Fiscal Transfers without Moral Hazard?*

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Recent debate has focused on the introduction of a central stabilization capacity as a completing element of the Economic and Monetary Union. Its main objective would be to contribute to cushioning country-specific economic shocks, especially when national fiscal stabilizers are run down. There are two main potential objections to such schemes proposed so far: first, they may lead to moral hazard, i.e., weaken the incentives for sound fiscal policies and structural reforms. Second, they may generate permanent transfers among countries. Here we present a scheme that is relatively free from moral hazard, because the transfers are based on changes in world trade in the various industrial sectors. These changes can be considered as largely exogenous, hence independent from an individual government's policy. Therefore, the scheme is better protected

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against manipulation compared with other schemes based on domestic variables (e.g., unemployment). Our scheme works as follows: if a sector is hit by a negative shock at the world market level, then a country with an economic structure that is skewed toward this sector receives a temporary transfer from the other countries. We show that the transfers generated by our scheme are countercyclical. In addition, since transfers are based on deviations from trends in sectoral export value-added, the danger of permanent transfers from one set of countries to the other countries is effectively ruled out. Finally, we show that the transfers are robust to different sectoral aggregation and revisions in the underlying export data.

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1. Introduction

The global economic and financial crisis that started in 2007 and the ensuing euro-zone debt crisis have shown the painful consequences of having an incomplete monetary union. In response to these developments, substantial effort has been made to improve the euro zone's fiscal and financial architecture with the introduction of the European semester, a strengthening of the Stability and Growth Pact (through the "Six-Pack" and the "Two-Pack"), the "Fiscal Compact," and the introduction of the first elements of a banking union. More recently, European governments have agreed to launch the "Next Generation EU" (NGEU) to mitigate the adverse consequences of the COVID-19 crisis. Still, Europe's Economic and Monetary Union (EMU) remains unfinished. As part of the process toward the completion of the EMU, further steps need to be taken. In particular, a fiscal union is deemed as needed. Indeed, in contrast to other monetary unions, the EMU lacks a central fiscal capacity, which could help cushion country-specific and common shocks.[1] Fiscal policy remains decentralized, implying that the potential for macroeconomic stabilization through area-wide fiscal policies is under-exploited. Even though the crisis was triggered within the global financial system, the lack of a euro-area central

[1]The NGEU has a temporary nature, and it is supposed to be phased out after the end of the pandemic crisis.

fiscal capacity may have contributed to its severity and, looking ahead, would not help to alleviate the impact of future crises.

Discussions about fiscal centralization already started some years ago. In a report in June 2012, the then president of the European Council, Van Rompuy (2012), identifies an integrated budgetary framework as one of four building blocks to consolidate the EMU. Shortly after, in December 2012, the "Four Presidents' Report" (Van Rompuy et al. 2012) discusses the gradual creation of a central fiscal capacity aimed at both promoting structural reforms and mitigating asymmetric shocks. The "Five Presidents' Report" (Juncker et al. 2015) sketches the steps toward completion of the EMU and, more specifically, also toward a fiscal union as one of its main building blocks. It discusses the notion of a euro-area stabilization function with the guiding principles that it should not lead to permanent transfers, which would be avoided through the convergence of economic structures beforehand, and not undermine the incentives for sound fiscal policy.[2] The capacity would also not be intended as a crisis management tool, but rather thought to improve the economic resilience to temporary shocks of the euro zone and its individual members. Most recently, the European Commission (2017)'s reflection paper sketches the main concrete options for a macroeconomic stabilization function for the euro area. One would be a scheme to protect investment in the case of a downturn. Another would be an unemployment reinsurance scheme to support national unemployment schemes. Importantly, the former scheme is generally conceived as a mechanism to cushion area-wide (aggregate) shocks, while the latter would address country-specific (idiosyncratic) shocks.

This paper proposes a novel "export-based stabilization capacity" (ESC) that allows for cross-border transfers in response to

[2] A future central stabilization capacity is more broadly discussed, for example, by European Central Bank board member Cœuré (2016) and the president of the Dutch central bank (Knot 2016) before the European Parliament. In their report, D'Alfonso and Stuchlik (2016) explore the potential options concerning a centralized fiscal capacity for the European Parliament. Recently, a motion was put to vote in the European Parliament which sets out a roadmap toward a budgetary capacity for the euro zone (European Parliament 2017). The case for enhanced fiscal risk sharing in the EMU is also made by a recent study of the International Monetary Fund (Berger, Dell'Ariccia, and Obstfeld 2018) and by the European Fiscal Board (2018). For a conceptual discussion, see De Grauwe (2018).

exogenous changes in the world trade in the various sectors. A stabilization capacity may be particularly beneficial in the presence of asymmetric shocks, which the ECB can by definition not address, as monetary policy is formed on the basis of aggregate developments in the euro zone,[3] while private insurance through cross-border capital flows remains limited, because asset holdings are notoriously home biased. Our ESC works in a very simple and intuitive way: suppose that world trade in a specific sector is hit by a negative shock, as reflected in total euro-zone export in that sector falling below its trend. Then, euro-zone members that are relatively more export intensive in this sector receive a transfer from the members that are relatively less intensive in this sector.

This ESC has a number of advantages, which should enhance its political acceptability when compared with many existing proposals, although quite naturally, as is the case with any cross-border transfer scheme, the prospect of having to pay a transfer to other countries at some point may generate political resistance. First, the transfers respond to exogenous developments in the world market, which are largely outside of the control of individual governments. As such, the scheme is relatively free from moral hazard, given that it would not weaken the incentives of governments to run virtuous fiscal policies and implement structural reforms. Indeed, as pointed out in the recent contribution by the group of 14 French and German economists (Bénassy-Quéré et al. 2018), the political feasibility of expanding arrangements for risk sharing in the euro area requires that moral hazard issues be taken seriously. Second, since it is based on deviations from trends in world trade in individual sectors and the estimated trend is updated each year, the scheme would by construction avoid permanent transfers from a set of countries to another. Third, our scheme does not need to rely on a long-run process of convergence of economic structures before it can be implemented. Fourth, the scheme is designed such that each period all the cross-border transfers (almost) add up to zero. Fifth, the scheme

[3]With perfectly flexible markets, asymmetric shocks can be handled easily, because production factors move quickly to those parts of the union where undercapacity prevails. However, there is an abundance of evidence that European markets are highly rigid. In particular, labor mobility is low, both within, but even more so, across countries.

is shown to be very robust to revisions in the underlying export data and to different sectoral disaggregations. Finally, it is important to realize that the transfers are not specifically earmarked for sectors in decline. They are intergovernmental[4] and, hence, under the simplest configuration of the scheme, a net recipient government can determine its use. However, in order to minimize possible adverse incentives that could emerge if a government delays the transition to emerging sectors, transfers could also be granted under certain conditionality: they could be disbursed only if a government actively supports the transition of activity toward upcoming sectors. In general, however, how transfers are best utilized goes beyond the present work. A discussion on this can be tackled in future research.

We perform a simulation of our ESC using sectoral export data from the Organisation for Economic Co-operation and Development (OECD) for all 19 euro-zone countries over the period 2002–14. This allows us to estimate how the transfers would have materialized over this period, if the ESC were in place. In the baseline version of our scheme, a country receives a transfer associated with a given sector if that sector is hit by a negative shock at the world market level, and if the export share of the country in that sector is higher than the total euro-area exports share of the country (i.e., the country has a relative specialization in that sector). In the baseline scheme, the income loss that a country experiences after a negative shock to the export sectors in which it is relatively more specialized is compensated by a transfer from the other EMU countries, i.e., the ones less affected by that shock. We then consider variants to the baseline scheme. More specifically, we first assume that the transfer is limited only to the labor income loss, which would be the more appropriate scheme if the holdings of the equity in the exporting firms were spread beyond national borders. The second variation imposes that the transfer that a country pays after experiencing on net a positive shock to its export sectors cannot be bigger than the net increase in government revenues resulting from the increased economic activity following the shock.

[4]Exactly the same allocation as under our mechanism could be achieved by sectors directly paying transfers to or receiving transfers from a central fund on the basis of the same shocks to sectoral net exports value-added we consider.

We find that the net transfers received (or paid) by the countries in our sample are countercyclical: they are more positive (or less negative) when the output gap is lower. Over the full sample, cumulative transfers tend to stabilize and to return toward zero toward the end of the sample, thus suggesting that permanent transfers are ruled out under this scheme. We also show that the transfers are robust to the use of preliminary rather than ex post data and to the reaggregation of the set of sectors into a smaller number of sectors.

To put our scheme into perspective, the transfers it generates tend to be non-negligible but limited in (cumulative) magnitude. However, transfers can reach larger magnitudes when this is most needed, i.e., during a severe recession. These properties may make our scheme more politically palatable than schemes that expose countries to the risk of large payments to other countries. Of course, the scheme cannot address all idiosyncratic shocks. However, if needed, it could be combined with auxiliary arrangements that address other sources of shocks or common shocks, though probably at a greater moral hazard risk (e.g., Feld and Osterloh 2013). As is the case for any scheme featuring in the public debate, practical obstacles also need to be overcome. The main obstacle is the timely availability of the data that serve as inputs for the calculation of the transfers. While we show that our results are robust to the use of nonrevised export data, even these data become available with quite some delay. Yet, the purpose of this paper is not to provide a blueprint for a system that can be implemented right away. Rather, we aim at demonstrating that a scheme like ours has the potential to generate plausible transfers with a number of desirable properties. As data provision becomes better and faster, practical implementation comes within sight. Viewed from a different angle: by exposing the data needs of the practical implementation of a plausible transfer scheme, we may encourage statistical agencies to work on fulfilling these data needs.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 lays out the design of our baseline ESC and its proposed variants, which is followed by a discussion of the data sources in section 4. Section 5 reports and discusses the transfers based on actual data. The robustness of the baseline scheme is investigated in section 6. Finally, section 7 concludes the main body of this paper.

2. Literature Review

2.1 Risk-Sharing Channels in Federations and across Countries

Eventually, the need for a centralized stabilization capacity in the euro zone will be determined by the amount of cross-border risk sharing that already exists. Over the past two decades, there has been a substantial amount of work, using a variety of empirical approaches, analyzing the magnitude of risk sharing across countries and across regions. A large fraction of it focuses on interregional risk sharing in the United States and other federal countries. However, there also exist a number of studies focusing on the euro zone.

Risk sharing of asymmetric shocks in federations can take place through a variety of private and public channels. For example, individuals may hold equity stakes in companies from different regions. In their seminal contribution, Asdrubali, Sorensen, and Yosha (1996) explore the importance of the various channels through which consumption risk sharing takes place among the states in the United States. They demonstrate that there exists substantial risk sharing through cross-state asset holdings. Among the public channels, a federal tax-transfer scheme may be important. Von Hagen (1999) summarizes the estimates in the early literature of the share of state-specific shocks insured through the federal tax-transfer system in the United States. It ranges from 7 to 40 percent, as found by Sala-i-Martin and Sachs (1991), although most of the estimates are on the order of 10 to 15 percent. Other countries for which insurance through the tax-transfer mechanism has been estimated are Canada, France, Germany, the United Kingdom, and Italy. For Canada, this source of insurance is quite consistently estimated to be close to 15 percent, although more recent work by Balli, Basher, and Jean Louis (2012) gets to an estimate of 27 percent. The estimated degree of implicit insurance among German and French regions is 35–40 percent (e.g., see Pisani-Ferry, Italianer, and Lescure 1993 and Mélitz and Zumer 1998), while for the United Kingdom it is around 20 percent. The lowest degree of implicit insurance seems to prevail in Italy, for which Obstfeld and Peri (1998) arrive at an estimate of only 3 percent. An important complication of this line of research is that it is hard to distinguish pure insurance against

asymmetric shocks from redistribution, which takes place at the same time if state incomes differ on average. Recent work by Poghosyan, Senhadji, and Cottarelli (2016) for the United States, Canada, and Australia distinguishes between interregional fiscal transfers smoothing idiosyncratic versus permanent shocks. They find that 4–11 percent of the idiosyncratic shocks are smoothed (i.e., risk sharing), as opposed to 13–24 percent of permanent shocks (i.e., redistribution). Work by Feld, Schaltegger, and Studerus (2018) for the Swiss federation suggests that the stabilization of short-term income fluctuations through the tax-transfer system is less than 10 percent, while redistribution amounts to about 20 percent.

The literature suggests that cross-border consumption risk sharing through private asset holdings plays only a limited role in Europe (for example, see Sorensen and Yosha 1998 and, more recently, European Central Bank 2018). Nevertheless, there exists evidence that overall consumption risk sharing has increased over time. Cimadomo, Fortuna, and Giuliodori (2017) estimate an increase from about 40 percent at the start of EMU to about 65 percent in 2015. Both increased cross-border holdings of financial assets and international official assistance contribute to this improvement (see also Milano 2017).[5,6] Farhi and Werning (2017) provide a rationale for this latter finding: they show theoretically that some degree of public intervention is helpful even in the presence of complete markets which would allow insurance against idiosyncratic shocks. Therefore, they make a strong case for fiscal insurance as a necessary complement to risk sharing via private channels.

2.2 Analysis of Proposed Stabilization Schemes

The debate around a supranational automatic stabilization mechanism for Europe dates back to the 1970s (see, e.g., Marjolin et al.

[5]Hepp and von Hagen (2013) estimate an increase in the role of factor markets in interstate consumption risk smoothing in Germany after its unification. However, risk sharing through the government sector continues to be important by smoothing around 10 percent of shocks after the unification.

[6]Not all private channels may have contributed to the increase in risk sharing. Hoffmann et al. (2018) find that the contribution via the credit channel collapsed with the breakdown of the interbanking market in 2008 (see also Beetsma et al. 2018).

1975) and reemerged in the 1990s (see, e.g., Padoa-Schioppa et al. 1987). However, as highlighted in Beblavý and Lenaerts (2017), proposals remained unexecuted for two main reasons. On the one hand, there was a common belief that market adjustment mechanisms alone would lead to macroeconomic stabilization. On the other hand, the launch of the EMU was expected to be accompanied by stronger business cycle synchronization for member states, and therefore by fewer and weaker asymmetric shocks (Allard et al. 2013). The recent crisis suggests that business cycle convergence is far from achieved. In addition, if national fiscal buffers are run down completely, shocks remain unsmoothed or are even amplified. This explains a renewed attention in the post-crisis debate on a centralized fiscal capacity which could help attenuate the effects of macroeconomic shocks in the euro area.

