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Chapter 11

An Empirical Analysis of the Trilemma of Exiting Expansionary Monetary Policy in the Euro Area

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Abstract

This study proposes a theoretic trilemma model for the case of a monetary union and measures it empirically. Accordingly, there exists a trade-off between stabilizing the monetary union, maintaining free capital mobility, and exiting expansionary monetary policy in the euro area. Our results underscore the existence of this trilemma and point out the importance of resolving it without jeopardizing the euro and financial stability in the European Union.

Keywords: European Central Bank (ECB), monetary policy, financial stability, financial crisis, trilemma

1. Introduction

In this chapter, the conflicting goals of (i) stabilizing a monetary union, (ii) maintaining free capital mobility in the union, and (iii) exiting expansionary monetary policy are described as a trilemma, where two of the three objectives can be achieved but not all three of them at the same time. Mundell (1963) already describes the three sides of a trilemma's policy goals for an open economy, namely, monetary independence, exchange rate stability, and financial integration. The result of this article is that, for the case of a monetary union, a new kind of trilemma is proposed. The analytic difference to Mundell's (1963) trilemma lies in the fact that the presented analysis builds on a voting model, which is independent of the assumptions made in IS-LM model types. In addition, the trilemma is induced by monetary policy and not caused by political decisions on the design of the exchange rate regime as in Mundell (1963). Classical trilemma situations in open economies such as Bekaert and Mehl (2019) have been adapted to develop an understanding of modern central bank policies, which often include the task of keeping financial stability. For example, Schoenmaker (2005, 2011) suggests a trilemma situation during the ongoing financial integration in the European Union. Magas (2018) observes different versions of adjustment to external shocks and financial integration for small, open economies in light of the trilemma.

In this context, De Grauwe (2015) finds that the euro crisis that emerged after 2010 was the result of two design failures of the euro currency. First, economic cycles continued to occur at the national levels, leading to large external imbalances of countries within the euro area. Second, the impossibility of national central banks to bail out their home countries allowed liquidity crises to emerge that eventually turned into solvency crises for some euro-area countries. Therefore, De Grauwe and Ji (2015) see the need for intervention by the ECB, when individual countries in the currency union get into debt problems. Steiner *et al.* (2019) argue that the euro area entails an inherent policy trilemma between maintaining financial stability in the common currency area, independent control over the monetary base, and the accommodation of unlimited internal capital flight via the euro-area central banks' so-called "TARGET2-system", the Trans-European Automated Real-time

Gross-settlement Express Transfer system. Also, Canale *et al.* (2018) find a policy trilemma faced by euro-area member countries. They provide empirical evidence on a trade-off between free capital mobility, financial stability, and fiscal policy flexibility by analyzing data for 11 euro-area countries. Lang and Schadner (2021) analyze the trilemma of expansionary monetary policy in the euro area during the COVID-19 crisis. Elnahass *et al.* (2021) find that the COVID-19 pandemic has impacted global banking stability significantly in a negative way. They conclude, based on a large international data sample of banks, that the COVID-19 pandemic has had detrimental impacts both on financial performance and financial stability. Trinh *et al.* (2022) examine the association between bank tail risk and the COVID-19 pandemic by using a large international sample of listed banks. They find that systematic and idiosyncratic components of bank tail risk have increased during the pandemic, but less so for more profitable banks, implying that the COVID-19 pandemic results in a higher possibility of suffering extremely large losses in the stock prices of the global banking sector.

This chapter contributes to the existing literature by focusing on the analysis of the trilemma notion of the monetary policy in a currency union empirically. Since the central bank is the main actor to implement monetary policy, the analysis proposes an explanation of how decisions are made at the European Central Bank in the framework of a voting model. Central bank governors are assumed to be policy-oriented and rational.

In terms of the policy implications of this study, we suggest that a common European fiscal stabilization capacity is necessary to reinforce the euro area in case of a recession, both at the country level and euro-area level. Combining a fiscal stabilization capacity with a stepwise reduction of the ECB's asset purchase programs could give the ECB room to raise interest rates in the medium term to counter inflation and to break free thoroughly of the described trilemma. This chapter proceeds as follows: Section 2 introduces a theoretical model of the trilemma in the European Monetary Union, Section 3 connects the existing trilemma with TARGET2-balances between national European central banks and the ECB. Building on this understanding of the problem, Sections 4 and 5 present empirical evidence on the trilemma and Section 6 concludes this study with an outlook on future research.

