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JEL Classification: E58, E63, F33

Keywords: Target2 system, European Monetary Union, Central bank capital

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1 INTRODUCTION

The monetary union, and in particular the European Central Bank, are the object of harsh criticism from several quarters. The reasons for these criticisms vary, but in Germany and other countries the Target system is among the most salient. That system is often cited as a serious threat to the very integrity of the monetary union, and its critique by a group of central European scholars has even become standard fare in the media and in the political debate of those countries[1].

The scholarly debate itself started almost ten years ago, and despite some heated exchanges (at least by the standards of academia) the views of the participants do not seem to get any closer. The earlier debate was particularly active during the sovereign and banking crisis of 2011-2012, which led to an accumulation of Target claims by Germany peaking at 730bn euros in the summer of 2014. At the time, a series of papers by academics, including De Grauwe and Ji (2012) and Whelan (2014), together with several contributions particularly on VoxEu.org, argued that most of the criticisms had no basis. It is fair to say that to many academics these contributions appeared to have conclusively shown that the criticisms of the Target system as such were theoretically unfounded.

After declining considerably, Target imbalances came back with a vengeance with the start of Quantitative Easing in January of 2015: the German net Target claims reached a peak of €932bn at the end of 2018, and with the end of QE in 2019 they declined only slightly to €804bn as of end-February 2020. With the resumption of QE in November 2019 and its subsequent enlargement under the Pandemic Emergency Purchase Program, the net Target claims of Germany are likely to increase further, all the more so should there be a new flight to safety from some country hit by a government debt crisis.

Predictably, the increase in Target claims associated with QE has reignited criticism of and worries about the Target system. The arguments used in this new wave of criticism are identical to those of the earlier debate (see e.g. Sinn 2018). Either the critics have not read carefully the earlier academic contributions that purportedly had proved them wrong, or the arguments of the critics' critics were not so self-evident after all.

There are several reasons why the debate does not seem to be anywhere nearer to being settled than it was five years ago. The criticism of the Target system was rarely formalized exactly, and it was not easy to understand exactly what it consisted of. In particular, it was rarely clear whether it was the Target system *per se* that was being criticized, or rather Target imbalances were seen only as the manifestation of problems created by specific choices of monetary policy. Most critics of the Target system would have claimed that it was both: see for instance Westermann (2014). It was also not always clear what realistic arrangements the Target critics had in mind as alternatives. On the other hand, in their defense of the Target system the critics of the critics went too far, and refused to concede some valid points of the latter.

The purpose of this paper is twofold. First, to try and clarify the many remaining misunderstandings about the workings and implications of the Target system. I propose a unified, systematic and simple approach to the study of the workings of the Target system in response to different shocks: in particular (i) a current account shock; (ii) capital flight or a capital repatriation shock (iii) and Quantitative Easing (QE). Also, I argue that the Target system can only be evaluated (and its criticism can

[1] It even found a way in the internal debate of the European Central Bank when in March 2012 the Bundesbank's president Jens Weidmann wrote a letter to the then President of the ECB Mario Draghi demanding guarantees for Germany's Target claims (see Reuters 2012).

only be understood) against carefully specified alternatives: I will consider a monetary union without a Target system, in which transfers of reserves between banks occur though the ECB directly and not via national central banks; a Target system with periodic settlement of balances; and a fixed exchange rate system.

In the process of clarifying the working of the Target system, I point out two results. First, Target balances are irredeemable and, in equilibrium, carry no effective remuneration. A private company subject to accounting standards might well have to value them at 0. Yet they appear in the conventional balance sheets of the national central banks at face value. This in turn has led to persistent misunderstanding on the interpretation of the whole Target system. I show that (to a first approximation) this is not a mistake, as the creation of a Target balance is always accompanied by a change in reserves of an equal amount but an opposite sign.

Second, I point out that one alternative variously advanced by both critics and defenders of the Target system, the settlement of Target balances, is nearly impossible to implement in the Eurozone. The parallel with the much cited Interdistrict Settlement Account of the Federal Reserve banks does not hold, for reasons that have gone previously unnoticed.

The second goal of this paper is to use this more systematic approach to reconsider the German criticism of the Target system. I argue that there are two types of criticisms that should be taken more seriously than the academic literature and many policymakers have been willing to do so far. First, the Target system is not just a reflection of monetary policy, but it could amplify the macroeconomic responses to monetary policy and other shocks. Second, the system does increase the risks to the German taxpayer in case of a Eurozone breakup.

I reach several conclusions. First, and contrary to what has been argued by some commentators, a default on the German Target claims *is* a loss of real resources to the German taxpayer, relative to what would have happened in alternative monetary regimes, like a fixed exchange rate or a Target system with settlement.

Second, and again contrary to a widely held position, this conclusion holds regardless of what is the cause of the accumulation of Target claims, whether they are the results of capital flows (which in themselves do not change the net foreign asset position of a country) or of current account surpluses.

Third, if it causes conventional capital to go very negative, a large default on its Target claims could force a post-breakup Bundesbank to face a trilemma: either accept an immediate recapitalization by the government, or accept a delayed recapitalization via a stream of subsidies over a long period of time, or else increase seigniorage and miss the inflation target. The first two options would jeopardize the independence of the central bank, the third would force it to adopt an undesired monetary policy stance.

Fourth, it is well known that in a world of fiat money a central bank could continue its business as usual even with a mildly negative capital, which does not force it to face the trilemma above. However, in practice central bankers and most politicians would simply find it inconceivable to work with negative capital: the central bank will be recapitalized. In the case of Germany the principle has even been affirmed by the constitutional court, and the ECB itself has taken a strong stance on the issue.

Sixth, a Target default , and the ensuing negative equity of the Bundesbank, could easily be much larger than nearly all the cases of negative equity studied in the literature. This would simply be unexplored territory, both for central bankers and for the public, where psychology could play a bigger role than economics.

Seventh Target balances and the associated default risk could easily influence the monetary policy of the Eurozone, contrary to what many have argued. It is true that the monetary policy of the

Eurozone is usually decided consensually, but a large Target claim might conceivably increase the threat point of the other countries and force Germany to accept a more accommodative Eurozone policy in order to reduce the risk of default.

Obviously this paper has many antecedents. The debate was sparkled by several contributions by a number of German and Austrian economists. Among the first, and making no pretense at completeness[2], Sinn and Wollmershäuser (2012a) (issued in 2011 as a working paper) and Sinn (2011a) and (2011b), with initial replies by Buiter, Rahbari, and Michels (2011a) and (2011b), RebelEconomist (2011), Whelan (2011), and Cecchetti, McCauley and McGuire (2012). Subsequent contributions will be cited in the next sections where relevant. An important one is Whelan (2014), that appeared in *Economic Policy* at the peak of the previous debate on Target balances. While the present paper has many overlaps with and builds on that paper, it also differs in its methodology, in its findings, in its focus, and most importantly in its assessment of the Target criticisms. While Whelan (2014) was dismissive of nearly all Target criticisms, I reach much more nuanced conclusions, and indeed do find that some of these criticisms are well grounded and should not be taken lightly. Continuing to ignore them might exacerbate and poison the political debate and could jeopardize, rather than reinforce, the integrity of the monetary union, as it will entrench the critics and radicalize the political opposition to the monetary union.

2 THE TARGET SYSTEM

Target is a real-time cross-border settlement system used by Eurozone central banks, and also by a few non-Eurozone ones. The details are technical, but for our purposes the basic features of the system are very simple. [3] Target records the claims and liabilities of each National Central Bank (NCB) of the Eurosystem vis à vis the rest of the Eurosystem. Whenever a payer in a country pays with deposits the payee in another country, a Target claim (liability) is penciled in to the NCB of the payee (payer). This is necessary because a transfer of deposits between banks always takes place via a transfer of central bank reserves; if the transfer of deposits concerns two commercial banks that hold reserves at two different NCBs, a system must be devised to keep track of these movements of reserves between NCBs. Target is such a system.

Consider first how a transfer of deposits would occur between Paolo and Kurt, who live in a country outside the Eurozone, with its own money and its own central bank (first panel of Table 1). Whenever Paolo pays Kurt 10 units of account with deposit money, Paolo's bank debits his account for 10 units, and then instructs the central bank to transfer ownership of 10 units of central bank reserves from Paolo's bank to Kurt's bank; the latter then credits Kurt's account for 10 units.

[2] I also cite only the literature in English. There exists also a considerable literature in German that I do not have access to.

[3] Perhaps the best, simple introduction to the Target system is Jobs, Handig, and R. Holzfeind (2012). Strictly speaking, what I call here "Target system" is "Target2", the second generation of the settlement system, that started operations in November 2007.

Table 1: The mechanics of Target claims

	Paolo and Kurt live in the same country							
	Paolo's bank		Central Bank				Kurt's bank	
	Assets	Liabilities	Assets		Liabilities		Assets	Liabilities
	Reserves at central bank = -10	Paolo's deposit = -10			Reserves of Paolo's bank = -10 Reserves of Kurt's bank = + 10		Reserves at central bank = +10	Kurt's deposit = +10
	Paolo and Kurt live in two different countries belonging to a monetary union							
	Paolo's bank		Bank of Italy		Bundesbank		Kurt's bank	
	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
	Reserves at own NCB = -10	Paolo's deposit = -10	Target net claim = -10	Reserves of Paolo's bank = -10	Target net claim = +10	Reserves of Kurt's bank = + 10	Reserves at own NCB = +10	Kurt's deposit = +10

Now suppose Paolo and Kurt live in Italy and Germany respectively, two countries that belong to the Eurozone: the two countries share a currency, but each keeps its own national central bank (second panel of Table 1). Paolo's bank holds reserves at the Bank of Italy, while Kurt's bank holds reserves at the Bundesbank. Because of this, the process of transferring reserves between two banks in two different jurisdictions cannot occur in one step, but it requires an intermediate step.

Like before, the transfer of deposits is effected via a transfer of reserves between two commercial banks; but if reserves were simply transferred from the reserve account of Paolo's bank at the Bank of Italy to the reserve account of Kurt's bank at the Bundesbank, the latter would suffer a decline in its net worth by 10 euros (commercial banks' reserves are a liability item of central banks) and would have to pay interests on the extra reserves.[4] To avoid this, a claim for 10 euros on the European Central Bank is penciled in on the balance sheet of the Bundesbank, and correspondingly a debit of 10 euros to the European Central Bank is penciled in on the balance sheet of the Bank of Italy. These are the net Target claims of the two banks.

Thus, Paolo's bank debits his account for 10 euros, and then has its own reserve account at the Bank of Italy debited for the same amount. In turn, the net Target claims of the Bank of Italy are reduced by 10 euros, while those of the Bundesbank are increased by 10 euros. The Bundesbank then credits the reserve account of Kurt's bank for 10 euros, and the latter credits Kurt's deposit account for the same amount. The end result for Paolo and Kurt and for their commercial banks is the same as in the first example, but now the balance sheets of the two NCBs have changed: the Bundesbank's (Bank of Italy's) net foreign asset position improves (worsens) by 10 euros. In the one-country example of the first panel, instead, the balance sheet of the single central bank had not changed.

Note that nothing in a monetary union requires this intermediate step. The European Monetary Union could have decided to eliminate all NCBs, and to keep a single central bank. All banks in the European Monetary Union would then hold reserves with this central bank, and any cross-border transfer of deposits would have occurred much as in the first example. Presumably for political reasons, the

[4] At the time of writing the interest rate on excess reserves is negative.

European Monetary Union preserved the existence of each country's NCB.[5] Whenever a monetary union is created that maintains separate central banks for separate jurisdictions, a system that keeps track of the debits and credits (i.e., the transfers of banks' reserves) between central banks is necessary.

Note that it makes no difference whether the cross-border deposit transfer occurs for the purpose of paying a purchase of goods and services (a current account transaction) or an asset (a private capital account transaction): in both cases the net Target balance of the payee's (payer's) NCB improves (worsens).[6] Concretely, this means that a country (or rather, its NCB) accumulates a Target liability whenever a transaction increases the current account deficit or causes an outflow of capital, *and* the transaction is paid for by a transfer of deposits.

3 CRITICISMS OF TARGET

Criticism of the Target system can be found in numerous contributions. In what follows, and at the risk of some oversimplification, I try to distil the main charges from this body of critical literature.

1. Misguided monetary policies led to the accumulation of large Target liabilities by periphery countries by creating large amounts of liquidity in the Eurozone (see e.g. Sinn 2018 and Sinn and Wollmershäuser 2012a). Since the inception of the Euro the ECB kept interest rates in periphery countries "artificially" low, thus making it easier to finance large public and current account deficits. Then, excessively loose monetary policy during and after the financial crisis also created the conditions for subsequent capital flights during the sovereign debt and banking crises of 2011 and 2012 in the periphery countries, and for the repatriation of German capital that had financed some of the current account deficit earlier. The "excessively loose monetary policy" took the form of, among others, very generous use of Emergency Liquidity Assistance, a very generous expansion of collateral accepted by the Eurosystem for refinancing operations, and the first outright purchase programs like the Security Market Program. Finally, the programs of large scale asset purchases that started in earnest in January 2015, also known as Quantitative Easing, also contributed to yet more accumulation of Target liabilities by periphery countries.

