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IMF Working Paper

Fiscal Affairs Department

Cross-Country Spillovers of Fiscal Consolidations in the Euro Area

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Abstract

This paper revisits the issue of cross-country spillovers from fiscal consolidations using an innovative empirical methodology. We find evidence in support of fiscal spillovers in 10 euro area countries. Fiscal consolidation in one country not only reduces domestic output (direct effect), but also the output of other member countries (indirect/spillover effect). Fiscal spillovers are larger for: (i) more closely located and economically integrated countries, and (ii) fiscal shocks originating from relatively larger countries. On average, 1 percent of GDP fiscal consolidation in 10 euro area countries reduces the combined output by 0.6 percent on impact, out of which half is driven by indirect effects from fiscal spillovers. The impact peters out and becomes insignificant over the medium-term. It is largely driven by tax measures, which have a relatively stronger effect on output compared to expenditure measures. The results are robust to alternative measures of bilateral links across countries.

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I. INTRODUCTION

The European integration process over the last several decades resulted in a greater interdependence across euro area countries. There is a broad consensus among economists that this increased the likelihood that fiscal policies in one-member state will spill over to the rest of the euro area. Recognizing spillovers from fiscal policy actions in individual member states to others, the European Commission has underscored the importance of appropriate fiscal stance in the euro area as a whole in its recent communication (see EC 2016; EPSC 2016).

In a number of euro area countries, the debate has centered on fiscal consolidation given elevated debt levels. Fiscal consolidation in one country can reduce domestic demand for imports, leading to lower output in its trading partners. Thus, trade linkages can play an important role in propagating fiscal shocks across countries, with more synchronized fiscal consolidations leading to significant cross-country spillover effects. These effects can potentially be larger for members of a currency union as the adjustment takes place through price compression and internal devaluation over the medium-term, even though theoretical literature does not provide a clear-cut answer (Beetsma and others 2001; Beetsma and Debrun 2004).

This paper revisits the issue of fiscal spillovers from fiscal consolidations using an innovative empirical methodology. The objective is to empirically assess the size of fiscal spillovers by taking into account spatial output links across 10 euro area countries covering more than 95 percent of the euro area GDP. Specifically, we quantify the domestic impact of fiscal consolidation measures by an individual euro area country, as well as bilateral spillovers to other euro area countries. We also assess spillovers from revenue and expenditure measures separately.

Our results suggest that fiscal consolidation in one country reduces not only the domestic output (direct effect), but also the output of other countries (indirect/spillover effects). Fiscal spillovers are larger for: (i) more closely located and economically integrated countries, and (ii) fiscal shocks originating from relatively larger countries. On average, 1 percent of GDP fiscal consolidation in 10 euro area countries reduces total output by 0.6 percent on impact, half of which is explained by indirect effects from fiscal spillovers. The impact is largely driven by tax measures, which have a relatively stronger effect on output compared to expenditure measures. The results are robust to alternative measures of bilateral links across countries.

This analysis has important policy implications and suggests large welfare gains from policy coordination at the euro area level. Country-specific estimates of fiscal spillovers can be used to run policy experiments to assess the effect of fiscal consolidations across countries and how it can impact the output gap of the euro area as a whole. One caveat is that the analysis does not assess the impact of fiscal expansions, which may not be symmetric. Such assessment is presented in a companion paper, which expands the analysis of fiscal spillovers to non-consolidation periods (Dabla-Norris and others 2017).

The remainder of the paper is structured as follows. Section II reviews the related literature. Section III presents a simple theoretical framework underpinning the empirical analysis. Section IV describes the data and presents descriptive statistics. Section V outlines the empirical

methodology used for estimating fiscal spillovers. Section VI presents estimation results. The last section concludes.

II. FISCAL SPILLOVERS: LITERATURE REVIEW

This section reviews the literature on fiscal spillovers. While there is a vast empirical literature on domestic fiscal multipliers (see Mineshima and others 2014 for a review), empirical evidence on cross-country spillovers from fiscal policy measures is relatively scarce. Mineshima and others (2014) note that there is no unique size for fiscal multiplier: the multiplier can be below or above one depending on the type of fiscal shocks and the country analyzed. In addition, some studies show that fiscal multipliers are state-dependent, with multipliers tending to be larger and frequently exceeding one in recessions.

The literature describes several channels for cross-country transmission of fiscal shocks, including trade, price, interest rate, and exchange rate channels (Weyerstrass and others 2006; In't Veld 2013). In a monetary union, where member countries have a common currency and interest rate, trade links between countries tend to play an important role in the cross-country transmission of fiscal shocks. Fiscal consolidation in one-member country affects others via reduced domestic activity and demand, some of which translates into reduced demand for foreign goods. The downward shift in aggregate demand, in turn, translates into lower domestic inflationary pressures, which can lead to a depreciation of the real effective exchange rate, improving the competitiveness of the home country and possibly triggering further negative spillover effects for other members of the monetary union. Nevertheless, other channels, such as risk premia contagion and financial integration may also play an important role, especially in periods of financial turbulence. Moreover, trade and financial integration often complement each other, strengthening the economic links further and making it difficult to isolate the impact of individual transmission channels.

In the literature, spillover effects are modeled using two main approaches: *model simulations* and *econometric analysis*.

Model Simulations

Several studies used various general equilibrium models to assess the magnitude of fiscal spillovers. In these models, fiscal multipliers and other model parameters are typically calibrated, rather than estimated.

The results of simulations vary widely depending on the countries under consideration, parameterization, and types of models. Some studies find small fiscal spillovers. For instance, Gros and Hobza (2001) find that spillovers from Germany range from 0.02 percent of GDP in Ireland to 0.22 percent of GDP in Belgium using four macroeconomics models.² IMF (2013) finds that a two-year increase in spending in Germany totaling 1 percent of GDP can boost real GDP in the rest of the euro area by a maximum of 0.2 percent. ECB (2014) finds that the largest spillovers

² The models are: QUEST II, NiGEM, Marmotte, and MULTIMOD Mark III.

from a fiscal consolidation in Germany range between 0.03 percent of GDP in France and 0.06 percent of GDP for a group of small euro area countries using the ECB's New Multi-Country Model. Other studies find relatively larger fiscal spillovers. For instance, In't Veld (2013) finds that a 1 percent of GDP increase in government investment in Germany increases the real GDP in other countries by between 0.2 percent and 0.3 percent using the QUEST model. Gaspar and others (2016) use IMF's suite of models and find that coordinated fiscal stimulus supported by the comprehensive, consistent, and coordinated approach will lead to a reduction of public debt-to-GDP ratio in the medium term due to strong cross-country spillovers.

Econometric Analysis

Empirical studies analyzing fiscal spillovers adopt different empirical methodologies and alternative approaches for the identification of fiscal shocks. The empirical methodologies can be grouped into three broad approaches: *two-step*, *global VAR*, and *local projections*.

The *two-step methodology* is based on assessing the impact of exogenous fiscal policy changes on domestic output (stage one) and calculating the partial equilibrium impact of fiscally-induced changes in domestic output on net exports of trading partners (stage two). Beetsma and others (2006) apply this approach, using the Blanchard and Perotti (2002) methodology to identify fiscal shocks. They find evidence of fiscal spillovers. For example, spillovers from a 1 percent of GDP fiscal shock in Germany range from 0.05 percent of GDP in Greece to 0.4 percent of GDP in Belgium.³

The *global VAR (GVAR) model* includes the series of weighted-average foreign endogenous variables as additional controls in individual country regressions (Pesaran and others 2004). Unlike the two-step methodology, it allows capturing spillovers from trade as well as other channels (e.g., interest rate and exchange rate channels). Hebous and Zimmermann (2010) apply the GVAR methodology with fiscal shocks identified using the orthogonalized impulse response function and find fiscal spillovers of mixed sign. For example, spillovers from a 1 percent of GDP fiscal shock in Germany range from -0.2 percent of GDP in Italy to 0.13 percent of GDP in Luxembourg. In the same spirit, Georgiadis and Hollmayr (2016) use a GVAR model, but identify government spending shocks using sign restrictions. They generally find small fiscal spillovers.⁴

The *local projections methodology (LPM)* computes impulse response functions of exogenous fiscal shocks on output using a univariate regression framework (Jorda 2005). Auerbach and Gorodnichenko (2013) adopt this approach for measuring fiscal spillovers from a weighted average of fiscal shocks emanating from other countries, where the weights are constructed using bilateral trade flows. Fiscal shocks are identified as the forecast errors of government spending. They estimate a large cross-border effect of government spending on output, with

³ See also Ivanova and Weber (2011)'s analysis using a similar approach.

⁴ Overall, fiscal spillovers depend on (i) the size of the domestic multiplier, (ii) the size of the domestic economy relative to the rest of the euro area, and (iii) the trade integration between countries originating the fiscal shocks and recipients of spillovers. Surprisingly, fiscal spillovers from shocks in France tend to outweigh those from Germany.

average annual multiplier (over a 6-year period) for 1 percent of GDP fiscal consolidation in all trading partners ranging between 1.6 and 2.0 for different subsamples, and reaching 3 in periods of economic slack. Goujard (2017) also employs the LPM approach, but identifies fiscal shocks using the narrative measure of fiscal consolidations (Devries and others 2011). The estimates of fiscal spillovers are sizeable. Moreover, fiscal spillovers are stronger between countries with limited exchange rate adjustment or within currency unions, than among countries with more flexible exchange rate arrangements.

Overall, the existing evidence suggests that the size of fiscal spillovers varies depending on the methodology employed and countries under consideration. Simulation of large macroeconomic models generally leads to smaller cross-country spillovers compared to results from empirical studies (see also Bayoumi and Vitek 2013), even though the comparison across studies is complicated because of different definitions of spillovers (e.g., exogenous shocks in structural models versus orthogonalized impulse responses in GVAR).

This paper provides an empirical assessment of cross-country spillovers from fiscal consolidations in a sample of 10 euro area countries using spatial econometrics methods that have been used widely in the empirical growth literature. Lopez-Bazo and others (2014) and Ertur and Koch (2007) provide a theoretical justification for using spatial econometrics methods for the empirical analysis of growth by extending the neoclassical growth model. Our paper is closest in spirit to Goujard (2017), with several differences. First, our narrative measure of fiscal consolidations covers the post-2009 period (Gupta and others 2017). Second, our methodology allows capturing both spillover and spillback effects from fiscal consolidations. Finally, we cover only 10 euro area countries (a subsample of OECD), which is the focus of our study.

III. THEORETICAL FRAMEWORK

In this section, we present a simple theoretical framework illustrating the impact of fiscal spillovers and motivating our empirical analysis. The framework is in the spirit of Barro and Gordon (1983a, 1983b).⁵ Consider several open economies. Policymakers in each economy i minimize the following loss function:

$$L_i = \frac{1}{2} [gap_i^2 + d_i^2] \quad (1)$$

where gap denotes the deviation of output from its potential and d denotes the change in structural fiscal deficit (fiscal stance). This loss function implies that the policymakers aim at minimizing deviations of output from its potential, while also minimizing the need to use discretionary fiscal measures to keep the output close to its potential due to potential distortions associated with these measures (e.g., tax burden).

For each economy, aggregate demand is given by:

$$gap_i = m_i \cdot d_i + s_i \cdot gap_j \quad (2)$$

⁵ See also Furceri (2009) for a similar framework.

where $m_i > 0$ is the domestic multiplier from discretionary fiscal measures in own country i , $s_i > 0$ is the spillover effect to country i from changes in the output gap of country j .

