeks following the announcement. In particular, the 10-year sovereign yield significantly increases by between 50 to 100 basis points within seven weeks after a US policy event, while the WIG20 significantly drops by around 2% to 3% throughout this period. US monetary policy shocks also result in a marked depreciation of the Polish currency and a significant increase in high-yield corporate funding costs. For the euro area, the magnitude and significance of monetary policy spillovers is somewhat lower than for pure monetary policy shocks originating in the United States.

At the same time, central bank information shocks following euro area monetary policy events have significant and persistent effects on Polish financial markets. In particular, following a positive information shock originating from a European Central Bank policy announcement, the Polish sovereign yield declines by around 1–1.5 percentage points during the first three months after the event, while the equity index is significantly up by around 6% throughout the estimation period. Furthermore, the Polish zloty exchange rate appreciates vis-à-vis the euro and the Polish high-yield corporate spread tightens significantly. In contrast, the spillovers of information effects from the United States are insignificant. Overall, these results suggest that financial market functioning and policy-related financial market monitoring in a small open economy like Poland needs to account for global monetary policy effects as well as novel information content embedded in large advanced economies' central bank announcements.

The remainder of the paper is structured as follows. Section 2 describes the data, includes their summary statistics and introduces the estimation methodology. Section 3 discusses the results of the impact of monetary policy and information shocks on Polish financial markets. Section 4 concludes.

## Data and methodology

The data used in this paper covers a 16-year period from 7 January 2005 to 21 January 2022. All variables are computed on weekly frequency and the sample covers 890 weeks. To comprehensively assess the reaction of the Polish financial markets to monetary policy shocks, I use the following variables, representing various market segments:

- 10-year government bond yield (in percentage points),
- equity index WIG20 (in logs),

- high-yield corporate bond spread (in basis points), defined as the difference between ICE Bank of America high-yield emerging markets corporate plus Poland issuers index to Polish 10-year government yield, as well as
- the exchange rate of the Polish zloty to the US dollar or to the euro, for the US and euro area shock regressions respectively (in units of PLN to USD and PLN to EUR respectively).

I also use several other financial and economic variables to control for in the regressions. These include the US implied stock market volatility VIX (in percentage points), 10-year US and euro area sovereign yields (in percentage points), as well as the Citigroup Economic Surprise Index for Poland, the United States and the euro area (in percent). The data on the exchange rates is from Haver, while the rest of the variables are sourced from Refinitiv Datastream. The daily time series are transformed to weekly frequency by using end-of-week observations.

The shock series used in this study are provided by [Jarociński and Karadi \[2020\]](#). I use the pure monetary policy and central bank information shock series for the United States and the euro area, as identified in their Bayesian structural vector autoregression model, which includes a set of real and financial variables. The model in their paper analyses the developments of financial market variables within a high-frequency window after central bank announcements. The shocks are identified employing sign restrictions, and assuming that tightening monetary policy shocks moves interest rates up while suppressing equity market prices within a half-hour window around FOMC announcements. Such shocks lead to a contraction in output and the price level, as well as a tightening of financial conditions. Positive central bank information shocks move interest rates as well as equity prices up lead to a higher price level and real activity, as well as looser financial conditions. The frequency of the provided shock series is daily. I use the sum of the daily shocks to convert the data to weekly frequency. Table 1 shows the descriptive statistics of the data used in this paper.

To assess the spillovers of monetary policy and information shocks from the Federal Reserve and the European Central Bank, I use the shock series provided by [Jarociński and Karadi \[2020\]](#) in local projections where the dependent variables are Polish government bond yields, corporate spreads, equity prices and the exchange rate. In particular, I estimate the following set of equations, following [Jorda \[2005\]](#), to assess the cumulative response of a variable of interest over a set of horizons  $h$ ,  $h=1, 2, \dots, 12$  weeks:

$$y_{t+h} - y_{t-1} = a^h + \beta^h s_t + \Gamma X_{t-1} + \varepsilon_{t+h} \quad (1)$$

where  $y_t$  is the Polish government bond yield (corporate spread, log equity price or the exchange rate respectively) in week  $t$ ,  $\beta^h$  is the coefficient of interest, capturing the reaction of the dependent variable to an identified shock  $s_t$ , which is either a pure monetary policy shock or an information shock of either the Federal Reserve or the European Central Bank. The model assumption underlying the shock identification is analogous to that in [Jarociński and Karadi \[2020\]](#), implying that pure monetary policy and information shocks are among the drivers of financial market variables. The specification of local projections assumes that the considered shocks may be driving Polish financial markets, alongside other drivers, such as domestic shocks.