To the extent that Target imbalances can be considered mere reflections of the underlying monetary policies, these are criticisms of the monetary policies adopted by the ECB. There is an enormous debate on these policies: the present paper is not an addition to this literature. However, the Target critics go further. They would start from the observation that the Target system "transforms" marketable claims with a well-defined maturity held by the private sector of the Target creditor into non-marketable, perpetual claims held by the central bank of the Target creditor against the Eurosystem (see Sinn 2012a p. 53). This leads to the next two criticisms of Target:

[5] Another reason might be that this system works better in the case of a breakdown of the cross-border interbank market: a bank of country A wishing to transfer deposits to country B deals directly with the NCB of country A, not with a bank in country B. However, a breakdown in the interbank market usually means that a bank in country A is not willing to lend to a bank in country B; it does not mean that the payment system breaks down, in the sense that bank A would be unwilling to transfer reserves to bank B if it decided to lend.

[6] Obviously in the first case – a current account transaction - the net foreign asset position of the payee's (payer's) country improves (worsens); in the second – a capital account transaction – it remains unchanged.

2. The Target system itself amplifies the responses to these monetary policy shocks and other shocks, which result in high cross-border flows of payments and high Target imbalances. For instance, if Target debt were collateralized Southern European countries would have been able to run much smaller current account deficits than they did.

3. The Target system increases the risks to the German taxpayer in case of a euro breakup. In other words, Target claims are a particularly risky asset for the creditor country; some alternatives exist that would be less risky.

This paper deals with questions 2. and 3, with a warning that in the Target debate they are not always clearly distinguished from question 1. In addition, these two issues might not be independent of each other, but for illustrative purposes I will deal with them separately. One source of misunderstandings in the debate is that these questions assume a comparison to other possible monetary regimes (the Target system "amplifies" the flows and "increases" the risks), but these alternative regimes are rarely spelled out explicitly and systematically. Thus, in what follows I will consider three specific alternatives to the current regime of monetary union *cum* Target.

1. A monetary union without national central banks, but with a single European Central Bank where all banks hold their reserves. Banks transfer reserves directly to and from their accounts at the ECB. After all, the Bank of Italy does not keep track of the movements of reserves between Lombardy and Piedmont.

2. A monetary union with a Target system, but in which the Target balances are settled periodically, as proposed by Hans-Werner Sinn and by others (see e.g. Sinn 2012b). Obviously settlement should be done with assets whose value cannot be manipulated by the Target debtor, such as gold or debt instruments issued by a reliable non-Eurozone debtor in a stable currency, etc.: I call this "breakup-proof" assets, to indicate that a Target debtor cannot threaten default on these assets in case of a Euro breakup. A persistent debit position in the Target system would lead to the depletion of the pool of breakup-proof assets of the NCB of that country.

3. An asymmetric fixed exchange rate system, where the periphery countries peg their exchange rate and are in charge of implementing the monetary policies that keep the system in place, or else must be willing and able to lose breakup-proof assets. Essentially, this would be a re-enactment of the European Exchange Rate Mechanism in place in Europe between 1979 and 1999.

In this framework, one could ask two types of questions:

1. Do different monetary regimes lead to different Target balances accumulated by each country, in response to similar shocks?

2. Do different monetary regimes imply different costs in case of a breakup of the monetary union, for a given level of Target balances accumulated by each country?

Answering the first question requires a full model. I will concentrate on the second question, although in the process I will have something to say also on the first. To address these questions, it is important to define the notion of Euro breakup precisely. I will focus on two. First, an "orderly" breakup, consisting of

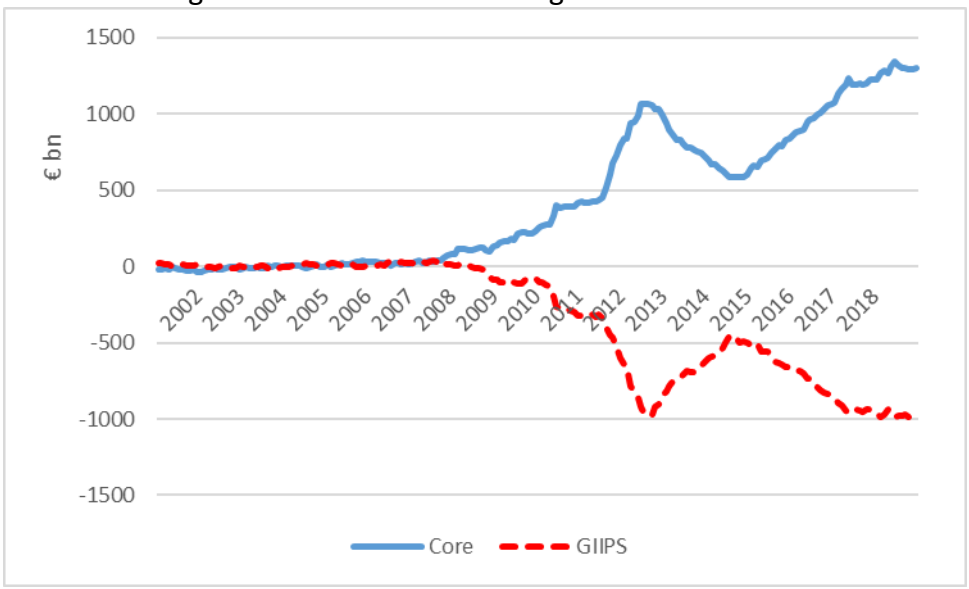
a split in two monetary unions, presumably a "southern" one and a "northern" one. Second, a "disorderly" breakup, in which all countries go their own way, and no monetary union exists anymore. In each case I assume that Target debtors recognize only the Target liabilities towards countries that have remained in their monetary union. Hence, in the case of a disorderly breakup, all Target net creditors lose all their Target net claims. I discuss later whether losing all the Target claims is a realistic scenario, or one should expect only a partial default.

There is widespread consensus – even among participants on the opposite sides of the debate -- that the buildup of Target imbalances has proceeded in four broad stages.[7] First, before the financial crisis, an accumulation of current account deficits by several Southern European countries. Second, the repatriation of German capital after 2008. Third, capital flights from Southern European countries when confidence in their banking systems and government finances deteriorated sharply in 2011-12. Fourth, Quantitative Easing.

4 A NARRATIVE OF THE ACCUMULATION OF TARGET IMBALANCES

Figure 1 displays the evolution of the Target balances of the four largest Target creditors – Germany, Luxembourg, Finland, and Netherlands – and the GIIPS (Greece, Ireland, Italy, Portugal, and Spain) countries. In this section I briefly describe the causes of the main episodes of accumulation of Target imbalances. Because the story has been told several times, I will keep it short.

Figure 1: The evolution of Target balances



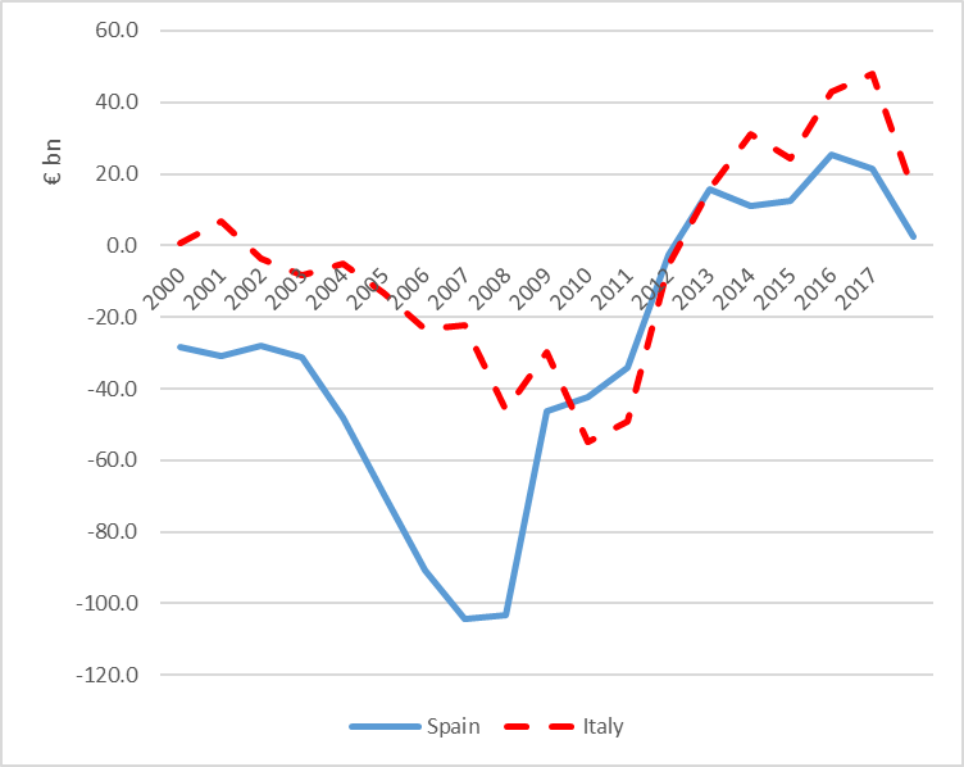
Source: The Euro Crisis Monitor, Institute of Empirical Economic Research of Osnabrück University

[7] See, among others, Whelan (2014) and (2017), Sinn (2018), Sinn and Wollmershauser (2012a) and (2012b) DeNederlanscheBank (2016), European Central Bank (2017). Although this narrative is by now fairly uncontroversial, it was not always so. In particular, Sinn and coauthors were often interpreted as emphasizing a pure "current account" interpretation of Target balances (see e.g. Cecchetti, McCauley and McGuire 2012) - an incorrect representation of their writings.

4.1 CURRENT ACCOUNT DEFICITS

The Target liabilities of GIIPS countries were limited until 2008. However, this masks a substantial difference of behavior between Italy and Spain. Italy had limited current account deficits; Spain had much larger deficits (see Figure 2) , but their effects on Target liabilities were offset by large capital imports (Figure 3). In other words, Spain was transferring deposits abroad in order to pay for an excess of imports over exports of goods, but was also receiving transfers of deposits from abroad, paying for the assets it was selling abroad.

Figure 2: The current account of Italy and Spain

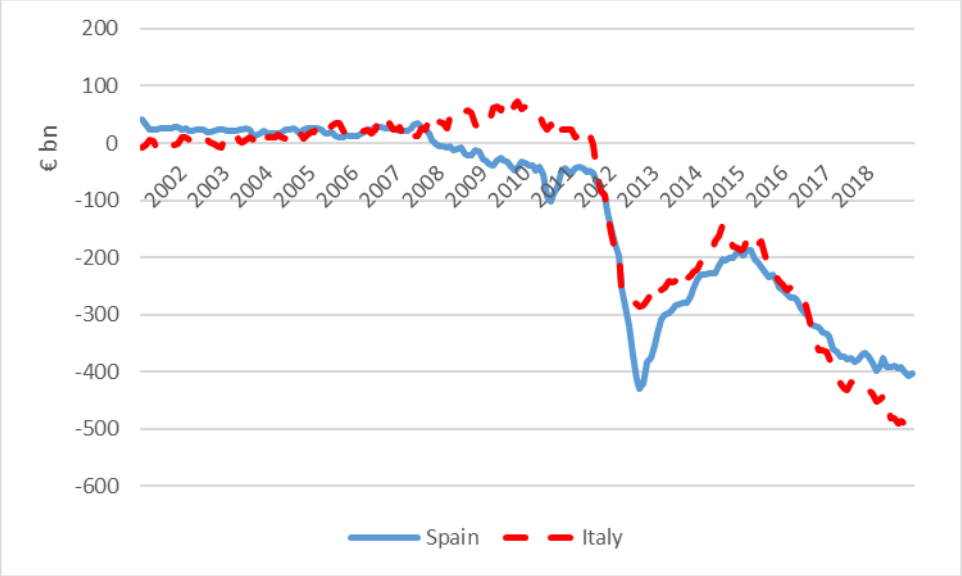


Source: EUROSTAT Database

4.2 CAPITAL REPATRIATION

With the financial crisis, the current account deficit of Spain declined (Figure 2), but a large amount of foreign capital that had financed the construction boom of Spain was repatriated, leading to a large accumulation of Target liabilities (Figure 3)

Figure 3: The evolution of the net Target claims of Italy and Spain



Source: The Euro Crisis Monitor, Institute of Empirical Economic Research of Osnabrück University

4.3 CAPITAL FLIGHTS AND CAPITAL REPATRIATION FROM GIPSIC COUNTRIES

In the summer of 2011 several GIIPS countries suffered a crisis of confidence in their banking system and in their government debt. Substantial amounts of domestic capital fled these countries, while core countries continued to repatriate their capital. For both reasons, the Target liabilities of GIIPS countries increased.