Recent proposals mainly build on schemes addressing either country-specific (i.e., idiosyncratic) shocks or aggregate shocks, i.e., shocks common to all members of the currency union. As regards the first category, studies have typically focused on shocks hitting country-specific GDP, the output gap, or employment. For example, Enderlein, Guttenberg, and Spiess (2013) propose a "European fund" calibrated on country-specific output gaps: member states would contribute to the fund when their cyclical position is better than the euro-area average, and they would receive a net transfer when they are in a worse position. Another scheme recently proposed is the one by Furceri and Zdzienicka (2015), which focuses on country-specific GDP shocks. The authors simulate a supranational fiscal stabilization mechanism for the euro area, financed by a gross contribution of $1^1/_2$–$2^1/_2$ percent of countries' gross national product (GNP). The scheme would imply transfers to countries hit by negative GDP shocks. The authors show that such a scheme could provide significant stabilization for the euro area, comparable to the level of fiscal risk sharing observed in Germany and other federally organized countries. In general, the main criticism of schemes based on the output gap is that this variable is unobservable and subject to large revisions. These revisions complicate the implementation of such schemes "in real time," while the unobservability of the output gap may lead to disagreement about its measurement, in particular when cross-border transfers are based on it. Schemes based on GDP, on the other hand, are less likely to be subject to big revisions.

However, the estimation of country-specific GDP shocks is not trivial and the outcomes would be subject to the deployed methodology.

Many of the current proposals have focused on a European unemployment insurance scheme. The main reason is that unemployment expenditure is the main category of public spending that moves automatically (although typically with a lag) with the business cycle. Therefore, a common unemployment insurance based on cross-country transfers could work well to reinforce national automatic stabilization mechanisms. Several proposals for such a scheme were brought into the political debate. For example, Dolls et al. (2015) model transfers based on household-level data for euro-zone economies and find that about 10 percent of the income fluctuations caused by transitions into and out of unemployment could be absorbed by means of a common unemployment insurance scheme.[7] The main advantage of a scheme based on unemployment is that it would be strongly countercyclical. In addition, unemployment data are subject to small revisions. However, unemployment insurance schemes are especially prone to moral hazard, as unemployment spending not only depends on cyclical developments but also crucially on structural characteristics of labor markets, on which economic policy has a decisive influence. Awareness of the fact that transfers received are on average higher when average unemployment is higher may weaken the government's incentive to conduct politically costly structural reforms. For this reason, it has been proposed that transfers should be triggered conditionally on the fulfilment of a so-called double condition: unemployment should exceed its historical average over, say, the past 15 years and it should be increasing significantly at, say, more than 1 percentage point in a year (see, e.g., Martinez Mongay 2019).

Other recent proposals focus on a euro-area "investment capacity." Such a scheme would finance national investment projects in downturns. This discourages countries from cutting public investment, thus reducing their growth potential, when faced with the need of fiscal consolidation. At the same time, it would contribute

[7]Other examples are Beblavý, Gros, and Maselli (2015), Abraham et al. (2017), Carnot, Kizior, and Mourre (2017), and Arnold et al. (2018). For surveys and analyses of different schemes, see Beblavý and Lenaerts (2017), Favaque and Huart (2017), and the German Council of Economic Experts (2018, chapter IV).

to stabilizing the economic cycle. For example, the German Ministry of the Economy and the French Treasury developed proposals for a common budget for infrastructure and stabilization as one of the main new elements of a reformed euro-area fiscal framework (see Zettelmeyer 2016; Bara, Castets, and Zakhartchouk 2017). Such schemes are typically designed to address aggregate shocks hitting the whole euro area, especially when monetary policy is constrained by the zero lower bound (see, e.g., International Monetary Fund 2016). By contrast, the European Investment Stabilisation Function (EISF) proposed by the European Commission (2018) intends to address asymmetric shocks. However, because of resistance of some European Union (EU) member states, stabilization facilities currently have a rather low priority on the EU policy agenda. The Budgetary Instrument for Convergence and Competitiveness (BICC) is the only central instrument likely to be implemented in the near future (see European Commission 2019). However, the BICC is not intended for stabilization. The stalemate in the area of central stabilization capacities creates room for new proposals that could become attractive in the future.

3. The Design of Our ESC

Ideally, our transfer scheme would optimize a formal microfounded welfare criterion.[8] However, this would be beyond the scope of this paper. Hence, our objective is more modest, and a useful starting point for the discussion of the design of our ESC is formed by the desiderata listed by Von Hagen and Hammond (1995) for a central stabilization capacity. First, insurance should be provided primarily against asymmetric shocks, because for these shocks the loss of an independent monetary policy is most important. Second, transfers should be based on serially uncorrelated shocks only. Transfers in response to persistent shocks might reduce policymakers' incentives to undertake politically costly reforms to overcome the structural

[8] An example of an analysis of transfers in a dynamic stochastic general equilibrium maximizing framework is Bandeira (2018), who investigates the welfare and economic stabilization properties of a fiscal transfer scheme between members of a monetary union in response to changes in sovereign spreads. Potential moral hazard on the side of governments resulting from such transfers and a numerical analysis like ours based on actual data are not addressed.

problems that form the source of the persistence of the shocks. Third, the scheme should be simple and automatic for it to be acceptable for the general public. Fourth, over time net transfers should be zero on average. Fifth, the scheme should be financially balanced at the supranational level. Finally, setting up such a scheme is only worthwhile if it is able to offset a substantial part of the asymmetric shocks.

Clearly, a central stabilization capacity that fulfills all these conditions simultaneously will be difficult to design and, in practice, tradeoffs seem unavoidable. For example, a larger scheme likely increases the danger of moral hazard, ceteris paribus. However, a suitable design of the scheme may mitigate this tradeoff. Also, more than two decades of experience with a common currency may have affected the general perspective on these tradeoffs. In particular, the experience of the global financial recession and the ensuing European sovereign debt crisis, with ECB policy rates stuck at the lower bound, may have strengthened the case for a central stabilization capacity to also provide stabilization in response to (highly adverse) common shocks. The divisions among EU member states on whether and how to proceed with EU integration have, even more than before, demonstrated that the viability of a central stabilization capacity requires broad political acceptability. Finally, allowing for some persistence of the shock underlying the capacity, in particular for the duration of a business cycle downturn or upturn, seems desirable. Indeed, all stabilization schemes proposed so far, such as those based on unemployment, allow for some degree of persistence in the underlying shocks (e.g., Dolls et al. 2015). However, when transfers flow in one direction for too long, political resistance from the net contributors will become so large that the scheme is bound to collapse. Hence, for a central stabilization capacity to be politically viable over a long time span, average annual transfers should be roughly equal to zero. The objective of the scheme we propose is to generate countercyclical transfers with only a limited effect on moral hazard, while fulfilling as much as possible other properties required to make it politically palatable.

To limit potential moral hazard, the cross-border transfers associated with a central stabilization capacity should be conditioned on estimates of shocks that are as much as possible beyond the control of the individual governments. The ESC we propose below

conditions cross-border transfers on changes in world market conditions in the individual exporting sectors of the economy. In contrast to, for example, the output gap or unemployment, these conditions are, at most, to a minor extent affected by an *individual* government's policies. Hence, the scope for moral hazard associated with our ESC should be limited.

3.1 Baseline Scheme: Equalizing Income Shifts as a Fraction of the Value-Added of Exports

In the following, we present the main building blocks of our workhorse scheme, which aims at compensating the full income losses (relative to the other participating countries) following shocks to exports. Suppose that there are $j = 1, \ldots, S$ sectors trading on the world market. The euro area is formed by N countries. Denote by x_{ijt} the period-t value-added of exports by sector j in country i toward the rest of the world. One can write

$$x_{ijt} = w_{ijt} x_{jt},$$

where $x_{jt} = \sum_i x_{ijt}$ is the total value-added of euro-area exports of sector j products, while w_{ijt} is country i's share in this total. In particular, it includes also the export value-added by euro-zone members to other euro-zone members.[9] An alternative would be to exclude intra-euro-zone trade. However, because most of the trade of euro-zone countries is among themselves, such an approach would miss a large fraction of the shocks to the value-added of exports hitting the countries in the system and the transfers based on the remaining shocks will become largely irrelevant. Now, consider the following decomposition:

$$\begin{aligned} x_{ijt} - x_{ij,t-1}(1+g_j) &= w_{ijt} x_{jt} - w_{ij,t-1} x_{j,t-1}(1+g_j) \\ &= (\Delta w_{ijt}) x^*_{jt} + (\Delta w_{ijt})\left(x_{jt} - x^*_{jt}\right) \\ &\quad + w_{ij,t-1}\left(x_{jt} - x^*_{jt}\right), \end{aligned} \tag{1}$$

[9] Double-counting is avoided by considering the value-added of exports instead of the total value of exports.

where g_j is the trend growth rate of the euro-area value-added exports of sector j and $x^*_{jt} \equiv x_{j,t-1}(1+g_j)$, i.e., the euro-area value-added exports of sector j we would expect in period t on the basis of the trend. Hence, the shock to be addressed by the transfer scheme is the deviation from the sector-specific trend value, $x_{jt} - x^*_{jt}$. We choose this shock definition because total exports tend to grow over time, but trend growth rates may systematically differ for different sectors. For example, upcoming high-tech sectors likely grow at a systematically higher rate than traditional sectors generating products with little technological content. Since countries feature different sectoral specializations, not taking account of these different sectoral trends may generate transfers that flow systematically in one direction. With our shock definition, we expect shocks to be temporary and to fluctuate around the trend. Hence, we expect them to have at most moderate serial correlation and to be close to zero on average. Below, we will explain in detail how we compute the trend growth rates of the individual sectors.

The first component on the right-hand side of equation (1), $(\Delta w_{ijt})\, x^*_{jt}$, could be negative, because country i's productivity grows more slowly than the EMU-average productivity in this sector or because the quality of its products improves more slowly than the EMU average in this sector, thus resulting in $\Delta w_{ijt} < 0$. The component could also be positive due to improvements in competitiveness relative to other EMU countries. Changes in the weight w_{ijt} are likely to be at least partly the result of differences in government policies, business climate, investment behavior, fiscal devaluations, and so on, and would not justify any cross-border transfers, because they are to a significant extent the result of national choices. The same is true for the second term on the right-hand side of (1), $(\Delta w_{ijt})\left(x_{jt} - x^*_{jt}\right)$. However, this term is only of a second-order magnitude and is, therefore, likely to be relatively small. Finally, the term $z_{ijt} \equiv w_{ij,t-1}\left(x_{jt} - x^*_{jt}\right)$, which is mainly driven by changes in total euro-zone exports in sector j, and which is based on sectoral weights for the previous period t–1, is largely beyond the control of *national* policymakers.[10] Hence, if moral hazard is to be

[10]Common policies at the EMU level may well have an effect on $x_{jt} - x^*_{jt}$. For example, ECB policy could lead to a fall in the external value of the euro, thereby boosting exports to the rest of the world. However, the influence of an *individual*

minimized, intra-European cross-border transfers could be based on the component z_{ijt} in (1). Of course, z_{ijt} is not perfectly insulated from potential moral hazard. While the weight $w_{ij,t-1}$ is given in period t, future weights can still be affected by current policies. However, we expect future weights to be less relevant for current policies than current weights, because of time discounting and because of the chance that another government will be in office next period.

The ESC requires a choice regarding the component of the income change beyond the government's direct control that is compensated by the transfer. Our baseline scheme aims at compensating the *full income loss*, which would be a natural choice if all the compensation to the capital providers went to domestic inhabitants. An alternative, which we study below, is to compensate the loss of labor income, which would be a natural choice if the shares in the companies producing in each country are perfectly spread over all the euro-zone inhabitants. A natural objective is that the change in the component of the value-added of exports that is beyond the direct control of the government, i.e., z_{ijt}, plus the transfer T_{ijt} implied by this change, is constant for each country as a *fraction* of its total value-added of exports, that is,

$$\frac{w_{kj,t-1}\left(x_{jt}-x_{jt}^{*}\right)+T_{kjt}}{X_{k,t-1}}=\frac{w_{ij,t-1}\left(x_{jt}-x_{jt}^{*}\right)+T_{ijt}}{X_{i,t-1}},\forall k\neq i, \quad (2)$$

where $X_{it} \equiv \sum_j x_{ijt}$ is defined as the total value-added of country i's exports in period t. Further, we want to impose that aggregated over all countries, the transfers associated with sector j are zero in period t, i.e.,

$$\sum_i T_{ijt} = 0. \quad (3)$$

This restriction obviates the need for a central budget capacity to implement the transfer scheme.[11] Imposing the above requirements,

government on $x_{jt} - x_{jt}^{*}$ and, hence, the incentive for moral hazard, would be limited at most.

[11] However, as discussed below, this restriction will be relaxed in the case in which a country that is supposed to contribute to the scheme in a given year is also affected by negative GDP growth in the same year. This may imply that the scheme will be unbalanced in those years.

we can now calculate the transfers as follows. Using (2), the equal percentage net (i.e., including the transfers) effects as a fraction of total value-added of exports for two countries i and k imply that

$$\begin{aligned} T_{kjt} &= \frac{X_{k,t-1}}{X_{i,t-1}} \left\{ \left[w_{ij,t-1} - \frac{X_{i,t-1}}{X_{k,t-1}} w_{kj,t-1} \right] \left(x_{jt} - x^*_{jt} \right) + T_{ijt} \right\} \\ &= \left[\frac{X_{k,t-1}}{X_{i,t-1}} w_{ij,t-1} - w_{kj,t-1} \right] \left(x_{jt} - x^*_{jt} \right) + \frac{X_{k,t-1}}{X_{i,t-1}} T_{ijt}, \forall k \neq i. \end{aligned} \tag{4}$$

There are $N-1$ such equations. Using the restriction (3) that the sum of the transfers across countries be zero, we have

$$\begin{aligned} \left[1 + \sum_{k \neq i} \left(\frac{X_{k,t-1}}{X_{i,t-1}} \right) \right] T_{ijt} = \sum_{k \neq i} &\left[w_{kj,t-1} - \frac{X_{k,t-1}}{X_{i,t-1}} w_{ij,t-1} \right] \\ &\times \left(x_{jt} - x^*_{jt} \right). \end{aligned} \tag{5}$$

Using the condition that the weights $w_{ij,t-1}$ sum to one over the countries, we obtain (see appendix A) for the transfers associated with sector j:

$$T_{ijt} = \left[\frac{X_{i,t-1}}{X_{t-1}} - w_{ij,t-1} \right] \left(x_{jt} - x^*_{jt} \right). \tag{6}$$

Expression (6) has a very simple intuitive interpretation. Recall that $X_{i,t-1}/X_{t-1}$ is country i's value-added of exports as a share of aggregate euro-wide value-added of exports, while $w_{ij,t-1} = x_{ij,t-1}/x_{j,t-1}$ represents the corresponding share for sector j only. If the difference between the two is negative, country i's value-added of exports share in sector j exceeds its overall value-added of exports share in the euro zone, i.e., its exports are relatively intensive in sector j (say, the Netherlands in agriculture) compared with its overall exports package. This implies that when there is, for instance, a *positive* shock in the total euro-area export in agriculture ($x_{jt} - x^*_{jt} > 0$), then the Netherlands will be more favorably affected than the other countries. In this case, the net transfer for the Netherlands (associated with this specific sector) would be negative according to (6), meaning that the country would be a contributor. The transfer would go to countries

which are relatively less exposed to agriculture (say, to Finland). Conversely, if a *negative* shock hits the same sector, the Netherlands will receive a transfer from countries in which agriculture is relatively less important (for instance, from Austria).

