On the Design of a European Unemployment Insurance

Ekaterina Jürgens

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First supervisor: Prof. Michael Krause, Ph.D.
Second supervisor: Prof. Dr. Andreas Schabert

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Abstract

To make Eurozone more resistant to crises, a common European Unemployment Insurance (EUI) has been discussed as a shock absorption instrument on the union level. Such a EUI could have a large capacity to work as an automatic stabilizer and ensure regional risk-sharing in the monetary union. However, its implementation is associated with challenges, namely, the moral hazard effect and the need to align the national unemployment benefit (UB) schemes. By means of literature review and theoretical macroeconomic analysis, based on a dynamic stochastic general equilibrium model with frictional labour markets, this paper evaluates whether a EUI could be a suitable shock absorption tool and how it should be designed to fit the purpose without hazardous side effects.

A model of two countries is developed and calibrated to the core and periphery of the Eurozone to inspect the stabilization effects of a centralized unemployment insurance in case asymmetric shocks hit the union. It is demonstrated that a common UB fund brings about substantial stabilization gains. Differences in labour market parameters and social security systems are not a major obstacle to implement it. The transfer system enables adoption of countercyclical fiscal policy, while keeping UB payments much more stable throughout the cycle. This ensures an overall smoother consumption path. The more business cycles diverge across the union, the larger gains are generated. Still, such scheme can induce substantial permanent transfers and thus moral hazard. The modelling exercise shows how unidirectional transfers can be limited by a repayment rule. The parameters of the clawback determine the trade-off between the stabilization and redistribution. In addition, a comparative review of the policy proposals for a EUI evaluates how the trade-off can be addressed in practice with a range of available instruments. All in all, the analysis suggests that a smart design can limit side effects of the common unemployment insurance while promoting its shock absorption properties.

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List of Abbreviations

DSGE Dynamic Stochastic General Equilibrium

EC European Commission

ECB European Central Bank

EMU European Monetary Union

EPL Employment Protection Legislation

EU European Union

EUI European Unemployment Insurance

GDP Gross Domestic Product

IMF International Monetary Fund

OCA Optimum Currency Areas

OECD Organisation for Economic Cooperation and Development

QE Quantitative Easing

SGP Stability and Growth Pact

UB Unemployment Benefits

1 Introduction

The European Economic and Monetary Union (EMU) has experienced a decade of sluggish growth triggered by the global financial crisis and the following multiple sovereign debt crises. Worryingly, the economic struggle is fuelling discontent among voters and can potentially result in a loss of political legitimacy of the European Union (EU). The dissent with the governance has manifested itself in increased support for populist parties on both sides of the political spectrum. This, in turn, makes the much needed political consensus and cooperation on the union level even less feasible. In the light of the economic and political trends and in anticipation of the upcoming European elections in May 2019, debates are reviving on how to heal the “design flaws” of the Eurozone and increase its resilience against crises.

Indeed, ten years after the Great Recession unfolded, euro economies are still slowly recovering, with the gross domestic product (GDP) exhibiting rather weak dynamics (International Monetary Fund - IMF, 2019). Although unemployment rates in EMU as a whole are declining, southern countries, such as Greece, Spain, and Italy, are lagging behind the euro average on job creation, especially for the young (see Figure 4). After a brief spark of hope for an accelerating upswing in 2017, recent forecasts have been corrected downwards as “Europe’s locomotive” – Germany – recorded negative and zero growth, respectively, in the last two quarters of 2018 (IMF, 2019), putting a question mark behind the steady improvement in the Eurozone.

As a matter of fact, are European institutions well-equipped to counteract the next crisis when it eventually hits? The opportunities of the monetary policy are, under today’s circumstances, exhausted because the interest rates are already at their lowest. Since the monetary policy is effectively constrained by the zero lower bound, which means that the interest rates cannot turn negative, the European Central Bank (ECB) has been running the quantitative easing (QE) programme, flooding the markets with money, to achieve its inflation target of 2 percent. The ECB is planning to wrap up the QE programme and subsequently start to return gradually to a more conventional interest rate policy, increasing the potential room for manoeuvre (“Monetary policy decisions”, 2018). However, a threat of a new slowdown can effectively put this plan on halt.

At the same time, fiscal policy options are still restricted in many member states by unprecedented debt levels which exploded in the wake of the global financial crisis (see Figure 2). Austerity measures, which Europe had to undergo to address the lingering debt problem, have brought little relief. Actually, some argue (Stiglitz, 2016, p.231) that they worsened the situation. Sovereign debt as a percentage of GDP has been climbing further up in Greece, Spain, and Italy since the economy did not improve under budget cuts. Instead, poor growth and austerity came hand in hand with political radicalization in Europe. Parties on both political extremes have gained power, whereas faith in European institutions and solidarity with other Europeans have dwindled (Adorf, 2017). There is evidence that individual exposure to austerity measures in the United Kingdom explains the support for the UK Independence Party and the "Leave" vote in the Brexit referendum (Fetzer, 2018).

Since conventional policy instruments lack the capacity to provide for enough stability in the Eurozone, unprecedented proposals for centralized shock absorption mechanisms have made it on the European agenda after the crisis. In fact, the discussion has a long-lasting history: European Commission (EC) reports stressed the need for advanced risk-sharing in EMU, in order to ensure economic stability, already in the seventies (Marjolin et al., 1975; MacDougall et al., 1977). These documents suggested that deeper fiscal unification would be necessary for the viability of the currency union. Nevertheless, it was not until the former President of the European Council Herman Van Rompuy published his report "Towards a genuine Economic and Monetary Union" (2012) that scholars and policy advisors engaged in more detailed discussion and evaluation of policy instruments for the shock absorption on the central level.

Among other policy proposals, an often discussed risk-sharing instrument to arm the union against idiosyncratic shocks is a *European Unemployment Insurance* (EUI) which is usually sketched out for the euro countries with the option to extend the scheme to further member states. A (partial) centralization of the national unemployment insurance funds is most often understood under a EUI. Under such a common unemployment benefit (UB) scheme social security contributions would be collected to a centralized budget, and Europeans would receive a share of their unemployment money paid out of that fund. This policy proposal has been dubbed a "genuine" EUI because it implies actual fiscal integration in Europe. Another option for a EUI, which gained popularity recently, is a reinsurance for the national UB budgets. This solution implies a creation of a joint rainy day fund where national social security systems can draw resources from in events of crises. Reinsurance is also called an "equivalent" EUI since it could enable risk-sharing without any further fiscal integration. In what follows, it is not explicitly distinguished between a genuine and an equivalent scheme in the text, unless their differences are what is being examined.

When German Finance Minister Olaf Scholz offered his own design proposal for a reinsurance of the national UB schemes last year ("Germany Has a Special Responsibility: Interview with Finance Minister Olaf Scholz", 2018), the idea seemed to gain political momentum. Actually, a recent representative survey conducted in 13 member states demonstrated that a EUI, in one or another version, might be supported by a majority of the European voters (Amsterdam Institute for Social Science Research, 2018).

Nevertheless, a EUI has been disputed as a policy instrument because it raises a number of concerns. The most prominent preoccupations include a potential moral hazard effect on domestic governments and the disparities in UB systems and labour market structures across the union. For example, German economic policy advisors voiced their scepticism about installing euro-wide risk-sharing instruments of this kind (Sachverständigenrat, 2018).

Stimulated by this controversy, this paper aims at addressing the following questions: should the Eurozone be equipped with a EUI? If so, what seems like a more suitable design for such an instrument, keeping in mind its purpose and possible caveats? One prominent and fruitful approach to the analysis of a EUI is based on employing dynamic stochastic general equilibrium (DSGE) models with frictional labour markets. This paper will look deeper into this strand of research and will make an independent attempt to evaluate a supranational UB scheme using this toolbox.

The paper will include the following steps. First, it will summarize the current state of debate on the rationale of equipping the Eurozone with risk-sharing instruments. Namely, it will examine why sharing a currency is associated with potential drawbacks, how the Eurozone copes with shocks and divergent reactions to macroeconomic events, and why a common UB scheme could be an appropriate mechanism to strengthen the currency area under the circumstances. Next, the difficulties of the implementation of a EUI will be explained, i.e. a potential moral hazard effect and the challenge of accounting for discrepancies in national unemployment insurance schemes.

The subsequent chapter will be devoted to the theoretical analysis of a common UB fund for a union of countries on the basis of a DSGE model with labour market frictions. A model of two countries will be developed and calibrated to the core and periphery of the Eurozone to inspect the stabilization effects of a centralized unemployment insurance in case asymmetric shocks hit the union. Indeed, the transfers between the countries allow them to conduct countercyclical fiscal policy during recessions and booms and thus smooth consumption. The greater the business cycles diverge across the union, the larger the stabilization gains are. However, the implemented UB scheme also leads to unidirectional transfers from the country which experiences smaller shocks to the one which is hit harder. To correct this, the common unemployment insurance will be completed by a clawback rule which ensures a gradual repayment of received transfers. It will be shown that there is a trade-off between the redistribution and stabilization.

In the light of the theoretical findings, existing policy proposals for a EUI will be reviewed and compared. It will be discussed how a common UB scheme should be designed to work as an automatic stabilizer and to avoid the standardization of the national UB systems. Options envisaged to address the trade-off between the redistribution and shock absorption will be evaluated. The analysis will highlight how the system could operate without distorting incentives and nevertheless bring about considerable stabilization gains. The last chapter will conclude.

2 The economics (and politics) of a EUI

This chapter will cover the extensive economic and political debate on the rationale for equipping EMU with a common UB scheme, as well as the difficulties associated with its implementation. The first section elaborates on the reasons why the currency union might need unprecedented risk-sharing instruments and why unemployment insurance could be a particularly well-suited mechanism for this goal. The second section will clarify the obstacles, such as large differences in the national UB systems and the moral hazard.

2.1 The case for a common UB scheme in the Eurozone

2.1.1 Downsides of sharing a currency

Members of a currency area, such as the Eurozone, are by definition subject to a uniform monetary policy conducted by a single central bank. Once hit by an idiosyncratic shock, a country in a monetary union cannot counteract it by setting interest rates and regulating the price of the domestic currency. It has to rely on other correction mechanisms instead, such as real wage adjustments, shifts of labour and capital, and fiscal policy. Giving up control over the monetary policy is considered to be the macroeconomic cost of sharing a currency (De Grauwe, 2016, p.3). The cost has to be weighed against the benefit, e.g. elimination of transaction expenses.

This peril is, however, lesser for a group of countries forming an optimum currency area. The seminal theory of optimum currency areas (OCA), pioneered by Mundell (1961), suggests that a monetary union is a viable endeavour, should it satisfy the following conditions: wage and price flexibility and factor (labour) mobility between the member states. This can be explained with a simple two-country example: imagine France and Germany share a currency. An exogenous shift in demand from French to German products would push France into recession and cause unemployment, whereas Germany would experience a boom and might "overheat". The automatic correction via appreciation of the German mark and devaluation of the French franc is not available in the monetary union. Instead, according to Mundell, France can undergo a period of deflation to restore its competitiveness vis-à-vis Germany, or French unemployed workers can migrate to take on German jobs.

Further OCA criteria complemented the theory over time: openness of the economy, i.e. the relative proportion of goods and services sold and bought abroad (McKinnon, 1963), and production diversification (Kenen, 1969) among others (for a comprehensive overview see Mongelli, 2008). These characteristics are critical for reducing the probability of divergent economic developments in a currency union and, therefore, curtailing the risks associated with the lack of discrete monetary adjustment mechanisms.

Prior to the euro launch, economists were pointing out that EMU does not adhere to the OCA criteria, and thus is vulnerable to idiosyncratic shocks (Eichengreen, 1991;

Bayoumi & Eichengreen, 1992; Feldstein, 1997). Krugman (1993) warned that monetary integration would exacerbate the economic asymmetry due to regional industrial concentration. Nevertheless, some believed that OCA criteria were endogenous and predicted that economic convergence in the euro area would be fostered by the common currency (European Commission, 1990; Bayoumi & Eichengreen, 1992). Others claimed that domestic business cycles would align due to trade integration (Frankel & Rose, 1998) since EMU would experience a sizable increase in interregional trade with the introduction of the euro – what is known as the Rose effect (Rose, 2000).

The Rose effect was estimated to be substantial: trade within the currency union was boosted by between 9 and 20 percent in comparison to non-euro countries (Micco, Stein, & Ordonez, 2003). However, the OCA endogeneity hypothesis did not prove empirically. Advanced trade integration did not result in convergence of the business cycles across the community. On the opposite, euro countries experienced remarkably discordant economic trends in the early years of the common currency. While the economy was booming in Spain, Greece, and Ireland, countries like Germany, Italy, and Portugal faced sluggish growth over the first euro decade (see Figure 1).

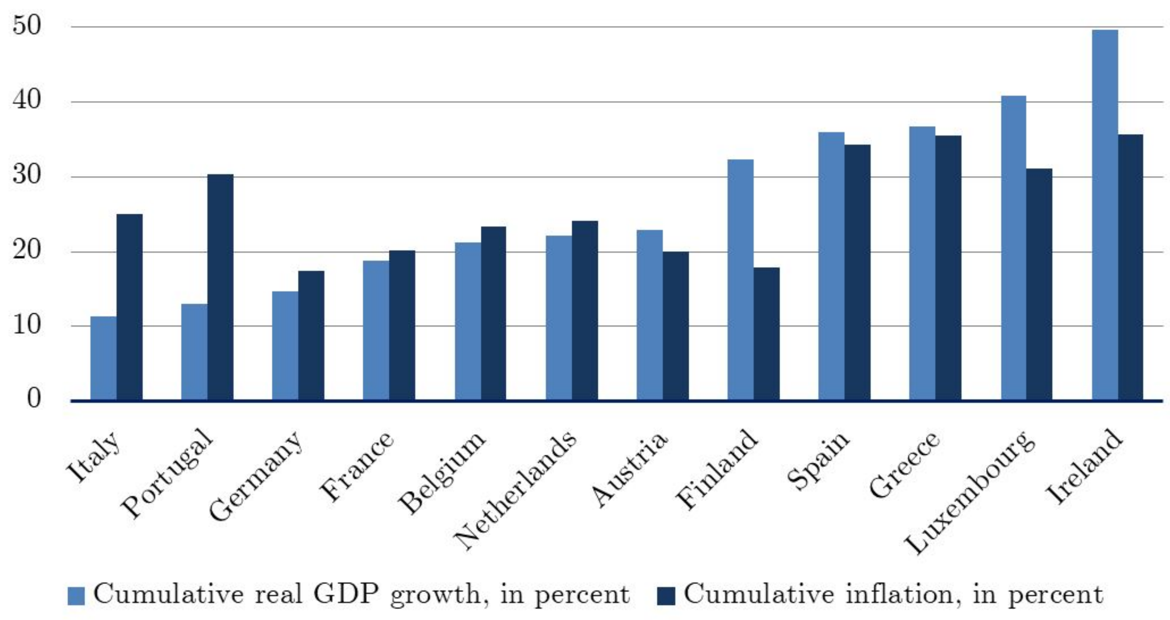

Figure 1: Diverging economic trends in the Eurozone, 1999-2008 (Eurostat, 2018b, own calculations)

In fact, the common currency in itself sufficed to exacerbate the divergent developments in the absence of a political union (De Grauwe, 2016, p.32). As long as national policies, such as taxation rules, labour market regulations, mortgage granting conditions, etc., remain desynchronized, they tend to produce positive or negative expectations which, in turn, can drive booms and busts contained within the sovereign borders. The uniform monetary policy would then tend to aggravate these developments because the "one size fits all" nominal interest rate would be expansionary for some economies and restrictive for others (De Grauwe, 2016, p.182).

It is, indeed, the real interest rate, i.e. the nominal interest rate less inflation, that determines the impact of the monetary policy on the real economy. Inflationary trends diverged substantially across the union after the introduction of the euro (see Figure 1), resulting in the discrepancy in real interest rates. Since prices were rising more steeply in the European South, the periphery boom was further fuelled by comparatively lower real interest rates. Eventually, the credit crunch unfolded during the global financial crisis, and those economies experienced a dramatic collapse of aggregate demand and a series of acute and contagious debt crises. Since then, the real interest rate has been higher for the periphery countries, with a procyclical effect, because the banks in those member states face higher borrowing costs in the interbank market (Baldwin & Wyplosz, 2015, p.459).

To sum up, giving up control over the national monetary policy has dangerous downsides. Divergent economic trends tend to be intensified by the uniform central bank policy. The next section will describe the possible ways to deal with idiosyncratic shocks in a currency union and how well they function in the Eurozone.

2.1.2 Shock absorption mechanisms in EMU

As already the early OCA theory suggested, labour mobility in a currency union should work to smooth asymmetric developments. Also, economic textbooks suggest that risk-sharing through capital markets is another way to deal with economic shocks. In addition, it was devised in the Maastricht Treaty that member states, being in full charge of their sovereign fiscal policies, would be able to counteract recessions with government spending. How well these instruments served their purpose in EMU will be discussed in what follows.