DeNederlanscheBank (2016) and European Central Bank (2017) among others have labelled this large increase in Target imbalances a "demand driven" phenomenon, as the process started with a shock to the private sector. In this account, the Eurosystem acted purely as an intermediary, simply transferring reserves from one NCB to another in response to a private sector shock. In other places Sinn and others have argued that these capital flights were facilitated and amplified by changes in the monetary policies implemented in those years of the Eurozone (see e.g. Sinn and Wollmershauser 2012a). A leveraged institution like a bank can buy foreign assets by borrowing funds. The most immediate source of funds to the banking system is the Eurosystem itself. In 2008, the Eurosystem started conducting marginal refinancing operations with the fixed rate, full allotment system: the Eurosystem would fix the interest rate at which it would provide funds, and it would satisfy any demand by banks, provided of course they could post adequate collateral.[8]

At the end of 2011 and beginning of 2012 the Eurosystem launched two Long Term Refinancing Operations, for a duration of three years and at very attractive interest rates, which eventually totaled almost 1tn euros, largely allocated to Spanish and Italian banks. These bought domestic (mostly government) and foreign assets, and replaced bonds that were coming due. A substantial fraction of these bonds had been bought by foreign investors, who thus repatriated their capital.

[8] In addition, the types of acceptable collateral were enlarged and their minimum quality relaxed.

4.4 QUANTITATIVE EASING

After peaking in mid-2014, Target imbalances declined substantially, only to rise again from 2016. At the end of 2018 Germany's Target claims stood at a record level of almost €1tn. This time the cause was Quantitative Easing, the set of programs of large scale asset purchases by the Eurosystem. Obviously this created a large amount of liquidity in the system, which as we have seen might contribute to the accumulation of Target imbalances in the presence of other shocks. However, this time there was a more immediate, and purely technical, reason why QE translated into large Target imbalances: Germany's Target claim increase when, say, the Bank of Italy buys Italian government bonds from a German bank or hedge fund, or from a non-Eurozone financial institution with a correspondent bank in Germany. This is equivalent to a repatriation of German capital, which leads to an accumulation of Target balances (I defer a more detailed discussion of the effects of QE on Target balances to section 9). DeNederlanscheBank (2016), European Central Bank (2017) label this a "supply driven" phenomenon, as the initial shock is a monetary policy change.

5 PRELIMINARIES

In the next sections I study the effects of the four shocks described above on the balance sheets of various sectors of a representative Target debtor, country A, and a representative Target creditor, country B, under the four different monetary regimes. I consider three sectors: the non-financial private sector ("private sector" for short), the banking system, the NCB, and the country as a whole. When the change in liabilities is different from the change in assets, the net worth of a sector changes; when this happens for the country as a whole, the net foreign asset position of the country changes.

In each case, I describe the change in the balance sheet in two cases: before and after a disorderly breakup in which all Target liabilities are defaulted.[9] I call the latter case the "shadow balance sheet" of the sector. The shadow balance sheet of the country determines the loss or gain for a country in the case of a breakup. A more negative (or less positive) balance in the shadow balance sheet than in the actual balance sheet for the country as a whole is an indication that the net foreign asset position of the country worsens as a consequence of the breakup.[10]

The numbers in each cell in the tables below have to be interpreted as changes with respect to the pre-shock situation. In the tables, "D" stands for "deposits"; "T" for Target balances (Target balances always appear on the asset side of a NCB: a negative sign represents a Target liability); "R" for reserves; "Z(J)" for an asset issued by entity J, i.e. a liability of that entity; hence, it appears on the liability side of that entity with a positive sign, and on the asset side of the purchaser of that asset, also with a positive sign. "Z(S)" represents a breakup-proof asset, i.e. an asset which, once it has been transferred to the creditor, is no longer in the power of the debtor to default on: this could be gold, a safe asset issued by a third entity in a stable currency that is not part of the Eurozone, like US Treasuries, etc.

[9] Obviously the same could be done in the case of an orderly breakup. The logic is the same in the case of a disorderly or an orderly breakup, only the default rate changes for a given net aggregate Target balance of a country.

[10] To highlight the role of Target *per se*, I assume, almost certainly counterfactually, that the breakup has no effect on the output of each country and on the aggregate wealth of the two countries combined.

One must make assumptions on what will happen to the assets and liabilities of each sector in case of a disorderly Euro breakup. NCBs default on any liability towards entities outside their monetary union; hence, Target liabilities are defaulted; the reserves and the refinancing operations of commercial banks end up on the balance sheet of the NCB of their own country. In the examples below, for illustrative purposes I assume a default rate of 100 percent. I also assume that the pattern of defaults on the liabilities of the private sector are independent of the monetary regime.

6 A CURRENT ACCOUNT DEFICIT IN COUNTRY A

I start with a current account shock: perhaps because of a shock to the discount factor, private sector A runs a current account deficit of 10 euros with private sector B. In the rest of the paper, country A is the Target debtor and country B the Target creditor.

6.1 IOU

I start with a case that does not involve deposits with the banking sector. Private sector A pays with a IOU: Table 2 shows what happens next. The first panel of the table refers to country A, the second to country B. The net foreign asset ("NFA") position of private sector A, and of the country as a whole, worsens without any effect on the two central banks (the change in the NFA position of the country as a whole is recorded in the last column). Private sector B has improved its NFA position vis à vis private sector B, and this remains true even after a breakup[11].

Table 2: CA deficit of A paid with a IOU

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup		IOU = +10						IOU = +10	-10
	Post-breakup		IOU = +10						IOU = +10	-10
B	Pre-breakup	IOU = +10						IOU = +10		+10
	Post-breakup	IOU = +10						IOU = +10		+10

When the current account deficit is paid with a IOU, Table 2 would apply to any other regime: monetary union without Target, monetary union with Target and settlement, and fixed exchange rates. In all these cases the key point is that the two private sector have settled the current account transaction with an IOU from the buyer of the goods to the seller, and with no intermediation of the banking sector nor of any central bank. Note, for future reference, that in this case private sector B owns a marketable claim on private sector A with a well defined maturity.

[11] Of course, this assumes that after a breakup private contracts are fulfilled.

6.2 A MONETARY UNION WITH TARGET

Paying with a private IOU is not common. Much more frequently, private sector B wants to be paid with a deposit. In the case of a monetary union with a Target system (Table 3), the deposits are transferred via a transfer of central bank reserves from the account of private sector A at banking system A to the account of private sector B at banking system B. Thus, private sector B improves its net asset position by increasing its deposit at banking sector B rather than by improving its net foreign asset position vis à vis private sector A, as in the IOU case. Now it is NCB B that improves its net foreign asset position thanks to a positive Target claim.

Table 3: Current account deficit of A in a monetary union with Target

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10		R = -10	D = -10	T = -10	R = -10	T = -10		-10
	Post-breakup	D = -10		R = -10	D = -10		R = -10			0
B	Pre-breakup	D = +10		R = +10	D = +10	T = +10	R = +10	T = +10		+10
	Post-breakup	D = +10		R = +10	D = +10		R = +10			0

R: banks' reserves issued by NCB.

In case of breakup, country A does not recognize the Target liability. Consequently, country B no longer records an improvement in the net foreign asset position, despite having recorded a current account surplus; therefore, NCB B's net worth declines by 10 euros, as on the liability side it recognizes its increase in reserves to banking system B.

6.3 A PURE MONETARY UNION

Suppose there is no Target system: there are no national central banks, just a common central bank, the ECB, where all banks of the monetary union hold a reserve account (Table 4). The transfer of reserves between the two banking systems occurs without any claim between national central banks being recorded, just as it happens when a bank based in Piedmont transfers deposits to a bank based in Lombardy. Rather, reserves issued by the ECB (denoted by "R(E)" in Table 4) are transferred between commercial banks.

No breakup-proof assets are transferred between the two countries. Hence, because in case of a breakup NCB B assumes the liability of reserves held by banking system B, its net worth declines by €10 after the breakup (recall that all changes in the table are relative to the situation before the current account shock). This is offset by an improvement by €10 in the net worth of private sector B, as its deposits increase. Country B as a whole records no improvement in the net foreign asset position despite the current account surplus. Thus, the shadow balance sheet of NCB B is exactly the same as in a monetary union with a Target system, shown in Table 3.

Table 4: Current account deficit of A in a monetary union without Target

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10		R(E) = -10	D = -10			R(E) = -10		-10
	Post-breakup	D = -10		R = -10	D = -10		R = -10			0
B	Pre-breakup	D = +10		R(E) = +10	D = +10			R(E) = +10		+10
	Post-breakup	D = +10		R = +10	D = +10		R = +10			0

R(E): banks' reserves issued by the ECB; R: banks' reserves issued by NCB

6.4 A FIXED EXCHANGE RATE REGIME

In a fixed exchange rate regime the transfer of deposits from private sector A to private sector B involves basically the same steps as in a monetary union with Target; the only, but key, difference is that the improvement in the net foreign asset position of NCB B occurs not by recording a Target claim, but via a transfer of foreign exchange reserve assets from NCB A (these assets, denoted as "Z(S)" in Table 5, are also breakup-proof). As a consequence, the shadow balance sheet of the NCBs is the same as the actual balance sheets; in case of a breakup, NCB B and country B preserve the improvement in the net foreign asset position, unlike in the previous two cases.

Table 5: Current account deficit of A in a fixed exchange rate regime

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10		R = -10	D = -10	Z(S) = -10	R = -10	Z(S) = - 10		- 10
	Post-breakup	D = -10		R = -10	D = -10	Z(S) = -10	R = -10	Z(S) = - 10		- 10
B	Pre-breakup	D = +10		R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = + 10		+ 10
	Post-breakup	D = +10		R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = + 10		+ 10

Z(S): foreign exchange reserve assets

6.5 A MONETARY UNION WITH TARGET AND SETTLEMENT

Settlement of the Target balances means that the Target liabilities incurred by a NCB over the previous period are made good by transferring the property of breakup-proof assets for the same value to the creditor NCB. The shadow balance sheet of the two NCBs under a fixed exchange rate regime can be

replicated by a monetary union with a Target system with settlement. The only difference is that, instead of exchanging reserve assets, the NCBs exchange breakup-proof assets (which of course could overlap with foreign reserve assets). Therefore, Table 6 is exactly like Table 5, with Z(S) now representing breakup-proof assets.

Table 6: Current account deficit in A in a monetary union with Target and settlement

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10		R = -10	D = -10	Z(S) = -10	R = -10	Z(S) = - 10		- 10
	Post-breakup	D = -10		R = -10	D = -10	Z(S) = -10	R = -10	Z(S) = - 10		- 10
B	Pre-breakup	D = +10		R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = + 10		+ 10
	Post-breakup	D = +10		R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = + 10		+ 10

Z(S): breakup-proof assets

One could therefore argue that a monetary union with Target and settlement combines the advantages of a monetary union (the near-irrevocability of exchange rates, and all other advantages of a monetary union, including political ones) with the advantages of a fixed exchange rate regime (a built-in mechanism for the automatic correction of current account imbalances and capital flights, and the insulation of the leading country from default of the followers). However, things are more complicated than this.

7 A TARGET SYSTEM WITH SETTLEMENT?

The Target critics have frequently pointed out that the Federal Reserve system is a monetary union with the equivalent of Target with settlement, as Federal Reserve banks settle their balances each year. This is correct, but the notion and the consequences of settlement in the Federal Reserve system are very different from what Target critics have in mind.

The Interdistrict Settlement Account ("ISA") is an item on the balance sheet of each Reserve bank where transactions that involve two Reserve banks are recorded. Exactly like the Target system, it records transfers of payments between two commercial banks in two different districts as an interdistrict claim (liability) of the Reserve bank of the payee (payer). And like in the Eurosystem, the recent increase in ISA balances is associated with the Quantitative Easing program of the Fed. The purchases of assets are conducted by the New York Fed for all Reserve banks; as a consequence, and much like the German NCB when it buys Italian assets for the Italian NCB from a hedge fund with an account at a German-based bank (see below), the New York Fed gets a ISA claim.

Differently from the Target system, the ISA balances are settled each year. In the Target debate, there has been considerable confusion over the modality of settlement. Some of this confusion has been cleared, but two fundamental misunderstandings persist, as I show below.

In the past, settlement occurred by transfers of the gold certificates accounts of the Reserve banks.[12] Nowadays, the settlement occurs via changes in the share of the System Open Market Account holdings (SOMA: basically, all the asset purchased via open market operations). The formula for this allocation is logically straightforward, although in practice it is complicated by the need to account for changes in the banknotes outstanding of each Reserve bank, an item that is quantitatively unimportant and that I will ignore for illustrative purposes.