The mechanism can be illustrated further with a simple numerical example: suppose that there are only two countries, Germany and Greece, with shares of total euro-zone exports of, respectively, 90 percent and 10 percent. Additionally, suppose that there is only one sector, say tourism (e.g., hotels and restaurants), and that Greece's exports are relatively more specialized in that sector (e.g., $w_{ij,t-1} = 20\%$). Suppose now that a negative shock hits the total euro-area export of that sector. For example, $x_{jt} - x^*_{jt} = -€1000$ million. Then, given that Greece's exports are relatively more exposed to that sector, it will receive a transfer from Germany amounting to $T_{GR,j,t} = (0.10 - 0.20) * (-1000) = +€100$ million.

From (6), we obtain country i's *total* transfer *from* (or *to*) the rest of the euro zone as

$$T_{it} = \sum_j \left[\frac{X_{i,t-1}}{X_{t-1}} - w_{ij,t-1} \right] \left(x_{jt} - x^*_{jt} \right), \tag{7}$$

where $X_t \equiv \sum_i X_{it}$ is aggregate (i.e., across all sectors) euro-area-wide value-added of exports in period t. When T_{it} is positive, there is a net resource flow from the rest of the euro zone to country i, while when it is negative, there is a net resource flow into the opposite direction.

Some remarks are warranted. First, equation (2) implies that the *sum* over all sectors j of the term $w_{ij,t-1}\left(x_{jt} - x^*_{jt}\right) + T_{ijt}$ as a share of the total value-added of a country's exports is the same for all countries. In other words, the total change in national income (including transfers associated with all the individual sectors) as a share of a country's value-added of exports is the same for all countries. Second, because of the period-by-period balanced budget of the scheme, all the transfers paid will find their way to the other countries in the same year, so there is no saving or dissaving at the aggregate level. Third, while for a given weight $w_{ij,t-1}$ transfers are a function of the temporary deviations $x_{jt} - x^*_{jt}$ from the trend, over a sufficiently long period of time these temporary deviations are zero

on average. Therefore, a sector that is on a declining trend should not lead to systematic transfers. Fourth, the derivative of T_{it} in (7) with respect to $w_{ij,t-1}$, given by $-\left(x_{jt} - x^*_{jt}\right)$, is positive in the case of a negative exports shock in sector j. The positive effect of a higher weight $w_{ij,t-1}$ on transfers precisely when such a negative shock hits could give the government an incentive to avoid policies that lead to a decline in the weight $w_{ij,t-1}$. However, because deviations from trend should cancel out on average, a priori we would not expect this to be a source of moral hazard. In the case of a long-lasting negative deviation from the trend, the transfer scheme could undermine the incentive of the government to enter into a politically costly restructuring of the economy toward activities with more long-run viability. Hence, as such, our scheme would not be fully immune to moral hazard. However, as time moves forward, the estimate of the trend is updated further (as we explain below), which reduces the likelihood of the described situation. A solution that further reduces the scope for moral hazard would be to earmark transfers explicitly for compensating losers from structural reforms toward activities with a better future.

Finally, we do not control for the source of the common sectoral shock $\left(x_{jt} - x^*_{jt}\right)$, which may be driven by world market developments, but may also be partly affected by euro-zone-wide (trade) policies. However, there is a priori no reason not to compensate countries if they are relatively badly hurt by the euro zone's own policies, as long as these policies are not affected by moral hazard at the *individual* country's level. The latter is unlikely, since the influence of an individual country on common euro-zone-wide policies is only limited.

We introduce two modifications to scheme (7) in order to increases its political acceptability. First, as suggested by Hebous and Weichenrieder (2015a, 2015b), a transfer scheme with a balanced budget requirement like the current one is likely to produce as a fraction of GDP more volatile transfers for small than for large countries. To see whether this may be the case here as well, we rewrite (7) as

$$T_{it} = \frac{X_{i,t-1}}{X_{t-1}} \sum_j \left[1 - \frac{x_{ij,t-1}/X_{i,t-1}}{x_{j,t-1}/X_{t-1}}\right] \left(x_{jt} - x^*_{jt}\right). \tag{8}$$

The part in square brackets depends on the sectoral diversification of the country, and is positive when country i is less exposed to sector j than the euro area as a whole, and vice versa. The fraction $X_{i,t-1}/X_{t-1}$ in front of the summation in (8) shows that transfers are proportional to the size of the country's value-added of exports relative to the euro-area aggregate. Due to their openness, the export shares of small countries in the euro-area aggregate are higher on average than their GDP shares in the euro-area aggregate. Hence, small and open countries will on average inevitably experience larger transfers in absolute terms as a percentage of GDP than larger and more closed economies. To better align the volatility of the transfers as a fraction of GDP across the participating countries, we modify the baseline transfer scheme into

$$T_{it} = \frac{Y_{i,t-1}}{Y_{t-1}} \sum_j \left[1 - \frac{x_{ij,t-1}/X_{i,t-1}}{x_{j,t-1}/X_{t-1}} \right] \left(x_{jt} - x^*_{jt} \right), \tag{9}$$

where $Y_{i,t-1}$ is the GDP of country i and Y_{t-1} is euro-area GDP.[12]

The second modification to arrive at our baseline transfer scheme is that we assume that a country cannot contribute to the scheme in a given year if its GDP growth is negative in the same year. Such a situation would be most likely to occur during a common and severe downturn coinciding with a collapse in world trade as we have seen during the global financial crisis. Widespread negative GDP growth coincides with a decline in essentially all export sectors. However, because sectoral structures and the magnitudes of the sectoral shocks differ, with zero euro-area aggregate transfers, some countries would still be required to make a net transfer payment even though their GDP growth is negative. As this would lead to procyclical transfers and, therefore, would unlikely be politically acceptable in practice, we rule this out by imposing a lower bound of zero on a country's transfers when GDP is contracting

As a result of these two modifications, the aggregate of transfers over the euro zone in a given year may be positive. However, our simulations show that the resulting imbalance when averaged over

[12] An alternative would be to replace $X_{i,t-1}/X_{t-1}$ with the population fraction of country i in the euro zone. However, we find that the differences with the case in which we replace $X_{i,t-1}/X_{t-1}$ with country i's GDP fraction are minimal and, hence, we do not report the case with population fractions.

the sample period will be very small. Therefore, we will not explicitly address in our simulations how this imbalance can be eliminated. There are several possible ways in which this can be done. For example, the scheme's participants could contribute a (very) small fraction of their GDP to a dedicated central budget when their growth is above a certain threshold. Or the central capacity may be allowed to issue debt to finance the imbalance, after which the participating countries share in the debt-servicing costs in proportion to their GDP, again as long as their growth is positive. Such financing of the central budget during periods when growth is (sufficiently) positive would in fact strengthen the countercyclical character of the scheme.

3.2 Compensation for Labor Income Loss

Suppose that asset holdings are perfectly diversified over all individuals in the euro area. Then, it is natural to assume that the ESC should cover unexpected changes in labor income only. Let p_{ijt} be the average productivity in sector j in country i measured as the value of production per worker expressed in euros. Hence, the change in employment in sector j in country i associated with z_{ijt} equals $w_{ij,t-1}\left(x_{jt}-x_{jt}^{*}\right)/p_{ijt}$. Furthermore, let s_{ijt} be the average salary in sector j in country i. Then, expressed in euros, the amount of labor income associated with z_{ijt} equals $w_{ij,t-1}\left(x_{jt}-x_{jt}^{*}\right)(s_{ijt}/p_{ijt})$. Notice that $lsh_{ijt} \equiv s_{ijt}/p_{ijt}$ is the *labor share* in value-added in country i in sector j.

Now, imposing equal net (i.e., after transfers) income changes as a share of the value-added of exports for the two countries i and k implies

$$\frac{w_{kj,t-1}\left(x_{jt}-x_{jt}^{*}\right)lsh_{kjt}+T_{kjt}}{X_{k,t-1}} = \frac{w_{ij,t-1}\left(x_{jt}-x_{jt}^{*}\right)lsh_{ijt}+T_{ijt}}{X_{i,t-1}}, \forall k \neq i. \tag{10}$$

Rewriting, using the fact that there are N–1 such equations and the restriction that the sum of the transfers be zero, we obtain after some manipulation (see appendix B):

$$T_{ijt} = \sum_{k \neq i} \left[\frac{X_{i,t-1}}{X_{t-1}} w_{kj,t-1} lsh_{ijt} - \frac{X_{k,t-1}}{X_{t-1}} w_{ij,t-1} lsh_{kjt} \right] \left(x_{jt} - x^*_{jt} \right). \tag{11}$$

The transfers are extremely easy to calculate. However, simplification of this expression is only possible in the simple case in which the labor shares of value-added in a given sector j are identical across the countries, i.e., $lsh_{jt} \equiv lsh_{ijt}, \forall i$. In that case,

$$T_{it} = \sum_j lsh_{jt} \left[\frac{X_{i,t-1}}{X_{t-1}} - w_{ij,t-1} \right] \left(x_{jt} - x^*_{jt} \right). \tag{7'}$$

Hence, in this case, up to the proportionality factor lsh_{jt} for sector j, the transfers are the same as when the full income effect from the shock is equalized across the countries.

In line with our baseline scheme, we align the volatilities of the transfers across countries by setting

$$T_{it} = \frac{Y_{i,t-1}}{Y_{t-1}} \sum_j lsh_{jt} \left[1 - \frac{x_{ij,t-1}/X_{i,t-1}}{x_{j,t-1}/X_{t-1}} \right] \left(x_{jt} - x^*_{jt} \right). \tag{9'}$$

Again, we will cap negative transfers at zero when a country's GDP growth is negative.

3.3 Compensation for Losses of Tax Revenues

According to the proposed ESC scheme, a country that experiences an improvement in the world trade of its relatively export-intensive sectors will have to make a net transfer that will benefit less fortunate countries. However, it may not be so easy to free up the resources for making these transfers: the extra export value-added resulting from the positive shock is spent on compensating the providers of labor and capital. Yet, the additional income also generates additional tax revenues for the government of the lucky country, and these can be used for transfers to unlucky countries that are confronted with a shortfall in tax revenues. A complication with conditioning transfers on tax revenues is that countries have different tax rates: countries with relatively low tax rates would experience relatively small transfers in absolute magnitude, and vice

versa for countries with relatively high tax rates. The transfer scheme should be designed in such a way that it avoids potential incentives to manipulate tax rates in order to extract more transfers. Hence, we assume that all transfers in a given period are based on a common tax rate τ_t. Further, to ensure that the governments that are net payers into the system have the resources available to pay their transfers, τ_t cannot be too high.

The transfer scheme based on the effect of sectoral value-added exports shocks for government revenues is a direct variation of the baseline scheme. Denote the tax rate of country i by τ_t. Hence, the transfer received from or paid to the other countries in the system would be

$$T_{it} = \tau_t \frac{Y_{i,t-1}}{Y_{t-1}} \sum_j \left[1 - \frac{x_{ij,t-1}/X_{i,t-1}}{x_{j,t-1}/X_{t-1}} \right] \left(x_{jt} - x^*_{jt} \right), \qquad (12)$$

and $T_{it} = 0$ if both the right-hand side of (12) and country-i GDP growth in period t are negative. Again, we align the cross-border volatility of the transfers by making them proportional to the GDP share, and we exclude negative transfers in case of a recession.

4. The Data

We obtain yearly data on x_{ijt}, the value-added content of exports by country and by sector toward the rest of the world (including the other EMU countries), from the OECD (2017b) Trade in Value Added (TiVA) database. The sample covers all the 19 euro-area (EA19) countries and runs from 1995 to 2014. The industrial sectors into which exports are subdivided correspond to those of the third revision of the International Standard Industrial Classification (ISIC Rev. 3). Using these data, we can calculate $x_{jt} = \sum_i x_{ijt}, x_t = \sum_j x_{jt}$, and $w_{ijt} = x_{ijt}/x_{jt}$. We exclude the sector "Finance and Insurance" from our analysis. The sector is generally tightly regulated by the authorities and often faces specific tax treatment. Moreover, its disproportionate presence in some relatively small countries would result in very large cross-border transfer payments (or receipts) when shocks hit that sector, undermining the political acceptability of the proposed arrangement. Hence, our data set comprises the 32 sectors listed in table 1.

Table 1. Country Shares of Value-Added Sectoral Exports (w_{ij})

	DE	FR	IT	ES	NL	GR	PT	IE	CV	LV	AT	BE	EE	FI	LT	LU	MT	SK	SI
Agriculture, Hunting, Forestry, and Fishing	12.3	25.9	8.4	17.5	18.7	4.0	1.4	1.4	0.1	0.6	1.7	3.4	0.3	1.4	0.9	0.3	0.1	1.2	0.4
Mining and Quarrying	13.3	7.7	4.9	5.2	57.4	1.0	1.8	1.2	0.0	0.1	2.9	2.0	0.2	0.8	0.3	0.1	0.0	1.0	0.1
Food Products, Beverages, and Tobacco	20.3	19.4	11.9	10.5	15.4	2.0	1.8	7.1	0.2	0.3	2.8	5.6	0.2	0.8	0.5	0.3	0.1	0.6	0.3
Textiles, Textile Products, Leather, and Footwear	15.6	14.6	40.1	9.3	2.2	2.1	5.6	0.5	0.1	0.3	2.5	3.6	0.3	0.6	0.6	0.3	0.1	0.9	0.7
Wood and Products of Wood and Cork	22.7	8.9	9.9	5.4	3.0	0.4	6.5	1.1	0.0	3.8	13.2	4.1	2.1	13.5	1.2	0.3	0.0	2.1	1.8
Pulp, Paper, Paper Products, Printing . . .	34.0	12.2	8.4	6.9	6.9	0.4	2.4	3.0	0.0	0.1	5.9	3.7	0.2	13.6	0.2	0.3	0.1	1.0	0.7
Coke, Refined Petroleum Products, and Nuclear Fuel	18.5	15.4	10.5	9.0	22.8	2.7	0.8	1.3	0.0	0.0	1.5	10.3	0.2	2.6	3.0	0.0	0.0	1.1	0.0
Chemicals and Chemical Products	34.2	19.6	9.9	6.7	9.2	0.7	0.6	8.1	0.0	0.1	2.1	6.2	0.1	1.3	0.1	0.1	0.0	0.4	0.6
Rubber and Plastics Products	37.4	15.4	16.7	8.0	5.7	0.7	1.7	0.9	0.0	0.1	4.0	4.0	0.1	1.6	0.3	0.9	0.1	1.3	1.0
Other Non-metallic Mineral Products	25.7	12.0	24.5	13.4	4.0	1.4	3.4	1.0	0.0	0.2	4.8	5.0	0.2	1.5	0.2	0.7	0.0	1.2	0.7
Basic Metals	34.1	16.0	14.3	9.8	4.8	1.7	1.1	0.3	0.0	0.3	5.4	6.5	0.0	3.2	0.0	0.8	0.0	1.4	0.5
Fabricated Metal Products Except . . .	33.5	11.1	24.3	7.3	6.1	0.7	1.6	0.6	0.0	0.1	5.2	4.1	0.2	1.8	0.2	0.3	0.0	1.5	1.3
Machinery and Equipment, nec	43.7	11.7	25.5	3.9	3.9	0.3	0.6	0.5	0.0	0.0	4.0	1.7	0.0	2.7	0.1	0.1	0.0	0.6	0.5
Computer, Electronic, and Optical Products	39.9	19.3	10.3	3.7	5.6	0.4	0.9	7.1	0.0	0.1	3.2	1.5	0.2	5.8	0.1	0.1	0.2	1.1	0.4
Electrical Machinery and Apparatus n.e.c.	46.8	15.9	14.2	6.2	2.1	0.6	1.4	1.1	0.0	0.1	4.4	2.2	0.2	2.5	0.1	0.1	0.1	1.3	0.7
Motor Vehicles, Trailers, and Semi-trailers	54.6	14.9	9.0	10.5	1.7	0.1	1.0	0.1	0.0	0.0	2.7	3.0	0.0	0.4	0.0	0.0	0.0	1.5	0.4