$X_{t-1}$  in equation 1 is a vector of lagged control variables, with  $\Gamma$  being the vector of coefficients. These variables include the level of VIX, to control for global financial market uncertainty, as well as the level of the US 10-year sovereign yield (or the euro area yield for the regressions with the euro area shock), to control for the overall level of the funding costs in the advanced economy where the shock originates. The controls further include the differential between the levels of the Polish and US indices of economic surprises (or the euro area index for the regressions with the euro area shock), used to control for the difference in the unexpected information about the state of the business cycle. I also include dummy variables for weeks of the peak of the global financial crisis as well as the peak of the COVID-19 turmoil as control variables, defined as 12/09/2008–27/02/2009 and 14/02/2020–24/04/2020 respectively. The introduction of these dummies helps to ensure that the regression results are not biased by the strong financial market effects observed during these two turbulent episodes.  $\varepsilon_t$  is the error term.

**Table 1. Descriptive statistics**

Variable	N	Min	Max	Median	Quartile 1	Quartile 3	Mean	St. Dev.
Polish financial market variables								
10-year yield – PL	890	1.16	7.01	4.18	2.94	5.64	4.17	1.55
Equity index – WIG20	890	1366	3900	2326	2122	2513	2372	462
Equity return – WIG20	890	-0.26	0.16	0.00	-0.02	0.02	0.00	0.03
PLN/EUR	874	3.20	4.76	4.18	3.99	4.31	4.15	0.27
PLN/USD	890	2.03	4.24	3.30	3.03	3.77	3.35	0.47
Corporate spread	890	-287.40	1981.50	229.75	123.98	429.80	330.90	336.22
Corporate yield	890	0.69	26.04	6.81	3.28	9.82	7.48	4.35
Monetary policy shocks								
Pure monetary policy shock – Fed	890	-0.25	0.12	0.00	0.00	0.00	0.00	0.02
Information shock – Fed	890	-0.15	0.07	0.00	0.00	0.00	0.00	0.01
Pure monetary policy shock – ECB	890	-0.08	0.18	0.00	0.00	0.00	0.00	0.02
Information shock – ECB	890	-0.12	0.06	0.00	0.00	0.00	0.00	0.01
Other financial market and economic variables								
10-year yield – US	890	0.54	5.23	2.57	1.91	3.57	2.75	1.12
10-year yield – EA	890	-0.73	4.69	1.51	0.28	3.26	1.70	1.62
VIX	890	9.14	79.13	16.28	12.95	21.90	18.96	9.21
CESI – PL	890	-139.60	138.00	7.50	-17.58	33.20	8.50	40.24
CESI – US	890	-1.41	2.59	0.03	-0.25	0.36	0.06	0.51
CESI – EA	890	-301.20	211.90	6.35	-31.90	50.08	6.69	68.94

Notes: The table shows the descriptive statistics of the variables used in the estimations. The first panel covers the dependent variables, the second panel includes information about the used shocks, while the third panel covers the control variables.

Source: Refinitiv Datastream, Haver, [Jarociński and Karadi \[2020\]](#) data and own calculations.