Assume that the ISA balances at the end of period t-1 have all been settled, so that the average ISA balance during period t is all due to operations during time t. Then the theoretical amount $V'_{j,t+1}$ of SOMA holdings allocated to district Reserve bank j *given the amount of total SOMA holdings* at time t, V_t, and therefore given $V_{j,t}$, is determined by:

$$V'_{j,t+1} - V_{j,t} = ISA_t \tag{1}$$

In other words, and abstracting from asymmetries in the allocation of banknotes, [13] a positive net asset position in the ISA implies an equal increase in the theoretical allocation of SOMA holdings to that district Reserve bank (recall that the ISA balance is a flow variable). The actual allocation $V_{j,t+1}$ is based on $V'_{j,t+1}$, adjusted to reflect the fact that total SOMA holdings in period t+1 might have changed relative to period t:

$$V_{j,t+1} = V'_{j,t+1}\frac{V_{t+1}}{V_t} \tag{2}$$

Thus, any negative position on the ISA leads to a loss of assets, hence less seigniorage and profits.

However, this mechanism is simply not replicable in the Eurosystem. The Fed system buys almost only federal government and agency debt; therefore, Reserve banks can use nearly all the Fed assets to settle their ISA imbalances: it is virtually impossible for a Reserve bank to run out of such assets. This is because settlement in the Federal Reserve system was not meant to be a protection against a breakup of the United States (an issue that is simply not in the debate), but a system to allocate profits equitably. In the European Monetary Union, the goal of settlement would not be to ensure an equitable distribution of profits among NCBs: this goal is already achieved by the current Target system, provided Target balances are remunerated at the "correct" interest rate.[14] Rather, the goal of settlement in the European Monetary Union would be to insulate the creditor NCB from the risk of default by the debtor NCB in case of breakup of the Eurozone. For this to happen, settlement must occur with breakup-proof assets: by definition, these assets cannot be assets issued by a public entity of the debtor country, and maybe not even by its private sector. In the four asset purchase programs of the ECB, the vast majority of assets purchased by each NCB have been issued by entities of the same nationality of that NCB. Quite simply, Target debtors NCBs do not have enough breakup-proof assets to even come close to be able to settle their Target balances. For instance, in March 2019 the Bank of Italy had €91.1bn of gold and €46.5bn

[12] The gold certificate account is an item on the asset side of each Reserve bank, and represents a claim on the gold held by the US Treasury.

[13] The correct expression, that takes into account asymmetries in the allocation of banknotes, is:

$$V'_{j,t+1} - V_{j,t} = ISA_t - N_{j,t}\left(\frac{G_t}{N_t} - \frac{G_{j,t}}{N_{j,t}}\right)$$

where N represents banknotes in circulation and G gold certificate accounts.

[14] Target critics argue, with reason, that this is not the case right now. We discuss this issue below.

claims on non-Euro area residents denominated in foreign currency, against a Target liability of €492.7bn.[15] Insisting on the settlement of Target balances would almost certainly trigger a breakup of the Eurozone.

There have been proposals that are implicitly or explicitly designed to get around this constraint. They all conflict with the requirement that the assets use for settlement should be breakup-proof. Sinn (2012b) proposes to collateralize the Target balances with senior claims to state-owned real estate or future tax revenues. In case of a disorderly breakup these claims would be easily reneged on, and almost certainly would be. Whelan (2014) proposes instead to use the collateral used in refinancing operations and from the Securities Market Program. However, the former consists mostly of domestic assets that, in case of disorderly breakup, would be redenominated in the currency of the debtor country; the latter are mostly government bonds, which suffer from the same problem and, as we have seen, are certainly not breakup-proof. Since Whelan wrote his paper, the much larger Public Sector Purchase Program has put trillions of government debt on the books of NCBs. But they too are unusable for settlement, for the reasons we have seen.

Even if insisting on settlement did not break up the Eurozone, and as long as monetary policy remains the same across Eurozone countries (with a common fixed rate of refinancing operations and full allotment), settlement of Target claims in the Eurozone would only work by rationing the amount of breakup-proof assets available to a NCB, not by changing interest rates. As such, it would not replicate the automatic adjustment mechanisms inherent in a fixed exchange rate regime.

In the end all this is hardly relevant however, because settlement itself in the Fed system is very different from what Target critics have in mind; in fact, one could argue that it is no settlement at all, in the sense that this term is widely understood. The point of settling the ISA balances is that, theoretically, a Reserve bank with a negative balance receives a smaller share of the SOMA portfolio, hence less seigniorage and profits. However, all earnings generated in the Fed system are remitted to the Treasury after paying the stockholders:[16] in fact, in 2017 the Fed system remitted earnings to the Treasury for $80,559mn after paying dividends for $784mn (see Federal Reserve System 2018, p. 47). Settlement simply changes the nominal distribution of profits, which however, after they have been distributed, are almost entirely transferred to the government anyway. As long as a Reserve bank earns enough profits to cover its operating expenditures, settlement of ISA balances is irrelevant.[17]

8 CAPITAL FLIGHTS FROM A AND CAPITAL REPATRIATION TO B

Now consider a shock that causes a reallocation of assets across the private sectors of the two countries. Because of a preference shock, or a shock to the confidence in the banking system or in the government of country A, the private sectors in country A or B want to get rid of some assets issued by entities residing in A, and instead buy assets issued by entities residing in B. If private sector A sells A assets and buys B

[15] See the 2017 Annual Report of the Bank of Italy, Table a3.1.

[16] Reserve banks are required to compensate their stockholders (depository institutions) at 6%, or, in the case of a stockholder with assets of more than $10bn, at the yield of the 10-year Treasury note auctioned at the last auction (see Board of Governors of the Federal Reserve System, Federal Reserve Act, Section 7).

[17] Of course, in practice it might be irrelevant even if earnings were less than operating expenditures. As shown by Konig (2012), the Fed has the right to suspend the settlement of ISA balances, and it did so on at least two occasions in the past, although in the thirties of the last century.

assets, it is typically called “capital flights from A”; if private sector B does the same, it is typically called “capital repatriation to B”. The effects on the balance sheets of all sectors involved are the same, and can be studied together. In fact, the logic of the Target system is exactly the same whether private sector A buys with deposits goods for 10 euros from private sector B (a current account deficit of A), or if it buys with deposits a financial asset issued by private sector B (a capital flight from A), or issued by private sector A but owned by private sector B (a capital repatriation to B). The T-accounts are illustrated in Table 7 to Table 11 (recall that, in what follows, the expression Z(J) stands for a financial assets issued by a private entity of country J).

8.1 A MONETARY UNION WITH TARGET

Table 7 illustrates the impact on the balance sheets of the various sectors in the two countries. The B asset purchased by private sector A is still paid for by a transfer of deposits from A to B. The only difference with the case of a current account deficit is that deposits belonging to private sector A are used to purchase an asset issued by private sector B instead of goods or services produced by private sector B: private sector A now records an improvement in its net foreign asset position, that offsets the worsening of the net foreign asset position of NCB A. As a consequence, before the breakup, instead of a worsening (improvement) in the net foreign asset position of country A (B) as in the case of a current account deficit, now the net foreign asset positions of the two countries are unchanged.

Table 7: Capital flights in a monetary union with Target

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10 Z(B) = +10		R = -10	D = -10	T = -10	R = -10	T = -10 Z(B) = +10		0
	Post-breakup	D = -10 Z(B) = +10		R = -10	D = -10		R = -10	Z(B) = +10		+10
B	Pre-breakup	D = +10	Z(B) = +10	R = +10	D = +10	T = +10	R = +10	T = +10	Z(B) = +10	0
	Post-breakup	D = +10	Z(B) = +10	R = +10	D = +10		R = +10		Z(B) = +10	-10

Z(B): asset issued by a resident of country B.

Therefore, after the breakup has occurred and Target liabilities are reneged, country A (B) now shows an improvement (worsening) of the net foreign asset position, instead of no change in the case of a current account deficit.

A comparison of Table 3 and Table 7 also sheds light on an issue that has caused considerable misunderstandings in the initial phases of the debate. Suppose that a country (like Spain before the financial crisis) runs a current account deficit for 10 euros and receives capital inflows (the opposite of capital flights) for 10 euros. Its accumulation of net Target balances would be 0, as the Target liability caused by the current account deficit would be offset by the Target claim caused by the capital inflows. This shows that there is no necessary connection between current accounts or private capital flows and changes in Target balances.

The case of a capital repatriation is similar, except that instead of private sector A buying an asset issued by a resident of country B, now private sector B sells back an asset issued by a resident of country A (see Table 8).

Table 8: Capital repatriation in a monetary union with Target

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10	Z(A) = -10	R = -10	D = -10	T = -10	R = -10	T = -10	Z(A) = -10	0
	Post-breakup	D = -10	Z(A) = -10	R = -10	D = -10		R = -10		Z(A) = -10	+10
B	Pre-breakup	D = +10 Z(A) = -10		R = +10	D = +10	T = +10	R = +10	T = +10 Z(A) = -10		0
	Post-breakup	D = +10 Z(A) = -10		R = +10	D = +10		R = +10	Z(A) = -10		-10

Z(A): asset issued by a resident of country A.

This table can be used to interpret Sinn's statement that "*QE can therefore be seen as a process of retroactively financing prior current account deficits with overdraft credit from the Eurosystem*" (Sinn 2016 p. 28). In the table, Z(A) represents assets issued in the past by A entities to pay for A's current account deficits, and purchased by the combination of the non-bank private sector and of the bank ssector of country B. With QE, these assets are replaced on the combined balance sheets of non-bank private sector and of the bank system of country B by reserves of NCB B. The latter in turn gets Target claims. Thus, country B as a whole has lost these assets and replaced them with Target claims, what Sinn calls "overdraft credit from the Eurosystem".

8.2 A PURE MONETARY UNION

Exactly the same outcome obtains in a pure monetary union, i.e. a monetary union without Target (Table 9, representing the case of a capital flight from A). As we know, in this monetary regime the transfer of reserves between accounts at the ECB takes the place of changes in Target claims and liabilities. But reserves issued by the ECB are not breakup-proof, as each NCB recognizes only the reserves credited to the commercial banks of their own country.

Table 9: Capital flights in a monetary union without Target

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10 Z(B) = +10		R(E) = -10	D = -10			Z(B) = +10 R(E) = -10		0
	Post-breakup	D = -10 Z(B) = +10		R = -10	D = -10		R = -10	Z(B) = +10		+ 10
B	Pre-breakup	D = +10	Z(B) = +10	R(E) = +10	D = +10			R(E) = +10	Z(B) = +10	0
	Post-breakup	D = +10	Z(B) = +10	R = +10	D = +10		R = +10		Z(B) = +10	-10

Z(B): asset issued by a resident of country B; R(E): banks' reserves issued by the ECB; R: banks' reserves issued by the NCB.

8.3 FIXED EXCHANGE RATES

In a fixed exchange rate regime a payment with deposits generates equivalent transfers of foreign exchange reserve assets. Hence, the shadow balance sheet of each sector is the same as its actual balance sheet, and a capital flight from A (or a capital repatriation to B) does not generate any change in the net foreign asset position of the country, whether before or after the breakup.

Table 10: Capital flights in a fixed exchange rate regime

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10 Z(B) = +10		R = -10	D = -10	Z(S) = -10	R = -10	Z(B) = +10 Z(S) = -10		0
	Post-breakup	D = -10 Z(B) = +10		R = -10	D = -10	Z(S) = -10	R = -10	Z(B) = +10 Z(S) = -10		0
B	Pre-breakup	D = +10	Z(B) = +10	R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = +10	Z(B) = +10	0
	Post-breakup	D = +10	Z(B) = +10	R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = +10	Z(B) = +10	0

Z(B): asset issued by a resident of country B; Z(S): foreign exchange reserve assets.

8.4 A MONETARY UNION WITH TARGET AND SETTLEMENT

Like before, a monetary union with Target and settlement generates exactly the same allocations as a fixed exchange rate regime.

Table 11: Capital flights in a monetary union with Target and settlement

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup	D = -10 Z(B) = +10		R = -10	D = -10	Z(S) = -10	R = -10	Z(B) = +10 Z(S) = -10		0
	Post-breakup	D = -10 Z(B) = +10		R = -10	D = -10	Z(S) = -10	R = -10	Z(B) = +10 Z(S) = -10		0
B	Pre-breakup	D = +10	Z(B) = +10	R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = +10	Z(B) = +10	0
	Post-breakup	D = +10	Z(B) = +10	R = +10	D = +10	Z(S) = +10	R = +10	Z(S) = +10	Z(B) = +10	0

Z(B): asset issued by a resident of country B; Z(S): breakup –proof assets.

9 QUANTITATIVE EASING

After declining to a minimum of €462bn in August 2016, in December 2018 the Target claims of the Bundesbank stood at €966bn, far above the previous August 2014 peak of €749bn during the sovereign debt crisis. This accumulation of Target claims started in earnest in 2015, with the beginning of QE. Since December 2018 the Target claims of the Bundesbank declined to €837bn in October 2019, to start increasing again to €870bn in November 2019. Note the perfect coincidence with the resumption of QE as of November 1 2019, albeit for smaller amounts (€20bn monthly).

