The Impact of Systemic Stress in the Euro Area on Bilateral Exports of Goods

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Abstract There is a growing interest among policymakers and researchers in estimating the impact of systemic stress on the economy. In this chapter, I present main findings of a panel study designed to estimate the impact of systemic stress in the euro area on bilateral exports of goods. Using the gravity model of international trade in goods, I found that systemic stress in the euro area, measured by the Composite Indicator of Systemic Stress for the euro area, the new Composite Indicator of Systemic Stress for the euro area and the EURO STOXX 50 Volatility Index negatively affects bilateral exports of goods, which is consistent with my expectations.

Ključne besede: • euro area • exports of goods • systemic stress • composite indicator of systemic stress • gravity model of international trade

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https://doi.org/10.4335/2021.9.1 ISBN 978-961-7124-08-8 (PDF)
Available at http://www.lex-localis.press.

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1 Introduction

There is a growing interest among policymakers and researchers at central banks, such as the European Central Bank (ECB), in estimating the impact of systemic stress on the (real) economy. Holló et al. (2012) defined systemic stress as the extent to which systemic risk has materialised. For example, a systemic financial crisis is characterised by high systemic stress. This means that when a systemic financial crisis occurs, the functioning of the financial system is disrupted. Research has shown that systemic stress negatively affects the economy (see Chavleishvili & Manganelli, 2019; Dajčman et al., 2020; Kremer, 2016a). As a result, there is a growing need among policymakers and researchers at central banks to measure and monitor systemic stress. There are at least four alternative measures of systemic stress in the euro area used by policymakers and researchers at the ECB. These are the Composite Indicator of Systemic Stress (CISS) for the euro area – a weekly measure of systemic stress in the euro area – developed by Holló et al. (2012), the NEW CISS for the euro area – a daily measure of systemic stress in the euro area – developed by the ECB, the SovCISS for the euro area – a monthly measure of sovereign financial stress in the euro area – developed by Garcia-de-Andoain and Kremer (2018), and the EURO STOXX 50 Volatility Index (VSTOXX), which is the European version of the CBOE Volatility Index (VIX). Research has shown that systemic stress is transmittable from one country to another (see Dajčman et al., 2020; Dovern & van Roye, 2014). Dajčman et al. (2020) found that systemic stress is transmittable from the euro area to the US, and vice versa. As a result, there is a growing need among policymakers and researchers at central banks to measure and monitor systemic stress at home (e.g., in the euro area) and abroad (e.g., in the US). To this end, Kremer (2016b) developed the CISS for the US. In his paper, he studied the systemic stress in the euro area and the US, using the CISS for the euro area and the CISS for the US.

In this chapter, I present the findings of a panel study designed to estimate the impact of systemic stress in the euro area on bilateral exports of goods. To date, there is little or no evidence to suggest whether systemic stress in the euro area negatively affects bilateral exports of goods. Therefore, the purpose of this chapter is to fill the gap in the literature. Unlike many others, I do not use a binary variable, having two possible values called "systemic financial crisis" and "no systemic financial crisis." Instead of a binary variable, I use the CISS for the euro area and two alternative measures of systemic stress in the euro area, namely the NEW CISS for the euro area and the VSTOXX. As I mentioned earlier, policymakers and researchers at the ECB use all three.

The rest of this chapter is divided into five sections. Section 2 reviews the literature on the impact of (systemic) financial stress on the (real) economy, Section 3 gives the materials and methods of the panel study, Section 4 gives the result of the panel study, Section 5 discusses the results of the panel study and Section 6 concludes this chapter.

2 Literature review

By its very nature, a systemic financial crisis is a rare event. Research has shown that it negatively affects the economy as a whole (see Lo Duca et al., 2017). As a result, there is a growing need among policymakers and researchers at central banks to prevent systemic financial instability (Arsov, 2013). For example, the bankruptcy of Lehman Brothers Holdings, Inc., on 15 September 2008 was the culmination of the subprime mortgage crisis in the US, which negatively affected financial markets around the world. As investor fled to quality and safety, the contagion of fear spread from one country to another.

There is a growing body of literature on the impact of financial stress on the economy. The rest of this section focuses on the impact of systemic stress on the economic activity.

2.1 The impact of financial stress on the (real) economy

Hakkio and Keeton (2009) studied the impact of financial stress on economic activity in the US. They found that financial stress negatively affects economic activity, which is consistent with recent evidence (see Evgenidis & Tsagkanos, 2017; Ferrer et al., 2018; Galvão & Owyang, 2018). Davig and Hakkio (2010) studied the impact of financial stress on economic activity in the US in stress and non-stress regimes. They found that financial stress negatively affects economic activity in both of the regimes. However, they found that the impact of financial stress on economic activity is larger in stress regimes than in non-stress regimes. Van Roye (2013) and Aboura and van Roye (2017) found similar results for Germany and France respectively.

2.2 The impact of systemic stress on the (real) economy

Systemic stress is a type of financial stress. Policymakers and researchers, for example at the ECB, use alternative measures of systemic stress in the euro area and in other major economies, such as the US. There are at least three alternative measures of systemic stress in the US used by policymakers and researchers at the ECB. These are the CISS for the US – a weekly measure of systemic stress in the US, the NEW CISS for the US – a daily measure of systemic stress in the US – developed by the ECB, and the VIX, known as the Fear Index. Table 1A shows alternative measures of systemic stress in the euro area and the US used by policymakers and researchers at the ECB.

The body of evidence on the impact of systemic stress on the (real) economy is more limited than for the financial stress. In this subsection, I focus on studies that use the CISS (see Chatterjee idr., 2017; Chavleishvili & Kremer, 2017; Chavleishvili & Manganelli, 2019; Dajčman et al., 2020; Hartmann et al., 2013; Holló et al., 2012; Kremer, 2016a; Silvestrini & Zaghini, 2015). Holló et al. (2012) and Kremer (2016a)

studied the impact of systemic stress on industrial production in the euro area. They found that systemic stress negatively affects industrial production. Consistent with previous findings, their studies suggest that the euro area needs to rethink some of its policies. Hartmann et al. (2013) and Silvestrini and Zaghini (2015) studied the impact of systemic stress on GDP growth in the euro area in stress and non-stress regimes. They found that systemic stress negatively affects GDP growth only in stress regimes. Chavleishvili and Kremer (2017) and Chavleishvili & Manganelli (2019) studied the impact of systemic stress on GDP growth in the US and the euro area respectively. They found that systemic stress negatively affects GDP growth only in recessionary regimes. In contrast, Dajčman et al. (2020) found that systemic stress negatively affects industrial production in the euro area in recessionary and non-recessionary regimes.