2. A Model of the Trilemma in the European Monetary Union

The Governing Council is the ECB's highest decision-making body and responsible for setting interest rates and conducting monetary policy. It consists of six Executive Board members and 19 national central bank governors of the euro-area countries. The accession of Lithuania to the euro area in 2015 triggered a change in the voting rights, as already envisaged by the Governing Council in December 2002. Before January 1st, 2015, the ECB Governing Council had the principle of "one member, one vote". From January 1st, 2015, onward a rotation system of voting rights was put into place, which we briefly summarize.

The rotation helps maintain the Governing Council's ability to take action even as the number of euro-area countries gradually increases and with them the number of members of the Governing Council. Euro-area countries are divided into groups according to the size of their economies and their financial sectors. To determine which national central bank governor belongs to which group, a ranking was established. The governors from countries ranked first to fifth — currently, Germany, France, Italy, Spain, and the Netherlands — share four voting rights. All others (14 since Lithuania joined on January 1st, 2015) share 11 voting rights. The governors take turns using the rights on a monthly rotation. The "one member, one vote" principle applies to those holding a voting right at that time. The ECB's Executive Board members hold permanent voting rights.

All members of the Governing Council attend the meetings and have the right to speak. Since the Governing Council takes most decisions on a consensual basis, in a spirit of cooperation, the decision-making process has not changed. However, the rotation system implies that majorities must be formed and respected in order to attain a broad consensual basis. Hence, in the following model, we abstract from the rotation system of voting rights in the ECB Governing Council because it was put into effect after the major decisions on the ECB's quantitative easing programs in the year 2015. Building on the models of Freixas (2003) and Schoenmaker (2011), we formalize the ECB's trilemma and thereby underscore the importance of solving the problem successively. To do so, we

consider the decisions of each country's member in the ECB governing council — the presidents of the national central banks — to vote for an exit or a continuation of the ECB's expansionary monetary policy. Hence, the policy instrument in the model is p, the expansionary monetary policy in the Eurosystem of the central banks of each of the 19 member countries, denoted by sub-index i.

Thus, the governing council members' choice is interpreted as a digital variable $z \in \{0, 1\}$, where $z = 0$ stands for stopping the expansionary monetary policy and $z = 1$ for its continuation. Furthermore, B_i denotes a country's benefit of the expansionary monetary policy and C_i its costs. A president of a national central bank chooses to continue the expansionary monetary policy in the Eurosystem only if the total benefits for his country are larger than the costs, $B_i - C_i > 0$. In a setting with more than one country, the total benefits of the expansionary monetary policy can be split into the benefits for the home country H_i and benefits for a foreign country F_i. The sum of the respective fractions of benefits $\alpha_{h,i}$ for home and $\alpha_{f,i}$ for the foreign country is 1 and sums up to $\alpha_{f,i} = \Sigma_{j \in J} \alpha_j$. Therefore, a majority of votes in the ECB's governing council in favor of the continuation of the expansionary monetary policy can be collected if the respective countries expect sufficient benefits altogether. As in Schoenmaker (2011), this is an example of an improvised cooperation between the countries, since economic and financial dependencies in the euro area may be of multiple natures. The national representatives in the ECB governing council gauge the overall profit or loss of the expansionary monetary policy for their country. If the total amount of policy gains is larger than its cost, the national central bank presidents vote for the continuation of the ECB's expansionary monetary policy measures. Thus, the optimal decision for each country's representative i in the ECB Governing Council is to maximize

$$z^* = (\alpha_i \cdot B_i - p_i) \tag{1}$$

s.t.

$$\begin{cases} z^* = 1 & \text{if } \sum_i p_i - C_i > 0 \\ z^* = 0 & \text{if } \sum_i p_i - C_i < 0 \end{cases} \tag{2}$$