In itself, QE does not have to create large Target imbalances. With QE, the Eurosystem buys long term assets, mostly government bonds, from banks and non banks like hedge funds. Each NCB purchases government bonds of its own country, and in proportion to its own capital key. These government bonds are carried on the books of the NCB that purchases them.[18] Thus, absent major rebalances of the nationality of the portfolios by the seller of the assets, there are no reasons to expect large Target imbalances resulting from QE.

QE generated large Target claims of Germany and other Nordic countries because many of the Italian government bonds the Bank of Italy purchased were sold by German entities, or even banks or hedge funds headquartered outside the Eurozone but with a correspondent bank (or a branch, in the case of a bank) located in Germany.[19] When the Bank of Italy buys 10 euros of Italian government bonds (Z(A) in Table 12 below) from a German bank, it instructs the Bundesbank to credit the reserve account of that bank for 10 euros, in exchange for the Italian government bonds. The Bank of Italy has 10 euros more of Italian government bonds and 10 euros more of Target liabilities. The German banking system has swapped an asset, Italian government bonds, for another asset, banks' reserves at the Bundesbank. The Bundesbank has extra liabilities for 10 euros of banks' reserves, and an equivalent amount of extra Target claim. If instead of a German bank the Bank of Italy bought Italian bonds from a German hedge fund, or

[18] A small proportion, 8 percent of all QE purchases, is bought directly by the ECB and held on its books.

[19] For more details on the impact of QE on Target balances, see Deutsche Bundesbank (2016), Auer and Bogdanova (2017), Castillo and Varela (2017), and European Central Bank (2016) and (2017).

a British hedge fund with a correspondent bank located in Germany, the process would require a few more intermediate steps but the end result would be the same.

Thus, an increase in Target claims arises mechanically when a NCB buys its QE assets from financial institutions located in the Eurozone but outside that NCB's country, or even located outside the Eurozone. In fact, 80 percent of assets purchased in QE programs have been sold by non-domestic counterparties, and about 50 percent by counterparties outside the Eurozone. Many of these non-Eurozone counterparties are located in the United Kingdom (which does not participate directly in the Target system), and have correspondent banks in Germany (see European Central Bank 2017).

Note that in some cases, like Spain and Italy, the decline in holdings of Spanish and Italian government bonds by foreign residents has been limited during QE. Between March 2015 and October 2019 holdings of Italian public debt by the Bank of Italy increased from 5.8 to 19.6 percent; holdings by nonresidents fell from 39.4 to 35.1 percent, one third of the QE purchases.[20] *Prima facie*, this seems to contradict the explanation above. But QE can cause an accumulation of Target claims via an indirect channel as well, namely a portfolio rebalancing effect. A domestic resident that sells Italian bonds to the Bank of Italy under the Public Sector Purchase Program might decide to re-invest the proceeds in, say, a US bond. This rebalancing too might take place via German banks, thus reinforcing the Target implications of QE (see European Central Bank 2017).

9.1 A MONETARY UNION WITH TARGET

Table 12 describes the changes in the actual and shadow balance sheets in the current monetary regime. This table can be understood by referring to the example above, where country A is Italy buying Italian government bonds from banks in country B, Germany. Because country B accumulates, mechanically, large Target claims, a disorderly breakup leads to a worsening of the net foreign asset position of the country.

Table 12: Quantitative Easing in a monetary union with Target

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup					Z(A) = + 10 T = -10		Z(A) = +10 T = -10		0
	Post-breakup					Z(A) = + 10		Z(A) = +10		+10
B	Pre-breakup			R = + 10 Z(A) = - 10		T = + 10	R = + 10	T = + 10 Z(A) = - 10		0
	Post-breakup			R = +10 Z(A) = - 10			R = + 10	Z(A) = - 10		-10

Z(A): asset issued by a resident of country A..

[20] Source: Bank of Italy online dataset, series FPI_FP.M.IT.S13.F3.S121.101.112.FAV.EUR.EDP, FPI_FP.M.IT.S13.F3.S12BI1.101.112.FAV.EUR.EDP, FPI_FP.M.IT.S13.F3.S12BI2.101.112.FAV.EUR.EDP, FPI_FP.M.IT.S13.F3.SBI1.101.112.FAV.EUR.EDP FPI_FP.M.IT.S13.F3.S2.101.112.FAV.EUR.EDP. The figures refer to public debt in the form of government securities only.

9.2 A PURE MONETARY UNION

Now suppose we are in a pure monetary union. The ECB buys A assets from banking system B, and pays with excess reserves. In country B, the banking system has, like before, €10 less of A assets but €10 more of ECB reserves. This is also the change in the balance sheet of the country. If the Eurozone breaks up, and the ECB's assets are allocated to the NCB of the issuer of the asset, the new NCB of A finds itself with €10 of assets issued by A entities. This is an improvement of the net foreign asset position of country A by €10. By the same token, central bank B now has €10 of liabilities to its banking system, but it has no assets to show for this. The net foreign asset position of country B worsens by €10.

Table 13: Quantitative Easing in a monetary union without Target

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup									0
	Post-breakup					Z(A) = +10		Z(A) = +10		+10
B	Pre-breakup			R(E) = + 10 Z(A) = - 10				R(E) = + 10 Z(A) = - 10		0
	Post-breakup			R = +10 Z(A) = - 10			R = +10	Z(A) = - 10		-10

Z(A): asset issued by a resident of country A; R(E): banks' reserves issued by the ECB; R: banks' reserves issued by NCB

9.3 FIXED EXCHANGE RATES

It is not obvious what should be the equivalent of a QE experiment in a fixed exchange rate regime: perhaps a coordinated purchase of assets by the two central banks A and B. Suppose NCB A buys assets issued by government A from banks residing in B. It would have to do so by transferring foreign exchange reserve assets to NCB B. The result is in Table 14.

Table 14: Quantitative Easing in a fixed exchange rate regime

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup					Z(A) = + 10 Z(S) = -10		Z(A) = +10 Z(S) = -10		0
	Post-breakup					Z(A) = + 10 Z(S) = -10		Z(A) = +10 Z(S) = -10		0
B	Pre-breakup			R = + 10 Z(A) = - 10		Z(S) = + 10	R = + 10	Z(S) = + 10 Z(A) = - 10		0
	Post-breakup			R = +10 Z(A) = - 10		Z(S) = + 10	R = + 10	Z(S) = + 10 Z(A) = - 10		0

Z(A): asset issued by a resident of country A; Z(S): foreign exchange reserve assets.

9.4 A MONETARY UNION WITH TARGET AND SETTLEMENT

As usual, a monetary union with Target and settlement would reproduce exactly the outcome of a fixed exchange rate regime: see Table 15.

Table 15: Quantitative Easing in a monetary union with Target and settlement

		Private sector		Banking system		NCB		Country		ΔNFA
		Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	Assets	Liabilities	
A	Pre-breakup					Z(A) = + 10 Z(S) = -10		Z(A) = +10 Z(S) = -10		0
	Post-breakup					Z(A) = + 10 Z(S) = -10		Z(A) = +10 Z(S) = -10		0
B	Pre-breakup			R = + 10 Z(A) = - 10		Z(S) = + 10	R = + 10	Z(S) = + 10 Z(A) = - 10		0
	Post-breakup			R = +10 Z(A) = - 10		Z(S) = + 10	R = + 10	Z(S) = + 10 Z(A) = - 10		0

Z(A): assets issued by a resident of country A; Z(S): breakup-proof assets.

10 THE EFFECTS OF A TARGET DEFAULT ON THE REAL RESOURCES OF A COUNTRY

I now address the second question set out in section 3, namely: "Do different monetary regimes imply different costs in case of a breakup of the monetary union, for a given level of Target balances accumulated by each country?"

10.1 THE RATE OF REMUNERATION OF TARGET BALANCES

The answer is not straightforward. It depends largely on how Target balances are remunerated, which is itself, remarkably enough, not a straightforward issue. The ambiguities arise from the peculiarities of the profit and loss account and of the balance sheets of Eurozone NCBs. It is useful to start from the resource constraint of a central bank of the Eurosystem. I will omit some non essential items and focus on the main ones:[21]

$$(X_{t+1} - X_t) + (H_{t+1} - H_t) + A_t(1+i) + M_t(1+i_r) + i_r T_t + MIR_t - MIP_t = \\ = A_{t+1} + M_{t+1} + i_x X_t + i_x X_t^T + D_{t+1} \qquad (3)$$

In this expression, H_t is currency, A_t is assets purchased outright by the NCB and i is the interest rate on these assets; M_t is assets held temporarily by the NCB, via repurchase agreements (refinancing operations in the parlance of the ECB); these are remunerated at the main refinancing operations rate, i_r. Both A_t and M_t are assumed to have a maturity of one year for simplicity. T_t represents net Target

[21] I make several simplifying assumptions. I abstract from the ECB share in banknotes (8 percent) and in QE purchases. I also abstract from complications regarding the distribution of banknotes issued by a NCB (whether or not they are in excess of the capital key of the NCB), in order to focus on the issues of interest in this paper.

claims and X_t^T the reserves created whenever a Target claim arises (recall that the formation of a Target claim is always accompanied by an equal change in reserves, hence X_t^T is identically equal to T_t). I take T_t and X_t^T to be outside the control of the NCB and fixed in nominal terms, the result of past shocks. X_t is reserves other than those created when the Target claim T_t arose; i_x the interest rate on reserves. The term $i_r T_t$ represents the remuneration of Target balances: according to the Eurosystem rules, Target claims are also remunerated at the main refinancing operations rate i_r. MIR_t and MIP_t is monetary income received and paid by the NCB, respectively (I explain these two terms below). D_{t+1} represents dividends paid by the NCB to its Treasury.

Thus, the left hand side of (3) represents the "resources" of the NCB. $H_{t+1} - H_t$ is issuance of new currency, or banknotes; $X_{t+1} - X_t$ is issuance of new reserves. By issuing new currency or reserves in excess of the existing stock, the central bank creates means of payment with which it can command resources. The right hand side of (3) can be seen as the "uses" of the resources. These can be used to buy assets outright A_{t+1}, to enter new refinancing operations M_{t+1}, to pay interest on reserves, or dividends to the Treasury (the profits of the NCB).

MIR_t and MIP_t represent "monetary income received" from the Eurosystem and "monetary income paid" to the Eurosystem, respectively. These two items are calculated as follows. First, each NCB pays to the "pool" of income an imputed return from its main assets, calculated at the reference interest rate i_r; the assets to be pooled are A_t, M_t, and the Target net claims T_t. From this, the NCB subtracts the interest paid on reserves, $i_x X_t$.[22] Thus the monetary income paid into the pool by the NCB is

$$MIP_t = i_r(A_t + M_t + T_t) - i_x(X_t + X_t^T) \tag{4}$$

The monetary income paid by all NCBs is pooled and redistributed to each NCB according to its capital key. If α is the capital key of our generic NCB, the monetary income it receives is calculated as follows

$$MIR_t = \alpha(MIP_t + MIP_t^*) = \tag{5}$$

$$= \alpha[i_r(A_t + A_t^* + M_t + M_t^*) - i_x(X_t + X_t^* + X_t^T + X_t^{T*})] \tag{6}$$

where an asterisk denotes the other countries. Because by definition the sum of all Target net claims is 0, Target balances do not appear in (6).

Expression (3) can be used to understand the remuneration of Target balances. Suppose there is a shock and capital inflows increase by ΔT_t. This is also the change in Target net claims. Also, as we know reserves increase by ΔT_t in the capital importing country and fall by the same amount in the capital exporting countries: $\Delta X_t^T = -\Delta X_t^{T*} = \Delta T_t$. Thus, from (3) the net change in the NCB's profits is

$$\Delta D_{t+1} = i_r \Delta T_t - i_x \Delta X_t^T + \Delta MIR_t - \Delta MIP_t \tag{7}$$

where from (4) $\Delta MIP_t = i_r \Delta T_t - i_x \Delta X_t^T$ and from (6) $\Delta MIR_t = -i_x(\Delta X_t^T + \Delta X_t^{T*}) = 0$. Therefore

[22] There is still some element of ambiguity because strictly speaking the Eurosystem directives state that one should subtract the interest paid on "Liabilities to euro area credit institutions related to monetary policy operations denominated in euro" (Annex I, paragraph A.2 of the Decision of the European Central Bank of November 25 2010 (ECB/2010/23)). The list that follows this statement does mention excess reserves; however, it is not clear that excess reserves acquired as a counterpart of a Target claim should be regarded as "related to monetary policy operations".

$$\Delta D_{t+1} = i_r \Delta T_t - i_x \Delta X_t^T - (\, i_r \Delta T_t - i_x \Delta X_t^T) = 0 \qquad (8)$$

Thus, after pooling, the effective remuneration of Target balances to the NCB is 0. Note that this is independent of the fact that, as of the time of writing, the interest rate on Target claims *before* pooling is 0, because so is the rate on main refinancing operations.[23]

10.2 Is a Target default a transfer of real resources?

10.2.1 Target balances represent real resources in an alternative regime

Target balances are not claims to any stream of resources; they are non marketable; and they are irredeemable: they cannot be exchanged against a medium of exchange at any time. What do they represent? In other words, if the Bundesbank's €1tn of a claim that has no intrinsic value are defaulted, does this represent a loss of real resources to Germany as a whole? To answer this question one should ask in turn: "loss" relative to what?