Minimizing (1) constrained by (2) with respect to d_i gives the following optimal level of fiscal stance in country i :

$$d_i^* = -d_j \cdot \frac{s_i \cdot m_i \cdot m_j}{m_i^2 + (1 - s_i \cdot s_j)^2} \quad (3)$$

Equation (3) suggests that the optimal fiscal stance in individual countries depends on the fiscal stance of other countries with a negative sign. The intuition is straightforward. A contractionary fiscal stance in country j will result in a decline in domestic output in country i below its potential through spillovers. To counteract this negative effect on domestic output, fiscal policy in country i should expand. Thus, the loss function would deviate from its global minimum of zero, corresponding to the situation of $gap_i = 0$ and $d_i = 0$.

The equation also shows that the interdependencies between policies are driven by spillovers. For instance, if spillovers s_i were zero, then the optimal fiscal stance in country i would not be dependent on that in country j and the global minimum of the loss function could be achieved by setting d_i to zero. Moreover, the larger is the size of the spillovers s_i , the stronger is the adverse association between the policies of these countries.

The above equation reflects the optimal policy response under decentralized policies. If policies were centralized, then the policymaker would minimize the sum of loss functions for countries i and j , subject to aggregate demand functions for each country. This would allow for internalizing the effects of spillovers, leading to optimal fiscal stances in each country that would not depend on fiscal stances of the other country. Hence, the larger is the size of spillovers, the greater are the welfare gains from policy coordination.

IV. DATA AND DESCRIPTIVE STATISTICS

A. Data

Our database comprises 10 euro area countries (covering more than 95 percent of euro area GDP) over the period 1980-2015.⁶ Table (1) lists the variables and their data sources. As in Goujard (2017), data on *fiscal consolidation measures* is taken from Devries and others (2011). However, we use its updated version from Gupta and others (2017) to capture the post-crisis period. The dataset presents series of discretionary changes in taxes and government spending primarily motivated by the desire to reduce the budget deficit and not in response to short-term economic developments/business cycle. This exogenous feature provides an identification

⁶ The countries are: Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, and Spain.

strategy for modeling using the univariate LPM approach.⁷ Using annual data diminishes the issue of measurement of errors and anticipation effects of fiscal policy changes (Ramey 2011; Beetsma and others 2006).⁸

Data on real GDP is taken from IMF's World Economic Outlook dataset. The weighting matrices measuring bilateral country economic linkages are constructed using geographical distances weighted by population (source: CEPII), export shares (source: UNCTAD), and input-output tables (source: WIOD).

B. Descriptive Statistics

Table (2) presents descriptive statistics of variables used in the analysis. Figure (1) shows the dynamics of fiscal consolidation measures from Devries and others (2011), updated for the post-crisis period by Gupta and others (2017). The mean size of consolidation measure is around 0.34 percent of GDP over the 1980-2015 period, but there is large variation across the 10 euro area countries. Decomposition of measures into revenue and expenditure components suggests a large variation in both. There is no clear evidence that consolidations took place around crisis episodes (with a possible exemption of the 2008-09 crisis), which supports their exogenous nature in the spirit of the narrative approach. Some measures have a negative sign, suggesting that some episodes of consolidations were accompanied by expansionary measures, either on the revenue or the expenditure side.

Figure (2) shows the association between various measures of bivariate linkages used for generating weighting matrices. The scatter plots (Panel A) suggest a close association between geographical distance (weighted by population), trade, and input-output weights, which is consistent with the evidence from gravity studies (see Disdier and Head 2008 for a survey). The network plots (Panel B) also confirm the close association, especially across export shares and input-output links measures. A notable exception is the relationship between Belgium and Netherlands, where distance links are much more intense compared to the export share and input-output links, suggesting that the close distance would have implied much closer economic links compared to what is observed in practice. We use all these measures of bilateral links to generate weighting matrices for our empirical analysis and provide a robustness check.

V. METHODOLOGY

We combine two empirical methodologies to assess spatial spillovers from fiscal consolidation measures. Specifically, we augment the LPM of Jorda (2005) by incorporating a spatial autoregressive term commonly used in the *spatial econometrics* literature (Elhorst 2010). Our

⁷ Dell'Erba and others (2014) confirm the exogeneity of fiscal consolidation measures by running country-by-country regressions of the fiscal measure variable on two lags of real GDP growth and lagged public debt ratio. The coefficients of independent variables are not significant (except for the estimate for the Netherlands). A similar exercise confirming the exogeneity of fiscal plans identified using the narrative approach is performed in Alesina and others (2016).

⁸ The narrative approach also has some drawbacks, including the reliance on judgement and the fact that not all policy announcements are implemented in practice (see Ramey 2011 and references therein).

methodology has several advantages over the methodologies used for measuring fiscal spillovers in previous studies.

- Unlike the two-step approach of Beetsma and others (2006), our approach is more efficient and allows for measuring fiscal spillovers in one step.
- Unlike the GVAR approach, our methodology is univariate which simplifies the interpretation of results. In addition, the identification of fiscal shocks is based on the commonly used narrative methodology, while identification in the GVAR model is based on generalized impulse responses which cannot be interpreted in a structural sense.
- Unlike the LPM approach of Auerbach and Gorodnichenko (2013) and Goujard (2017), our empirical methodology does not assume that fiscal measures in the home country have a direct impact on the output of trading partners. Instead, fiscal measures in the home country affect domestic output, which in turn spills over to the outputs of trading partners and exerts a feedback on the home country. Finally, our approach allows for gauging the relative importance of fiscal spillovers by assessing the magnitudes of direct and indirect effects separately.

The empirical specification takes the following form (see also Annex):

$$y_{it+h} - y_{it-1} = \underbrace{\alpha_i^h + \beta^h F_{it} + \sum_{j=1}^p \gamma^h X_{it-j}}_{\text{local projection component}} + \underbrace{\rho^h \sum_{k \neq i} w_{ik} (y_{kt+h} - y_{kt-1})}_{\text{spatial lag}} + \varepsilon_{it}^h \quad (4)$$

where i denotes countries, t denotes time, $h=[0,...,5]$ denotes the projection horizon, p denotes the number of lags, y denotes the log real GDP, F is the fiscal consolidation measure (revenues, expenditures, or total), X is a vector of lagged control variables (dummy variable for the pre-Euro period, real domestic credit to private sector growth, real GDP growth, global GDP growth and output gap), w is the weighting matrix measuring the proximity between countries i and k , and ε is the *i.i.d.* error term. Regressions include country fixed effects (α_i) to control for country-specific unobserved heterogeneity. We do not include time fixed effects given that global GDP growth already captures common shocks affecting all euro area countries within the same year. In addition, as indicated by Elhorst (2010), the inclusion of time fixed effects will make it difficult to assess the magnitude of fiscal spillovers, which transmit across countries in the year of the fiscal shock through bilateral linkages.

The first component of specification (4) is the standard LPM component of Jorda (2005). Unlike standard VAR methods that solve for the impulse responses recursively, Jorda's method estimates response for each variable at each horizon using a different equation. However, these impulse responses measure only the direct effects of fiscal measures in home country on domestic output and spillover effects on outputs of trading partners are assumed away.

We augment this otherwise standard LPM specification by including a spatial lag term widely used in the applications of spatial spillovers in regional studies of strategic government interactions (see Brueckner 2003 and Revelli 2005 for a literature review). A key component of

the spatial analysis is the coefficient of the spatial lag (ρ). If significant, it would confirm the presence of cross-country spillovers and would lend support to the use of the spatially-augmented LPM against the traditional LPM. For instance, a fiscal consolidation in one country will reduce the domestic output in the first round (*direct effect*). However, a reduction in domestic output would also have adverse effects on outputs of other countries in the second round (*indirect effect*), with the impact increasing with the strength of economic and trade linkages. The reduction of output in trading partners will spill back to the country originating the fiscal shock in the third round, suppressing its output further. These spillover and spill-back effects will continue until the full impact of direct and indirect effects is materialized.

The weighting matrix (W) measures the economic links (proximity) of countries and could be based on various indicators, including export shares (the larger is country i 's the share of exports to country j , the larger is the impact of country j 's fiscal shocks on country i) and geographical distance (the closer is country i located to country j , the closer are the economic links and the larger is the impact of country j 's fiscal shocks on country i).

As discussed above, in traditional LPM the dynamic impact of fiscal measures in country i on its output would be captured by the coefficient β estimated over different projection horizons h and there would be no spillovers to other countries ($k \neq i$) from fiscal measures implemented by country i . This is no longer the case in our LPM specification augmented by the spatial autoregressive term. Fiscal measures implemented by country i will have a direct impact on output of country i and indirect (or spillover) effects on outputs of other countries ($k \neq i$). Similarly, output in country i will be affected by fiscal measures implemented by other countries ($k \neq i$) even if no fiscal action was taken by country i itself. Specifically, the direct and indirect effect of fiscal measures for each horizon h can be described by the following matrix:

$$\frac{\partial y_{it+h}}{\partial F_{it}} = I_N \beta^h (I_N - \rho W)^{-1} = I_N \beta^h (I_N + \rho W + \rho^2 W^2 + \dots) = \begin{bmatrix} S_{11}^h & \dots & S_{1N}^h \\ \dots & \dots & \dots \\ S_{N1}^h & \dots & S_{NN}^h \end{bmatrix} \quad (5)$$

where N is the number of countries, I_N is the identity matrix, h is the projection horizon of the impulse response function, and W is the standardized weighting matrix (sum of each row = 1). For example, the impact of a fiscal impulse of 1 percent of GDP in country 1 on its own output will be measured by entry S_{11} (*direct effect*), the impact of a fiscal impulse of 1 percent of GDP implemented in each of other countries (2, 3,... N) on the output of country 1 will be measured by $S_{12}, S_{13}, \dots, S_{1N}$ entries (*indirect effect*), respectively. Hence, the total impact of a fiscal impulse of 1 percent of GDP implemented in all countries on the output of country 1 will be measured by the sum of direct and indirect effects (all entries in the first row). A similar logic extends to other countries (2, 3,... N).

VI. ESTIMATION RESULTS

In this section, we present estimates of spillovers from fiscal consolidations for the 10 euro area countries over the period 1980-2015. As discussed above, unlike the traditional LPM, the spatially augmented LPM suggests that the impact of fiscal measures depends not only on the slope coefficient, but also on the spatial lag term (ρ) and the weighting matrix (W). Given that the

coefficient on the spatial lag is common to all countries, the variation in cross-country spillovers mainly depends on the bilateral links in the weighting matrix. Hence, we also check the robustness of our results using alternative weighting matrices.

A. Baseline Specification

The baseline specification employs export shares as the relevant weighting matrix. Table (3) presents estimation results, while Figure (3) presents the impulse response functions (IRFs).

The coefficient of the spatial lag term is positive and significant for all forecast horizons. This implies that fiscal measures implemented in one country have an impact not only on domestic output, but also on outputs of other countries. A 1 percent of GDP fiscal consolidation in all countries reduces output by 0.60 percent on impact (out of which 0.32 percent is driven by fiscal spillovers) and by 1.19 percent in the 6th year.

The breakdown of consolidation measures by tax and expenditure components suggests that most of the impact comes from tax measures. A 1 percent of GDP tax consolidation in all countries reduces output by 1.33 percent on impact (out of which 0.72 percent is driven by fiscal spillovers) and by 2.38 percent on the 5th year. This effect turns insignificant by the 6th year. Expenditure-based consolidations are insignificant on impact, but increase to 0.92 percent and turn significant in the next period, out of which 0.47 percent is due to fiscal spillovers.