## Results

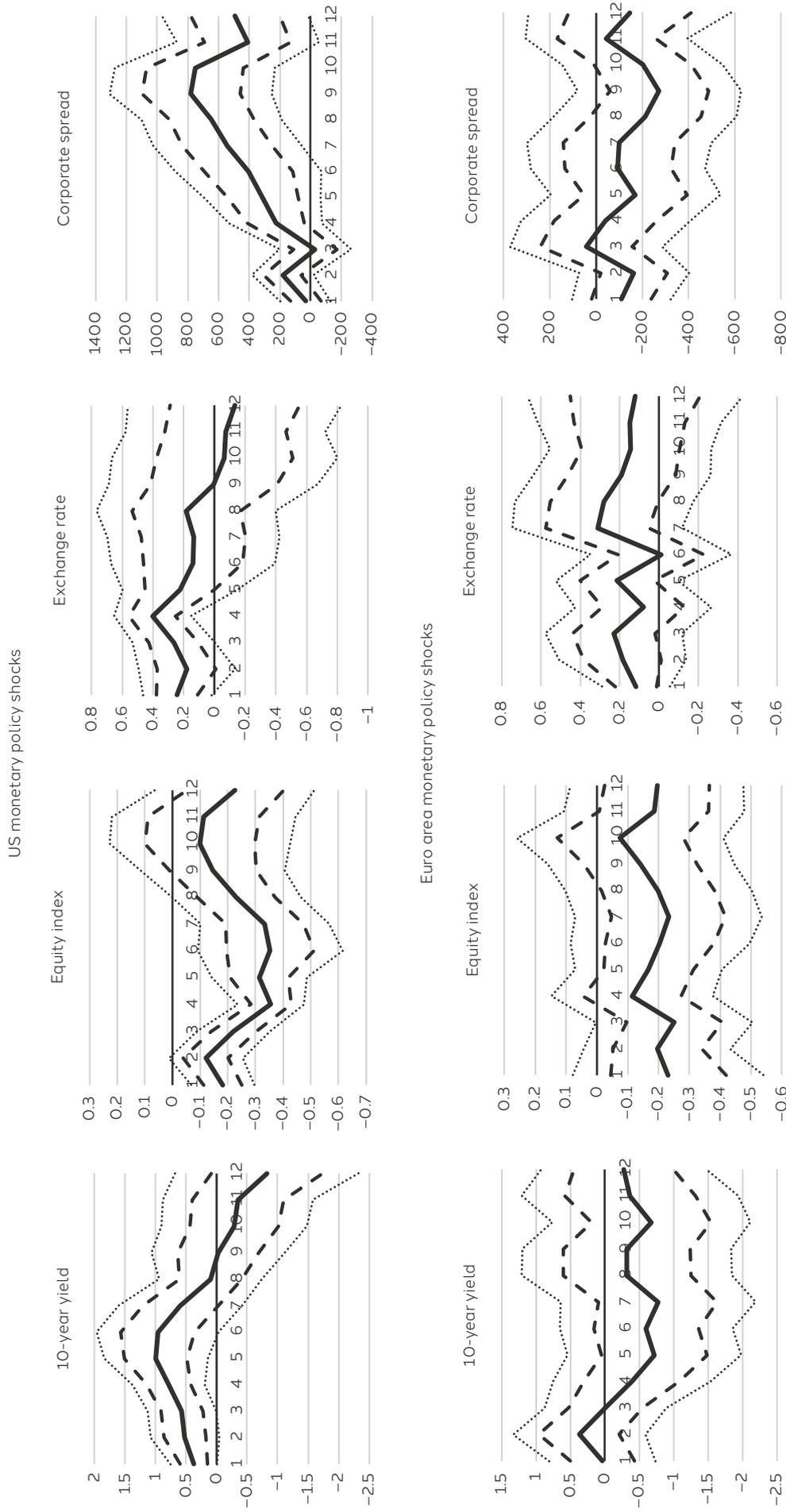
This section discusses the estimation results of the reaction of Polish financial markets to pure monetary policy shocks and central bank information shocks originating from the United States and the euro area.

To illustrate the magnitude of the shocks, [Jarociński and Karadi \[2020\]](#) show that one standard deviation of a US monetary policy shock corresponds to an around 5 basis point-increase of the three-month fed funds futures and an around 40 basis point-drop in the S&P 500 index in the 30-minute window around the Federal Open Market Committee announcement. The central bank information shock is associated with an around 3 basis point-increase in the three-month fed funds futures and an around 30 basis point-increase in the S&P 500 index in the announcement window. Consequently, 1-year US government bond yield increases by around 5 basis points and the equity index drops by approximately 1% in the initial months following the pure monetary policy shock. After the central bank information shock, 1-year sovereign yield increases by around 10 basis points and the S&P500 increases by around 0.6% in the consecutive months.<sup>5</sup> For the euro area, the pure monetary policy shock corresponds to an around 5 basis point drop in 1-year German yield and an around 1% drop in the euro area equity index (Euro Stoxx 50) in the initial months following the announcement. After the central bank information shock, the 1-year sovereign yield increases by around 5 basis points, and the equity index increases by around 0.9% in the consecutive months.<sup>6</sup>

<sup>5</sup> See also Figure 2 in [Jarociński and Karadi \[2020\]](#).

<sup>6</sup> See also Figure 6 in [Jarociński and Karadi \[2020\]](#).

