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What drives the German TARGET balances? Evidence from a BVAR approach

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Non-technical summary

Research Question

The extent to which different factors affect the evolution of Germany's TARGET claims has not yet been researched. These factors might include global or European shocks, or the Eurosystem's monetary policy. To gain a better understanding of current and historical developments in TARGET claims, it is necessary to determine the relevant factors and explain their impact on the evolution of TARGET claims using a suitable model.

Contribution

Using a dynamic multivariate model, we begin by identifying the drivers of Germany's TARGET claims with the aid of sign restrictions. Our approach differentiates between a rise in the global assessment of risk, tensions within the euro area, and European monetary policy as potential causes. The estimated model can be used to determine the impact of the various factors on the TARGET claims at any point in time.

Results

The analysis suggests that TARGET flows between 2015 and 2017 were driven to a very large extent by the Eurosystem's asset purchase programme and to a lesser degree by the risk assessment within the euro area. At the peak of the European debt crisis between 2010 and mid-2012, the dominant factor affecting TARGET flows was uncertainty in the euro area, though the model indicates that global factors played a key role as well.

Nichttechnische Zusammenfassung

Fragestellung

In welchem Ausmaß verschiedene Einflussfaktoren den zeitlichen Verlauf der deutschen TARGET-Forderungen bestimmen, ist bisher nicht erforscht worden. Mögliche Einflussfaktoren sind globale oder europäische Schocks sowie die Geldpolitik des Eurosystems. Um aktuelle und historische Entwicklungen der TARGET-Forderungen genauer erklären zu können, müssen die relevanten Faktoren bestimmt und ihr Einfluss auf die Entwicklung der TARGET-Forderungen im Rahmen eines geeigneten Modells erklärt werden.

Beitrag

In einem dynamischen, multivariaten Modell werden zunächst die Einflussfaktoren der deutschen TARGET-Forderungen mithilfe von Vorzeichenrestriktionen identifiziert. Dabei werden ein Anstieg der globalen Risikobewertung, Spannungen innerhalb des Euroraums und die europäische Geldpolitik als potenzielle Ursachen unterschieden. Das geschätzte Modell kann benutzt werden, um den Einfluss der verschiedenen Ursachen auf die TARGET-Forderungen zu jedem Zeitpunkt zu bestimmen.

Ergebnisse

Die Analyse legt nahe, dass die TARGET-Ströme zwischen 2015 und 2017 zu einem wesentlichen Teil dem Anleihekaufprogramm des Eurosystems und zu einem geringeren Teil der Risikobewertung innerhalb des Euroraums zuzurechnen sind. Während des Höhepunkts der europäischen Schuldenkrise zwischen 2010 und Mitte 2012 wurden die TARGET-Ströme von der Unsicherheit im Euroraum dominiert, doch auch globale Einflüsse spielten dem Modell zufolge eine wesentliche Rolle.

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Abstract

Applying a BVAR model, the present paper first identifies the possible drivers of Germany's TARGET claims. In this context, in terms of potential causes, a distinction is made between a rise in the global risk assessment, tensions within the euro area, and European monetary policy. It becomes evident that the TARGET flows between 2015 and 2017 can be ascribed in large part to monetary policy and to a minor extent to the risk assessment within the euro area. At the peak of the European debt crisis between 2010 and mid-2012, the TARGET flows were affected by uncertainty in the euro area as a dominant factor, although global factors also played a key role according to the model. The BVAR model we use opens up the possibility of studying the causes of current fluctuations in Germany's TARGET claims.

Keywords: target balances, risk, monetary policy, bayesian vector autoregression, sign restrictions

JEL classification: C32, E52, F32.

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1 Introduction

The past 12 years have seen considerable fluctuations in the TARGET balances of the national central banks (NCBs) and the European Central Bank (ECB).[1] The German balances, in particular, were often put under spotlight because of their strong increase to almost €1 trillion for a time. The Eurosystem has already commented on the way this pattern unfolded and identified various causes for individual periods such as global risk, euro area (EA) risk and securities purchases (see, for example, European Central Bank (2013), Deutsche Bundesbank (2016), Deutsche Bundesbank (2017) and Deutsche Bundesbank (2018)). The comments, however, are based on descriptive observations rather than statistical evidence. Consequently, the (quantitative) contributions of the drivers to the developments of the TARGET balances are unknown, too.

This paper aims to quantify the drivers of the German TARGET balances with the help of a Bayesian vector autoregressive (BVAR) model. We identify global risk, EA risk and EA monetary policy as potential drivers by imposing sign restrictions on the impulse response functions of the model. The BVAR model is well suited to decompose the changes in the TARGET balances into the contributions of the afore mentioned drivers. The model can thus be used to estimate and explain current developments in the TARGET balance in near time with regard to how far they are affected by global compared with European shocks or by Eurosystem monetary policy. The results can then be drawn on as guidance for monetary and economic policy decisions.

The emergence of TARGET imbalances across the euro area has led to a controversial discussion on their consequences. While some studies argue that the imbalances entail a potential risk for certain countries, others are less concerned (see, for example, Bindseil, Cour-Thimann, and König (2014), Bindseil and König (2012), Buiter and Rahbari (2012), Hellwig (2018), Sinn (2019), Sinn and Wollmershäuser (2012a), Sinn and Wollmershäuser (2012b) and Whelan (2014)). A second strand of literature focuses on the macroeconomic dynamics between the TARGET balances and other variables. Auer (2014), for example studies the relationships between the TARGET balances, current account balances and private capital flows in a panel analysis. He shows that the evolution of the TARGET balances were uncorrelated with current account dynamics in the pre-crisis period. However, he documents a link in the period thereafter, when private capital flows stopped financing the current account imbalances. Fagan and McNelis (2014) show in a framework of a DSGE model the TARGET financing system helps in mitigating the adverse effects of a sudden stop on output, consumption and investment. Hristov, Hülsewig, and Wollmershäuser (2020) study the developments of the TARGET balances between the onset of the 2008 financial crisis until 2014. They conclude that developments of the TARGET balances can be explained by capital flow shocks, rather than cyclical factors.