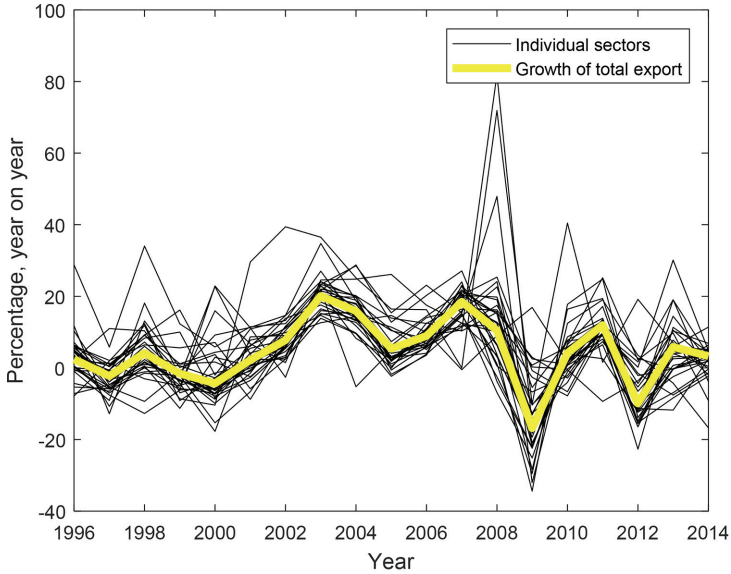
(*continued*)

Table 1. (Continued)

	DE	FR	IT	ES	NL	GR	PT	IE	CV	LV	AT	BE	EE	FI	LT	LU	MT	SK	SI
Other Transport Equipment	33.9	37.6	11.7	6.5	3.5	0.5	0.5	0.4	0.0	0.1	1.8	1.0	0.1	1.7	0.2	0.0	0.0	0.3	0.5
Manufacturing n.e.c.; Recycling	23.4	17.3	26.1	7.7	7.6	1.0	1.7	1.3	0.2	0.2	4.3	4.6	0.4	1.1	0.7	0.1	0.2	1.0	1.1
Electricity, Gas, and Water Supply	68.1	8.9	2.0	2.5	5.6	0.4	0.3	0.2	0.0	0.1	3.3	5.9	0.3	0.8	0.1	0.3	0.0	0.3	0.8
Construction	12.0	34.4	6.2	2.5	8.1	2.3	2.9	0.6	2.1	0.3	7.3	11.6	0.6	5.3	0.4	0.9	0.1	1.3	1.1
Wholesale and Retail Trade; Repairs	27.0	20.1	17.1	8.4	7.3	1.1	1.8	3.1	0.2	0.2	4.1	5.3	0.3	1.6	0.3	0.8	0.1	1.0	0.4
Hotels and Restaurants	8.8	13.3	22.9	25.9	2.4	6.0	3.2	1.4	1.0	0.1	8.7	2.7	0.3	0.8	0.2	0.8	0.4	0.6	0.6
Transport and Storage	20.9	18.6	12.8	12.2	10.0	5.8	2.3	1.7	0.4	0.6	3.0	6.6	0.5	1.5	0.7	1.0	0.2	0.7	0.6
Post and Telecommunications	18.9	12.7	14.9	8.3	10.5	1.8	1.9	3.7	1.0	0.3	5.5	11.3	0.4	1.3	0.3	5.4	0.3	0.9	0.7
Real Estate Activities	15.1	13.6	28.8	12.8	5.5	2.7	4.7	0.8	2.7	0.1	7.0	2.2	0.2	0.7	0.5	1.1	0.2	0.6	0.6
Renting of Machinery and Equipment	24.0	31.8	4.1	6.3	3.9	1.1	1.0	16.9	0.4	0.2	2.7	3.3	0.3	1.9	0.1	1.8	0.2	0.2	0.0
Computer and Related Services	28.0	4.1	6.6	12.2	7.8	0.6	0.6	23.2	0.4	0.1	2.9	5.2	0.2	5.4	0.1	1.6	0.2	0.5	0.3
Research and Development and Other . . .	28.9	16.6	10.2	11.2	7.7	0.6	0.8	2.8	0.5	0.2	4.3	11.4	0.2	2.6	0.1	0.8	0.2	0.5	0.4
Public Admin. And Defense; Compulsory . . .	1.3	25.7	1.1	30.9	18.7	1.3	3.8	0.0	0.0	0.0	4.6	7.8	0.2	2.7	0.0	1.1	0.1	0.4	0.2
Education	11.8	16.3	5.6	8.5	25.0	1.8	2.6	2.7	2.1	0.1	3.7	14.4	0.3	0.8	0.2	1.4	0.3	0.8	1.7
Health and Social Work	24.6	28.8	2.5	9.3	9.0	2.1	2.9	3.1	0.2	0.1	9.1	2.0	0.1	2.7	0.3	1.0	0.1	1.3	0.9
Other Community, Social, and Personal Services	21.7	20.5	10.6	10.0	7.2	4.5	1.8	1.7	1.4	0.2	6.9	4.9	0.4	1.3	0.6	2.7	0.9	1.6	1.3
Country's Total in Euro-Area Export Value-Added	31.2	17.4	15.0	9.0	7.4	1.6	1.6	3.0	0.2	0.2	3.8	4.8	0.2	2.2	0.3	0.5	0.1	0.9	0.5

Notes: This table reports the share (in percent) of each euro-zone country's export value-added over total euro-zone export value-added for each of the 32 sectors included in the sample. Numbers are averages over the 1995–2014 period. The sum of each row is therefore 100 percent, while the last row indicates the share of that country's total export value-added over the total euro-zone export value-added. AU = Austria, BE = Belgium, EE = Estonia, FI = Finland, FR = France, DE = Germany, GR = Greece, IE = Ireland, IT = Italy, LV = Latvia, LU = Luxemburg, NL = Netherlands, PT = Portugal, SK = Slovakia, SI = Slovenia, ES = Spain, CY = Cyprus, LT = Lithuania, and MT = Malta. Green (red) are the three largest (smallest) value-added export shares, for each country.

Figure 1. Growth Rate of Value-Added of Sectoral Exports at the Euro-Area Level



Notes: The figure shows the annual growth rate of the individual sectoral export value-added at the euro-area level. Sectoral labels are not shown for sake of space.

Figure 1 depicts the annual growth rate of total euro-zone exports (gray or yellow line in the print and online version, respectively) and of euro-zone exports by individual sector (not labeled for simplicity). The annual growth rate of total exports averages 5.4 percent over the full sample. Export growth is generally positive, but several years are also characterized by negative growth rates. Most notably, the 2009 global economic and financial crisis exhibits a very severe fall of more than 15 percent in total exports, with some sectors dropping by as much as 35 percent in that year.

Table 1 also reports, for each sector and country, the country's average (over time) exports share in that sector's total euro-zone exports. At the bottom of the table we report, for each country, its share in total euro-zone exports. For each country, we have marked the three smallest (shaded dark gray) and the three largest (shaded light gray) sectors in terms of euro-zone share. Obviously, given

that Germany is the largest economy and the largest exporter, it is also the largest exporter in a substantial number of sectors. In some sectors, it is very dominant, such as "Electrical Machinery and Apparatus n.e.c.," "Motor Vehicles, Trailers, and Semi-trailers," and "Electricity, Gas, and Water Supply." Hence, large negative shocks in these sectors could potentially lead to large transfers to Germany that need to be financed by all the other countries. This effect is mitigated by the fact that Germany is a relatively diversified economy over the various sectors and that, in the case of our baseline, the transfers are essentially driven by the *difference* between Germany's share in individual sectors with Germany's share in total exports (recall equation (7)), which is high not only because of its size but also because of its openness, and its share in the exports of the specific sectors.

Data on nominal and real GDP of the EA19 countries are retrieved from the OECD (2017a) and from the World Bank (2017). The output gap is taken from the OECD (2017a). Using data on compensation of employees as a fraction of value-added by industry and country from the OECD (2019) structural analysis (STAN) database, we calculate the labor share of gross value-added in sector j (lsh_{jt}) as

$$lsh_{jt} = \sum_i \left[\frac{\frac{WL_{ijt}}{GVA_{ijt}} Y_{it}}{\sum_i Y_{it}} \right],$$

where WL_{ijt} is the total compensation of employees and GVA_{ijt} is gross value-added in country i, sector j, and year t. Hence, lsh_{jt} is a weighted average of the labor shares in sector j in the different countries. Data are available over the full sample period 1995–2014.

The tax rate τ_t is the EA19 value for "Total Receipts from Taxes and Social Contributions (including imputed social contributions) after Deduction of Amounts Assessed but Unlikely to be Collected" as a percentage of euro-area GDP. It is retrieved from Eurostat (2017). It ranges from 39.0 percent in 2010 to 41.3 percent in 2014.

Average revisions of export data over time are computed using different editions of the AMECO database (2017).

All data are annual, and expressed either in million US$ or percentages. U.S. dollars were chosen for all amounts expressed in currency so as to avoid exchange rate complications.

5. Transfers Calculated on the Basis of Actual Data

In this section, we present the results for our baseline scheme, described in subsection 3.1, and of its variants (presented in subsections 3.2–3.3) simulated over the period 2002–14 and based on the data described above.

The first step consists of estimating the sectoral trends for each sector j, which underpin the equation for the baseline scheme (9). To that aim, we adopt a "pseudo real-time" approach: we assume that we are in year t, and that we observe data from t_0 (the beginning of the sample) until t. Then, we apply the Hodrick-Prescott filter to that sample and come up with an estimate of the trend value for sector j, i.e., x^*_{jt}. Finally, we estimate the shock for period t and sector j as $x_{jt} - x^*_{jt}$, and include the estimate in equation (9). We repeat these steps from 2002 until the end of the sample, i.e., $t = 2002, 2003, \ldots, 2014$, while keeping the first available year as fixed (1995). Hence, for each year t, we will therefore come up with a (slightly) different estimate of the trend, given that available information would be updated based on the incoming year.[13] This "recursive" approach addresses the end-period problem of the Hodrick-Prescott filter and avoids the use of future observations in performing the trend-cycle decomposition. This procedure will result in a time series of shocks for each sector j from 2002 until 2014. It turns out that these shocks are on average close to zero and symmetrically distributed around it.

5.1 Baseline Scheme: Equalizing Income Shifts as a Fraction of the Value-Added of Exports

Figure 2 depicts, for each euro-zone country, the simulated annual transfers in percent of GDP of the same year (the solid line). In addition, the figure plots the cumulative transfers (the dashed line). The latter are calculated as $x_{jt} = \sum_{\tau=2002}^{t} T_{i,\tau}/y_{it}$, i.e., the sum of the transfers up to year t over GDP in year t. Finally, the figure also shows the output gap as the gray filled area. We first report the "big-5" euro-zone countries (Germany, France, Italy, Spain, the

[13] We have experimented with a different starting year, 2001 and 2003, and results are very similar (not reported, available upon request).

Figure 2. Annual and Cumulated Transfers Implied by the Baseline Scheme in Percent of the Country's GDP