This decision problem has many equilibria, but only one non-cooperative equilibrium leads to a unanimous vote for the full termination of the ECB's expansionary monetary policies. This is the case if no individual country can bear the total cost C by itself so that for no country i we can assert $\alpha_i \cdot B_i - C_i > 0$ and therefore $p_i = 0$, $z^* = 0$. If this non-cooperative equilibrium is selected, the decision to exit expansionary monetary policies completely is inefficient in terms of (i) supporting the monetary union and (ii) maintaining unrestricted capital mobility in the union. This is the case because it would mean a *de facto* limitation of TARGET2-balances and a restriction of credit to peripheral countries in the euro area. The equilibrium occurs only when part of the externalities fall outside the home country. Let us therefore further assume that the country with the highest benefits from expansionary monetary policies is the home country. The home country, however, is not prepared to meet the costs of the expansionary monetary policies entirely.

Proposition: The efficiency of exiting expansionary monetary policies from the perspective of the home country depends on the size of the fraction $\alpha_{h,i}$, where the range of benefits B_i in the home country is $\alpha_{h,i} \in [C_i/B_i, 1]$. If $\alpha_{h,i} < C_i/B_i$, then reducing expansionary monetary policies will be efficient. Vice versa, a home country increases expansionary monetary policies if $\alpha_{h,i} > C_i/B_i$. Therefore, given rational decision-making, a home country will reduce expansionary monetary policies only if the benefits are sufficiently large.

Proof of Proposition: The efficient solution is $z^* = 1$ *if* $B_i > C_i$ and $z^* = 0$ *if* $B_i < C_i$. Using Equations (1) and (2), the first best solution will be reached in the case of $\alpha_{h,i} = 1$. Given that $\alpha_{h,i} > \alpha_j \forall j \in J$, a continuation of expansionary monetary policies ($z^* = 1$) will be voted for if the benefits in the home country are larger than the total costs: $\alpha_{h,i} \cdot B - C$. Otherwise, if $\alpha_{h,i} < C/B$, the exit equilibrium ($z^* = 0$) occurs even if the continuation of expansionary monetary policies is optimal ($B_i > C_i$).

The proposition states that as soon as measures toward an exit of expansionary monetary policies increase ($\alpha_{f,i} \uparrow$ and $\alpha_{h,i} \downarrow$), they will destabilize the monetary union.

3. The Trilemma and TARGET2-Balances

The trilemma is that upholding free capital mobility and stabilizing the monetary union are compatible only as long as no or very limited reduction of expansionary monetary policies occurs. Sinn and Wollmershäuser (2012) show that TARGET2-balances measure the intra-Euro-area balances of payments. Therefore, they indirectly also reflect international credit given through the Eurosystem in terms of reallocating the ECB's net re-financing credit. If a substantial reduction in the monetary base would take place, the monetary union would be jeopardized, since this leads to capital flight via the TARGET2-system to safe havens within the euro area. This capital flight is perceivable in the rise of the TARGET2-balances of peripheral countries in the euro area. TARGET2-balances are equalized if banks in surplus countries in the euro area grant credit to banks in deficit countries and importers use these loans to pay for imports from surplus countries. With the aggravation of the financial and debt crises, banks in peripheral countries in the euro area started to refinance themselves more and more directly via the ECB, with the effect that capital in the euro inter-banking market also started flowing directly from surplus countries to deficit countries. Inversely, the TARGET2-balances in the euro area built up. For example, the net accounts receivable of the German central bank ("Deutsche Bundesbank") in the TARGET2-system amount to 1,266.65 billion euros as of September 2022, while almost half of the Greek external debt stems from TARGET2-accounts payable. Hence, limiting TARGET2-balances would be equal to restricting the free mobility of capital, which is irreconcilable in a monetary union.

4. Empirical Evidence on the Trilemma

The task of finding empirical evidence on the ECB's trilemma is twofold. First, we define suitable indices for the three dimensions of the trilemma, similar to the research strategy in Canale *et al.* (2018). So the ECB's conflicting goals of (i) stabilizing the monetary union, (ii) maintaining free capital mobility in the union, and (iii) exiting expansionary monetary policy have to be quantified. Second, we test

the existence of the trilemma by supposing a trade-off and therefore a linear relationship between these conflicting goals.

