Projektbericht

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Medium-run impacts of cross-country transfers through a European Union central budget: a general equilibrium evaluation*

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Abstract

The European Union budget mostly redistributes resources across its member countries. Using a multi-country overlapping-generations model covering 14 European countries, I investigate the macroeconomic and labor market impacts of central budget options, each leading to different transfers between governments. Simulations show that one can shift prosperity from country to country, measured as gross domestic product variations, at no efficiency cost nor efficiency gains, as long as the central budget can be operated for free and net recipient countries use the transfers to stimulate economic activity rather than support household income. Failing these conditions, the net deadweight loss caused by the distortionary nature of taxation can reach 5% to 8% of the size of the central budget. Simulations also show that the economic burden of large, one-time asymmetric shocks can be shared by all members of the union with a limited public finance cost. Chief among policy implications is a recommendation for earmarking cross-country transfers.

Keywords: cross-country transfers, EU Structural Funds, EU Cohesion Fund, deadweight loss, computable general equilibrium
JEL-Classification: C68, F35, F42, H21

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1 Introduction

As public good provision mostly remains at the national level, the European Union (EU) budget is essentially a cross-country redistribution mechanism. Existing quantitative economic studies restrict their attention to net recipients, both at the empirical and theoretical level. I use a multi-country computable general equilibrium model to investigate the impact of different cross-country transfer options not only on net recipient countries, but also on net contributors. Among other results, I quantify the maximal net deadweight loss from cross-country transfers emanating from the financing of the redistribution programme.

The EU budget amounts to 1% of GDP, a much lower figure than national budgets due to the fact that public good provision remains at the national level. In spite of this low amount, the debates on the composition of the EU budget are intense, at both the policy and scientific levels. Both the Common Agricultural Policy (CAP) and the Cohesion Funds (technically the combination of the so-called Structural Funds and the Cohesion Fund), the two largest components of the budget, are part of the debate.

The main goal of the Cohesion Funds is to reduce per capita income differences across countries. Early empirical analyses find no impact of Cohesion Funds on the growth rate of recipient countries, questioning the use of such funds (Boldrin and Canova, 2001). Using more robust econometric approaches, more recent studies find a positive impact on growth rates (Becker et al., 2010), up to a certain point (Becker et al., 2012). Theoretical studies using simulations also find a positive impact on the growth rate (Allard et al., 2008; Varga and in't Veld, 2011).

These and other existing economic studies which quantify the impact of cross-country transfers however restrict their attention to net recipient countries. One contribution of this paper is to consider both net contributors and net recipients when transfers are neutral with respect to convergence[1]. As expected, my simulations show that the gross domestic product increases in net recipient countries and decreases in net contributor countries. Beyond that, the simulations also show that the net impact at the union level is zero when the cross-country transfers are operated at no administrative costs and recipient countries use the net transfers for economic stimulation, such as reductions of the tax burden. In this case, cross-country transfers lead to neither efficiency gains nor efficiency losses at the EU level. However, there are efficiency losses when recipient countries use the net transfer for unconditional support to household incomes. In this case, the deadweight loss due to the distortive nature of labor income taxes reaches 5% to 8% of the overall gross contributions. The finding is consistent with the analysis of Allard et al. (2008), who show that Cohesion Funds would stimulate economic growth to a higher degree if they are used for investment than if they are used for income support.

The finding is also consistent with the arguments from Boldrin and Canova (2003), who write: "*as net transfers add up roughly to zero for most countries, all one is left with is the deadweight loss of taxation, and the cost of maintaining an expensive and unproductive bureaucracy*" (p.36). When the operating costs are neglected and labor in-

[1] In other words, transfers can have a level effect on output but not a growth effect.

come taxes are used as financing instrument, I show that the deadweight loss of taxation amounts to 5% to 8%.

As policy implication, cross-country transfers should be earmarked to measures which stimulate economic activity. This implication is consistent with some analyses from the foreign aid literature, but not all, a contribution to the open debate on aid and conditionality (Temple, 2010).

The paper also investigates the redistribution properties of cross-country transfers in case of large, one-time asymmetric shocks. Co-financing the costs of a domestic relief programme helps countries hit by a shock to recover faster, coming at an economic cost for shock-free countries. I find that the public finance costs of such a solidarity programme may be lower than expected. In the cases I consider, a co-financing share as low as 30% can be sufficient for sharing the burden across all countries.

Further properties of cross-country transfers inside an union such as the European Union are investigated. I consider in particular the potential of transfers to reduce differences in unemployment rates across countries. I find impacts in this case to be ambiguous.

The paper continues as follows. A brief overview of the relevant literature is provided in the next section, as well as details on the difference between this study and existing studies. Section 3 describes the model. Section 4 provides the simulation results and section 5 their policy implications. Section 6 concludes.

2 Literature overview

There is a large academic literature on cross-country transfers, in particular on foreign aid, which focuses on transfers from high- to low-income countries. Cross-country transfers between countries with comparable development, such as members of the European Union, have also attracted attention, mostly in the policy literature.

This section provides a brief overview of the large literature on cross-country transfers, focusing on academic contributions related to the research presented in this paper. Key differences between the paper and the existing literature are identified, other details being provided when relevant in the rest of the paper. I start with the foreign aid literature, continue with EU transfers, move to transfer efficiency and finish with differences between this paper and the literature.

2.1 Foreign aid

The foreign aid literature, which considers transfers from high-income to low-income countries, is large, both empirically and theoretically.

Clemens et al. (2012) provide an overview of the empirical literature and their own empirical analysis of the impact of foreign aid on economic growth of recipient countries. They note that empirical studies have found conflicting outcomes. Thanks to their approach with details on timing, they show that the divergence between three influential studies shrinks and find that foreign aid increases investment and growth, on average.

A recurrent question related to the efficiency of foreign aid is its form. Aid can be provided under conditions or without conditions: it can be provided as a grant, which does not have to be repaid, or as a loan. In its review of the literature, Temple (2010) notes that the debate on foreign aid conditionality is still on-going. Based on their experience for instance, policy analysts at the World Bank in the early 1990's were skeptical of the benefits of earmarking (McCleary, 1991). Gupta et al. (2003) empirically find that loans are associated with higher tax revenue effort while grants are associated with declining tax revenue, which they present as a "*drawback*" (p.18).

Another recurrent question related to the efficiency of foreign aid is the decision mechanism behind aid spending. Rodríguez-Pose and Ezcurra (2011) empirically find that fiscal decentralization has a negative impact on economic growth. More specifically, Gemmell et al. (2013) find that spending decentralization is associated with lower economic growth but revenue decentralization is associated with higher economic growth.

From a theoretical point of view, impacts of foreign aid on growth can also differ. In a standard neoclassical two-country setting where cross-country transfers take place between households, Galor and Polemarchakis (1987) identify a transfer paradox: the donor country benefits from the transfer and the recipient country suffers from it, because the equilibrium interest rate after the transfer is closer to the optimal interest rate of the donor country under autarky. In a more complete setting where transfers take place between governments and public investment is a production factor, Chatterjee et al. (2003) find that cross-country transfers earmarked for public investment enhance growth and welfare in the recipient country, while non-earmarked transfers are welfare enhancing only. Building on this analysis, Chatterjee and Turnovsky (2007) show that the endogeneity of labor supply decisions is critical in analyzing whether conditional or unconditional cross-country transfers are preferable.

2.2 European Union transfers

Since the provision of public goods is decentralized at the country level, most of the European Union budget consists of transfers between its member countries. The two largest components are the Common Agricultural Policy (CAP) and Cohesion Funds (technically the combination of the so-called Structural Funds and the Cohesion Fund), the latter being used to support income convergence across countries. Fueled by the absence of an executive authority at the EU level and by the cross-country redistribution impact of the EU budget, the debate on the EU budget is intense (for an overview of the debate: on the CAP, see Burrell, 2009; on the Cohesion Funds, see Begg, 2010).

There exist stylized theoretical analyses which provide a rationale for all or part of Cohesion Funds. Casella (2005) shows for instance that international transfers similar to Cohesion Funds deliver an efficiency improvement when differences in productivity levels are large and labor is not perfectly mobile. Taking tax competition and mobile firms into account, Becker and Fuest (2010) show that cross-country transfers for public infrastructure projects, typically financed by Cohesion Funds, deliver welfare improvements. Whether these theoretical predictions are confirmed in reality or not is an empirical matter.

Early empirical studies on Cohesion Funds obtained conflicting results: some found that the Cohesion Funds do not help to close the income gap between countries, calling the existence of the policy into question (Boldrin and Canova, 2001); others found the opposite result (Cappelen et al., 2003). Ederveen et al. (2006) find that Cohesion Funds help close the income gap but only in countries with high institutional quality, an outcome disputed by Beugelsdijk and Eijffinger (2005), who find a positive effect of Cohesion Funds on growth, whether the country has a high corruption index or not.

As noted by Pellegrini et al. (2013), the methodologies used by early empirical studies suffer from limitations, making causality interpretations difficult. Using more robust econometric approaches, recent empirical studies find that Cohesion Funds have a positive impact on growth in receiving countries (Becker et al., 2010).

Mourmouras and Rangazas (2007) note the same causality challenge in empirical studies of foreign aid and suggest the use of simulations with computable general equilibrium (CGE) models instead. Following this approach, Allard et al. (2008) estimate the impact of Cohesion Funds with a microfounded CGE model. Consistent with recent econometric analyses, they find that Cohesion Funds would lead to higher growth in New Member States, all would-be recipients. More recent analyses confirm this finding (e.g. Varga and in't Veld, 2011).

On top of causality, another benefit of CGE models are counterfactual analyses. A number of studies quantify the net impact of the CAP, a complex set of agricultural policies generating transfers across countries which involves price controls, quantity controls and subsidies. Early studies with simple models find a negative impact of the CAP, leading to a net domestic loss of up to 1% of GDP (see the survey by Winters, 1987). More recent studies with richer models also find a negative but smaller impact. Philippidis and Hubbard (2001), for instance, find an average net domestic loss of 0.2% of GDP.

Although not part of the current EU budget, additional functions for the EU budget have been suggested in the literature which would generate cross-country transfers, temporarily or permanently. One of the main suggestions is a stabilization function in case of asymmetric shocks for Eurozone countries, a form of insurance transferring resources from countries in a good state to countries in a bad state. The rationale for such a stabilization function is based on the optimal currency area literature (Mundell, 1961). This literature identifies three prerequisites for currency unions: large trade between members, similar exposure to exogenous shocks, and appropriate cross-member adjustment mechanisms to offset asymmetric shocks. While the first two prerequisites were considered to hold at the start of the Euro, the third one was not. A number of policy commentators attribute part of the difficulties of the Eurozone after the 2007 subprime crisis to the lack of adjustment mechanisms for asymmetric shocks. A stabilization function could play such a role.

One stabilization option is fiscal transfers. A few theoretical studies provide analytical results on properties of fiscal transfers. Sanguinetti and Tommasi (2004) show for instance that a full insurance regime may be preferable to rule-based fiscal coordination providing partial insurance, when idiosyncratic shocks are large enough. Evers (2006)

shows that a combination of cross-country transfers to households and government can provide perfect insurance against asymmetric shocks. Smart (1998) however shows that local strategic behavior may increase the overall deadweight loss of taxation under some federal equalization schemes.