The paper is organised as follows: In the following section, we describe the development of the TARGET balances since the launch of the system and motivate our approach. We then present the BVAR model, the corresponding results as well as a robustness analysis

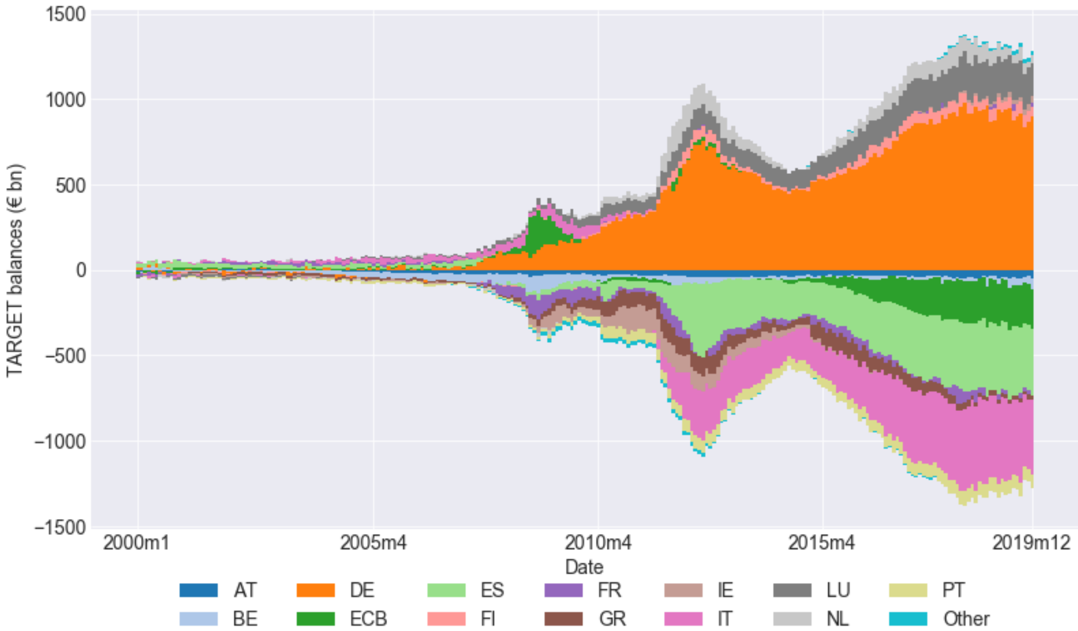
[1]The first generation of TARGET, the real-time gross settlement (RTGS) system owned and operated by the Eurosystem, commenced operations on 4 January 1999, a few days after the launch of the euro. Migration to the more advanced TARGET2 took place in successive stages in 2007 and 2008. The term "TARGET" is used throughout the present paper to refer to both the first and second generation of the system.

in Section 3. Finally, Section 4 concludes.

2 Development of TARGET balances

Since the establishment of European monetary union (EMU) the dispersion of TARGET balances across euro area countries widened considerably (see Figure 1). All in all, we usually distinguish four phases in the development of dispersion of the TARGET balances until the end of 2019:

Figure 1: TARGET claims and liabilities within the Eurosystem



Note: Others represent aggregated data for CY, EE, LT, LV, MT, SI and SK.

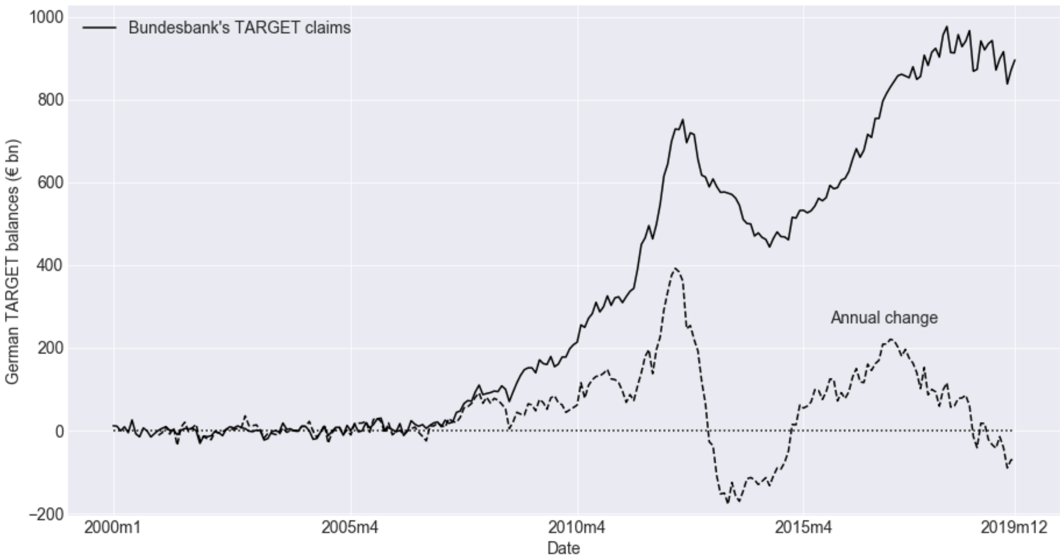
The first phase represents the period after the launch of the third stage of the European economic and monetary union. During this episode, national TARGET claims remained at a relatively low level and happened to change their corresponding sign very often. Transactions of cross-border payments in the euro area occurred largely on the private interbank market.