3 Materials and methods

In this study, I use unbalanced panel data to estimate the impact of systemic stress in the euro area on bilateral exports of goods. The full panel consists of 1,560 country pairs for the period of 15 years (i.e., from 2000 to 2014). Each country pair consists of one exporter and one importer. These are Australia, Austria, Belgium, Brazil, Canada, China, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Iceland, India, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Mexico, the Netherlands, New Zealand, Norway, Portugal, Russia, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, the UK, and the US. I selected these countries at random. In doing so, I took into account the availability of data. 19 out of these countries are members of the euro area. These are Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain. In 2019, the countries in the full panel accounted for 56.65% of world GDP, 75.47% of world exports in goods and 83.41% of world population. Table 1 shows data on GDP in millions of current USD, exports of goods in millions of current USD and population in millions by country.

Table 1: Exports of goods, GDP, and population by country, 2019

Country	GDP in millions of current USD	Exports of goods in millions of current USD	Population in millions
Australia	1,396,567.01	271,440.97	25.37
Austria	445,075.39	170,815.51	8.88
Belgium	533,254.52	314,369.21	11.49
Brazil	1,877,810.51	225,799.58	211.05
Canada	1,741,576.39	450,803.21	37.59
China	14,279,937.47	2,386,640.08	1,397.72
Cyprus	24,949.07	3,481.94	1.20
Czechia	250,686.48	156,104.42	10.67

Country	GDP in millions of current USD	Exports of goods in millions of current USD	Population in millions
Denmark	350,104.33	120,638.90	5.81
Estonia	31,471.10	14,910.31	1.33
Finland	268,966.07	72,633.13	5.52
France	2,715,518.27	597,146.50	67.25
Germany	3,861,123.56	1,460,913.26	83.09
Greece	205,326.72	36,,308.42	10.72
Hong Kong	363,016.37	547843.80	7.51
Iceland	24,836.71	5,334.35	0.36
India	2,870,504.10	331,271.58	1,366.42
Ireland	398,590.21	254662.82	4.93
Israel	394,652.21	60,229.90	9.05
Italy	2,004,913.36	513,843.21	59.73
Japan	5,064,872.88	695,179.08	126.26
Latvia	34,055.46	14,249.75	1.91
Lithuania	54,639.94	29,049.29	2.79
Luxembourg	71,104.92	23,017.15	0.62
Malta	15,215.71	3,881.61	0.50
Mexico	1,268,870.53	461,039.50	127.58
Netherlands	907,050.86	552,950.71	17.34
New Zealand	209,127.45	39,687.13	4.98
Norway	405,510.00	103,285.33	5.35
Portugal	239,510.77	64,886.27	10.29
Russia	1,687,448.53	419,850.69	144.41
Slovakia	105,119.16	84,721.51	5.45
Slovenia	54,174.23	35,845.63	2.09
South Africa	351,431.65	90,118.87	58.56
South Korea	1,646,739.22	556,667.90	51.71
Spain	1,393,490.52	329,045.24	47.13
Sweden	531,283.30	176,288.41	10.28
Switzerland	731,474.37	347,071.67	8.58
UK	2,830,813.51	476,271.23	66.84
US	21,433,224.70	1,652,437.00	328.33

Source: The World Bank Group (2021).

In this study, we use the panel data gravity model of international trade (in goods) to estimate the impact of systemic stress in the euro area on bilateral exports of goods. In doing so, I followed some of the recommendations of Santos Silva and Tenreyro (2006, 2010a, 2010b, 2011a, 2011b) and Yotov et al. (2016). Like many others, I use the Poisson Pseudo-Maximum Likelihood (PPML) regression, recommended by the

UNCTAD and the WTO (see Yotov et al., 2016). As I mentioned in Section 1, I use three alternative measures of systemic stress in the euro area, namely the CISS for the euro area, the NEW CISS for the euro area, and the VSTOXX. Today, many researchers recommend the use of the VSTOXX as an alternative to the CISS for the euro area and the NEW CISS for the euro area. The main advantage of this study is that it uses all three of them.

Like others, I use yearly data on exports of goods, GDP, population, etc. I collected these data for the same time period as Oberhofer and Pfaffermayr (2021). The panel database I use in this study includes data on nominal and real exports of goods and GDP. Some authors use data on nominal exports of goods and GDP ("nominal data"), while others use data on real exports of goods and GDP ("real data"). In this study, I use both data sets. De Benedictis and Taglione (2011) recommended the use of nominal data. According to them, the use of these data is consistent with the theory.

In the first case, in which I use nominal data, the regression equation is:

$$X_{ijt} = \exp\left[\beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln E_{jt} + \beta_3 \ln POP_{it} + \beta_4 POP_{jt} + \beta_5 \ln AREA_{it} + \beta_6 \ln AREA_{jt} + \beta_7 \ln DIST_{ij} + \beta_8 \ln CISS_t + \beta_9 CNTN_{ij} + \beta_{10} CNTG_{ij} + \beta_{11} LANG_{ij} + \beta_{12} TA_{ijt} + \beta_{13} EA_{ijt} + \beta_{14} LNDL_i + \beta_{15} LNDN_j + \beta_{16} ISLN_i + \beta_{17} ISLN_j\right] \times \varepsilon_{ijt}, \quad (1)$$
$$i = 1, \dots, N, j = 1, \dots, N, i \neq j, j = 1, \dots, T_{ij},$$

where X_{ijt} is the value of exports of goods from country i to country j at time t in current USD; $\ln Y_{it}$ is the natural logarithm of the value of the GDP of country i at time t in current USD; $\ln E_{jt}$ is the natural logarithm of the value of the GDP of country j at time t in current USD; $\ln POP_{it}$ is the natural logarithm of the population of country i at time t; $\ln POP_{jt}$ is the natural logarithm of the population of country j at time t; $\ln AREA_{it}$ is the natural logarithm of the land area of country i at time t in square kilometres; $\ln AREA_{jt}$ is the natural logarithm of the land area of country i at time t in square kilometres; $\ln DIST_{ij}$ is the natural logarithm of the distance between the capitals of countries i and j; $\ln CISS_t$ is the natural logarithm of the value of the CISS for the euro area at time t; $CNTN_{ij}$ is a dummy variable, the value of which is 1, if countries i and j lie on the same continent, otherwise 0; $CNTG_{ij}$ is a dummy variable, the value of which is 1, if countries i and j share a common land border, otherwise 0; $LANG_{ij}$ is a dummy variable, the value of which is 1, if countries i and j share a common language, otherwise 0; TA_{ijt} is a dummy variable, the value of which is 1, if countries i and j are signatories of the same trade agreement at time t, otherwise 0; EA_{ijt} is a dummy variable, the value of which is 1, if countries i and j are members of the euro area, otherwise 0; $LNDL_i$ is a dummy variable, the value of which is 1, if country i is a landlocked country, otherwise 0; $LNDL_j$ is a dummy variable, the value of which is 1, if country j is a landlocked country, otherwise 0; $ISLN_i$ is a dummy variable, the value of

which is 1, if country i is an island country, otherwise 0; $ISLN_j$ is a dummy variable, the value of which is 1, if country j is an island country, otherwise 0; and ε_{ijt} is the error term.