Labour mobility Mundell (1961) recognized in advance that workers' migration is essential in smoothing regional shocks in a monetary union. However, early studies (Fatás, 2000) indicated that Eurozone's labour mobility was low, compared to the United States, and Europeans were more likely to drop out of the labour force than to migrate elsewhere for employment. It has to do with cultural reasons, such as large differences in languages and customs across the community, and importance of family ties for the Europeans, but also with economic barriers, such as the non-continuity of the social support systems and high costs associated with the change of dwellings (Baldwin & Wyplosz, 2015, p.370-371). The share of the European Union residents, who relocated permanently to another EU member state in 2016, amounted to 0.33 percent (Eurostat, 2018a) and remained well below of the 0.83 percent of US residents relocating interregionally[1] in the same year (US Census, 2018). Labour mobility, however, constitutes only a minor share of the overall migration flows (Baldwin & Wyplosz, 2015, p.370-371).

Recent research suggests that the role of interregional mobility in shock absorption has increased over time in Europe, narrowing the gap with the US (Dao, Furceri, & Loungani, 2014; Beyer & Smets, 2015; Jauer, Liebig, Martin, & Puhani, 2018). Nevertheless, there's one caveat when it comes to the labour migration as a smoothing mechanism. There is evidence that human capital is not (perfectly) portable across borders (Friedberg, 2000; Basilio, Bauer, & Kramer, 2017). Thus, a potential efficiency loss is associated with relocation in case immigrant workers, due to a lack of language or other area specific skills, cannot be employed in the jobs of the same quality abroad as at home. If it eventually results in destruction of human capital, labour mobility is an economically inefficient mechanism of adjustment (Dullien, 2017b).

Risk-sharing through financial markets As classical textbooks describe (Mankiw & Taylor, 2011, p.850-851), integrated credit and stock markets in a currency union serve as a risk-sharing mechanism. First, households can bolster an adverse shock to their income by holding a diversified international stock portfolio. Second, they can turn to banks abroad to borrow and smooth their consumption during the downturn. Asdrubali, Sørensen, and Yosha (1996) provided a widely cited evidence that capital markets cushion

[1] Regions defined as Northeast, Midwest, South, and West.

39 percent and credit markets 23 percent of asymmetric shocks in the US, albeit the study is being criticized for its methodology (Dullien, 2017a).

In practice, however, private insurance via financial markets in EMU is impeded by the fact that a large share of European households does not hold substantial financial assets. A representative survey on saving behaviour conducted annually by the ING International Survey (2019) showed that 27 percent of all respondent households in 12 European countries and Turkey didn't have any savings at all in 2018. Furthermore, among those Europeans, who manage to preserve for the future, the majority prefers bank deposits to bonds and stocks (Véron & Wolff, 2015). Moreover, private and institutional investors, who do hold financial instruments, are biased towards domestic assets and, therefore, use cross-border risk sharing insufficiently. Similarly, European credit markets are also subject to considerable home bias, and shock absorption via international lending remains limited in the euro area (Véron & Wolff, 2015).

Government spending Fiscal policy is another shock smoothing mechanism which, ideally, works as an automatic stabilizer (Mankiw & Taylor, 2011, p.778). When the economy enters a recession, tax revenues decline (and if the tax system is designed progressively, tax revenues fall faster than the income does) and social security payments increase without any deliberate action, working countercyclically to smooth the shock. It implies, however, that the government maintains a liquidity reserve or can borrow to make up for the lower income and larger spending in an economic crunch.

Importantly, public financial injections into the economy often result in a GDP boost of an over-proportional magnitude. The degree of the eventual growth response depends on the fiscal multiplier. The multipliers are country-specific and vary depending on the business cycle and type of expenditure (IMF, 2009). They are estimated to be larger when the economy is sluggish, compared to periods of high growth; their values fall roughly in the range between 1 and 1.5 during recessions (Auerbach & Gorodnichenko, 2012). Monacelli, Perotti, and Trigari (2010) also provide empirical evidence that, in the US, an additional 1 percent of government spending boosts GDP by 1.2 to 1.5 percent, whereas the unemployment falls significantly. Using a model with frictional labour markets calibrated to the euro area, Rendahl (2016) illustrates the mechanism of the multiplier effect: while government spending creates higher employment anticipated to persist, the expectation of increasing incomes in the future induces a rising demand already today, setting off a virtuous employment-spending spiral.

The Maastricht treaty envisaged that, while the central bank would be addressing euro area wide shocks, country specific shocks could be tackled by the national fiscal policies. It was, therefore, deemed important to keep sovereign budgets viable, so the brakes on the government debt and the mechanisms ensuring fiscal prudence were adopted with the Stability and Growth Pact (SGP).[2] But, with the low political pressure to reduce debt levels during good times and with the need for unprecedented government spending to rescue the failing banking system, the debt levels in many European countries exploded in the aftermath of the global crash (Stiglitz, 2016, p.14).

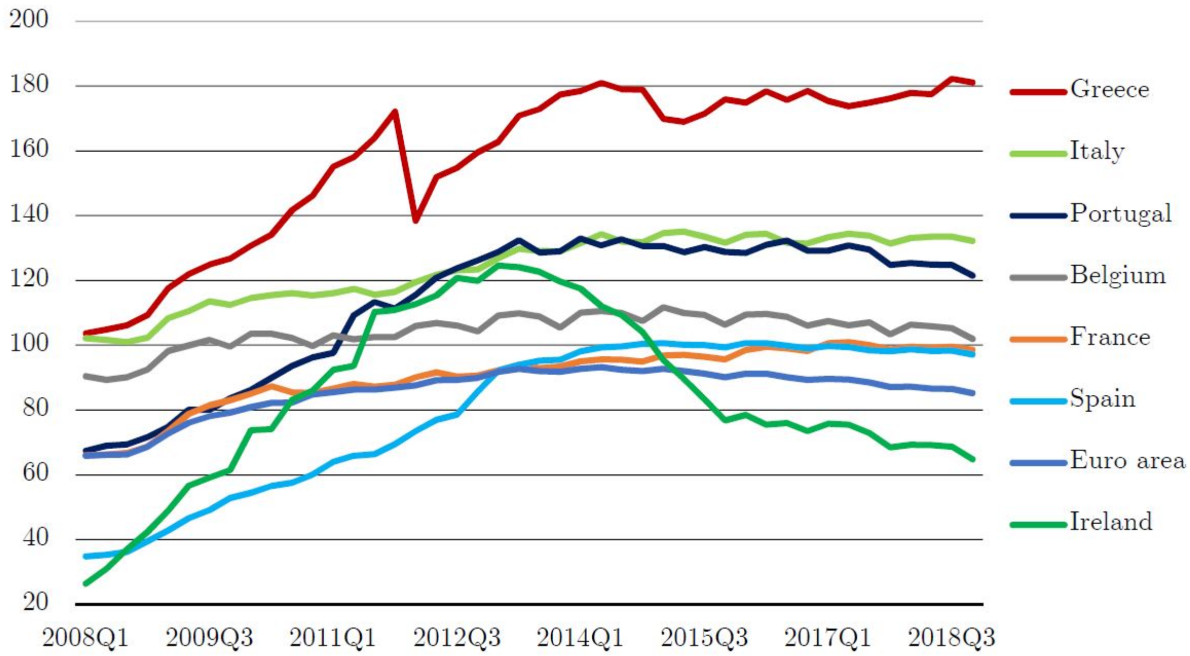

Figure 2: Debt-to-GDP ratios in selected euro countries, in percent, quarterly data, 2008-2018 (Eurostat, 2019a)

The following European sovereign debt crisis effectively cut off lending to the periphery states. Even the governments, which adhered to the fiscal rules prior to the crisis, such as Spain and Ireland, were practically denied the opportunity to borrow in the financial markets. Indeed, since euro countries don't have the full control of the currency, in which

[2]Debt must not exceed 60 percent of GDP and deficit 3 percent of GDP.

they borrow, they are prone to self-fulfilling liquidity crises which, in the absence of "the lender of last resort" can translate into a default (De Grauwe, 2016, p.11-12). As a consequence, the troubled member states had to accept loans from the troika (formed by the EC, the ECB, and the IMF) under austerity conditions which, in turn, further limited their fiscal sovereignty (Stiglitz, 2016, p.17).

Presently, since actual monetary policy faces zero lower bound, fiscal policy has gained even more importance as a stabilization mechanism for EMU. It is argued that government spending stimulates the economy more effectively when interest rates are close to zero (Christiano, Eichenbaum, & Rebelo, 2011). However, after a decade of low growth, debt-to-GDP ratios are still well above the SGP requirements in Southern Europe, as well as in France and Belgium (see Figure 2). Thus, national room for fiscal manoeuvre remains constrained today by the fiscal rules and the anticipated market reaction, as the prominent dispute on the Italian budget makes evident (Claeys & Collin, 2018).

All in all, with a rather low labour mobility, in the absence of fully integrated capital and credit markets, with restricted fiscal sovereignty, the currency union has nowadays a limited capacity to counteract idiosyncratic shocks or asymmetric reactions to a common external shock. The decade after the global financial crisis has illustrated the consequences of such fragility. The last ten years were characterized by low growth rates in the Eurozone as a whole, and by persistently high unemployment in the European South. This, in turn, resulted not only in social hardships and a loss of human capital in the European South, but also came with the rise of the populist powers across the union. Inevitably, a new acute crisis will hit. Some scholars voice concerns that the euro project might not survive it, if not completed with stabilization mechanisms (Bénassy-Quéré et al., 2018; Feldstein, 2015; Stiglitz, 2016). This is why De Grauwe (2016, p.19) calls for the completion of the "fragile monetary union" with a budgetary union.

Recently, there has been an outbreak of theoretical studies providing the evidence in favour of completing a currency union with common fiscal instruments. A prominent paper by Farhi and Werning (2017), who analyse monetary unions with incomplete financial markets, shows that it is optimal to provide a fiscal transfer mechanism to compensate for risks emerging from nominal rigidities. Engler and Voigts (2013) find that asymmetric shocks in a monetary union with low labour mobility and imperfect goods and capital markets considerably exacerbate consumption and employment fluctuations. The authors demonstrate that fiscal transfers, with net payments cancelling out over time, are more efficient at stabilization, than the national policies, since they are not subject to Ricardian equivalence effects and risk premia. Evers (2012) evaluates various automatic triggers for fiscal transfers in a currency union, finding that a combination of consumption and labour income targeting should be optimal. In his later paper, Evers (2015) argues that a common fiscal authority brings substantial welfare gains by smoothing consumption fluctuations over the business cycle, but revenue sharing within the union destabilizes regional consumption and income. The contribution by Hjortsoe (2016) shows that, for a currency union lacking insurance against asymmetric shocks, a centralized fiscal authority could create sizable welfare gains by reducing inefficient current account movements.

To sum up, a partial fiscal centralization appears beneficial for EMU. However, such reform could be implemented in various ways. Whether the architecture of EMU would be improved by the new mechanism or not, depends, to the highest extent, on its capacity to cushion country specific shocks. Why a EUI could be a particularly suitable common fiscal instrument to make the Eurozone more robust is illustrated in the next section.

2.1.3 EUI as an automatic stabilizer and a risk-sharing instrument

A common European (Eurozone) UB scheme is supported by several arguments. Its first advantage is the ability to smooth asymmetric shocks automatically.[3] The net contributions of the member states into the common fund would increase naturally during growth times, when more people find jobs, whereas the UB transfers decrease, dampening the boom development. The opposite holds for a recession: euro countries experiencing a slump would see their unemployment insurance receipts quickly decline and spending spike, automatically bolstering the fall in aggregate demand. Moreover, UB spending primarily targets those who suffer the most from a shock and who are likely to immediately inject the transferred liquidity into the economy, giving it thus a very timely and efficient push (Beblavý, Maselli, & Marconi, 2015).

[3]Various solutions for a EUI are described in Chapter 4. For the argument outlined here, a genuine EUB scheme or an automatically triggered one is assumed.

The policy is in this respect identical to the national government spending, characterized by large multipliers, as described above. Nevertheless, the advantage of a EUI would be its independence of the markets, which are prone to sudden mood swings, and the maintenance of a liquidity reserve for stability purposes. A partial centralization of the social security funds, thus, circumvents the current limitations of the national budgets, illustrated in the previous section, and re-establishes the stabilization function of the fiscal policy.

Indeed, European governments demonstrated a remarkably strong deficit bias prior to the Great Recession since politicians have little incentive to repay already existing debts during their ruling term, even if the economy is recovering (Baldwin & Wyplosz, 2015, p.430-431). In this case, a commonly maintained financial pool, e.g. a EUI, could overtake the role of a rainy day fund (Beblavý et al., 2015). The instruments to maintain the balance between the payments into and out of the system, such as experience ratings, could ensure that the countries with a greater need for stabilization also save more for the future. In fact, if such a supranational fiscal institution were by design able to additionally borrow in the financial markets, it would be not vulnerable to the same self-fulfilling debt crises as single member states (De Grauwe, 2016, p.18). Thus, a EUI appears suited to perform as an automatic stabilizer to a higher extent than the national budgets. In addition, if member states shift a part of their social security systems to the EU or Eurozone level, they might see their borrowing costs sink, making more room for national fiscal manoeuvre during a crisis (Dullien, 2017b).

Another major advantage of a EUI is its role as a risk-sharing instrument. If the business cycles in EMU are asymmetric, a supranational social security system can smooth the regional shocks by reducing upward pressure on the prices in the booming areas and bolstering the income drop in sluggish regions. Under such a system, the euro countries could smooth their consumption path not in spite of, but rather because of divergent business cycles (De Grauwe, 2016, p.17). A common UB scheme would thus allow for geographical risk-sharing among the member states and might be able to diminish the asymmetry of adverse shocks across the community.

The idea of the interregional risk-sharing in Europe is also supported by the notion of fiscal externalities (Beblavý et al., 2015). Fiscal spillovers occur between interlinked economies (Goodhart & Smith, 1993). Since a massive share of the European trade occurs within EU borders (Eurostat, 2018d), the results of a fiscal stimulus in one country affect other member states positively via increased demand for their goods (Beetsma, Giuliodori, Klaassen, & Wieland, 2006). Individual countries have, therefore, a reduced incentive to counteract the regional shock if they don't fully internalize the benefits of the costly policy. If the shocks are not bolstered, however, the whole union is hurt. Therefore, geographical risk-sharing is desirable.

In this section, the theoretical and empirical characteristics of EMU, which allow to consider it an "incomplete" monetary union, were outlined: euro area does not comply to OCA criteria and lacks sufficient automatic stabilizers. It was argued that centralized fiscal instruments are desirable in the Eurozone to improve shock absorption. It was explained why a common unemployment insurance (or reinsurance) could be an especially suiting policy mechanism. A EUI can provide for more stability in Europe for two main reasons. First, it has a greater capacity to work as an automatic stabilization instrument with potentially large multiplier effects. Second, it enables interregional risk-sharing in an environment characterized by asymmetric cycles and substantial fiscal externalities. Having now established that there is a case for a common euro area UB scheme, the challenges of its implementation and the potential perils will be clarified.

2.2 Challenges of a EUI

2.2.1 Differences in national UB schemes

One of the crucial issues to consider, when it comes to discussing Eurozone or EU-wide unemployment insurance schemes, is the conspicuous diversity of the national support solutions for the jobless and the structures of the labour markets across the union. The goal of a EUI is not to alter incentives for the unemployed, but to provide risk-sharing. Therefore, a newly established common system should ideally let the national schemes as they are. But accounting for their disparities is challenging. Albeit the effort to provide a benchmark for unemployment insurance standards to enable coherent social security is on the European agenda (European Commission, 2017), there is presently a notable divergence in national UB systems on many levels, as this section will outline.

A range of characteristics – the replacement rate (the share of previous earnings substituted by the UB), the duration of the payments, the qualifying conditions, etc. – varies remarkably across the member states. In addition, unemployment rates, as well as the rates of labour market transitions and average job tenure, are not harmonized in Europe. This section will illustrate the discrepancies and attempt to find their common denominator. Since the goal of a EUI would be to target people losing jobs in the event of an acute economic downturn, the focus of this section lays on the short-term unemployment, lasting no longer than one year.

An obvious comparison criterion is the generosity of the social security payments to people who have recently lost their job. According to the data of the Organisation for Economic Cooperation and Development (OECD), an average single European without children, upon entering unemployment, would receive a monthly UB ranging from 13 to 86 percent of her previous net income, depending on the country of residence (see Figure 3). The dispersion is, however, less striking for a family with two kids and less pronounced if one only considers the euro countries.