Consider the case of a current account surplus shock, as in Table 3. The non-bank private sector in country B experiences a temporary positive income shock of 10 euros and wants to postpone its consumption by transferring these 10 euros abroad. It does so by acquiring a deposit at its own banking system; the latter receives the deposit from abroad in the form of central bank reserves; NCB B receives a notional external asset to compensate it for the extra liabilities (reserves) that it takes on its balance sheet.

What ensures that the non-bank private sector B will be able to consume more in the future is not the Target claim accumulated by NCB B, but the extra deposit that it has received by running a current account surplus. There is no constraint on Target claims, they could be negative by large amounts and still the non-bank private sector B will be able to transfer deposits abroad in the future to consume its 10 euros.

In the case of a capital repatriation to B, the non-bank private sector B wants to swap a foreign asset for a domestic deposit; the foreign asset ends up on the balance sheet of the NCB of B as a Target claim. In both cases – current account shock and capital repatriation shock - the banking system of country B is a pure intermediary and ends up with more deposits and more reserves; the NCB also is a pure intermediary and ends up with a higher Target claim and more reserves.

In a monetary union with settlement or in a fixed exchange rate regime, the outcome is exactly the same except that NCB B receives marketable, default-proof assets that are claims on *real* resources of other countries.

Thus, in case of a breakup of the monetary union with Target, and assuming that the interbank market is still functioning, the non-bank private sector B will still be able to use its deposits to carry out consumption smoothing, but NCB B will start operation with 10 euros less than if the monetary regime had been a monetary union with settlement or a fixed exchange rate regime. These 10 euros of default-free assets would have represented a claim on real resources of foreign countries.

[23] Recently, Fuest and Sinn (2018) and Sinn (2019) have argued that Target claims do receive a remuneration. I present their arguments in Appendix A, and I argue that they are incorrect because they omit some elements in the calculation of the remuneration.

In other words: Target claims do not themselves constitute claims on real resources of other countries, but they stand for the claims on the resources of other countries that the post-breakup NCB of the creditor country would have had if the pre-breakup regime had been a monetary union with settlement or a fixed exchange rate regime.

A default on Target claims represents a loss (relative to a different regime) of real resources for the post-breakup NCB B, but also for the country as a whole: it is not offset by a default-free asset on the balance sheet of the private sector. If the monetary regime had been a monetary union with settlement or a fixed exchange rate regime, after the breakup NCB B could have used the 10 euros of the default free asset to buy goods for 10 euros and distribute them for free to its citizens, or it could have used these resources to reduce the taxes that its citizens pay. Having done this, it could still have started operations exactly like NCB B after the breakup of the monetary union with Target.

10.2.2 Does the risk facing Germany depend on the underlying cause of the Target claim?

It might also be tempting to think that only those Target claims that are due to a current account surplus represents a claim on resources, as stated in the following passage that it is worth quoting in its entirety. " […] *if Germany has net claims on the rest of the eurozone it must be that Germany has accumulated current account surpluses against these countries in the past. There is no other way Germany can accumulate financial claims on the rest of the eurozone. These observations lead to the following insights. First, it is true that by holding large foreign claims, a country can take a risk. This risk will materialize when some of the foreign debtors* ***default*** *on their debt. Second, the Target2 claims of Germany are not a good indicator of this risk.* ***Put differently, when in 2010 the Target2 claims started to increase dramatically, this did not change the risk Germany was facing. As we have made clear, the Target liabilities have increased mainly as a result of speculative flows*** *[emphasis added]****.*** *The latter do not change the net claims of Germany on the rest of the eurozone – only the composition of these claims and liabilities*" (De Grauwe and Ji 2012, p. 10).

According to this quote, the risk faced by Germany depends only on the overall net foreign asset position of the country as a whole, not on its composition. Before the repatriation of capital from Spain, the German private sector had a bond issued by a Spanish bank; now the German NCB has a Target claim. Both are external assets of the country as a whole, and it is not obvious which one is more risky. Dullien and Schieritz (2012) argue that in case of a euro breakup even Spanish private debtors would default to some extent.[24] This might be true, but it also remains true that, contrary to De Gauwe and Ji's assertion, in an alternative monetary regime Germany would face a lower risk whether the Target claim arose from a current account surplus or a capital inflow.

To see this, suppose Germany starts with 100 euros in Spanish bonds and 0 Target claims, hence with a net foreign asset position of 100 euros. Now due to a current account shock the German Target balances increase by 100: the net foreign asset position of Germany is now 200. Alternatively, due to a capital repatriation shock Germany sells the Spanish bonds for 100 euros and acquires a Target claim for 100 euros: the net foreign asset position is still 100 euros. It is true that in the first case Germany could experience a default on 200 euros of net foreign assets, and in the second case only on 100 euros. But it remains true that in an alternative regime where Target claims are replaced by default-proof assets, Germany would face a lower risk in *both* cases: the maximum default that German can experience is 100 euros in the first case and 0 in the second.

[24] However, a private retaliatory default by Spanish debtors would require a coordination mechanism that is hard to envision, except if the default occurs via a depreciation of the new Spanish currency.

10.2.3 Target claims as a creeping expropriation?

The Target system is frequently considered as a kind of creeping expropriation of the savers of Target creditors. Consider this quote from Sinn and Wollmershäuser (2012a) p. 486, about the repatriation of German loans to Spain after the debt crisis: "*their wealth is gradually being converted from marketable assets held by their savings institutions into mere claims against their NCBs, which are in turn backed only by Target claims against the ECB system: claims […] which can never be called due and that may vaporize should the euro cease to exist*". Table 8 can be used to understand this quote: there, the aggregate of the non-bank private sector and of the banking system in B replaces assets issued by an entity in A with newly created reserves at NCB B; the latter backs these reserves with a newly acquired Target claim vis à vis the Eurosystem.

This and many other similar statements could be interpreted in different ways. First, that the (combined non-bank and bank) private sector of Germany was expropriated of a foreign asset, Spanish bonds, and given bank reserves in exchange for that. This would be incorrect. This was a voluntary private capital repatriation by German savers: in other words, they *wanted* to replace their claims on the Spanish private entity with a claim on a German entity. This claim on a German entity is reserves at the NCB, that are not backed by anything anyway, and are always convertible into currency, and also into foreign deposits (the opposite flow to a capital repatriation).

Thus, the question is not what the private sector gets, but what the German NCB gets. The second interpretation of the quote above is that in an alternative monetary regime the claims received by the German NCB would be of a different nature, with the consequences that we have examined: the country as a whole could sell the gold or the default-proof assets it would receive; in monetary union with Target, it is stuck with an irredeemable, non-monetizable asset. This is a valid interpretation of the statement.

A third interpretation is that the easy monetary policies of the ECB made this substitution of claims easier, by giving Spanish debtors access to almost unlimited credit from their central bank on better terms than from their German creditors. This is a legitimate argument, but it is about monetary policy rather than the Target system *per se*.

A fourth interpretation is that the Target claims of the German NCB on the Eurosystem are more *risky* than the private claims that they have replaced. This is the opposite claim to that of Dullien and Schieritz (2012) that we have seen above. It is an empirical question.

11 THE EFFECTS OF A TARGET DEFAULT ON THE OPERATION OF MONETARY POLICY

Target balances are part of the capital of a NCB as it is published in the official balance sheets. A breakup of the Eurozone with default on Target liabilities would cause a decline in the capital of NCBs that are Target creditors. To many, this has potentially severe implications for the conduct of monetary policy of the post-breakup central bank. Although the two issues obviously have a common cause, this "monetary policy consequence" issue is different from the "loss of real resources" issue.

Views on the monetary policy consequences of a large decline in central bank capital differ sharply depending on the professional role: "*If you ask monetary economists whether we should care if*

a central bank's capital level falls below zero (even for an extended period of time), most will say no. Pose the same question to central bank governors, and the answer in nearly every case will be yes." (Cecchetti and Schoenholtz 2015).

Why do virtually all economists argue that central bank capital is irrelevant to the conduct of monetary policy? In a world of fiat money, a central bank can create its own liabilities as it pleases at (nearly) zero cost of production and with a zero interest rate, or in any case with an interest rate lower than the interest rate on the assets it can purchase with these liabilities. Because these liabilities happen to be accepted by everyone as means of payment, the standard notion of insolvency does not apply to a central bank. In fact, I know of no theoretical model of the transmission of monetary policy where the ability of a central bank to pursue its monetary policy targets impinges on the central bank's accounting capital being positive.

As De Grauwe and Ji (2012) write, referring to Sinn and Wollmershäuser (2012a)'s point that a default on Germany's Target claims would imperil the ability of the Bundesbank to pursue its monetary policy goals: "*The mistake is to believe that the value of the money base (the central bank's liabilities) is determined by the value of the assets held by the central bank. […] In fact in the fiat money system we live in, the central bank could literally destroy the assets without any effect on the value of the money base. In order to stabilize the value of the money base, the central bank should keep the right supply of money base, i.e. a supply that will maintain price stability. That is all that is needed. This condition is independent of the value of the assets held by the central bank*".

Whelan (2014) p. 111 makes a similar point: "*As discussed above, a central bank operating a fiat currency could have assets that fall below the value of the money it has issued – the balance sheet could show it to be 'insolvent' – without having an impact on the value of the currency in circulation. A fiat currency's value, its real purchasing power, is determined by how much money has been supplied and the factors influencing money demand, not by the central bank's stock of assets*."

This is correct ….up to a point. For a start, the value of money is not independent of *any* stock of assets of the central bank: if the interest earned on the stock of assets is insufficient to pay interest on reserves, the central bank must be forced either to sell more assets, or to issue new reserves to pay for the interest on reserves. In the former case in the long run the central bank will end up with zero assets; in the latter it might be forced to create more monetary base than is consistent with its inflation target.

To see this, consider the highly simplified balance sheet of a central bank that does not belong to a monetary union, and therefore does not have Target balances, as in Table 16. This will allow us to focus on the role of central bank capital on the operations of the central bank. The central bank starts with assets A_t (government bonds) equal to €1500. On the liability side, it has currency for €500 and excess reserves for €1000.[25] Accounting capital is 0.

Table 16: Balance sheet of the central bank, I

Assets	**Liabilities**
Government bonds $A_t = 1500$	Currency $H_t = 500$
	Excess reserves $X_t = 1000$
	Equity $K_t = 0$

[25] As shown below, on the liability side the central bank also has a government deposit account. However, its balance is typically small, as it is utilized mainly to transfer funds to and from the governments accounts at the central bank and at the banking system. For simplicity I assume that its balance is always 0, except for a few instantaneous operations as described below. Therefore, they earn 0 interest at the end of the period.

Assets are remunerated at 1 percent; for simplicity, I assume that excess reserves are also remunerated at 1 percent. Suppose that the central bank's objective is to keep the monetary base stable. How does it achieve this goal? To follow the process, it might be useful to keep in mind the central bank's budget constraint, expression (3). Each year the central bank receives 15 euros from the government in interest: this destroys 15 euros of monetary base.[26] To restore the monetary base, the central bank pays 10 euros of interest on reserves by issuing reserve; the remaining 5 euros of monetary base it restores by buying assets for 5 euros, or by paying dividends to the government for 5 euros, or a combination of both.[27] The end result is no change in the monetary base and a combination of increase in asset holdings and dividends to the government. The details of the process are displayed in Appendix B.

Now suppose the central bank shreds 500 euros of assets, leaving it with negative capital for 500 euro, as in Table 17:

Table 17: Balance sheet of the central bank, II

Assets	Liabilities
Government bonds $A_t = 1000$	Currency $H_t = 500$
	Excess reserves $X_t = 1000$
	Equity $K_t = -500$

The central bank can pay interest on reserves with the interest it receives on its assets: even though equity is negative, it can still control inflation without reducing it holdings of assets; dividends to the government are 0.

Assume instead that the central bank shreds 750 euros of assets, resulting in negative equity for 750 euros as in Table 18.

Table 18: Balance sheet of the central bank, III

Assets	Liabilities
Government bonds $A_t = 750$	Currency $H_t = 500$
	Excess reserves $X_t = 1000$
	Equity $K_t = -750$

The central bank receives only 7.5 euros from the government in interest: this destroys 7.5 euros of monetary base. But it still creates 10 euros of monetary base to pay interest on reserves; hence it must now *sell* 2.5 euros of assets to avoid an increase in the monetary base. The end result is a decline in its

[26] Monetary base is destroyed because the government pays 15 euros of interest by transferring that amount from its deposit account at commercial banks to its account at the central bank; to do so, commercial banks instruct the central bank to reduce their reserves by 15 euros and credit the government account at the central bank by the same amount.

