Eurozone Architecture and Target2: Risk-sharing and the Common-pool Problem*

Aaron Tornell

UCLA, Department of Economics

June 2018 (Preliminary and Incomplete)

Abstract

The introduction of the Euro has brought about an implicit risk-sharing mechanism across members of the Eurozone, which works via the Target2 system: when a country is hit by a negative shock, it may activate an automatic loan from the currency union via the ECB. This risk-sharing mechanism has helped smooth the effects of shocks. However, it may have contributed to lending booms, excessive national debt accumulation and capital flight. In this paper, we present some stylized facts that illustrate these two effects and develop a dynamic political-economy model, in which both effects are part of an internally consistent mechanism. We analyze the interaction of systemic bailout guarantees with two common-pool problems: inter-country and within-country. In equilibrium, risk-premia fall—which is good for investment and growth—but a voracity effect arises, under which a greater ability of national central banks to support distressed banks during crises leads to a dynamic path, which features unsustainable national debt coexisting with capital flight.

*This is a revised version of "The Tragedy of the Commons in the Eurozone and Target2," September 2012. I thank Young Kim, Frank Westermann and Sven Steinkamp for insightful discussions. Max Marczinek, David Nie, and Ziqi Zang provided excellent research assistance.

1 Introduction

The creation of the Eurosystem of national central banks and the introduction of the Euro have brought about an implicit risk-sharing mechanism across members of the currency union: when a country is hit by an adverse shock—due either to real factors or to expectations—its central bank may borrow from the currency union via the Target2 system. This implicit risk-sharing mechanism has helped smooth out the effects of shocks, but it has also contributed to lending booms, excessive national debt accumulation and capital flight.

In this paper, we present some stylized facts that illustrate these two opposing effects and develop a dynamic political-economy model, that helps account for such phenomena. We analyze the interaction of systemic bailout guarantees with two common-pool problems: inter-country and a within-country. In equilibrium, risk-premia on interest rates fall, which is good for investment and growth. But a voracity effect arises under which greater ability of national central banks to support distressed banks during crises leads to a dynamic path in which greater national debt coexists with capital flight.

Our model's equilibrium helps explain three salient stylized facts concerning the Eurozone. First, prior to the 2008 crisis, private capital inflows into Greece, Italy, Portugal and Spain–the GIPS–fueled lending booms and current account deficits. Even though imbalances were growing at an alarming pace, GIPS bond yields were driven down to the level of German yields.

Second, the GIPS residents' private assets held abroad were growing at the same time that national debts were growing to unsustainable levels (with Greece as an extreme example). It is not possible to reconcile the buildup of GIPS national debts with observed increases in investment and consumption. In fact, BOP data reveal a large gap between the increase in the GIPS gross national debts and their cumulative current account deficits of around €1.5 Trillion over 2005-2017. The evolution of this gap coincides quite closely with the increase in a measure of private assets abroad held by GIPS' residents.

Third, during episodes of private financial inflow reversals, i.e., sudden-stops, the resulting financing gap in the GIPS has been covered by higher financial inflows from official sources. These 'official financial inflows' have shielded the GIPS from abrupt current account

adjustments typically observed in other sudden-stop episodes, such as the Tequila and Asian crises. Official financial inflows have mainly taken the form of higher Target2 liabilities of the GIPS's national central banks vis-à-vis the Eurosystem. The increase in Target2 liabilities has been associated with a sharp increase in GIPS' central bank credit to banks during 2008-2012 and with quantitative easing during 2015-2018.[1]

The main driver in the model is a dual tragedy-of-the-commons (TOC): the standard within-country commons-problem and an inter-country commons-problem, which acts principally through the Eurosystem of central banks. The former TOC problem arises because, within each country, decision-makers are neither benevolent central planners nor small-competitive agents, but rather rent-seeking groups with the power to extract resources from the rest of the economy via connected lending. These powerful groups include both foreign investors–such as large banks–as well as domestic elites, such as well-connected individuals and firms (Lagarde's list in Greece), local political machines (Baltar's associates in Galicia), state-owned firms, etc.[2] The latter TOC problem stems from the interaction of the Target2 mechanism with the leeway that each national central bank wields over extension of credit to its domestic financial institutions.

During private financial inflow reversals, the NCB expands credit to domestic banks so that they stay afloat. This de facto bailout of the banking system allows domestic agents to continue borrowing from banks, and it also allows (foreign) investors to sell their assets at no major loss. The key role played by Target2 is to allow the NCB to expand credit to banks without risking a loss in its international reserves.[3] In other words, we can think of Target2 as supporting the–implicit–systemic bailout guarantees that ensure creditors are repaid during a sudden-stop. The bailout, in turn, allows for a smoother current account adjustment than what would otherwise occur.

[1] Target2 liabilities are automatic loans from the Eurosystem to a national central bank within the Eurozone. See Tornell and Westermann (2011) and the references therein.

[2] The Lagarde list refers to the list handed by Mrs. Lagarde to George Papaconstantinou, Greece's finance minister, in 2010, containing around 2000 offshore banking accounts. Mr. Baltar has been Orense's political boss since the beginning of the democratic regime in Spain.

[3] Without Target2 NCBs would suffer speculative attacks on their international reserves if they were to increase domestic credit beyond a limit.

In our model economy, an NCB has leeway over its liquidity injections to the domestic banking system, in the short-run. However, because the NCB is part of a currency union, it faces an (implicit) dynamic constraint over the maximum amount of credit it can extend to the domestic banking system. This NCB dynamic constraint in turn determines an upper bound on the aggregate credit that banks can extend to the powerful groups. This is because the NCB's implicit systemic bailout guarantee implies that during a sudden stop, the NCB will have to provide liquidity to the banking system.

In other words, because groups have open-access to the borrowing window of the banks, they have de facto access to a common-pool: here, available NCB credit. In equilibrium, the groups find it optimal to overexploit this common-pool. Even though the common-pool is not immediately depleted in equilibrium, the economy is launched on a path of gradual depletion of available NCB credit. Each powerful groups finds it optimal to store its appropriations safely abroad, even if it receives an inefficiently low rate of return. In contrast, a unitary decision-maker would not over-exploit available NCB credit. Under divided control among several domestic power-holders, however, this cannot be part of an equilibrium path: if one group refrains from overexploiting the common-pool, other groups simply increase their overexploitation. The equilibrium path exhibits a simultaneous increase in national debt and private assets abroad. Both domestic groups and investors are content with the unsustainable buildup of gross national debt.

The structure of the paper is as follows. In Section 2 we present the stylized facts. In Section 3 we describe institutional characteristics of the Eurosystem and monetary instruments that have been used in the Eurozone. In Section 4 we present a dynamic game that captures such institutional characteristics and derive the interior Markov perfect equilibrium of the commons-problem.

2 Stylized Facts

In this section, we present several stylized facts that illustrate the implicit risk-sharing mechanism across the Eurozone, as well as some consequences of the common-pool problems. The data corresponds to aggregate data for Greece, Italy, Portugal and Spain. We will refer to

them as the 'GIPS.'

Sudden-Stops and Current Account Adjustment. The implicit risk-sharing mechanism has allowed for a smoother adjustment when a country has experienced a reduction in private financial inflows. This mechanism operates via the Eurosystem of Central Banks through the TARGET2 system, which stands for "Trans-European Automated Real-time Gross Settlement Express Transfer" system.[4] In the aftermath of the 2008 financial crisis, private financial inflows into GIPS reversed and a massive exodus of private capital took place. This sudden-stop of private financial flows was especially acute in 2010-2012. Typically, across emerging markets, there is a sharp reduction in national spending in response to a sudden-stop. As a result, the current account—the excess of spending over national income—improves immediately to close the external financing gap within a year. As we can see in Figure CA1, Korea and Thailand during the 1997 Asian crisis, improved their current accounts by more than 10% of GDP in one year. Mexico's adjustment during the Tequila 1994 crisis was of more than 5% of GDP in one year.

In contrast, the implicit risk-sharing mechanism spared the GIPS from this sudden collapse in consumption and investment, as well as the deadweight losses associated with generalized bankruptcies. However painful for their residents, the GIPS were able to reduce their current account deficits gradually, not abruptly, in response to the reversal of private capital inflows. From a consumption smoothing perspective this is a more efficient path than the one followed by Mexico in 1995 and Korea in 1997.