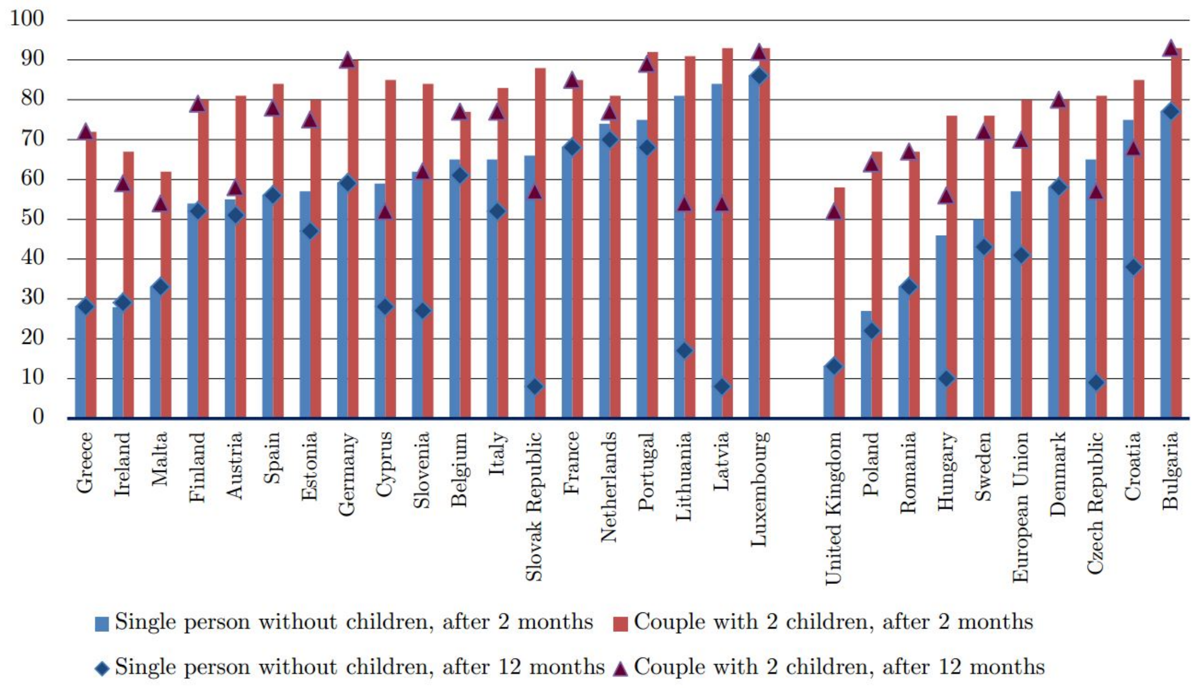

Figure 3: Net replacement rates across the Eurozone and the EU, in percent of previous net income, 2018 (OECD, 2019a)

Besides that, after a year without a job, some national schemes still ensure a high replacement rate, while others reduce the transfers dramatically (see Figure 3), since the duration of the UB payments also varies considerably across the EU, between several months and over two years (OECD, 2018, p.198). In addition, coverage rates differ a lot, mostly due to discrepancies in qualifying conditions and bureaucratic hurdles. For example, eligibility of self-employed and workers in non-standard employment is regulated differently in various member states. In 2016, less than 15 percent of all unemployed received benefits in Greece, Italy, Poland, and the Slovak Republic, whereas the share of recipients was almost as high as 70 percent in Finland (OECD, 2018, p.193-194).

The variation in the social security generosity manifests itself in the government budgets, too. While some European welfare states, such as Finland, spend about 2.3 percent of their GDP on UB payments, former Soviet Bloc countries only allot 0.1 to 0.5 percent of GDP to UB transfers (Eurostat, 2018c). The financing side also differs considerably. Some countries, e.g. Denmark, fund their socials systems with taxes, and others predominantly with employees' (Slovenia) and employers' (Estonia) social security contributions (Eurostat, 2018c).

These design differences between the national schemes are to keep in mind when drafting a supranational solution. Under a genuine common EUI, net replacement rate, as well as the duration of UB payments, would be effectively constrained by the lowest level among the country members adopting it. These limits do not constitute a fatal obstacle. However, divergent eligibility conditions and funding systems are harder to make provisions for. It is difficult to account for these differences in national social security systems, whether they result from dissimilar preferences or wealth levels. A common solution might require some harmonization of the present structures.

2.2.2 Potential moral hazard effects

International risk-sharing comes with a trade-off: it can discourage local governments from exercising prudent domestic policies (Persson & Tabellini, 1996). The disincentive results from the moral hazard effect, inherent to any insurance: if the expected costs of idiosyncratic shocks are lower, the motivation to pursue sound policies, in order to reduce the risk of a sudden shock, also sinks. In case a EUI induces substantial moral hazard effects, the insurance union can become a "transfer union". The latter is characterized by substantial, unidirectional, and permanent transfers from economically successful member states to poorer ones. Permanent transfers would, in turn, further undermine the competitiveness and the willingness to reform in the receiving countries, closing the vicious circle. Such scenario is validated by some regional examples, such as the Mezzogiorno territory in southern Italy which has been long receiving sizable transfers from the central government. The incentive to implement painful reforms to restore local competitiveness has deteriorated with federal support. Thus, fiscal transfers became self-perpetuating in nature (De Grauwe, 2016, p.217).

Some calculations show that distributional effects of a common fiscal mechanism could be large in the Eurozone (Bargain et al., 2013; Feld & Osterloh, 2013; Arnold, Barkbu, Ture, Wang, & Yao, 2018). On that account, centralized insurance instruments are often criticized, e.g. by German policy advisors, since "transfers would potentially allow a member state to pursue economic and labour market policy which is politically opportune, but leads to more unemployment" (Sachverständigenrat, 2018, p.43). It is argued that the unemployment reaction to shocks is more pronounced if markets are rigid, for example, if strict employment protection legislation (EPL) is in place (Blanchard and Wolfers, 2000). Transfers linked to unemployment rates, as in case of a EUI, would flow more often and at a higher magnitude towards countries where labour markets exhibit less flexibility. Thus, the incentives for necessary structural reforms in those member states should diminish with partial centralization of the unemployment insurance. All in all, a common UB scheme is rejected as an unsuitable policy on the grounds of associated moral hazard risks (Sachverständigenrat, 2018, p.217).

So, it is instructive to explore how the labour market conditions and structures vary across the union and reflect on their potential implications for a EUI and its effects. The unemployment rates still diverge greatly, ranging from 2.1 percent of the active population in the Czech Republic to 18.5 percent in Greece (see Figure 4). Youth unemployment is dispersed even more dramatically, between 5.4 and 39.6 percent. If one compares Figures 4 and 5, it is eye-catching that workers' protection is stringent in the Southern Europe, where unemployment is high. However, it is not very lax in Germany or the Czech Republic, where labour markets are currently at full employment. The correlation

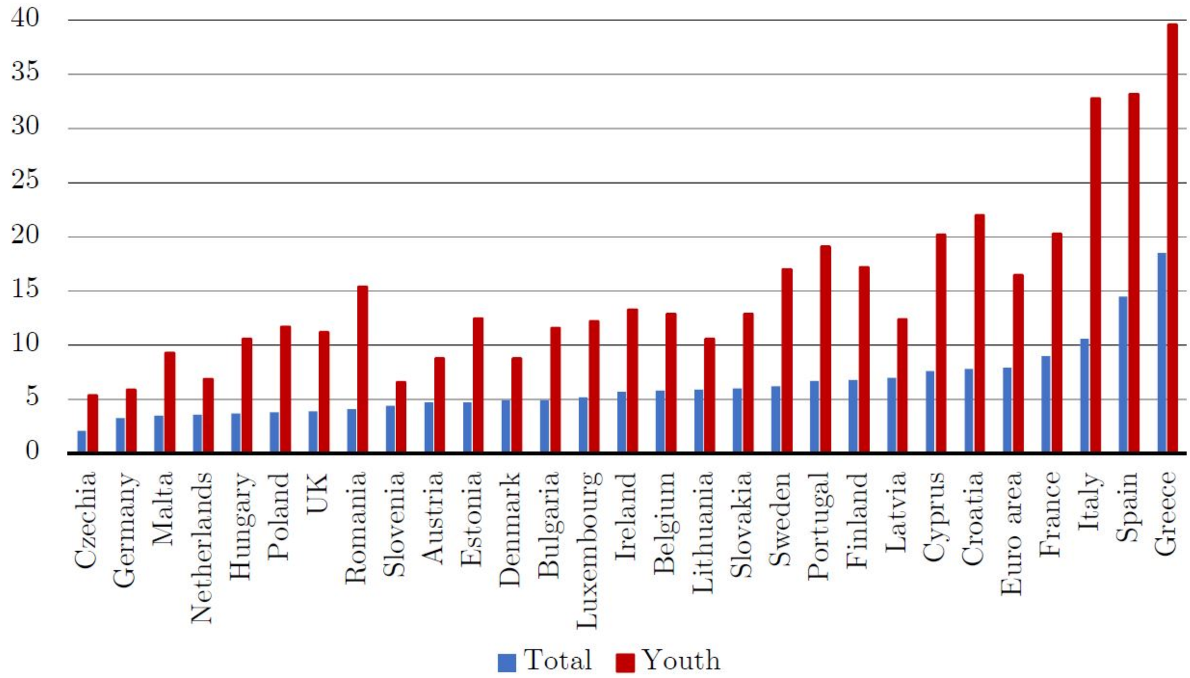

Figure 4: Total and youth unemployment rates across the EU, in percent of active population, Q4 2018 (Eurostat, 2019c)

between the EPL indicators and the current unemployment rates is not obvious.

Nevertheless, it is evident that people tend to stay in the same job for a longer time in the countries with stricter EPL (see Figure 5). This might signify that the rigid labour market structures in those countries prevent job-seekers from being employed. Indeed, if it is expensive and difficult to lay off workers, firms can be reluctant to new hires, thus creating an insider-outsider problem (Lazear, 1990).

In fact, literature delivers mixed evidence concerning the relationship between strict EPL and high unemployment rates, but most studies agree that protection from dismissals reduces workers' flows into and out of joblessness (Boeri, 2011). The changes in those transition rates, added up, explain the adjustments in the unemployment stock (Elsby, Hobijn, & Şahin, 2013). When both inflows and outflows are low, the unemployment pool stagnates, so people stay out of the jobs longer (Boeri, 2011). However, an increase in transition rates, e.g. as a result of loosening workers protection legislation, has an uncertain overall effect on unemployment rates. It depends on whether inflows or outflows accelerate to a larger extent.

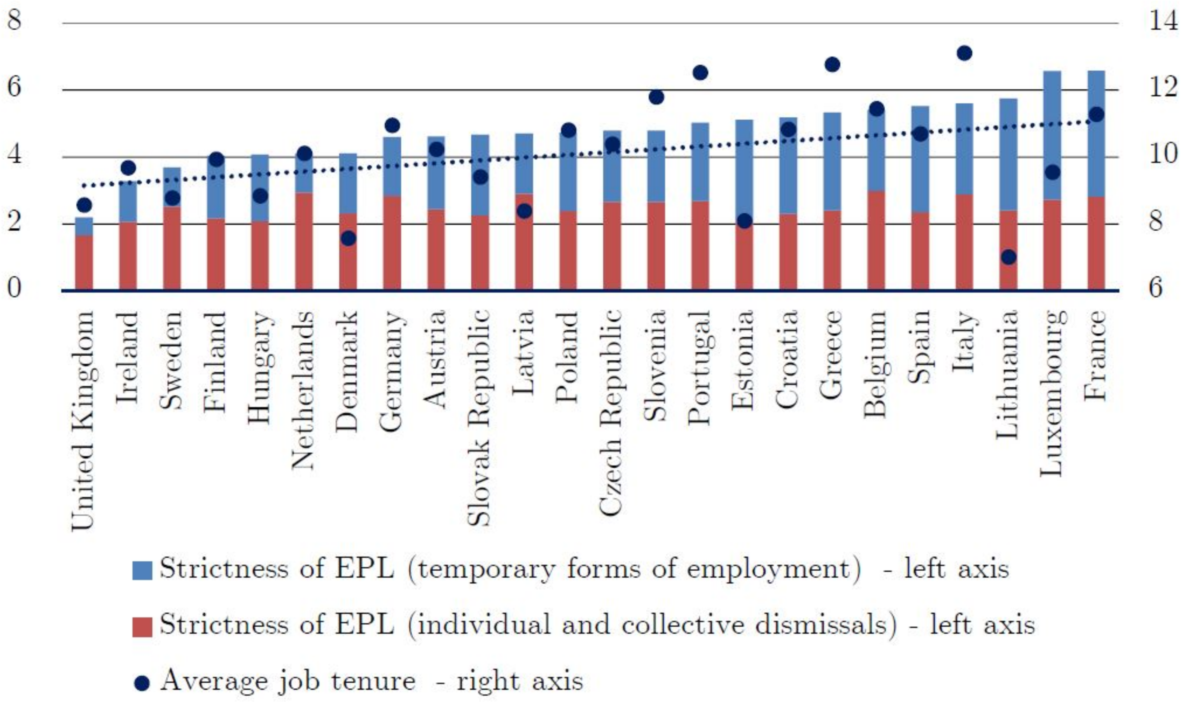

Figure 5: Strictness of EPL, latest available data 2013-2015, and average job tenure in years, 2017, for selected EU countries (OECD, 2019b)

Actually, some studies of the recent recession find that job loss was contained significantly better in those countries which exhibit higher EPL (Amable & Mayhew, 2011; Eichhorst, Escudero, Marx, & Tobin, 2010). For example, unemployment has shown barely any increase in Germany, which the studies attribute to the "hoarding effect", that is companies' politics of avoiding massive layoffs, but reducing working hours. It is also argued that a smaller spike in unemployment rates helped avoid the "hysteresis effect" which could otherwise lead to a more prolonged phase of adverse conditions in the labour markets (Amable & Mayhew, 2011).

In sum, lower flexibility in the labour markets seems to make it more difficult to exit unemployment, creating stagnant job-seeker pools, but does not necessarily cause sharper short-term or medium-term increases in unemployment in events of sudden shocks. Since a EUI is designed to target immediate reactions to adverse developments, the concern seems exaggerated that it would induce governments to neglect structural reforms and cause self-perpetuating unidirectional transfers. Nevertheless, any insurance is subject to loopholes which, albeit sometimes unforeseen, can be taken advantage of, and moral hazard risk should be properly accounted for. Therefore, it is crucial to conceive a EUI in an intelligent way that corrects for the possibility of permanent transfers.

This section outlined challenges, associated with the implementation of a common UB scheme in Europe. First, the discrepancies in the national social security systems, such as various replacement rates, duration, eligibility conditions, etc., were weighted. It was acknowledged that a EUI might require some degree of institutional standardization across the union. Next, the potential moral hazard risk was discussed. Albeit the moral hazard risk might come not from where it is expected, permanent transfers in the system should be ruled out.

In a nutshell, this chapter discussed in what ways a EUI could improve the architecture of the monetary union and sketched out what issues should be properly addressed when implementing such a scheme. The next chapter will provide a theoretical analysis of the stabilization effects of a UB system shared by a group of countries.

3 Stabilization effects of a EUI

The body of research on common UB schemes for the euro area has been growing intensively in the recent years. A notable branch of related literature comprises macroeconomic studies based on DSGE models incorporating search and matching frictions in the labour market. This chapter will provide a theoretical analysis that builds conceptually and methodologically on this area of research. After a broad literature review, a model of two economies, which could opt to unify their social security funds, will be set up and calibrated to the Eurozone to assess how a common unemployment insurance can provide for more stability in the union.

Two challenges identified in the previous chapter will be taken into consideration. First, the simulation will account for a heterogeneity in the labour market structures and social security systems. It will be demonstrated that a common UB scheme can be implemented even if the countries exhibit different parameters. Second, the exercise will show how permanent transfers can arise in a centralized system. The model will then be extended by a clawback mechanism to limit the arising redistribution. It will be discussed how the repayment rule affects the stabilization gains.

3.1 Literature review

Since the inception by Diamond (1982), Mortensen (1982), and Pissarides (1985), the models of the job market incorporating search and matching frictions became the standard framework to examine questions related to unemployment insurance.[4] The concept of costly matches and congestion externalities in the labour markets helps explain why unemployment persists and, thus, why it can take time to return to the previous employment and output levels after an adverse shock. In this way, it is a particularly suitable modelling approach to investigate how macro policies influence aggregate labour market outcomes.

The influential applications of the framework, which provide a foundation for further literature, include Hosios (1990) who studied the optimality of unemployment levels in an economy with labour markets imperfections. His famous result indicates that, for risk-neutral agents, the allocation of workers to jobs is constrained efficient if workers' bargaining power equals to the elasticity of the matching function. Baily (1978) was concerned with the optimality of providing insurance against job loss and found that unemployment benefits should be higher, the higher the risk-aversion of the workers and the lower the elasticity of unemployment duration with respect to benefits. Chetty (2008) decomposes the negative effect of an increase of unemployment payments on search behaviour into a liquidity effect and a moral hazard effect, where only the latter is undesirable.

One central question of this strand of literature is how the optimal insurance level varies over the business cycle. The ambiguity lies in the trade-off between, on one hand, the consumption smoothing effect of higher unemployment benefits during recessions and, on the other hand, the response of unemployed who would, as a consequence, stay out of the job longer. Mitman and Rabinovich (2015) argue that the optimal unemployment insurance is overall procyclical, i.e. if the economy stagnates, benefits should decline to boost employment. Other recent papers, however, show that a more generous support during recessions is optimal because of a dampened moral hazard effect when many people are out of jobs (Kroft & Notowidigdo, 2016; Landais, Michaillat, & Saez, 2018). There is also evidence that an increase in unemployment payments during a downturn is optimal

[4]See Pissarides (2000) for a comprehensive description of the framework and an outline of the full scope of the cornerstone contributions.

when the room for monetary policy is exhausted (Albertini & Poirier, 2015; Kekre, 2018). Moyen and Staehler (2014) claim that the optimal policy depends on specific circumstances: it could be countercyclical, even though it drives the wages up, provided that the labour market is flexible enough to absorb this effect. Jung and Kuester (2015) find that the unemployment benefits should be more generous during recessions, but only if hiring subsidies and lay-off taxes also increase to reduce the fluctuations in unemployment which are otherwise too costly.