The second phase was characterised by a sharp increase in TARGET balances and can be divided into two subperiods: The first push was closely related to the outbreak of the global financial crisis, which had its origin in the subprime mortgage crisis in the United States. At the time, an accommodative monetary policy in Europe along with a newly created network of swap agreements between leading global central banks made it possible to provide commercial banks with liquidity despite a collapse of the interbank market. The next expansion of the TARGET funnel followed in the spring of 2010 and became stronger in the year after. This development reached a preliminary peak in the summer of 2012. This was against the backdrop of the European sovereign debt crisis, which was again accompanied by a generous provision of central bank money and an asymmetric utilisation of the funds on offer. At this time, the Eurosystem announced the Securities Markets Programme (SMP) to address the malfunctioning of securities markets and restore an appropriate monetary policy transmission mechanism. However, those operations were sterilised in such a way that the liquidity injected by interventions in the euro area public and private debt securities markets was re-absorbed by specific operations. The ECB also provided liquidity by fixed-rate tender procedures with full allotment in longer-term refinancing operations (LTROs) with different maturities.[2]

The TARGET funnel shrank during the years 2012 to 2014 (third phase). The statement of the then governor of the ECB to do whatever it takes to preserve the euro as well as the outright monetary transactions program, which has not yet been used, helped to strengthen the confidence of the market participants.

The fourth phase started in mid-2014 and the total European TARGET claims reached a new preliminary peak of almost €1.4 trillion in mid-2018. This increase was not connected with a European or global financial crisis, however. Instead, it reflected the asset purchase program in conjunction with Germany as a financial centre and its role as a gateway to the global financial markets.

Figure 2: Bundesbank's TARGET balance



The TARGET funnel is clearly dominated by the German balances (orange bars in Figure 1). In the first decade following the establishment of EMU, German TARGET balances were either positive or negative, with corresponding balances rapidly going back down or back up again (see Figure 2). In the following years, however, German TARGET balances showed a marked rise and went up to almost €1 trillion for a time. This was not a steady increase, however, and was accompanied by considerable fluctuations. The following econometric investigation is therefore confined to explaining Germany's TARGET balance.

[2]See ECB press release, 10 May 2010.

3 Model

As mentioned above, descriptive analyses suggest that the changes in the German TARGET balances were driven by a rise in the global risk assessment, tensions within the euro area, and European monetary policy. The following sections describe how the effects of those determinants are estimated.

We present two models in this section: The first model is based on yield spreads and the second model is based on capital flows. We clearly prefer the first model for two reasons. First, data are available without any time lag. Capital flows data are only available with a time lag of several months. Second, the results of the first model reflect the European sovereign debt crisis slightly better than those of the second model. Nevertheless, the results of both models are roughly similar, which allows us to focus on the yield spread model and consider the capital flows model as a robustness analysis.

3.1 Data

The determinants of the TARGET balances are estimated using a BVAR model. For estimating the model we use monthly data of $n = 5$ variables: Changes in Germany's TARGET balances compared with the same month of the previous year (variable: $target_t$; in €), yield spread on 10 year bonds of other euro area countries and 10 year Bunds (variable: $EAspread_t$; in pp), yield spread between 10 year US Treasuries and 10 year Bunds (variable: $USspread_t$; in pp), VIX (variable: vix_t; in index points) and change in the sum of all assets of the consolidated balance sheet of the Eurosystem compared with the same month of the previous year affecting monetary policy operations (variable: $balance_t$; in €). More precisely, we take the sum of the balance sheet items 5 (*Lending to euro area credit institutions related to monetary policy operations denominated in euro*) and 7.1 (*Securities held for monetary policy purposes*). Data sources are listed in Table 1.

Table 1: Data sources

Variable	**Source**
TARGET flows	Deutsche Bundesbank (stocks)
Long term interest rates (10 years)	
United States	IMF, International Financial Statistics
Euro Area	ECB, Interest Rate Statistics
Germany	ECB, Interest Rate Statistics
Financial flows	Deutsche Bundesbank, BoP Statistics
VIX	Chicago Board Options Exchange
Eurosystem balance sheet: assets	ECB

For the model, which is based on capital flows, we use German balance of payments data, more specifically net portfolio investment (variable: $portfolio\ investment_t$; in €) and net other investment, which essentially comprises credits and deposits (variable: $other\ investment_t$; in €). Transactions in direct investment are excluded, because they are typically based on strategic consideration and are hence less exposed to short-term impacts. German balance of payments data are obtained from Bundesbank sources.

Our data covers the period from January 1999 to December 2019. Owing to the calculation of the target and balance flows from balance sheet items, only data from January 2000 onward are available for the estimation, however. The effective estimation period is further shortened by the inclusion of lags.

3.2 The BVAR model

The BVAR model is estimated with help of a modified version of the BEAR Toolbox by Dieppe, van Roye, and Legrand (2016). The prior is a Minnesota type prior.[3] In total, 12 lags and thus a whole year of back data are included. The lag length is motivated by the data, which includes cumulative flows. The estimated reduced form BVAR model is written as

$$y_t = c + \sum_{i=1}^{12} A_i y_{t-i} + \epsilon_t, \tag{1}$$

where $y_t = (y_{1,t}, y_{2,t}, \ldots, y_{n,t})$ describes a $n \times 1$ vector of the above-described observations, c a constant, A_i the $n \times n$ coefficient matrices of the observations y_{t-i} lagged by i periods and ϵ_t a $n \times 1$ vector of residuals which follow a multivariate normal distribution (i.e. $\epsilon_t \sim N(0, \Sigma)$). $E(\epsilon_t, \epsilon_t') = \Sigma$ represents the positive definite variance-covariance matrix of the residuals. The sign restrictions, which will be explained in the following sections are imposed according to Arias, Rubio-Ramírez, and Waggoner (2018).