Our result on the relatively stronger effect of tax consolidations is consistent with studies on fiscal multipliers using the narrative approach (Leigh and others 2010; Dell’Erba and others 2014), but it contrasts with Goujard (2017), who finds a larger impact of expenditure measures, on average, over a 3-year period for 17 OECD countries. While there is no consensus in the literature on the size of revenue versus expenditure multipliers, there are at least two reasons why revenue multipliers are likely to be more sizeable in the euro area countries we are analyzing. First, as shown in Trabandt and Uhlig (2012), many euro area countries are already on the top of their respective Laffer curves, suggesting that additional tax hikes would lead to relatively lower increases in tax revenues while having distortionary effects on output. Second, theoretical models suggest that tax hikes have a more depressing effect on potential output than expenditure cuts. While this result is partially reversed in the theoretical exercise for a currency union (Erceg and Linde 2017), empirical evidence suggests that tax measures are more detrimental to growth even when monetary policy cannot respond to the fiscal policy of individual members of a currency union (Alesina and others 2016).

Nevertheless, our results on individual effects of revenue and expenditure consolidation measures should be treated with care given that some of these measures were often taken as part of a broader fiscal package, which is not controlled for when assessing their individual impacts.

Table (7) and Figure (7) illustrate spillover effects from individual country fiscal shocks to other countries for the baseline specification. The illustration proxies bilateral links across countries using a weighting matrix based on the export shares. The coefficients of the spatial lag term and

fiscal measures are taken from Table (3).⁹ Several observations are worth noting. First, the direct effect of fiscal shocks is close to 0.8 percent in the medium term. This number is lower than the slightly more than 1 percent medium-term multiplier found in Dell’Erba and others (2014), but is higher than medium-term multipliers found in other studies using the narrative approach (see, for example, Leigh and others 2010; Abiad and others 2011). Second, fiscal shocks in larger countries have a more sizeable impact on average. For instance, the largest total effect on impact comes from Germany (0.16 percent of euro area GDP, of which 0.07 percent is due to spillovers and spillbacks) followed by France (0.12 percent of euro area GDP, of which 0.06 percent is due to spillovers and spillbacks). By contrast, shocks originating from smaller countries (e.g., Ireland, Finland) have negligible spillover effects. Third, countries that are more closely linked via trade are affected most. This could be due to closer trade linkages, but also closer financial integration and other economic links that usually complement trade integration. For instance, Germany’s impact on Austria, Belgium, and Netherlands is larger than Germany’s impact on Ireland. Finally, the spillover effects are large on impact, but tend to dissipate over time.

How do our baseline estimates of fiscal spillovers compare with those in the literature? Unfortunately, the direct comparison is difficult, since most empirical studies do not report a matrix summarizing cross-country spillovers. The only exception is Beetsma and others (2006), which provide spillover estimates for a 1 percent of GDP fiscal consolidation in Germany and France. The comparison of our spillover estimates with those in Beetsma and others (2006) suggests that spillovers for most countries are comparable. The main difference is Austria, Belgium, Ireland and Netherlands (fiscal shock in Germany) and Belgium (fiscal shock in France), for which Beetsma and others (2006) find 2-4 times larger spillovers.

B. Robustness Checks

Table (4) and Figure (4) present estimation results and IRFs from the specification with inverse geographical distance between countries (weighted by population) as the weighting matrix. Evidence on spillovers from fiscal consolidations stands, with the impact of spillovers from a trading partner country being larger the closer is the distance to that country. The magnitude of total and spillover effects is very close to that based on export shares. The latter could be explained by the close association between geographical distance and trade, as shown in many gravity studies (see Disdier and Head 2008) and Figure (2).

Table (5) and Figure (5) present estimation results and IRFs from the specification with input-output weights as a weighting matrix. Evidence on fiscal spillovers stands when using this variable to measure bilateral links.

Finally, we run our regressions using the original sample period of Devries and others (2011) that does not include the global financial crisis. One objective is to check whether the results are affected by possible differences in the methodological approach used for updating the database for the post-2009 period by Gupta and others (2017). Another objective is to obtain results that are more comparable to previous studies using the narrative approach. Table (6) and Figure (6)

⁹ As shown in specification (5), the size of spillovers will vary depending on the type of the weighting matrix, as well as coefficient estimates for the spatial lag term and fiscal measures.

present estimation results and IRFs from this specification. The results are qualitatively and quantitatively comparable to those in the baseline specification.

C. Heterogeneous Effects: Introduction of the Euro and State of the Economy

We also checked the sensitivity of fiscal spillovers to the monetary policy regime (currency union) and the cyclical state of the economy (bad versus good times). The effect of fiscal consolidation on trade flows could be larger within currency unions given the absence of nominal exchange rate flexibility to cushion the impact of the shock (Bluedorn and Leigh 2011; Goujard 2017). Moreover, greater economic integration makes trade flows within currency unions more sensitive to changes in relative prices. Thus, fiscal spillovers are expected to be stronger in currency unions, even though the theoretical literature does not provide a clear answer (Beetsma and others 2001; Beetsma and Debrun 2004).

The cyclical state of the economy can also affect the size of fiscal multipliers from domestic consolidations, which in turn will have implications for fiscal spillovers to trading partners. Empirical evidence suggests that fiscal multipliers tend to be larger during downturns, as fiscal consolidations weigh on already underutilized resources (capital, labor), further compressing consumption and investment (Mineshima and others 2014; Auerbach and Gorodnichenko 2013). Therefore, fiscal spillovers are also expected to be larger if fiscal consolidations are implemented in downturns.

To assess the impact of currency unions and the cyclical state of the economy on fiscal spillovers, we use the following empirical specification:

$$y_{it+h} - y_{it-1} = \underbrace{\alpha_i^h + \beta_1^h d_{it} F_{it} + \beta_2^h (1 - d_{it}) F_{it}}_{\text{local projection component}} + \underbrace{\sum_{j=1}^p \gamma^h X_{it-j} + \rho^h \sum_{k \neq i} w_{ik} (y_{kt+h} - y_{kt-1})}_{\text{spatial lag}} + \varepsilon_{it}^h \quad (6)$$

where d captures the heterogeneous effects as follows:

- *Currency union.* d is a dummy variable taking the value of 1 over the 1999-2015 period. Coefficient β_1 then captures the effects of fiscal shocks in the post-Euro period, while coefficient β_2 captures the effects of fiscal shocks in the pre-Euro period.
- *State of the economy.* d is a continuous variable ranging between 0 and 1 and measuring the probability of being in a recession. Following Auerbach and Gorodnichenko (2013), it is estimated as $\exp(-\eta z_{it}) / [1 + \exp(-\eta z_{it})]$, where z is the output gap normalized to have a zero mean and unit variance and $\eta = 1.5$ so that an economy spends about 20 percent of time in a recession. Coefficient β_1 then captures the effects of fiscal shocks in bad times, while coefficient β_2 captures the effects of fiscal shocks in good times.

Figures (8) and (9) show the estimation results for both specifications, respectively. As expected, fiscal shocks tend to have larger effect on output in the post-Euro period (Figure 8). Specifically, the cumulative impact on output peaks at close to 3.5 percent in the third year following the

shock in the post-Euro period, while the peak effect in the pre-Euro period is much smaller and largely insignificant (close to 1.0 percent in the fifth year).

Similarly, fiscal shocks tend to have a larger effect on output if implemented in periods of relatively weaker cyclical conditions (Figure 9). Specifically, the cumulative impact on output peaks at close to 3.0 percent in the third year following the shock in bad times, while the peak effect in the pre-Euro period is much smaller (close to 1.5 percent in the fourth and fifth years).

VII. CONCLUSIONS

This paper assesses spillovers from fiscal consolidations in 10 euro area countries using an innovative empirical methodology. The analysis lends support to the existence of fiscal spillovers, with fiscal consolidation in one country reducing not only the domestic output but also the output of other member states. Spillover effects are larger for: (i) more closely located and economically integrated countries, and (ii) for fiscal shocks originating from relatively larger countries. Most of the impact comes from revenue measures, while the impact of expenditure measures is relatively weaker. The latter result is consistent with the distortionary effects of taxation and empirical literature on fiscal multipliers using the narrative approach (Leigh and others 2010; Abiad and others 2011).

Our results have important policy implications. They suggest that fiscal consolidations in individual euro area countries, especially the larger ones, can reduce aggregate demand in others. The magnitude of cross-country spillovers has strengthened with the economic integration and introduction of a single currency. Also, spillovers can be larger if fiscal consolidations are implemented in downturns. Therefore, individual euro area countries should consider fiscal measures implemented in other members as well as the state of the economy when implementing domestic policies.

Two caveats are in order. First, the sample used in the analysis covers the zero lower bound period and quantitative easing policies launched by the ECB recently, but does not separately examine interactions with monetary policy actions. In the absence of offsetting monetary policy actions, fiscal spillovers may be larger if measures were to be implemented now. Second, given potentially important asymmetries between spillovers arising from fiscal expansions versus consolidations, our analysis may not directly translate to expansion episodes. A companion paper analyses fiscal spillovers in both consolidation and non-consolidation periods (Dabla-Norris and others 2017).

Annex. Measuring Cross-Country Spillovers: Spatial Regression Approach

The issue of spatial dependence often arises in the context of a panel data representing individual country observations over time. The conventional panel data methods assume independent observations across countries. Spatial econometrics methods are designed to tackle situations when observations in one country are dependent on observations in other countries.

Let's consider a two-country example:

$$\begin{aligned} y_{1t} &= \alpha_1 + \beta_1 y_{2t} + \gamma X_{1t} + \epsilon_{1t} \\ y_{2t} &= \alpha_2 + \beta_2 y_{1t} + \gamma X_{2t} + \epsilon_{2t} \end{aligned} \quad (B.1)$$

The system of equations (B.1) implies a simultaneous data generating process, where the value taken by the dependent variable in country 1 depends on the value of the dependent variable in country 2, and vice versa. Economically speaking, spatial dependence implies that changes in an independent variable X_1 will affect not only the dependent variable in country 1 through coefficient γ , but also the dependent variable in country 2 through $\gamma\beta_2$.

Expanding the example to a more general case of N countries suggests that the system can quickly become over-parameterized, giving rise to $(N^2 - N)$ cross-country relations. To solve the issue of over-parameterization, spatial econometrics literature proposes a parsimonious relationship between cross-country observations in the form of a spatial autoregressive process:

$$\begin{aligned} y_{1t} &= \alpha_1 + \rho y_{1t}^* + \gamma X_{1t} + \epsilon_{1t} \\ y_{2t} &= \alpha_2 + \rho y_{2t}^* + \gamma X_{2t} + \epsilon_{2t} \\ y_{3t} &= \alpha_3 + \rho y_{3t}^* + \gamma X_{3t} + \epsilon_{3t} \\ &\dots\dots\dots \\ y_{Nt} &= \alpha_N + \rho y_{Nt}^* + \gamma X_{Nt} + \epsilon_{Nt} \end{aligned} \quad (B.2)$$

where the term y_N^* is the spatial lag for country N , representing the linear combination of values of the dependent variable constructed from observations of other countries. For instance, $y_{1t}^* = w_{12}y_{2t} + w_{13}y_{3t} + \dots + w_{1N}y_{Nt}$, where w_{1N} is the weight of country N in the spatial lag for country 1. The weights are greater for more closely connected country pairs (e.g., geographical distance, economic and trade linkages).

Coefficient ρ is the spatial lag coefficient, which measures the direction and intensity of cross-country dependence. If the spatial lag coefficient is insignificant, it would imply that the data generating process follows the conventional panel data structure, with independent observations across countries. Alternatively, if the spatial lag coefficient is significant, it would imply spatial dependence and existence of cross-country spillovers. The size of spillovers from changes in X_1 to country N would then be $\gamma\rho w_{N1}$. Spillovers from changes in independent variables in other countries X_N could be estimated similarly.