The first dimension of stabilizing the monetary union has been at the center of attention since the European debt crisis could only be resolved through the clear and determined intervention of the European Central Bank in the year 2012. To stabilize the European financial system, the ECB then sent the clear message to capital markets that it would do "whatever it takes" to defend the euro. This lifted pressure from the euro and restored financial stability. There are many ways of measuring financial stability, as the definition of the notion is rather wide. In this study, we use the CISS index, the Composite Indicator of Systemic Stress, proposed by Hollo *et al.* (2012) and published by the ECB to measure the stability of the financial system in the euro area.

The CISS is an indicator of contemporaneous stress in the European financial system. It is designed according to definitions of systemic risk and uses portfolio theory to aggregate an additional set of market-specific stress measures.[1] The aggregation takes into account the time-varying cross-correlations between the measures. As a result, the CISS puts relatively more weight on situations in which financial stress prevails in several market segments at the same time, capturing the idea that financial stress easily overspills in the euro area and is thus more dangerous for the European economy as a whole.

In order to measure the inner-euro-area capital mobility, we construct an index focused on TARGET2-balances. Following Sinn

[1]Realized volatility of the 3-month Euribor rate, realized volatility of the German 10-year benchmark government bond index, realized volatility of the Datastream non-financial sector stock market index, CMAX for the Datastream non-financial sector stock market index, stock-bond correlation, realized volatility of the idiosyncratic equity return of the Datastream bank sector stock market index over the total market index, yield spread between A-rated financial and non-financial corporations (7-year maturity), CMAX as defined above interacted with the inverse price-book ratio (book-price ratio) for the financial sector equity market index, and realized volatility of the euro exchange rate vis-à-vis the US Dollar, the Japanese yen, and the British pound.

(2011), we understand TARGET2-balances as real loans, which are secured by countries with positive TARGET2-balances and granted to countries with negative TARGET2-balances to import foreign goods and assets. Behind this stands the idea that current account deficits in the peripheral countries of the euro area are financed by TARGET2-loans, which are granted by countries with current account surpluses.

We construct a TARGET2-index ($T2B_t$) by adding up the TARGET2-balances retrieved from the ECB Statistical Data Warehouse (ECB, 2020) for the top three countries with positive balances and normalize the result to the numeric space [0;1] according to the following formula:

$$T2B_t = (T2B_t - [T2B_t]_{min})/([T2B_t]_{max} - [T2B_t]_{min}) \quad (3)$$

In the final step, we use the Monetary Conditions Index (MCI) published by the European Commission (2020) to evaluate the ECB's monetary policy. The MCI is an index number calculated from a linear combination of the short-run interest rate and the exchange rate. The weights reflect the relative effects of the respective MCI component on aggregate demand.[2] A dropping index value means that monetary policy is loosened, while a rising index value indicates a tightening of monetary policy conditions by the ECB. This leads to the following set of trilemma indices, which we graph along the timeline from the outbreak of the sub-prime crisis in the USA in the second quarter of 2007 until July 2020, as shown in Figure 1. Accordingly, the summary statistics of the full sample are as shown in Table 1.

Now, it must be demonstrated that there is a trade-off between the policy goals of (i) stabilizing the monetary union, (ii) maintaining free capital mobility in the union, and (iii) exiting expansionary monetary policy in order to be able to suppose the existence of a trilemma. We

[2]The relative weights of the interest rate and the exchange rate components are 6:1, reflecting each variable's relative impact on GDP after two years, and are derived from simulations in the OECD's Interlink model following Richardson (1988). We also normalize the index to the [0;1] space.