3.3 Specification and identification of the yield spread model

By means of sign restrictions on the impulse-response functions, the model is converted into a structural form so that the shocks can be interpreted economically. These restrictions are set up so that they have to be fulfilled only when the shock occurs, i.e. simultaneously. All the shocks are defined so that they lead to an increase in the $target_t$ variable. The other restrictions are selected as follows (see Table 2):

1. Risk (global): In line with the assumption, a global risk shock leads to strong capital flows to the United States and also to Germany. Both countries are seen as safe havens. Because of the United States' outstanding role as a global safe haven, the decline in yields in the US should more than offset the decline in Germany, however, leading to a compression of the positive yield spread between US Treasuries and Bunds during the observation period. Based on the same line of argument, an increase in the yield spread between bonds of other euro area countries and Bunds is to be expected. The higher risk should be reflected in a rise in VIX.[4] These

[3] A robustness analysis with an uninformative Minnesota type prior delivered qualitatively similar results.

[4] Generally, there is a wide range of measures that reflect uncertainty. In this paper, we use the VIX, since it appropriately records risk assessment in financial markets, which are key for the dynamics of the other variables used in this model. Furthermore, its calculation is transparent and the index is timely available in a monthly frequency. Other indicators like survey data, composite indices or indicators based on big data gauge uncertainty in a broader sense and may be more relevant for other economic variables. However, additional information is often bought at the price of less transparency.

sign restrictions are in line with findings by Habib, Stracca, and Venditti (2020), who show that a large VIX shock translates into a decline in US yields, which outweighs the decline in yields of other safe havens (including Germany). They provide evidence, suggesting that the special role of the US market is partly due to its' depth and liquidity as well as role of the US dollar as international reserve currency.

Table 2: Sign restrictions: Yield spread model

Shock	$target_t$	$EAspread_t$	$USspread_t$	vix_t	$balance_t$
Risk (global)	+	+	-	+	*
Risk (euro area)	+	+	+	+	*
Monetary policy	+	*	*	-	+

Note: A +/− denotes a restriction, which forces a positive/negative impulse response of variable following the corresponding shock. A * shows that the impulse response function of the variable is unrestricted following the corresponding shock.

2. Risk (euro area): The identification of this shock rests on the assumption that an increase in risk in the euro area leads to capital flows from other euro area countries to Germany. The reason for this is that Germany is regarded as a safe haven within the euro area. This should lead to higher yields in other euro area countries. In Germany, by contrast, declining yields are to be expected, which should be reflected in an increase in the yield spread between the other euro area countries and Germany (see Habib et al. (2020)). As a result of the lower yields in Germany, the yield spread between US Treasuries and Bunds should also increase. Even though the euro area represents only a (small) part of the global economy, it is to be expected that there will be a tendency for VIX to rise due to international financial linkages (see Gilbert (2019)).

3. Monetary policy (euro area): Owing to Germany's particular role in international investment within the euro area, an increase in central bank liquidity and especially the Eurosystem's asset purchase programme also lead to rising German TARGET claims. In this case, there would be a simultaneous rise in the Eurosystem's claims from monetary policy operations, which is seen here as crucial for the monetary policy impulse of the TARGET flows. European Central Bank (2013) provides a detailed discussion on the relationship between TARGET balances and monetary policy operations. Ideally, the monetary policy operations would lead to a compression of the euro area spread (see Baumeister and Benati (2013)) and in line with the previous shock also a decline in the VIX (see Gilbert (2019)). We do the estimation without a restriction on the euro area yield spread, in order to have an identical identification with respect to the capital flows model in section 3.4.[5]

4. Unidentified shocks: These remaining shocks are defined so that, overall, no combination of impulse response functions is excluded and each shock nevertheless pos-

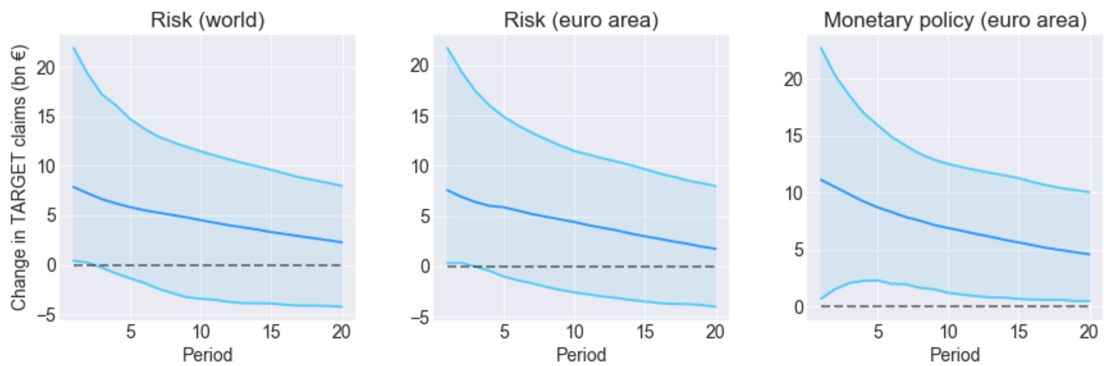
[5]Estimating the model with a negative restriction on $EAspread_t$ yields qualitatively similar results. Results are available upon request.

sesses an individual pattern, i.e. all shocks are orthogonal to each other. The shocks are included for purely econometric reasons and cannot therefore be interpreted in economic terms.[6]

3.3.1 Impulse response analysis

This subsection investigates the dynamic effects of the identified shocks on the German TARGET claims using impulse response analysis (see Figure 3). The sign of each impulse response functions is pre-determined by a sign restriction, but the quantitative effect as well as the persistence of each shock is determined by the data and the priors. We show the 95% credible interval of the German target claims' impulse response functions following each identified shock (one standard deviation). The corresponding intervals correspond to the areas shaded in blue. The dark blue line is the median of each interval.