Estimation of the system of simultaneous equations (B.2) with standard panel data OLS techniques can lead to inconsistent estimates because of the violation of assumption on independence of observations across countries. Elhorst (2010) develops a maximum likelihood methodology to estimate fixed effects panel data spatial regression models.

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Table 1. List of Variables

Variable	Definition	Source
<i><u>Fiscal Measures</u></i>		
Revenue, expenditure, and total measures	Discretionary changes in taxes and government spending primarily motivated by a desire to reduce the budget deficit and not by a response to prospective economic conditions (narrative approach).	Devries et al. (2011) and Gupta and others (2016)
<i><u>Macro variables</u></i>		
Real GDP	Value added of all industries at the country level (constant prices).	World Economic Outlook, IMF (October, 2016)
Output gap	Difference between real and potential real GDP (in percent).	World Economic Outlook, IMF (October, 2016)
Global real GDP	Value added of all industries at the global level (constant prices).	World Economic Outlook, IMF (October, 2016)
Domestic credit to private sector	Loans provided to private sector by banks.	World Development Indicators, World Bank (2016)
<i><u>Weighting Matrix</u></i>		
Inverse distance	Inverse of the distance between capitals of the countries.	CEPII
Bilateral exports	Share of bilateral exports between two countries in total exports.	UNCTAD
Input-Output matrix	Value added used as an intermediate input in a bilateral format.	WIOD

Table 2. Descriptive Statistics

	Obs.	Mean	Median	St. Dev.	10th percentile	90th percentile
Total fiscal measures (% of GDP)	360	0.34	0.00	0.78	0.00	1.45
Tax measures (% of GDP)	360	0.12	0.00	0.42	0.00	0.50
Expenditure measures (% of GDP)	360	0.22	0.00	0.54	0.00	0.91
Real GDP growth (%)	360	2.12	2.04	2.65	-0.73	4.66
Output gap (%)	360	-0.39	-0.72	2.84	-3.51	2.91
Global real GDP growth (%)	360	3.41	3.40	1.23	2.06	5.28
Real credit to private sector growth (%)	360	3.45	3.06	8.04	-3.52	10.96

Note: The sample includes 10 euro area countries for the period 1980-2015.

Table 3. Baseline Results: Spillovers Based on Export Shares

	Total fiscal measures						Tax measures						Expenditure measures					
	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5
Spatial lag (ρ)	0.58*** [0.04]	0.53*** [0.03]	0.48*** [0.04]	0.44*** [0.07]	0.39*** [0.09]	0.34*** [0.10]	0.58*** [0.04]	0.54*** [0.03]	0.49*** [0.04]	0.45*** [0.07]	0.40*** [0.09]	0.35*** [0.10]	0.58*** [0.04]	0.53*** [0.03]	0.49*** [0.04]	0.45*** [0.07]	0.40*** [0.09]	0.34*** [0.11]
Total impact of fiscal measures	-0.60*** [0.16]	-1.24*** [0.31]	-1.59*** [0.43]	-1.79*** [0.57]	-1.59*** [0.53]	-1.19** [0.54]	-1.33*** [0.45]	-2.44*** [0.65]	-2.75*** [0.65]	-2.77*** [0.76]	-2.38*** [0.69]	-1.39 [1.02]	-0.32 [0.31]	-0.92* [0.49]	-1.47*** [0.52]	-1.91*** [0.73]	-1.75** [0.81]	-1.62 [1.00]
Direct	-0.28*** [0.08]	-0.62*** [0.15]	-0.87*** [0.23]	-1.05*** [0.34]	-1.00*** [0.30]	-0.78*** [0.28]	-0.61*** [0.23]	-1.20*** [0.33]	-1.48*** [0.35]	-1.60*** [0.45]	-1.48*** [0.38]	-0.86 [0.54]	-0.14 [0.14]	-0.45* [0.23]	-0.79*** [0.27]	-1.11*** [0.42]	-1.08** [0.49]	-1.09* [0.65]
Indirect (spillovers)	-0.32*** [0.09]	-0.62*** [0.17]	-0.72*** [0.22]	-0.74*** [0.27]	-0.59** [0.27]	-0.41 [0.29]	-0.72*** [0.23]	-1.24*** [0.34]	-1.27*** [0.33]	-1.17*** [0.37]	-0.91** [0.39]	-0.53 [0.51]	-0.18 [0.18]	-0.47* [0.27]	-0.68*** [0.26]	-0.80** [0.34]	-0.67* [0.37]	-0.53 [0.41]
# observations	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
# countries	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
R ²	0.43	0.46	0.44	0.42	0.42	0.41	0.43	0.47	0.45	0.42	0.43	0.41	0.42	0.45	0.43	0.41	0.42	0.41

Note: Estimations are performed using the LPM model augmented by the spatial lag term. The weighting matrix is based on export shares. The sample includes 10 euro area countries for the period 1980-2015. Control variables (lagged output gap, lagged real GDP growth, lagged world real GDP growth, lagged real credit to the private sector growth, and dummy variable for the pre-Euro period) are included but not reported.

Robust standard errors are in brackets. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 4. Robustness Check: Spillovers Based on Inverse Geographical Distances

	Total fiscal measures						Tax measures						Expenditure measures					
	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5
Spatial lag (ρ)	0.54*** [0.04]	0.50*** [0.04]	0.47*** [0.05]	0.43*** [0.07]	0.40*** [0.09]	0.36*** [0.09]	0.55*** [0.03]	0.51*** [0.04]	0.47*** [0.05]	0.44*** [0.07]	0.40*** [0.08]	0.37*** [0.09]	0.55*** [0.03]	0.51*** [0.04]	0.48*** [0.05]	0.44*** [0.07]	0.40*** [0.09]	0.36*** [0.09]
Total impact of fiscal measures	-0.51*** [0.14]	-1.15*** [0.27]	-1.58*** [0.39]	-1.89*** [0.51]	-1.78*** [0.49]	-1.36** [0.55]	-1.06** [0.47]	-2.13*** [0.65]	-2.61*** [0.64]	-2.79*** [0.73]	-2.55*** [0.72]	-1.52 [1.10]	-0.33 [0.32]	-0.94* [0.50]	-1.54*** [0.46]	-2.11*** [0.63]	-2.05*** [0.75]	-1.90** [0.93]
Direct	-0.25*** [0.07]	-0.60*** [0.13]	-0.88*** [0.20]	-1.12*** [0.28]	-1.09*** [0.25]	-0.87*** [0.27]	-0.52** [0.24]	-1.10*** [0.33]	-1.44*** [0.32]	-1.63*** [0.40]	-1.56*** [0.34]	-0.92 [0.58]	-0.15 [0.15]	-0.48* [0.26]	-0.85*** [0.26]	-1.23*** [0.37]	-1.25*** [0.43]	-1.24** [0.59]
Indirect (spillovers)	-0.26*** [0.07]	-0.55*** [0.15]	-0.70*** [0.21]	-0.77*** [0.27]	-0.69** [0.30]	-0.49 [0.31]	-0.54** [0.23]	-1.03*** [0.34]	-1.17*** [0.36]	-1.15*** [0.39]	-0.99** [0.44]	-0.6 [0.56]	-0.17 [0.17]	-0.46* [0.25]	-0.69*** [0.23]	-0.87*** [0.31]	-0.80** [0.39]	-0.66 [0.40]
# observations	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
# countries	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
R ²	0.45	0.48	0.46	0.43	0.43	0.41	0.45	0.48	0.46	0.44	0.44	0.42	0.44	0.47	0.45	0.43	0.43	0.42

Note: Estimations are performed using the LPM model augmented by the spatial lag term. The weighting matrix is based on inverse distances (weighted by population). The sample includes 10 euro area countries for the period 1980-2015. Control variables (lagged output gap, lagged real GDP growth, lagged world real GDP growth, lagged real credit to the private sector growth, and dummy variable for the pre-Euro period) are included but not reported. Robust standard errors are in brackets. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 5. Robustness Check: Spillovers Based on Input-Output Weights

	Total fiscal measures						Tax measures						Expenditure measures					
	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5
Spatial lag (ρ)	0.57*** [0.04]	0.52*** [0.03]	0.48*** [0.04]	0.43*** [0.07]	0.39*** [0.09]	0.34*** [0.10]	0.57*** [0.04]	0.53*** [0.03]	0.49*** [0.04]	0.44*** [0.07]	0.40*** [0.09]	0.35*** [0.10]	0.57*** [0.04]	0.53*** [0.03]	0.49*** [0.04]	0.44*** [0.07]	0.39*** [0.09]	0.34*** [0.11]
Total impact of fiscal measures	-0.57*** [0.16]	-1.20*** [0.31]	-1.56*** [0.43]	-1.77*** [0.57]	-1.58*** [0.53]	-1.19** [0.54]	-1.27*** [0.45]	-2.38*** [0.66]	-2.70*** [0.66]	-2.74*** [0.77]	-2.39*** [0.69]	-1.38 [1.00]	-0.29 [0.31]	-0.88* [0.50]	-1.43*** [0.51]	-1.89*** [0.73]	-1.74** [0.82]	-1.61 [1.00]
Direct	-0.26*** [0.08]	-0.61*** [0.15]	-0.86*** [0.23]	-1.05*** [0.33]	-1.00*** [0.30]	-0.78*** [0.28]	-0.60** [0.23]	-1.19*** [0.34]	-1.47*** [0.35]	-1.60*** [0.45]	-1.49*** [0.38]	-0.87 [0.54]	-0.13 [0.14]	-0.44* [0.24]	-0.78*** [0.27]	-1.10*** [0.42]	-1.08** [0.49]	-1.09* [0.65]
Indirect (spillovers)	-0.30*** [0.09]	-0.59*** [0.17]	-0.70*** [0.22]	-0.72*** [0.27]	-0.59** [0.27]	-0.4 [0.28]	-0.67*** [0.23]	-1.19*** [0.34]	-1.24*** [0.34]	-1.14*** [0.38]	-0.90** [0.39]	-0.52 [0.49]	-0.16 [0.18]	-0.44* [0.26]	-0.66*** [0.25]	-0.78** [0.34]	-0.66* [0.38]	-0.52 [0.41]
# observations	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
# countries	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
R ²	0.43	0.46	0.44	0.42	0.42	0.41	0.44	0.47	0.45	0.43	0.43	0.42	0.42	0.45	0.43	0.42	0.42	0.41

Note: Estimations are performed using the LPM model augmented by the spatial lag term. The weighting matrix is based on input-output weights. The sample includes 10 euro area countries for the period 1980-2015. Control variables (lagged output gap, lagged real GDP growth, lagged world real GDP growth, lagged real credit to the private sector growth, and dummy variable for the pre-Euro period) are included but not reported.