Another stabilization option, recently suggested, would be a EU-level unemployment insurance. Systematic theoretical and empirical analysis is only starting. Depending on the exact setting and simulation scenario, such as scheme may lead to large permanent transfers between countries, generating moral hazard issues (transfers: Dolls et al., 2017; no transfers: Dullien, 2013). To reduce exposure to moral hazard issues, some suggest the use of a deductible (Gros, 2014).

2.3 Cross-country transfers efficiency costs

Cross-country transfers generate obvious benefits for recipients but may also come with efficiency costs. For instance, the foreign aid literature has been concerned with the possibility that aid increases corruption. Still on the receiving side, cross-country transfers may lead to other forms of misallocation of resources, including rent-seeking, lobbying or investment distortions (Gylfason, 1995). On the contributing side, cross-country transfers need to be financed by some form of taxation, thus generating distortion. If transfers are financed by labor taxes for instance, the disincentive effects of labor supply may be such that the total cost of the transfer for the donor countries is larger than the total gain of the transfer for the recipient countries, a remark made by Boldrin and Canova (2003).

The literature identifies a number of possible efficiency losses but provides only few quantitative estimates. Del Rosal (2011) mentions the difficulty of estimating efficiency costs in its survey of rent-seeking with any form of government transfers.

In a domestic transfer context, Busso et al. (2013) estimate a deadweight loss of 13% for a local economic stimulation programme in the US, not taking distortions on the financing side into account.

On the financing side, Feldstein (1999) notes that the elasticity of labor supply with respect to labor taxes underestimates the excess burden of taxation, as households can avoid labor taxes by shifting income to other tax bases, for instance. He recommends exploiting the elasticity of taxable income with respect to income tax rates, and finds a deadweight loss of 30%. Reviewing the subsequent literature, Saez et al. (2012) end up with a midpoint estimate of the deadweight loss of 20% for proportional tax increases. These estimates, however, disregard the use of tax revenue, which may or may not generate efficiency and welfare gains.

In an international context, Parry (2003) estimates welfare costs of capital income tax competition comprised between 5% and 10% of capital income tax revenue, the mobility of capital and competition pushing governments towards low tax rates.

There are no estimates of the net deadweight loss of cross-country transfers. Concerns that foreign aid might support corruption practices are frequently voiced. Because of the illicit nature of corruption, data is scarce and the associated deadweight loss estimation difficult. Kopczuk et al. (2005) do not quantify waste but the perception of waste by

agents: they find that the aid behavior of agents is consistent with international aid data only if agents in rich countries perceive that waste is very large or if these agents put the welfare of foreigners at a much lower value than the welfare of domestic citizens.

The same concerns regarding corruption apply to cross-country transfers within the European Union. These concerns are dismissed by some empirical studies (Beugelsdijk and Eijffinger, 2005), but not all. For instance, there is some evidence that the allocation of Cohesion Funds by recipient countries is based on non-economic political criteria (Bouvet and Dall'Erba, 2010).

The literature investigating the CAP focuses on economic distortions. As noted above, Philippidis and Hubbard (2001) estimate the domestic efficiency costs to average 0.2% of GDP. Estimates however do not take the distortion costs arising from the financing side into account.

2.4 Differences with the existing literature

I finish this section with key differences between this paper and the existing literature.

The focus of the paper are cross-country transfers within the European Union. It thus ignores typical differences between countries usually considered in the foreign aid literature, such as productivity gaps and growth catch-up phenomena. Findings of the paper, however, also apply to international transfers outside the EU, in particular with regard to efficiency and earmarking. I follow however critical insights of the theoretical literature on foreign aid, using endogenous labor supply decisions, as recommended by Chatterjee and Turnovsky (2007).

The paper uses a CGE model for macroeconomic analyses of the impact of cross-country transfers. It is thus not directly related to theoretical analysis yielding analytical results nor empirical studies. Policy implications can however be compared, as will be done in section 5. Compared to existing CGE analysis of EU transfers, there are a few differences.

As far as I am aware and whether the focus is the CAP (for instance, Philippidis and Hubbard, 2001) or Cohesion Funds (for instance, Allard et al., 2008), none of the existing CGE studies consider the financing cost of the transfers, as they restrict their attention to net recipient countries. By contrast, I consider the impact on both net contributors and net recipient countries. This scope allows for the provision of estimates of the net deadweight loss of cross-country transfers, taking the benefits for net recipients as well as the drawbacks for net contributors into account.

A further difference between this and other parts of the literature is the source of the deadweight loss I quantify. In my study, I only consider the loss due to the distortionary nature of taxation, as Feldstein (1999) and Saez et al. (2012). Philippidis and Hubbard (2001) on the other hand abstract from the distortionary impact of taxation, but quantify the loss due to the distortionary impact of the CAP policies on the agricultural market, including price distortions.

For the sake of generality and clarity in results and their mechanisms, I also abstract from some key features used in typical CGE studies of the CAP and Cohesion Funds. Unlike Philippidis and Hubbard (2001), I do not model the details of the CAP policy

nor of the agricultural market and use a single composite good. My findings will thus only apply to a portion of the CAP policies. Different from both Allard et al. (2008) and Varga and in't Veld (2011), I do not consider growth catch-up processes and thus avoid the debate on the proper calibration of production functions with endogenous growth features. I also abstract from price rigidities, focusing on medium-run impacts. The last key difference is my attention to the use of capital in production, given the driving role in economic integration played by capital markets (Lane, 2006). Consistent with empirical evidence, I use a production function with capital-skill complementarity (Duffy et al., 2004). As shown by Davoine and Molnar (2017), this feature influences the size of cross-country spillovers, which can play a role in the overall impact of cross-country transfers.

3 Model

To investigate the macroeconomic impact of central fund options in the European Union context, I use a computable general equilibrium model. One of the research question being the total deadweight loss of cross-country transfers, if any, a multi-country model is used to capture costs in net contributor countries and benefits in net recipient countries, as well as cross-country spillovers which might be generated by the transfers and can influence the total deadweight loss.

Specifically, I use the same model as in Davoine and Molnar (2017), which investigates the cross-country spillovers from fiscal policy reforms and asymmetric shocks. The model basis is a single-country version used on a regular basis for policy evaluation which is extended to a multi-country model, assuming perfectly integrated capital markets. Below I provide an overview of the model and its calibration, referring to Davoine and Molnar (2017) for details.

3.1 Model overview[2]

The single-country model is an overlapping-generations model in the Auerbach and Kotlikoff (1987) tradition. As unemployment varies across countries, the single-country model starts from Jaag et al. (2010), an overlapping-generations model with imperfect labor markets. Because the skill distribution also differs across countries, this basis is extended to include three skill classes with exogenous education decisions[3].

Concretely, households in the model take consumption and labor supply decisions to maximize lifetime utility. Once their education is completed, households decide to participate in the labor market or not; if they participate, they choose search effort to find a job; if they have a job, they decide how many hours to work. Retirement is exogenously defined. Representative firms maximize discounted future profits through investment and hiring decisions. In a static search-and-matching framework, workers and firms bargain over the wage. Governments collect social security contributions as

[2]The model overview is taken from Davoine (2017).

[3]There is also a version of the model with endogenous education decisions, which follows Heckman et al. (1998).

well as labor income taxes, capital income taxes, firm income taxes and consumption taxes. Government revenue is used to finance its own expenditures, welfare benefits, unemployment insurance, age-dependent health- and long-term care, as well as public pay-as-you-go pensions with a flat part and an earnings-related part. All policy parameters are exogenously defined, with one exception: one parameter is chosen and varies endogenously to meet a public debt target. Consistent with empirical evidence, production exhibits capital-skill complementarity. Production output is a single composite good.

For the multi-country extension of the model, the main assumption is that labor is immobile but capital is perfectly mobile. This assumption can be relaxed by allowing mobility of labor with exogenously defined international flows. One also assumes that all countries produce the same composite good and that they either belong to the same currency union, or that exchange rates are constant.

Our implementation covers 14 countries from the European Union[4]. Although this subset defines a large economic compound, it is still insufficient to be isolated from the world capital markets. A pair of stylized Rest-of-the-world countries (or regions) is included in the model to capture the influence from the world capital market. One such region represents developed countries (the North Rest-of-the-world) and the other developing countries (the South Rest-of-the-world), which differ in economics and policy terms[5].

Under these assumptions, there is a unique world interest rate in equilibrium: investors ship investments abroad if the home interest rate is initially too low, which depresses the capital-labor ratio at home and increases it abroad and gradually closes any interest rate differential. Note that in models with a single composite good, trade flows and investment flows are identical.

3.2 Calibration overview

The calibration is identical to Davoine and Molnar (2017).

Where available, we take consensual empirical estimates from the literature. Labor supply elasticities are derived from Immervoll et al. (2007), which we assume are identical in all countries, an assumption which is supported by empirical evidence (Bargain et al., 2014). I abstract from growth catch-up phenomena so that the analysis remains valid whichever country is the net beneficiary of cross-country transfers. While initial productivity differs, I thus assume an identical exogenous trend for productivity growth across countries[6].

[4]Austria, Belgium, Czech Republic*, Denmark, Finland, France, Germany, Italy, The Netherlands, Poland*, Slovakia, Spain, Sweden* and the UK*. In this list, stars identify the four countries whose currency is neither the Euro nor pegged to the Euro, and thus do not meet our assumption of fixed exchange rates. We keep these countries in the list to have broader diversity and because exchange rate variations vanish over the medium run. In reality, exchange rate variations absorb some of the country-specific shocks over the short run, reducing the size of cross-country spillovers for these four countries, ceteris paribus.

[5]Concretely, we calibrate the North Rest-of-the-world country by averaging values for Canada, Japan and the US, while the South Rest-of-the-world country is calibrated with average values for Brazil, China and India. With these choices the model overall captures close to 60% of the actual real world GDP and 40% of the total trade of the EU.

[6]See Allard et al. (2008) or Varga and in't Veld (2011) for general equilibrium analysis of cross-country

Average participation rates, unemployment rates and working hours per age and skill classes are computed from LFS and EU-SILC datasets. Parameters for institutions are derived using the European Commission MISSOC database and OECD's Tax-Benefit model. Intervivo transfer parameters are calculated to generate life-cycle consumption profiles in line with empirical evidence.

To avoid undue influence of the uncharacteristic economic developments which have followed the 2010 European sovereign debt crisis and which are still visible in some countries, the model is calibrated to pre-crisis values.

4 Quantitative results

In this section, I investigate the economic impacts of different options which define a central budget at the EU level. Given the large number of options available, the analysis does not aim for comprehensiveness.

In all cases, I assume that public goods are provided at the country level. The central budget is balanced, collecting contributions from European countries and allocating transfers to some or all European countries, depending on circumstances and objectives. For simplification I assume that administration of the central budget comes at no cost. The central budget has thus mainly redistributive purposes, consistent with most of the current European Union budget. I consider four cross-country redistribution schemes stemming from differences in public finances, output, unemployment or asymmetric shocks. The focus will be on macroeconomic and labor market impacts. Given this focus, I assume that public debt in each country is kept constant through variations of tax rates.