Figure 3: Impulse response functions of German TARGET claims



Note: Figures show 95% credibility intervals (blue area) and the medians (dark blue lines) of IRFs following different shocks.

The monetary policy shock, which corresponds to an annual increase in the ECB's balance sheet by €26,704bn (median) on impact, has the strongest effect on the change in TARGET claims (annual increase by €11,128 bn (median) on impact) and yields also the response with the highest persistence.

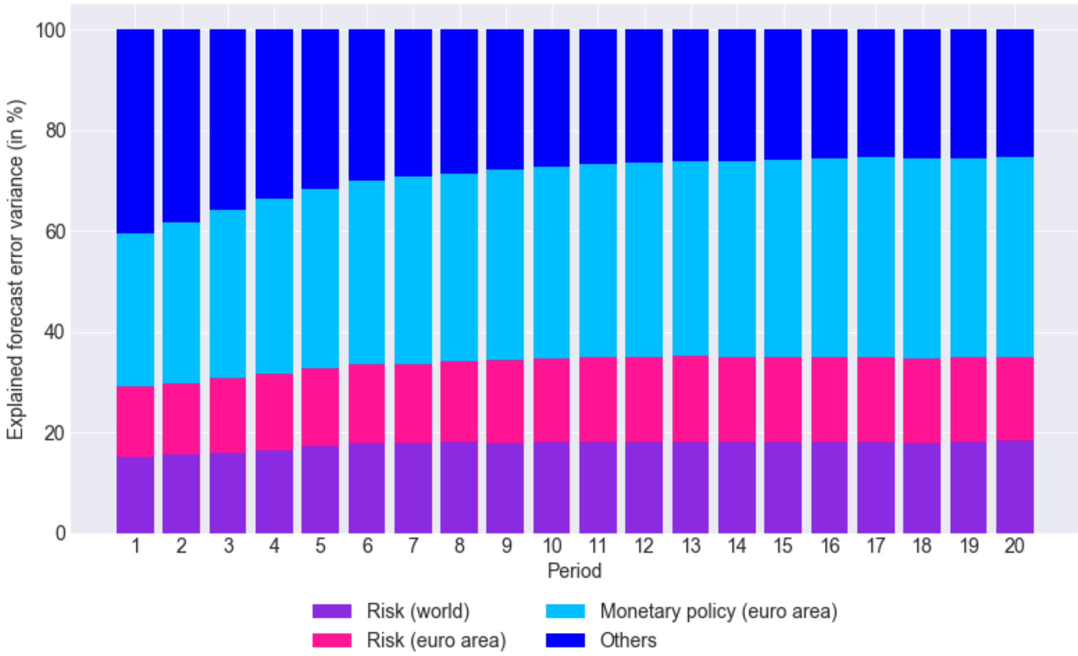
3.3.2 Forecast error variance decomposition

We also analyse the contributions of the identified shocks to the German TARGET balance forecast error variance. Figure 4 shows the individual shares after different time horizons. We observe that there is no shock, which dominates the TARGET balance variability. It is rather the case that all shocks are important, even though the level of importance varies slightly across the different shocks. In line with the impulse response analysis, we see that euro area monetary policy shocks explain a relatively high share (30% to 40%, depending on the forecast horizon) of forecast error variance. Both risk shocks together

[6] We modified the BEAR Toolbox in order to include such unidentified shocks. In the present case, two shocks are required to consider all sign restrictions not already implied by the identified shocks.

account for approximately 29% to 35% of the German TARGET balances' forecast error variance, depending on the forecast horizon. The forecast error variance decomposition, however, is silent about the contribution of the shocks at different times. Such a historical decomposition of the time series will be computed in the next section.

Figure 4: Forecast error variance decomposition of German TARGET balances



Note: Figure shows the shares of German TARGET balance forecast error variance, which is explained by specific shocks, over different forecast horizons.