We use the same method as Tornell and Westermann (2011a) in order to measure the financial inflows from official sources, intended to smooth the GIPS's current account adjustment in the face of private financial inflow reversals. Namely, we add the net incurrence of liabilities in two categories of the Financial Account of the Balance of Payments statistics of the IMF: Other Investment, Other Debt Instruments, General Government and Other Investment, Other Debt Instruments, Central Bank. Using these "official financial rescue

[4]For a description of the Target2 mechanism see Garber (1998), Sinn and Wollmershäuser (2011), and Tornell and Westermann (2011).

flows," we can express the Balance of Payments equation as follows:

$$\begin{array}{l} \textit{Current Account} \\ \textit{Deficit} \end{array} = \begin{array}{l} \textit{Net Official Rescue} \\ \textit{Financial Flows} \end{array} + \begin{array}{l} \textit{Net Private \& other} \\ \textit{Financial Flows} \end{array} + \begin{array}{l} \textit{Capital} \\ \textit{Account} \end{array} + e\&o$$

Figure FA1 depicts the evolution of the components of this Balance of Payments equation. The sudden stop can be seen in the reversal of private financial inflows. As we can see, the gradual reduction in the current account deficits in the GIPS was made possible by the increase in official financial inflows in the wake of the sudden-stop. We would like to emphasize that historically, private financial flow reversals have typically not been accompanied by large financial inflows from official sources. Typically, when a country like Mexico or Korea has experienced a sudden-stop, international organizations–such as the IMF–have imposed strict spending-reduction conditions and official loans have mainly been directed towards repaying creditors.[5]

Figure OFF1 shows that most of the net official financial rescue inflows to the GIPS correspond to an increase in the Target2 net liabilities of GIPS's NCBs vis-a-vis the ECB. During 2011-2012 crisis, the GIPS's Target2 net liabilities increased by nearly €600 Billion, while the official net financial rescue inflows were around €780 Billion. During 2012-2014, GIPS's Target2 liabilities declined substantially, arguably thanks to the ECB announcement of the outright monetary transactions program (OMT) and other policies. However, from the latter part of 2014 up to date, the GIPS's Target2 liabilities resumed their ascending path. Notice that the increase in Target2 liabilities is different from stabilization-packages of official institutions, such as the IMF and the EU, other parliament-approved loans from Eurozone governments, and from the SMP.

Domestic Credit Expansion. As we can see in Figure TG1, the increase in the Target2 liabilities of the GIPS during 2008-2012 and their decline during 2012-2014, moves closely with the pattern of money creation by the NCBs of the GIPS, i.e., with NCB credit to domestic financial institutions. However, starting in 2015, this close comovement has disap-

[5] In fact, Guillermo Calvo, who coined this term, identifies sudden stops by looking at reversals in the aggregate financial account, which includes private as well as official flows (e.g., Calvo, et al. (200X)).

peared. Instead, there is a close comovement between the GIPS's Target2 liabilities and the purchase of debt securities by NCBs, i.e., quantitative easing.

Typically, in the face of the sudden-stops that have befell emerging markets, one observes massive central bank credit creation in an attempt to avoid a recession or a meltdown. Mexico, prior to the Tequila crisis in 1994, is a canonical example. In early 1994, when it became obvious to markets that the exchange rate peg was unsustainable, Banco de Mexico increased its credit to domestic financial institutions by around 500%. This strategy failed to stem a crisis because the central bank's domestic credit creation was reflected almost one-to-one in losses in its international reserves, as shown by Sachs, Tornell and Velasco (1995) and illustrated in Figure MX1. As is well-known, in December 1994, Mexico suffered a speculative attack and was forced to abandon the peg. A large–unwanted–depreciation resulted, followed by a sudden collapse of bank credit, generalized bankruptcies and a sharp recession.

In the aftermath of the 2008 crisis, such a sharp disruption of bank credit to the economy did not occur in the Eurozone. While the GIPS experienced a reversal of private financial flows, their NCBs were able to increase credit to domestic financial institutions by around 700 Billion Euro between 2007:I and 2012:I, as shown in Figure TG1.[6] This tenfold increase in central bank domestic credit avoided a generalized meltdown like the one experienced by Mexico in 1994 or by Korea in 1997. This is the lever by which the implicit risk-sharing mechanism worked.[7]

The Mexican case is typical. Historically, massive central bank credit creation—to avoid a recession—is a well established fact and its demise is swift because there is a natural limit imposed by a depletion of international reserves. In contrast, the NCB credit creation in the GIPS has not met a corresponding full-blown Balance-of-Payments crisis. The reason behind this implicit risk-sharing mechanism is that GIPS's NCBs have been able to finance such domestic credit creation by borrowing—indirectly, via the ECB—from other Eurozone NCBs,

[6] For details see Tornell and Westermann (2012).

[7] Notice that at the Eurozone aggregate level, the central bank balance sheet expansion between 2007:I and 2012:I is of the same order of magnitude as that of other major central banks. During this period the balance sheet of the ECB has increased by around 170%, that of the US Fed by 220%, and that of the Bank of England by 350%.

rather than by drawing down their own gold and international reserves. Such borrowing has been made possible by the Target2 system. As we can see in Figure TG1, the GIPS's international reserves do not commove with NCB domestic credit nor with Target2 liabilities.

The counterpart of the Target2 net liabilities of the GIPS are the Target2 net claims of the main creditor countries: Finland, Germany, Luxembourg and Netherlands (FGLN), as we can see in Figure FGLN2.

Capital Flight. While GIPS have been rapidly accumulating external debt, a subset of the GIPS's residents has been increasing its assets in other countries as rapidly. Between 2005 and 2012, the increase in total external debt of the GIPS was roughly €2 Trillion, while their cumulative current account deficit was only around €1 Trillion, as shown in Figure KF1. To see whether this gap can be accounted for by the investments made by domestic private agents abroad, we use data from the BOP statistics to compute the cumulative net acquisition of financial assets abroad by GIPS residents, "private assets abroad" for short.

Our measure of the GIPS's private assets abroad has increased by roughly €700 Billion over the period 2005-2012. During 2013 and 2014 this accumulation pattern stopped. However, it resumed in the latter part of 2014, coinciding with the announcement of the ECB's quantitative easing program. Between the beginning of 2015 and end of 2017, the total external debt of the GIPS increased by around €200 Billion, while their cumulative current account deficits were reduced by around €180 Billion, resulting in a gap of roughly €380 Billion. Over this period our measure of the GIPS's private assets abroad increased by roughly €480 Billion.

Surely, it will not escape to the reader that—because of implicit bailout guarantees—a large portion of the additional gross external debt may ultimately be the responsibility of the taxpayer. Meanwhile, the private assets abroad may be out of the reach of the GIPS's authorities. To the extent that the private assets abroad are owned by a small share of the GIPS population, such an asymmetric tax burden might have regressive effects on wealth distribution.[8]

[8] In theory, there are circumstances under which it may be optimal for such an economy to increase its external debt. Due to the standard no-Ponzi condition, the higher debt is expected to be financeable over the long-run because the higher investment or consumption–associated with the current account deficits–reflect

This phenomenon may be considered a type capital flight, distinct from that measured by the errors & omissions in the BOP statistics. And it suggests that a political-economy model, rather than a representative-agent model, is called for to rationalize certain aspects of the Eurozone's dynamics.

The Lending Boom Preceding the Crisis. A reduction of interest rate risk-premia has been one of the channels through which the implicit risk-sharing mechanism promoted more investment and growth. It is well-known that the inception of the Euro led to a sharp reduction in the interest-rate spreads across the Eurozone governments' bonds. Following the inception of the Euro, yields on the GIPSs' government bonds converged to the yields on German Bunds. This spread compression came to an abrupt end in the wake of the 2008 financial crisis. The implicit risk-sharing mechanism in the Eurozone worked in a similar way as systemic bailout guarantees work in models with endogenous borrowing constraints. Their effect is to reduce interest rate risk-premia and in this way relax borrowing constraints, increasing investment and growth (e.g., Schneider and Tornell (2004) and Ranciere et.al. (2008)). In this class of models, lower interest rate risk-premia are associated with lending booms and current account deficits, as it was the case in the GIPS. An internally consistent account of the Eurozone crisis should also explain the lending boom that preceded the crisis.