Results for each of the four types of redistribution schemes are presented in the continuation. Policy implications are derived in section 5. In the presentation, I formally characterize as *findings* those outcomes of the experiments which are either unexpected or of particular policy relevance. All outcomes will however be presented and discussed.

4.1 Central budget based on public finance differences

A central budget has a public finance nature. I thus consider a cross-country transfer scheme based on public finance differences across countries. The goal of this experiment, whether it is an economically useful and politically realistic option or not, is to gain a basic understanding of mechanisms at work.

Specifically, every country contributes to the same extent (as % of GDP) to the central fund but receives transfers which depend on their public debt, in a proportional fashion[7]. The net transfer is thus negative for low debt countries; it is positive for high debt countries; and the higher the debt, the larger the transfer. The actual contribution

transfers where productivity growth may differ across countries.

[7]Formally and in units normalizing the size of countries, each country j receives transfers $tr_j = TR \cdot DG_j/\overline{DG}$, where TR is the size of the central fund (total transfers), DG_j the public debt of the country and $\overline{DG}$ is the average public debt across countries. In other words, for any pair of countries, the ratio of transfers they receive equals the ratio of their public debt.

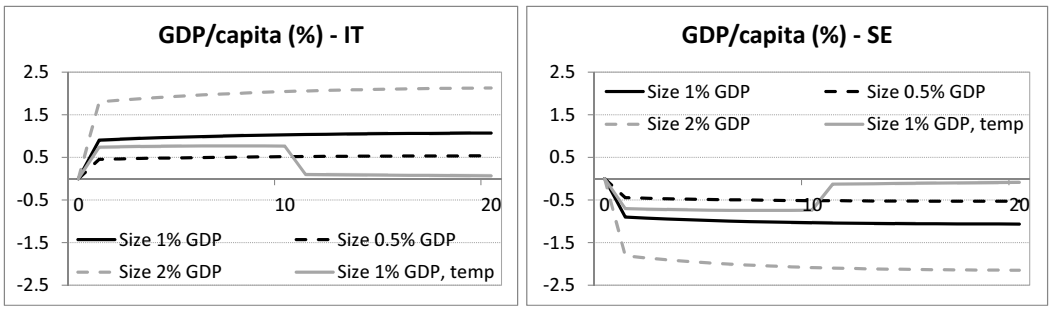

Figure 1: Public-financed based options, GDP impact, Italy and Sweden.

and transfers have constant values based on the pre-transfer equilibrium, so that the central budget is balanced every year[8].

Four budget options are investigated, differing in size and duration. In the baseline case, transfers are permanent and the central fund amounts to 1% of the initial aggregated GDP across countries, a size which corresponds to the actual European Union budget. Since the contribution rate is identical, each country transfers an amount which equals 1% of its pre-transfer GDP to the central fund each year, taking the proceeds from its government budget. Transfers from the central fund to the countries are made so as to split the total budget according to the initial public debt levels. Because Italy has the largest debt (127% of GDP in our pre-crisis 2010 calibration), it receives a yearly net transfer amounting to about 0.46% of its initial GDP. Sweden on the other hand has one of the lowest debt levels (49% of GDP) and makes a yearly net contribution of 0.43% of its initial GDP. Countries vary their labor income tax rates to keep their public debt constant.

The second budget option is the same as the baseline, except that the size of the central fund is only half as large (at 0.5% of the initial GDP). The third budget option is also the same as the baseline option, but the size of the central fund is twice as large (at 2% of the initial GDP). The fourth and last budget option has the same size as the baseline option, but transfers only last 10 years.

The core results are provided in figure 1 and table 1 for selected countries. The figure provides outcomes for the four options. The table focus on outcomes for the baseline option. Results for other countries are similar and provided in appendix A.

The figure provides the time path in Italy and Sweden of the main macroeconomic indicator, the variation of GDP compared to its pre-transfer value. Outcomes are no surprise: Italy, a recipient of net transfers, benefits from the policy, as opposed to Sweden, who is a net contributor; the larger the size of transfers, the larger the gain for Italy and the loss for Sweden; benefits for Italy and losses for Sweden only last as long

[8]Another option would be to define contributions and transfers in a dynamic fashion, so that they depend on the post-transfer equilibrium or the path towards that equilibrium. If a country for instance benefits from the transfer policy and its GDP increases, then its contribution would also increase in absolute terms. I do not consider this option for computational reasons and because the main terms of the EU budget are only revised every six years.

	Italy	Sweden	Avg 14EU
Net govt transfer received (% GDP)	0.46	-0.43	
Net transfers to households (% GDP)	0.00	0.00	
Labor tax (%)	-8.37	6.24	
Gross wages (%)	-0.29	0.28	
Labor/capita (%)	0.57	-0.54	
Interest rate (%)	0.00	0.00	
Capital stock (%)	0.28	-0.32	
GDP/capita (%)	1.02	-1.02	0.00

Legend: yearly average values 20 years following the policy change, EU central fund of size 1% of GDP; *(%)* = percentage change compared to pre-reform equilibrium; *Avg 14EU* = Average for 14 European countries in simulation sample (weighted by economic size).

Table 1: Baseline public financed-based option, Selected macroeconomic impacts.

as the central fund is in place.

Similar outcomes are visible in the table: countries which are net recipients benefit from the policy, while countries which are net contributors lose from it. The table also reports the averaging GDP variations over all European countries (weighted by economic scale) in the simulation sample, which happens to be zero. The following summarizes the key outcomes:

Finding 1. *Economic activity is stimulated in countries which are net recipients of a EU-level central fund and slowed in countries which are net contributors to the fund (GDP/capita variations ranging from -1% to +1% when the size of the central fund is 1% of GDP). Overall, the central fund leads to neither efficiency gains nor efficiency losses (the average GDP/capita variation being 0%).*

The first part of the finding is intuitive, as net recipients receive resources from net contributors[9]. Technically, governments in net recipient countries benefit from additional funding, which allows them to reduce the labor income tax rate and keep their public debt constant. The tax cut stimulates labor supply, which increases production. Conversely, governments in net contributor countries need to increase labor income taxes, reducing labor supply incentives and production.

The explanation for the second part of the finding, efficiency neutrality, requires several arguments. First, the trend productivity growth is assumed to be identical across countries and the central fund to operate at no cost. The second assumption in particular is key to avoid efficiency losses. Second, the central fund is balanced every year: resources transferred out of one country are used in another country. Third, as will be shown and discussed in the next finding, there is a linear relationship between the size of the net transfer and the size of the economic (GDP) impact. Hence, economic gains and losses are proportional and, with a balanced budget, cancel out.

[9]The experiments thus also show that the transfer paradox (Galor and Polemarchakis, 1987) does not apply to all transfer schemes.

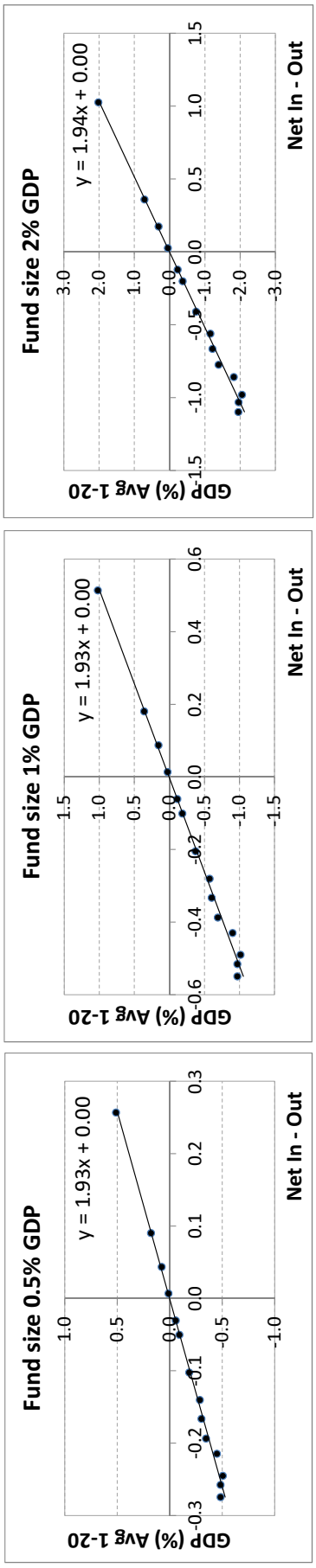

Figure 2: Public-financed based options, transfers versus GDP impacts

I finish analysis in this section with a discussion of size effects. Figure 2 displays outcomes for central fund options where the fund represents 0.5% of aggregate GDP, when it represents 1% of aggregate GDP and when it represents 2% of aggregate GDP. In each case, the figure provides GDP variations for all European countries in the sample and the value of the net transfers they receive (when positive) or make (when negative). The linear curve fitting the values is also displayed on the graphs.

Two points are worth making on the figure. First, the (net transfer, GDP variation) points lie almost perfectly on the linear fitting curve in each of the central fund options. Second, the slope of the linear fitting curve is almost identical for each of the three central fund options (at about 1.93). In other words, the economic benefit from the transfer programmes varies in proportion with the size of the net transfer received or made, and this relationship is independent of the overall size of the transfer programme.

The following summarizes these observations:

Finding 2. *For the public-debt based transfer programmes of limited size considered here (up to 2% of aggregate GDP), the macroeconomic benefit or loss (GDP variation) from the transfer programme varies in (linear) proportion with the size of the net transfer received or made.*

This result may come as a surprise. Indeed, as countries differ in economic policies as well as population structures and labor markets, one might expect that similar-sized fiscal shocks lead to different labor market and macroeconomic equilibrium. More formally, research using the same modelling setting has shown that cross-country spillovers from domestic fiscal policy reforms are bigger in some countries than others (Davoine and Molnar, 2017). Following a large asymmetric shock in Germany for instance, the GDP loss in Spain would be 24% of the loss in Germany, while the loss in Poland would only be 10% of the loss in Germany. Some spillovers are bigger than others, for the same external shock, mainly because countries differ in the skill structure of their population and in their use of capital in production. Yet, these differences are also present in the current analysis but lead to similar macroeconomic outcomes for similar fiscal shocks.

A plausible explanation for the finding is the following. Labor supply elasticities are assumed to be identical across countries. The fiscal shock is transmitted to economic agents through variations of labor income tax rates, which modify labor supply incentives and thus labor market equilibria and macroeconomic outcomes. As the labor supply elasticities are the same, a similar fiscal shock should lead to similar variations in labor supply and thus production. By contrast, production elasticities differ by countries in the research with heterogeneous spillovers mentioned above. We leave for future research counterfactual simulations where labor supply elasticities differ by countries to confirm the explanation and assess the role of identical elasticities.