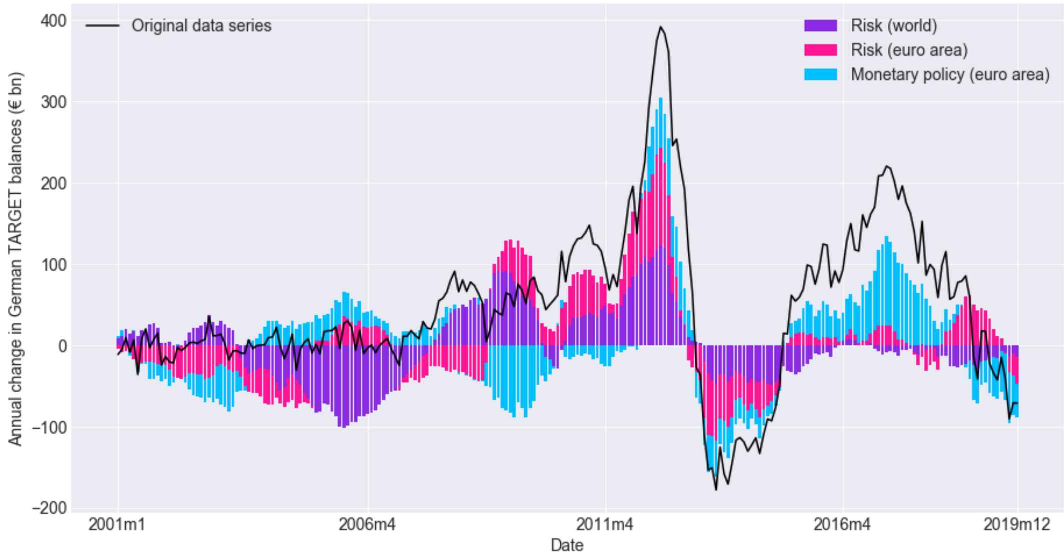
3.3.3 Historical decomposition

The BVAR estimation permits the time series of all the variables involved to be broken down into components which are to be assigned to the shocks defined above. Figure 5 shows this for the annual growth of Germany's TARGET balance, with neither the unidentified shocks nor the constant being depicted.

It becomes evident that the positive TARGET flows between 2015 and 2017 can be ascribed in large part to European monetary policy (i.e. the APP) and, to a lesser extent, to the risk assessment within the euro area. At the peak of the European debt crisis between 2010 and mid-2012, the TARGET flows were affected by uncertainty in the euro area as a dominant factor, although global factors also played a key role according to the model. Finally, the temporary rise in Germany's TARGET balances during the global financial crisis can be attributed – to a large part – to contributions by the global risk shock.

Apparently, monetary policy has gained importance for the dynamics of German TARGET balances in recent years. Interestingly, this is especially true for relatively *calm* periods, when global or European risk shocks were not prevalent. Whereas quantitative easing has substantially increased German TARGET balances due to the financial architecture in Europe, the normalization of monetary policy between mid-2012 and end

Figure 5: Historical decomposition of German TARGET balances (yield spread model)



Note: Figure shows time-specific contributions of shocks to the motion of the annual changes in the German TARGET balance.

2014 or in 2018 entailed a noticeable TARGET outflows from Germany. This means that high TARGET balances in the euro area are reversible, if the economic environment and monetary policy enter calmer water. However, it should be kept in mind that TARGET balances are not an objective in its own for monetary policy, but rather an indicator of possible asymmetries between euro area member states.

3.4 Specification and identification of the capital flows model

Similarly to the price-based definition of the driving forces behind TARGET flows, the analysis can also focus on Germany's private capital flows with other euro area member states and with the rest of the world. This way of looking at things is based on the thinking that a large part of German capital exports via TARGET transactions co-exists with transactions in specific categories of the financial account, namely "portfolio investment" or "other investment". This means that changes in the German TARGET balances are to a large extent mirrored in these financial flows. The geographical breakdown of these transactions can give some insight into the underlying reasons. More specifically, the structure of bilateral net private flows with other euro area members (*intra*) and the rest of the world (*extra*) indicate, whether the main driver is a global shock, a European shock or monetary policy. We create two variables in order to capture these flows:

$$
\begin{aligned}
fin-intra_t &= \sum_{i=0}^{12}[portfolio\ inv.^{intra}]_{t-i} + \sum_{i=0}^{12}[other\ inv.^{intra} - target]_{t-i} \\
fin-extra_t &= \sum_{i=0}^{12}[portfolio\ inv.^{extra}]_{t-i} + \sum_{i=0}^{12}[other\ inv.^{extra}]_{t-i}
\end{aligned}
$$

Table 3: Sign restrictions: Capital flow model

Shock	$target_t$	$fin - intra_t$	$fin - extra_t$	vix_t	$balance_t$
Risk (global)	+	-	-	+	*
Risk (euro area)	+	-	+	+	*
Monetary policy	+	*	*	-	+

Note: A +/− denotes a restriction, which forces a positive/negative impulse response of variable following the corresponding shock. A * shows that the impulse response function of the variable is unrestricted following the corresponding shock.

1. Risk (global): In the event of a shock originating outside the euro area and accompanied by a rise in the VIX index, more capital would be likely to flow out of Europe and other countries into the safe haven of Germany. German investment (excluding direct investment and TARGET) both vis-à-vis the rest of the euro area and the rest of the world would thus see net capital imports.[7]

2. Risk (euro area): If the causes of the safe haven flows lay in Europe, capital would also flow into Germany from the European periphery countries. At the same time, German investors are likely to withdraw a part of their capital from the crisis-affected European countries and invest it instead in third countries which would result in additional net capital imports from the euro area and net capital exports to the rest of the world. Moreover, the VIX would rise due to international financial linkages.

3. Monetary policy (euro area): This shock is identified exactly as the shock in the previous model.

4. Unidentified shocks: Again, these shocks are defined so that, overall, no combination of impulse-response functions is excluded and each shock nevertheless possesses an individual pattern.[8]

All the other parameters of the BVAR model remain unchanged from the yield spread model. Table 3 gives an overview of the sign restrictions for identifying the different types of shocks.