Figure 1. Impulse response functions to monetary policy shocks



Notes: The figure shows the impulse response functions of (1) the Polish 10-year sovereign yield, (2) the log of the WIG20 equity index, (3) the PLN/US (PLN/EUR) exchange rate, and (4) the spread of Polish high-yield corporate bonds vis-à-vis sovereign bonds, to pure monetary policy shocks identified around FOMC (upper panel) and ECB (lower panel) monetary policy announcements. The magnitude of the US shock corresponds to an increase in the 1-year US government bond yield by around 5 basis points and a drop in the equity index by approximately 1% in the initial months following the shock. For the euro area, the pure monetary policy shock corresponds to an around 5-basis-point drop in the 1-year German yield and an around 1% drop in the euro area equity index (Euro Stoxx 50) in the initial months following the policy announcement. The solid lines represent the estimated impulse responses, while the dashed and dotted lines correspond to 68% and 90% confidence intervals, respectively.

Source: Refinitiv Datastream, Haver, [Jarociński and Karadi \[2020\]](#) data and own calculations.

Figure 1 presents the impulse response functions of key Polish financial market variables to pure monetary policy shocks. The results illustrate that the spillovers from US monetary policy decisions to Polish markets are lasting and significant (top panel of Figure 1). The 10-year sovereign yield significantly increases by between 50 and 100 basis points within the first seven weeks after a US policy event, while the WIG20 index significantly drops by around 2% – 3% throughout this period. US monetary policy shocks also result in a marked depreciation of the Polish currency (by around 0.2 points) and a significant increase in high-yield corporate funding costs, amounting to around 200–600 basis points over the sovereign yield. For the euro area, the magnitude and significance of monetary policy spillovers is somewhat lower than for pure monetary policy shocks originating in the United States (bottom panel of Figure 1). The WIG20 equity index drops by around 2%, while the PLN/EUR exchange rate depreciates by around 0.1–0.2 points, with greater uncertainty than for US shocks. The responses of the Polish financial market variables are in most cases not statistically different from zero.

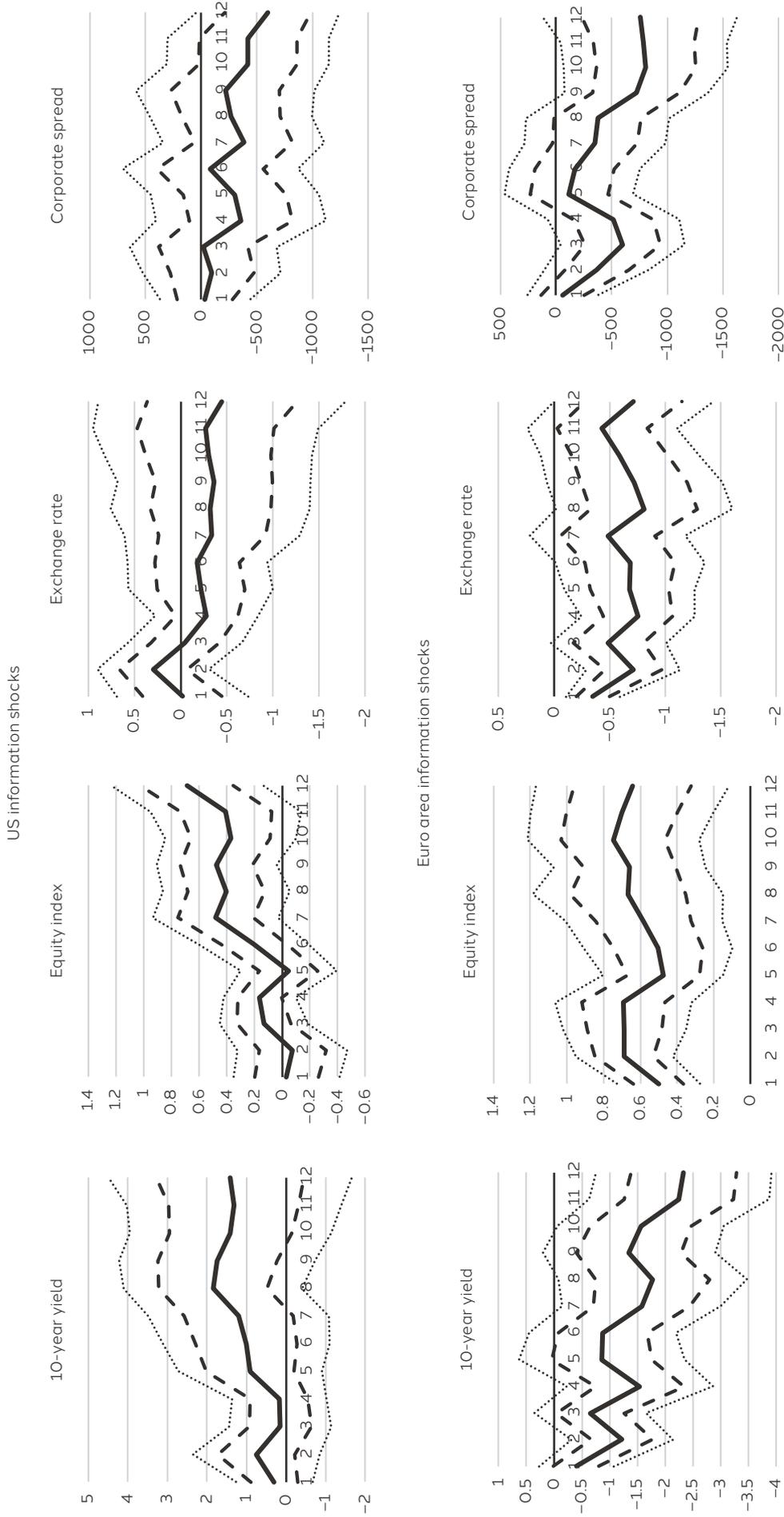
These results are overall in line with the evidence in the literature discussed in Section 1, which shows that US monetary policy is the key source of international spillovers and is also closely related to the global financial cycle, as, for example, in [Dedola, Rivolta and Stracca \[2017\]](#) or [Miranda-Agrippino and Rey \[2020\]](#). Thus the predominant impact of US monetary policy, compared with euro area policy, on Polish financial markets is not surprising. In fact, some studies illustrate also the significant role of the Federal Reserve's monetary policy on euro area variables themselves – see, for example, [Ca' Zorzi et al. \[2021\]](#), [Brandt et al. \[2021\]](#), and [Grothe et al. \[2021\]](#).