3 Institutional Characteristics of the Eurozone: A Dual Common-Pool Problem

One should view the Eurozone architecture as providing an implicit systemic bailout guarantee across members of the currency union: when a country is hit by a negative shock—either real or to expectations—that induces a private financial outflow, the currency union provides temporary loan to the country to smooth out the necessary current account adjustment. Here we describe the mechanism through which this loan occurs, and the common-pool situation it generates. In the model of next Section, we investigate the consequences of introducing such systemic bailout guarantees into an environment with two common-pool problems that

news of higher expected future productivity.

exist in the Eurozone: an inter-country problem and a within-country problem.

3.1 Inter-country Common-Pool Problem

Contrary to popular opinion, it is not the case that new Euros are printed by the ECB in Frankfurt and then distributed to the Eurozone countries. In fact, in the short-run, NCBs have plenty of leeway to print money. The decisions to grant central bank credit to domestic financial institutions in the Eurosystem are not made by a *unitary decision-maker.* Instead, they are the result of decisions taken by the ECB governing board in Frankfurt and by the NCBs that are in many ways independent from the ECB. In this subsection we explain how the interaction of the leeway that each NCB has over its credit to domestic financial institutions, the Target2 mechanism, and the full-allotment tenders, gives rise to a commons-pool problem among the countries in the Eurosystem.

Central Bank Domestic Credit Creation. In the short-run, each NCB in the Eurozone has leeway over its credit to domestic financial institutions. The ECB has only indirect control over this process via interest rates and eligibility criteria on its refinancing operations. There are several reasons for this. First, the Eurosystem uses so-called *full allotment tenders,* under which the ECB announces the interest rate at which it is willing to satisfy any amount of banks' loan demands. Every bank can then borrow as much as it wants from its NCB, as long as the bank: (i)is financially sound and (ii) has eligible collateral. In the short run, national authorities have de facto regulatory power to decide whether a bank is financially sound.[9] Over longer horizons centralized bodies at the ECB may be involved. Regarding eligible collateral, the ECB has relaxed significantly the criteria for eligible collateral since 2008. So much so that currently national authorities have significant leeway in determining what is eligible collateral. In particular, the rating-agency grading requirement has been eliminated. Now even private loans count as eligible collateral–against appropriate haircuts.[10]

In addition to the above, an NCB has recourse to emergency liquidity assistance (ELAs).

[9] Steinkamp, Tornell and Westermann (2017) describe the regulatory framework and the voting mechanisms in the Euro Area.

[10] See Tornell and Westermann (2012) for details on the inter-country commons-problem and the relaxation of collateral rules.

These are emergency loan agreements that allow a bank, with no collateral eligible for standard refinancing operations, to borrow from its NCB. The eligible collateral in this case comes from a government guarantee to repay the loan.[11]

The SMP, ESM and QE. In addition to rediscounting operations, there are other instruments with which the risk-sharing mechanism may provide financial resources. First, the secondary market purchase program (SMP), under which government bonds are purchased in the secondary market. By promising to buy bonds in the secondary market, the ECB provides implicit guarantees to private investors that bond yields will not increase significantly. Investors, in turn have more incentives to buy government bonds in primary Treasury auctions. Second, the ESFS and its successor–the ESM–are bailout agencies that give countries in distress access to fiscal resources subject to conditionality. The capital of these agencies come from governments not from the ECB. Third, through the quantitative easing program the ECB has purchased debt securities in exchange for new base money to Euro Area countries.

The Target2 Mechanism. The Target2 mechanism is an automatic payments system that permits NCBs to send and receive transfers across countries within the Eurozone. The objective of this mechanism is to ensure a seamless currency union by allowing the smooth financing of inter-bank and trade imbalances. Furthermore, the Target2 mechanism is necessary to anchor exchange rate expectations across the Eurozone: having a Euro deposit in Spain should the same thing as having a Euro deposit in Finland. Without such mechanism, a rumor may lead to a run on the banking system of a country.

In principle, Target2 balances should be netted out in the medium-run. This was the case until 2007. However, following the 2008 financial crisis the Target2 liabilities of the GIPS shut up. The reason for this is the following. As private capital inflows to the GIPS reversed, there was a risk of generalized bank failures. Faced with this threatening situation, the NCBs increased dramatically their credit to domestic financial institutions. This is the

[11] This mechanism was used heavily in Greece in the run-up to the 2012 elections. Greek banks suffered a huge deposit flight, which was financed via ELAs. ELAs have also been used in Ireland, Portugal. During 2012 they have been used in Spain.

ten-fold increase in NCB domestic credit we described earlier.

When agents request domestic banks to wire funds abroad, domestic banks may borrow from their NCBs using their assets as collateral, rather than having to sell their assets in the market. In order to complete the transfer to another country in the Eurozone (say country X), the GIPS's NCBs may borrow from the Eurosystem via the Target2 mechanism. Once the wire to a bank in country X is completed, the NCB of country X increases its Target2 claims on the Eurosystem. In other words, when the newly created liquidity by the GIPS NCBs is transferred to other countries in the Eurozone, it generates higher Target2 liabilities of the GIPS NCBs vis-à-vis the Eurosystem.

A comparison with emerging markets is illustrative. Typically, in emerging markets when an NCB increases its domestic credit to finance fiscal deficits or to backstop banks so as to avoid an imminent crisis, the NCB experiences a loss of its international reserves. When reserves reach a critical level, a speculative attack occurs. Therefore, there is a natural limit to unsustainable NCB domestic credit creation in emerging markets; a crisis makes the unsustainable path come to an abrupt end. Of course, there is no presumption that such an abrupt end is optimal.

Because of Target2, this reserve-loss process is not operative in the Eurozone. An NCB can increase its domestic credit without risking a loss of its international reserves. When agents decide to transfer the newly printed money abroad, there is an increase in the Target2 liabilities of the NCB rather than a depletion of its international reserves. In plain language, it is *as if* an NCB could borrow at short notice—without asking for anyone's approval—from other NCBs, via the ECB.

In principle, even with Target2, there are limits to the ability of an NCB to increase its domestic credit. These limits are imposed by the solvency of domestic banks and the availability of eligible collateral that banks can pledge at the NCB. As we explained above, such natural limits have been blurred in the Eurozone.

To analyze Eurozone dynamics, we should add a new item to the standard textbook's

central bank's balance sheet: Target2 balances.

Balance Sheet of a National Central Bank in the Eurozone

Assets	*Liabilities*
Credit to Domestic Agents	*Money Balances*
Gold & Reserves	*MFIs' Reserves*
Target2 Claims	*Target2 Liabilities*
Debt Securities (QE)	

In sum, as long as a country is considered solvent by the ECB, its NCB has ample leeway in extending domestic credit to domestic banks. There are three institutional characteristics that make this implicit risk-sharing mechanism possible: There is no explicit upper limit on the size of an NCBs Target2 liabilities; there is no explicit upper bound on the maturity of Target2 liabilities; unlike standard debt contracts, when a Target2 liability is incurred, it is not specified when it has to be settled; and decisions at the ECB are made by majority voting and one-country one-vote applies. Since creditor countries in the Target2 mechanism–Finland, Germany, Luxembourg, and Netherlands–are a minority, deficit countries may have leeway in extending domestic credit and increase their Target2 liabilities in the short-run.[12]

3.2 Within-Country Commons Problem

Arguably, if there only was a inter-country common-pool problem, but countries had unitary governments, we would not observe unsustainable national gross debt levels coexisting with large stocks of gross assets abroad. A unitary government with a long-horizon would internalize the cost of unsustainable debt and would refrain from following unsustainable spending paths.

Unfortunately, as it is well-known, country-level decisions, such as bank-solvency and fiscal deficits, are not decided by a unitary agent–a central planner–but are determined by

[12] The USA has a mechanism analogous to Target2. Note, however, that the common-pool problem at the Eurosystem of central banks is not operative in the Fed system in the USA. The Federal Reserve Bank of San Francisco cannot buy bonds from the State of California. There are other common-problems in the USA, but not this one.

the interaction of several powerful rent-seeking groups within a country. In other words, even a nominally strong official running the government needs to satisfy the interests of powerful groups, and cannot act as a benevolent dictator with a long-horizon.

The within-country commons-pool problem arises because NCBs and regulators do not act in a vacuum, but tend to respond to domestic political pressures. In particular, in the face of a catastrophic situation, that threatens generalized bankruptcies, there are strong pressures for central bank financing of fiscal deficits and for regulatory forbearance. The latter includes decisions such as not declaring a bank insolvent when it is de facto insolvent and allowing banks to refinance de facto non-performing loans.