3.4.1 Impulse response analysis and forecast error variance decomposition

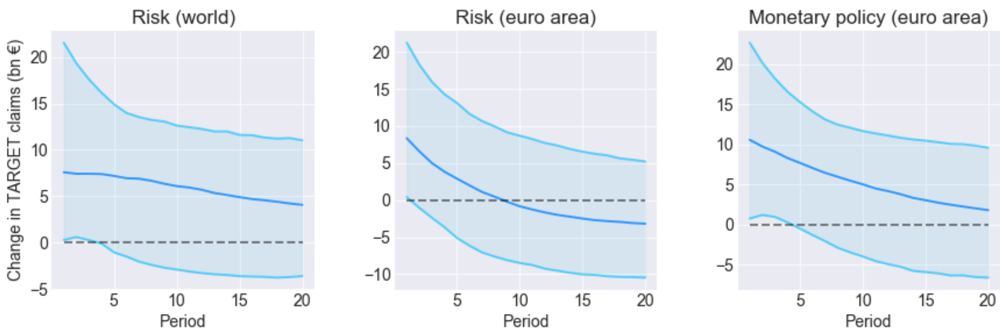
Both, the impulse response functions (see Figure 6) and the forecast error variance decomposition (see Figure 7) yield qualitatively very similar results compared with those of the

[7] This shock of rising global risk differs from a possible monetary policy impulse from the United States in that it has the opposite effect on the VIX. An accommodative monetary policy by the Fed should, taken in isolation, lower the risk assessment on the financial markets. It is not explicitly identified as it is unlikely to have any clear-cut and systematic impact on Germany's TARGET balances. Possible effects are captured in the model by the two unidentified shocks.

[8] This requires the definition of two unidentified shocks in this model as well.

yield spread model. The impulse response functions shown are generally less persistent. The euro area-specific risk shock and the monetary policy shock, in particular, show a much lower persistence.

Figure 6: Impulse response functions of German TARGET claims (capital flows model)



Note: Figures show 95% credibility intervals (blue area) and the medians (dark blue lines) of IRFs following different shocks.

These findings also affect the forecast error variance decomposition. The three shocks of interest taken together explain a lower share of TARGET balance forecast error variance, on impact and for longer forecast horizons due to slightly lower contributions of the shock, representing monetary policy. However, the contribution of the global risk is somewhat stronger in the present model.

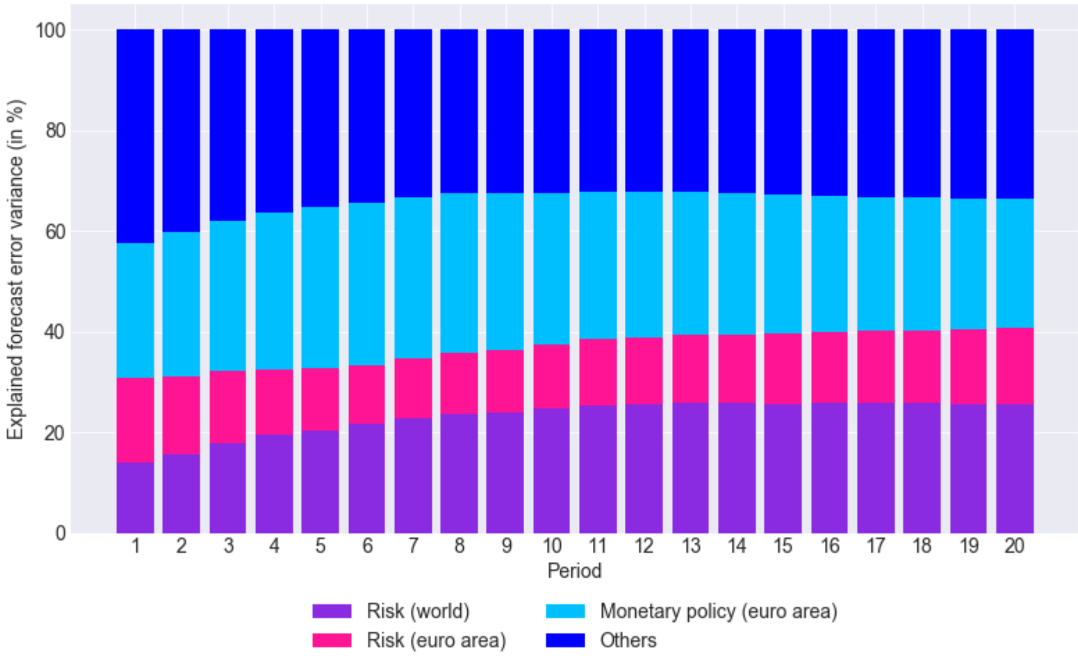
3.4.2 Historical decomposition

The relevant breakdown of the TARGET flows into the identifiable shocks (i.e. excluding unidentified shocks and constant) are shown in Figure 8. Just like in the interest-rate-based identification of the various shocks, the rise in Germany's TARGET balance during the APP is ascribed primarily to monetary policy and, from mid-2017, also partly to growing uncertainty in the euro area. During the sovereign debt crisis, global risk rather than European risk aspects were dominant up to mid-2011. After this, however, the generous provision of liquidity by the Eurosystem is identified as the key factor behind the continuing TARGET flows. As expected, the temporary outlier during the global crisis is attributed to growing risk on the global financial markets, even though its scale appears underestimated as it was in the yield spread model.

Overall, identifying the various shocks on the basis of Germany's private bilateral investment gives results qualitatively similar to those produced by an identification using interest rate spreads (see Figure 8). Differences exist, above all, at the height of the European sovereign debt crisis. The interest rate model ascribes the rise in Germany's TARGET claims during this period more to the high degree of uncertainty in the euro area, while the capital flow model assigns chief responsibility to the Eurosystem's accommodative monetary policy.