4.2 Central budget based on output differences

In contrast to section 4.1, I now consider central budget options which are realistic from a policy standpoint, as some of the options are close to the current EU budget arrange-

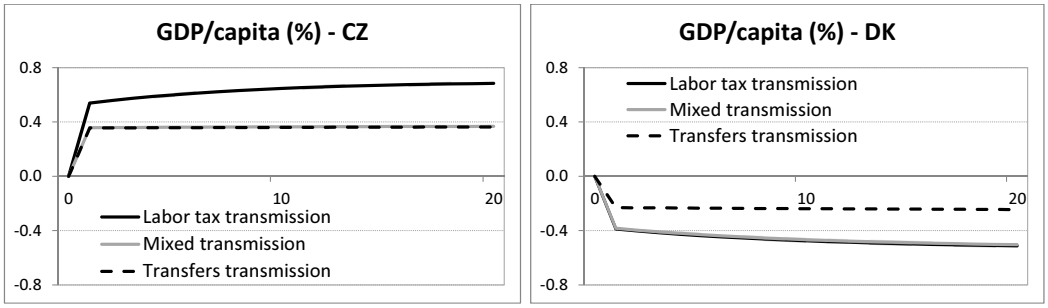

Figure 3: Output-based options, GDP impact, Czech Republic and Denmark.

ments. A significant fraction of the EU budget is used to support income convergence across countries, net transfers flowing to countries with lower GDP per capita through the so-called *Structural Funds* and the *Cohesion Fund*.

I thus analyze the introduction of the same central budget options as in section 4.1 except that transfers to countries are made on the basis of their GDP per capita, instead of the public debt position of the country. Specifically, the government of each country contributes at the same rate (as % of GDP) to the fund but receives transfers which are inversely proportional to their GDP/capita: the lower it is, the higher the transfer[10]. Countries with below average GDP/capita are thus net recipients while countries with above average GDP/capita are net contributors. In the simulation, contribution and transfer values are permanent and based on the pre-policy equilibrium. The central budget is always balanced.

In this presentation I focus on three different central budget options. Cross-country transfers takes place at the government level. Governments then have several options to transmit the transfers to economic agents. I consider three cases. In the first case (denoted *labor tax transmission* below), they use labor income taxes: the governments of net recipient countries lower taxes so that public debt remains constant. In the second case (denoted *transfers transmission* later), government vary transfers made to households which are unrelated to economic activity, such as housing subsidies. When negative, these transfers correspond to lump sum taxes. In this case too, governments vary transfers to households to keep public debt constant. In the last case (denoted later *mixed transmission*), net contributors countries use labor income taxes to balance their government budget while net recipients use household transfers. Again the variation is made to keep public debt constant. The labor tax and mixed transmission cases are realistic and can be implemented. The transfers transmission case is not realistic, because lump sum taxes do not exist in practice[11].

[10]Formally, each country j receives transfers $tr_j = TR \,/\, (GDP_j/N_j) \cdot \overline{GDP/N}$, where TR is the size of the central fund (total transfers) and $\overline{GDP/N}$ is the average GDP per capita across countries. In other words, for any pair of countries, the ratio of transfers they receive equals the inverse of the ratio of their GDP/capita.

[11]Cases with different central fund sizes have also been considered, as in subsection 4.1. The same conclusions can be derived on the role of the fund size. In the interest of space, I thus abstain from reporting outcomes for these cases.

Figure 3 and table 2 provide the first results of the experiment. The presentation is focused on the Czech Republic, one of the largest net recipient, and Denmark, one of the largest net contributor. Impacts are similar for other countries and can be found in appendix A.

As with debt-related budget options (in subsection 4.1), the figure and the table show that output-related budget transfers lead to macroeconomic benefits in net recipient countries and macroeconomic losses in net contributor countries. The novelty here and the main take from the figure is that labor tax transmission leads to bigger macroeconomic impacts than transfers transmission, in both the net recipient and the net contributor countries. Quantitatively, the table shows an average GDP per capita gain in the Czech Republic of 0.64% with labor tax transmission but only 0.36% with transfers transmission, while the average GDP per capita loss in Denmark is 0.47% with labor tax transmission but only 0.24% with transfers transmission. I will return to the mixed transmission case later. Taking impacts over all countries into account, one can summarize these observations with:

Finding 3. *EU-transfers which are used for or financed by labor income tax variations lead to bigger macroeconomic impacts (gains in net recipient countries and losses in net contributor countries) than those which are used for or financed by household transfers (lump sum taxes) variations (when the size of the central fund is 1% of GDP, GDP/capita variations range from -0.5% to +1.3% with labor tax transmission and from -0.3% to +0.7% with transfers transmission).*

The reason for such a finding is the distortive nature of labor income taxes, unlike lump sum taxes. In both cases, governments of net recipient countries receive the same transfer from the EU central fund (0.31 of initial GDP in the Czech Republic case). When they transmit the resources to households through a reduction in labor income taxes (-11% in the same case), incentives to provide labor are increased (+0.3%), boosting investment (+0.2%) and production (+0.6%). The labor income tax distortions are reduced and lifetime household income increased both by the resource transfer and by larger labor income. When governments transmit the resources to households via higher transfers, there are no incentives to provide additional labor (0%). Households simply enjoy higher lifetime income, which they spend on consumption, increasing aggregate consumption and production (+0.4%). Since the lifetime household income is only increased by the resource transfer, the consumption and production impacts are smaller. The opposite takes place for net contributor countries.

As with debt-related budget options, the macroeconomic benefits or gains from transfers vary in proportional fashion with the size of the net transfer in most, but not all cases. Figure 4 shows indeed that the (net transfer, GDP impact) points lie almost perfectly on linear curves in the labor tax transmission case and in the transfer transmission case. However, the points do not lie on a linear curve in the mixed transmission case. Finding 2 in section 4.1, formulated for debt-related budget options, can thus be extended to output-related budget options, provided the transmission mechanism is

	Transmission labor tax			Transmission transfers			Mixed transmission		
	CZ	DK	Avg 14EU	CZ	DK	Avg 14EU	CZ	DK	Avg 14EU
Net govt transfer received (% GDP)	0.31	-0.19		0.31	-0.19		0.31	-0.19	
Net transfers to households (% GDP)	0.00	0.00		0.36	-0.24		0.36	0.00	
Labor tax (%)	-11.13	1.78		0.00	0.00		0.00	1.76	
Gross wages (%)	-0.21	0.08		0.00	0.00		0.00	0.08	
Labor/capita (%)	0.32	-0.25		0.00	0.00		0.00	-0.24	
Interest rate (%)	0.01	0.01		0.01	0.01		-0.03	-0.03	
Capital stock (%)	0.19	-0.15		0.00	0.00		0.01	-0.14	
GDP/capita (%)	0.64	-0.47	0.00	0.36	-0.24	0.00	0.36	-0.46	-0.044

Legend: yearly average values 20 years following the policy change, EU central funds of size 1% of GDP; *(%)* = percentage change compared to pre-reform equilibrium; *Avg 14EU* = Average for 14 European countries in simulation sample (weighted by economic size).

Table 2: Output-based options, Selected macroeconomic impacts.

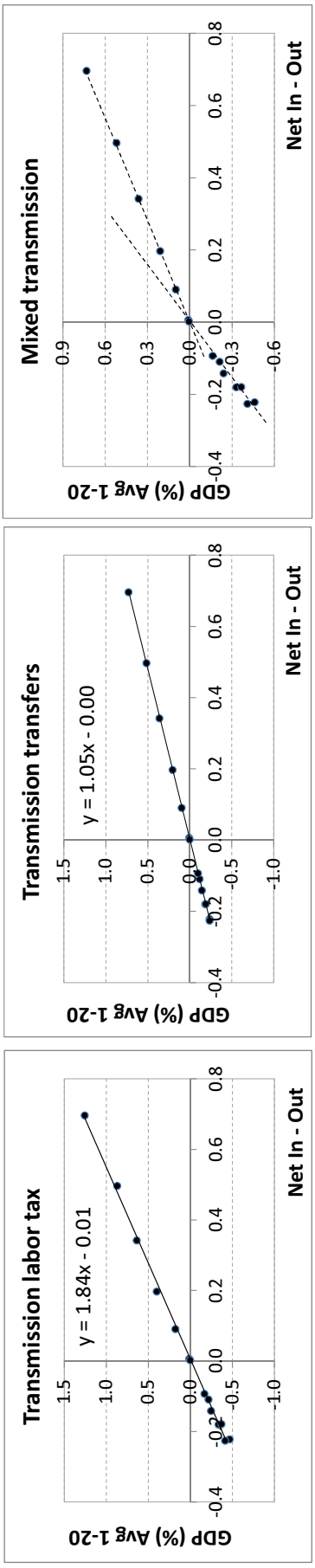

Figure 4: Output-based options, transfers versus GDP impacts

symmetric:

Finding 4. *For the output-based transfer programmes of limited size considered here (up to 1% of aggregate GDP), the macroeconomic benefit or loss (GDP variation) from the transfer programme varies in (linear) proportion with the size of the net transfer, but only when the transmission mechanism is symmetric (either labor income taxes or lump sum taxes in both net recipient and net contributor countries).*

The explanation for finding 4 is the same as for finding 2, when the transmission mechanism is symmetric. When the mechanism is asymmetric, as in the mixed transmission case, the explanation is based on the fact that labor income taxes are distortive while lump sum taxes are not, as for finding 3. Net contributor countries increase labor income taxes to finance the net transfer to the central fund, which reduce labor supply incentives and has a larger negative impact on the economy. Net recipient countries on the other hand do not reduce labor income taxes but increase transfers to households, which does not stimulate labor supply in that country and thus leads to a smaller positive impact on the economy. There is thus no linear relationship between net transfers and macroeconomic impact when the country set includes both net donor and recipients.

The explanation further hints at efficiency issues in case of asymmetric transmission. If the negative macroeconomic impacts are made larger by labor income tax transmission and the positive impact made smaller by transfers transmission, one may expect an overall negative impact of the transfer programme. Table 2 confirms this expectation: the average GDP per capita variation over all European countries in the sample (weighted by economic scale) is negative, at -0.04%. The central fund policy with mixed transmission thus leads to efficiency losses. By contrast, there are neither efficiency losses nor gains with symmetric transmission, either labor income taxes or lump sum taxes. The explanation is the same as for finding 1 (see section 1). Summing up, one has:

Finding 5. *The cross-country transfers operated by the EU central fund lead to neither efficiency losses nor efficiency gains when government transfers are transmitted to households symmetrically across countries (with either labor income taxes or lump sum transfers) but lead to efficiency losses when transfers are transmitted asymmetrically, contributor countries financing the net transfer with labor income taxes and recipient countries using net transfers for unconditional lump sum transfers to households (average loss of 0.044% of GDP when the fund size is 1% of GDP).*

4.3 Central budget based on unemployment differences

There are large unemployment differences across countries, ranging in our sample from 4.0% in the Netherlands to 14.4% in Slovakia for our pre-crisis calibration period. High unemployment rates may to some extent come from entrapment: in a high unemployment trap, higher aggregate unemployment insurance costs require higher tax or social security

contribution rates, which would depress the incentive for job search and thus could contribute to remaining in a high unemployment state. Cross-country redistribution might help to get out of high unemployment traps.

In this section, I thus consider a EU central fund where the transfers depend on various indicators related to unemployment and where governments use variations of social security contributions (SSC) to balance their budget. Net recipients will thus lower their SSC rate, which should increase job search incentives and thus reduce unemployment, reducing the strength of potential entrapment effects. Conversely, net contributors will increase the SSC rate, which should on the other hand lead to higher unemployment. Whether unemployment at the EU level is reduced or increased is however unclear and part of the investigation.