In the second case, in which I use real data instead of nominal data, the regression equation is:

$$RX_{ijt} = \exp\left[\beta_0 + \beta_1 \ln RY_{it} + \beta_2 \ln RE_{jt} + \beta_3 \ln POP_{it} + \beta_4 POP_{jt} + \beta_5 \ln AREA_{it} + \beta_6 \ln AREA_{jt} + \beta_7 \ln DIST_{ij} + \beta_8 \ln CISS_t + \beta_9 CNTN_{ij} + \beta_{10} CNTG_{ij} + \beta_{11} LANG_{ij} + \beta_{12} TA_{ijt} + \beta_{13} EA_{ijt} + \beta_{14} LNDL_i + \beta_{15} LNDN_j + \beta_{16} ISLN_i + \beta_{17} ISLN_j\right] \times \varepsilon_{ijt} \quad (2)$$
$$, i = 1, \dots, N, j = 1, \dots, N, i \neq j, j = 1, \dots, T_{ij},$$

where RX_{ijt} is the value of exports of goods from country i to country j at time t in constant USD; $\ln RY_{it}$ is the natural logarithm of the value of the GDP of country i at time t in constant USD; and $\ln RE_{jt}$ is the natural logarithm of the value of the GDP of country j at time t in constant USD.

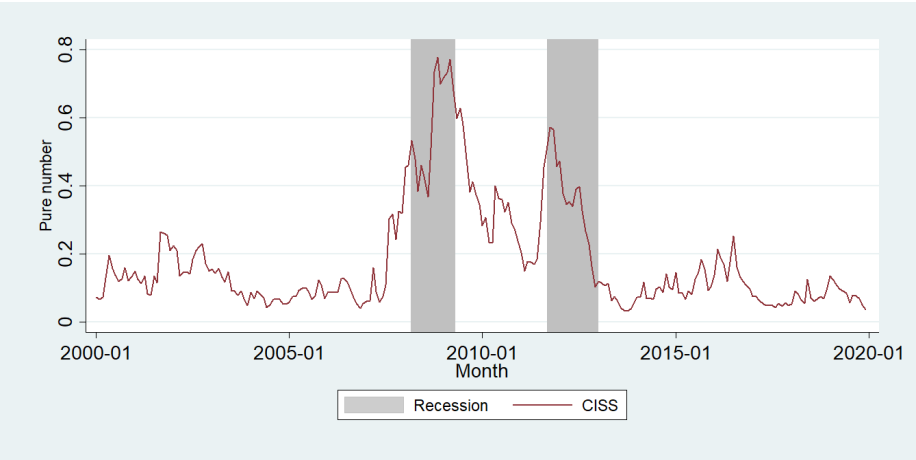
I obtained data on the value of the GDP in current USD by country and year from the World Bank, on the value of exports of goods in current USD by country and year from the UN, on the population by country and year from the UN, on the land area in square kilometres by country and year from the World Bank, on the coordinates of the capitals by country from latlong.net, on the value of the CISS and the NEW CISS for the euro area by date from the ECB, on the value of the VSTOXX by date from Qontigo, on trade agreements and their signatories from the WTO and on languages by country from Eberhard et al. (2021). I obtained other data from other public sources.

4 Results

In this study, I test the hypothesis that systemic stress in the euro area negatively affects bilateral exports of goods. Unlike many others, I use my own panel database, which includes the CISS for the euro area, the NEW CISS for the euro area and the VSTOXX. In creating the panel database, I followed the instructions of Yotov et al. (2016). In the years following the Great Recession, there has been a growing trend among policymakers and researchers at the ECB to use the CISS as a measure of systemic financial instability. As far as I know, it was first used in this sense by the ECB in 2010. Today, there is a growing body of evidence suggesting the usefulness of the CISS as a measure of systemic financial instability.

Figure 1 shows the CISS for the euro area from January 2000 to December 2019, while Figure 2 shows its frequency distribution.

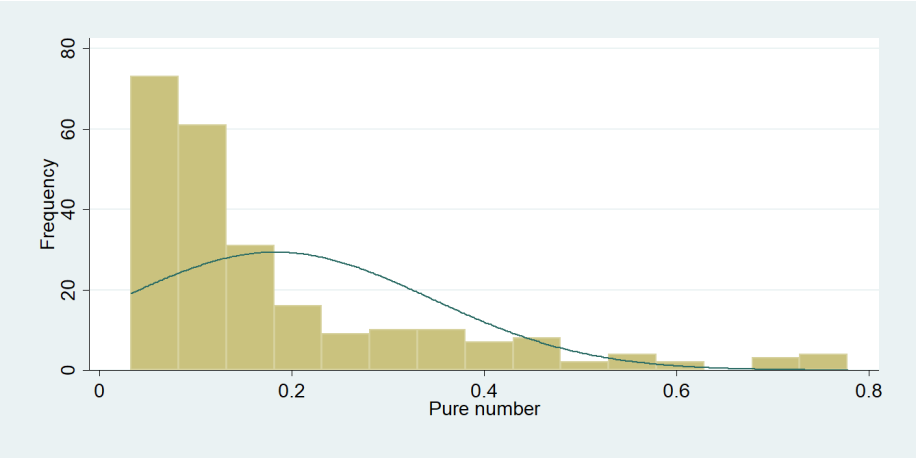
Figure 1: CISS for the euro area from January 2000 to December 2019



Source: ECB (2021).

As you can see from Figure 1, systemic stress in the euro area, measured by the CISS for the euro area, peaked during the Great Recession and the European debt crisis.

Figure 2: Frequency distribution of the CISS for the euro area from January 2000 to December 2019



Source: Own calculations based on data from the ECB (2021).

Table 2 shows descriptive statistics for study variables.

Table 2: Descriptive statistics for study variables – full sample

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
X_{ijt}	23,384	4.95E+09	1.89E+10	77	3.97E+11
RX_{ijt}	23,384	5.18E+09	1.93E+10	94	3.56E+11
$\ln Y_{it}$	23,384	26.4719	1.8019	22.1833	30.4871
$\ln RY_{it}$	23,384	26.6309	1.7715	22.6892	30.4146
$\ln E_{jt}$	23,384	26.4721	1.8022	22.1833	30.4871
$\ln RE_{jt}$	23,384	26.6311	1.7719	22.6892	30.4146
$\ln POP_{it}$	23,384	16.4690	1.9597	12.5469	21.0377
$\ln POP_{jt}$	23,384	16.4871	1.9684	12.5469	21.0377
$\ln AREA_{jt}$	23,384	12.0682	2.4501	5.7683	16.6117
$\ln AREA_{it}$	23,384	12.0682	2.4514	5.7683	16.6117
$\ln DIST_{ij}$	23,384	8.1870	1.0877	4.0070	9.8962
$\ln CISS_t$	23,384	–1.7977	.6882	–2.7121	–.5802
$\ln NCISS_t$	23,384	–2.3007	1.2135	–4.1871	–.6045
$\ln VSTOXX_t$	23,384	3.1846	.2901	2.6415	3.6151
$CNTN_{ij}$	23,384	.4565	.4981	0	1
$CNTG_{ij}$	23,384	.0513	.2206	0	1
$LANG_{ij}$	23,384	.0898	.2859	0	1
TA_{ijt}	23,384	.5074	.5000	0	1
EA_{ijt}	23,384	.1226	.3280	0	1
$LNDL_i$	23,384	.1001	.3001	0	1
$LNDL_j$	23,384	.0996	.2995	0	1
$ISLN_i$	23,384	.1748	.3798	0	1
$ISLN_j$	23,384	.1750	.3800	0	1
$\ln REM_{it}$	23,384	18.3009	.6715	17.5092	20.1417
$\ln REM_{jt}$	23,384	18.2727	.6601	17.2964	20.1401

Source: Own calculations.