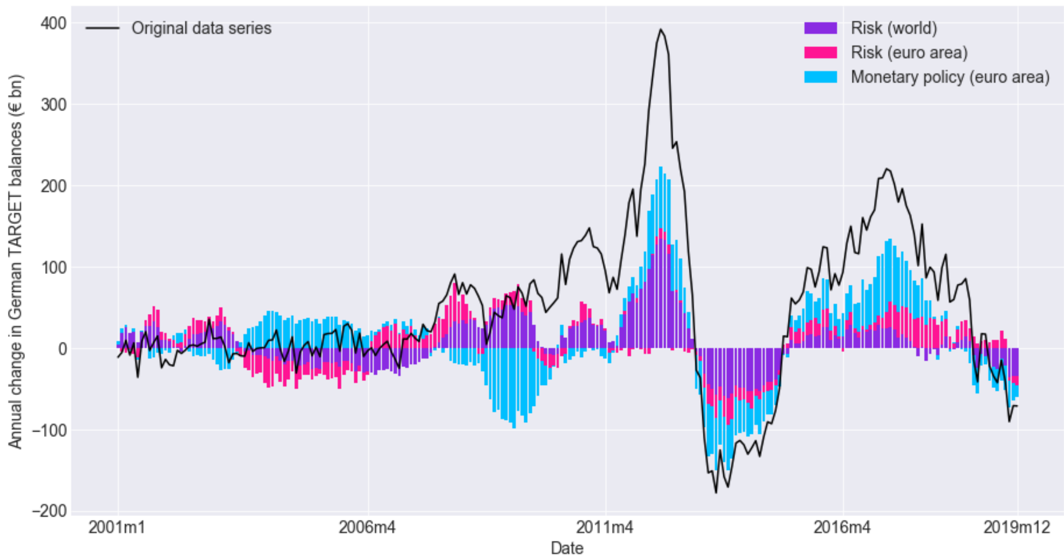
These findings correspond to the results of Hristov et al. (2020) who also identify capital flows as the driving forces of TARGET balances between 2008 and 2014. Specifically,

Figure 7: Forecast error variance decomposition of German TARGET balances (capital flows model)



Note: Figure shows the shares of German TARGET balance forecast error variance, which is explained by specific shocks, over different forecast horizons.

Figure 8: Historical decomposition of German TARGET balances (capital flows model)



Note: Figure shows time-specific contributions of shocks to the motion of the annual changes in the German TARGET balance.

we agree with the authors that the dynamics of TARGET balances reflect asymmetric liquidity needs in euro area member countries in times of elevated risk. However, in our study we do not look at the impact on the real economy. The period after 2014, when monetary policy was characterised by the APP, was not included in the empirical analysis of Hristov et al. (2020), so we cannot compare results for this apparently different economic environment.

3.5 Robustness analysis: Shadow rate based identification

Overall, we provide two models, which are very different in spirit. One that models risk on the basis of yields (prices) and one that models risk on the basis of flows (quantities). Even though the identified shocks in the capital flows model account for a lower share of forecast error variance, the qualitative narrative is very similar.

We also consider modeling monetary policy with different sign restrictions. We estimated the first model with a negative sign on $EAspread_t$ while keeping vix_t unrestricted. In the second model, we set a zero restriction on $fin - intra_t$ and a negative restrictions an $fin - extra_t$ in order to capture the capital flows, representing asset purchases by non-German national central banks in the euro area.[9] Of course, the importance of the shocks changes due to changes in the sets of sign restrictions. The qualitative narrative, however, remains the same, as above.

Additionally, we estimate both models with help of overnight interest rates. In the vicinity of the zero lower bound, we rely on an estimated shadow interest rate.[10] An estimation conducted as a robustness test arrives at qualitatively similar results, which are available upon request. Modelling monetary policy using the consolidated Eurosystem balance sheet appears superior precisely for the period of the APP, however. Moreover, the shadow rate is a variable, which is generated by a model, creating generated regressor problems. The literature, too, makes use of balance sheet variables to model monetary policy measures (see, for example, Boeckx, Dossche, and Peersman (2017)).

4 Conclusions

This study provides empirical evidence regarding the drivers of the considerable fluctuations in Germany's TARGET balances.

Using the BVAR model, changes in Germany's TARGET claims were broken down into the components of different shocks. In this context, a distinction was made between a rise in the global risk assessment, tensions within the euro area, and European monetary policy as possible drivers of the TARGET balances. In order to identify these triggers,

[9]These restrictions represent a euro area-specific settlement process and account for Germany's role as a financial gateway to the world. If a national central bank in the euro area (other than the Bundesbank) purchases a domestic government bond from an investor outside the euro area, the transaction is usually settled via a commercial bank in Germany. This process translates into an increase in German target claims and a liability of the German commercial bank vis-á-vis the trading partner outside the euro area.

[10]Shadow interest rates by Leo Krippner can be obtained from the website of the Reserve Bank of New Zealand, https://www.rbnz.govt.nz/research-and-publications/research-programme/additional-research/measures-of-the-stance-of-united-states-monetary-policy/comparison-of-international-monetary-policy-measures. Note that the use of shadow rates requires a negative sign on the restriction on the policy variable.

monetary policy balance sheet items of the Eurosystem and VIX were used along with the interest rate spreads between European government bonds and US Treasuries on the one hand and Bunds on the other. As an alternative to the interest rate spreads, Germany's bilateral investment with the rest of the euro area and the rest of the world was used in a separate specification. Both specifications performed quite well in assigning the historical periods of rising TARGET balances to the a priori suspected causes.

The presented BVAR model opens up the possibility of studying the causes of current fluctuations in Germany's TARGET claims at as early a stage as possible. In this way it can assist in the economic policy analysis of German investment.

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