Recently, a variety of authors have examined the introduction of a EUI by means of the modelling approach with search and matching frictions. Among others, the contribution by Moyen, Staehler, and Winkler (2016) has provided an insight into how a cross-country unemployment benefit system improves risk-sharing. They find that supranational insurance allows for a more counter-cyclical replacement rate and thus, stabilizes consumption across the union, especially in the periphery countries. Importantly, they model transfers as being zero in expectations, so that the moral hazard concerns are addressed. The authors also show that debt-financing does not work in the same way to smooth the risks across the countries. Their two-country business cycle model with international transfers will serve as the starting point for the following analysis.

Claveres and Clemens (2017) construct a similar two-country model, integrating limited access to financial markets into it and making it more realistic by accounting for short-time and long-time unemployment as well as for a double-layered insurance system (supranational on top of the national). They calibrate it to the core and periphery of the Eurozone and simulate three types of shocks: technology, government spending, and labour market specific. Their analysis shows that a supranational UB scheme has a countercyclical effect in the event of a supply or demand shock, but works procyclically if the shock is due to a change in the labour market institutions.

Enders and Vespermann (2019) investigate whether a EU-wide UB scheme can function as a substitute for flexible exchange rates. They calibrate their model to Germany and the rest of the Eurozone. The authors conclude that, in an event of a supply (technology) shock, unemployment insurance transfers would indeed stabilize consumption in a way resembling exchange rate adjustments. However, the money would be mostly spent on locally, and thus inefficiently, produced goods, bringing about misallocations of factor inputs. For a demand (government spending) shock, Enders and Vespermann do not identify any considerable effects of such a UB scheme.

Ábrahám, Brogueira de Sousa, Marimon, and Mayr (2018) adopt a different approach than other authors. They find only small welfare gains from risk-sharing via a common insurance. However, they show that optimal unemployment policies are similar across EU members. It is, therefore, advantageous to introduce a harmonized European UB scheme which would correct for discrepancies in national schemes and for union-wide externalities of suboptimal domestic policies. They suggest that a perpetual benefit payment with a replacement rate of 15 percent would be close to optimum for all members. The authors also argue that a functioning system is possible without unidirectional transfers, whereas differences in levies on countries would reflect the inefficiencies of the local labour markets and, thus, provide incentives for reform.

To sum up, although the above studies come to different conclusions, several of them indicate that a EUI could promote anticyclical fiscal policy and bring about stabilization gains. In what follows, an independent attempt to evaluate the introduction of a common UB fund for two economies, calibrated to the core and periphery of the Eurozone, will be pursued. The exercise will focus on the stabilization effects of the centralized fund, while taking the job market conditions and the national unemployment support schemes as given. It will inspect the trade-off between the stabilization and redistribution.

3.2 Model setup

3.2.1 Assumptions

This section develops a DSGE model for further analysis. Its key structure is based on the simplified model setup from Moyen et al. (2016). The system includes two economies, Home and Foreign, which are in all aspects independent of each other but can opt for a common unemployment insurance. First, a basic model will be outlined to explain the main insights of the mathematical setup and derive the solution for the transfers of the UB funds. Later, the model will be extended with further periods to allow for a dynamic simulation exercise. The solution for the transfers will also be complemented by a clawback rule to limit the redistribution between the countries.

Home and Foreign are inhabited by a mass of workers ω and $1-\omega$, respectively, where $\omega \in (0,1)$. The countries are deemed identical with respect to the conditions below, albeit the values of parameters potentially differ. Foreign variables will be thus denoted with an asterisk where applicable.

Firms in both countries make no profits in equilibrium and are owned by workers. The workers can only be employed in the country of origin. To keep the model very simple, their search effort is not accounted for. In such a setup, providing full insurance is optimal. However, a net replacement rate of 100 percent would distort the labour market by providing incentives for people to stay unemployed longer. This issue will be circumvented by fixing the net replacement rate at its empirical value below one. This is because the goal of the analysis is not to evaluate the optimal level of the unemployment insurance, but to assess the stabilization effects induced by centralizing the funds to finance it.

Also, government debt is not accounted for in the model. Since markets have a tendency to cut off financing for euro members in events of acute distress and because SGP rules pose rigid brakes on public debt, the model assumes that the government budget must be balanced.

3.2.2 Basic model

First, a basic two-period environment will be set up, where all workers are jobless in the first period, but some of them find employment in the second period at rate n, whereas $1-n$ remain unemployed. The matching process in the labour market is subject to frictions, so the number of matches in the second period is given by

$$n = \chi\theta^{1-\mu}, \tag{1}$$

with a measure of efficiency χ and match elasticity μ.

Since all workers are unemployed at the beginning of the second period ($u = 1$), tightness of the labour market is $\theta = v/u = v$, where v is the number of vacancies. Job filling rate is characterized by

$$q = \chi\theta^{-\mu}. \tag{2}$$

If the worker finds a job, her output amounts to a and the wage to w. The value of productivity a is uncertain in the first period. Zero profits assumption implies that the cost of posting a vacancy equates to expected gain, or $k_v = q(a - w)$. The aggregate output net of vacancy creation cost is derived as

$$y = an - k_v v. \tag{3}$$

Substituting equation (1) into (3) and using $v = \theta$ yields:

$$y = a\chi\theta^{1-\mu} - k_v\theta. \tag{4}$$

If the worker remains unemployed, she receives an unemployment benefit, defined as $b = \rho(1-\tau)w$, where parameter ρ is the net replacement rate. The government collects revenue for the UB with a payroll tax τ. The wage is determined by the Nash bargaining with exogenous γ - the bargaining power of workers:

$$\max_{w} \gamma \ln\big((1-\tau)w - b\big) + (1-\gamma)\ln\big(a - w\big)$$

First order condition:

$$\frac{\gamma(1-\tau)}{(1-\tau)w - b} - \frac{(1-\gamma)}{a-w} \overset{!}{=} 0$$

Resulting surplus splitting rule:

$$\gamma(1-\tau)(a-w) = (1-\gamma)((1-\tau)w - b)$$

$$\gamma(a-w) = (1-\gamma)(1-\rho)w$$

$$w = \frac{\gamma a}{\gamma + (1-\gamma)(1-\rho)} \tag{5}$$

The wages are thus assumed to be flexible and comprise a constant share of productivity.

Consumption of the employed in the second period is thus $c_e = (1-\tau)w$, and consumption of an unemployed person is simply $c_u = b$, with aggregate consumption $c = nc_e + (1-n)c_u$. Utility function is given by $u(c) = \ln(c)$.

Now, if the countries have not centralized the unemployment insurance and there is no possibility for the government to borrow, the aggregate consumption cannot exceed what has been produced in the economy in the given period, or $c = y$. Therefore, the social planner solves the following optimization problem:

$$\begin{aligned} \max_{\theta,n} \quad & \mathbb{E}[nu(c_e) + (1-n)u(c_u)] \\ \text{subject to} \quad & c = a\chi\theta^{1-\mu} - k_v\theta \end{aligned}$$

Set up the Lagrangian:

$$\mathcal{L} = \mathbb{E}[n\ln(c_e) + (1-n)\ln(c_u)] - \lambda(c - a\chi\theta^{1-\mu} + k_v\theta)$$

First order conditions:

$$\frac{\partial\mathcal{L}}{\partial\theta} = a\chi\theta^{-\mu}(1-\mu) - k_v \overset{!}{=} 0$$
$$\frac{\partial\mathcal{L}}{\partial n} = \ln(c_e) - \ln(c_u) \overset{!}{=} 0$$

Thus, the optimal vacancy creation level in the economy is determined by:

$$k_v = a\chi\theta^{-\mu}(1-\mu). \tag{6}$$

In this world, where workers cannot influence their employment status, it is optimal to provide full insurance against unemployment, so that everybody gets to consume the same:

$$c_u = c_e = c.$$

Moving on, if the countries arrange a supranational fund to finance the unemployment benefit payments, the overall consumption in Home and Foreign is limited by the net output in both countries. A utilitarian social planner puts a relative welfare weight of $\tilde{\omega}$ on Home and of $(1-\tilde{\omega})$ on Foreign, with $\tilde{\omega} \in (0,1)$ and not necessarily equal to the population size ω. The optimization problem is, therefore, as follows:

$$\max_{c,c^*} \quad \tilde{\omega}\mathbb{E}[u(c)] + (1-\tilde{\omega})\mathbb{E}[u(c^*)]$$
$$\text{subject to} \quad \omega(c) + (1-\omega)c^* = \omega y + (1-\omega)y^*$$

The Lagrangian takes form:

$$\mathcal{L} = \tilde{\omega}\mathbb{E}[\ln(c)] + (1-\tilde{\omega})\mathbb{E}[\ln(c^*)]$$
$$- \lambda[\omega(c) + (1-\omega)c^* - (\omega y + (1-\omega)y^*)]$$

Resulting first order conditions:

$$\frac{\partial\mathcal{L}}{\partial c} = \frac{\tilde{\omega}}{c} - \lambda\omega \overset{!}{=} 0$$
$$\frac{\partial\mathcal{L}}{\partial c^*} = \frac{(1-\tilde{\omega})}{c^*} - \lambda(1-\omega) \overset{!}{=} 0$$

Rearranging first order conditions obtains:

$$\frac{\omega}{\tilde{\omega}}c = \frac{(1-\omega)}{(1-\tilde{\omega})}c^* \tag{7}$$

The optimal solution for the fiscal union implies that the disparities in consumption levels in Home and Foreign should be smoothed to the extent determined by the welfare weight $\tilde{\omega}$.

A simple solution to achieve this is to implement a common UB fund with transfers $T = c - y$ to smooth the variation in consumption caused by the productivity shocks. From the Home perspective, the transfer is a positive influx into their economy, if the aggregate net output in the economy falls short of the optimal consumption level for the union as a whole. If the opposite is true, the transfer is negative for Home and positive for Foreign since $T = -T^*$. Importantly, it must be ensured that there are no permanent transfers:

$$\mathbb{E}[T] = 0, \tag{8}$$

to prevent the moral hazard effect. Thus, $\mathbb{E}[c] = \mathbb{E}[y]$. Inserting this into (7) yields:

$$\frac{\omega}{\tilde{\omega}}\mathbb{E}[y] = \frac{(1-\omega)}{(1-\tilde{\omega})}\mathbb{E}[y^*]$$

It implies that the weight $\tilde{\omega}$ must be chosen to reflect that, in the long run, the countries are expected to contribute equally to the common fund. Since ω is a constant:

$$\frac{\mathbb{E}[\omega y]}{\tilde{\omega}} = \frac{\mathbb{E}[(1-\omega)y^*]}{1-\tilde{\omega}}$$

$$\tilde{\omega} = \frac{\mathbb{E}[\omega y]}{\mathbb{E}[\omega y + (1-\omega)y^*]} \tag{9}$$

$$(1-\tilde{\omega}) = \frac{\mathbb{E}[(1-\omega)y^*]}{\mathbb{E}[\omega y + (1-\omega)y^*]} \tag{10}$$

The budget constraint can be rewritten as $\omega(c-y) + (1-\omega)(c^* - y^*) = 0$. To find the optimal transfer, we use $T = c - y$ and (7):

$$\omega T + (1-\omega)\left(\frac{\omega(1-\tilde{\omega})}{(1-\omega)\tilde{\omega}}c - y^*\right) = 0$$

$$\omega T + \frac{\omega(1-\tilde{\omega})}{\tilde{\omega}}(y+T) = (1-\omega)y^*$$

$$T = \frac{\tilde{\omega}(1-\omega)}{\omega}y^* - (1-\tilde{\omega})y$$

Inserting (9) and (10) to define the optimal transfer which is chosen to compensate the variations in the output from the expected level:

$$T = \frac{\mathbb{E}[y]\mathbb{E}[y^*]}{\mathbb{E}[\frac{\omega}{1-\omega}y + y^*]}\left(\frac{y^*}{\mathbb{E}[y^*]} - \frac{y}{\mathbb{E}[y]}\right)$$

With the supranational system in place, the unemployment benefit is given by:

$$b = \rho \frac{nw + T}{n + (1 - n)\rho},$$

and the payroll tax rate is:

$$\tau = 1 - \frac{1}{w} \frac{nw + T}{n + (1 - n)\rho}.$$

Since replacement rate is determined as

$$\rho = \frac{b}{(1 - \tau)w},$$

it is possible to increase consumption of both the employed (by lowering the payroll tax) and the unemployed (by paying more in benefits), keeping the replacement rate fixed. Thus, because transfers have an effect on wages only through the replacement rate, the supranational insurance can be implemented in such a way that it leaves the relative bargaining position of workers and, thus, wages and job creation unchanged.

In this simplified world, it was an optimality condition to provide full insurance. But $\rho = 1$ would result in vacancy creation collapsing to zero because in this case (5) reduces to $w = a$ and the gains from job creation vanish. Since the aim is not to find the optimal net replacement rate, but to investigate stabilization gains of the system, ρ is assumed to be exogenous and fixed at its empirical value below one for further analysis.

3.2.3 Model for calibration

Having established the above framework, stabilization effects of the centralized UB scheme will be assessed in a dynamic environment prone to persistent productivity shocks. We extend the model with further periods. Employment in period $t > 1$ is determined by the number of matches kept alive from the previous period and the new matches formed in the present period:

$$n_t = (1 - s)n_{t-1} + q_t v_t, \tag{11}$$

where separation rate s is exogenous, the job filling rate q_t is

$$q_t = \chi \, (\frac{v_t}{u_t})^{-\mu}, \tag{12}$$

and unemployment rate $u_t = 1 - n_t$. The optimal vacancy level condition (6), derived above, prescribes how many vacancies are opened each period:

$$v_t = \left(\frac{a_t \chi {u_t}^{\mu}(1-\mu)}{k_{vt}} \right)^{1/\mu} \tag{13}$$

Since the wage moves along with the productivity, it does not affect the job creation. The net output, the wage rule, and the aggregate consumption remain as above determined:

$$y_t = a_t n_t - k_{vt} v_t \tag{14}$$

$$w_t = \frac{\gamma a_t}{\gamma + (1-\gamma)(1-\rho)} \tag{15}$$

$$c_t = n_t(1-\tau_t)w_t + (1-n_t)b_t \tag{16}$$

The UB and the tax rate are defined as follows, where the net replacement rate ρ is given exogenously:

$$b_t = \rho \frac{y_t + T_t}{n_t + (1-n_t)\rho} \tag{17}$$

$$\tau_t = 1 - \frac{1}{w_t} \frac{y_t + T_t}{n_t + (1-n_t)\rho} \tag{18}$$

The only source of uncertainty in the model is the productivity a_t. It is determined by an autoregressive process, where $\bar{a}$ is a long term productivity level and the exogenous shock ϵ is expected to be zero:

$$a_t = \rho_a \bar{a} + (1-\rho_a)a_{t-1} + \epsilon_t \tag{19}$$

The transfers are determined to compensate the relative deviations of the output from the steady state:

$$T_t = \frac{\mathbb{E}[y]\mathbb{E}[y^*]}{\mathbb{E}[\frac{\omega}{1-\omega}y + y^*]} \left(\frac{y_t^*}{\mathbb{E}[y^*]} - \frac{y_t}{\mathbb{E}[y]} \right), \tag{20}$$

which allows non-zero transfers in expectations. The further exercise will investigate how stabilization gains differ if some redistribution is tolerated and if transfers are zero in the long run. The latter is ensured by a clawback mechanism determined as a gradual reimbursement of the received funds which kicks in after a certain period. In this case, the transfer rule takes the form:

$$T_t = \frac{\mathbb{E}[y]\mathbb{E}[y^*]}{\mathbb{E}[\frac{\omega}{1-\omega}y + y^*]} \left(\frac{y_t^*}{\mathbb{E}[y^*]} - \frac{y_t}{\mathbb{E}[y]} \right) - \delta \sum_{i=1}^{t-j} (T_i), \tag{21}$$

where δ is the instalment rate and j is the repayment lag.

3.3 Calibration

In line with Moyen et al. (2016), the model will be calibrated to the Eurozone (12 initial member states), where Home corresponds to the core countries (Austria, Belgium, Germany, Finland, France, Luxembourg, Netherlands) and Foreign to the periphery (Greece, Ireland, Italy, Portugal, Spain). In what follows, the terms "Core" and "Periphery" will be used next to Home and Foreign to define the calibrated areas. The calculations are based on the Core and Periphery data, summarized in Table 1.

Population share, real GDP share, and unemployment rate are averages over the time period from 1998 to 2018. Net replacement rate is the mean of the current replacement rates for a single person without kids and a couple with two children after being out of the job for two consecutive months, previously earning the average wage. Strictness of EPL is the average value of the OECD employment protection indicator (individual and collective dismissals) in 2013 (latest available data).