4.1 Estimation of the impact of systemic stress in the euro area on bilateral exports of goods without controlling for multilateral resistance

In this subsection, I estimate a (panel data) gravity model of international trade (in goods) without controlling for multilateral resistance (i.e., average trade barrier, see Anderson & van Wincoop, 2003). Using GPML regression, I found that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in current USD decreases by .06 per cent; see column (1) of Table 3. In other words, systemic stress in the euro area negatively affects bilateral exports of goods. I also found that if the value of the CISS for the euro area increases by one per cent, the

value of bilateral exports of goods in constant USD decreases by .04 per cent; see column (3) of Table 3. Using PPML regression, I found that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in current USD decreases by .05 per cent; see column (2) of Table 3. Contrary to the results of the GPML regression, the results of the PPML regression show that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in constant USD increases by .02 per cent; see column (4) of Table 3. In this case, you can see that using real data instead of nominal data, as recommended by De Benedictis and Taglione (2011), can be problematic. The p-values in the bottom row of columns (1), (3) and (4) of Table 3 indicate specification errors. In other words, only the first PPML specification of the (panel data) gravity model of international trade (in goods) passed the RESET test.

Table 3: Estimates of the impact of systemic stress on bilateral exports of goods – full sample (nominal and real data, CISS for the euro area)

	Nominal data		Real data	
	(1)	(2)	(3)	(4)
	GPML	PPML	GPML	PPML
$\ln Y_{it}$	0.8327***	.7504***	.8814***	.7968***
	(.0335)	(.0518)	(.0416)	(.0557)
$\ln E_{jt}$	.7283***	.8581***	.8174***	.9524***
	(.0315)	(.0628)	(.0402)	(.0695)
$\ln POP_{it}$	.1223***	.1955**	.0792**	.1822**
	(.0367)	(.0757)	(.0403)	(.0759)
$\ln POP_{jt}$	.1193***	.1167*	.0605	.0859
	(.0334)	(.0599)	(.0368)	(.0623)
$\ln AREA_{jt}$	−.1169***	−.1576***	−.1163***	−.1606***
	(.0187)	(.0477)	(.0191)	(.0488)
$\ln AREA_{it}$	−.1289***	−.1532***	−.1506***	−.1800***
	(.0200)	(.0474)	(.0204)	(.0492)
$\ln DIST_{ij}$	−.7155***	−.3036***	−.6806***	−.2647***
	(.0658)	(.0904)	(.0674)	(.0983)
$\ln CISS_t$	**−.0619*** **	**−.0495*** **	**−.0374*** **	**.0243*** **
	(.0127)	**(.0065)**	**(.0108)**	**(.0070)**
$CNTN_{ij}$	.3422***	.5964***	.4177***	.7260***
	(.1233)	(.1603)	(.1231)	(.1677)
$CNTG_{ij}$	1.0179***	.7305***	1.0771***	.7078***
	(.1645)	(.1329)	(.1799)	(.1384)
$LANG_{ij}$	.7593***	.4836***	.7309***	.4797***
	(.1098)	(.1345)	(.1065)	(.1410)
TA_{ijt}	−.0736	.2232*	−.0062	.2281
	(.0853)	(.1319)	(.0889)	(.1405)
EA_{ijt}	−.2001**	−.1889	−.2597***	−.2651**

	Nominal data		Real data	
	(1)	(2)	(3)	(4)
	GPML	PPML	GPML	PPML
$LNDL_i$	(.0855) −.4795*** (.0924)	(.1260) −.2542** (.1168)	(.0878) −.5039*** (.0961)	(.1324) −.2195* (.1165)
$LNDL_j$	−.7903*** (.1314)	−.1621*** (.1444)	−.7761*** (.1444)	−.0951 (.1483)
$ISLN_i$	−.3403*** (.0890)	−.2823** (.1305)	−.3568*** (.0899)	−.3344*** (.1288)
$ISLN_j$	−.1237 (.0893)	−.3697*** (.1178)	−.0747 (.0941)	−.4123*** (.1283)
Constant	−16.2489*** (1.0473)	−21.5095*** (1.7054)	−18.2989*** (1.2924)	−24.6009*** (2.1089)
Number of country pairs	1580	1580	1580	1580
Number of observations	23384	23384	23384	23384
R-squared	.5473	.7302	.5342	.7419
RESET (p-value)	.0018	.3195	.0180	.0349

Notes: Standard errors are clustered by country pair and are reported in parentheses. *** p < .01, ** p < .05, * p < .10.
Source: Own calculations.

4.2 Estimation of the impact of systemic stress in the euro area on bilateral exports of goods with controlling for multilateral resistance

In this subsection, I estimate a (panel data) gravity model of international trade (in goods) with controlling for multilateral resistance. Using GPML regression, I found that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in current USD decreases by .04 per cent; see column (1) in Table 4. In other words, systemic stress in the euro area negatively affects bilateral exports of goods. Contrary to the results listed in the column (1) of Table 4, the results listed in the column (3) of Table 4 show that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in constant USD increases by .04 per cent. Using PPML regression, I found that that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in current USD decreases by .06 per cent; see column (2) of Table 4. Contrary to the results listed in the column (2) of Table 4, the results listed in the rightmost column of Table 4 show that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in constant USD increases by .03 per cent. The p-values in the bottom row of columns (1) and (3) of Table 4 indicate specification errors. In other words, both PPML specifications of the regression equation pass the RESET test.