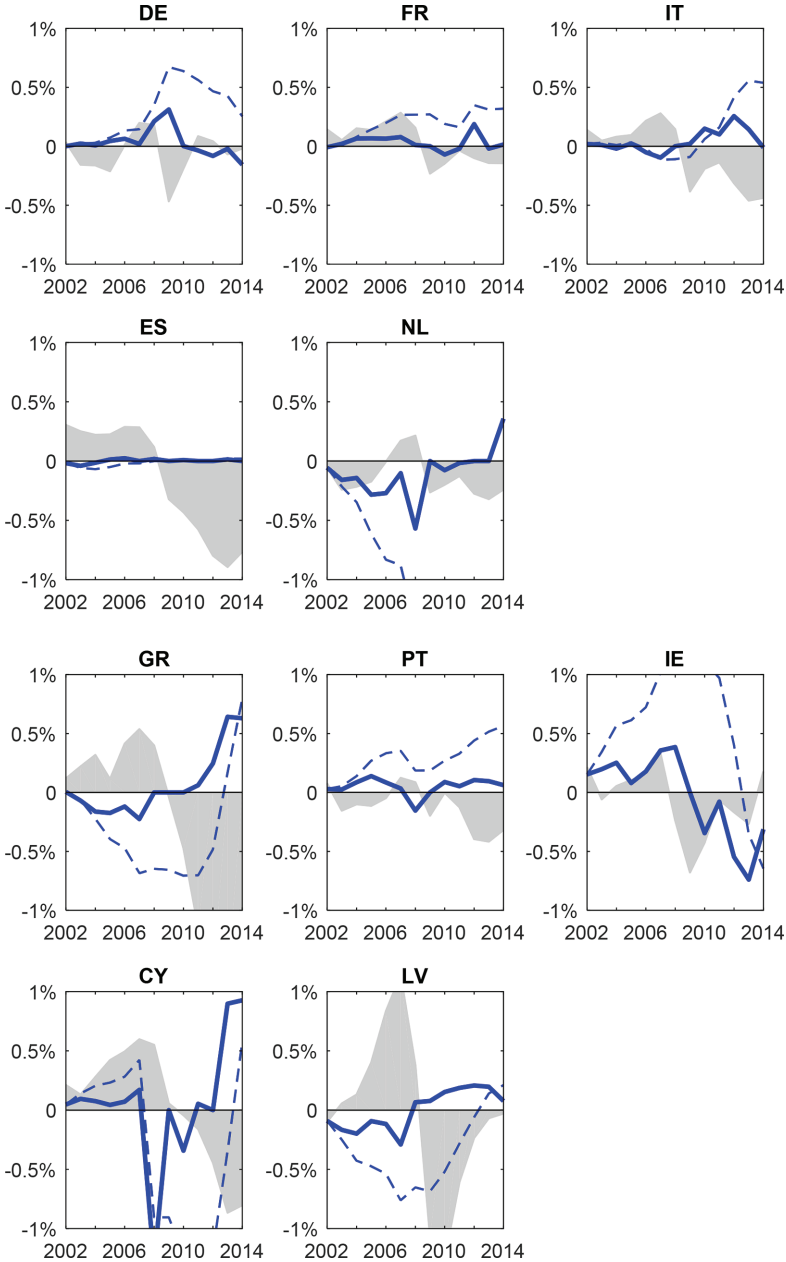


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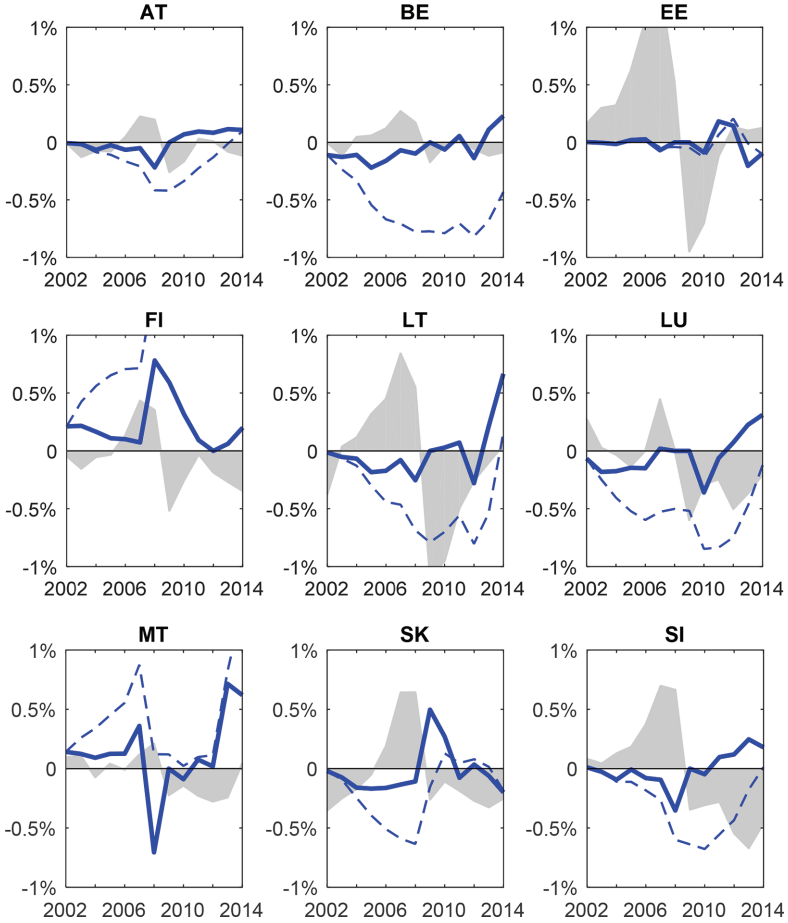
Figure 2. (Continued)



Notes: The figure shows the annual and cumulated transfers for each country, generated by the baseline scheme (equation (9)), as a percent of a country's GDP in that year. The solid lines are the annual transfers, while the dashed lines are the cumulated transfers. The gray shaded areas are output gaps published by the OECD (2017a). For all countries, we report data in the scale +1 to −1 percent of GDP, for consistency. In the case of the Netherlands, the cumulated transfers are at around 1 percent of GDP in 2014. For Finland, they are about 2.5 percent of GDP. For country codes, see the notes to table 1.

Netherlands), then the countries that received financial aid during the 2008–09 global financial crisis and the ensuing 2010–12 sovereign debt crisis (Greece, Portugal, Ireland, Cyprus, Latvia), followed by the remining nine euro-area countries.

We start by discussing the results for the "big-5" euro-zone countries. In the depth of the global financial crisis, in 2009, in particular Germany is a major receiver of transfers—in that year it receives about 0.3 percent of GDP in net transfers. Indeed, this year is characterized by sizable and negative shocks in sectors, such as "Motor Vehicles, Trailers, and Semi-trailers" and "Machinery and Equipment n.e.c.," in which Germany is relatively more specialized.[14] That would have been compensated by small but negative transfers (contributions to other countries) in the following years, bringing down cumulative transfers by the end of the sample (dashed line). According to the baseline scheme, France receives small transfers (amounting to less than 0.1 percent of GDP) in the pre-crisis period, and a somewhat larger transfer in 2012, driven by the performance of the sectors in which it is more exposed (transport equipments and construction). The case of Italy, being a large country going through a period of low and even negative growth after the start of the sovereign debt crisis, provides a particularly interesting illustration. In each of the years 2009–13 it receives net transfers, although those for 2009 are very small. These net transfers cannot be attributed to any sector specifically, although there are a number of sectors, "Textiles, Textile Products, Leather, and Footwear," "Fabricated Metal Products except Machinery and Equipment," "Machinery and Equipment n.e.c.," "Manufacturing n.e.c.; Recycling," and "Electricity, Gas, and Water Supply," responsible for a relatively substantial fraction of the incoming transfers. Except for "Electricity, Gas, and Water Supply," all these sectors switch from contributing to transfer outflows before the crisis to generators of transfer inflows after the crisis. Interesting, there is also a set of sectors, "Chemicals and Chemical Products," "Motor Vehicles, Trailers, and Semi-trailers," "Computer, Electronic, and Optical Products," and "Transport and

[14]The euro-area value-added shares of Germany's exports in "Motor Vehicles, Trailers, and Semi-trailers" and "Machinery and Equipment n.e.c." are, respectively, 54.6 percent and 46.8 percent, which compares with an overall share—of total German exports over euro-area exports—of 31.2 percent (see table 1).

Storage," that switch from contributing to transfer inflows before the crisis to transfer outflows after the crisis. Hence, for a large, sectorally diversified country like Italy, net transfers are the result of many offsetting contributions coming from the individual sectors. This is, in particular, also the case for Spain. Net transfers to and from Spain are very close to zero in each period. More detailed inspection shows that the overall low transfers are due to the fact that some dominant sectors are hit by shocks that go into opposite directions, thus generating offsetting effects. If we aggregate the absolute values of the transfers associated with the individual sectors, the result would be similar to that for Italy. Finally, the Netherlands contribute to the scheme in the first part of the sample, due to the good performance of sectors in which it is highly exposed (mining and fuel) and low exposure to declining sectors (textile). In the last part of the sample, however, it becomes a net receiver of transfers.

Moving to the set of "crisis countries," figure 2 shows that Greece, the EU country hit hardest by the sovereign debt crisis, would after the start of the crisis benefit in particular from substantial incoming transfers associated with "Transport and Storage" and "Hotels and Restaurants," while it would experience outgoing transfers associated with "Chemicals and Chemical Products," "Fabricated Metal Products except Machinery and Equipment," "Machinery and Equipment n.e.c.," and "Computer, Electronic and Optical Products," sectors that were hit relatively hard, but in which it has relatively little export presence. The case of Ireland is also of specific interest. The country has negative growth in 2008 and 2009 and is one of the major victims of the sovereign debt crisis. However, the problems seem to have been largely absorbed in the public sector, by taking over failing banks. As of 2010, the country grows again at a rather substantial speed and it becomes a net payer of transfers. For Portugal, we see a substantial turnaround of transfers associated with "Transport and Storage," which switch from being relatively large and negative up to 2008 to being relatively large and positive as of 2009. "Textiles, Textile Products, Leather, and Footwear" also switches from being a subtractor to a contributor to the net transfer in 2009 and this is also the case for "Hotels and Restaurants." However, Portugal's net transfer is the sum of many sector-related contributions that can be positive and negative. In

particular, the contributions by "Machinery and Equipment n.e.c.," "Computer, Electronic and Optical Products," and "Motor Vehicles, Trailers, and Semi-trailers" are quite strongly negative shortly after the start of the crisis. This is the consequence of the combination of these (rather large) sectors being hurt particularly severely by the crisis and Portugal having relatively little export presence in these sectors. Finally, for Latvia we observe a switch in 2009 from negative to positive contributions to the net transfer by the sectors "Wood and Products of Wood and Cork" and "Transport and Storage." This switch dominates a simultaneous switch into the other direction caused by "Motor Vehicles, Trailers, and Semi-trailers," a badly hurt sector in which Latvia has negligible export presence. In size, these three switches are the dominant ones for Latvia.

In general, we note that—even if the baseline scheme would have prescribed negative transfers for some countries in some years—these were put to zero due to the condition that a country cannot contribute to the scheme in times of negative GDP growth. This is, for instance, the case of France in 2009, Greece in 2008 and 2009, and Portugal in 2009.

Overall, the graphs suggest that, first, annual transfers are *on average* rather small in absolute magnitude, amounting in most cases to less than 0.2 percent of GDP. Figure 3A, which depicts for each year the cross-country dispersion of the baseline transfers in percent of GDP, shows that the median transfer is zero or close to zero in all years, while the 25th and 75th percentiles are generally also close to zero. However, occasionally, annual transfers can become quite substantial, reaching levels on the order of 0.5–1 percent of GDP. The dispersion is widest during the economically difficult years of 2008 and 2013–14. Generally speaking, transfers tend to be somewhat larger in absolute magnitude for the smaller economies. A priori one might expect this to be the result of a smaller degree of sectoral diversification of these countries' exports. The so-called Herfindahl index, calculated as $H_{it} = \left(\sum_j \left(w_{ijt}/\sum_j w_{ijt}\right)\right)^2$, is increasing in the degree of sectoral export specialization of a country i.[15] Figure 4

[15]The idea of the Herfindahl index is that if an economy is weakly diversified, it features some sectors with large export weights, which drive up the index, because the latter is based on the sum of the quadratic values of the weights.

Figure 3. Dispersion of Transfers for the Different Schemes (% of GDP)

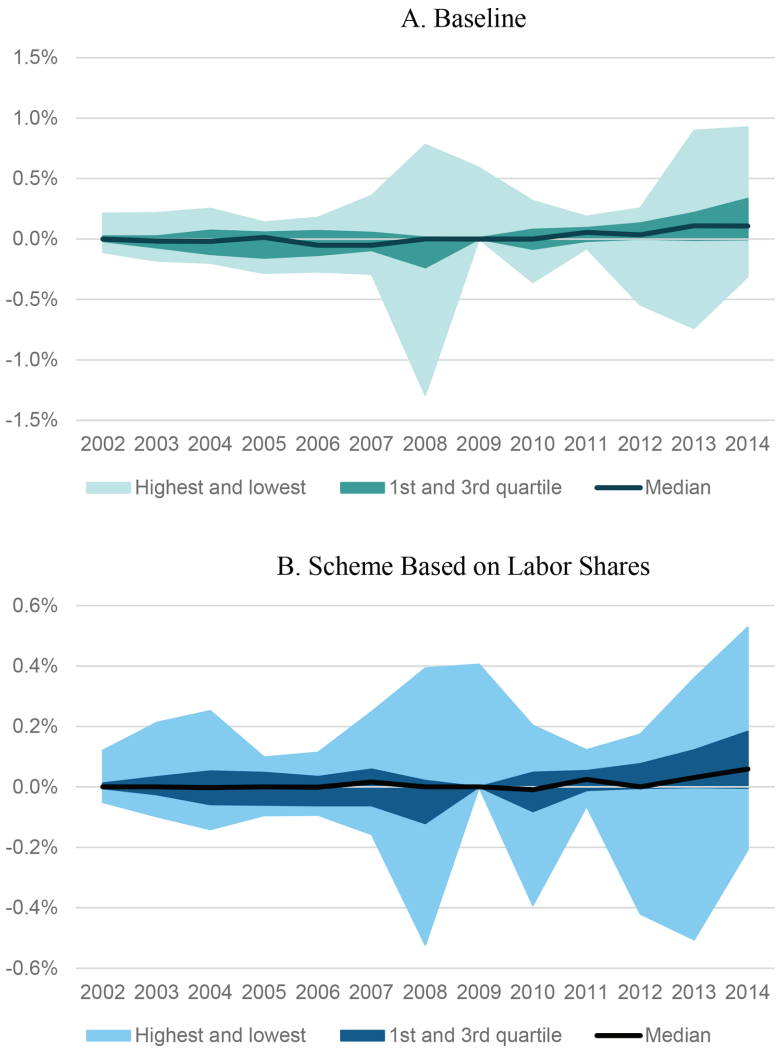


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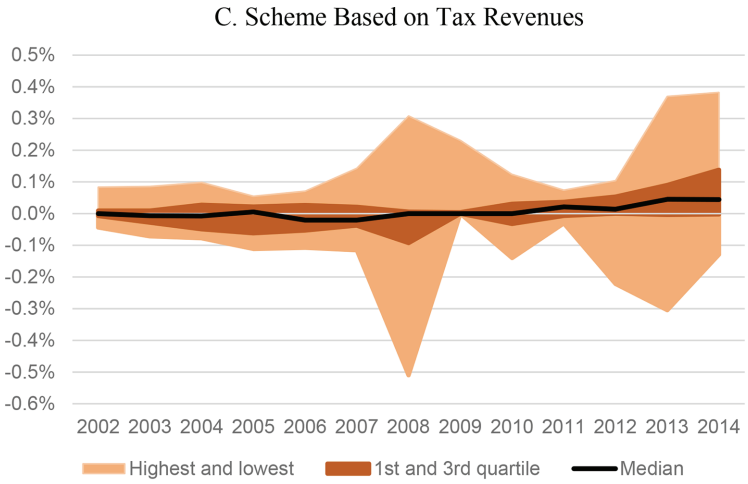
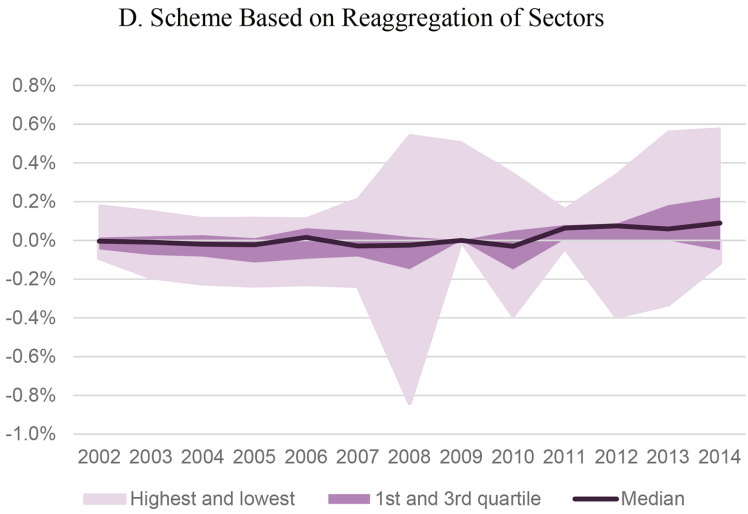
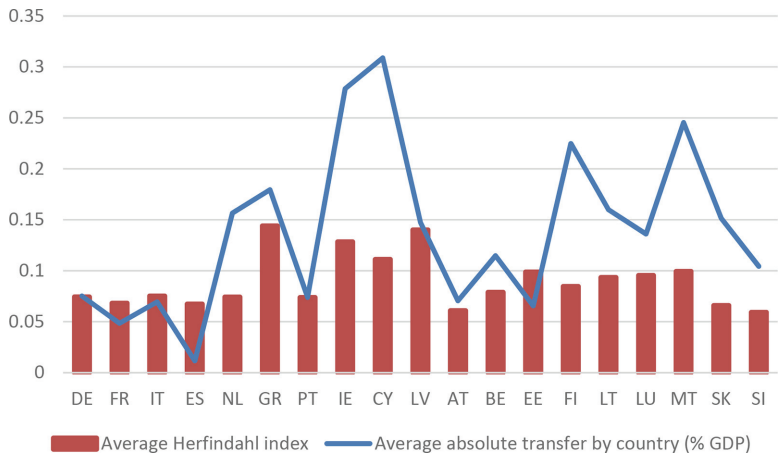
Figure 3. (Continued)





Notes: The figure reports the dispersion of the transfers generated by (A) the baseline scheme, (B) the scheme based on labor shares, (C) the scheme based on tax rate revenue, and (D) the scheme based on reaggregation of sectors. In particular, the charts show, for each year, the highest and lowest values, the first and third quartile, and the median value.