Indicator	**Core**	**Periphery**	**Source**
Population share	0.59	0.41	Eurostat (2019b)
Real GDP share	0.655	0.345	Eurostat (2019b)
Mean unemploymebnt rate	6.7%	11.6%	Eurostat (2019b)
Net replacement rate	0.75	0.65	OECD (2019a)
Strictness of EPL	2.71	2.48	OECD (2019b)

Table 1: Core and Periphery characteristics for calibration

The core countries comprise about 59 percent of the population of the above defined union, but their share of the real GDP amounts to 65.5 percent. They exhibit a lower mean unemployment rate of 6.7 percent, in contrast to 11.6 percent in the periphery states. The average net replacement rate is also somewhat more generous in the Core: 75 percent of previous income versus 65 percent in the Periphery. In addition, the Core's employment protection regulation appears to be overall slightly tighter than in the Periphery.

Calibrated parameters are chosen to conform to the empirical data (see Table 2). Population share at Home is 0.59. The Core steady-state (SS) productivity level $\bar{a}$ is normalized to one. Calibrated value for productivity in the Periphery is set to 0.56 to reflect the real GDP ratio in the union. Steady-state employment and unemployment rates correspond to the empirical figures above, and so do the net replacement rates.

As in Moyen et al. (2016), the calibrated values for the matching efficiency χ, the separation rate s and the vacancy costs k_v are determined to match the unemployment rates and the average vacancy-filling probability of 70 percent. Vacancy costs are proportional to countries' productivity. A lower Home separation rate reflects the relatively more stringent labour protection regulations. Such parameters, as the elasticity of the matching function μ, the bargaining power of the workers γ, and the coefficient of the productivity shock persistence ρ_a, are set to their conventional values of 0.95, 0.5, and 0.9, respectively, also in accordance with the mentioned work.

Parameters	**Symbol**	**Core**	**Periphery**
Population share	ω	0.59	0.41
SS productivity	$\bar{a}$	1	0.56
SS unemployment rate	u	0.067	0.116
SS employment rate	n	0.933	0.884
Replacement rates	ρ	0.75	0.65
Matching efficiency	χ	0.46	
Separation rate	s	0.022	0.039
Vacancy costs	k_v	0.344	0.199
SS vacancy filling rate	q	0.7	
Matching elasticity	μ	0.5	
Workers' bargaining power	γ	0.9	
Productivity shock persistence	ρ_a	0.95	
Steady-state values			
Net output	y	0.923	0.485
Consumption	c	0.923	0.485
Wage	w	0.973	0.539
Vacancy level	v	0.0299	0.0488
Unemployment benefits	b	0.704	0.329
Tax rate	τ	0.035	0.061
Transfers	T	0	

Table 2: Calibrated parameter and steady-state values

The resulting steady-state values of the endogenous variables are also reported in the table. Home and Foreign consumption equals to net output in absence of shocks. The transfers, since they are determined by the relative deviations of the net output from its expected level, i.e. from the steady-state value, are equal to zero. The larger Foreign steady-state vacancy level results from the greater unemployment and job separation rates. Albeit the unemployment support is less generous in the Periphery, a higher tax is necessary to finance the UB payments.

In further analysis, two shock scenarios developing over 250 periods are going to be simulated. The long-term structure of the simulation allows observing how transfers react over extended periods of time. The scenarios imitate diverging business cycles in the union since the purpose of the common unemployment insurance is to address asymmetric shocks. Thus, productivity shocks hit both economies, but at contrasting points of time, to focus on the stabilization effects of a common UB scheme.

The difference between the two scenarios is the following: the first one only generates exogenous negative productivity shocks in the system (supply-side shock), whereas the second one implies that the economic slump in the Core (Periphery) results from a demand shift to the Periphery (Core) and, thus, brings about a boom in the other part of the union (demand-side shock). Shocks are calculated in percent of domestic productivity. Under both scenarios, Home experiences a smaller meltdown of 8 percent, whereas Foreign productivity falls by 10 percent. The simultaneous mirroring positive shock under the second scenario is set to capture 3/4 of the negative one.

Figures 7 and 8 report on the simulated shocks.[5] They display the impulse responses of selected endogenous variables (in absolute values) under the described scenarios, namely, productivity, net output, unemployment, and vacancies. The wage develops identically with technology, so it is not displayed. Presented variables respond in the same way in the status quo and under UB schemes. As the graphs show, the net output reacts almost as strong as the productivity does. However, due to the lack of wage rigidity, the model does not produce a large change in unemployment. Nevertheless, the reaction of the Foreign labour market to the shock is over-proportionately strong: the unemployment climbs up by 0.75 percentage points and vacancies drop by 0.009 (18.4 percent), in contrast to Home,

[5]Table 6 (in Appendix A) gives descriptive statistics for the endogenous variables under the two implemented scenarios. The first one results in lower means, but also in a lower variation. The second one creates a larger dispersion of the values. Also, see Appendix B for the Dynare code of the simulation.

where the unemployment increases by less than 0.5 percentage points and the decline in the vacancy rate comprises about 0.0047 (15.7 percent). Under the demand shift scenario, the Periphery job market also responds stronger to the productivity increase.

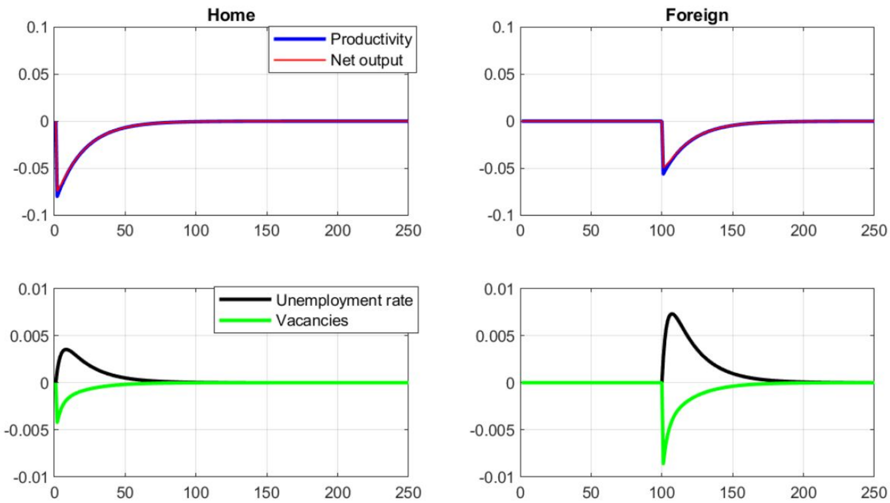

Figure 6: Impulse responses of selected endogenous variables, Scenario 1

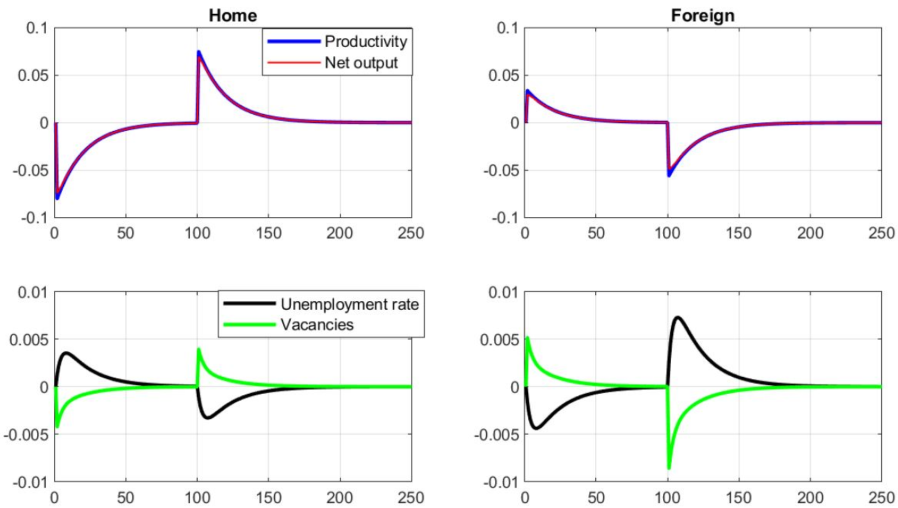

Figure 7: Impulse responses of selected endogenous variables, Scenario 2

Importantly, on the contrary to the variables depicted in Figures 6 and 7, UB payments, taxes, and consumption will develop differently depending on whether a common UB scheme is in place. The next section will illustrate how transfers allow for shock smoothing in the union. Also, it will be discussed what difference it makes if the unemployment insurance features a clawback mechanism.

3.4 Results

The results of the simulation will be now discussed. Figure 8 shows the transfer flows generated by the two exercises. The first (supply shock) scenario generates sizeable flows from Foreign to Home and vice versa, with the peak payment of 0.02 from Foreign to Home and of 0.025 from Home to Foreign in the period when the shock hits. Under the second scenario (demand shift), the payments have almost twice the magnitude.

After the peak, the transfers fall gradually, whereas the UB with the clawback mechanism brings the flows back to zero (and then below zero) much sooner. The clawback parameters are chosen to ensure a (roughly) full repayment within the observed time span. The reimbursement kicks in already in the period after the shock ($j = 1$), and the instalment rate δ amounts to 5 percent in the first case and 7 percent in the second (since a larger sum has to be paid back within the same period).

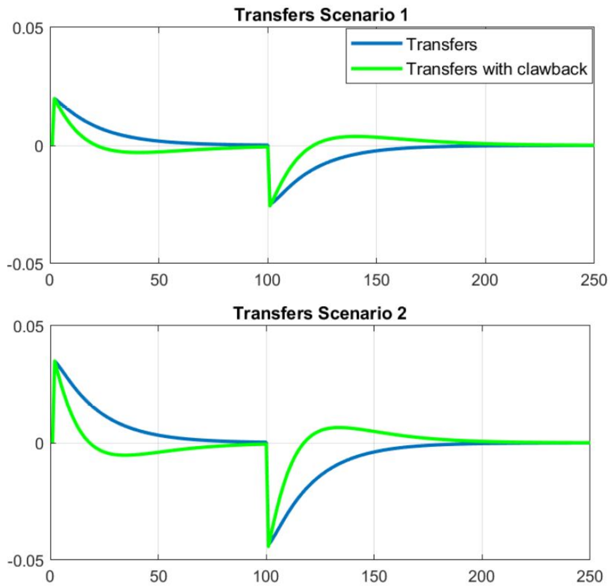

Figure 8: Transfer flows under the two shock scenarios

In all cases, having a supranational unemployment system in place has a stabilization effect on the UB payments and consumption. Indeed, although the averages of the unemployment money and consumption do not alter much with the introduction of the common UB scheme, their paths are smoother and the standard variation is lower. Figure 9 and Table 3 present the stabilization gains of the first shock scenario, whereas Figure 10 and Table 4 report on the second one.

Consider first the unemployment insurance without the reimbursement mechanism. Under the supply shock scenario (Table 3), the UB scheme dampens 25 percent of the shock in the Core (calculated as the reduction in the standard deviation of the UB payments and consumption). In the Periphery, the respective stabilization gain is as high as 43 percent.

The demand shift scenario, by driving the business cycles in the different parts of the union further apart, results in more variation of UB payments and consumption in both areas. The centralized unemployment insurance enables a very large stabilization gain in this case (Table 4). The variation in Home benefits and consumption is reduced by about 55 percent, while the figure is as large as 89 percent for Foreign: the fluctuations in consumption get almost entirely eliminated in the Periphery.

In both cases, the stabilization is achieved via a countercyclical fiscal policy. The tax rate, which barely reacted in the status quo, assumes the shock smoothing role in the presence of the common unemployment insurance. In the event of a shock, the country in recession has now the possibility to lower its tax rates and relieve the workers whose wages fall abruptly. At the same time, unemployment payments do not have to be drastically reduced. In addition, the opposite is the case if the country experiences a boom. The government is able to increase taxes temporarily to reduce the pressure on the economy. This allows to smooth out the consumption spike and avoid a potential bubble development.

Importantly, under both scenarios, the initial drop in unemployment support and consumption is mitigated. However, the UB scheme appears more advantageous in case of asymmetric developments in the union, i.e. when the recession in one area goes hand in hand with an upswing in the other region. In this case, the shock in one country does not merely get spread out across the union, but actually helps soften inflationary trends in the other member states.

Nevertheless, it is instructive to evaluate if such a UB scheme leads to permanent transfers. As discussed earlier, redistribution could induce a potential moral hazard effect. Notably, due to diverging business cycles, transfer flows balance out over the time span. However, by design of the shocks, which were not even and comprised 8 percent in the Core and 10 percent in the Periphery, transfers are not zero in the long run. Overall in 250 periods, Home redistributes about 0.0663 under the first and 0.1305 under the second

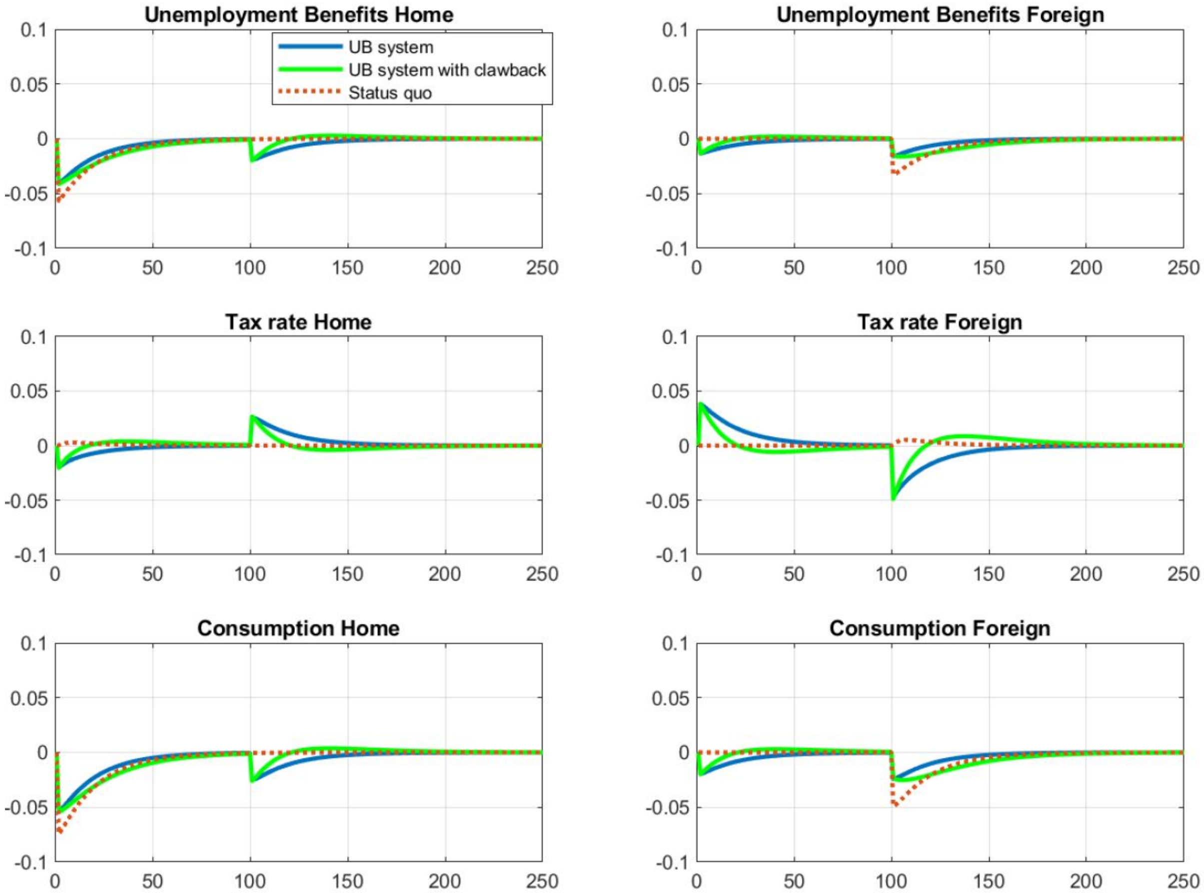

Figure 9: Stabilization gains: Impulse responses under Scenario 1

	Status quo		UB scheme			UB scheme, clawback		
Variable			**Mean**	**StD**	**Sum**	**Mean**	**StD**	**Sum**
Transfers			-0.0003	0.0069	-0.0663	0	0.005	-0.002
Variable	**Mean**	**StD**	**Mean**	**StD**	**Stabil. gain**	**Mean**	**StD**	**Stabil. gain**
UB Home	0.6993	0.0109	0.6991	0.0082	25%	0.6993	0.0098	10%
UB Foreign	0.3261	0.0065	0.3263	0.0037	43%	0.3261	0.0051	21.5%
Consumption Home	0.9167	0.0145	0.9164	0.0109	25%	0.9167	0.013	10%
Consumption Foreign	0.4812	0.0099	0.4814	0.0056	43%	0.4812	0.078	21%
Tax rate Home	0.0356	0.0007	0.0359	0.0068		0.0356	0.0051	
Tax rate Foreign	0.0619	0.0012	0.0614	0.0124		0.0619	0.0093	