Table 4: Estimates of the impact of systemic stress on bilateral exports of goods – full sample (nominal and real data, CISS for the euro area and remoteness indices)

	Nominal data		Real data	
	(1)	(2)	(3)	(4)
	GPML	PPML	GPML	PPML
$\ln Y_{it}$	.6676***	.7717***		
	(.0467)	(.0791)		
$\ln RY_{it}$			.8725***	.8007***
			(.0407)	(.0421)
$\ln E_{jt}$	.7187***	.9240***		
	(.0447)	(.0756)		
$\ln RE_{jt}$			.8312***	.9649***
			(.0391)	(.0628)
$\ln POP_{it}$	.1294***	.1987***	.0825**	.1293*
	(.0386)	(.0754)	(.0385)	(.0721)
$\ln POP_{jt}$	.1162***	.0993	.0351	.0202
	(.0365)	(.0607)	(.0356)	(.0536)
$\ln AREA_{jt}$	−.0731***	−.1689***	−.1281***	−.1806***
	(.0194)	(.0525)	(.0184)	(.0397)
$\ln AREA_{it}$	−.1305***	−.1701***	−.1703***	−.1998***
	(.0212)	(.0481)	(.0204)	(.0365)
$\ln DIST_{ij}$	−.6762***	−.3585***	−.8563***	−.4487***
	(.0700)	(.0825)	(.0832)	(.0638)
$\ln CISS_t$	**−.03774*** **	**−.0551*** **	**.0428*** **	**.0325*** **
	(.0121)	**(.0075)**	**(.0105)**	**(.0067)**
$CNTN_{ij}$	.2673**	.5389***	.5654***	.5137***
	(.1198)	(.1490)	(.1188)	(.1421)
$CNTG_{ij}$	1.0913***	.6987***	.9239***	.6221***
	(.1807)	(.1234)	(.1763)	(.1112)
$LANG_{ij}$	.8403***	.4679***	.5044***	.2797**
	(.1226)	(.1310)	(.0972)	(.1088)
TA_{ijt}	−.0904	.2192*	.0561	.2857**
	(.0879)	(.1242)	(.0888)	(.1203)
EA_{ijt}	−.2487***	−.1390	−.2019**	−.0186
	(.0806)	(.1228)	(.0890)	(.1009)
$LNDL_i$	−.5272***	−.2674**	−.4402***	−.2094*
	(.0947)	(.1175)	(.1013)	(.1163)
$LNDL_j$	−.7427***	−.2466	−.6782***	−.0713
	(.1364)	(.1528)	(.1486)	(.1549)
$ISLN_i$	−.2371**	−.2907**	−.3948***	−.3915***
	(.0969)	(.1276)	(.0863)	(.1131)
$ISLN_j$	−.1196	−.3968***	−.1127	−.4958***

	Nominal data		Real data	
	(1)	(2)	(3)	(4)
	GPML	PPML	GPML	PPML
$\ln REM_{it}$	(.0964) −.1234*** (.0247)	(.1261) .0251 (.0448)	(.0945) .3680*** (.0660)	(.1371) .3647*** (.0861)
$\ln REM_{jt}$	−.0228 (.0209)	.0539** (.0211)	.4558*** (.0661)	.4267*** (.0769)
Constant	−9.2554*** (1.8150)	−24.5251*** (2.2262)	−31.4015*** (1.9910)	−35.3893*** (2.5455)
Number of country pairs	1580	1580	1580	1580
Number of observations	23384	23384	23384	23384
R-squared	.5213	.7394	.5656	.7991
RESET (p-value)	.0009	.6705	.0368	.6608

Notes: Standard errors are clustered by country pair and are reported in parentheses. *** p < .01, ** p < .05, * p < .10.
Source: Own calculations.

4.3 Estimation of the impact of systemic stress in the euro area on bilateral exports of goods with and without controlling for multilateral resistance based on data for the euro area

In this subsection, I use a subsample consisting of members of the euro area. Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, the Netherlands, Portugal, and Spain joined the euro area in 1999, Greece in 2001, Slovenia in 2007, Cyprus and Malta in 2008, Slovakia in 2009, Estonia in 2011, Latvia in 2014 and Lithuania in 2015. As the study period ends in 2014, I did not include Lithuania in the subsample. In the first case, I estimate the impact of systemic stress in the euro area on bilateral exports of goods without controlling for multilateral resistance. In this case, the regression equation is:

$$X_{ijt} = \exp\left[\beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln E_{jt} + \beta_3 \ln POP_{it} + \beta_4 \ln POP_{jt} + \beta_5 \ln AREA_{it} + \beta_6 \ln AREA_{jt} + \beta_7 \ln DIST_{ij} + \beta_8 \ln CISS_t + \beta_9 CNTG_{ij} + \beta_{10} LANG_{ij}\right] \times \varepsilon_{ijt}$$
$$i = 1, \dots, N, j = 1, \dots, N, i \neq j, j = 1, \dots, T_{ij}. \quad , \quad (3)$$

Using GPML and PPML regression, I found that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in current USD decreases by .09 per cent and .07 per cent respectively (see Table 5). In this case, the impact of systemic stress in the euro area on bilateral exports of goods is larger than in

previous cases. The reason for this is that I use a different sample of (bilateral) trade partners in this case than in the previous cases.

Table 5: Estimates of the impact of systemic stress on bilateral exports of goods – subsample (nominal data, CISS for the euro area)

	(1)	(2)
	GPML	PPML
$\ln Y_{it}$	.8458***	.9674***
	(.1052)	(.0960)
$\ln E_{jt}$	.4147***	.6428***
	(.0981)	(.1235)
$\ln POP_{it}$	.1309	.2131*
	(.1396)	(.1220)
$\ln POP_{jt}$	.5182***	.2574*
	(.1285)	(.1555)
$\ln AREA_{it}$	−.0356	−.4121***
	(.0531)	(.0710)
$\ln AREA_{jt}$	−.0753	−.1279*
	(.0604)	(.0660)
$\ln DIST_{ij}$	−.7839***	−.4562***
	(.1556)	(.0892)
$\ln CISS_t$	**−.0867*** **	**−.0693*** **
	(.0218)	**(.0102)**
$CNTG_{ij}$	.4961**	.5718***
	(.2206)	(.1261)
$LANG_{ij}$	.3434	.2064
	(.2283)	(.1355)
Constant	−16.0243***	−19.7818***
	(2.0962)	(2.1248)
Number of country pairs	306	306
Number of observations	2868	2868
R-squared	.7851	.8995
RESET (p-value)	.0661	.1706

Notes: Standard errors are clustered by country pair and are reported in parentheses. *** p < .01, ** p < .05, * p < .10.
Source: Own calculations.

In the second case, I estimate the impact of systemic stress in the euro area on bilateral exports of goods with controlling for multilateral resistance with remoteness indices. In this case the regression equation is:

$$X_{ijt} = \exp\left[\beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln E_{jt} + \beta_3 \ln POP_{it} + \beta_4 \ln POP_{jt} + \beta_5 \ln AREA_{it} + \beta_6 \ln AREA_{jt} + \beta_7 \ln DIST_{ij} + \beta_8 \ln CISS_t + \beta_9 CNTG_{ij} + \beta_{10} LANG_{ij} + \beta_{11} \ln REM_{it} + \beta_{12} \ln REM_{jt}\right] \times \varepsilon_{ijt}$$
$$i = 1, \ldots, N, j = 1, \ldots, N, i \neq j, j = 1, \ldots, T_{ij}, \quad (4)$$

where

$$\ln REM_{it} = \ln\left(\frac{\sum_j DIST_{ij}}{\frac{E_{jt}}{Y_t}}\right) \quad (5)$$

and

$$\ln REM_{it} = \ln\left(\frac{\sum_i DIST_{ij}}{\frac{Y_{it}}{Y_t}}\right). \quad (6)$$

Controlling for multilateral resistance with remoteness indices, I found that systemic stress in the euro area negatively affects bilateral exports of goods. However, when PPML regression is used, the regression coefficient of −.0119 is not statistically significant (see the rightmost column of Table 6). Contrary to PPML regression, GPML regression gives a statistically significant result. However, the regression coefficient of −.0404 is higher than in the previous case.