Figure 4. Sectoral Diversification and Size of Transfers



Notes: The figure depicts by country the average of the absolute values of the transfers across the years and the average of the Herfindahl index across the years. Values are in percent of that country's GDP.

suggests that the index, calculated for each country as the average over the sample years, is indeed slightly larger on average for the smaller than for the larger economies, thus confirming some positive correlation (precisely, 0.59) between the absolute magnitude of the transfers and the Herfindahl index.

Second, transfers tend to be countercyclical, i.e., they are generally positive (negative) when the output gap is negative (positive), as is also visible from the charts, which combine transfers with the output gap for each country. As mentioned above, for example, Germany was hit relatively more by the 2009 crisis, thus receiving a transfer in that year. Countries relatively less exposed to sectors that are hit particularly hard by the crisis would, in principle, have to make net transfer payments, but due to the widespread negative growth, these net payments are capped at zero. As shown in figure 2, however, in spite of these net receipts in the depth of the crisis, German cumulative transfers are almost identical to zero at the end of the sample.

The period 2012–14, which contains the double-dip recession in the wake of the EU sovereign debt crisis, is also characterized by

strong countercyclical net transfers: Greece receives net transfers of 0.64 percent and 0.63 percent of GDP in 2013 and 2014, respectively, while Italy receives net transfers of 0.26 percent and 0.14 percent in 2012 and 2013, respectively. Other examples of substantial net transfers are Cyprus with 0.90 percent and 0.93 percent of GDP and Malta with 0.71 percent and 0.62 percent of GDP in 2013 and 2014, respectively. Other examples are the crisis countries Latvia and Portugal. Overall, while transfers are on average of limited magnitude, at specific moments of severe economic circumstances they can be quite substantial, meaningfully helping to ameliorate a country's cyclical situation. This has in particular been the case for most crisis countries at moments when they suffered from substantial economic slack.

Indeed, crucial for the transfer scheme's economic usefulness and political viability is the degree to which the transfers correlate with overall economic activity: it is desirable that transfers are positive when the economy is doing relatively poorly and vice versa when it is doing relatively well. Table 2 reports the coefficient estimates of various panel regressions. We perform separate regressions of transfers on the net value of exports, its lag, and various measures of activity, namely the output gap and its first lag, and GDP growth and its first lag. We also estimate a variant in which we split observations into positive and negative output gaps.[16] The table reports just the coefficient associated with these explanatory variables, for simplicity. We find that transfers are significantly countercyclical to the net value of exports and to all activity measures, as indicated by the negative coefficients. The lagged value of exports enters with a negative sign, but is not significant, presumably because the number of observations is rather limited due to the rather short sample period, which results from the need to initialize the trend. The degree of countercyclicality is stronger and more significant in the case of a negative output gap than in the case of a positive output gap, indicating that transfers act as stabilizers precisely when this is most desirable, i.e., when the economy is relatively depressed.

Third, transfers tend to revert to zero or to switch sign after a few years (e.g., see Germany). This is a direct consequence of the

[16]We include country fixed effects and allow standard errors to be clustered by country.

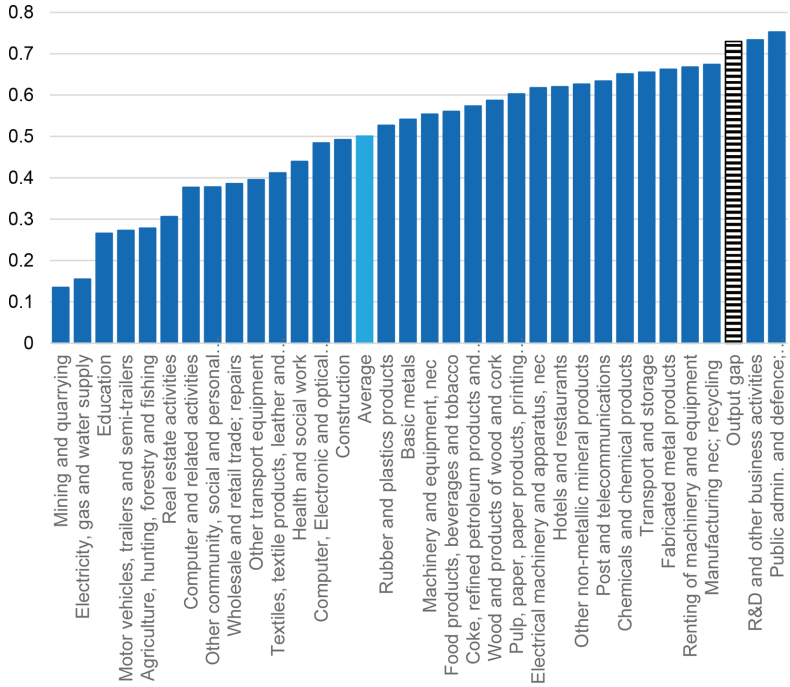
Table 2. Testing the Countercyclicality of the Schemes

Dependent →	**Transfers/GDP for Variant**			
Explanatory ↓	**Baseline**	**Labor Shares**	**Taxes**	**Reagg-regation**
Exports	-0.32^{*}	-0.14	-0.13^{*}	-0.27^{**}
	(0.18)	(−0.13)	(0.073)	(0.12)
Lagged Exports	-0.20	-0.022	-0.083	-0.16^{*}
	(0.17)	(0.10)	(0.066)	(0.088)
Output Gap	-0.019^{***}	-0.0077^{**}	-0.0078^{***}	-0.014^{**}
	(0.0060)	(0.0029)	(0.0025)	(0.0052)
Lag Output Gap	-0.016^{**}	-0.0054	-0.0064^{**}	-0.011^{*}
	(0.0074)	(0.0039)	(0.0030)	(0.0056)
Positive Output Gap	-0.017^{*}	-0.0093^{*}	-0.0069	-0.0068
	(0.0099)	(−0.0048)	(0.0040)	(0.0061)
Negative Output Gap	-0.028^{**}	-0.015^{**}	-0.011^{**}	-0.020^{**}
	(0.012)	(0.0065)	(0.0051)	(0.0099)
GDP Growth	-0.011^{**}	-0.0051^{**}	-0.0045^{**}	-0.0083^{**}
	(0.0044)	(0.0024)	(0.0018)	(0.0035)
Lag GDP Growth	-0.0113^{*}	-0.0035	-0.0046^{*}	-0.0070
	(0.0059)	(0.0030)	(0.0024)	(0.0047)

Notes: The table reports regression coefficients from panel regressions which are run on the explanatory variables reported in the first column, country fixed effects, and a constant, over all countries in the sample and period 2002–14. The regressions are conducted on one explanatory variable at a time, except for the positive and negative output gaps, which are entered jointly as explanatory variables in the same regression. The standard errors, reported in the parentheses, are based on clustering over the countries. ***, **, and * indicate significance at the 1 percent, 5 percent, and 10 percent level, respectively.

design of the transfer scheme, whereby transfers depend on deviations of sectoral value-added from sectoral trends. These deviations cannot be permanently positive or negative. Moreover, net transfers depend on the relative performances of sectors to the extent that sectoral exports structures differ across countries. Generally, cumulative transfers are close to zero at the end of the sample period or they stabilize at relatively low levels. Only for the Netherlands, Finland, and Malta do cumulative transfers in absolute value end above 1 percent of GDP. Moreover, the only country for which cumulative transfers are monotonic over our sample period is Finland. Obviously, even under a pure insurance scheme ex post cumulative transfers are likely

Figure 5. Autoregressive Coefficients of Sectoral Shocks

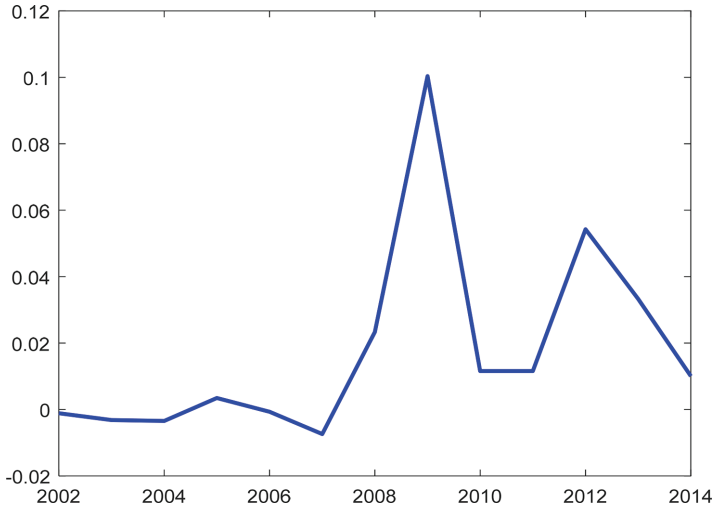


Notes: The figure reports the coefficient of a regression of sectoral shocks on their first lag. The regression is done for each sector separately. The lightest bar reports the average of the estimated regression coefficients. The bar with horizontal lines in the figure reports the AR(1) coefficient of a (year, country) panel regression of the output gap on its first lag.

to differ from zero at the end of the sample period, because the specific shock materializations are unlikely to be fully symmetric at the individual country level.

Cumulated transfers are driven by the degree of persistence of the shocks. Therefore, we formally test this persistence with a panel regression for each sector, in which we regress the sectoral shocks on a country fixed effect and their own lag, again clustering standard observations by country. Figure 5 depicts the coefficient estimates by sector. The coefficient estimate is always significantly positive. Hence, the sectoral shocks exhibit persistence. Indeed, persistence is a necessary condition to provide enough countercyclical force,

Figure 6. Sum of Transfers across Countries, Each Year, as Percent of Euro-Area GDP



Note: The figure shows the sum of transfers across countries, each year, as percent of euro-area GDP in that year.

because output gaps are also persistent reflecting the duration of business cycles.[17] However, the coefficient estimates are also always significantly smaller than one, and generally substantially so, indicating that shocks die out within a reasonable amount of time. Ideally, to exert maximal countercyclical effect, the sectoral shocks and thus the transfers exhibit an amount of persistence that reflects a business cycle downturn (or upturn). Indeed, the average persistence of the sectoral shocks turns out to be only somewhat smaller than that of the output gap.

As explained earlier, the scheme is generally not completely balanced at the aggregate level. Figure 6 depicts the sum of the transfer payments each year, across all countries. The scheme is in practice close to balance before the 2008–09 crisis. The imbalance is largest during the global financial crisis in 2009 and the widespread recession in 2012–13 associated with the debt crisis that forced governments to

[17] A panel regression of the output gap on its first lag yields a coefficient of 0.73, which is highly significantly different from zero.

consolidate in order to retain capital market access. These are precisely the sample years of widespread negative growth, hence during which the transfer scheme is at its most useful. The average annual imbalance amounts to only 0.02 percent of GDP.

5.2 Transfers Based on Compensation of Loss of Labor Income

This subsection explores transfers that are intended to compensate for the loss of labor income. Conceptually, this would be the more natural scheme to consider when there is no home bias in asset holdings in companies, i.e., all stakes in equity, corporate bonds, and other corporate financing vehicles are perfectly evenly spread over the entire euro zone. Transfers are now governed by expression (7′). The transfers generated under this scheme are qualitatively very similar to the baseline transfers: they are largely a scaled-down version of the transfers in the previous subsection. Hence, for the sake of space, we do not show the charts for each individual country, but only report the results in the summary charts and tables.[18] Figure 3B summarizes the information in the individual country figures by showing for each year the dispersion in the cross-country transfers' distribution. As expected, the dispersion is smaller than under the baseline. As before, the coefficient estimates in table 2 reveal countercyclicality of the transfers. Finally, table 3 reports a correlation coefficient between the new transfers and the baseline transfers of 0.93.

5.3 Transfers Based on Tax Revenues

As we argued earlier, a country that is required to pay a transfer because of a positive shock in the main export market(s) has already spent part of the resources generated by the additional activity in the form of wages to the workers and compensation for the capital hired to produce the extra output. Hence, these resources are not readily available to the government. However, the government obtains additional tax revenues because of the taxes paid on the generated additional income. In this subsection, we assume that the

[18]Results for individual countries are available upon request.

Table 3. Correlation between Annual Transfers Generated by Different Schemes

	Baseline	Labor Share	Taxes	Reaggregation	Leaving Out One Country
Baseline	1.00	0.93	1.00	0.93	0.99
Labor Share	0.93	1.00	0.93	0.84	0.92
Taxes	1.00	0.93	1.00	0.93	0.99
Reaggregation	0.93	0.84	0.93	1.00	0.92
Leaving Out One Country	0.99	0.92	0.99	0.92	1.00

Notes: The table reports the correlation coefficients between transfers of each pair of schemes. The numbers are the average of these pairwise correlations, across all 19 countries.

transfers are based on the change in tax revenues, i.e., they are calculated using expression (12). Figure 3C shows the dispersion of the transfers by year. Obviously, the dispersion is smaller than under the baseline. As reported in table 3, the new transfers are almost perfectly correlated with the baseline transfers.[19] This is also borne out by the regressions in table 2, which continue to show a high degree of countercyclicality of the transfers under this alternative scheme.

5.4 Summary

The preceding discussion of the different transfer schemes warrants a number of conclusions. First, in general, transfers are (strongly) countercyclical. Second, cumulative transfers tend to stabilize over time or end at values not too far from zero. Third, the annual transfers are generally of limited size, but reach in some instances quite large values, suggesting that they can exert quite a strong countercyclical force, in particular during highly adverse economic circumstances. That is, they reach relatively large values when they matter most. In absolute magnitude, transfers tend to be larger for

[19]The correlation is not entirely perfect, because the applied common tax rate varies slightly over time.

the smaller economies than for the larger economies. The rather limited *average* size of the transfers should be conducive to the political feasibility of the scheme. Starting on a small scale also seems to have been the strategy of the European Commission when in 2018 it proposed the EISF to be included in the new EU multiannual financial framework 2021–27.