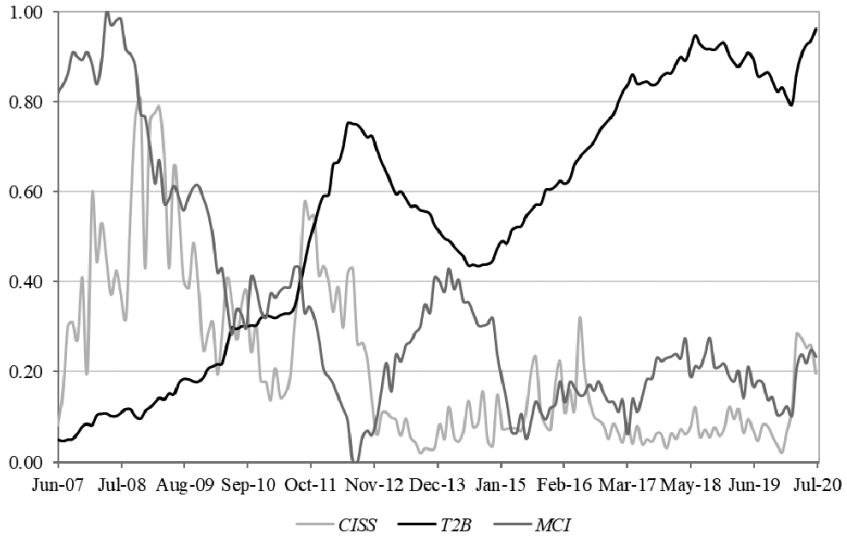

Figure 1. The figure shows the development of the monthly data time series of the three trilemma indices CISS, T2B, and MCI from June 2007 to July 2020.

Table 1. Summary statistics. The table provides the summary statistics of the sample of the three indices CISS, T2B, and MCI.

	CISS	**T2B**	**MCI**
Observations	158	158	158
Frequency	monthly	monthly	monthly
Sample start	June 1st 2007	June 1st 2007	June 1st 2007
Sample end	July 31st 2020	July 31st 2020	July 31st 2020
Mean	0.22	0.54	0.34
Standard deviation	0.19	0.28	0.25
Minimum	0.02	0.05	0.00
Maximum	0.80	0.96	1.00

therefore follow Aizenman *et al.* (2008, 2013) and empirically test whether the weighted sum of the three policy variables adds up to the constant 1. This test is carried out by examining the coefficient of determination R^2 of a simple OLS regression. Thereby, the higher the R^2, the stronger the support for the trilemma:

$$1 = \alpha_1 \mathrm{CISS}_t + \alpha_2 \mathrm{T2B}_t + \alpha_3 \mathrm{MCI}_t + \varepsilon_t \tag{4}$$

Alternatively, as in Hsing (2012), we also estimate the logarithmic specification of the model:

$$1 = \beta_1 \ln\text{CISS}_t + \beta_2 \ln\text{T2B}_t + \beta_3 \ln\text{MCI}_t + \mu_t \tag{5}$$

Our first step is to compare the results of the linear specification of regression (4) with the logarithmic specification in regression (5) (see Tables A1 and A2 in Appendix). We find statistically significant coefficients of similar magnitude in both specifications. Also, the F-tests of both specifications suggest that neither of the models has to be rejected. Hence, comparing the R^2 of the regressions, we find that the logarithmic regression specification (5) has the better fit at $R^2 = 98.41\%$.

Therefore, we can conclude that Equation (5) models the trade-off between the three policy variables in the ECB's trilemma best. If we would find a low goodness of fit and coefficients with negative signs, this would indicate that the theory behind the trilemma was incorrect or econometrically misspecified. Thus, our empirical evidence constitutes that the European Central Bank faces an impossible trinity between stabilizing the monetary union, maintaining free capital mobility, and trying to exit expansionary monetary policy.

Furthermore, it is important to know the contribution that each policy goal has to the trilemma. In order to assess the contributions to each policy goal, we multiply the estimated coefficients of Equation (5) with the actual values of the variables. We do this by multiplying the estimated coefficients with the sample means of each variable reported in the second column of Table 2.

Table 2. Contribution (weights). Drivers of the policy trilemma and their relative contribution to it. Coefficients are estimated from Equation (5). TARGET2-balance (T2B) has the greatest impact, followed by monetary conditions (MCI) and systematic stress (CISS).

	Coefficient	**Sample Mean**	**Contribution (Weight)**
lnCISS	0.4487***	0.1854	0.08
lnT2B	1.3611***	0.4120	0.56
lnMCI	1.2380***	0.2747	0.34

Notes: Sum of contributions (R^2): 98%. ***Significance level at 1%.