Robust standard errors are in brackets. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 6. Robustness Check: Spillovers Based on Export Shares (Devries and others 2011 Sample)

	Total fiscal measures						Tax measures						Expenditure measures					
	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5	h=0	h=1	h=2	h=3	h=4	h=5
Spatial lag (ρ)	0.60*** [0.02]	0.53*** [0.04]	0.48*** [0.06]	0.45*** [0.07]	0.41*** [0.08]	0.35*** [0.10]	0.61*** [0.02]	0.54*** [0.04]	0.49*** [0.05]	0.45*** [0.06]	0.42*** [0.08]	0.36*** [0.10]	0.60*** [0.02]	0.53*** [0.04]	0.48*** [0.06]	0.45*** [0.07]	0.42*** [0.08]	0.35*** [0.10]
Total impact of fiscal measures	-0.57*** [0.21]	-1.14*** [0.38]	-1.42*** [0.53]	-1.68** [0.80]	-1.72** [0.85]	-1.14* [0.64]	-0.78** [0.33]	-1.86*** [0.60]	-2.51*** [0.75]	-2.81*** [1.09]	-2.78*** [1.02]	-1.49 [1.03]	-0.71** [0.32]	-1.19** [0.48]	-1.32** [0.66]	-1.70* [1.02]	-1.8 [1.26]	-1.47 [1.24]
Direct	-0.25*** [0.09]	-0.57*** [0.17]	-0.77*** [0.26]	-0.96** [0.42]	-1.03** [0.48]	-0.74** [0.36]	-0.34** [0.14]	-0.90*** [0.26]	-1.34*** [0.33]	-1.58*** [0.53]	-1.65*** [0.52]	-0.91* [0.51]	-0.31** [0.14]	-0.60** [0.24]	-0.72** [0.35]	-0.98* [0.57]	-1.08 [0.74]	-0.98 [0.81]
Indirect (spillovers)	-0.32*** [0.12]	-0.58*** [0.21]	-0.65** [0.29]	-0.72* [0.41]	-0.69* [0.42]	-0.41 [0.31]	-0.44** [0.19]	-0.96*** [0.35]	-1.17*** [0.44]	-1.23** [0.60]	-1.13** [0.56]	-0.58 [0.55]	-0.40** [0.18]	-0.59** [0.25]	-0.60* [0.32]	-0.72 [0.48]	-0.71 [0.56]	-0.49 [0.47]
# observations	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310	310
# countries	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
R ²	0.46	0.52	0.50	0.46	0.45	0.41	0.47	0.52	0.50	0.47	0.45	0.42	0.47	0.52	0.49	0.46	0.45	0.41

Note: Estimations are performed using the LPM model augmented by the spatial lag term. The weighting matrix is based on input-output weights. The sample includes 10 euro area countries for the period 1980-2009.

Robust standard errors are in brackets. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 7. Illustration: Direct and Indirect Effects of Total Fiscal Consolidation Measures

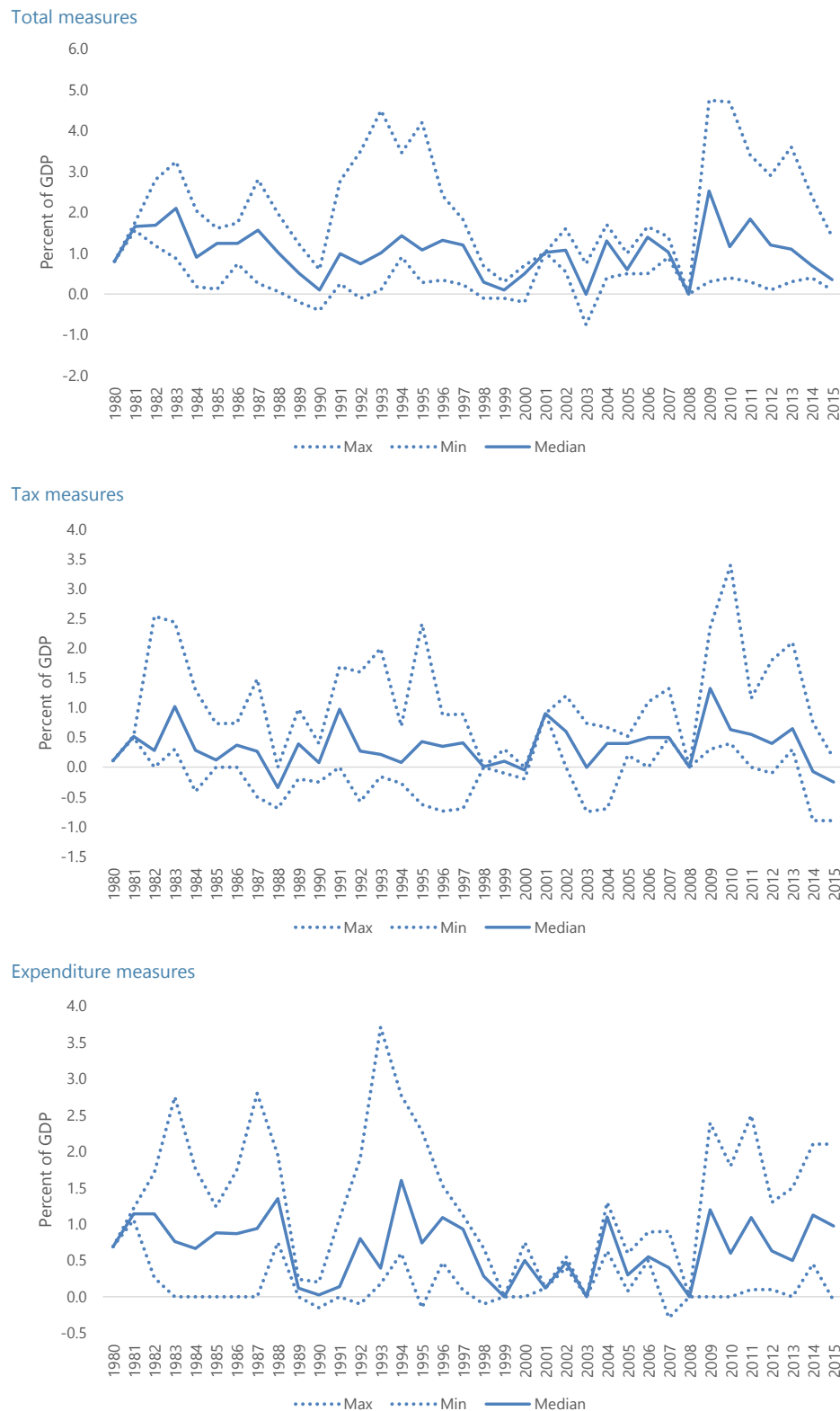
A. Immediate impact (same year, h=0)

Recipient country	Country originating fiscal shock									
	Austria	Belgium	France	Germany	Italy	Netherlands	Finland	Ireland	Portugal	Spain
Austria	-0.26	-0.03	-0.06	-0.14	-0.05	-0.03	0.00	0.00	-0.01	-0.02
Belgium	-0.01	-0.27	-0.08	-0.10	-0.04	-0.05	0.00	0.00	-0.01	-0.03
France	-0.02	-0.04	-0.30	-0.10	-0.05	-0.03	0.00	0.00	-0.01	-0.04
Germany	-0.03	-0.04	-0.08	-0.31	-0.05	-0.04	-0.01	0.00	-0.01	-0.03
Italy	-0.02	-0.03	-0.08	-0.10	-0.28	-0.03	0.00	0.00	-0.01	-0.04
Netherlands	-0.02	-0.05	-0.07	-0.11	-0.04	-0.27	-0.01	0.00	-0.01	-0.03
Finland	-0.02	-0.03	-0.06	-0.10	-0.04	-0.05	-0.25	0.00	-0.01	-0.03
Ireland	-0.01	-0.08	-0.06	-0.08	-0.04	-0.03	0.00	-0.25	-0.01	-0.03
Portugal	-0.01	-0.03	-0.07	-0.08	-0.03	-0.03	0.00	0.00	-0.26	-0.07
Spain	-0.01	-0.03	-0.09	-0.08	-0.05	-0.03	0.00	0.00	-0.03	-0.27
Direct (% Euro Area GDP)	-0.01	-0.01	-0.06	-0.09	-0.05	-0.02	-0.01	-0.01	0.00	-0.03
Indirect (% Euro Area GDP)	-0.02	-0.04	-0.06	-0.07	-0.04	-0.03	0.00	0.00	-0.01	-0.03
Total (% Euro Area GDP)	-0.03	-0.05	-0.12	-0.16	-0.08	-0.05	-0.01	-0.01	-0.01	-0.06

B. Medium-term impact (6 years, h=5)

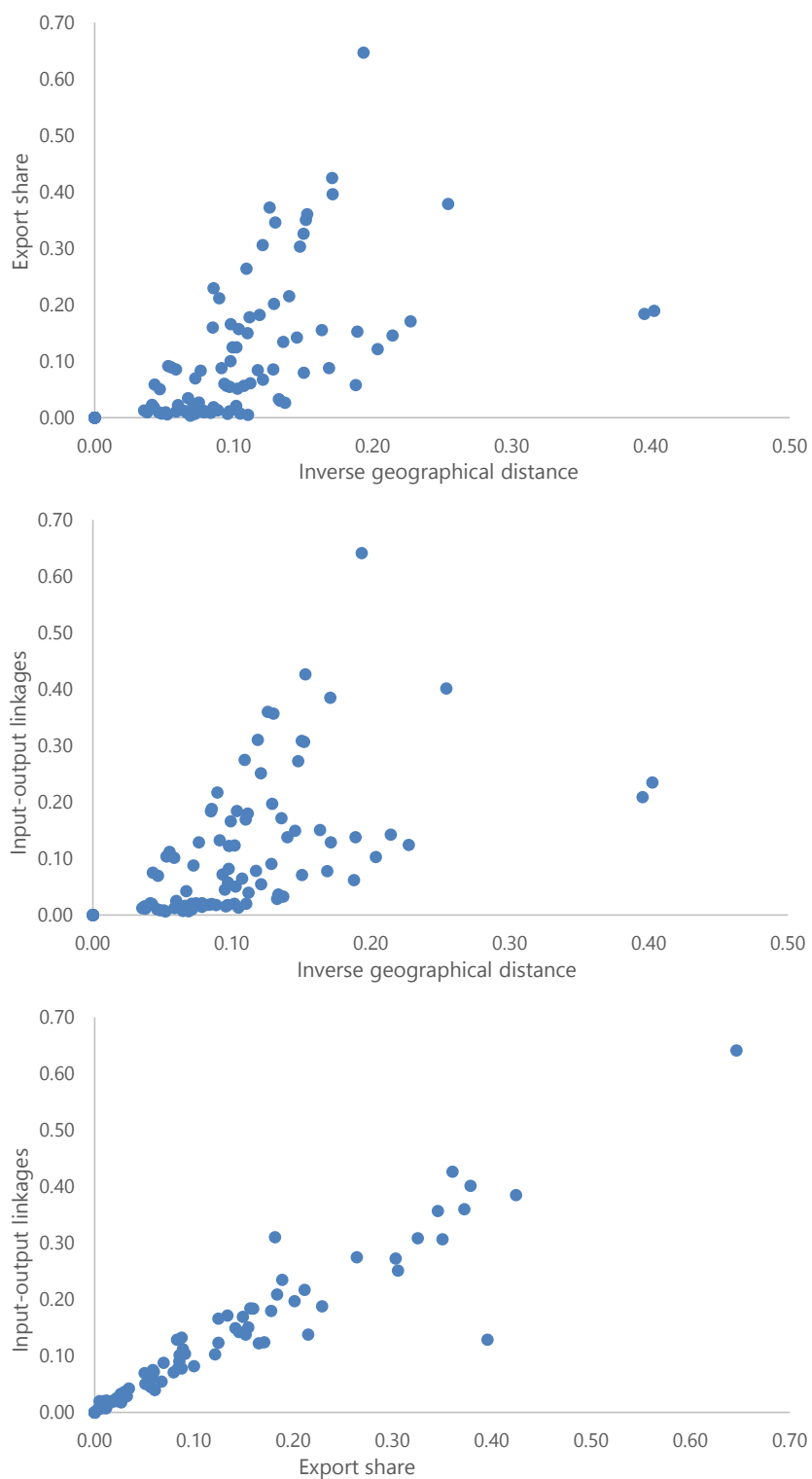
Recipient country	Country originating fiscal shock									
	Austria	Belgium	France	Germany	Italy	Netherlands	Finland	Ireland	Portugal	Spain
Austria	-0.77	-0.02	-0.05	-0.19	-0.06	-0.02	0.00	0.00	0.00	-0.02
Belgium	-0.01	-0.78	-0.10	-0.12	-0.04	-0.06	-0.01	0.00	-0.01	-0.03
France	-0.01	-0.05	-0.79	-0.13	-0.06	-0.04	0.00	0.00	-0.01	-0.05
Germany	-0.04	-0.04	-0.09	-0.80	-0.06	-0.06	-0.01	0.00	-0.01	-0.04
Italy	-0.02	-0.03	-0.10	-0.12	-0.78	-0.03	0.00	0.00	-0.01	-0.05
Netherlands	-0.02	-0.06	-0.07	-0.14	-0.04	-0.78	-0.01	0.00	-0.01	-0.03
Finland	-0.02	-0.04	-0.06	-0.13	-0.04	-0.07	-0.76	0.00	-0.01	-0.03
Ireland	-0.01	-0.11	-0.06	-0.08	-0.04	-0.04	0.00	-0.76	-0.01	-0.03
Portugal	-0.01	-0.03	-0.08	-0.09	-0.03	-0.03	0.00	0.00	-0.77	-0.11
Spain	-0.01	-0.03	-0.11	-0.09	-0.05	-0.03	0.00	0.00	-0.04	-0.78
Direct (% Euro Area GDP)	-0.03	-0.03	-0.17	-0.24	-0.13	-0.05	-0.02	-0.02	-0.01	-0.08
Indirect (% Euro Area GDP)	-0.02	-0.04	-0.07	-0.08	-0.05	-0.04	-0.01	0.00	-0.01	-0.04
Total (% Euro Area GDP)	-0.05	-0.07	-0.25	-0.33	-0.17	-0.09	-0.02	-0.02	-0.03	-0.12