I present two central fund options related to unemployment differences[12]. Several indicators related to unemployment can be used to define transfers. In the first option, I define transfers based on aggregate costs of the unemployment insurance (denoted *cost-only option* below). In the second option, I define transfers based on aggregate costs of the unemployment insurance and the unemployment rate (denoted *cost-and-rate option* below). Specifically, the government of each country contributes at the same rate (as % of GDP) to the fund so that all unemployment insurance costs at the EU level are covered by the fund (resulting in a contribution rate of 0.7% of GDP). In the first option, the government receives transfers which are proportional to the aggregate costs of their unemployment insurance: the higher the costs, the higher the transfer[13]. In the second option, the transfers received are proportional to the aggregate unemployment insurance costs and (inversely) to the unemployment rate: at identical costs, a country with higher unemployment rate will receive a higher transfer[14].

Other central fund options related to unemployment are conceivable. For instance, the transfer could be the product of the number of unemployed with an identical amount per unemployed workers. This option may be especially interesting if unemployment insurance replacement rates are identical in each country. There are however large differences in replacement rates across countries. Because a central budget is a public finance instrument and not a tool for harmonization of labor market policy, I do not consider here these central budget options which would be best coupled with labor market policy coordination and leave such research for the future.

Figure 5 and table 3 provide the results of the experiment, focusing on the Netherlands, Slovakia and the United Kingdom. Outcomes for other countries are similar and

[12]Cases with different central fund sizes have also been considered, as well as cases where a combination of social security contributions and labor income taxes are used to transmit the transfers to households. The main conclusions remain unchanged. In the interest of space, I do not report the results for these other options.

[13]Formally and in units normalizing the size of countries, each country j receives transfers $tr_j = TR \cdot UI_j / \overline{UI}$, where TR is the size of the central fund (total transfers), UI the aggregate unemployment insurance costs and $\overline{UI}$ is the average costs over all countries. In other words, for any pair of countries, the ratio of transfers they receive equals the ratio of their aggregate unemployment insurance costs.

[14]Formally and in units normalizing the size of countries, each country j receives transfers $tr_j = TR \cdot UI_j / \overline{UI} \cdot u_j / \overline{u}$, where u_j is the unemployment rate, $\overline{u}$ is the average unemployment rate and the other variables are defined as in the previous footnote. In other words, for any pair of countries, the ratio of transfers they receive equals the ratio of their aggregate unemployment insurance costs times the ratio of their unemployment rate.

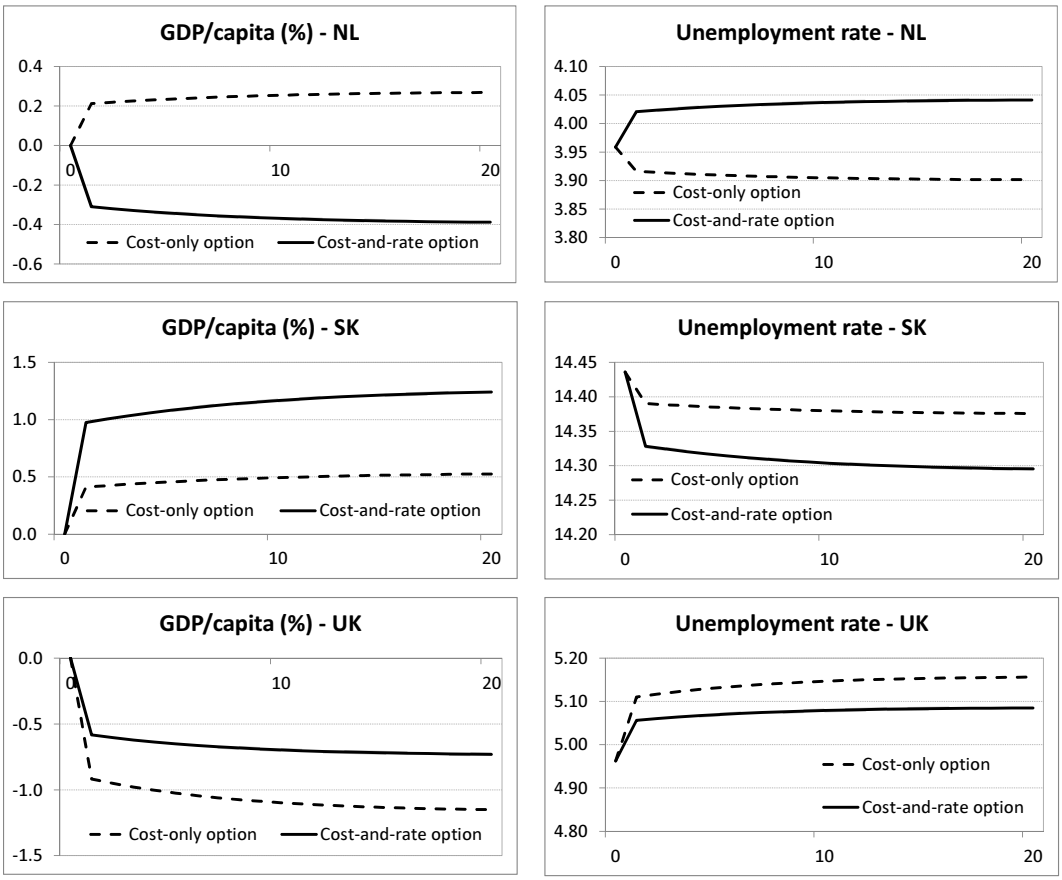

Figure 5: Unemployment-related options, GDP and unemployment impacts, Denmark, Slovakia and UK

can be found in appendix A.

The figure provides variations in GDP per capita and the unemployment rate, compared to the pre-policy equilibrium. Netherlands and Slovakia are both net recipients in the *cost-only* option, given their high unemployment insurance costs, while the UK is a net contributor. Because the first two countries are net recipients, they can lower the SSC rate, stimulating job search and activities on the labor market along other margins, which reduces unemployment, increases labor supply and output. The opposite takes place for the UK. It is thus not a surprise to see a decline in unemployment and an increase in GDP in Netherlands and Slovakia, and the opposite in the UK, for the *cost-only* option.

In the *cost-and-rate* central fund option, Slovakia remains a net recipient and the UK a net contributor, but the Netherlands becomes a net contributor. Its unemployment rate is indeed low but the replacement rate high, explaining why the country is a net recipient in the *cost-only* option but a net contributor in the *cost-and-rate* option. As expected then, the unemployment rate declines and GDP increases in Slovakia, and the opposite takes place in the Netherlands and the UK.

These observations can also be made in table 3. Unemployment increases for instance 0.2 %-points in the UK with the *cost-only* option and 0.1 %-points with the *cost-and-rate* option, but declines about 0.1 %-points in Slovakia. The table further shows that in both options, the average unemployment variation in all European countries of the sample is 0% (scaled by economic size, namely GDP). From a labor market perspective thus, none of the two central budget options lead to a decline of unemployment at the EU level, nor to an increase. Similarly, the average GDP variation is 0%. Stretching definitions for illustration, there are thus neither efficiency losses nor efficiency gains, neither in GDP terms nor in unemployment terms. All these observations are summarized in the following:

Finding 6. *Economic activity is stimulated in countries which are net recipients of a EU-level central fund based on unemployment* cost-only *and* cost-and-rate *options, and slowed in countries which are net contributors to the fund (GDP/capita variations ranging from -1.1% to +1.4% when the size of the central fund is 1% of GDP). Overall, the central fund leads to neither efficiency gains nor efficiency losses (the average GDP/capita variation being 0%) and to neither reductions nor increases in the EU-level unemployment (the average unemployment variation being 0%).*

While the two central fund options may not reduce the average unemployment, they might still contribute to reduce the extreme levels observed in some countries. If they do, it would be interesting to know if the impact that they have is proportional to the size of the transfers. Figure 6 provides information related to these questions.

For both options, the figure displays, respectively, the relationship between size of the net transfer received and GDP variation; between size of the net transfer received and unemployment rate variation; as well as between initial unemployment level and unemployment rate variation. Each data point represents one of the 14 European countries

	Cost-only option				Cost-and-rate option			
	NL	SK	UK	Avg 14EU	NL	SK	UK	Avg 14EU
Net govt transfer received (% GDP)	0.11	0.24	-0.48		-0.16	0.57	-0.31	
Net transfers to households (% GDP)	0.00	0.00	0.00		0.00	0.00	0.00	
Social security contributions (%)	-1.44	-4.52	11.88		2.14	-10.73	7.52	
Gross wages (%)	-0.03	-0.07	0.18		0.06	-0.18	0.11	
Unemployment (p.p)	-0.05	-0.06	0.18	0.00	0.08	-0.13	0.12	0.00
Labor/capita (%)	0.14	0.25	-0.61		-0.20	0.58	-0.39	
Interest rate (%)	-0.02	-0.02	-0.02		-0.01	-0.01	-0.01	
Capital stock (%)	0.12	0.23	-0.53		-0.17	0.53	-0.34	
GDP/capita (%)	0.26	0.51	-1.12	0.00	-0.38	1.21	-0.71	0.00

Legend: final equilibrium values after the policy change; *(%)* = percentage change compared to pre-reform equilibrium; *(p.p)* = percentage points change compared to pre-reform equilibrium; *Avg 14EU* = Average for 14 European countries in simulation sample (weighted by economic size).