Since the approximation is good, we find that the contributions are close to 1 and note that R^2 coincides with the sum of the three calculated weights. The estimated contributions to each policy goal show that the European Central Bank's main focus has been on maintaining free capital mobility with the help of the TARGET2-system. The second most important measure that the ECB has been taking was to constantly loosen monetary policy, culminating in the asset purchase programs as mentioned earlier. Third, calming financial markets and thereby stabilizing the European financial system have been and still are the goals of the ECB, as indicated by the CISS index.

5. Robustness Analysis

The idea behind the concept of cointegration is to analyze a long-run equilibrium between non-stationary economic variables. A long-run relationship between economic variables may exist; however, this relation does not necessarily appear during the observation period. If the observed deviations from the assumed equilibrium relationship are stationary, the variables under examination are deemed cointegrated. Cointegrated variables do not contain independent trends but are driven by common stochastic trends.

Since the presented estimation model has three indexes ranging between zero and one, it is possible that these indexes are non-stationary, and the regression estimation could hence be spurious. Still, if the indexes were non-stationary but cointegrated, the linearity assumption holds. Although our primary focus is not to show any specific long-run equilibrium relationship among the three indexes, we conduct cointegration tests for each of the indexes to show their linearity. Following Johansen's (1991) method, we rank the cointegration relationship among CISS, T2B, and MCI by conducting multiple trace tests, assuming the lag length of 4. Applying this analysis to the dataset, we find that the linear relationship between the three variables holds, as summarized in Table 3.

Table 3. Cointegration tests identify scenarios where the non-stationary time series are integrated together in a way that they cannot deviate from equilibrium in the long term. The linear relationship between all three variables CISS, T2B, and MCI holds.

Included Observations: 153
Series: MCI CISS T2B
Lags Interval: 1 to 4

Selected (0.05 Level*) Number of Cointegrating Relations by Model

Data Trend: Test Type	None No Intercept No Trend	None Intercept No Trend	Linear Intercept No Trend	Linear Intercept Trend	Quadratic Intercept Trend
Trace	1	1	1	0	1
Max-Eig	1	1	1	1	1

Information Criteria by Rank and Model

Data Trend: Rank or No. of CEs	None No Intercept No Trend	None Intercept No Trend	Linear Intercept No Trend	Linear Intercept Trend	Quadratic Intercept Trend
Log Likelihood by Rank (rows) and Model (columns)					
0	1009.496	1009.496	1011.304	1011.304	1011.927
1	1021.773	1022.740	1024.358	1024.520	1025.129
2	1024.178	1026.251	1027.352	1027.977	1028.585
3	1024.866	1028.617	1028.617	1030.687	1030.687
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	−12.72544	−12.72544	−12.70986	−12.70986	−12.67878
1	−12.80749*	−12.80706	−12.80207	−12.79111	−12.77292
2	−12.76049	−12.76146	−12.76277	−12.74480	−12.73968
3	−12.69106	−12.70088	−12.70088	−12.68872	−12.68872
Schwarz Criteria by Rank (rows) and Model (columns)					
0	−12.01240*	−12.01240*	−11.93740	−11.93740	−11.84690
1	−11.97561	−11.95537	−11.91076	−11.87999	−11.82220
2	−11.80977	−11.77112	−11.75262	−11.69504	−11.67011
3	−11.62150	−11.57189	−11.57189	−11.50032	−11.50032

Note: *Critical values based on MacKinnon–Haug–Michelis (1999).

6. Conclusion

The crisis of the European Monetary Union is still not settled to this date and has revealed different flaws in the construction of the euro. National fiscal policies did not build sufficient buffers before the crisis, which forced some countries to tighten the fiscal policy too rapidly during the economic downturn in 2011 to restore market confidence in sovereign borrowing. As the sovereign stress remains

high and the banking sector is highly exposed to government bonds, the combination has further weakened the sector. In return, the confidence in fiscal sustainability has undergone even greater damage. As a result, the ECB's monetary policy and emergency measures are the main public supporting instruments. In conclusion in the aftermath of the sovereign debt crisis, euro-area countries agreed on a banking union with a common supervisor to break up the links between banks and their sovereigns.