6. Robustness

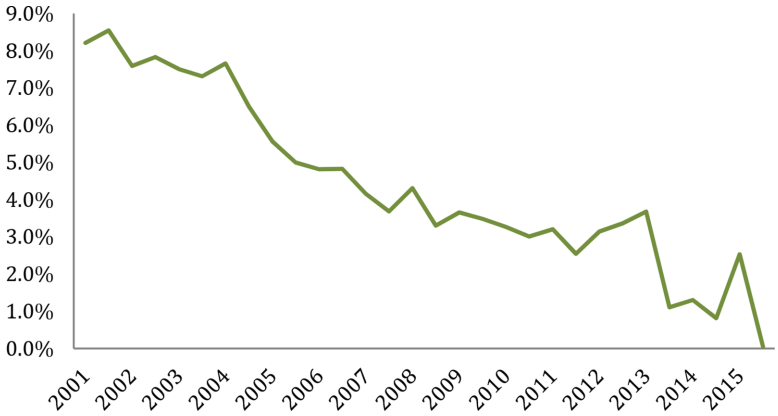
This section explores the robustness of the baseline results to revisions in the underlying data, the country composition of the panel, and a reaggregation of the sectors.

6.1 Data Revisions

Data on exports are subject to revisions over time, as better information becomes available and definitions and computation procedures change. As our transfer scheme would have to make use of real-time data for its implementation, it is important to assess whether it is sufficiently robust to data revisions.

The lagged variables entering equation (7) are likely to be relatively stable, as they have been already subject to one round of revision. Moreover, the shares x_{it}/x_t are generally quite robust to revisions, as both the numerator and the denominator tend to be revised in the same direction and with comparable proportions. Inspection of the data for subsequent vintages shows that large parts of the data revisions are common across all the countries in the sample. This is not surprising, as changes in the common methodology of constructing figures, for example, will apply to all the sample countries. However, in particular the data for x_{jt} may be affected by revisions. Does this significantly affect the level of annual transfers? While real-time data for exports *by sector* are not available in existing data sets, the AMECO database reports real-time values for *total* exports in each country. Figure 7 shows the simple average of revisions for this variable. Revisions are calculated as the difference between the "ex post" values, as published in the winter 2017 edition of the database, and the real-time estimates. Revisions are reported

Figure 7. Average Absolute Value of Revisions (in % of real-time value)



Notes: The figure depicts the average (across countries) percent difference of the total export value-added from the winter 2017 edition of the AMECO database and the real-time estimate of the year indicated on the horizontal axis.

in absolute value as a percentage of the real-time estimate.[20] The figure shows that revisions generally increase with the time passed since the first publication of the figures. They are close to 9 percent at their maximum and around half of this on average over the whole sample period.

We use this information to conduct a counterfactual experiment. In particular, based on the findings about the size of the revisions of total exports, we assume that sectoral exports are affected by randomly drawn annual revisions that are uncorrelated across countries, sectors, and years. The revisions are drawn from a uniform distribution and range between –10 percent and +10 percent of the "true" data (with an average absolute magnitude of 5 percent, therefore broadly comparable with the average revisions reported in

[20]Data for Malta and Cyprus are excluded from the average because the revisions are extremely large. The small size of the two economies justifies this choice of excluding them in order to avoid biases.

figure 7).[21] Concretely, we generate artificial samples in which each actual value x_{ijt} (export by country i, sector j, year t) reported in our ex post data is multiplied by a different random number extracted from a uniform distribution between 0.9 and 1.1 around one. The resulting randomly generated $\hat{x}_{ijt}$ is then used to compute all the variables needed for the transfers in (7).

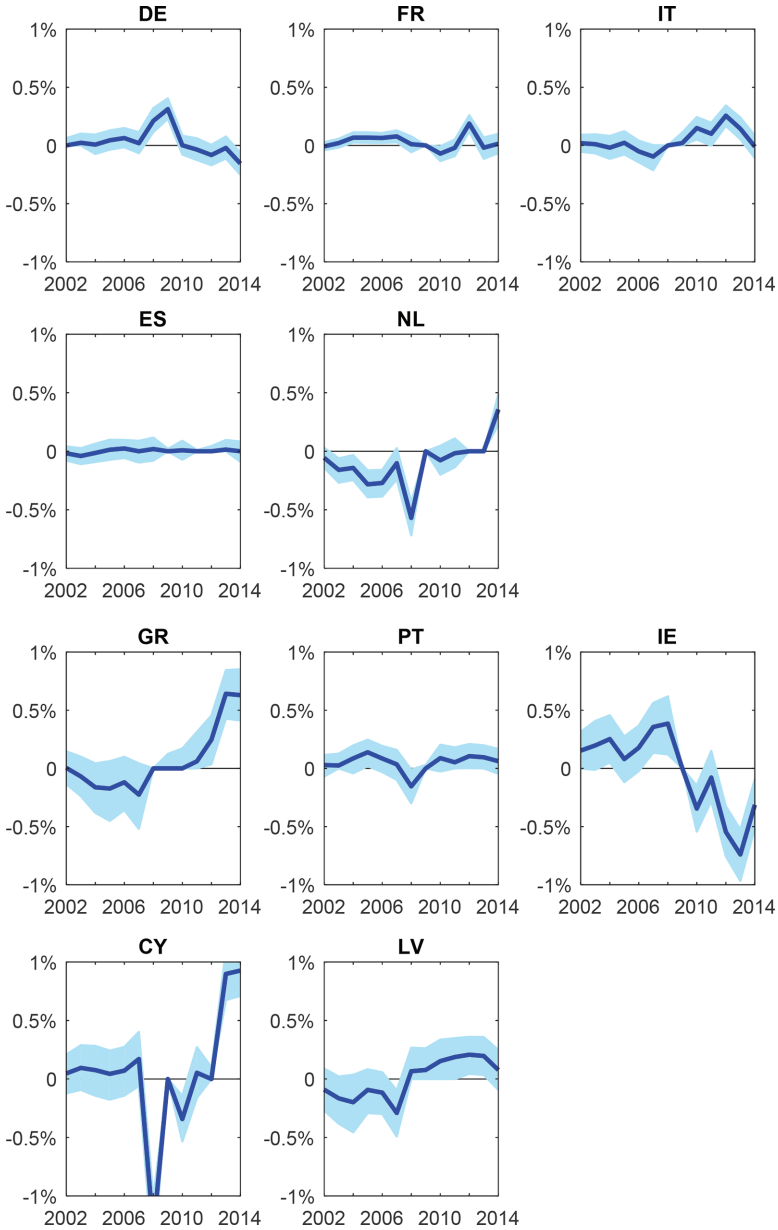
Figure 8 shows the annual transfers implied by our baseline scheme based on the actual data (the dark solid line) together with the transfers based on 1,000 artificial data sets generated randomly as explained above. Shaded areas represent the 90 percent confidence region of the distribution of simulated transfers. It can be seen how, regardless of the artificially constructed revisions, the simulated annual transfers exhibit the same qualitative pattern as that of the "actual" transfers. This is also evident for the cumulated transfers (the figure is omitted for space reasons, but available upon request), suggesting that the scheme maintains the same features and remains countercyclical. Indeed, repeating the previous regressions with the simulated series yields medians of the coefficient estimates that are all negative, thus confirming the countercyclicality of the simulated transfers.

6.2 Leaving Out One Country at a Time

The countries in our transfer scheme vary substantially in size, while they are also quite different in terms of sectoral structure. In this robustness check, we explore whether the baseline transfers are affected by leaving out individual countries. In particular, we calculate the transfers to and from the other countries in the system, while we leave out one country at a time. The remaining 18 countries form a "closed system" with transfers calculated exactly as under the baseline with just one country less. Hence, all the shares are expressed in terms of the total for the euro area minus that country, while the transfers among the remaining countries (almost) add up to zero each year. Since there are 19 countries, we do this 19 times. Deviations from the baseline transfer patterns could be expected if

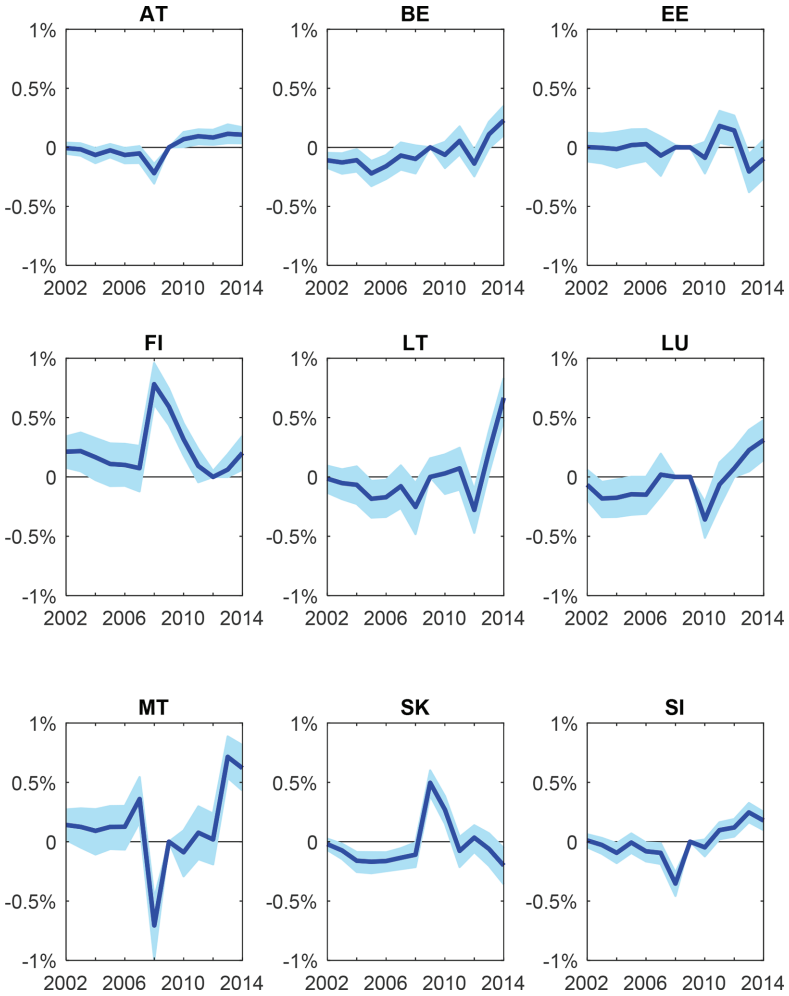
[21] If anything, assuming that all these correlations are zero stacks the odds of this experiment against us, since the noise introduced in the fluctuations in sectoral exports of a country relative to other countries as a result of the revisions is likely larger than in reality.

Figure 8. Baseline Annual Transfers under Actual and Simulated Revisions Data in Percent of the Country's GDP



(*continued*)

Figure 8. (Continued)



Notes: The figure reports the annual transfers calculated for 1,000 simulated series using the baseline scheme in equation (9). Transfers are in percent of GDP. The simulations are based on the assumption that each value of x_{ijt} is subject to a random revision drawn from the uniform density ranging from -10 percent to $+10$ percent around the actual value in the data. Shaded areas represent the 90 percent confidence bands. For country codes, see the notes to table 1.

Table 4. Reaggregation of Original Sectors

Original Aggregation	New Aggregation
Agriculture, Hunting, Forestry, and Fishing	Agriculture, Hunting, Forestry, and Fishing
Mining and Quarrying	Mining and Quarrying
Food Products, Beverages, and Tobacco	Food Products, Beverages, and Tobacco
Textiles, Textile Products, Leather, and Footwear	Textiles, Textile Products, Leather, and Footwear
Wood and Products of Wood and Cork	Wood, Paper, Paper Products, Printing, and Publishing
Pulp, Paper, Paper Products, Printing, and Publishing	
Coke, Refined Petroleum Products, and Nuclear Fuel	Chemicals and Non-metallic Mineral Products
Chemicals and Chemical Products	
Rubber and Plastics Products	
Other Non-metallic Mineral Products	
Basic Metals	Basic Metals and Fabricated Metal Products
Fabricated Metal Products except Machinery and Equipment	
Machinery and Equipment n.e.c.	Machinery and Equipment n.e.c.
Computer, Electronic, and Optical Products	Electrical and Optical Equipment
Electrical Machinery and Apparatus n.e.c.	
Motor Vehicles, Trailers, and Semi-Trailers	Transport Equipment
Other Transport Equipment	
Manufacturing n.e.c.; Recycling	Manufacturing n.e.c.; Recycling
Electricity, Gas, and Water Supply	Electricity, Gas, and Water Supply
Construction	Construction
Wholesale and Retail Trade; Repairs	Wholesale and Retail Trade; Hotels and Restaurants
Hotels and Restaurants	

(*continued*)

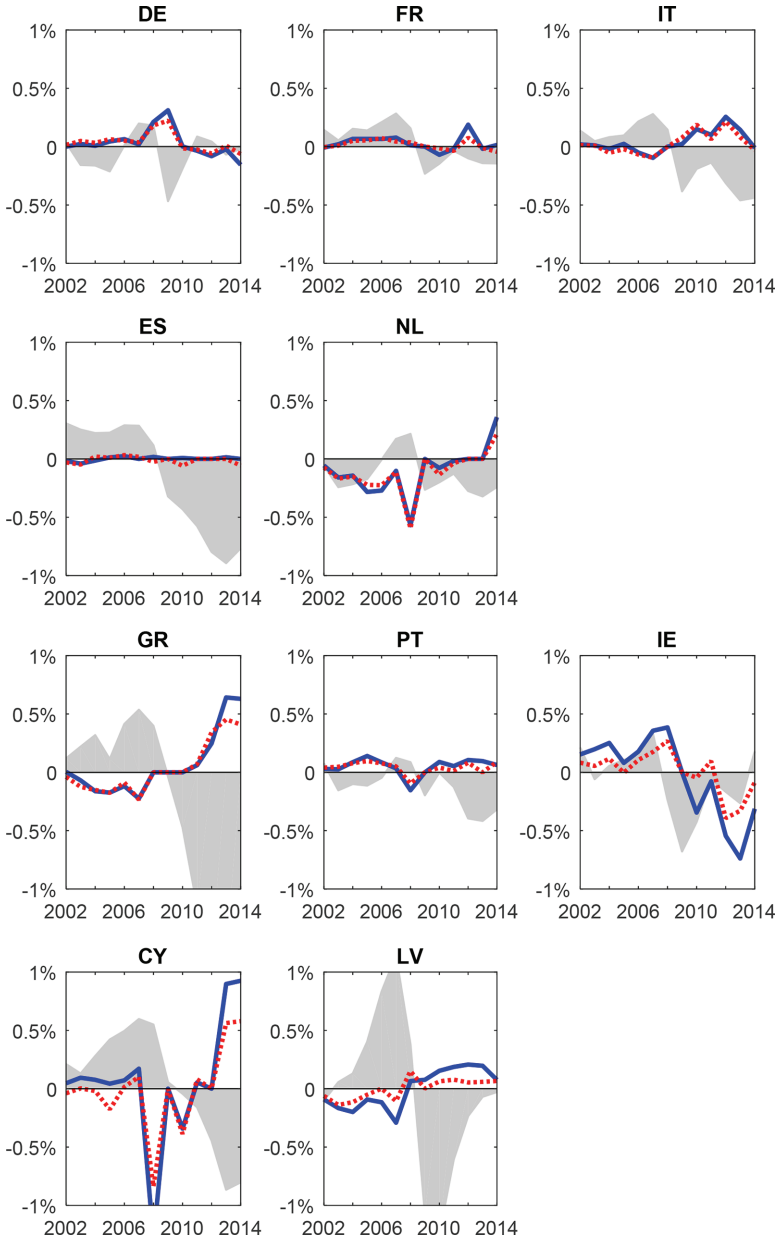
Table 4. (Continued)

Original Aggregation	New Aggregation
Transport and Storage	Transport and Storage, Post and Telecommunication
Post and Telecommunications	
Real Estate Activities	Real Estate, Renting, and Business Activities
Renting of Machinery and Equipment	
Computer and Related Activities	
Research and Development and Other Business Activities	
Public Admin. and Defense; Compulsory Social Security	Community, Social, and Personal Services
Education	
Health and Social Work	
Other Community, Social, and Personal Services	

Notes: The original aggregation is based on the OECD 33 industry list (TiVA 2016); the new aggregation is based on the OECD TiVA 2013 classification. The sector "Finance and Insurance" has been removed from the original data set. The sector is generally tightly regulated by national authorities and often faces specific tax treatment. Moreover, its disproportionate presence in some relatively small countries would result in very large cross-border transfer payments (or receipts) when shocks hit that sector.