Table 3: Unemployment-related options, Selected macroeconomic impacts

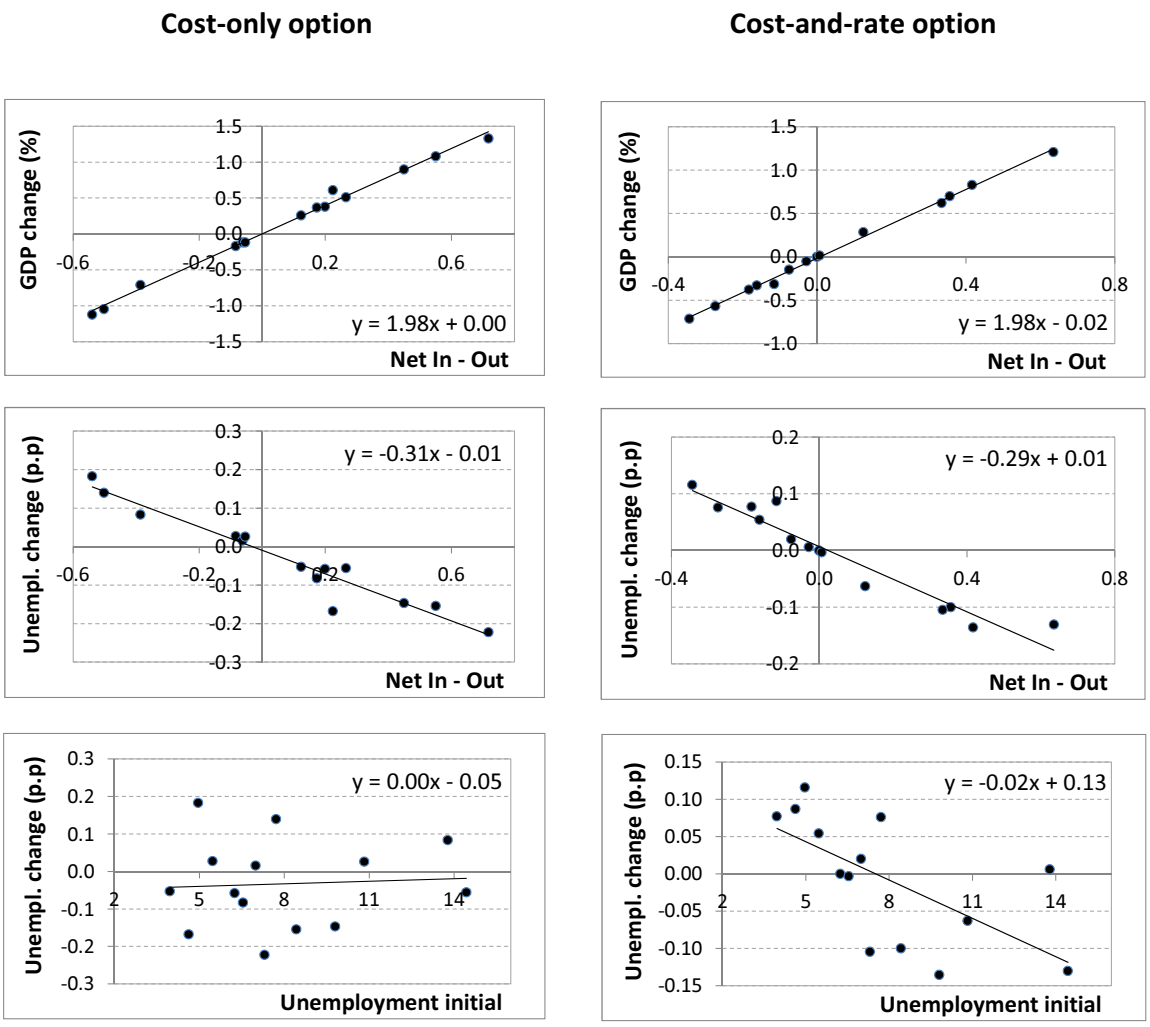

Figure 6: Unemployment-related options, transfers size and impacts

from our sample. On each graph, the linear fitting line is graphically and algebraically represented.

The first observation on figure 6 is similar to finding 2 for debt-related transfers, namely a linear variation between the size of the net transfer and the GDP impact: the 14 points are almost perfectly on the fitting line. Finding 2 can thus be extended to the two central fund options based on unemployment indicator investigated here.

The second observation on figure 6 is related to the heterogeneity in unemployment levels across countries and the impact of the central fund options. In the *cost-and-rate* option, one can see a negative relationship between initial unemployment rate and unemployment rate variation. Ceteris paribus, countries with higher initial unemployment end up with a lower rate, once the central fund is activated. In the *cost-only* option however, there are no apparent relationships between initial unemployment and unemployment variation. The *cost-and-rate* option thus leads to a convergence of unemployment rates across countries, but not the *cost-only* option. The observation for the *cost-and-rate* option conforms to expectations, as the size of the transfers received from the central fund depends positively on initial unemployment rates and countries use net transfers to lower the SSC rate, which stimulates job search. The observation for the *cost-only* option is also no surprise, once one recalls that the transfers are related to aggregate costs only and that unemployment insurance replacement rates vary widely across countries: countries receiving large transfers, and thus able to reduce unemployment, may have initially low unemployment rates if their replacement rates are high, and thus aggregate costs high; but countries can also have low replacement rates but a high unemployment rate and thus receive a large transfer; the Netherlands is an example of the first type of country and Slovakia of the second type.

Summing up, one can state:

Finding 7. *EU central budgets with unemployment-related transfers based on the* cost-only *option do not lead to unemployment convergence, but central budgets with unemployment-related transfers based on the* cost-and-rate *option lead to unemployment convergence across countries.*

The third and last observation that one can make on figure 6 relates to the *cost-and-rate* option mainly. While the 14 points are almost perfectly aligned in the (net transfers; GDP variation) graph, they are less so but remain closely aligned in the (net transfers; unemployment variation) graph but show much more dispersion in the (initial unemployment; unemployment variation) graph. This observation implies a stronger convergence process in overall macroeconomic terms (GDP per capita) than in labor market terms (in particular the unemployment rate), which illustrates the complexity and heterogeneity of labor markets, as well as the heterogeneity of unemployment insurance policies across countries. As reminded at the start of this section, differences in unemployment rates are large, ranging from 4.0% to 14.4% in our sample. Exploiting pre-crisis data from the EU-SILC, our calibration ends up with net unemployment insurance replacement rates which vary from 7% to 55%. It should thus not be surprising

that net transfers similar in size have different labor market impacts, which the dispersion in the (net transfers; unemployment variation) graph visually illustrates. As the size of transfers indirectly depends on unemployment insurance policy in the *cost-and-rate* option, there is a compounding effect which increases the dispersion in the (initial unemployment; unemployment variation) graph, compared to the other graphs. The discussion can be summarized the following way[15]:

Finding 8. *The convergence effect due to EU central budgets with unemployment-related* cost-and-rate *transfers is stronger in overall macroeconomic terms (GDP/capita) than in labor market terms (unemployment rate), illustrating the complexity of labor markets and the influence of cross-country heterogeneity in labor market policies.*

4.4 Central budget based on asymmetric shocks

Countries are exposed to exogenous shocks to various degrees. Natural disasters for instance often hit only one country at a time. Countries across the European Union have been recovering at different speed from the 2007 subprime crisis. As seen in Davoine and Molnar (2017), cross-country spillovers can be large in some circumstances, which provides a rationale for joint policy action. In this section, I thus consider large, one-time asymmetric shocks and investigate to which extent a central fund administrated by the European Union could help countries hit by the shock to recover faster. Because the shock is large and unique, the central fund plays a burden-sharing solidarity role[16]. I also investigate consequences for other countries.

Specifically, I use the same case as in Davoine and Molnar (2017) which leads to large spillovers and compare outcomes with and without a central fund. In this case, Germany is assumed to be hit by a large shock which requires government support for recovery. Following the shock, the German government provides financial relief to households and firms, increasing its expenditure to make direct financial payouts and instantly wipe out negative consequences for households and firms. I assume that such a relief programme lasts 5 years and amounts yearly to 2.5% of GDP, totaling 12.5% of GDP. The shock, relief programme and government support is comparable to the public support provided by the local and central governments in Germany after the 2007 subprime crisis, which, as of 2012, amounted to 10.8% of GDP for the financial industry alone (International Monetary Fund, 2013). I also assume the goal of keeping public debt constant, by raising labor income taxes when necessary.

I then compare this *no-central fund* case to a case denoted *central fund* where Germany is hit by the same shock and provides the same relief programme, but where there is a EU level central fund which covers part of the costs of the relief programme. More specifically, I assume that 30% of the costs of the relief programme are covered by the

[15]The finding is consistent with the analysis of Boeri and Jimeno (2016), which argue that the divergence in unemployment rates in the European Union since the mid 2000's is largely due to differences in labor market institutions.

[16]I leave to future research the insurance properties of central funds against smaller and repeated shocks, typical for instance of business cycles.

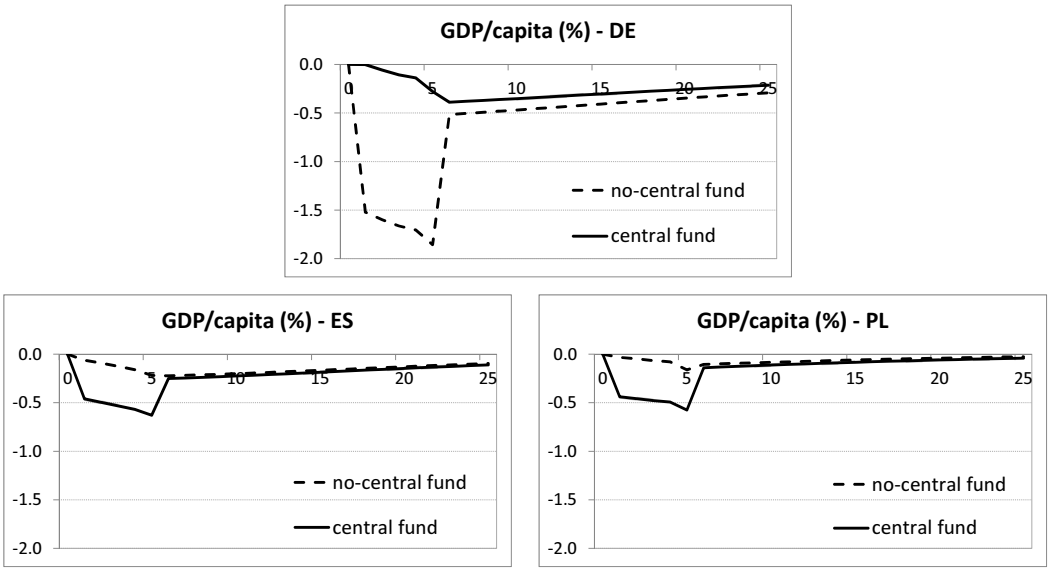

Figure 7: Asymmetric shock option, GDP impact, Germany, Poland and Spain.

burden-sharing central fund, the remaining 70% being paid by the German government itself. All countries except Germany contribute to the central fund at the same rate (as % of the pre-shock GDP) so that the central fund is balanced, resulting in a contribution rate of 0.28% of GDP. The central fund operates as long as the relief programme is in place, namely 5 years[17]. All countries share the goal of constant public debt and use labor income tax variations, if needed, to achieve this.

Results for the *no-central fund* and *central fund* cases are provided in figure 7 and table 4 for Germany, Poland and Spain. Outcomes for other countries are similar and provided in appendix A.

As expected, the figure shows, and numbers in the table confirm, that co-financing with the central fund helps to reduce the negative macroeconomic impact in the country hit by the shock, Germany. Because of the goal to keep public debt constant, Germany needs to make a large income tax increase (more than 50%) during the relief programme when there is no help through the central fund, reducing labor supply incentives and leading to a larger GDP reduction (average 0.66% loss over the next 25 years). When the central fund operates and co-finances the relief programme, a smaller tax increase is sufficient (less than 40%), which leads to a smaller reduction in labor supply and GDP (average 0.26% loss).

The negative macroeconomic impacts on shock-free countries when the central fund operates are also expected. Because of the integration of capital markets, there are negative spillovers even when there is no central fund: the government expenditures increase in Germany is a sudden drag on the integrated capital markets, as production in Germany is not able to accommodate the expenditures increase and the country needs to borrow abroad; the capital markets being integrated, this reduces private investment

[17]Other central fund options with a co-financing share larger than 30% have been considered but not reported here, in the interest of space. No additional findings are delivered from the analysis of these other options.

Table 4: Asymmetric shock option, Selected macroeconomic impacts.