Table 3: Stabilization gains of the common UB system under Scenario 1

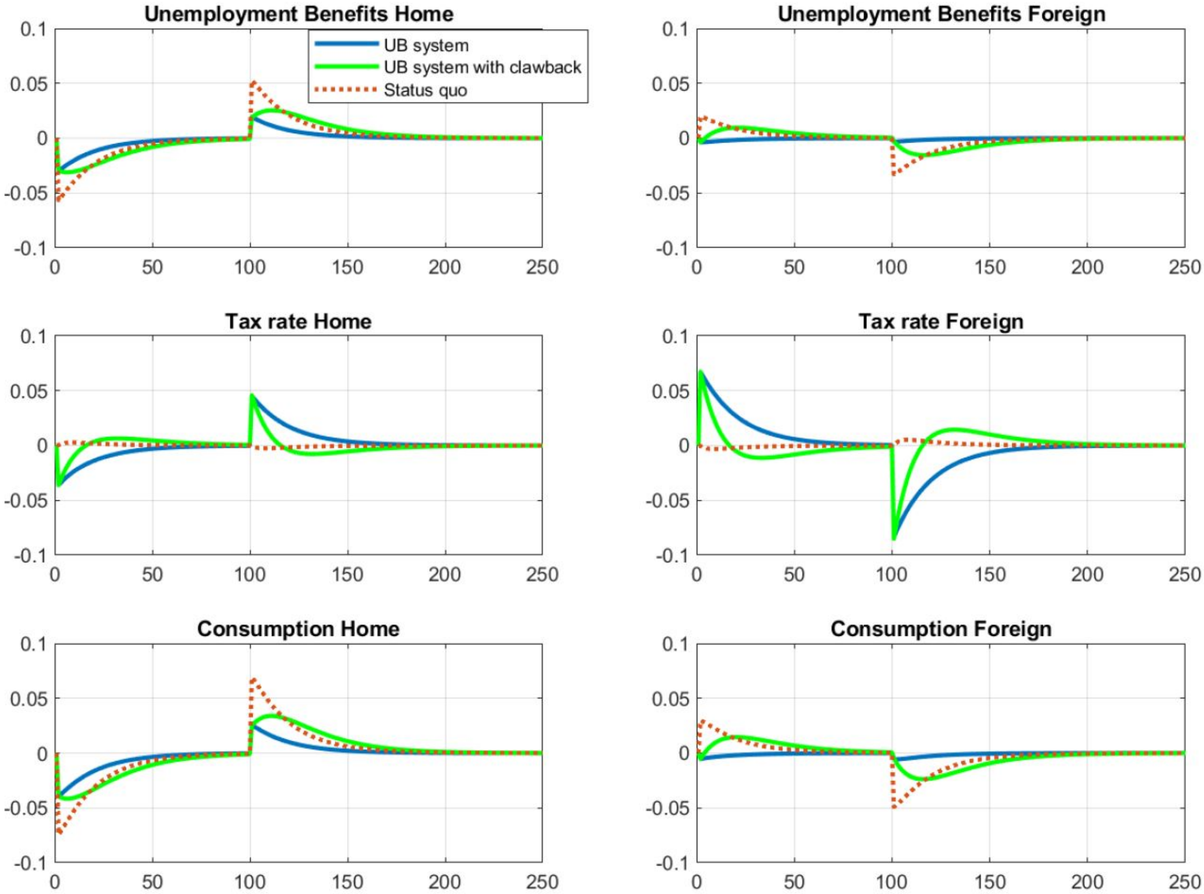

Figure 10: Stabilization gains: Impulse responses under Scenario 2

	Status quo		**UB scheme**			**UB scheme, clawback**		
Variable			**Mean**	**StD**	**Sum**	**Mean**	**StD**	**Sum**
Transfers			-0.0005	0.012	-0.1305	0	0.008	-0.001
Variable	**Mean**	**StD**	**Mean**	**StD**	**Stabil. gain**	**Mean**	**StD**	**Stabil. gain**
UB Home	0.7037	0.0163	0.7033	0.0072	56%	0.7037	0.0132	19%
UB Foreign	0.3278	0.0082	0.3281	0.0009	89%	0.3278	0.0063	23%
Consumption Home	0.9226	0.0216	0.9221	0.0098	55%	0.9226	0.0176	19%
Consumption Foreign	0.4838	0.0125	0.4843	0.0014	89%	0.4842	0.0096	23%
Tax rate Home	0.0353	0.001	0.0358	0.0117		0.0353	0.0081	
Tax rate Foreign	0.0615	0.0016	0.0605	0.0218		0.0615	0.015	

Table 4: Stabilization gains of the common UB system under Scenario 2

scenario to Foreign, which comprises, respectively, 7 and 14 percent of the Home steady-state output. On average, flows are also not zero. The Periphery, being a net receiver, can increase its consumption and significantly reduce its average tax rate under both shock scenarios at the Core's extent. This could induce a potential moral hazard effect: Periphery engaging in policies which provoke further shocks in the future. Indeed, if the Core were the country experiencing a larger crash, the outcome of the simulation would be reversed. Nevertheless, permanent transfers cannot be ruled out without a repayment mechanism since the system directs funds to the areas that experience tougher times, inherently creating redistribution.

To correct this, an alternative UB scheme with a clawback is introduced. Such a scheme allows for substantial financial support in the acute crisis but brings the transfers back to zero in a rather timely manner, eventually reversing the direction of the money flows. The repayment achieves that the redistribution goes to zero in the long run. Although within the limited observed period some minimal redistribution is not entirely avoided, the mean transfers are zero. Thus, the averages of consumption and tax rates are not distorted and equal to their status quo values in both countries.

However, while the UB scheme with a clawback mechanism can rule out permanent transfers, it brings about a considerably weaker stabilization of the unemployment support and consumption. The stabilization gain is only half of what it was without repayment under the first scenario (10 and 21.5 percent for Home and Foreign, respectively), and constitutes even a smaller share (19 and 23 percent) under the second scenario.

Notably, the parameters of the repayment rule (the instalment rate δ and the lag j) determine the degree to which the stabilization effect dwindles. Indeed, the instalment rate can be deemed to be zero under the scheme without repayment (as a special case of the clawback rule). This finding indicates that there's a trade-off between the stabilization and the moral hazard effect. Whether the system can rule out permanent transfers and ensure sufficient shock absorption, therefore, depends on its design parameters. With the values chosen for this exercise, the stabilization gain remains substantial, and the drastic drops in consumption are still alleviated. Although the unemployment support and consumption stay below their steady-state values for a longer time, the scheme with repayment achieves smoother paths for all variables.

An essential issue to be addressed at this point is that the theoretical model used in the above exercise is extremely simplified. It does not account for the feedback of the stabilized consumption on unemployment, wages, and output. If it did, the stabilization gains would multiply through the demand effects on the rest of the simulated economy.

Also, the analysis abstained from modelling any debt and thus accounting for intertemporal smoothing. However, if the fund could run deficits and surpluses, larger stabilization gains would be possible. Fluctuations in consumption would be smoothed not only across regions, but also across periods. In addition, the reimbursement of the received transfers would be not placed into the future, but happen continuously in time. This would allow lowering the instalment rate and avoiding the repayments in the immediate aftermath of the shock, thus increasing the stabilization capacity of the system.

To sum up, this chapter has presented the theoretical analysis of a centralized UB fund for a union of countries. It has been demonstrated that differences in labour market parameters and social security systems are not a major obstacle to implement it. The simulation exercise has shown that the scheme brings significant stabilization gains. The effect is larger if some regions of the union bear a recession while others experience a boom. The centralized system is able to smooth drops and peaks in consumption via a countercyclical fiscal policy, by lowering the tax rates in the suffering areas and rising them in the overheating regions.

Yet, the system can induce substantial redistribution effects. To avoid permanent transfers and the associated moral hazard, the UB scheme should ensure a gradual repayment, e.g. through implementing a clawback rule. However, the higher the repayments and the sooner they kick in after the shock, the smaller the stabilization gain. It is the decision on the payback conditions that would, ceteris paribus, determine the stabilization effects. Allowing for intertemporal risk-sharing could further increase the positive effects.

These findings are in line with the theoretical literature, such as Moyen et al. (2016) and Claveres and Clemens (2017), who also confirm that EUI can promote countercyclical fiscal policy and provide shock absorption. But the discoveries of this analysis also have practical implications for the design of such a common instrument for the Eurozone. How existing policy proposals address the identified issues will be discussed in the following chapter.

4 Design options of a EUI

In the light of the findings discussed above, this chapter will address the question how a (more) suitable design for a common UB scheme in EMU could look like. First section will summarize the critical characteristics to keep in mind when assessing various policy drafts. Second section will compare the most prominent design proposals for a EUI and highlight their stronger and weaker aspects.

4.1 Evaluation criteria

Although published EUI drafts differ on many levels, several major evaluation criteria can be identified. These are the characteristics that are crucial to ensuring that such fiscal instrument can fulfil its purpose without causing undesirable side effects. To compare the design proposals on these grounds, it is instructive to answer the following questions:

Does the scheme operate as an automatic stabilizer? A genuine EUI would substitute a part of national schemes and, thus, should work, by definition, automatically since the social security contribution shrink and UB payments spike in recessions without any deliberate action. On the contrary, an equivalent scheme builds a rainy day fund, comprised of contributions from the governments, where pay-outs are triggered by a specific rule. Depending on how the trigger mechanism is designed and if the payment is subject to administrative hurdles, the eventual transfers can considerably lag in time, so that the capacity of the system to bolster shocks automatically would be hindered.

How does it deal with the diversity of the national UB systems? A genuine UB system might require a certain degree of harmonization between the European social security institutions, e.g. of the eligibility criteria, the generosity, and the duration of UB payments, but not necessarily a complete one-size-fits-all standardization. Indeed, a reinsurance also needs common rules and a clear definition of what the financial assistance is covering (e.g. only short-term UB payments). Besides that, when devising the financing part, it is to bear in mind that there's much variation in magnitude and sources of UB funding across the union.

Does it limit potential permanent transfers and moral hazard? As discussed in the previous chapters, it is crucial to limit the moral hazard effect. One way to do it is to rule out free lunches: in other words, to ensure that payments into the common fund offset the received transfers over time, so no permanent transfers occur. This could be achieved by experience rating systems or clawback rules. Another way to limit the danger, that some member states engage in risky behaviour when a centralized insurance is in place, is to impose a high threshold for the transfers.

How strong is the stabilization capacity? Last but not least, the size of the stabilization effect is an important factor. A number of papers examining stabilization gains of various proposals will be reviewed. The ability of a EUI to cushion shock is usually measured in percent of the GDP or in percent of the shock bolstered by the scheme. Intertemporal smoothing can also play a significant role for the stabilization capacity of the system, so the ability of the proposed UB schemes to run surpluses and deficits will be noted.

4.2 Comparative analysis of policy proposals

Now that the evaluation criteria are defined, this section can proceed with the comparison of a range of policy drafts. The selection is far from being comprehensive, but serves to highlight particular design features available. Proposals will be set apart in two categories, genuine and equivalent, since the two groups potentially perform differently with respect to the mentioned criteria.

Genuine EUI schemes One of the widely discussed EUI drafts is the UB scheme proposed by Dullien (2014). It is envisaged to substitute a part of the existing European social security systems. As a genuine unemployment insurance, this solution has a great capacity to work as an automatic stabilizer. Under this solution, unemployment support would be provided for 12 months out of the common fund, with a replacement rate of 50 percent of past earnings, capped at the half of the national average wage. Financial assistance could be then extended in terms of magnitude and duration out of the national security system, if desired. By allowing the sovereigns to top up the unemployment support, such EUI avoids the need for standardization of the UB schemes across the union. However, the suggested replacement rate and duration are higher than the current benchmark in some euro countries (see Figure 3), requiring a change of national agencies.

A simulation, conducted on basis of historical macroeconomic data, showed that the fund would remain rather small, with contributions raised via a very modest payroll tax. Nevertheless, the stabilization effect is estimated to be sizeable, especially if the system were allowed to run deficits and surpluses. The borrowing in this case could be done against the future revenues. But, although no country is a permanent net receiver or net payer, the scheme does not rule out cross-country redistribution, potentially leading to moral hazard.

Brandolini, Carta, and D'Amuri (2014) address the issue ahead and devise an incentive-compatible and politically feasible scheme by comparing alternatives at the efficiency frontier of stabilization and redistribution. They restrict the maximum payment duration to 8 months to comply better with existing national UB standards, arguing that the replacement rate also could be reduced to 35 percent. The authors conclude that employment-based triggers, as well as experience ratings, are both desirable instruments to limit permanent transfers, although they scale stabilization gains down. Their preferred solution features a partial experience rating and a substantial trigger threshold, so that the scheme only operates during recessions.

Dolls, Fuest, Neumann, and Peichl (2018) run a micro data simulation to evaluate a comparable EUI scheme and test several design features, such as a borrowing capacity and transfer eligibility thresholds. The stabilization gains of the interregional and intertemporal shock smoothing are found to be both important, but unevenly distributed across the union. The authors find, contrary to Brandolini et al. (2014), that a high threshold, albeit limiting redistribution, could have a destabilization effect on the system because some countries might never become eligible for transfers.

In sum, genuine schemes can ensure large shock absorption, especially if devised as automatic stabilizers and equipped with a borrowing capacity. They don't necessarily urge to modify existing institutions if only the minimum of the national schemes is replaced by a EUI in terms of coverage, duration, and generosity of the UB payments. Importantly, they might generate permanent transfers. Therefore, a limiting mechanism is recommended.

Equivalent EUI schemes An equivalent EUI is a reinsurance for the national UB systems triggered by an economic shock. Whether it can function as an automatic stabilizer depends a lot on the nature of the trigger. For example, the output gap seems not to suit the purpose well since it is often corrected (and sometimes even changes sign) post factum (Brandolini et al., 2014). On the opposite, labour market statistics, such as harmonized unemployment rates, are rather precise, available in a timely manner, and politically visible. In particular, the short-term unemployment rate correlates strongly with the cycle. Seasonal unemployment can be ruled out by installing a certain prerequisite in terms of previous employment. On that account, schemes based on employment related indicators are selected for this review.

Dullien et al. (2017) propose a reinsurance scheme consisting of two parts: self-insurance, created for own use, and a union-wide rainy day fund. Annual contributions are divided 80/20 between those. On average, each country is expected to store a deposit of 1 percent of its GDP in the system, and a borrowing capacity is envisaged to cope with extended shocks. Transfers from the national compartments are triggered by minor increases in unemployment rates, whereas large shocks set off payments from the common fund, progressively linked to the unemployment rate. A dynamic clawback mechanism would ensure progressive reimbursement of received transfers as soon as unemployment stabilizes. The advantage of the two-tier system is that the repayment of resources drawn from the common fund can be done from the national compartment. The stabilization gains of such scheme are estimated to be significant, whereas a combination of the clawback and the trigger system limits the moral hazard effect.

The reinsurance scheme suggested by Bénassy-Quéré et al. (2018) is, in contrast, only triggered by a large shock (a "catastrophic loss" insurance). In addition to a high trigger, losses would be covered only partially to prevent the moral hazard effect. In the event of a shock, for each percentage point of the employment decline below the defined threshold of 2 percentage points, the country in question would receive a one-off transfer corresponding to 0.25 percent of its GDP. Also, participation would be conditional on specific ex-ante and ex-post requirements. It is envisioned as a true insurance (with experience rating) so that the received transfers do not have to be paid pack. The scheme does not allow for borrowing, but sets up a large and ever-growing rainy day fund, since contributions are paid each period without exceptions. The overall stabilization would then be only limited by the amount of accumulated resources.

Carnot, Kizior, and Mourre (2017) developed a EUI scheme that features a two-tier trigger. They devise the trigger mechanism to consist of two conditions that both must be fulfilled, namely, the unemployment rate must be already above a long-term average and still rising. This ensures that transfers are triggered only by actual shocks. In contrast to Bénassy-Quéré et al. (2018), contributions are only paid when the opposite holds to avoid procyclicality. The payments are then calculated as the change in unemployment times 0.5 percent of the country's GDP. An experience rating would complement the system to limit the moral hazard, since small insurance premia and bonuses can largely (although not completely) bring redistribution down without impeding stabilization, especially in the aftermath of large shocks. This is confirmed by Dolls (2019) who also evaluates such a reinsurance scheme with a double condition trigger. He finds that this scheme brings about large, but unevenly distributed, interregional and intertemporal stabilization gains, with some countries never reaching the eligibility condition for pay-outs.

Table 5 presents a detailed comparison of options discussed here. Because of the two distinct approaches to measuring shock absorption, it is not always possible to compare them on this matter. But two observations can be made. First, the average stabilization effects, when measured in percent of the shock, are comparable to the results of the simulation exercise carried out in the previous chapter. One good reference point is the disentangled interregional smoothing effect of 15 to 25 percent from Dolls (2019) which roughly falls in the same range as the stabilization gains of the simulated UB scheme with clawback.

Second, it appears that equivalent schemes might be able to provide stabilization of at least the same or higher level as a genuine EUI, as also Beblavý and Maselli (2014) highlight when comparing the two solutions. At the same time, reinsurance schemes seem to be equipped better to limit undesirable incentives.

The conclusions of the comparative analysis can be summarized as follows. First of all, the crucial condition, that the UB scheme functions automatically, can be met either with a genuine solution or a reinsurance linked to a labour market indicator, provided no long bureaucratic process to set the system into action is required.