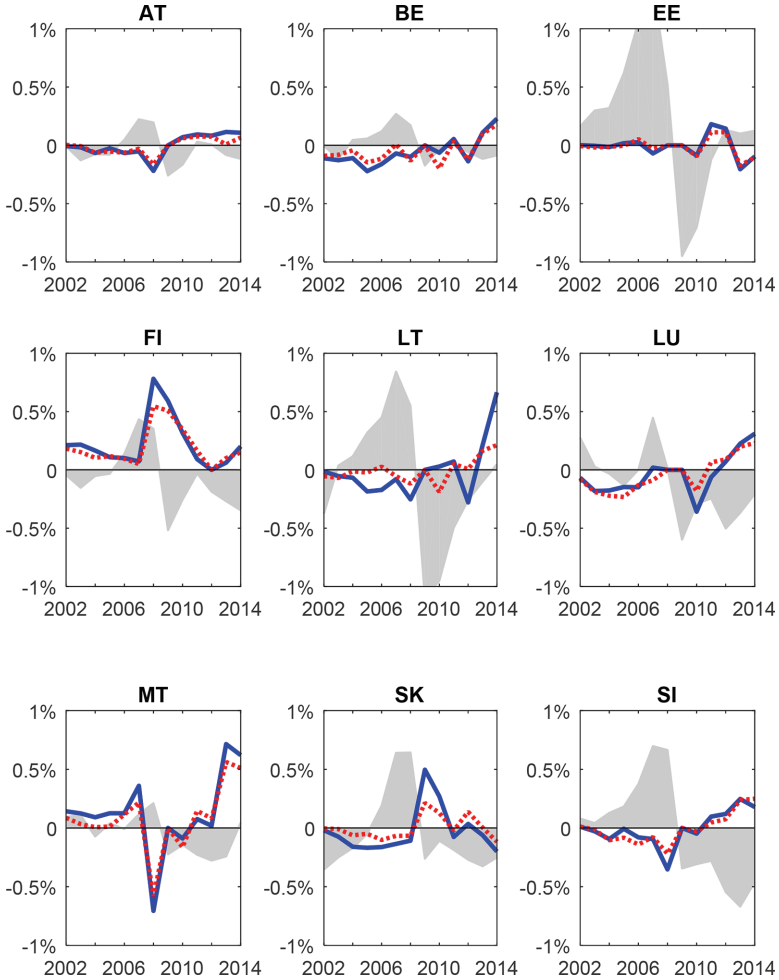
individual countries dominate specific export sectors and those sectors account for a substantial fraction of the overall transfers flowing to or from individual countries. However, for each of the 19 sample countries, the 18 plots of the transfers (each one corresponding to leaving out one of the other countries) coincide to a very substantial extent. To save space, we do not report the figures here. However, they are available upon request. The robustness of the transfers for leaving out individual countries is also clear from table 3. The average correlation with the baseline transfers over all (year, country) combinations and averaged over all 19 cases of dropping one country at a time is 0.99.

Figure 9. Annual and Cumulated Transfers under Baseline Scheme for Reaggregated Sectors in Percent of the Country's GDP



(*continued*)

Figure 9. (Continued)



Notes: The figure shows the annual transfers for each country, generated by the scheme where we include 17 reaggregated sectors, as in table 4 (dotted line), together with the baseline transfers as of figure 2 (solid line). Transfers are in percent of a country's GDP in that year. The gray shaded areas are output gaps published by the OECD (2017a). For all countries, we report data in the scale +1 to −1 percent of GDP, for consistency. In the case of the Netherlands, the cumulated transfers are at around 1 percent of GDP in 2014. For Finland, they are about 2.5 percent of GDP in 2014. For country codes, see the notes to table 1.

6.3 Sectoral Reaggregation

In this subsection, we investigate the robustness of our findings to reaggregating the exports sectors. In particular, we impose a higher level of aggregation by merging related sectors into a new set of sectors and recalculating transfers analogously to how we calculate them under the baseline. Table 4 lists the aggregation of the original 32 sectors into the new, smaller set of 17 sectors. Figure 9 depicts the transfers under the new sectoral aggregation. They remain very similar to the baseline transfers: the correlation of the cross-border transfers generated by this scheme with the baseline transfers is 0.93 (see table 3). If anything, the variability of transfers within each country (see, e.g., Ireland and Cyprus) and the cross-country dispersion decreases somewhat. This is the consequence of the fact that we now have fewer sectors, therefore fewer shocks which are also more smoothed due to an averaging effect. Finally, the regressions reported in table 2 confirm that the newly computed transfers remain strongly countercyclical.

7. Concluding Remarks and Discussion

Asymmetries in shocks and transmission mechanisms are major obstacles to the proper functioning of a monetary union. The current range of possibilities to deal with such shocks in the EMU is rather limited. Cross-border labor mobility is low, although it may increase in the future as European economic integration proceeds and national institutions become more alike. Risk sharing at the private level through capital markets is rather limited too, although again one might expect this channel to become more important as impediments to the cross-border trade of assets are reduced and the capital market union draws to a completion. Finally, the use of fiscal policy is restricted because of the rules imposed through the Stability and Growth Pact. The latter calls for a government budget that is close to balance or in surplus in the medium run, to enable automatic stabilizers to do their work. However, reaching a situation in which all the EMU participants have eliminated their structural deficits will be difficult.

Because the cross-border sharing of asymmetric shocks will remain limited for the foreseeable future, we analyze the adoption of

a cross-border transfer scheme. Obviously, a major source of (political) resistance to such a scheme is the potential for moral hazard. However, we propose a scheme that goes a substantial way toward avoiding moral hazard by conditioning transfers on (exogenous) world market developments for the relevant sectors in the euro area. Our scheme has other advantages as well: transfers are imposed to (almost) add up to zero on an annual basis and they are based on deviations of exports from sectoral trends, implying that they can only go into the same direction for a limited amount of time. In particular, a permanent reduction in a sector's exports cannot lead to permanent transfers. Our baseline scheme aimed at equalizing income shifts as a fraction of exports yields highly countercyclical transfers. Moreover, the cumulative transfers return toward zero over time or they end the sample period at a low level. These findings are robust for different variants of our transfer scheme and in particular also for the case in which we allow for revisions in the real-time figures of the sectoral export value-added.

Of course, before our scheme can be made fully operational, practical obstacles would need to be overcome. Although we have demonstrated the robustness of our scheme to data revisions, we still view the timely availability of the data that serve as input for the calculation of the transfers as the main practical obstacle. This is in particular the case for data on sectoral activity. However, when sufficient practical need is perceived for the timely availability of such data, governments and statistical agencies may invest more resources in achieving this objective.

Another issue concerns the question of how transfers received by governments should be put to best use. Because a transfer receipt comes on top of regular resource flows, it could be politically easier to earmark it for ameliorating the consequences of structural reforms or help in transforming the economy toward activities with a more prosperous future. In general, however, the concern that our scheme may delay the transition to more productive sectors is mitigated by the fact that transfers are *on average* relatively small (apart from when they are most needed, i.e., in recessions). Therefore, countries would continue to be confronted with the cost (in terms of higher unemployment, less tax receipts, etc.) of delaying the restructuring of declining sectors.

A final issue concerns the possibility that some countries may benefit more from the stabilizing effects of the transfer scheme than other countries. Our baseline scheme limits the differences in the average magnitudes of the transfers across the countries. Still, to enhance the political acceptability of the scheme further, one could, for example, envisage that countries that benefit more from the sharing of asymmetric shocks pay an "insurance premium" that goes into a collective fund that can compensate countries that benefit less or that can absorb small temporary aggregate imbalances in the scheme. As an alternative, the transfer scheme could start with a subset of countries that are expected to experience roughly equal variance in their transfers. The fact that transfers add up to (almost) zero and that they are robust against dropping countries would facilitate this option. However, further investigation of these options is left for future research.

To investigate further whether our proposed scheme does not distort incentives, one could explore whether countries with more rigid labor and product markets would on average receive more transfers. Thorough investigation of this issue would require comparable panel data on market rigidities. It would also require a sufficiently long sample period. Such an analysis is beyond the scope of the present paper but would be an interesting avenue for further research.

Appendix A. Derivation of (6)

We can rewrite (2) as

$$w_{kj,t-1}\left(x_{jt}-x_{jt}^{*}\right)+T_{kjt}=\frac{X_{k,t-1}}{X_{i,t-1}}\left[w_{ij,t-1}\left(x_{jt}-x_{jt}^{*}\right)+T_{ijt}\right]\Leftrightarrow$$

$$T_{kjt}=\frac{X_{k,t-1}}{X_{i,t-1}}\left[w_{ij,t-1}\left(x_{jt}-x_{jt}^{*}\right)+T_{ijt}\right]-w_{kj,t-1}\left(x_{jt}-x_{jt}^{*}\right)\Leftrightarrow$$

$$T_{kjt}=\left[\frac{X_{k,t-1}}{X_{i,t-1}}w_{ij,t-1}-w_{kj,t-1}\right]\left(x_{jt}-x_{jt}^{*}\right)+\frac{X_{k,t-1}}{X_{i,t-1}}T_{ijt}.$$

Hence,

$$\sum_{k\neq i}T_{kjt}=\sum_{k\neq i}\left[\frac{X_{k,t-1}}{X_{i,t-1}}w_{ij,t-1}-w_{kj,t-1}\right]\left(x_{jt}-x_{jt}^{*}\right)+\sum_{k\neq i}\frac{X_{k,t-1}}{X_{i,t-1}}T_{ijt}.$$

Using that transfers add up to zero:

$$-T_{ijt} = \sum_{k\neq i}\left[\frac{X_{k,t-1}}{X_{i,t-1}}w_{ij,t-1} - w_{kj,t-1}\right]\left(x_{jt} - x^*_{jt}\right) + \sum_{k\neq i}\frac{X_{k,t-1}}{X_{i,t-1}}T_{ijt} \Leftrightarrow$$

$$\left[1 + \sum_{k\neq i}\frac{X_{k,t-1}}{X_{i,t-1}}\right]T_{ijt} = \sum_{k\neq i}\left[w_{kj,t-1} - \frac{X_{k,t-1}}{X_{i,t-1}}w_{ij,t-1}\right]\left(x_{jt} - x^*_{jt}\right) \Leftrightarrow$$

$$\frac{X_{t-1}}{X_{i,t-1}}T_{ijt} = \left[1 - w_{ij,t-1} - \frac{X_{t-1} - X_{i,t-1}}{X_{i,t-1}}w_{ij,t-1}\right]\left(x_{jt} - x^*_{jt}\right) \Leftrightarrow$$

$$T_{ijt} = \left[\frac{X_{i,t-1}}{X_{t-1}} - w_{ij,t-1}\right]\left(x_{jt} - x^*_{jt}\right).$$

Appendix B. Derivation of (11)

Start from (10) and rewrite:

$$\begin{aligned} T_{kjt} &= \frac{X_{k,t-1}}{X_{i,t-1}}\left\{\left[w_{ij,t-1}lsh_{ijt} - \frac{X_{i,t-1}}{X_{k,t-1}}w_{kj,t-1}lsh_{kjt}\right]\right. \\ &\quad \left.\times\left(x_{jt} - x^*_{jt}\right) + T_{ijt}\right\} \\ &= \left[\frac{X_{k,t-1}}{X_{i,t-1}}w_{ij,t-1}lsh_{ijt} - w_{kj,t-1}lsh_{kjt}\right]\left(x_{jt} - x^*_{jt}\right) \\ &\quad + \frac{X_{k,t-1}}{X_{i,t-1}}T_{ijt}, \forall k \neq i. \end{aligned}$$

Hence,

$$\sum_{k\neq i}T_{kjt} = \sum_{k\neq i}\left[\frac{X_{k,t-1}}{X_{i,t-1}}w_{ij,t-1}lsh_{ijt} - w_{kj,t-1}lsh_{kjt}\right]\left(x_{jt} - x^*_{jt}\right) + \sum_{k\neq i}\frac{X_{k,t-1}}{X_{i,t-1}}T_{ijt}.$$

Using that transfers add up to zero:

$$-T_{ijt} = \sum_{k \neq i} \left[\frac{X_{k,t-1}}{X_{i,t-1}} w_{ij,t-1} lsh_{ijt} - w_{kj,t-1} lsh_{kjt} \right] \left(x_{jt} - x^*_{jt} \right)$$

$$+ \sum_{k \neq i} \frac{X_{k,t-1}}{X_{i,t-1}} T_{ijt} \Leftrightarrow$$

$$\left[1 + \sum_{k \neq i} \frac{X_{k,t-1}}{X_{i,t-1}} \right] T_{ijt} = \sum_{k \neq i} \left[w_{kj,t-1} lsh_{kjt} - \frac{X_{k,t-1}}{X_{i,t-1}} w_{ij,t-1} lsh_{ijt} \right]$$

$$\times \left(x_{jt} - x^*_{jt} \right) \Leftrightarrow$$

$$\frac{X_{t-1}}{X_{i,t-1}} T_{ijt} = \sum_{k \neq i} \left[w_{kj,t-1} lsh_{kjt} - \frac{X_{k,t-1}}{X_{i,t-1}} w_{ij,t-1} lsh_{ijt} \right] \left(x_{jt} - x^*_{jt} \right) \Leftrightarrow$$

$$T_{ijt} = \sum_{k \neq i} \left[\frac{X_{i,t-1}}{X_{t-1}} w_{kj,t-1} lsh_{kjt} - \frac{X_{k,t-1}}{X_{t-1}} w_{ij,t-1} lsh_{ijt} \right] \left(x_{jt} - x^*_{jt} \right).$$

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