Interest groups with the power to influence policy include: local authorities, unions, industrial groups, and banks. Importantly, they also include foreign investors.[13]

Puzzlingly, the ample leeway that NCBs and domestic regulators have over domestic credit expansion, makes them politically weak. It generates strong temptations for powerful groups to influence–or capture–the regulators. In the typical small economy, this temptation is checked by the danger of a speculative attack on the NCB's stock of gold and internal reserves. In the Eurozone,

3.3 Systemic Bailout Guarantees.

The pre-sudden-stop boom in private capital inflows and the corresponding dirt-cheap interest rates suggest that investors were either irrationally over-optimistic or that investors believed a bailout guarantee was in place. A model of the current Eurozone crisis should also explain these stylized facts. Two classes of models that could account for these two stylized facts are models with bounded-rationality and models where the provision of inter-country insurance in a currency union plays center-stage. In this paper we focus on the latter perspective and consider a model with *systemic bailout guarantees*. Namely, a model where there is an–implicit–guarantee whereby if a shock were to hit a certain country and this

[13] As Enda Kenny, prime minister of Ireland, puts it: "Because of the fact that the country that I lead politically was the only one that had a policy imposed on it from Brussels and from Frankfurt at that time–*that a bank would not be allowed to fail*–we've had to shoulder a unique burden from any other country in Europe." Quoted in the Finnacial Times, Decemeber 18, 2012, pg 4.

country were unable to repay its debts, then other countries in the Eurozone would come to the rescue. Such a bailout would allow the country hit by the shock to both smooth out the effects of the shock and repay foreign investors.[14]

In our view, the Eurozone's institutional arrangement that provides an automatic risk-sharing mechanism and systemic bailout guarantees is the combination of the Target2 system and the leeway that NCBs have to increase credit to domestic institutions. This mechanism is automatic as it needs not go through uncertain and slow-moving parliamentary approval processes across the Eurozone countries. An abrupt increase in the Target2 liabilities of countries that suffer a sudden-stop would take place even if a handful of countries were to oppose it. This is because there is one-country one-vote rule at the Eurosystem of Central Banks. Thus, it is fair to think of Target2 as being part of an implicit inter-country risk-sharing mechanism. The NCBs play center-stage in this mechanism because they handle important share of the bailout payments via the increase in NCB credit to domestic institutions, as well as the purchase of debt securities via the quantitative easing program.

4 Model

We focus on the within-country common-pool problem by considering a minimal dynamic-game across powerful rent-seeking groups in a country that belongs to a currency union, in which there is an implicit sharing mechanism. We will refer to the currency union as the Eurozone. The model has three key ingredients:

1. Decisions that determine the level of public debt are not made in a unitary fashion, but rather are made in a divided fashion by interest-groups that have power to appropriate—directly and indirectly—fiscal resources.

2. There are implicit systemic bailout guarantees throughout the Eurozone that promise investors they would be repaid in case of a systemic crisis in a member country. During

[14] One can view such an insurance scheme from two perspectives: (i) as the design of a benevolent central planner whose objective is to smooth the effects of shocks and avoid a shift to a 'bad-equilibrium;' or (ii) as the result of unplanned policymakers' responses that try to avoid a catastrophic crisis.

hardships, these bailouts are operated by national central banks (NCBs), who are compelled to extend credit to domestic banks in order to avoid a meltdown.

3. In the short-run, the Eurozone's central bank—the ECB—does not restrain the leeway of NCBs to extend credit to domestic agents. Over the long-run, however, the ECB determines the upper bound of the NCBs net liabilities vis-à-vis the Eurosystem.

4.1 Setup

We consider a periphery economy that belongs to a currency union, i.e., the Eurozone. This economy is small, open, and it has a single consumption good, which is perfectly tradable across the Eurozone. Because the economy is open and purchasing power parity holds, the domestic price level equals that in the rest of the Eurozone. Because the country is small it does not affect the Eurozone's price level, which we set to one. We consider a setup where the country will never break away from the Eurozone, and so the price level in the country is expected to be constant over the entire horizon.

The economy is populated by rent-seeking groups, domestic banks, foreign investors, a private competitive sector, and a national central bank.[15]

Rent-seeking groups. These groups are agents with the power to extract resources from the rest of the economy. They include public sector actors, such as government agencies, subnational governments, and unions, as well as private actors, such as banks, politically connected industrial groups, and protected industries. They also include foreign investors, which have shown to wield power across the Eurozone.

A group obtains funds by borrowing ($g_{i,t}$) from domestic banks at an interest rate ρ_t. The debt of each groups may be rolled over indefinitely, and so the aggregate gross debt of the groups evolves according to

$$\Gamma_t = \Gamma_{t-1}\left[1+\rho_{t-1}\right] + \sum\nolimits_{i=1}^{n} g_{i,t-1}, \qquad \Gamma_0 = 0. \tag{1}$$

[15] The setup is similar to that in Tornell and Velasco (2000), where the government consists of a national central bank that passively responds to the demands of a fiscal authority. Here, the domestci banks play the role of the fiscal authority.

As is well known, elites in the GIPS—the model's powerful groups—have the ability to invest their assets abroad, arguably to keep them safe from tax authorities and from expropriation. To focus on this aspect, we assume that groups have no access to a domestic investment technology. They can either consume ($c_{i,t}$) or store their assets abroad ($b_{i,t}$) in a core Eurozone country. The key characteristic of assets stored abroad is that they are safe from appropriation by others. The assets that a group invests safely abroad earn a rate of return β. Thus, the group i's "safe assets abroad" evolve according to

$$b_{i,t+1} = (1+\beta)b_{i,t} + g_{i,t} - c_{i,t}. \tag{2}$$

The rate of return β can be thought of as the Eurozone safe interest rate net of the costs of keeping it effectively private. Thus, we allow β to take arbitrarily small value, which can be even be negative. To sum up, accumulation equations (1) and (2) say that a group simply borrows (or issues bonds) and uses the proceeds to either consume or store abroad. We will refer to $g_{i,t}$ as the fiscal appropriation of group i.

The objective function of each group is the standard discounted value of utility derived from consumption

$$U_{i,s} = \sum_{t=s}^{\infty} \frac{1}{\delta^{t-s}} \log(c_{i,t}), \qquad \delta \equiv 1 + r. \tag{3}$$

Domestic Banks. Banks are passive agents controlled by interest-groups that make loans to the groups. Banks fund such loans by either selling one-period bonds to foreign investors or by borrowing from the NCB. The one-period bonds promise a return $1 + \rho_t$ and enjoy a bailout guarantee from the NCB.

Foreign Investors. Are competitive risk-neutral agents with an opportunity cost r. Regulation allows an investor to buy domestic bonds only of good-standing issuers and only if the country is deemed investment-grade. An issuer is said to be be in good-standing if it has never defaulted in the past. A country is deemed to be investment-grade if its government has the ability to provide a bailout guarantee over all the outstanding bonds' promised repayments.

The National Central Bank (NCB). The NCB is a passive actor that provides a systemic bailout guarantee to foreign bond-holders and to domestic banks.

Systemic Bailout Guarantees If a majority of domestic banks is at risk of bankruptcy, the NCB extends credit to them so that: (i) they honor the promised repayment on all their outstanding bonds and (ii) they fund new loans demanded by groups. If a majority of domestic banks is *not* at risk of bankruptcy, the NCB does not make any loans to any bank.

There are two states of the world: good and bad.

Good State. Investors believe that a *bailout guarantee* is in place.

Bad State. Investors believe that no bailout payments will be made next period by the NCB.

The bad state is absorbing: once the economy falls into the bad state, it is stays there forever.