Note: The illustration is based on the baseline estimation results (export shares as the weighting matrix). The diagonal values are domestic effects of 1 percent of GDP fiscal consolidation, while off-diagonal values represent the effect of fiscal consolidation in the originating country (columns) on the GDP of the recipient country (rows). All are expressed as percent deviations from domestic GDP in the absence of a fiscal consolidation. For example, 1 percent fiscal of GDP fiscal consolidation in Germany will reduce: (i) domestic output by 0.31 (0.80) percent on impact (in the medium term), (ii) output of Italy by 0.10 (0.12) percent on impact (in the medium term), and (ii) output of 10 euro area countries by 0.16 (0.33) percent on impact (in the medium term).

Figure 1. EA-10: Dynamics of Fiscal Consolidation Measures

Note: The sample includes 10 euro area countries. Positive numbers indicate fiscal consolidation.

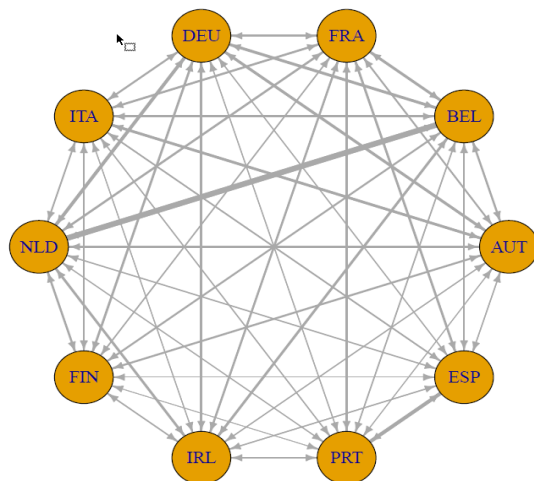
Figure 2. Relationship Between Various Measures of Bivariate Linkages
Panel A: Scatterplots



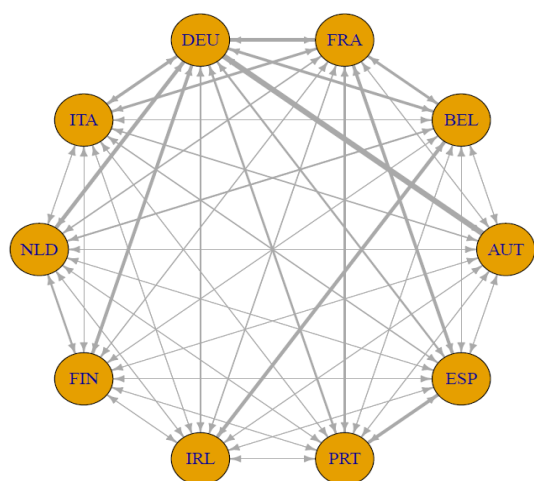
Note: All measures are normalized to sum up to 1 for each country.

Figure 2. Relationship Between Various Measures of Bivariate Linkages
Panel B: Networks (Continued)