Design proposal	Threshold	Experience rating or clawback	Annual average contributions	Annual average size of fund	Debt	Average stabilization effect
GENUINE SCHEMES						
Dullien (2014)	No	No	Payroll tax 0.65-1.66%	0.3-0.6% of GDP	Yes	16.5% of the shock
Brandolini et al. (2014)	Employment drop of 20% of standard deviation	Experience rating	Consumption tax, no calculation	No calculation	Yes	0.1% of GDP
Dolls et al. (2018)	No (in the baseline)	Experience rating	Payroll tax 1.56%	47 bill. euro	Yes	19.2% of the shock
EQUIVALENT SCHEMES						
Dullien et al. (2017)	Unemployment rise of 0.2 pp for national funds; 2 pp for common fund	Progressive clawback rule	0.1% of GDP	1% of GDP	Yes	0.9% of GDP
Bénassy-Quéré et al. (2018)	Employment drop of 2 pp	Conditional participation; experience rating	0.1% of GDP even in crises	Growing continuously	No	No calculation, limited to fund volume
Carnot et al. (2017)	No	Double condition trigger, experience rating	0.24% of GDP	0.5% of GDP	Yes	0.5% of GDP
Dolls (2019)	Unemployment rise of 1 pp	Double condition trigger, experience rating	From -0.1 to +0.1% of GDP	From -8 to 15 bill. euro	Yes	15-25% inter-regional, 16-27% intertemporal (of the shock)

Table 5: Comparison of selected EUI proposals (baseline scenarios)

Second, both genuine and equivalent schemes can be implemented without a drastic standardization of the national social security systems. However, either one would require some harmonization of the UB schemes, at least in terms of duration and eligibility (to prevent subsidizing structural or cyclical unemployment). In addition, reasonably small contribution rates allow even those countries without large social security budgets to participate. Nevertheless, reinsurance seems to be a more practical solution since it requires less administrative effort and leaves the revenue decisions to the national governments.

Third, the approach towards limiting moral hazard constitutes the major difference between the proposals and reflects the trade-off between the stabilization and redistribution. On the one hand, clawback mechanisms ensure complete repayment of transfers over time, but might undermine fragile recovery after the shock. On the other hand, a "catastrophic loss" insurance does not require repayment; instead, it eradicates moral hazard by leaving the largest loss with the sovereign. But such scheme stays dormant until the crisis reaches a severe stage, so that moderate recessions remain untackled. Besides, high thresholds might call the system into question if some countries never become eligible for payouts. A two-tier trigger or a solution, where smaller shocks are self-insured and common funds are drawn only in case of a severe crisis, might perform better. Comparing clawback and experience ratings mechanisms indicates that it is more sensible to activate the reimbursement only in good times, which then could accelerate if the economy improves quickly.

Fourth, most proposals underline that, for the instrument to be truly countercyclical and for the contributions to be reduced during crises and increased during booms, the scheme should allow for borrowing. Last, most simulation find sizeable stabilization effects of a EUI in its various configurations. To sum up, the analysis suggests that a EUI can be an effective shock-smoothing mechanism, while adequate design can prevent permanent transfers and moral hazard.

5 Conclusion

The Eurozone has been struggling to overcome the deep economic crisis of the last decade and is facing the challenge of safeguarding the European project from the rising populism. Scholars and policy makers seek new, effective solutions to increase resilience of the union. A common unemployment insurance for the euro area is one of the intensely debated risk-sharing mechanisms. By means of literature review and theoretical macroeconomic analysis, based on a DSGE model with frictional labour markets, this paper evaluated whether a EUI could be a suitable shock absorption tool and how it should be designed to fit the purpose without hazardous side effects.

Not complying to OCA criteria, the euro area proved to be vulnerable to asymmetric shocks. Conventional stabilization options of a currency union, such as labour mobility, risk-sharing through financial markets, and sovereign fiscal policy, remain constrained and unsuccessful to provide sufficient shock smoothing in EMU. Centralized fiscal instruments, along the lines of a common UB scheme, are advised by a vast body of research to improve the architecture of the currency union.

Indeed, a EUI seems to be an appropriate choice for a risk-sharing instrument on the union level for two reasons. First, it has a great capacity to work as a truly automatic stabilizer with large multiplier effects. Second, by design, it provides regional risk-sharing in a union prone to asymmetric developments and fiscal externalities. Nevertheless, the implementation of a common UB scheme for the Eurozone brings about two main challenges: coordinating large differences in social security systems and limiting the moral hazard risk inherent to any insurance system.

The DSGE modelling exercise, carried out in this paper, revealed that a common UB scheme brings about substantial stabilization gains, even in a union characterized with heterogeneous labour markets and UB systems. The greater the business cycle diverge, the larger gains are generated. The transfer system enables adoption of countercyclical fiscal policy, i.e. increasing taxes during booms and cutting them in recessions, while keeping UB payments much more stable throughout the cycle. This ensures an overall smoother consumption path.

Still, such scheme can induce substantial permanent transfers and thus moral hazard. It is demonstrated how the transfer system can be complemented by a clawback rule to limit the risk. However, there is a trade-off between stabilization and redistribution. Large and quick repayments impede the shock absorption, while gradual and slow reimbursement makes more room for stabilization. However, the stabilization gain of the simulated UB scheme with clawback is still found to be substantial. Allowing for deficits and surpluses could enable more gradual repayment and higher stabilization gains.

The findings of the theoretical analysis are confirmed by the evaluation of the existing proposals for a EUI, including the rough magnitude of the stabilization effects. The comparative analysis of the design schemes showed that the implementation of both a genuine and an equivalent UB scheme is possible without modifying national institutions and in the manner which ensures its automatic operation. To address the moral hazard, a range of instruments is available with their advantages and disadvantages. In the light of this analysis, a two-tier trigger, a self-insurance extended with a shared fund, and a progressive experience rating mechanism activated in good times appear to be well-suited design features to limit permanent transfers without compromising stabilization. In addition, a borrowing capacity could enhance the potential of the UB scheme to smooth shocks. All in all, intelligent design can limit side effects of the common unemployment insurance while promoting its shock absorption properties.

Having said all of the above, a thought experiment suggests itself: a centralized UB scheme implemented during the conception phase of the Eurozone. In the first euro decade, characterised by the rapid growth and the development of the real estate bubble in the periphery of the Eurozone, large contributions could have been paid by the Southern Europe into the UB pot. These funds, as well as further contributions of the member states, could have been used later to cushion the massive economic slump and might have scaled down the European Great Recession in terms of its length and severity. Yet, the scheme was not in place as the global financial crisis unfolded. Today, the policy makers can learn from the painful lessons of the last decade, and a EUI may become the safety net for next crises which the European communities are about to face.

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A Characteristics of the shock scenarios

	Scenario 1			Scenario 2		
Variable	**Mean**	**Coefficient of variation**	**Difference to SS**	**Mean**	**Coefficient of variation**	**Difference to SS**
Productivity Home	0.9936	1.50%	-0.64%	0.9996	2.21%	-0.04% %
Productivity Foreign	0.5555	1.87%	-0.80%	0.5582	2.35%	-0.32%
Net output Home	0.9167	1.58%	-0.68%	0.9226	2.34%	-0.04%
Net output Foreign	0.4812	2.06%	-0.78%	0.4838	2.58%	-0.25%
Unemployment Home	0.0672	1.19%	+0.02pp	0.0668	1.95%	-0.02pp
Unemployment Foreign	0.01166	1.46%	+0.06pp	0.1161	1.89%	+0.01pp
Vacancies Home	0.0296	2.03%	-1%	0.0298	2.68%	-0.33%
Vacancies Foreign	0.0481	2.49%	-1.43%	0.0483	2.90%	-1.02%
UB Home	0.6994	1.56%	-0.67%	0.7037	2.32%	-0.04%
UB Foreign	0.3261	1.99%	-0.88%	0.3278	2.50%	-0.36%
Tax rate Home	0.0356	1.97%	+0.06pp	0.0353	2.83%	+0.03pp
Tax rate Foreign	0.0619	1.94%	+0.09pp	0.0615	2.60%	+0.05pp
Consumption Home	0.9167	1.58%	-0.68%	0.9226	2.34%	-0.04%
Consumption Foreign	0.4812	2.06%	-0.78%	0.4838	2.58%	-0.25%

Table 6: Impact of the shock scenarios on endogenous variables

B Dynare code

B.1 Status quo. Scenario 1

```
%-----------------------------------------------------------------
% Two countries, Home and Foreign, with subscripts h and f, respectively
% Variables are output, productivity, employment, unemployment, vacancies,
% job filling rate, wage, unemployment benefit, tax rate, consumption
%-----------------------------------------------------------------
var
% Home
yh ah nh uh vh qh wh bh th ch
% Foreign
yf af nf uf vf qf wf bf tf cf;

% Productivity shocks
varexo e_h e_f;

% Parameters
parameters
gamma chi mu rho_a
sh kh rhoh a_ssh
sf kf rhof a_ssf;

gamma = 0.9; % bargaining power of workers
chi = 0.46; % matching efficiency
mu = 0.5; % elasticity of the matching function
rho_a = 0.95; % autocorrelation productivity

sh = 0.022; % separation rate Home
kh = 0.344; % vacancy cost Home
rhoh = 0.75; % replacement rate Home
a_ssh = 1; % productivity in steady state Home

sf = 0.039; % separation rate Foreign
kf = 0.199; % vacancy cost Foreign
rhof = 0.65; % replacement rate Foreign
a_ssf = 0.56; % productivity in steady state Foreign

model;
yh = ah*nh - kh*vh; % output net of vacancy costs Home
ah = rho_a*ah(-1) + (1-rho_a)*a_ssh - e_h; % productivity Home
nh = (1-sh)*nh(-1) + qh*vh; % employment rate Home
uh = 1-nh; % unemployment rate Home
vh = uh*((1-mu)*ah*chi/kh)^(1/mu); % vacancies Home
qh = chi*(vh/uh)^(-mu); % vacancy filling rate Home
wh = gamma*ah/(gamma + (1-gamma)*(1-rhoh)); % wage Home
bh = rhoh*yh/(nh + (1-nh)*rhoh); % unemployment benefit Home
th = 1 - ((1/wh)*yh/(nh + (1-nh)*rhoh)); % tax rate Home
ch = nh*(1-th)*wh + (1-nh)*bh; % consumption Home
yf = af*nf - kf*vf; % output net of vacancy costs Foreign
af = rho_a*af(-1) + (1-rho_a)*a_ssf - e_f; % productivity Foreign
nf = (1-sf)*nf(-1) + qf*vf; % employment rate Foreign
uf = 1-nf; % unemployment rate Foreign
vf = uf*((1-mu)*af*chi/kf)^(1/mu);  % vacancies Foreign
```

```
qf = chi*(vf/uf)^(-mu); % vacancy filling rate Foreign
wf = gamma*af/(gamma + (1-gamma)*(1-rhof)); % wage Foreign
bf = rhof*yf/(nf + (1-nf)*rhof); % unemployment benefit Foreign
tf = 1 - ((1/wf)*yf/(nf + (1-nf)*rhof)); % tax rate Foreign
cf = nf*(1-tf)*wf + (1-nf)*bf; % consumption Foreign
end;

initval;
yh = 0.923;
ah = 1;
nh = 0.933;
uh = 0.067;
vh = 0.0299;
qh = 0.7;
wh = 0.973;
bh = 0.704;
th = 0.035;
ch = 0.923;
yf = 0.485;
af = 0.56;
nf = 0.884;
uf = 0.116;
vf = 0.0485;
qf = 0.7;
wf = 0.539;
bf = 0.329;
tf = 0.061;
cf = 0.485;
e_h = 0;
e_f = 0;
end;
steady;

shocks;
%----------------------------------------------------------------
% Shocks of magnitude proportional to the productivity
%----------------------------------------------------------------
var e_h = 0.08;  %8 percent of Home productivity
var e_f = 0.056; %10 percent of Foreign productivity
end;

stoch_simul(order=1, periods=1000, irf=250, nograph);

initial_condition_states = repmat(oo_.dr.ys,1,M_.maximum_lag);
shock_matrix = zeros(options_.irf,M_.exo_nbr);
shock_matrix(2,strmatch('e_h',M_.exo_names,'exact')) = 0.08;
shock_matrix(2+99,strmatch('e_f',M_.exo_names,'exact')) = 0.056;
notr2 = simult_(initial_condition_states,oo_.dr,shock_matrix,1);
notr_IRF2 = notr2(:,M_.maximum_lag+1:end)-repmat(oo_.dr.ys,1,M_.maximum_lag);
```

B.2 Common UB system. Scenario 1

```
var
% Home
yh ah nh uh vh qh wh bh th ch
% Foreign
yf af nf uf vf qf wf bf tf cf
Tr;

% Productivity shocks
varexo e_h e_f;

% Parameters
parameters
omeg gamma chi mu rho_a
sh kh rhoh y_ssh a_ssh
sf kf rhof y_ssf a_ssf;

omeg = 0.59; % population share Home
gamma = 0.9; % bargaining power of workers
chi = 0.46; % matching efficiency
mu = 0.5; % elasticity of the matching function
rho_a = 0.95; % autocorrelation productivity

sh = 0.022; % separation rate Home
kh = 0.344; % vacancy cost Home
rhoh = 0.75; % replacement rate Home
y_ssh = 0.923; % steady state output Home
a_ssh = 1; % productivity in steady state Home

sf = 0.039; % separation rate Foreign
kf = 0.199; % vacancy cost Foreign
rhof = 0.65; % replacement rate Foreign
y_ssf = 0.485; % steady state output Foreign
a_ssf = 0.56; % productivity in steady state Foreign

model;
yh = ah*nh - kh*vh; % output net of vacancy costs Home
ah = rho_a*ah(-1) + (1-rho_a)*a_ssh - e_h; % productivity Home
nh = (1-sh)*nh(-1) + qh*vh; % employment rate Home
uh = 1-nh; % unemployment rate Home
vh = uh*((1-mu)*ah*chi/kh)^(1/mu); % vacancies Home
qh = chi*(vh/uh)^(-mu); % vacancy filling rate Home
wh = gamma*ah/(gamma + (1-gamma)*(1-rhoh)); % wage Home
bh = rhoh*(yh + Tr)/(nh + (1-nh)*rhoh); % unemployment benefit Home
th = 1 - ((1/wh)*(yh + Tr)/(nh + (1-nh)*rhoh)); % tax rate Home
ch = nh*(1-th)*wh + (1-nh)*bh; % consumption Home
yf = af*nf - kf*vf; % output net of vacancy costs Foreign
af = rho_a*af(-1) + (1-rho_a)*a_ssf - e_f; % productivity Foreign
nf = (1-sf)*nf(-1) + qf*vf; % employment rate Foreign
uf = 1-nf; % unemployment rate Foreign
vf = uf*((1-mu)*af*chi/kf)^(1/mu);  % vacancies Foreign
qf = chi*(vf/uf)^(-mu); % vacancy filling rate Foreign
wf = gamma*af/(gamma + (1-gamma)*(1-rhof)); % wage Foreign
bf = rhof*(yf - Tr)/(nf + (1-nf)*rhof); % unemployment benefit Foreign
tf = 1 - ((1/wf)*(yf - Tr)/(nf + (1-nf)*rhof)); % tax rate Foreign
```

```
cf = nf*(1-tf)*wf + (1-nf)*bf; % consumption Foreign
Tr = (y_ssh*y_ssf)/(omeg/(1-omeg)*y_ssh + y_ssf)*(yf/y_ssf-yh/y_ssh); % transfer
end;

initval;
yh = 0.923;
ah = 1;
nh = 0.933;
uh = 0.067;
vh = 0.0299;
qh = 0.7;
wh = 0.973;
bh = 0.704;
th = 0.035;
ch = 0.923;
yf = 0.485;
af = 0.56;
nf = 0.884;
uf = 0.116;
vf = 0.0485;
qf = 0.7;
wf = 0.539;
bf = 0.329;
tf = 0.061;
cf = 0.485;
Tr = 0;
e_h = 0;
e_f = 0;
end;
steady;

shocks;
%-----------------------------------------------------------------
% Shocks of magnitude proportional to the productivity
%-----------------------------------------------------------------
var e_h = 0.08;  %8 percent of Home productivity
var e_f = 0.056; %10 percent of Foreign productivity
end;

stoch_simul(order=1, periods=1000, irf=250, nograph);

initial_condition_states = repmat(oo_.dr.ys,1,M_.maximum_lag);
shock_matrix = zeros(options_.irf,M_.exo_nbr);
shock_matrix(2,strmatch('e_h',M_.exo_names,'exact')) = 0.08;
shock_matrix(2+99,strmatch('e_f',M_.exo_names,'exact')) = 0.056;
tr2 = simult_(initial_condition_states,oo_.dr,shock_matrix,1);
tr_IRF2 = tr2(:,M_.maximum_lag+1:end)-repmat(oo_.dr.ys,1,M_.maximum_lag);
```