Table 6: Estimates of the impact of systemic stress on bilateral exports of goods – subsample (nominal data, CISS for the euro area and remoteness indices)

	(1)	(2)
	GPML	PPML
$\ln Y_{it}$	.8572***	1.0342***
	(.1112)	(.0999)
$\ln E_{jt}$	.4370***	.6950***
	(.1051)	(.1220)
$\ln POP_{it}$	.1049	.1444
	(.1458)	(.1198)
$\ln POP_{jt}$	.4834***	.1957
	(.1319)	(.1481)
$\ln AREA_{jt}$	−.0278	−.4055***
	(.0541)	(.0704)
$\ln AREA_{it}$	−.0732	−.1158*
	(.0552)	(.0647)

	(1)	(2)
	GPML	PPML
$\ln DIST_{ij}$	−.7722***	−.4501***
	(.1527)	(.0912)
$\ln CISS_t$	**−.0404****	**−.0119**
	(.0170)	**(.0088)**
$CNTG_{ij}$	.5012**	.5481***
	(.2203)	(.1216)
$LANG_{ij}$	.3219	.2237
	(.2323)	(.1357)
$\ln REM_{it}$	−.0558	−.0321
	(.1063)	(.0819)
$\ln REM_{jt}$	−.0257	−.0650
	(.1145)	(.0814)
Constant	−16.0243***	−19.5965***
	(2.0962)	(2.1178)
Number of country pairs	306	306
Number of observations	2868	2868
R-squared	.7860	.9077
RESET (p-value)	.0933	.3591

Notes: Standard errors are clustered by country pair and are reported in parentheses. *** p < .01, ** p < .05, * p < .10.
Source: Own calculations.

In the third case, I estimate the impact of systemic stress in the euro area on bilateral exports of goods with controlling for multilateral resistance with exporter-time and importer-time fixed effects, as recommended by Yotov et al. (2016). In this case the regression equation is:

$$X_{ijt} = \exp\left[\beta_0 + \beta_1 \ln DIST_{ij} + \beta_2 \ln CISS_t + \beta_3 \ln CNTG_{ij} + \beta_4 LANG_{ij} + \pi_{it} + \rho_{jt}\right] \times \varepsilon_{ijt}$$
$$i = 1, \dots, N, j = 1, \dots, N, i \neq j, j = 1, \dots, T_{ij}, \quad (7)$$

where π_{it} and ρ_{jt} are exporter-time and importer-time fixed effects respectively.

Controlling for multilateral resistance with exporter-time and importer-time fixed effects, I found that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in current USD decreases by 1.8 per cent (see Table 7). Considering a p-value of less than .01 (which is not unusual in the case of a large number of variables), PPML specification of the regression equation passes the RESET test.

Table 7: Estimate of the impact of systemic stress on bilateral exports of goods – subsample (nominal data, CISS for the euro area, exporter-time and importer-time fixed effects)

	PPML
$\ln DIST_{ij}$	−.5506***
	(.0861)
$\ln CISS_t$	**−1.8038*** **
	(.3161)
$CNTG_{ij}$	.6077***
	(.0674)
$LANG_{ij}$	.2528*
	.1422
Exporter-time fixed effects	yes
Importer-time fixed effects	yes
Number of country pairs	306
Number of observations	2868
R-squared	.9769
RESET (p-value)	.0141

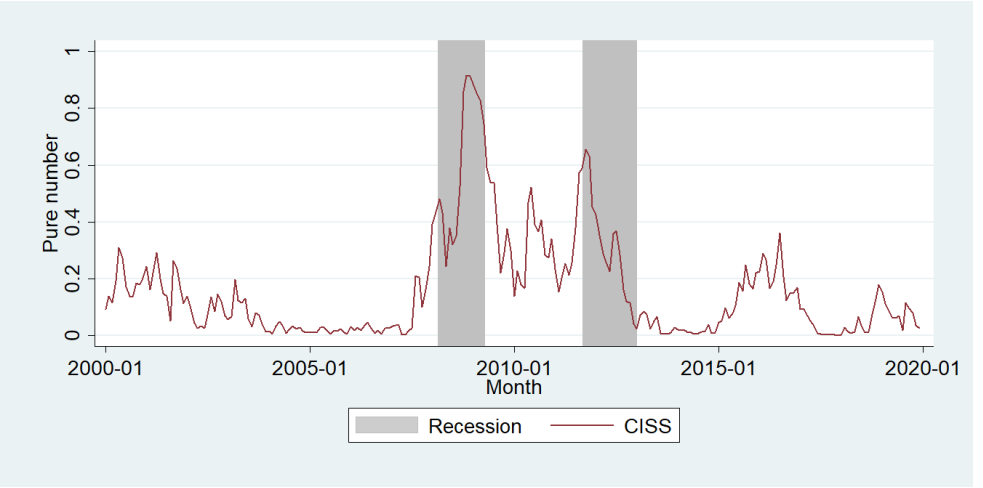
Notes: Standard errors are clustered by country pair and are reported in parentheses. *** p < .01, ** p < .05, * p < .10.
Source: Own calculations.

In the latter case, the coefficient for systemic stress is much lower than in previous cases. This is due to the use of different variables.

4.4 Robustness check

In this subsection, I reestimate the impact of systemic stress in the euro area on bilateral exports of goods. In doing so, I use two alternative measures of systemic stress in the euro area, namely the NEW CISS for the euro area and the VSTOXX. Figure 3 shows the NEW CISS for the euro area from January 2000 to December 2019, while Figure 4 shows its frequency distribution.