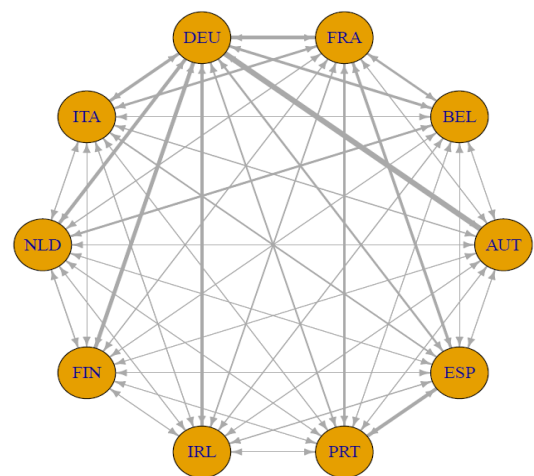
Geographical distance



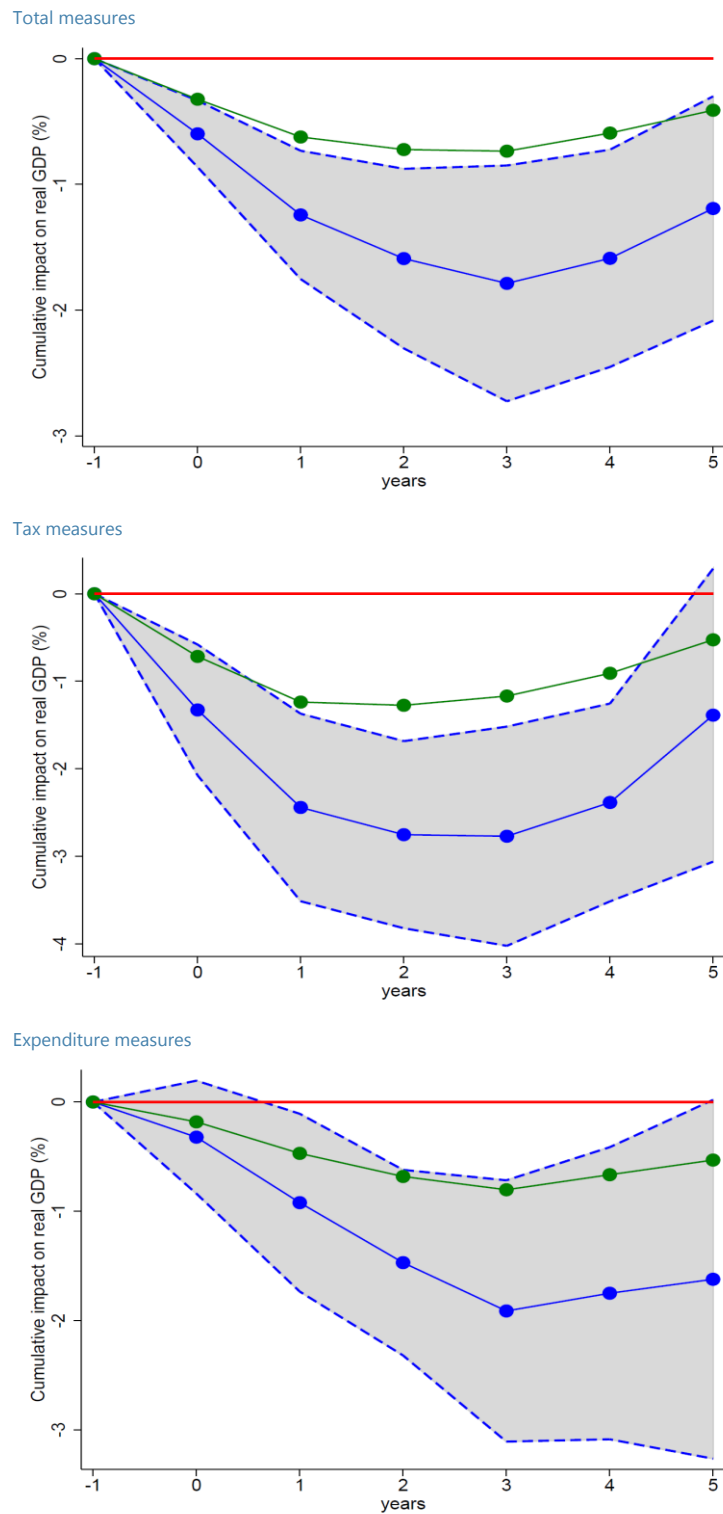
Export shares



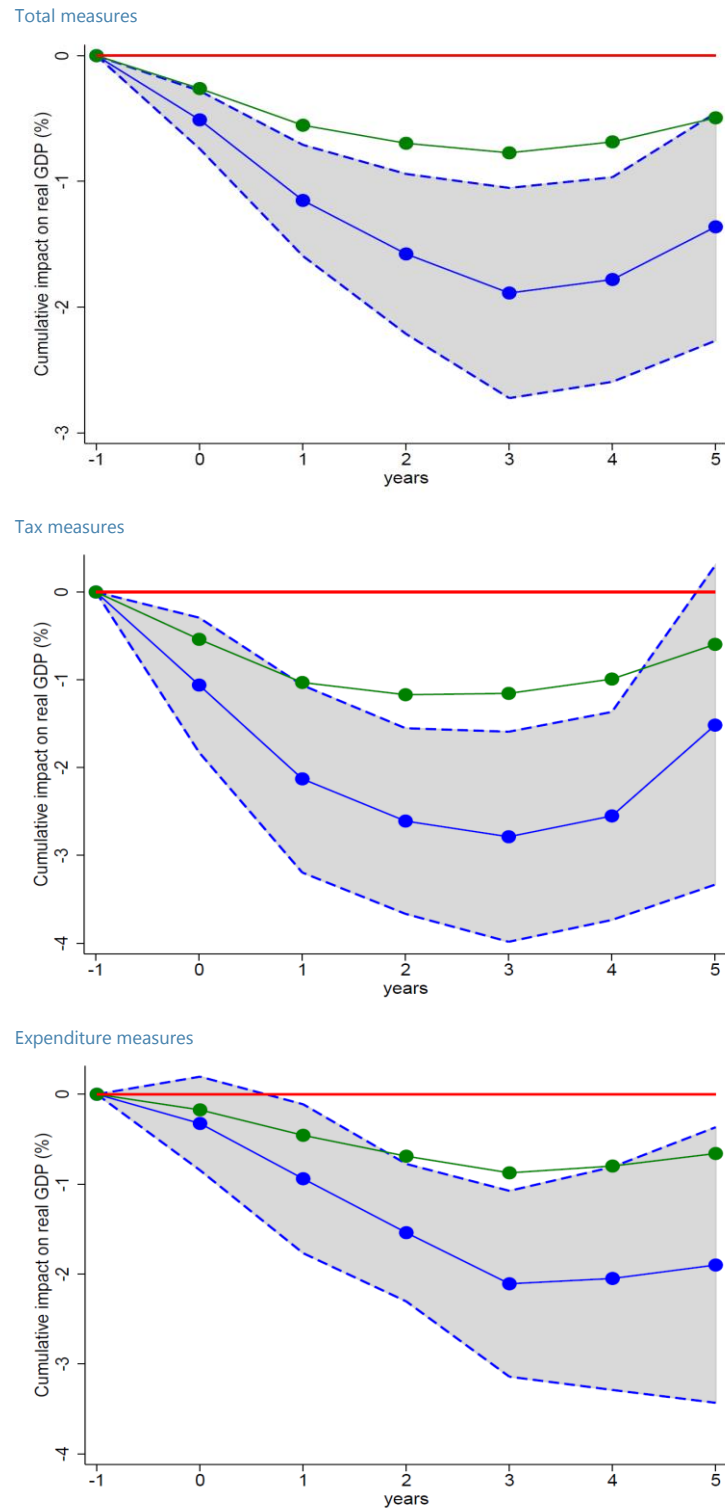
Input-output links



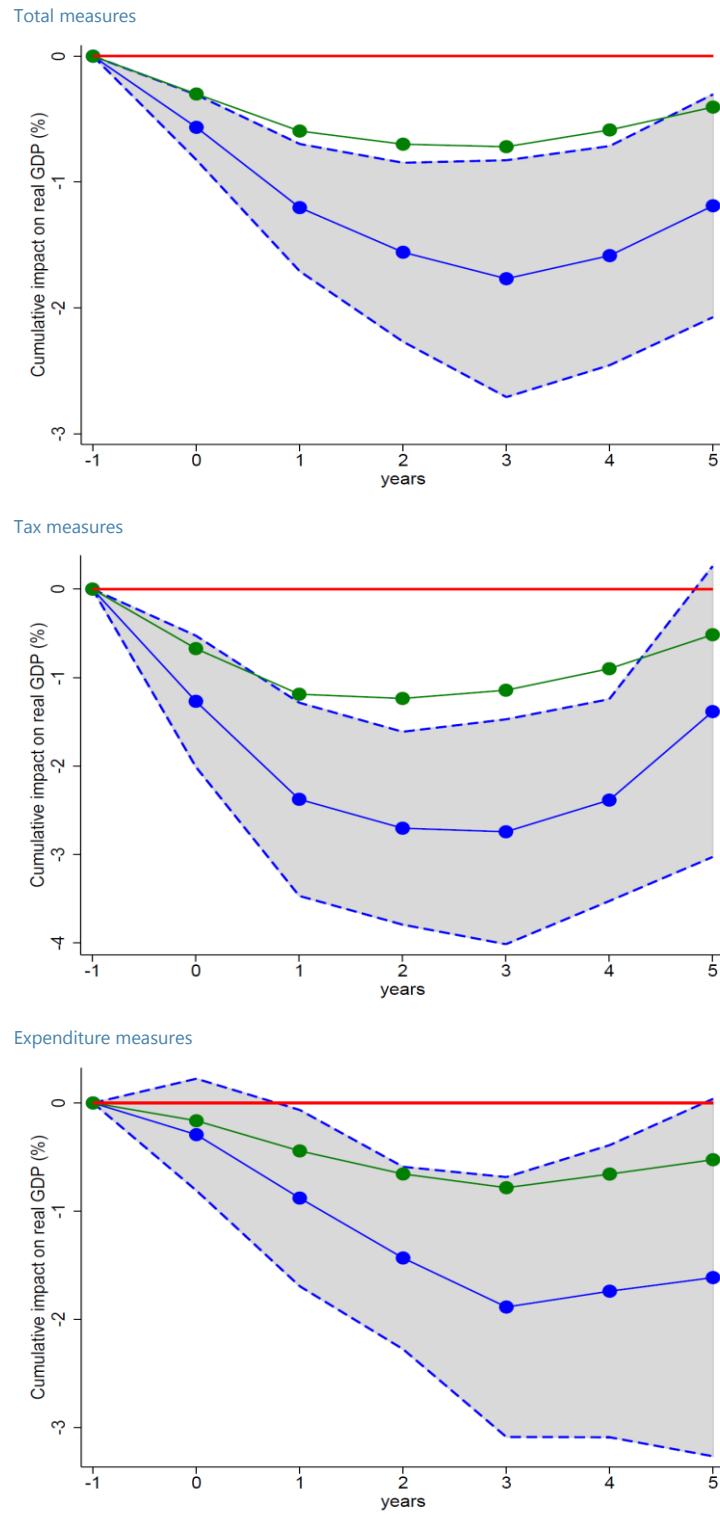
Note: The width of the arrow indicates the intensity of the relationship

Figure 3. Baseline Results: Spillovers Based on Export Shares

Note: $t=0$ is the initial year of fiscal consolidation. Blue line represents the total (direct + indirect) effect of 1 percent of GDP fiscal consolidation in all countries on the combined output, while green line represents the indirect (spillover) effect. Dashed lines represent 90 percent confidence intervals. .

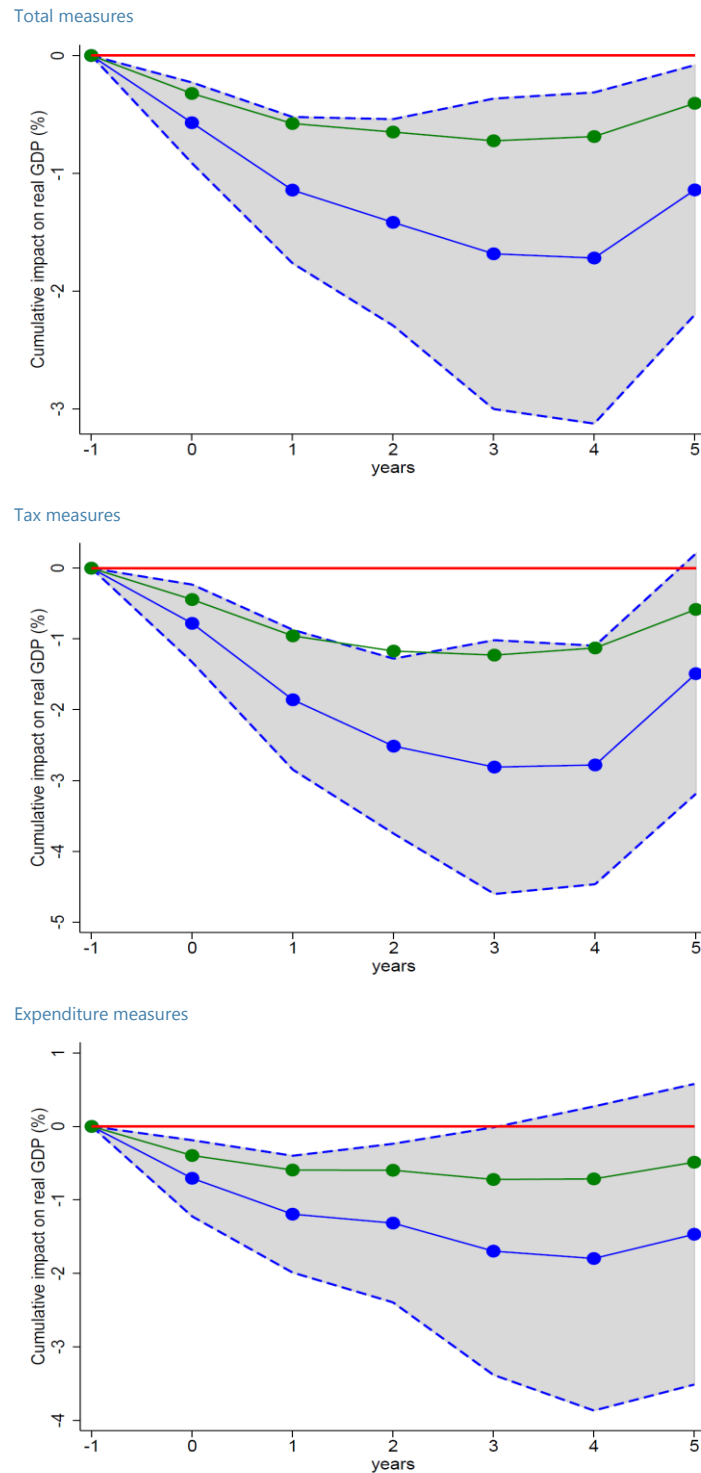
Figure 4. Robustness Check: Spillovers Based on Inverse Geographical Distance

Note: $t=0$ is the initial year of fiscal consolidation. Blue line represents the total (direct + indirect) effect of 1 percent of GDP fiscal consolidation in all countries on the combined output, while green line represents the indirect (spillover) effect. Dashed lines represent 90 percent confidence intervals.

Figure 5. Robustness Check: Spillovers Based on Input-Output Weights

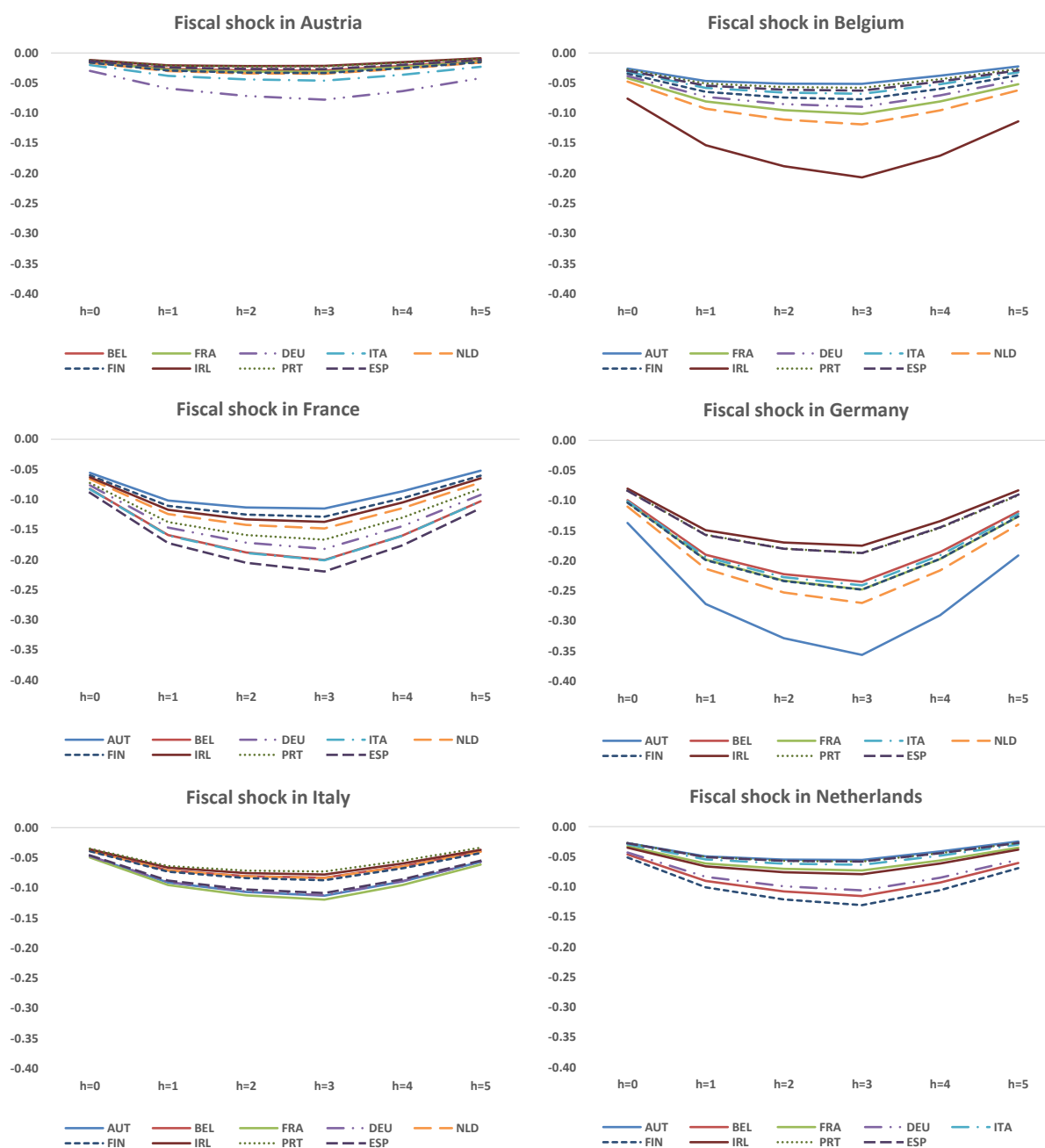
Note: $t=0$ is the initial year of fiscal consolidation. Blue line represents the total (direct + indirect) effect of 1 percent of GDP fiscal consolidation in all countries on the combined output, while green line represents the indirect (spillover) effect. Dashed lines represent 90 percent confidence intervals.