	No central fund							**Central fund**						
	Germany		Poland		Spain		14EU	Germany		Poland		Spain		14EU
	Year 5	1-25	Year 5	1-25	Year 5	1-25	1-25	Year 5	1-25	Year 5	1-25	Year 5	1-25	1-25
Net transfer (% GDP)	0.00		0.00		0.00			0.98		-0.28		-0.28		
Labor tax (%)	56.5		2.8		2.2			39.8		7.1		7.9		
Gross wages (%)	2.18		0.02		-0.06			1.47		0.19		0.19		
Labor/capita (%)	-2.41		-0.16		-0.19			-1.69		-0.35		-0.43		
Interest rate (%)	-0.87		-0.87		-0.87			-0.85		-0.85		-0.85		
Capital stock (%)	-0.55		-0.17		-0.27			-0.44		-0.19		-0.29		
GDP/capita (%)	-1.86	-0.66	-0.16	-0.06	-0.22	-0.16	-0.22	-0.28	-0.26	-0.57	-0.17	-0.63	-0.25	-0.22

Legend: values at the 5th year after the shock (*Year 5*) and average values over years 1 to 25 after the shock (*1-25*); *Net transfer* = net government transfer received from the central fund; *(%)* = percentage change compared to pre-reform equilibrium; *14EU* = Average for 14 European countries in simulation sample (weighted by economic size).

in all countries (average GDP loss ranging from 0.06% in Poland to 0.16% in Spain). When additional resources are transferred from governments of shock-free countries to Germany, labor income taxes need to be raised, depressing labor supply incentives and further decreasing output in shock-free countries. Despite identical contribution rates (as % of GDP) however, the impact of the central fund differs across shock-free countries (average GDP loss ranging from 0.17% in Poland to 0.25% in Spain). The reason for this heterogeneity is the same as in the no central-fund case, investigated in Davoine and Molnar (2017): because capital is used with a different intensity across countries, the decline in private investment hurts more these countries where capital is more intensely used in production, in particular by high-skilled workers.

Thanks to the central fund thus, an asymmetric shock with partial spillovers to shock-free countries can be transformed into a symmetric shock impacting all countries in comparable fashion. While the German GDP drops 0.66% on average over the next 25 years without the central fund, four times more than in any other country, the German GDP drops only 0.26% on average with the central fund, close to the maximum drop in shock-free countries (0.25% in Spain). Interestingly, there is neither any efficiency loss nor efficiency gain at the EU level in the process, the average GDP loss amounting to 0.22% in both cases (weighted by economic size). Such an outcome comes from the assumption that the central fund itself operates at no cost and from the choice of the fund size (a characteristic we will further discuss below).

The following sums up this discussion:

Finding 9. *The co-financing through a central fund of relief programmes in countries hit by large, one-time asymmetric shocks can reduce and spread the negative macroeconomic consequence from directly affected countries to all other countries at neither overall efficiency costs nor gains, but, for an identical contribution rate into the fund, with larger negative impacts in some shock-free countries than others.*

As discussed above, the finding is consistent with initial expectations. The next observation may, on the other hand, be more of a surprise.

The finding shows that the negative consequences of an asymmetric shock can be spread to other countries when the contribution rate is identical across shock-free countries. A complete equalization of the shock over all countries is possible when different contribution rates across shock-free countries are used, for the same reason that cross-country spillovers differ in size along the capital market integration channel.

I conducted such an experiment and found that a small modification of the parameters of the central fund allows for complete equalization of the shock, such that the GDP of all European countries drops 0.22% on average over the next 25 years following the shock. The outcome holds both for the country hit by the shock and shock free countries. Compared to the central-fund option investigated above, the main change is that the contribution rates differ by country. Specifically, shock-free countries which suffer less from the shock in Germany pay a little more in the fund. The resulting range of contribution is from 0.18% of GDP in Spain to 0.41% of GDP in Poland. Further,

Germany pays a slightly smaller share of its relief programme (69.5% instead of 70.0%).

What may come as a surprise is that the central fund only needs to cover 30.5% of the German relief programme to equalize macroeconomic impacts across countries. One could expect that the central fund needs to pay the bulk of the programme to share the burden over all countries. Unreported simulations with a larger co-financing share than 30% actually shows that Germany suffers less from the shock than other countries, as more of the burden is taken by other countries. Collecting these unexpected outcomes leads to the following:

Finding 10. *Low co-financing shares of relief programmes in countries hit by a large, one-time asymmetric shock can be sufficient to equalize the negative macroeconomic consequences across all countries, when contributions by shock-free countries slightly decrease with their exposure to cross-country spillovers (a co-financing quota of 30.5% can be sufficient to reduce the average GDP/capita losses in Germany from 0.66% to 0.22% while losses in shock-free countries increase from an average of 0.10% to 0.22%).*

The explanation for such an outcome are Laffer curve effects, compounded by the crowding-out effects of investments generated by the government relief programme. Without co-financing of the relief programme, taxes need to be increased by a large amount in Germany to avoid a surge in public debt. Incentives for labor supply drop significantly. With the central fund co-financing, taxes do not need to be increased as much and labor supply drops to a lesser extent. Because of tax base effects and because labor disutility increases in a convex fashion, the relative labor supply gains are large. These labor supply gains and the corresponding output gains are compounded by the drop in private investment due to the relief programme: the drop in the capital stock indeed magnifies the impact of any reduction of labor supply on output.

The co-financing measure is thus not only a direct financial support to Germany; it is also an indirect help to the own recovery efforts of the country, as the economy is able to generate a stronger contribution to government revenue. A partial co-financing measure is thus sufficient to equalize the economic impact across countries.

5 Policy implications

I derive policy implications from results obtained in the previous section and compare key implications with those from the literature. There are two main implications, one on earmarking central budget funds and one on burden sharing. I present other implications at the end of the section.

5.1 Earmarking central budget funds

Finding 5 in section 4.2 shows that there is an efficiency loss when net contributor countries use labor income taxes to finance their payment to the central fund and net recipient countries transmit the funds proceeds to households by unconditional transfers

(lump sum taxes): the average GDP impact of the central fund over all European countries (weighted by economic size) is indeed negative.

The reason for such an outcome is the distortive nature of labor income taxes and the asymmetric use of this instrument to link households, governments and the central fund. Net contributors need to raise labor income taxes, which reduces incentives for labor supply and thus decreases output. As shown in section 4.2, there is no efficiency loss if net recipient countries also use labor income taxes as transmission mechanism: by reducing these taxes, they stimulate labor supply and output in their country, compensating for the losses in the net contributor countries. However, when net recipient countries use unconditional transfers as transmission mechanism, there are no incentives to provide more labor, and the losses in the net contributor countries are not compensated. Using such an asymmetric transmission mechanism thus leads on average to a GDP loss. From an economic standpoint, such a missed opportunity represents deadweight loss, due to the disincentive effects of labor income taxes. It thus represents one source of waste, distinct for instance from corruption or poor management. For ease of reading, I will use the word *waste* in the following. One should keep in mind that it is only a fraction of potential waste.

The simulations allow to quantify the waste effect of this asymmetric transmission mechanism. When the size of the central fund is 1% of GDP, the average GDP loss is 0.044%, which sets the waste rate at 4.4% (see finding 5). The same waste rates are found in unreported simulations where the size of the fund is either half as large or twice larger[18].

Because labor supply incentives play a key role, I performed sensitivity analyses with a different model calibration where the labor supply elasticities are different. There has been a long debate in the literature about the size of these elasticities, found to be much smaller in empirical analyses using microdata than in those using macrodata (with up to a tenfold difference). The consensus in the quantitative macroeconomic literature has been to use microdata-based elasticities, which are smaller. A few authors, however, have presented arguments for larger elasticities (see Keane, 2011). I thus performed a sensitivity analysis where labor supply elasticities are twice as large as in the baseline calibration. Because our baseline values are conservative, the values in the sensitivity analysis remain realistic. In this case, I find for a central fund of size 1% of GDP and the same asymmetric transmission mechanism that the average GDP loss is 0.089%, setting the waste rate at 8.9%. Waste rate estimations are thus sensitive to the calibration values of labor supply elasticities. Overall however, a waste rate comprised between 5% and 8% appears realistic and conservative at the same time.

Recall from section 4.2 that the waste is technically due to the asymmetric use of transmission instruments: if the net contributor countries could also use lump sum taxes to finance their part of the central fund, then there would be no efficiency loss and no waste. However, lump sum taxes do not exist in practice[19].

[18]The 4.4% waste rate (deadweight loss) is expressed in terms of the gross contributions to the central fund, set at 1% of GDP. When the waste rate is expressed in terms of average net contribution rate (weighted by economic size and only considering net positive contributions), the waste rate jumps to 31%.

[19]One could even hope to generate efficiency gains with a central fund if lump sum taxes existed, net

In generic terms, there is thus a case for earmarking net receipts from central funds:

Policy implication 1 (earmarking). *To prevent waste at a rate which can reach 5% to 8%, governments in net recipient countries should be expected to use the payment from EU central funds to stimulate economic activity, for example by reducing labor income taxes, and to avoid the use of these funds to make unconditional transfers to households.*

As noted in the literature discussion in sections 2.3 and 2.4, there are few estimates of efficiency losses in the literature. Existing numbers are however comparable. Busso et al. (2013) find a 13% waste rate for a local stimulation programme where labor supply responses play a role, slightly larger than my estimates. Parry (2003) estimate at 5% to 10% the tax revenue loss due to international tax competition with missing coordination. One should also remember that the midpoint 20% deadweight loss estimate for income taxes summarized by Saez et al. (2012) disregards the use of tax revenue but allows for income shifting and other tax minimizing behavior, while my estimates do the opposite, namely take the use of tax revenue into account but abstract from tax minimization. This explains why my estimates are smaller.

I finish with a brief comparison of this policy implication with the current use of actual EU central funds and related literature findings. The EU had a budget in 2015 of 145 billions EUR, or 1% of the GDP for the whole area. As the EU has restricted public good provision roles, its running costs are low, using 6% of the budget. The majority of the EU budget is used for operating two kinds of central funds, where each country contributes but transfers depend on country characteristics, close to the modelling set up considered in this paper. The first kind of funds (called *Structural Funds* and the *Cohesion Fund*) are used to help close the income gap between countries. For that purpose, receipts are mostly (but not only) allocated to countries with low GDP per capita. The second type of fund (which falls under the *Common Agricultural Policy* umbrella) supports programmes related to agriculture which mostly consist of subsidies[20].

Are these two types of funds consistent with the policy implication formulated above? There is a variety of funds in the first category requiring a case-by-case analysis, which prevents a definitive answer. In general, however, these funds are allocated after an evaluation of projects and the progress is monitored, which represents some form of earmarking. The earmarking policy implication thus supports this set up. Whether appropriate evaluation criteria and monitoring is provided is another question.

A definitive answer is also difficult for the second type of funds. The Common Agricultural Policy indeed mostly operates subsidies, including direct payments to farmers which depend on land size but not on production stemming from exploitation of the

contributors financing the payment to the fund with non-distortive lump sum taxes while net donors use the payment from the fund to lower distortive labor income taxes. Again, this is not realistic. Besides, if lump sum taxes existed, one would not need a central fund to generate efficiency gains, as one could simply replace existing labor income taxes with lump sum taxes at a domestic level.