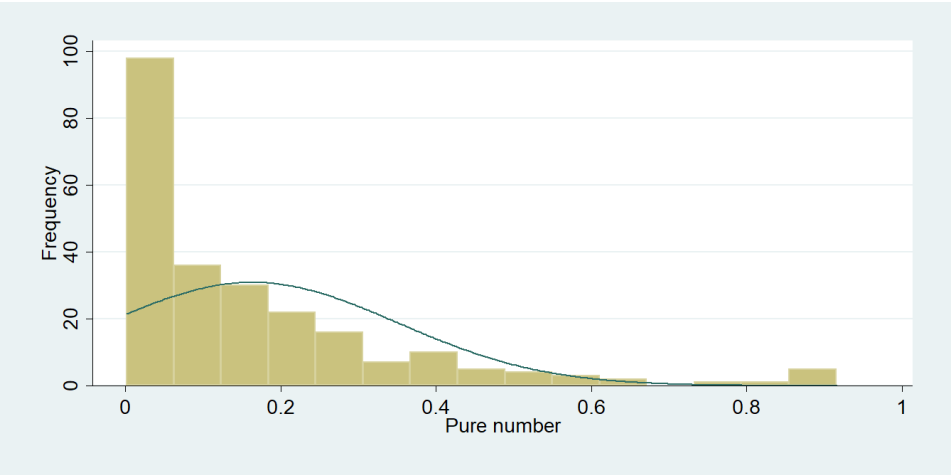
Figure 3: NEW CISS for the euro area from January 2000 to December 2019



Source: ECB (2021).

Figure 3 is similar to Figure 1. As you can see from Figure 3, systemic stress in the euro area, measured by the NEW CISS for the euro area, peaked during the Great Recession and the European debt crisis.

Figure 4: Frequency distribution of the NEW CISS for the euro area from January 2000 to December 2019



Source: Own calculations based on data from the ECB (2021).

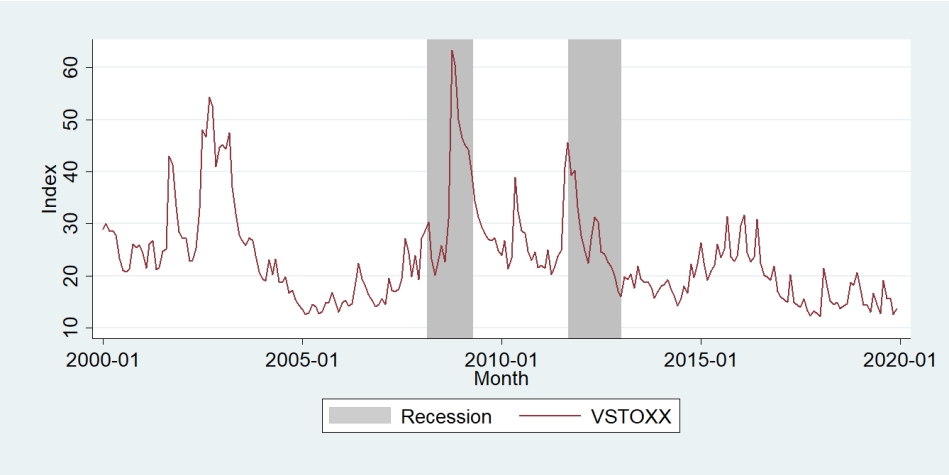
In the first case, in which I use the NEW CISS for the euro area, the regression equation is:

$$X_{ijt} = \exp\left[\beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln E_{jt} + \beta_3 \ln POP_{it} + \beta_4 POP_{jt} + \beta_5 \ln AREA_{it} + \beta_6 \ln AREA_{jt} + \beta_7 \ln DIST_{ij} + \beta_8 \ln NCISS_t + \beta_9 CNTN_{ij} + \beta_{10} CNTG_{ij} + \beta_{11} LANG_{ij} + \beta_{12} TA_{ijt} + \beta_{13} EA_{ijt} + \beta_{14} LNDL_i + \beta_{15} LNLN_j + \beta_{16} ISLN_i + \beta_{17} ISLN_j + \beta_{18} \ln REM_{it} + \beta_{19} \ln REM_{jt}\right] \times \varepsilon_{ijt} \quad (8)$$

$$i = 1, \ldots, N, j = 1, \ldots, N, i \neq j, j = 1, \ldots, T_{ij}.$$

Figure 5 shows the VSTOXX for the euro area from January 2000 to December 2019, while Figure 6 shows its frequency distribution.

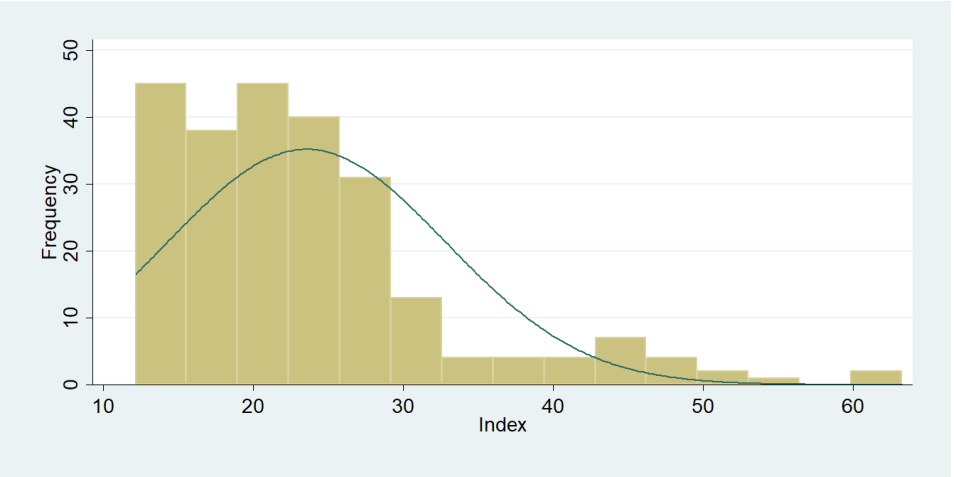
Figure 5: VSTOXX from January 2000 to December 2019



Source: Qontigo (2021).

As you can see from Figure 5, VSTOXX also peaked during the Great Recession and the European debt crisis.

Figure 6: Frequency distribution of the VSTOXX from January 2000 to December 2019



Source: Own calculations based on data from Qontigo (2021).
In the second case, in which I use the VSTOXX, the regression equation is:

$$X_{ijt} = \exp[\beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln E_{jt} + \beta_3 \ln POP_{it} + \beta_4 POP_{jt} + \beta_5 \ln AREA_{it} + \beta_6 \ln AREA_{jt} + \beta_7 \ln DIST_{ij} + \beta_8 \ln VSTOXX_t + \beta_9 CNTN_{ij} + \beta_{10} CNTG_{ij} + \beta_{11} LANG_{ij} + \beta_{12} TA_{ijt} + \beta_{13} EA_{ijt} + \beta_{14} LNDL_i + \beta_{15} LNLN_j + \beta_{16} ISLN_i + \beta_{17} ISLN_j + \beta_{18} \ln REM_{it} + \beta_{19} \ln REM_{jt}] \times \varepsilon_{ijt} \quad (9)$$

$$i = 1, \dots, N, j = 1, \dots, N, i \neq j, j = 1, \dots, T_{ij}.$$

Using the NEW CISS for the euro area (VSTOXX) instead of the CISS for the euro area, I found that if the value of the NEW CISS for the euro area (VSTOXX) increases by one per cent, the value of bilateral exports of goods in current USD decreases by .01 (.03) per cent (see Table 8), which is less than in previous cases (see Sections 4.1 and 4.2).