For spillovers from central bank information shocks, Figure 2 shows the impulse response functions of the Polish financial market variables for shocks originating from Federal Reserve and European Central Bank policy announcements. The estimation results show that US information shocks induce hardly any spillovers to Polish financial markets, with some upward pressure on the WIG20 index and downward pressure on corporate spreads several weeks after the announcement.<sup>7</sup> However, positive information shocks from the euro area induce econometrically and economically significant spillovers on Polish markets. In particular, following a positive information shock originating from a European Central Bank policy announcement, the Polish sovereign yield declines by around 1–1.5 percentage points during the first three months after the event, while the equity index rises significantly by around 6% throughout the estimation period. Furthermore, the Polish zloty exchange rate appreciates vis-à-vis the euro by around 0.6 points and the Polish high-yield corporate spread tightens significantly by around 600–800 basis points. Overall, Polish financial market variables react to euro area information shocks in a way typical for risky assets. In response to a positive surprise related to economic prospects in the euro area, the valuations of risky assets, both equity and bond prices, increase. Assuming that the risk premia are significantly priced in Polish sovereign yields, this explains why both Polish sovereign and corporate yields decline (i.e., their prices increase) following a positive information shock.

Such a significant response to euro area-originated information shocks, as compared to US-originated shocks, may be attributable to the proximity and strong trade linkages of Poland to the euro area. For example, [Andrle, Garcia-Saltos and Ho \[2013; 2014\]](#) find that developments in the euro zone can explain a significant share of Poland's output and interest rate business cycle variance. The significant role of the information effect on Polish financial markets shown in Section 3 is also consistent with some of the findings in the literature. In a comprehensive comparison of monetary policy and risk shocks across three major economic areas, [Bekaert, Hoerova and Xu \[2021\]](#) show that central bank information shocks originating in the euro area are significant for international spillovers and can produce strong effects on international markets.

<sup>7</sup> The reaction of the sovereign yield and the exchange rate is not significant and, therefore, the signs of these variables cannot be interpreted. But it is interesting that – bearing in mind the lack of statistical power – the sign of the response of the sovereign yield is positive, as opposed to the significantly negative response of the sovereign yield after the ECB information shock. This very weak effect from the Fed information shock might suggest that positive macro-related news from the United States is not sufficient to push the risk premia on Polish sovereign yields down, and only very slightly decreases the risk premia on corporate spreads. If anything, the spillovers from US central bank information shocks are driving the sovereign yield slightly up, suggesting that in this case the global effect of correlation in yields with the US seems to be slightly stronger than the effect of higher risk appetite and decreasing premia on risky assets.