[20]The discussion here is consistent with the EU budget representation until 2013. As of 2014, the representation differs. The underlying activities are however similar and the 2013 representation easier to discuss.

land. Objectives are always attached to the subsidies, but payments are not always conditional on meeting the objectives because the generic definition of objectives (such as sustainable production) prevents verifying their achievement. Technically, it is thus possible that parts of the funds operated under the Common Agricultural Policy are unconditional transfers to households. This brief discussion does not imply that parts of the funds are in practice unconditional transfers, only that it is theoretically possible.

As of 2016, yearly expenditures of the Common Agricultural Policy amounted to 55 billions EUR, representing close to 40% of the total EU budget. In a worst case scenario where 100% of the Common Agricultural Policy expenditures are unconditional transfers and applying the highest waste rate estimate of 8%, the overall economic waste of this policy would amount to 4.4 billions EUR (or 0.03% of GDP). In a more optimistic but still hypothetical scenario where 50% of the expenditures represent unconditional transfers and using the lower waste rate estimate of 5%, the overall waste would amount to 1.4 billions EUR (or 0.01% of GDP). At the EU level, these waste estimates are small. As indicated above, these estimates are only theoretical possibilities. They may however be large enough to reconsider the use of unconditional subsidies in the Common Agricultural Policy.

There are no efficiency loss estimates for Cohesion and Structural Funds in the literature, but some for the Common Agricultural Policy. As discussed in section 2.4, existing CGE studies ignore the distortionary cost of taxation but quantify the efficiency cost due to price controls and other specific policy prescriptions. Philippidis and Hubbard (2001) find such a distortion to amount to 0.2% of GDP. Both distortions thus should be added up. In the worst case scenario, the distortion would thus amount to 0.23% of GDP.

The literature on Cohesion and Structural Funds in particular, and foreign aid in general, provides policy recommendations which are sometimes consistent, sometimes inconsistent, with the earmarking policy implication presented here. It is consistent for instance with Allard et al. (2008), who find with simulations that the EU cohesion policy would increase the growth rate of New Member States more if cross-country transfers are used for private investment than if they are used for income support. The earmarking policy implication is also consistent with the empirical finding by Gemmell et al. (2013) that greater spending decentralization than revenue decentralization is associated with lower economic growth, as non-earmarked transfers correspond to a form of spending decentralization. Finally, the earmarking implication is also consistent with the policy analysis of Farole et al. (2011), recommending a greater usage of conditionality in EU structural funds.

The earmarking policy implication which favors labor tax reductions as a way to use net receipts differs however from part of the foreign aid literature, which either views as a "*drawback*" the decline in the tax revenue associated with the reception of grants (Gupta et al., 2003) or has been looking at earmarking with skepticism (McCleary, 1991). The earmarking policy implication may thus contribute to the on-going debate on conditionality of foreign aid (Temple, 2010).

It is finally worth noting that the earmarking implication applies not only to cross-

country transfers, but also to domestic transfers with a degree of fiscal decentralization. As noted by Bloechliger and King (2007), earmarking is already used in OECD countries (on average, earmarked transfers represent 22% of local government revenue, the second largest revenue source behind the 38% generated by their own taxes) but not to the largest extent possible (as 19% of grants are non-earmarked, on average).

5.2 Burden sharing under asymmetric shocks

Capital market integration is already one way to share the costs of asymmetric shocks: as section 4.4 reminded, shocks hitting only one country can spill over to other countries, because public relief programmes drag resources away from integrated capital markets and crowd out private investment in all countries. Cross-country spillovers remain however limited, with spillover rates never found to exceed 30%.

According to the theory of optimum currency areas (Mundell, 1961), a number of conditions need to be fulfilled before creating a currency union: trade between members should be large, countries subject to similar exogenous shocks and there should be appropriate adjustment mechanisms to offset country-specific exogenous shocks. The consensus in the literature is that the first two conditions were met at the creation of the Euro, but not the third one (Eichengreen, 1990). Given the limited size of cross-country spillovers, additional policy measures may be needed to increase the degree of burden sharing in case of asymmetric shocks.

The use of central funds is one option to share the burden of large, one-time asymmetric shocks. There are other options, which may be better or worse. What may be surprising with central funds are their relatively low public finance costs, building on finding 10 of section 4.4:

Policy implication 2 (burden sharing). *In public finance terms, sharing the economic burden of large, one-time asymmetric shocks is a smaller task than it appears at first sight, as co-financing as little as 30% of domestic relief programmes can be sufficient to equalize the macroeconomic losses of all countries, hit by shocks or not.*

Full sharing of the public finance costs of domestic relief programmes is thus not necessary in all cases. The same conclusion may or may not be reached for insurance against frequent and low magnitude shocks. The answer to this question is left to future research.

5.3 Other policy implications

Simulation results presented in section 4 have additional policy implications.

When central funds can be operated with no efforts and countries grow at the same long-run rate, a consistent outcome of the simulations is that one can shift economic prosperity around countries through central fund allocations at no efficiency cost (nor gain), in the sense that the average GDP impact per capita over all countries remains unaffected by the central fund. This finding holds whatever the redistribution motive

considered here, whether it be differences in public finances, output, asymmetric shocks or unemployment (see findings 1, 5, 6 and 9)[21].

The analysis of central fund options based on unemployment differences delivers additional specific insights. Overall, designing central fund schemes based on public finance indicators only is unlikely to reduce differences in unemployment rates across countries, which may be inconsistent with the policy objectives. For instance, defining transfer schemes on the basis of aggregate unemployment insurance costs will not lead to convergence of unemployment rates across countries (finding 7). Instead, labor market indicators, such as the unemployment rate, appear necessary to define a resource allocation scheme that leads to convergence.

6 Concluding remarks

This paper investigates macroeconomic consequences of cross-country transfers within the European Union using a multi-country computable general equilibrium model covering 14 countries. Unlike previous studies, it devotes as much attention to net contributor countries as net recipients and takes capital-skill complementarities into account, a feature consistent with empirical evidence which influences cross-country spillovers with integrated capital markets.

The simulations show that cross-country transfers can shift prosperity around at no efficiency costs nor gains, provided there are no administration costs and net recipient countries use the transfers to stimulate economic activity, for instance through a reduction of distortive taxation. If net recipients however use the transfers to support household income with unconditional subsidies, the net deadweight loss can reach 5% to 8% of the total transfer scheme. Cross-country transfers should thus be earmarked to reduce distortions due to taxes or other causes. This policy implication is consistent with some analyses of the foreign aid literature and inconsistent with others, a contribution to the on-going debate on the conditionality of aid (Temple, 2010).

Simulations also show that the economic burden of large, one-time asymmetric shocks can be shared across the union at a reduced public finance cost, for a co-financing share of relief programmes in countries under stress as low as 30%. Burden sharing may thus be cheaper than expected, from a public finance standpoint. Whether such a finding holds or not in case of repeated, high-frequency and smaller asymmetric shocks, typical of real business cycle fluctuations, is left for future research.

[21] As a caveat, remember the assumption of identical exogenous productivity growth across countries. Analysis with an endogenous growth multi-country model would be needed to investigate potential efficiency gains from redistribution programmes with growth catch-up objectives.

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A Appendix: overview of results for all countries

Public financed-based option

	Baseline	
	Net transfer	GDP/capita (%)
Austria	-0.10	-0.19
Belgium	0.18	0.35
Czech Republic	-0.52	-0.97
Denmark	-0.43	-0.91
Finland	-0.39	-0.69
France	0.09	0.15
Germany	0.01	0.02
Italy	0.51	1.02
Netherlands	-0.20	-0.38
Poland	-0.33	-0.61
Slovakia	-0.55	-0.97
Spain	-0.28	-0.58
Sweden	-0.49	-1.02
United Kingdom	-0.06	-0.12

Legend: see table 1.

Output-based options

	Transmission labor tax		Transmission transfers		Mixed transmission	
	Net transfer	GDP/ capita(%)	Net transfer	GDP/ capita(%)	Net transfer	GDP/ capita(%)
Austria	-0.18	-0.34	-0.18	-0.19	-0.18	-0.33
Belgium	-0.11	-0.22	-0.11	-0.12	-0.11	-0.21
Czech Republic	0.34	0.64	0.34	0.36	0.34	0.36
Denmark	-0.22	-0.47	-0.22	-0.24	-0.22	-0.46
Finland	-0.09	-0.17	-0.09	-0.10	-0.09	-0.16
France	0.00	0.00	0.00	0.00	0.00	0.01
Germany	-0.14	-0.25	-0.14	-0.15	-0.14	-0.24
Italy	0.09	0.18	0.09	0.09	0.09	0.10
Netherlands	-0.23	-0.42	-0.23	-0.24	-0.23	-0.41
Poland	0.70	1.25	0.70	0.73	0.70	0.73
Slovakia	0.50	0.87	0.50	0.51	0.50	0.52
Spain	0.20	0.40	0.20	0.20	0.20	0.21
Sweden	-0.18	-0.37	-0.18	-0.19	-0.18	-0.37
United Kingdom	0.01	0.01	0.01	0.01	0.01	0.01

Legend: see table 2.

Unemployment-related options

	Cost-only option			Cost-and-rate option		
	Net transfer	GDP/ capita(%)	Unemp-loyment (p.p)	Net transfer	GDP/ capita(%)	Unemp-loyment (p.p)
Austria	-0.08	-0.17	0.03	-0.16	-0.33	0.05
Belgium	0.55	1.08	-0.15	0.36	0.70	-0.10
Czech Republic	-0.06	-0.12	0.02	-0.08	-0.15	0.02
Denmark	0.22	0.61	-0.17	-0.12	-0.31	0.09
Finland	0.72	1.33	-0.22	0.33	0.62	-0.10
France	0.45	0.90	-0.15	0.42	0.83	-0.14
Germany	0.20	0.38	-0.06	0.00	0.00	0.00
Italy	-0.50	-1.05	0.14	-0.27	-0.57	0.08
Netherlands	0.12	0.26	-0.05	-0.18	-0.38	0.08
Poland	-0.39	-0.71	0.08	-0.03	-0.05	0.01
Slovakia	0.27	0.51	-0.06	0.63	1.21	-0.13
Spain	-0.05	-0.12	0.03	0.12	0.29	-0.06
Sweden	0.17	0.37	-0.08	0.01	0.01	0.00
United Kingdom	-0.54	-1.12	0.18	-0.34	-0.71	0.12

Legend: see table 3.

Asymmetric shock options

	No central fund		Central fund	
	Net transfer	GDP/capita (%)	Net transfer	GDP/capita (%)
Austria	0.00	-0.10	-0.31	-0.20
Belgium	0.00	-0.08	-0.31	-0.18
Czech Republic	0.00	-0.09	-0.31	-0.19
Denmark	0.00	-0.10	-0.33	-0.22
Finland	0.00	-0.08	-0.32	-0.18
France	0.00	-0.09	-0.31	-0.19
Germany	0.00	-0.66	1.10	-0.26
Italy	0.00	-0.12	-0.31	-0.23
Netherlands	0.00	-0.09	-0.31	-0.20
Poland	0.00	-0.06	-0.32	-0.17
Slovakia	0.00	-0.10	-0.31	-0.19
Spain	0.00	-0.16	-0.30	-0.25
Sweden	0.00	-0.07	-0.32	-0.19
United Kingdom	0.00	-0.07	-0.31	-0.18

Legend: see table 4.

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