**Figure 6. Robustness Check: Spillovers Based on Export Shares
(Devries and others 2011 Sample)**



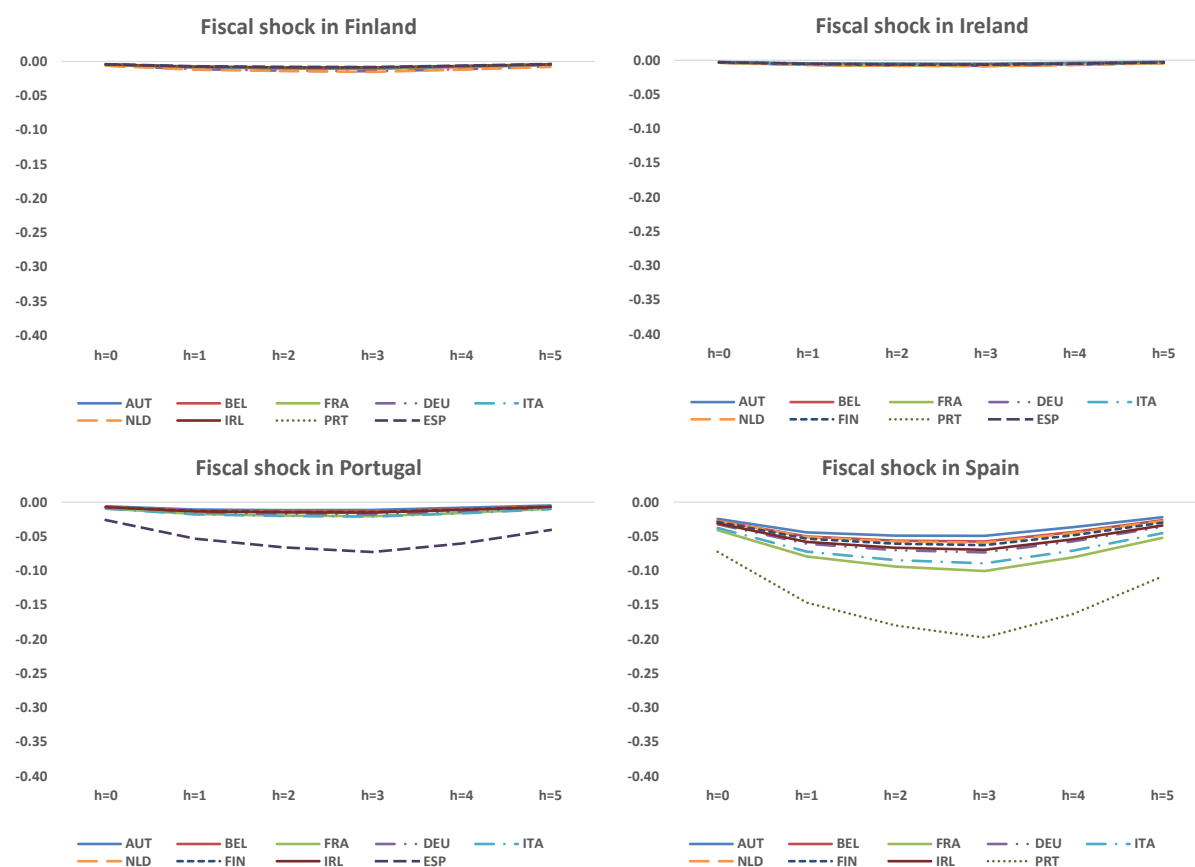
Note: $t=0$ is the initial year of fiscal consolidation. Blue line represents the total (direct + indirect) effect of 1 percent of GDP fiscal consolidation in all countries on the combined output, while green line represents the indirect (spillover) effect. Dashed lines represent 90 percent confidence intervals.

Figure 7. Illustration: Spillovers from Individual Country Total Fiscal Consolidation Measures



Note: Reported IRFs show spillover effects from individual country consolidations (1 percent of GDP) to other countries (in percent of GDP).

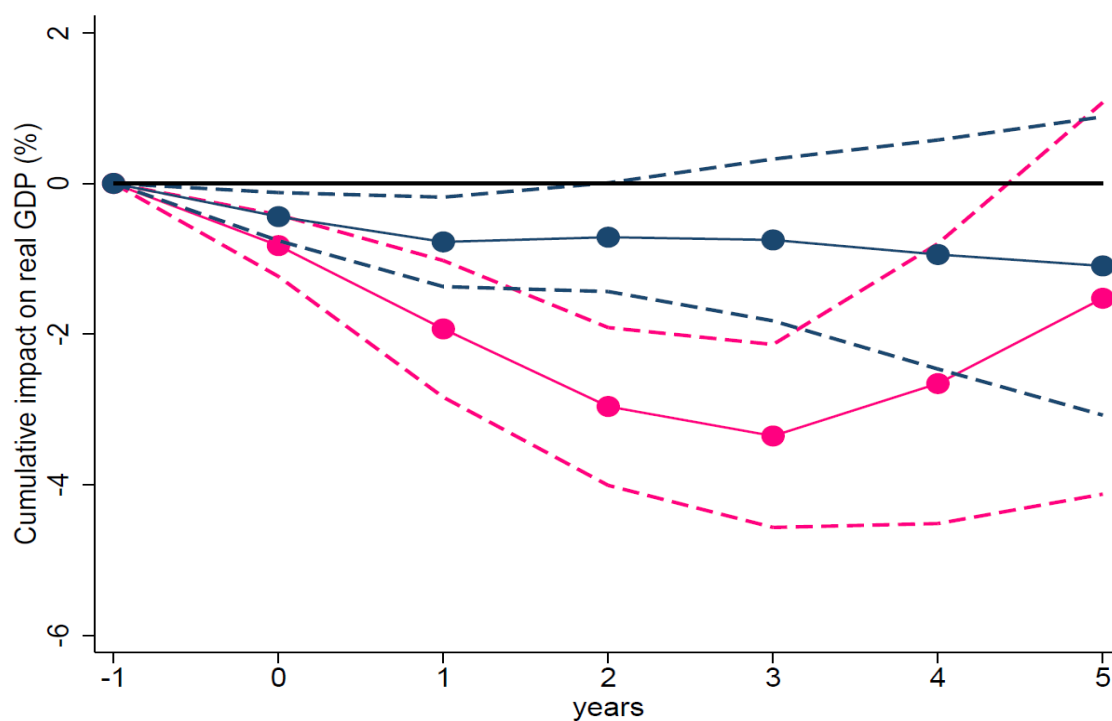
Figure 7. Illustration: Spillovers from Individual Country Total Fiscal Consolidation Measures (continued)



Note: The illustration is based on the baseline estimation results (export shares as the weighting matrix). Reported IRFs show spillover effects from individual country consolidations (1 percent of GDP) to other countries (in percent of GDP).

Figure 8. Impact of Fiscal Shocks in the Pre- and Post-Euro Period

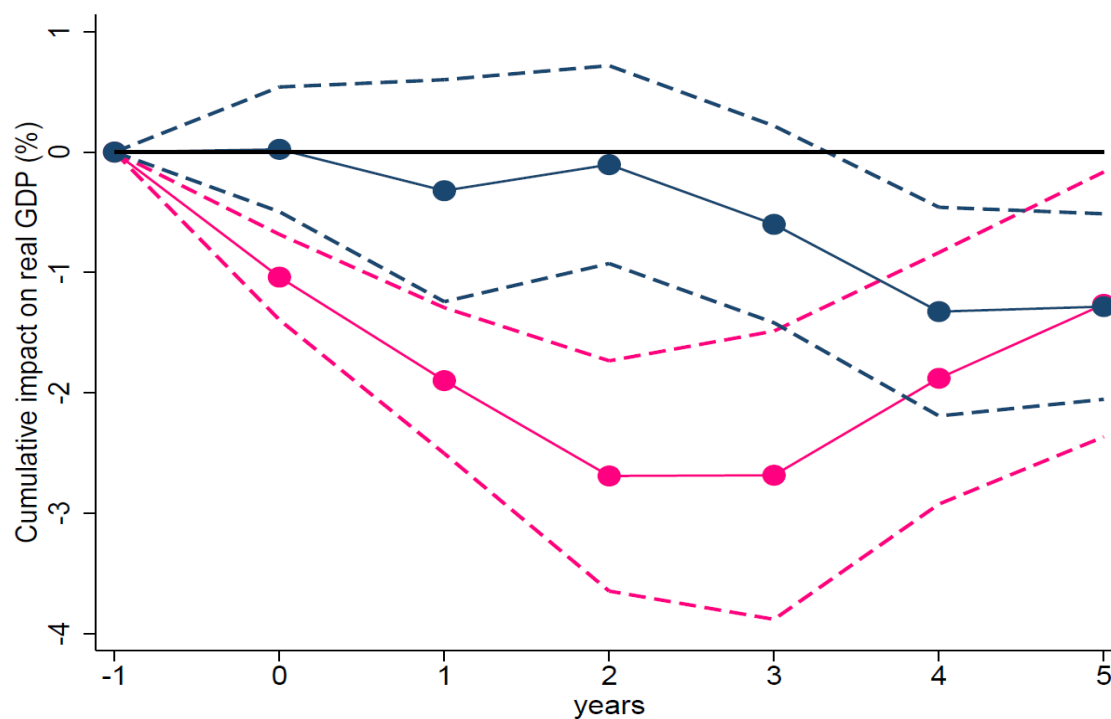
Total measures



Note: $t=0$ is the initial year of fiscal consolidation. Blue line represents the total effect of fiscal shocks in the pre-Euro period, while pink line represents the total effect of fiscal shocks in the post-Euro period. Dashed lines represent 90 percent confidence intervals.

Figure 9. Impact of Fiscal Shocks in Bad and Good Times

Total measures



Note: $t=0$ is the initial year of fiscal consolidation. Blue line represents the total effect of fiscal shocks in good times (economic upturns), while pink line represents the total effect of fiscal shocks in bad times (economic downturns). Dashed lines represent 90 percent confidence intervals.