Figure 2. Impulse response functions to information shocks



Notes: The figure shows the impulse response functions of (1) the Polish 10-year sovereign yield, (2) the log of the WIG20 equity index, (3) the PLN/US (PLN/EUR) exchange rate, and (4) the spread of Polish high-yield corporate bonds vis-à-vis sovereign bonds, to central bank information shocks identified around FOMC (upper panel) and ECB (lower panel) monetary policy announcements. The magnitude of the US information shock corresponds to an increase in the 1-year sovereign yield by around 10 basis points and an increase in the S&P500 by around 0.6% in the months following the policy announcement. For the euro area, the 1-year sovereign yield increases by around 5 basis points, and the equity index increases by around 0.9% in the consecutive months. The solid lines represent the estimated impulse responses, while the dashed and dotted lines correspond to 68% and 90% confidence intervals respectively.

Source: Refinitiv Datastream, Haver, [Jarociński and Karadi \[2020\]](#) data and own calculations.

For robustness purposes, I also use the second set of series for pure monetary policy and central bank information shocks, as provided by Jarociński and Karadi [2020], based on the so-called poor man's sign restrictions. The results of the impulse response functions of Polish financial markets are broadly similar.

Overall, the results show that spillovers from US and euro area monetary policy announcements to Polish financial markets are significant and economically relevant. In particular, news about the monetary policy stance and the expected evolution of interest rates in the United States (so-called pure monetary policy shocks), as well as new information about the state of the economy revealed through a euro area policy announcement (so called central bank information shocks) have significant effects on Polish sovereign yields, equity prices, exchange rates and corporate funding costs. These results suggest that US monetary policy strongly impacts the Polish financial market, in line with the literature claiming that it is a major driver of international markets. At the same time, information effects originating in the largest economic area in the proximity of Poland also generate relevant spillovers to the Polish financial market.

## Conclusions

This paper explores the spillovers of monetary policy shocks from large advanced economies to Polish financial markets, differentiating between pure signals about the monetary policy stance and central bank information effects. The results reveal the significant and persistent role of pure monetary policy shocks in the United States for the development of Polish sovereign and corporate yields, equity prices and the exchange rate. Also, the significant role of central bank information effects about euro area economic developments is shown to be a major factor behind spillovers to Polish financial markets. These findings suggest that financial market functioning and policy-related financial market monitoring in a small open economy like Poland needs to account for global monetary policy effects as well as novel information content embedded in central bank announcements in large advanced economies.

Further avenues of research may include an investigation of the conditions in which spillovers are the most significant and lasting. For example, it could be interesting and relevant to explore whether the magnitude and persistence of the spillovers varies and depends, for example, on financial market and economic conditions, such as the level of interest rates, investor risk aversion and uncertainty, or the position of the business cycle.

## References

- Andrade P., Ferroni F. [2021], Delphic and Odyssean Monetary Policy Shocks: Evidence from the Euro Area, *Journal of Monetary Economics*, 117: 816–832.
- Andrle M., Garcia-Saltos R., Ho G. [2013], *The role of domestic and external shocks in Poland: results from an agnostic estimation procedure*, IMF Working Paper No. 2013/220, October 2013.
- Andrle M., Garcia-Saltos R., Ho G. [2014], *A model-based analysis of spillovers: the case of Poland and the euro area*, IMF Working Paper No. 2014/186, October 2014.
- Apostolou A., Beirne J. [2019], Volatility spillovers of unconventional monetary policy to emerging market economies, *Economic Modelling*, 79: 118–129.
- Bekaert G., Hoerova M., Xu N. [2021], *Risk, monetary policy and asset prices in a global world*, SSRN Working Paper, March 2021.
- Benecka S., Fadejeva L., Feldkircher M. [2018], *Spillovers from euro area monetary policy: A focus on emerging Europe*, Česká Národní Banka Working Paper 2018/2.
- Bluwstein K., Canova F. [2016], Beggar-thy-neighbor? The international effects of ECB unconventional monetary policy measures, *International Journal of Central Banking*, 12 (3): 69–120.
- Brandt L., Saint Guilhem A., Schroder M., Van Robays I. [2021], *What drives euro area financial market developments? The role of US spillovers and global risk*, ECB Working Paper No. 2560, May 2021.
- Ca' Zorzi M., Dedola L., Georgiadis G., Jarociński M., Stracca L., Strasser G. [2020], *Monetary policy and its transmission in a globalised world*, ECB Working Paper No. 2407, May 2020.