The Private Competitive Sector. It is a mass of measure one of competitive infinitely-lived agents that derive utility from consumption of the single good and from real money balances

$$\sum_{t=s}^{\infty} \frac{1}{\delta^{t-s}} \left[\log(c_t^{priv}) + \log(M_t)\right]. \tag{4}$$

During every period, the representative private agent receives an endowment of the consumption good y_t, pays a tax ϕy_t and consumes. Since she can accumulate her wealth in either money or an internationally traded bond (b_t) that pays a real interest rate $\delta - 1$, it follows that her budget constraint is

$$y_t[1-\phi] - c_t = b_t + \delta b_{t-1} + M_t - M_{t-1} \tag{5}$$

4.1.1 The NCB's Budget Constraint

In a small-open economy, the extent of an NCB's domestic credit creation is constrained by its international reserves and its seniorage. In the Eurozone, an NCB does not face such a tight constraint because it has recourse to the Target2 mechanism, as we described in Section 2. That is, in the Eurozone, an increase in the NCB's domestic credit (ΔD_t^a) or an increase

in its holdings of debt securities, i.e., quantitative easing (ΔQE_t), has as a counterpart either an increase in its Target2 net liabilities ($\Delta Tg2_t \equiv Tg2_t - Tg2_{t-1}$), a reduction in its international reserves ($+\Delta IR_t$), an increase in money in circulation (ΔM_t), or an increase in banks' reserves (ΔRE_t). Thus, to analyze the Eurozone, the standard textbook NCB constraint should be replaced by the following equation.[16]

$$\Delta D_t^a + \Delta QE_t = \Delta Tg2_t - \Delta IR_t + \Delta M_t + \Delta RE_t. \tag{6}$$

There is no explicit date by which an NCB's Target2 liabilities at the ECB have to be repaid, nor is there an explicit upper limit on them. Not withstanding this formal unboundedness, it is important to recognize that an NCB cannot increase domestic credit without bound indefinitely for at least two reasons. First, as we discussed in Section 2, the ECB requires that NCBs lend only against eligible collateral, and that appropriate haircuts be applied to the collateral pledged by banks. Second, even if there was plenty of eligible collateral, the large increase in Target2 liabilities vis-a-vis other NCBs, that would result from an unlimited increase in NCB's domestic credit, would give rise to opposition at the ECB's Governing Council and in creditor countries.

In order to capture this implicit upper-limit on NCB domestic credit expansion, it is useful to track the "NCB's *shadow* domestic credit" which is the contingent bailout obligation of the NCB. That is, the bailout payments that the NCB would have to make if the current state were a bad state. Let's denote such shadow NCB's domestic credit by D_t, distinct from D_t^a, which is the actual NCB domestic credit. Then the implicit constraint on the NCB's domestic credit expansion is given by the upper bound $\overline{D}_t$.

$$D_t \leq \overline{D}_t \tag{7}$$

This upper bound on the NCB's contingent obligations $\overline{D}_t$ evolves over time as follows

$$\overline{D}_{t+1} - \overline{D}_t = \lambda \left[\overline{D}_t - D_t\right] + rD_t, \qquad \lambda \geq 0. \tag{8}$$

That is, the smaller the gap between the NCB's contingent obligations and its upper bound, the smaller the growth of the upper bound on the NCB's contingent obligations. In the

[16] Notice that we have set to zero the return on international reserves. Furthermore, notice that there is no inflation revenue because inflation is zero.

limit, when the NCB has hit its limit—the gap $\overline{D}_t - D_t$ is zero—the Eurosystem increases the upper bound $\overline{D}_{t+1}$ just enough so as to allow the NCB to cover the interest payments on the existing pile of debt, but no more. Notice that in the context of consumer credit, we observe rules similar in spirit to (8). Consumers with lower credit card balances–relative to their credit limit–have greater FICO scores and so are more likely to see their credit limit increased and to have easier access to new credit cards and revolving credit.

In other words, the more an NCB uses the printing press, the more tension with other members of the currency union, and the more likely the ECB will implement policies that would hamper the ability of the NCB to extend domestic credit indefinitely. The parameter λ indexes such tension: it captures Eurosystem policies that determine the ability of an NCB to extend domestic credit indefinitely. For instance, an increase in λ may reflect a decision by the ECB to relax collateral rules in this particular country and in this way increase the availability of collateral pledgeable at the NCB.

4.2 The Groups' Bond Issuance Game

Because the path of the NCB's shadow domestic credit is determined by the bond issuance of the banks, who in turn are controlled by the groups, it follows that groups have de-facto access to a common-pool resource: available NCB domestic credit. Each group knows that its bond issuance—essentially, its fiscal appropriation—as well as the issuance of the other $n-1$ groups, will ultimately have to be financed by the NCB via 'money printing' and also knows that there is an upper bound to such money printing.

To make this common-pool characteristic explicit, let us rewrite the NCB's constraint (7) in terms of "available NCB domestic credit"

$$L_t \equiv \overline{D}_t - D_t \geq 0. \tag{9}$$

Then the NCB's dynamic constraint (8) can be reexpresed as follows

$$L_t = [1+\lambda]L_{t-1} - \sum\nolimits_{i=1}^{n} g_{i,t-1}, \qquad L_t \geq 0. \tag{10}$$

Each group maximizes its utility (3) subject to the NCB's dynamic constraint (10) and its private assets accumulation equation (2). Furthermore, each group takes as given the

strategies of the other *n-1* groups. The resulting set of n interdependent problems constitutes a dynamic game.

We will use Markov perfect equilibrium (MPE) as the solution concept. In an MPE, the strategies depend only on the value of the payoff-relevant state variables $(L_t, b_t^1, ...b_t^n)$. We allow groups to choose appropriation policies from the class of continuously differentiable functions of these payoff-relevant state variables

$$\hat{g}_{j,t} = g_j(L_t, b_{j,t}) \in C^1, \qquad g_j(0, b_{j,t}) = 0. \tag{11}$$

As is standard in dynamic models of common-access (e.g., Benhabib and Radner), we impose an upper bound on bond issuance to ensure that there is enough NCB's available domestic credit to cover the bailout associated with the promised debt repayments of all groups

$$g_{i,t} \in [0,\ \overline{g}L_t], \qquad \text{with } \overline{g} < \frac{1+\lambda}{n}. \tag{12}$$

The upper bound on the appropriation rate $\overline{g}$ will not be binding in the MPE we will characterize. This upper bound ensures that even in the extreme situation in which all groups appropriate as much as they can, available NCB credit is not depleted.[17]

In an MPE, each group i takes as given the strategies of the other groups. Thus, in order to derive the MPE, let's consider n optimization problems–one for each group–and in each Problem-i let's consider the strategies of the other $n-1$ groups as undetermined functions of the state variables, satisfying (12): $\hat{g}_j(L_t, b_{j,t})$ for $j \neq i$.

Problem of Group i. Taking as given the appropriation strategies of the other $n-1$ groups (11), choose $\{g_{i,t}, c_{i,t}\}_{t=s}^{\infty}$ to maximize utility function (3), subject to the private assets accumulation equation (2), the upper appropriation bound (12) and the NCB's dynamic constraint

$$L_{t+1} = [1+\lambda]\, L_t - g_{i,t} - \sum_{j \neq i} \hat{g}_j(L_t, b_{j,t}), \qquad t = s, s+1, ... \tag{13}$$

An equilibrium of the groups' issuance game is defined as follows.

[17] If the country were to hit the lower bound on its net debt with the rest of the Eurozone, then the ECB would stop accepting the country's collateral, and so the country will have to let its exchange rate float. If such a crisis event were to occur at τ, then all groups would get zero transfer forever after ($g_{it}^j = 0$ for all $t \geq \tau$).

Definition 4.1 (Markov Perfect Equilibrium of the Issuance Game.) *An MPE is a collection of n pairs of bond-issuance policies and consumption policies* $\{\hat{g}_{i,t}(L_t, b_{j,t}), \hat{c}_{i,t}(L_t, b_{j,t})\}_{t=s}^{\infty}$, $i = 1, ..., n$, *such that taking as given the* $n-1$ *policy pairs of the other* n-1 *groups* $\{\hat{g}_{j,t}(L_t, b_{j,t}), \hat{c}_{j,t}(L_t, b_{j,t})\}_{t=s}^{\infty}$, $j \neq i$, *the solution to the Problem of group* i *is* $\{\hat{g}_{i,t}(L_t, b_{j,t}), \hat{c}_{i,t}(L_t, b_{j,t})\}_{t=s}^{\infty}$.

4.3 Discussion of the Setup

Here we discuss some assumption we have made.