Table 8: Estimates of the impact of systemic stress on bilateral exports of goods – full sample (nominal data, the NEW CISS for the euro area, VSTOXX and remoteness indices)

	PPML	PPML
$\ln Y_{it}$	.7615***	.7607***
	(.0501)	(.0502)
$\ln E_{jt}$	.9039***	.9030***
	(.0643)	(.0644)
$\ln POP_{it}$	.1334*	.1338*
	(.0732)	(.073)
$\ln POP_{jt}$	.05255	.0531
	(.0555)	(.0555)
$\ln AREA_{jt}$	–.1740***	–.1739***
	(.0342)	(.0342)
$\ln AREA_{it}$	–.1732***	–.1731***
	(.0363)	(.0363)
$\ln DIST_{ij}$	–.4774***	–.4780***
	(.0584)	(.0584)
$\ln NCISS_t$	**–.0129*** **	
	(.0025)	
$\ln VSTOXX_t$		**–.0256****
		(.0120)
$CNTN_{ij}$	.4021***	.4003***
	(.1329)	(.1329)
$CNTG_{ij}$	.6480***	.6482***
	(.1075)	(.1075)
$LANG_{ij}$	.2996***	.2994***
	(.1026)	(.1023)
TA_{ijt}	.2747**	.2759**
	(.1114)	(.1113)
EA_{ijt}	.0476	.0478
	(.0996)	(.0996)
$LNDL_i$	–.2330*	–.2339*
	(.1168)	(.1168)
$LNDL_j$	–.0894	–.0903
	(.1537)	(.1538)
$ISLN_i$	–.3342***	–.3335***
	(.1099)	(.1099)
$ISLN_j$	–.4490***	–.4482***
	(.1251)	(.1251)
$\ln REM_{it}$	.3869***	.3873***
	(.0772)	(.0771)

	PPML	PPML
$\ln REM_{jt}$	.3963***	.3965***
	(.0702)	(.0703)
Constant	–33.2208	–33.0876***
	(2.2675)	(2.2651)
Number of country pairs	1580	1580
Number of observations	23384	23384
R-squared	.7895	.7895
RESET (p-value)	.2714	.2747

Notes: Standard errors are clustered by country pair and are reported in parentheses. *** p < .01, ** p < .05, * p < .10.
Source: Own calculations.

5 Discussion

This study helps policymakers and researches (at central banks) to understand the impact of systemic stress in the euro area on bilateral exports of goods. Using the (panel data) gravity model of international trade (in goods), I found that systemic stress in the euro area negatively affects bilateral exports of goods. Bernanke et al. (1996), who introduced the financial accelerator, offer a possible explanation for this. Krishnamurthy (2010) explained the phenomenon by analysing the subprime mortgage crisis in the US. Bernanke et al. (1996) argued that the deterioration in the credit market conditions amplifies the negative impact of a shock on the (real) economy. History provides many examples of this phenomenon (e.g., the Great Recession). Amiti and Weinstein (2011) studied the impact of the health of financial institutions (i.e., creditors) on (unilateral) exports of goods. They found that the deterioration in the health of financial institutions negatively affects (unilateral) exports of goods. They offered two possible explanations for this. The first one is that the deterioration in the health of financial institutions makes trade finance more expensive (higher prices), while the second one is that the deterioration in the health of financial institutions makes it more difficult for them to finance and provide credit to the (real) economy (lower liquidity). Many economists believe that the financial accelerator helps to explain the Great Trade Collapse (Vaubourg, 2016). Using nominal data (as recommended by the literature), I found that if the value of the CISS for the euro area increases by one per cent, the value of bilateral exports of goods in current USD decreases by .06 per cent. However, using the NEW CISS for the euro area and the VSTOXX, I got different results. In the case of the NEW CISS for the euro area, the regression coefficient is –.01, while in the case of the VSTOXX, the regression coefficient is –.03. In both cases, the regression coefficients are statistically significant.

6 Conclusions

In the years following the bankruptcy of Lehman Brothers Holdings, Inc., many policymakers, and researchers (at central banks, including the ECB) have focused on

estimating the impact of systemic stress on the (real) economy. This chapter adds to the growing body of literature on this subject. It suggests that systemic stress in the euro area negatively affects bilateral exports of goods, which is consistent with my expectations. Today we know that systemic stress negatively affects the economy. There is little or no evidence yet that would support a contrary argument. However, further research is needed to extend the current findings about the impact of systemic stress in the euro area on bilateral exports of goods, using expanded samples and other methodologies. The downside is that we still do not have a CISS for every country in the world.

The results of this study show that bilateral exports of goods are not immune to (an increase in) systemic stress in the euro area. In this study, I argue that policymakers and researchers (at central banks) need to pay heed to systemic stress in the euro area as it negatively affects bilateral trade (in goods). So therefore, there is a need among policymakers and researchers (at central banks) to introduce new measures of systemic stress for the euro area. The Covid-19 crisis has shown that financial markets are not immune to shocks.

Acknowledgment:
I would like to thank Professor Silvo Dajčman from the University of Maribor and Professor João M. C. Santos Silva from the University of Surrey for their comments.

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Appendix

Table A1: Alternative measures of systemic stress for the euro area and the US

Measure (composite indicator)	Frequency	From
Euro area		
CISS for the euro area (changing composition)	Daily (weekly)	8 January 1999
NEW CISS for the euro area (changing composition)	Daily	1 January 1999
SovCISS for the euro area (changing composition)	Monthly	September 2000
VSTOXX	Daily	4 January 1999
NEW CISS for Austria	Daily	5 January 1999
NEW CISS for Belgium	Daily	5 January 1999
NEW CISS for Finland	Daily	5 January 1999
NEW CISS for France	Daily	4 February 1985
NEW CISS for Germany	Daily	4 January 1980
NEW CISS for Ireland	Daily	5 January 1999
NEW CISS for Italy	Daily	1 January 1986
NEW CISS for Portugal	Daily	5 January 1999
NEW CISS for Spain	Daily	1 July 1999
NEW CISS for the Netherlands	Daily	5 January 1999
SovCISS for Austria	Monthly	September 2000
SovCISS for Belgium	Monthly	September 2000
SovCISS for Finland	Monthly	September 2000
SovCISS for France	Monthly	September 2000
SovCISS for Germany	Monthly	September 2000
SovCISS for Greece	Monthly	September 2000
SovCISS for Ireland	Monthly	September 2000
SovCISS for Italy	Monthly	September 2000
SovCISS for Portugal	Monthly	September 2000
SovCISS for Spain	Monthly	September 2000
SovCISS for the Netherlands	Monthly	September 2000
US		
CISS for the US	Daily (weekly)	5 January 1973
NEW CISS for the US	Daily	2 January 1980
VIX	Daily	2 January 1990

Source: ECB (2021).