[27] Distributing dividends to the government creates monetary base because the central bank credits the government account at the central bank for 5 euros; when the government transfers this amount to its deposits at commercial banks, the central bank credits the reserves of commercial banks by 5 euros.

asset holdings and no profits rebated to the government: exactly the opposite of the previous case. The details of this process are detailed in Appendix C.

As the process continues, the central bank might find itself with no assets: at that point it will have to pay for interest on reserves with more reserves, thus losing control of inflation. Note that this problem is not due to negative equity *per se*, but to the relative size of interest bearing assets and reserves; as a comparison of Table 17 and Table 18 shows, beyond a certain point (in this case 500 euros) negative capital leads to a self-reinforcing loss of assets and further decline in capital.

The worry of losing all assets in this spiral might seem far-fetched: the central banks of advanced countries have quintupled their asset holdings in the space of a few years, and interest on reserves is negative in the Eurosystem. Yet as far as I can reconstruct it, this is the main rationalization one can find for the notion that negative central bank equities (even small ones) have to be eliminated, and fast.[28]

So far, we have not mentioned two alternatives to the apocalyptic scenario in which the central bank loses all its interest bearing assets and therefore loses control of inflation: the central bank could pay the interest on reserves by getting more interest-bearing assets from the government ("immediate recapitalization") or by getting each year a subsidy from the government, i.e. a negative dividend ("delayed recapitalization"). Central bankers would hate these two options too, however, because the government might exact something in exchange for its help: the central bank would lose its independence. [29]

It is time to put all this together more formally. Start from the budget constrain of the central bank, expression (3). In a symmetric equilibrium in which the share in each type of central bank asset and liability is equal to the capital key α, $MIR_t - MIP_t = 0$ and expression (3) becomes

$$(H_{t+1} - H_t) + (X_{t+1} - X_t) + A_t(1+i) + M_t(1+i_r) + i_r T_t = \\ = A_{t+1} + M_{t+1} + i_x X_t + i_x X_t^T + D_{t+1} \qquad (9)$$

Assume, as it is standard in the literature on seigniorage, that $i = i_r = i_x$, and define seigniorage as $S_{t+1} = H_{t+1} - H_t$. [30] Divide all sides of (9) by P_{t+1} and let a small letter denote a variable in real terms. Then (9) can be written as

$$(a_t + m_t - x_t)(1+i)\frac{P_t}{P_{t+1}} = \qquad (10)$$

[28] Consider for instance the following quote from a 2010 speech by the then Bank of England's governor Mervin King: "*cancelling our holding of gilts means that the Bank of England has no assets to sell when the time comes to tighten monetary policy. And when Bank Rate eventually starts to return to a more normal level, as one day it will, the Bank would then have no income, in the form of coupon payments on gilts, to cover the payments of interest on reserves at the Bank of England that we had created. The Bank would become insolvent unless it created even more money to finance those interest payments, and that would lead ultimately to uncontrolled inflation.*"

[29] Note that in theory there is a fourth option, an alternative to eliminating negative equity: the central bank could issue its own debt, which would reduce reserves (see Bindseil, Manzanares and Weller 2004). Thus, effectively this would replace reserves with central bank debt certificates: in other words, it would be a sterilization of reserves. However, the central bank's debt certificates would be a very close substitute for reserves. They would not formally count as monetary base, but for all practical purposes they would be equivalent.

[30] In the present context, the assumption that $i_r = i$ is problematic, as reserves currently pay a negative interest rate, hence it would be more appropriate to define seigniorage as $(H_{t+1} - H_t) + (X_{t+1} - X_t)$. I follow the standard definition in order to make use of existing estimates of the present value of seigniorage, and I discuss this exstension below.

$$= (a_{t+1} + m_{t+1} - x_{t+1}) - s_{t+1} + d_{t+1} + ix_t^T \frac{P_t}{P_{t+1}} - it_t \frac{P_t}{P_{t+1}}$$

Define the (constant) inflation rate and the real interest rate as

$$\frac{P_{t+1}}{P_t} \equiv 1 + \pi; \;\; 1 + r \equiv \frac{1+i}{1+\pi} \tag{11}$$

Then we can then write (10) as

$$(a_t + m_t - x_t) = \frac{(a_{t+1} + m_{t+1} - x_{t+1})}{1+r} - \frac{s_{t+1}}{1+r} + \frac{d_{t+1}}{1+r} + \frac{ix_t^T}{1+i} - \frac{it_t}{1+i} \tag{12}$$

Now shift forward by one period, recalling that we are holding constant T_t and X_t^T in nominal terms and that $X_t^T/P_{t+2} = (X_t^T/P_t)(P_t/P_{t+2}) = x_t^T/(1+\pi)^2$, and similarly for T_t/P_{t+2}:

$$(a_{t+1} + m_{t+1} - x_{t+1}) = \frac{(a_{t+2} + m_{t+2} - x_{t+2})}{1+r} + \frac{d_{t+2} - s_{t+2}}{1+r} + \frac{i(x_t^T - t_t)}{(1+r)(1+\pi)^2} \tag{13}$$

Replacing into (12) and then continuing the recursion

$$a_t + m_t - x_t = \sum_{j=1}^{\infty} \frac{d_{t+j} - s_{t+j}}{(1+r)^j} + \frac{i}{1+i} \sum_{j=0}^{\infty} \frac{x_t^T - t_t}{(1+i)^j} + \lim_{J\to\infty} \frac{(a_{t+J} + m_{t+J} - x_{t+J})}{(1+r)^J} \tag{14}$$

Assuming $\lim_{J\to\infty} \frac{(a_{t+J} + m_{t+J} - x_{t+J})}{(1+r)^J} = 0$

$$a_t + m_t = x_t + \sum_{j=1}^{\infty} \frac{d_{t+j}}{(1+r)^j} - \sum_{j=1}^{\infty} \frac{s_{t+j}}{(1+r)^j} + x_t^T - t_t \tag{15}$$

Expression (15) is sometimes called the "comprehensive" balance sheet of the central bank, to distinguish it from the conventional balance sheet. [31] Conventional, or accounting, equity is defined as the excess of accounting assets over accounting liabilities

$$k_t = a_t + m_t + t_t - x_t - x_t^T - h_t \tag{16}$$

Hence from (15)

$$\sum_{j=1}^{\infty} \frac{d_{t+j}}{(1+r)^j} = k_t + h_t + \sum_{j=1}^{\infty} \frac{s_{t+j}}{(1+r)^j} \tag{17}$$

[31] As far as I can reconstruct, the notion of comprehensive balance sheet of a central bank was first introduced by Fry (1992) and then Stella (1997).

Expression (17) says that the present value of dividends is equal to the sum of currency in circulation, conventional capital, and the present value of future seigniorage, The sum of the last two items is sometimes called "comprehensive capital". One might wonder how a financial asset with no expiration and carrying no effective remuneration ends up with a positive value t_t in the expression for conventional capital (16). The reason is that it always accompanied by the matching liability x_t^T, which is the reason why in equilibrium the remuneration of Target claims is 0.[32]

Expression (17) illustrates clearly the trilemma discussed above, faced by a central banker in case of a large decline in conventional equity k_t: the central bank must either accept a higher present value of seigniorage, or an increase in assets a_t, presumably provided by the government (the case of "immediate recapitalization"), or a lower present value of dividends, which could become negative if k_t is low enough (the case of "delayed recapitalization"). [33] The last two alternatives are unpalatable to the central bank because, should the present value of dividends become negative, the government might exact conditions in exchange for the help it extends the central bank.

Note that, aside from issues of reputation, public relations, and repeated interactions, "immediate" and "delayed" recapitalizations are very similar. There is no substantive difference between the following two scenarios. Referring to the example above, in an immediate recapitalization the government hands the central bank a consol with a yearly coupon of €2.5; in a delayed recapitalization the government commits to pay the central bank a subsidy of €2.5 every year. However, a central banker will certainly prefer the former alternative, for two reasons. First, it is easier for a future government to renege on the promise to pay a subsidy to the central bank than to default on the consol: it is unlikely that a path for future dividends has been set. Second, an immediate recapitalization is a one-off event; a delayed recapitalization makes the central bank dependent on the government forever.

In fact, the reaction of central bankers to a negative equity position of their central bank is almost invariably "immediate recapitalization". The 2018 ECB Convergence report, pp. 25-26, writes: "[…]*the event of an NCB's net equity becoming less than its statutory capital or even negative would require that the respective Member State provides the NCB with an appropriate amount of capital at least up to the level of the statutory capital within a reasonable period of time"* [emphasis added]. The German Constitutional court has also affirmed the principle that the Bundesbank should not operate with negative capital.[34]

Still, a central banker would like even more not to be facing then choice between immediate or delayed recapitalization. From her point of view, both alternatives are a threat to her independence. This is the fundamental reason why central bankers do not like negative central bank equity: because, they claim, it prevents them from pursuing some of the monetary policies that they might want to implement in the future, or else puts them at the mercy of politicians.[35]

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[32] This result is correct only to a first approximation because we have assumed that $i = i_x$.

[33] Reis (2013) calls a configuration where the present value of central bank dividends is negative "intertemporal insolvency".

[34] See German Constitutional Court (2017), cited in Fuest and Sinn (2018) p. 42.

[35] Even aside from issues of default, there is another reason why a Target claim is not like other assets and can be problematic for a central banker. Within conventional capital k_t there is an important difference between a_t and t_t. The former is made of marketable assets, the latter is not: as a consequence, they are not perfect substitutes. It could be that k_t is large and the present value of dividends positive calculated according to expression (17); but if a_t is small and t_t large, the central bank might be unable to absorb liquidity, because t_t cannot be sold in a liquidity-absorbing open market operation. On the other hand, one could argue that the impact of a Target default on the ability to implement a tighter monetary policy is overdone. It is widely acknowledged now that the "normalization" of monetary policy, i.e. an increase in the short interbank interest rate like the EONIA rate, does

12 IMPLICATIONS FOR THE BUNDESBANK

How realistic are all these worries? Let's consider the implications of a decline in Target balances caused by a breakup of the Eurozone. I will make some educated guesses about the monetary policy implications of this event for the Bundesbank. To do so, I will proceed in steps. I will first take expression (17) literally, and ask whether there are realistic configurations under which the post-breakup Bundesbank would end up with a negative present value of dividends if it wanted to stick to a 2 percent inflation rate target. I will then move to more realistic scenarios, in which central bankers (and taxpayers) are not interested only in the expected present value of dividends.

The first term on the right hand side of (17), capital plus reserves of the Bundesbank, is approximately €100bn. The second term, banknotes in circulation, is currently €700bn, of which about €400bn issued in excess of the German capital key. It is plausible to assume that Germany would recognize its currency liabilities at the moment of breakup, as defaulting on them would be a heavy reputational blow, and could even be economically harmful, as it would imply giving up future seigniorage.[36]

This brings us to the last term on the right hand side of (17), the expected present value of seigniorage. This is obviously also the hardest term to estimate, as it depends on a number of assumptions. For simplicity, in the derivation of expression (17) I have assumed no GDP growth. But as GDP grows, the demand for currency increases, and so does seigniorage. Formally, this means that the correct discount rate is not the real interest rate r, but $r - g$, where g is the rate of growth of GDP. The estimate depends also on the elasticity of the demand for currency to the interest rate and to GDP, because this determines how much seigniorage can be extracted from the private sector without increasing inflation above the target 2 percent rate.

Buiter and Rahbari (2012a) and (2012b) assume a real interest rate of 2 percent, a real growth rate of 1 percent, an inflation rate of 2 percent, and estimate an interest rate semielasticity of the demand for currency of 2.9. If the income elasticity of the demand for currency is assumed to be 0, they estimate a present value of seigniorage for the whole Eurozone of €1.4tn; if the income elasticity is assumed to be 1, the present value of seigniorage is estimated at €2.5tn. Banknotes issued by the Bundesbank are about half of the total issuance of Euro banknotes. If the proportion remains unchanged after breakup, the Buiter – Rahbari estimates imply a present value of seigniorage for the post-breakup Bundesbank between roughly €700bn and €1.25tn.

Hilscher, Raviv and Reis (2015) and Reis (2015) advocate using risk adjusted discount factors to discount the future flow of uncertain seigniorage, and calculate that doing so could easily cut the present values seigniorage as calculated by Buiter and Rahbari by a factor of 3 or more. This would leave a range of present value of seigniorage roughly between €200bn and €400bn. Note that these are all lower bounds because excess reserves are not counted as seigniorage in these calculations.