Accumulation Equation for Private Assets Abroad. Interest groups have two asset-accumulation equations: the 'open-access' equation (10), which describes the evolution of the common-pool (i.e., available NCB credit) and the private-access equation (2), which describes the assets that each group keeps abroad. This structure will allow us to investigate condition sunder which the equilibrium exhibits a simultaneous increase in national public debt and in private assets abroad observed in the data. This setup seems realistic as it captures the ability of elites in the GIPS to borrow from banks and at the same time invest their assets abroad, arguably safe from expropriation. An example is the 'Lagarde List' tax-evasion scandal in Greece. In 2010, Mrs. Lagarde, the French finance minister, passed on a list of around 2000 Greek tax dodgers to the former Greek finance minister, George Papaconstantinou. He then handed the list to Greece's financial police, which amounted to around €1.5 billion held in Swiss accounts. The squad failed to prosecute tax dodgers as Greek authorities have treated it as stolen data, which makes it illegal to pursue the case.[18] This drama took a turn in December 2012 as it was revealed that 3 cousins of Mr. Papaconstantinou were deleted from the Lagarde list that he handed to the financial police. Mr. Papaconstantinou negotiated Greece's first international bailout and presided over its first austerity round.[19]

[18] On December 2012, a report prepared by the International Monetary Fund and the European Union said that Greece will miss five out of 10 goals set for December in relation to audits and tax collection. "Considerable arrears remain on the books—€53 billion—of which most likely 15% to 20% could be paid," the report said. Furthermore: "The mission expresses concern that work being conducted is falling idle and that the drive to fight tax evasion among the very wealthy and the self employed is at risk of weakening." According to Margarita Tsoutsoura, tax evasions costs Greece E28bln yearly (around 15% of GDP).

[19] This story has been reported in several articles in the Wall Street Journal: "Tax-Evasion Allegations Dog

The NCB's Constraint. Throughout this paper we take as exogenously given the upper bound $\overline{D}_t$ in (7) and the associated dynamic constraint (8). The shadow NCB credit available $\overline{D}_t - D_t$ in (8) may be interpreted as the fiscal space of a country. In a more elaborate political-economy model, one could characterize the determinants and dynamics of this upper-bound $\overline{D}_t$ by specifying a structural game across NCBs in the Eurozone. Such game may entail a common-pool problem among NCBs.

One can interpret (7)-(8) in several ways. For instance, in terms of available collateral pledgeable at the NCB, in terms of an implicit upper-bound on the Target2 liabilities that an NCB can have with the rest of the Eurosystem, etc. To see this, let $\overline{\varsigma}_t$ be the total amount of bank collateral–net of haircuts–pledgeable at the NCB and let ς_t be the collateral that banks have already pledged at the NCB. Because the NCB can extend credit to domestic banks only against pledgeable collateral, we can identify $\overline{\varsigma}_t$ with the upper-bound on shadow NCB domestic credit $\overline{D}_t$ and ς_t with D_t. In this case, (8) would describe how pledgeable collateral evolves over time. An increase in λ would reflect the relaxation of collateral rules by the ECB.[20]

Under the second interpretation, suppose there is an–implicit–upper bound $\overline{Tg2}_t$ on a periphery NCB's Target2 net liabilities vis-a-vis the Eurosystem. Because along the equilibria we will characterize, the change in the actual NCB's domestic credit equals the change in the Target2 liabilities, we can replace $\overline{D}_t$ by $\overline{Tg}2_t$ and D_t by $Tg2_t$.

The Role of the NCB and of Banks. In our model the NCB simply provides a systemic bailout guarantee to banks, who in turn funnel such guarantees to powerful groups. We have assumed away the possibility that bank lending is directed towards productive investment by either the powerful groups or the private competitive sector in order to focus on the common-pool problem that generates the simultaneous increase in external debt and private assets abroad.

Greece," October 25, 2012; "Greece Urged to Get Tough on Tax," December 24, 2012; "Scandal Deepends over Greece's Lagarde List," December 28, 2012.

[20] A key aspect of the ECB's December 2011 LTRO package was the relaxation of collateral rules, not only the announcement of leng term refinancing operations. Such a relaxation was an emergency response to the inability of periphery banks to get credit from their NCBs in the face of a reversal in the interbank funding market.

Banks loans in our model may be interpreted as including fiscal transfers to groups. In a more elaborate setup, one could introduce a fiscal authority that hands out transfers to groups and makes bailout payments. To finance such transfers the fiscal authority would issue bonds that would be purchased by banks who would then rediscount them at the NCB.

4.4 The Tragedy-of-the-Commons Equilibrium

We characterize equilibria in which the country will remain in the currency union forever, and this is known by all agents in the economy.[21] Thus, there are no expectations of explosive inflation that would result from a break away from the Eurozone. Inflation is equal to that in the rest of the Eurozone, which we have set equal to zero.

The representative private agent maximizes (4) subject to (5). The solution is

$$\begin{aligned} c_t &= \overline{c} \\ M_t &= \frac{\delta}{\delta - 1}\overline{c} \end{aligned} \tag{14}$$

Since inflation is zero, it follows from the private agent's problem that $\Delta M_t = 0$.[22]

Consider next foreign investors. If the bad state realizes at time t, foreign investors expect that a bailout will not be granted at *t+1* and so are not willing to hold any amount of domestic bonds. Since the bad state is absorbing, domestic banks–and the groups that control them–will not find it profitable to repay the loans at $t+1$.

In the good state, investors are willing to hold domestic bonds only if they are promised a rate of return no lower than their opportunity cost r. Since a bailout guarantee is in place, whereby the NCB pays the promised bond repayment in full in the bad state, investors will receive the promised interest rate ρ_t in both states: in the good state they will be repaid by the banks, who will be able to roll-over their debts; in the bad state, they will be repaid by the bailout. Since investors are competitive, it follows that they are willing to accept an interest rate equal to the Eurozone rate

$$\rho_t = r. \tag{15}$$

[21] If this country were to break appart from the monetary union, its inflation rate would be time-varying.

[22] There is another standard channel for capital outflows, via a fall in M_t. This channel is not operative in this paper as we concentrate on the case where the Eurozone will stay intact forever.

Investors buy domestic bonds only up to the present value of the bailout the NCB will be able to make at $t+1$:

$$F_t \leq \overline{F}_t \equiv \frac{\overline{D}_{t+1} - \sum_{i=1}^{n} g_{i,t}}{1+r}. \tag{16}$$

If $F_t \leq \overline{F}_t$, the country is deemed investment-grade because the NCB has enough resources to repay foreign investor at *t+1.* It follows that the stock of external debt evolves according to

$$F_t = \begin{cases} [1+r]\, F_{t-1} + \sum_{i=1}^{n} g_{i,t-1} & \text{if } S_t = good \\ 0 & \text{if } S_t = bad \end{cases}, \quad F_0 = 0. \tag{17}$$

Consider next the balance sheet of the NCB. There are three cases. First, if the state is good at *t*, the NCB extends zero credit to banks. Second, if the state shifts from good at *t-1* to bad at *t*, investors sell all their holding of domestic bonds and do not buy new domestic bonds. In this case the NCB extends credit to domestic banks so that they can make the promised repayment $[1+r]\, F_{t-1}$ to foreign investors, and are able to make new loans to groups $\sum_{i=1}^{n} g_{i,t-1}$. Third, if the state is bad at t and it was bad in *t-1,* then at time t the NCB (i) rolls over the loans it made to domestic banks the previous period $[1+r]\, D^a_{t-1}$ and (ii) grants new credit to banks, so that they make new loans to the groups $\sum_{i=1}^{n} g_{i,t-1}$. Because the NCB carries out full-allotment auctions, the credit from the NCB to domestic banks carries the same interest rate as the Eurozone interest rate r. It follows that the actual stock of NCB domestic credit evolves according to

$$D^a_t = \begin{cases} 0 & \text{if } S_t = good \\ [1+r]\, F_{t-1} + \sum_{i=1}^{n} g_{i,t-1} & \text{if } S_t = bad \ \& \ S_{t-1} = good \\ [1+r]\, D^a_{t-1} + \sum_{i=1}^{n} g_{i,t-1} & \text{if } S_t = bad \ \& \ S_{t-1} = bad \end{cases} \tag{18}$$

In order to derive the equilibrium we need to track the stock of the NCB's shadow domestic credit, which is the contingent bailout obligation of the NCB

$$D_t = [1+r]\, D_{t-1} + \sum_{i=1}^{n} g_{i,t-1}, \qquad D_0 = 0. \tag{19}$$

Finally, the NCB's shadow domestic credit equals F_t if the state is good, while it equals D^a_t if the state is bad. That is, even though during good times the NCB does not issue any domestic credit, it must provide a bailout guarantee to support the demand of foreign investors.