- Ca' Zorzi M., Dedola L., Georgiadis G., Jarociński M., Stracca L., Strasser G. [2021], *Making waves – Fed spillovers are stronger and more encompassing than the ECB's*, ECB Research Bulletin No. 83, April 2021.
- Chen Q., Lombardi M., Ross A., Zhu F. [2017], *Global impact of US and euro area unconventional monetary policies: a comparison*, BIS Working Paper No. 610, February 2017.
- Cieslak A., Schrimpf A. [2019], Non-monetary News in Central Bank Communication, *Journal of International Economics*, 118: 293–315.
- Dedola L., Rivolta G., Stracca L. [2017], If the Fed sneezes, who catches a cold?, *Journal of International Economics*, 108(1): S23–S41.
- Gajewski K., Jara A., Kang Y., Mok J., Moreno D., Serwa D. [2019], International spillovers of monetary policy: Lessons from Chile, Korea, and Poland, *Journal of International Money and Finance*, 90: 175–186.
- Georgiadis G. [2016], Determinants of global spillovers from US monetary policy, *Journal of International Money and Finance*, 67(C): 41–61.
- Goczek L., Mycielska D. [2017], Actual monetary policy independence in a small open economy: the Polish perspective, *Empirical Economics*, 56(2): 499–522.
- Goczek L., Partyka K. [2019], Too small to be independent? On the influence of ECB monetary policy on interest rates of the EEA countries, *Economic Modelling*, 78(C): 180–191.
- Grothe M., Helmersson T., Quint D., Vassallo D. [2021], *Analysis on spillovers from a potential US equity market correction*, ECB Financial Stability Review Box, May 2021.
- Hajek J., Horvath R. [2018], International spillovers of (un) conventional monetary policy: The effect of the ECB and the US Fed on non-euro EU countries, *Economic Systems*, 42(1): 91–105.
- Horvath R., Voslarova K. [2017], International spillovers of ECB's unconventional monetary policy: The effect on Central Europe, *Applied Economics*, 49(24): 2352–2364.
- Iacoviello M., Navarro G. [2019], Foreign effects of higher U.S. interest rates, *Journal of International Money and Finance*, 95(C): 232–250.
- Janus J. [2020], Is ECB rocking the boat? Unconventional monetary policy in the EMU and volatility spillovers to Poland, *Eastern European Economics*, 58(1): 50–67.
- Jarociński M., Karadi P. [2020], Deconstructing monetary policy surprises – the role of information shocks, *American Economic Journal: Macroeconomics*, 12(2): 1–43.
- Jorda O. [2005], Estimation and Inference of Impulse Responses by Local Projections, *American Economic Review*, 95(1): 161–182.
- Kearns J., Schrimpf A., Xia F. D. [2018], *Explaining monetary spillovers: the matrix reloaded*, BIS Working Paper No. 757, November 2018.
- Kerssenfischer M. [2019], *Information Effects of Euro Area Monetary Policy: New Evidence from High-Frequency Futures Data*, Deutsche Bundesbank Discussion Paper 07/2019.
- Maćkowiak B. [2007], External shocks, U.S. monetary policy and macroeconomic fluctuations in emerging markets, *Journal of Monetary Economics*, 54(8): 2512–2520.
- Miranda-Agrippino S., Rey H. [2020], US Monetary Policy and the Global Financial Cycle, *Review of Economic Studies*, 87(6): 2754–2776.
- Moder I. [2021], *The transmission of euro area monetary policy to financially euroised countries*, ECB Working Paper No. 2611, October 2021.
- Nakamura E., Steinsson J. [2018], High-frequency identification of monetary non-neutrality: the information effect, *Quarterly Journal of Economics*, 133(3): 1283–1330.
- Potjagailo G. [2017], Spillover effects from euro area monetary policy across Europe: A factor-augmented VAR approach, *Journal of International Money and Finance*, 72(C): 127–147.
- Rey H. [2016], International channels of transmission of monetary policy and the Mundellian trilemma, *IMF Economic Review*, 64(1): 6–35.
- Romer C., Romer D. [2000], Federal Reserve information and the behavior of interest rates, *American Economic Review*, 90(3): 429–457.