Now let's consider reasonable figures for a loss on the Target claims. Let's take the round figure of €1tn for the current German Target claims. What would be the default rate in case of a disorderly

not necessarily require absorbing liquidity, but can be done with a progressive increase of the interest on excess reserves.

[36] It is probably the case that a large share of these €300bn excess banknotes circulates in Germany. Whelan (2017) assumes instead that Germany would renege on these banknotes, but this seems unrealistic.

Eurozone breakup? If the other countries did pay their Target liabilities, but in their currency, the default rate would be roughly equal to the weighted average depreciation of the debtor countries vis à vis the new deutschemark. A reasonable guess would be in the order of 30 percent, or a €300bn default.

But it is not difficult to imagine a more drastic scenario. After all, Target liabilities and claims are a rather arcane concept, as the debate of the recent years has confirmed over and over again. It would not be difficult for a populist Southern European government to interpret it, in good or bad faith, as "bankers' debt" with which "we want nothing to do". It might not even be difficult to try to present it as no debt at all: Target debt represents a liability towards the Eurosystem, not towards a specific country or NCB, and it would be tempting, if disingenuous, to claim that this is a debt to an entity that does not exist anymore. Hence a scenario in which the leavers default on the entire €1tn Target debt cannot be ruled out. Certainly this scenario is envisaged as a possibility in numerous contributions to the Target debate, as Sinn (2012b) or Whelan (2014).

The numbers that follow refer to a disorderly breakup, in which all Eurozone countries go their own way. In case of an orderly breakup, in which the Eurozone splits into two monetary unions, Germany's Target loss would be a fraction of the total Target default of "southern" Eurozone equal to its (new) capital key share in the "northern" Eurozone. In this sense, the calculations I present below are upper bounds.

Table 19 displays the present value of the Bundesbank's dividends (left half of each cell) and ,the Bundesbank's capital (right half of each cell), calculated using expression (17), for a default on Target claims between €300bn and €1000bn, for a present value of seigniorage between €200bn and €1,250bn, and for values of banknotes in circulation of €700bn. Even in the most extreme scenario, with a complete default on Target claims and the lower bound of the estimates of the present value of seigniorage, the present value of dividends would still be non-negative.

Table 19: Present value of Bundesbank dividends

		Present value of seigniorage, € bn					
		200		700		1,250	
Default on Target claims, € bn	-300	700	-200	1,200	-200	1,750	-200
	-1,000	0	-900	500	-900	1,050	-900

The table displays the present value of Bundesbank dividends (left half of the cell) and the conventional capital (right half of the cell), using the formula of expression (17), under various hypotheses about the present value of seigniorage (top row) and of default on the Bundesbank's Target claims (left column). The table assumes a current liability for currency in circulation of €700bn, and initial capital plus reserves of €100bn.

Of course, conventional equity in this case would be negative by €900bn, but if one takes this result literally it appears that the German Bundesbank would not need financial support from the government (in present value terms) in order to pursue its monetary policy objectives. [37] This is consistent with the economists' view.

[37] Note however that the estimates of the present values of seigniorage presented here are based on a definition of seigniorage that includes only the change in currency $H_{t+1} - H_t$. If one instead defines seigniorage as $H_{t+1} - H_t + X_{t+1} - X_t$, as it might be more appropriate in the current situation of negative interest on reserves, then there would be even more scope for a default on Target claims without affecting the ability of the Bundesbank to pay a positive present discounted value of dividends to the government and without impacting on its target inflation rate.

However, at closer inspection this table is far from reassuring from the point of view of a central banker. The condition that the *present value* of seigniorage be consistent with a two percent inflation rate and the result that the *present value* of dividends be non-negative are not very relevant for a real-life discussion of the issue. Real-life central bankers and taxpayers simply do not care about what might happen 200 years from now. A non-negative present value of dividends is compatible with a long string of highly negative dividends now or in the near future if capital is small or negative. [38]

In fact, in all the cells of Table 19 the central bank's capital is negative, and in the second row heavily so. As we have seen, a negative accounting capital increases the risk of facing, possibly just for a few periods, a trade-off between getting financial help from the government or relaxing monetary policy. Central bankers tend to be risk-averse, conservative people, for reasons that are well known to (and advocated by) economists: such an event has an enormous weight in a central banker's loss function. For a number of reasons (culture, politics, prestige, and some would perhaps say even misguided economic theories) it is simply inconceivable that a post-breakup Bundesbank would accept to start operations with negative conventional equity, whatever its amount. Any shortfall of the conventional equity (let alone the comprehensive equity) of the Bundesbank *will* be recapitalized.

It is true that there are numerous examples of central banks that have operated with negative conventional equity[39] without suffering any apparent impediment to the pursuit of their goals of monetary policy. However, the shortfalls in conventional equity that have been studied in the literature are small relative to what would happen in case of a total default on the Target claims of the Bundesbank. Quite simply, this is unexplored territory, where psychological factors might play an equal or more important role than rational economic factors, as envisaged in this quote by the then governor of the Bank of Japan Fukui "[in the event of negative capital t]*he central bank might either run into difficulties in conducting its policy or other business operations, or might cause the view to spread that it will, and eventually it will become difficult to maintain public confidence in the currency.*" (Fukui, 2003, cited in Cukiermann (2006), p.5)

13 THE COSTS OF RECAPITALIZATION

It has been argued that a recapitalization, besides being unnecessary because a central bank can operate with negative capital, would anyway be costless, a mere book-keeping item: "*However, even if it is decided after a break-up that the Bundesbank should be provided with assets from the Federal government for recapitalization purposes, rather than being hugely costly, this recapitalization would have no impact on either the net asset position of the German state or its flow of net income. Let's assume the German government recapitalizes the Bundesbank by providing it with an interest-bearing government bond. While the government's gross debt will increase, the government bond becomes an asset of< the Bundesbank, so the total public net debt does not change, while the higher net interest income arising from these assets would increase the amount the Bundesbank could return in dividends to the German government by the same amount, resulting in no change in the total flow of income for the public sector.*" (Whelan 2014 p. 111)

[38] Reis (2015) calls this "period central bank insolvency".

[39] See for instance Dalton and Dziobek (2005) and Archer and Moser-Boehm (2013) and the literature cited therein.

This statement is correct but can easily be misinterpreted. A recapitalization is to a first approximation neutral from the point of view of the private sector, in that it does not change the net asset position of the private sector or of the consolidated public sector (the combination o fthe government and the central bank): tax receipts are transferred from the government to the central bank, and the same amount comes back to the government in the form of higher dividends from or lower subsidies to the central bank. By the same logic, shredding domestic government bonds held by the central bank is also neutral.

But shredding Target claims, or any claim on foreign entities, is not neutral for the private sector. A recapitalization is neutral *conditional on* net foreign assets of the central bank having been lost; but the loss of these net foreign assets itself is not neutral. This key distinction has not always been clear in the discussion. A default on the Target claims of Germany is not a purely nominal or accounting phenomenon: as we have seen, it is a loss of *real* resources for the German taxpayer, irrespective of what caused the accumulation of Target claims in the first place.[40]

14 CONCLUSIONS

Rather than restating the main conclusions of the analysis so far (see the Introduction for a brief summary of the main results) this section addresses very briefly the first question set out in section 3: even aside from issues of default, does the Target system alter monetary policy in such a way to amplify the macroeconomic imbalances of Eurozone members, like capital flows or current account imbalances? One could argue that the Eurozone monetary policy is agreed upon collectively, hence Target balances are just a manifestation of a monetary policy that Germany has agreed to. This is formally correct. However, what Germany agrees to today depends also on the terminal conditions, which in turn determine the threat point of the other countries. A larger Target claim for Germany means more bargaining power for the debtor countries, because it implies larger German losses from a Target default. Even in a cooperative setting, Germany might find it in its own interest to agree to a more accommodative monetary policy just to reduce the probability of a breakup, with the accompanying Target default.

[40] Recently, Whelan (2017) has argued that in case of a breakup Germany would lose the interest on its Target claims but would benefit from the increase in seigniorage as the demand for a safe currency like the Deutschemark would increase.

15 APPENDIX A

Recently, Fuest and Sinn (2018) and Sinn (2019) have argued that Target claims do receive a remuneration. Their argument is best made with one example taken from their contribution. To abstract from the effects of differences between the shares of each country's assets and liabilities and their respective capital keys, let's assume a symmetric world in which all countries have the same capital keys *and* their shares in each asset and liability of the Eurozone are equal to their capital keys. Now suppose that there is a shock, causing a capital outflow of €10 from country A to country B. As we know, other things equal this generates an increase of Target claims and of excess reserves for the same amount at NCB B, and the opposite at NCB A. NCB B's contribution to the pool of monetary income (the term in brackets on the right hand side of (6)) falls by $i_x \; x \; 10$, while NCB A's contribution increases by the same amount. The total pool of interest income does not change, hence effectively central bank B's saves $i_x \; x \; 10$: Fuest and Sinn (2018) and Sinn (2019) conclude that the remuneration of the marginal €10 of Target balances is i_x, the interest rate on excess reserves. However, as I have shown in expression (8) of section 10, this is not the whole effect: taking into account also the monetary income received, the remuneration of Target balances is 0.

Suppose instead that both central banks want to undo the effects of the capital flow on their monetary base. NCB A buys assets for $\Delta A_t =$ €10, and increases excess reserves correspondingly; NCB B sells assets for €10 and reduces excess reserves by the same amount. Thus now the net change in excess reserves at each central bank is 0. The combined non-Target assets on the balance sheets of the two NCBs also do not change, hence the pool of monetary income on the right hand side of (6) does not change; however, after the shock NCB B contributes $i_r \; x \; 10$ less to the pool (it has sold €10 of assets), but receives the same share (of an unchanged pool of monetary income) as before the shock. Hence, the savings in the contribution to the pool can be considered the remuneration of the extra €10 of Target claims. According to Fuest and Sinn (2018) and Sinn (2019), the rate of return on Target balances is therefore i_r.

However, here too the actual remuneration should take into account also the entire monetary income paid, expression (4), and the other elements in expression (3). Once this is done, one finds that the net effect on the income of NCB B is a *decline* in income equal to $-\Delta A_t(i - i_r)$, because NCB B has *sold* assets. However, this is not the remuneration of Target balances: this is just the effect of the discretionary change in the balance sheets of the two central banks after the shock. In other words, they could always do this, regardless of the Target balance shock.

16 APPENDIX B

In step 1 of Table 20, the central bank pays interest on excess reserves for €10. It does so by crediting the reserve accounts of banks for that amount; in other words, by creating excess reserves for €10. In step 2 the government pays the central bank €15 in interest payments. As the government does so by transferring €15 from its deposit account at commercial banks to its deposit account at the central bank, and then by having its deposit account at the central bank debited for €15, this results in a decline in reserves by €15. The net result so far is a decline in excess reserves and the monetary base by €5. Because the central bank's objective is to keep the monetary base stable, in step 3 it can restore the initial value of the monetary base by conducting a liquidity injecting open market operation: it just has to buy assets

for €5. It does this by creating reserves for that amount. These extra assets for €5 represent the profit of the central bank, that it rebates to the government as dividends in step 4.[41]

Table 20: Stabilizing the monetary base, I

	Resources	Uses
Step 1: Central bank pays interest on reserves	$X_{t+1} - X_t = +10$	$i_x X_t = +10$
Step 2: Government pays interests	$X_{t+1} - X_t = -15$ $iA_t = +15$	
Step 3: Central bank restores the monetary base	$X_{t+1} - X_t = +5$	$A_{t+1} - A_t = +5$
Step 4: Central bank devolves profits to government		$A_{t+1} - A_t = -5$ $D_{t+1} = +5$
Total effect	$iA_t = +15$ $X_{t+1} - X_t = 0$	$D_{t+1} = +5$ $i_x X_t = +10$ $A_{t+1} - A_t = 0$

17 APPENDIX C

Consider Table 21. Now it receives only €7.5 in interest from its holdings of government bonds (step 2). To restore the value of the monetary base, it now has to conduct a liquidity *absorbing* operation (9nstead of a liquidity injecting operation, as in Table 20) for €2.5, by selling €2.5 of assets (step 3). It cannot pay a positive dividend (step 4).

Table 21: Stabilizing the monetary base, II

	Resources	Uses
Step 1: Central bank pays interest on reserves	$X_{t+1} - X_t = +10$	$i_x X_t = +10$
Step 2: Government pays interests	$X_{t+1} - X_t = -7.5$ $iA_t = +7.5$	
Step 3: Central bank restores the monetary base	$X_{t+1} - X_t = -2.5$	$A_{t+1} - A_t = -2.5$
Step 4: Central bank devolves profits to government		
Total effect	$iA_t = +7.5$ $X_{t+1} - X_t = 0$	$D_{t+1} = 0$ $i_x X_t = +10$ $A_{t+1} - A_t = -2.5$

[41] The end result would be the same if in step 1 the central bank paid interest by selling assets for 10 euros instead of creating new reserves for 10 euros.

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