B.3 Common UB system with a clawback. Scenario 1

```
var
% Home
yh ah nh uh vh qh wh bh th ch
% Foreign
yf af nf uf vf qf wf bf tf cf
Tr R;

% Productivity shocks
varexo e_h e_f;

% Parameters
parameters
omeg gamma chi mu rho_a
sh kh rhoh y_ssh a_ssh
sf kf rhof y_ssf a_ssf
delta;

omeg = 0.59; % population share Home
gamma = 0.9; % bargaining power of workers
chi = 0.46; % matching efficiency
mu = 0.5; % elasticity of the matching function
rho_a = 0.95; % autocorrelation productivity

sh = 0.022; % separation rate Home
kh = 0.344; % vacancy cost Home
rhoh = 0.75; % replacement rate Home
y_ssh = 0.923; % steady state output Home
a_ssh = 1; % productivity in steady state Home

sf = 0.039; % separation rate Foreign
kf = 0.199; % vacancy cost Foreign
rhof = 0.65; % replacement rate Foreign
y_ssf = 0.485; % steady state output Foreign
a_ssf = 0.56; % productivity in steady state Foreign

delta = 0.05; % installment rate for reimbursement

model;
yh = ah*nh - kh*vh; % output net of vacancy costs Home
ah = rho_a*ah(-1) + (1-rho_a)*a_ssh - e_h; % productivity Home
nh = (1-sh)*nh(-1) + qh*vh; % employment rate Home
uh = 1-nh; % unemployment rate Home
vh = uh*((1-mu)*ah*chi/kh)^(1/mu); % vacancies Home
qh = chi*(vh/uh)^(-mu); % vacancy filling rate Home
wh = gamma*ah/(gamma + (1-gamma)*(1-rhoh)); % wage Home
bh = rhoh*(yh + Tr)/(nh + (1-nh)*rhoh); % unemployment benefit Home
th = 1 - ((1/wh)*(yh + Tr)/(nh + (1-nh)*rhoh)); % tax rate Home
ch = nh*(1-th)*wh + (1-nh)*bh; % consumption Home
yf = af*nf - kf*vf; % output net of vacancy costs Foreign
af = rho_a*af(-1) + (1-rho_a)*a_ssf - e_f; % productivity Foreign
nf = (1-sf)*nf(-1) + qf*vf; % employment rate Foreign
uf = 1-nf; % unemployment rate Foreign
vf = uf*((1-mu)*af*chi/kf)^(1/mu);  % vacancies Foreign
qf = chi*(vf/uf)^(-mu); % vacancy filling rate Foreign
```

```
wf = gamma*af/(gamma + (1-gamma)*(1-rhof)); % wage Foreign
bf = rhof*(yf - Tr)/(nf + (1-nf)*rhof); % unemployment benefit Foreign
tf = 1 - ((1/wf)*(yf - Tr)/(nf + (1-nf)*rhof)); % tax rate Foreign
cf = nf*(1-tf)*wf + (1-nf)*bf; % consumption Foreign
Tr = (y_ssh*y_ssf)/(omeg/(1-omeg)*y_ssh + y_ssf)*(yf/y_ssf-yh/y_ssh) - delta*R; % transfer
R = R(-1) + Tr(-1); % reimbursement (sum of received funds)
end;

initval;
yh = 0.923;
ah = 1;
nh = 0.933;
uh = 0.067;
vh = 0.0299;
qh = 0.7;
wh = 0.973;
bh = 0.704;
th = 0.035;
ch = 0.923;
yf = 0.485;
af = 0.56;
nf = 0.884;
uf = 0.116;
vf = 0.0485;
qf = 0.7;
wf = 0.539;
bf = 0.329;
tf = 0.061;
cf = 0.485;
R = 0;
Tr = 0;
e_h = 0;
e_f = 0;
end;
steady;

shocks;
%-----------------------------------------------------------------
% Shocks of magnitude proportional to the productivity
%-----------------------------------------------------------------
var e_h = 0.08;  %8 percent of Home productivity
var e_f = 0.056; %10 percent of Foreign productivity
end;

stoch_simul(order=1, periods=1000, irf=250, nograph);

initial_condition_states = repmat(oo_.dr.ys,1,M_.maximum_lag);
shock_matrix = zeros(options_.irf,M_.exo_nbr);
shock_matrix(2,strmatch('e_h',M_.exo_names,'exact')) = 0.08;
shock_matrix(2+99,strmatch('e_f',M_.exo_names,'exact')) = 0.056;
tr3 = simult_(initial_condition_states,oo_.dr,shock_matrix,1);
tr_IRF3 = tr3(:,M_.maximum_lag+1:end)-repmat(oo_.dr.ys,1,M_.maximum_lag);
```

B.4 Status quo. Scenario 2

```
var
% Home
yh ah nh uh vh qh wh bh th ch
% Foreign
yf af nf uf vf qf wf bf tf cf;

% Productivity shocks
varexo e_h e_f;

% Parameters
parameters
gamma chi mu rho_a
sh kh rhoh a_ssh
sf kf rhof a_ssf;

gamma = 0.9; % bargaining power of workers
chi = 0.46; % matching efficiency
mu = 0.5; % elasticity of the matching function
rho_a = 0.95; % autocorrelation productivity

sh = 0.022; % separation rate Home
kh = 0.344; % vacancy cost Home
rhoh = 0.75; % replacement rate Home
a_ssh = 1; % productivity in steady state Home

sf = 0.039; % separation rate Foreign
kf = 0.199; % vacancy cost Foreign
rhof = 0.65; % replacement rate Foreign
a_ssf = 0.56; % productivity in steady state Foreign

model;
yh = ah*nh - kh*vh; % output net of vacancy costs Home
ah = rho_a*ah(-1) + (1-rho_a)*a_ssh - e_h + 1.34*e_f; % productivity Home
nh = (1-sh)*nh(-1) + qh*vh; % employment rate Home
uh = 1-nh; % unemployment rate Home
vh = uh*((1-mu)*ah*chi/kh)^(1/mu); % vacancies Home
qh = chi*(vh/uh)^(-mu); % vacancy filling rate Home
wh = gamma*ah/(gamma + (1-gamma)*(1-rhoh)); % wage Home
bh = rhoh*yh/(nh + (1-nh)*rhoh); % unemployment benefit Home
th = 1 - ((1/wh)*yh/(nh + (1-nh)*rhoh)); % tax rate Home
ch = nh*(1-th)*wh + (1-nh)*bh; % consumption Home
yf = af*nf - kf*vf; % output net of vacancy costs Foreign
af = rho_a*af(-1) + (1-rho_a)*a_ssf + 0.42*e_h - e_f; % productivity Foreign
nf = (1-sf)*nf(-1) + qf*vf; % employment rate Foreign
uf = 1-nf; % unemployment rate Foreign
vf = uf*((1-mu)*af*chi/kf)^(1/mu);  % vacancies Foreign
qf = chi*(vf/uf)^(-mu); % vacancy filling rate Foreign
wf = gamma*af/(gamma + (1-gamma)*(1-rhof)); % wage Foreign
bf = rhof*yf/(nf + (1-nf)*rhof); % unemployment benefit Foreign
tf = 1 - ((1/wf)*yf/(nf + (1-nf)*rhof)); % tax rate Foreign
cf = nf*(1-tf)*wf + (1-nf)*bf; % consumption Foreign
end;

initval;
```

```
yh = 0.923;
ah = 1;
nh = 0.933;
uh = 0.067;
vh = 0.0299;
qh = 0.7;
wh = 0.973;
bh = 0.704;
th = 0.035;
ch = 0.923;
yf = 0.485;
af = 0.56;
nf = 0.884;
uf = 0.116;
vf = 0.0485;
qf = 0.7;
wf = 0.539;
bf = 0.329;
tf = 0.061;
cf = 0.485;
e_h = 0;
e_f = 0;
end;
steady;

shocks;
%-----------------------------------------------------------------
% The same shock to productivity affects Home negatively and Foreign positively,
% also at a different magnitude (see model)
%-----------------------------------------------------------------
var e_h = 0.08;  %8 percent of Home productivity
var e_f = 0.056; %10 percent of Foreign productivity
end;

stoch_simul(order=1, periods=1000, irf=250, nograph);

initial_condition_states = repmat(oo_.dr.ys,1,M_.maximum_lag);
shock_matrix = zeros(options_.irf,M_.exo_nbr);
shock_matrix(2,strmatch('e_h',M_.exo_names,'exact')) = 0.08;
shock_matrix(2+99,strmatch('e_f',M_.exo_names,'exact')) = 0.056;
notr2 = simult_(initial_condition_states,oo_.dr,shock_matrix,1);
notr_IRF2 = notr2(:,M_.maximum_lag+1:end)-repmat(oo_.dr.ys,1,M_.maximum_lag);
```

B.5 Common UB system. Scenario 2

```
var
% Home
yh ah nh uh vh qh wh bh th ch
% Foreign
yf af nf uf vf qf wf bf tf cf
Tr;

% Productivity shocks
varexo e_h e_f;

% Parameters
parameters
omeg gamma chi mu rho_a
sh kh rhoh y_ssh a_ssh
sf kf rhof y_ssf a_ssf;

omeg = 0.59; % population share Home
gamma = 0.9; % bargaining power of workers
chi = 0.46; % matching efficiency
mu = 0.5; % elasticity of the matching function
rho_a = 0.95; % autocorrelation productivity

sh = 0.022; % separation rate Home
kh = 0.344; % vacancy cost Home
rhoh = 0.75; % replacement rate Home
y_ssh = 0.923; % steady state output Home
a_ssh = 1; % productivity in steady state Home

sf = 0.039; % separation rate Foreign
kf = 0.199; % vacancy cost Foreign
rhof = 0.65; % replacement rate Foreign
y_ssf = 0.485; % steady state output Foreign
a_ssf = 0.56; % productivity in steady state Foreign

model;
yh = ah*nh - kh*vh; % output net of vacancy costs Home
ah = rho_a*ah(-1) + (1-rho_a)*a_ssh - e_h + 1.34*e_f; % productivity Home
nh = (1-sh)*nh(-1) + qh*vh; % employment rate Home
uh = 1-nh; % unemployment rate Home
vh = uh*((1-mu)*ah*chi/kh)^(1/mu); % vacancies Home
qh = chi*(vh/uh)^(-mu); % vacancy filling rate Home
wh = gamma*ah/(gamma + (1-gamma)*(1-rhoh)); % wage Home
bh = rhoh*(yh + Tr)/(nh + (1-nh)*rhoh); % unemployment benefit Home
th = 1 - ((1/wh)*(yh + Tr)/(nh + (1-nh)*rhoh)); % tax rate Home
ch = nh*(1-th)*wh + (1-nh)*bh; % consumption Home
yf = af*nf - kf*vf; % output net of vacancy costs Foreign
af = rho_a*af(-1) + (1-rho_a)*a_ssf + 0.42*e_h - e_f; % productivity Foreign
nf = (1-sf)*nf(-1) + qf*vf; % employment rate Foreign
uf = 1-nf; % unemployment rate Foreign
vf = uf*((1-mu)*af*chi/kf)^(1/mu);  % vacancies Foreign
qf = chi*(vf/uf)^(-mu); % vacancy filling rate Foreign
wf = gamma*af/(gamma + (1-gamma)*(1-rhof)); % wage Foreign
bf = rhof*(yf - Tr)/(nf + (1-nf)*rhof); % unemployment benefit Foreign
tf = 1 - ((1/wf)*(yf - Tr)/(nf + (1-nf)*rhof)); % tax rate Foreign
```

```
cf = nf*(1-tf)*wf + (1-nf)*bf; % consumption Foreign
Tr = (y_ssh*y_ssf)/(omeg/(1-omeg)*y_ssh + y_ssf)*(yf/y_ssf-yh/y_ssh); % transfer
end;

initval;
yh = 0.923;
ah = 1;
nh = 0.933;
uh = 0.067;
vh = 0.0299;
qh = 0.7;
wh = 0.973;
bh = 0.704;
th = 0.035;
ch = 0.923;
yf = 0.485;
af = 0.56;
nf = 0.884;
uf = 0.116;
vf = 0.0485;
qf = 0.7;
wf = 0.539;
bf = 0.329;
tf = 0.061;
cf = 0.485;
Tr = 0;
e_h = 0;
e_f = 0;
end;
steady;

shocks;
%-----------------------------------------------------------------
% The same shock to productivity affects Home negatively and Foreign positively,
% also at a different magnitude (see model)
%-----------------------------------------------------------------
var e_h = 0.08;  %8 percent of Home productivity
var e_f = 0.056; %10 percent of Foreign productivity
end;

stoch_simul(order=1, periods=1000, irf=250, nograph);

initial_condition_states = repmat(oo_.dr.ys,1,M_.maximum_lag);
shock_matrix = zeros(options_.irf,M_.exo_nbr);
shock_matrix(2,strmatch('e_h',M_.exo_names,'exact')) = 0.08;
shock_matrix(2+99,strmatch('e_f',M_.exo_names,'exact')) = 0.056;
tr2 = simult_(initial_condition_states,oo_.dr,shock_matrix,1);
tr_IRF2 = tr2(:,M_.maximum_lag+1:end)-repmat(oo_.dr.ys,1,M_.maximum_lag);
```

B.6 Common UB system with a clawback. Scenario 2

```
var
% Home
yh ah nh uh vh qh wh bh th ch
% Foreign
yf af nf uf vf qf wf bf tf cf
Tr R;

% Productivity shocks
varexo e_h e_f;

% Parameters
parameters
omeg gamma chi mu rho_a
sh kh rhoh y_ssh a_ssh
sf kf rhof y_ssf a_ssf
delta;

omeg = 0.59; % population share Home
gamma = 0.9; % bargaining power of workers
chi = 0.46; % matching efficiency
mu = 0.5; % elasticity of the matching function
rho_a = 0.95; % autocorrelation productivity

sh = 0.022; % separation rate Home
kh = 0.344; % vacancy cost Home
rhoh = 0.75; % replacement rate Home
y_ssh = 0.923; % steady state output Home
a_ssh = 1; % productivity in steady state Home

sf = 0.039; % separation rate Foreign
kf = 0.199; % vacancy cost Foreign
rhof = 0.65; % replacement rate Foreign
y_ssf = 0.485; % steady state output Foreign
a_ssf = 0.56; % productivity in steady state Foreign

delta = 0.07; % installment rate for reimbursement

model;
yh = ah*nh - kh*vh; % output net of vacancy costs Home
ah = rho_a*ah(-1) + (1-rho_a)*a_ssh - e_h + + 1.34*e_f; % productivity Home
nh = (1-sh)*nh(-1) + qh*vh; % employment rate Home
uh = 1-nh; % unemployment rate Home
vh = uh*((1-mu)*ah*chi/kh)^(1/mu); % vacancies Home
qh = chi*(vh/uh)^(-mu); % vacancy filling rate Home
wh = gamma*ah/(gamma + (1-gamma)*(1-rhoh)); % wage Home
bh = rhoh*(yh + Tr)/(nh + (1-nh)*rhoh); % unemployment benefit Home
th = 1 - ((1/wh)*(yh + Tr)/(nh + (1-nh)*rhoh)); % tax rate Home
ch = nh*(1-th)*wh + (1-nh)*bh; % consumption Home
yf = af*nf - kf*vf; % output net of vacancy costs Foreign
af = rho_a*af(-1) + (1-rho_a)*a_ssf + 0.42*e_h - e_f; % productivity Foreign
nf = (1-sf)*nf(-1) + qf*vf; % employment rate Foreign
uf = 1-nf; % unemployment rate Foreign
vf = uf*((1-mu)*af*chi/kf)^(1/mu);  % vacancies Foreign
qf = chi*(vf/uf)^(-mu); % vacancy filling rate Foreign
```

```
wf = gamma*af/(gamma + (1-gamma)*(1-rhof)); % wage Foreign
bf = rhof*(yf - Tr)/(nf + (1-nf)*rhof); % unemployment benefit Foreign
tf = 1 - ((1/wf)*(yf - Tr)/(nf + (1-nf)*rhof)); % tax rate Foreign
cf = nf*(1-tf)*wf + (1-nf)*bf; % consumption Foreign
Tr = (y_ssh*y_ssf)/(omeg/(1-omeg)*y_ssh + y_ssf)*(yf/y_ssf-yh/y_ssh) - delta*R; % transfer
R = R(-1) + Tr(-1); % reimbursement (sum of received funds)
end;

initval;
yh = 0.923;
ah = 1;
nh = 0.933;
uh = 0.067;
vh = 0.0299;
qh = 0.7;
wh = 0.973;
bh = 0.704;
th = 0.035;
ch = 0.923;
yf = 0.485;
af = 0.56;
nf = 0.884;
uf = 0.116;
vf = 0.0485;
qf = 0.7;
wf = 0.539;
bf = 0.329;
tf = 0.061;
cf = 0.485;
R = 0;
Tr = 0;
e_h = 0;
e_f = 0;
end;
steady;

shocks;
%----------------------------------------------------------------
% The same shock to productivity affects Home negatively and Foreign positively,
% also at a different magnitude (see model)
%----------------------------------------------------------------
var e_h = 0.08;  %8 percent of Home productivity
var e_f = 0.056; %10 percent of Foreign productivity
end;

stoch_simul(order=1, periods=1000, irf=250, nograph);

initial_condition_states = repmat(oo_.dr.ys,1,M_.maximum_lag);
shock_matrix = zeros(options_.irf,M_.exo_nbr);
shock_matrix(2,strmatch('e_h',M_.exo_names,'exact')) = 0.08;
shock_matrix(2+99,strmatch('e_f',M_.exo_names,'exact')) = 0.056;
tr3 = simult_(initial_condition_states,oo_.dr,shock_matrix,1);
tr_IRF3 = tr3(:,M_.maximum_lag+1:end)-repmat(oo_.dr.ys,1,M_.maximum_lag);
```