In order to capture the gradual deterioration of the NCBs' balance sheets in the Eurozone periphery–as distinct from an explosive pattern–we will construct an 'interior MPE,' in which all groups find it optimal to set their appropriation in the interior of the appropriation set: $\hat{g}_{i,t} < \overline{g} L_t$ for all i and all t.[23]

Recall that the bond-issuance strategies are undetermined functions of the state variables $g_{i,t}(L_{t+1}, b_{i,t+1})$, $i = 1, 2, ..., n$. The next Proposition states that in an interior MPE these functions are uniquely determined and characterizes them in closed-form.

Proposition 4.1 (Interior Equilibrium) *There exists an interior MPE of the common-pool bond issuance game if and only if*

$$\beta < \lambda < \beta + [1 + \beta][n - 1]. \tag{20}$$

The interior MPE is unique and symmetric. In this equilibrium, each group appropriates a constant share of the National Central Bank's available credit to domestic banks

$$\hat{g}_i(L_t) = \frac{\lambda - \beta}{n - 1} \cdot L_t, \qquad i = 1, 2, ..., n. \tag{21}$$

Each group consumes a constant share of the assets to which it has access (i.e., the sum of the private assets it holds abroad and the NCB's available credit)

$$\hat{c}_{i,t}(L_t, b_{i,t}) = r \cdot \left[\frac{1 + \beta}{1 + r}\right] \cdot [L_t + b_{i,t}], \qquad i = 1, 2, ..., n. \tag{22}$$

The proof is in the Appendix. To grasp the intuition note that in an interior solution to the problem of group i, three optimality conditions must be satisfied. First, group i must find it optimal to set its appropriation in the interior of the appropriation set: $\hat{g}_{i,t} < \overline{g} L_t$. This condition holds only if the equilibrium appropriation of the other $n - 1$ groups is low enough

$$\hat{g}_{i,t} < \overline{g} L_t \quad \text{only if} \quad \sum_{j \neq i} \frac{\partial \hat{g}_{j,t}(L_{t+1}, b_{j,t+1})}{\partial L_{t+1}} \leq \lambda - \beta. \tag{23}$$

[23] There are other "catastrophic MPEs" where $g_{i,t} = \overline{g} L_{t-1}$.

To see the intuition for equilibrium condition (23) notice that from group i's 'private' perspective, the rate of return on the common-pool asset is $\lambda - \sum_{j \neq i} \hat{g}_j(L_t, b_{j,t})/L_t$, while that on her private asset abroad is β. Thus, group i expects a return on the common-pool asset no smaller than on the private asset, i.e., $\lambda - \sum_{j \neq i} \hat{g}_j(L_t, b_{j,t})/L_t \geq \beta$, if and only if the other *n-1* groups set their appropriation rates as in (23).

Notice that the optimality condition (23) of group i imposes restrictions on the bond-issuance policies of the other *n-1* groups, but does not impose any restriction on her appropriation policy $\hat{g}_{i,t}$. Moreover, the same is true for each of the other *n-1* groups. Thus, group i must set its appropriation rate such that each of the other groups finds strategy (21) optimal. In other words, if an interior MPE exists, the following set of n conditions must hold simultaneously

$$\sum_{j \neq i} \frac{\partial \hat{g}_{j,t}(L_{t+1}, b_{j,t+1})}{\partial L_{t+1}} \leq \lambda - \beta \qquad \text{for } i = 1, 2, ..., n. \tag{24}$$

This set of n equations holds simultaneously only if $\frac{\partial \hat{g}_{j,t}(L_{t+1}, b_{j,t+1})}{\partial L_{t+1}} \leq \frac{\partial \hat{g}_{i,t}(L_{t+1}, b_{i,t+1})}{\partial L_{t+1}}$ for all i and all j. Thus, (24) holds only if $[n-1]\frac{\partial \hat{g}(L_{t+1}, b_{j,t+1})}{\partial L_{t+1}} = \lambda - \beta$. Integrating we have $[n-1]\hat{g}(L_{t+1}, b_{j,t+1}) = [\lambda - \beta]L_{t+1} + \textit{constant}$. Since bond issuance must be zero whenever $L_{t+1} = 0$, i.e., $g_{i,t+1}(0, b_{i,t+1}) = 0$, the constant in $\hat{g}(L_{t+1}, b_{j,t+1})$ must be zero. This is equilibrium policy (21).

It is straightforward to verify that the optimal policy is indeed in the interior of the issuance set (i.e., $\hat{g}_{i,t} < \overline{g}_t$) if and only if (20) holds: $\hat{g}_{i,t} = \frac{\lambda - \beta}{n-1} L_t < \frac{1+\lambda}{n} L_t = \overline{g} \Leftrightarrow -n\beta < n - 1 - \lambda$. To see that the last condition is equivalent to (20) notice that $\lambda < \beta + [1+\beta][n-1]$ can be rewritten as $\lambda < n\beta + n - 1$.

The second optimality condition is the familiar Euler condition: along the optimal path, groups' consumption growth equals the ratio of the return on investment to the discount factor. In order to determine the equilibrium private rate of return on investment notice that, if every group follows equilibrium bond issuance policy (21), then each group perceives a private rate of return β on its two investment opportunities (the common-pool asset and the private access asset). Thus, along the interior equilibrium path the Euler condition is

$$\frac{\hat{c}_{i,t+1}}{\hat{c}_{i,t}} = \frac{1+\beta}{\delta}. \tag{25}$$

The third optimality condition is the transversality condition, which requires the marginal discounted value of both assets (L_t and $b_{i,t}$) to converge to zero.

$$\lim_{t\to\infty} \frac{\hat{L}_t}{\delta^t \hat{c}_{i,t}} = 0, \qquad \lim_{t\to\infty} \frac{\hat{b}_{i,t}}{\delta^t \hat{c}_{i,t}} = 0. \tag{26}$$

Integrating forward Euler condition (25) and using the transversality condition (26) yields equilibrium consumption policy (22).

Lastly, we derive the equilibrium path of the shadow state variable L_t, i.e., the available NCB credit to domestic banks. By substituting equilibrium appropriation policy (21) in the NCB's dynamic constraint (13) we get

$$\hat{L}_t = [1+\lambda]L_{t-1} - n\frac{\lambda-\beta}{n-1}L_{t-1} = \left[1 + \frac{n\beta-\lambda}{n-1}\right] L_{t-1}. \tag{27}$$

The condition on parameters for existence of equilibrium (20) ensures that L_t is positive in equilibrium. Along the equilibrium path L_t may be increasing if $\lambda \in (\beta, n\beta)$ or decreasing if $\lambda \in (n\beta, n\beta + n - 1)$. In either case, along the equilibrium path, L_t does not hit zero in finite time. That is, the interior equilibrium is consistent with a situation where a break-up of the Eurozone will never occur. We may refer to the first case as the optimistic-path and the second as the gloomy-path, in which groups know that the loans the will be able to get will asymptotically fall to zero. This latter scenario might be gloomy, but not catastrophic.

5 From the Equilibrium Path to the Stylized Facts

Here, we link the equilibrium path of our model economy to the stylized facts documented in Section 2.

NCB's Domestic Credit and Target2 Liabilities. In Section 2 we show that in the wake of the sudden-stop–when private capital inflows into the GIPS reversed–the credit of GIPS NCB's to domestic banks started to increase significantly. This increase has been associated with the growth of GIPS Target2 liabilities vis-a-vis the rest of the Eurosystem. In our model, these two variables are captured by the *actual* NCB's domestic credit (D_t^a) and by the Target2 net liabilities of the NCB ($Tg2_t$).

In our model, a 'sudden stop' occurs at time t if the state was good up to time $t-1$ and the state is bad at t. Because the bad state is absorbing, there is only one sudden stop. We will denote the sudden-stop date by τ.

When a sudden stop occurs, foreign investors do not buy new domestic bonds and do not roll-over their domestic bond holdings $\hat{F}_{\tau-1}$. Thus, at τ, domestic banks must repay foreign investors $[1+r]\,\hat{F}_{\tau-1}$. In addition, domestic banks must fund the new loans committed to groups $\sum_{i=1}^{n}\hat{g}_{i,\tau-1}$.