Since the process of policy normalization was initiated, the ECB governing council has pledged to act against resurgent fragmentation and inflation risks. The COVID-19 pandemic has left lasting vulnerabilities in the euro-area economy, which are contributing to an uneven transmission of the ECB's monetary policy across member states. Based on this assessment, the ECB governing council decided to reinvest redemptions coming due from the pandemic emergency purchase program (PEPP) flexibly in different Euro area jurisdictions, in order to support monetary policy transmission where it is needed. In addition, a new "ECB anti-fragmentation instrument" by the name of "Transmission Protection Instrument (TPI)" was presented in July 2022 by the ECB. The TPI is based on more careful bond-buying programs to reduce possibly rising credit spreads in selected euro-area countries during times of crises.

However, from a practical point of view, further progress is needed in reducing and sharing risks in the euro area in the long run, such as creating a common deposit guarantee scheme and reducing banks' exposures to domestic sovereign bonds. Such progress may not be sufficient though for national fiscal policies and monetary policy to smooth future major crises. Hence, as Stráský and Claveres (2018) underscore, the introduction of common fiscal stabilization capacity is necessary to reinforce the euro area in case of a recession, both at the country and euro-area levels. Combining a fiscal stabilization capacity with a stepwise reduction of the asset purchase programs could give the ECB additional room to raise interest rates in the medium term in order to reduce inflation to the initial target range of two percent. Furthermore, the ECB could break free thoroughly of the trilemma, which we describe in this study. Future research could focus on a deeper understanding of the design and incentive structures of monetary unions and should lead the way to concepts of how to stabilize and consolidate economically heterogenous monetary unions, such as the euro area.

Appendices

Table A1. Linear specification, $1 = \alpha_1 \text{CISS}_t + \alpha_2 \text{T2B}_t + \alpha_3 \text{MCI}_t + \varepsilon_t$.

Regression Statistics — Linear Specification								
Multiple correlation coefficient		0.9864						
R^2		0.9730						
Adjusted R^2		0.9662						
Standard error		0.1659						
Observations		158						
	Degrees of Freedom (df)	**Square Sums (SS)**	**Mean Squared Sums (MS)**	***F*-value**	***F*-criterion**			
Regression	3	153.7318	51.2439	1860.9234	0.0000			
Residuals	155	4.2682	0.0275					
Sum	158	158						
	Coefficients	**Standard Errors**	***t*-statistic**	***p*-value**	**Lower 95%**	**Upper 95%**	**Lower 99%**	**Upper 99%**
CISS	0.4123	0.0852	4.8369	0.0000	0.2439	0.5806	0.2439	0.5806
T2B	1.0521	0.0252	41.7442	0.0000	1.0024	1.1019	1.0024	1.1019
MCI	0.9459	0.0580	16.2955	0.0000	0.8313	1.0606	0.8313	1.0606

Table A2. Logarithmic specification, $1 = \beta_1 \ln\text{CISS}_t + \beta_2 \ln T2\text{B}_t + \beta_3 \ln\text{MCI}_t + \mu_t$.

Regression Statistics — Logarithmic Specification	
Multiple correlation coefficient	0.9920
R^2	0.9841
Adjusted R^2	0.9774
Standard error	0.1275
Observations	158

	Degrees of Freedom (df)	**Square Sums (SS)**	**Mean Squared Sums (MS)**	***F*-value**	***F*-criterion**
Regression	3	155.4802	51.8267	3187.9918	0.0000
Residuals	155	2.5198	0.0163		
Sum	158	158			

	Coefficients	**Standard Errors**	***t*-statistic**	***p*-value**	**Lower 95%**	**Upper 95%**	**Lower 99%**	**Upper 99%**
lnCISS	0.4487	0.0856	5.2399	0.0000	0.2796	0.6179	0.2796	0.6179
lnT2B	1.3611	0.0275	49.4301	0.0000	1.3067	1.4155	1.3067	1.4155
lnMCI	1.2380	0.0629	19.6803	0.0000	1.1137	1.3622	1.1137	1.3622

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