Since the stock of domestic banks' debt is the compounded sum of previous bond issuances, along the equilibrium path we have that

$$\begin{aligned}
\hat{F}_{\tau-1} &= \sum_{j=1}^{\tau-2}\delta^{\tau-2-j}\left(\sum\nolimits_{i=1}^{n}\hat{g}_{i,j}\right), \qquad \tau\geq 2 \qquad (28)\\
&= \frac{1-(\Upsilon/\delta)^{\tau-1}}{1-\Upsilon/\delta}\delta^{\tau-2}\Gamma L_0\\
1sarafr &= \frac{\delta^{\tau-1}-\Upsilon^{\tau-1}}{\delta-\Upsilon}\Gamma L_0, \quad \text{with } \Gamma\equiv\frac{n\left[\lambda-\beta\right]}{n-1}, \quad \Upsilon\equiv 1+\frac{n\beta-\lambda}{n-1}
\end{aligned}$$

In the equation above we have used $\hat{g}_{i,t}=\frac{\lambda-\beta}{n-1}\hat{L}_t$ and replaced the equilibrium value of the shadow available NCB credit to domestic banks $\hat{L}_t$.

When a sudden-stop occurs, the NCB comes to the rescue: it makes loans to domestic banks so they can repay the obligations to foreign investors and also make new loans to the groups. Thus, at τ the NCB's domestic credit jumps from zero to $\hat{D}^a_\tau=[1+r]\,\hat{F}_{\tau-1}+\sum_{i=1}^{n}\hat{g}_{i,\tau-1}$. Thereafter, it increases by $\hat{D}^a_{t+1}-\hat{D}^a_t=r\hat{D}^a_t+\sum_{i=1}^{n}\hat{g}_{i,t}$.[24]

In order to link the equilibrium path of NCB domestic credit to the path of Target2 net liabilities notice that the interior equilibrium is consistent with a situation in which the periphery country never breaks away from the Eurozone, and private agents do not expect a future increase in inflation above the Eurozone inflation (which is zero). Thus, $\Delta M_t=0$. It follows from the NCB's budget constraint that in equilibrium the change in Target2 liabilities equals the change in NCB domestic credit: $\Delta Tg2_{t+1}=\Delta D^a_{t+1}$. We can then state the following Corollary.

[24] Notice that the first term is the "evergreening component" of domestic credit.

Corollary 5.1 *Along the equilibrium path, Target2 liabilities and domestic credit extended by the NCB are constant during good times, jump during a sudden-stop, and are increasing in the bad times thereafter.*

- *For any sudden-stop time $\tau \geq 2$, Target2 liabilities evolve according to*

$$\widehat{Tg2}_t = \widehat{D}_t^a = \begin{cases} 0 & \text{if } t = 1, ..., \tau - 1 \\ \frac{\delta^{\tau-1} - \Upsilon^{\tau-1}}{\delta - \Upsilon} \Gamma L_0 + \Gamma \Upsilon^{t-1} L_0 & \text{if } t = \tau \\ \delta Tg2_{t-1} + \Gamma \Upsilon^{t-1} L_0 & \text{if } t \geq \tau + 1, \tau + 2, ... \end{cases} \tag{29}$$

  where

$$\Upsilon \equiv 1 + \frac{n\beta - \lambda}{n-1}, \quad \Gamma \equiv \frac{n\left[\lambda - \beta\right]}{n-1}. \tag{30}$$

  If $\tau = 1$, Target2 liabilities evolve according to $\widehat{Tg2}_t = \delta Tg2_{t-1} + \Gamma \Upsilon^{t-1} L_0$.

- *In the wake of a sudden-stop, Target2 liabilities are increasing. Their growth may vanish asymptotically if $\lambda \in (\beta, n\beta)$ or may increase if $\lambda \in (n\beta, n\beta + n - 1)$.*

To see why equilibrium Target2 liabilities and actual NCB domestic credit are necessarily increasing notice that an interior equilibrium exists only if $\lambda > \beta$ and $\lambda < n\beta + n - 1$. These conditions imply that Υ and Γ in (29) are positive. Their growth may vanish asymptotically because the shadow available NCB credit L_t is decreasing if $\lambda \in (n\beta, n\beta + n - 1)$.

As we showed in Section 2, Target2 net liabilities increased in tandem with NCB domestic credit. This is the pattern that Corollary 5.1 accounts for. In Greece, for instance, NCB domestic credit remained practically constant until the end of 2008, while private capital was flowing in. However, from the end of 2008 to the beginning of 2012, NCB domestic credit increased more than €100 billion, while cumulative private capital outflows have reached more that €100 billion. Moreover, the increase in Target2 liabilities has been around €100 billion over that period.

The Current Account and Private Assets Abroad. Section 2 showed that over the last decade, increasing unsustainable gross national debt in the GIPS has coexisted with increasing gross private assets abroad. In fact, over 2005-2017 the increase in GIPS total gross

external debt is nearly €1.5 Trillion greater than their cumulative current account deficits, while private assets abroad of GIPS residents has increased by nearly €1.5 Trillion.

The equilibrium of our model economy can help account for the simultaneous increase in gross national debt and gross private assets abroad. In equilibrium, powerful groups find it optimal to save abroad the difference between their new loans–de facto fiscal appropriations– and their consumption. This is true even if the return on their assets abroad β is lower than the interest rate on their loans r or even if β is negative. Therefore, it is an equilibrium outcome to have an 'unsustainable' increasing national gross external debt coexist with an increasing path of private assets abroad. Furthermore, because the current account deficit reflects groups' consumption and net interest income, having a cumulative current account deficit smaller than the increase in gross external debt is part of an internally consistent mechanism.

To determine the conditions under which these stylized facts occur in equilibrium let us derive the equilibrium path of the current account, private assets abroad and total national debt.

The current account–the excess of national income over spending–in our model economy equals the net interest payments to foreigners, minus rent-seeking groups' consumption, plus the difference between the private competitive sector's flow-endowment and its consumption. The net interest payments equal the difference between the return on gross private assets abroad minus the interest on gross national debt

$$CA_t = \beta \sum_{i=1}^{n} b_{i,t} - rD_{t-1} - \sum_{i=1}^{n} c_{i,t} + Y_t - c_t^p. \tag{31}$$

Recall that in good times, the gross debt of rent-seeking groups to domestic banks equals the stock of bonds issued by the latter, while in the wake of the sudden-stop they equal the Target2 liabilities of the NCB

$$D_{t-1} = \begin{cases} F_{t-1} & \text{if } t < \tau \\ Tg2_{t-1} & \text{if } t \geq \tau \end{cases}$$

In our simple economy, the path of $Y_t - c_t^p$ is independent of whether the state is good or bad. Thus, the response of the current account to a sudden-stop is determined by the consumption of groups.

In order to characterize the current account along the equilibrium path we need a closed-form representation of the groups' consumption policy and the path of their private assets abroad. The groups' consumption policy is given by (22). Replacing this consumption policy and bond issuance policy (21) in accumulation equation (2), we have that the safe private assets abroad of each group evolve according to

$$\begin{aligned} \hat{b}_{i,t} &= (1+\beta)\hat{b}_{i,t-1} + \hat{g}_{i,t} - \hat{c}_{i,t} \\ &= \left[\frac{1+\beta}{\delta}\right]^t [b_{i,0} + L_0] - \left[1 + \frac{n\beta - \lambda}{n-1}\right]^t L_0 \end{aligned} \tag{32}$$

The stock of private assets abroad might increase or decrease depending on the size of L_t relative to $b_{i,t}$ and on parameter values. To capture the fact that it is costly for groups to keep their assets abroad 'safe' we set $1+\beta \leq 1+r \equiv \delta$. This restriction implies that the first term in (32) is either constant or decreasing over time. Consider two cases depending on the sign of $\lambda - n\beta$. The case $\lambda > n\beta$ is empirically the relevant for the GIPS as the available NCB credit (L_t) shrinks over time, i.e., the size of the second term in (32) decreases over time and converges to zero. In this case, private assets abroad follow an increasing path if β is near to r. In the case $\lambda < n\beta$, the second term in (32) increases over time, and so private assets abroad become negative.

National debt D_t might take the form of domestic banks' debt to foreign investors in good times or Target2 liabilities of the NCB vis-a-vis other NCBs. However, regardless of the form it takes, it grows at a constant rate in equilibrium: (28) and (29) imply that national debt evolves according to

$$\hat{D}_t = \delta^{t-1} \sum_{j=0}^{t-1} \left(\delta^{-j} \sum_{i=1}^{n} \hat{g}_{ij} \right) = \delta^{t-1} \Gamma \left[\frac{1 - (\Upsilon/\delta)^t}{1 - \Upsilon/\delta} \right] L_0 \tag{33}$$

where Υ and Γ are defined in (30).

Figure KF1 exhibits the equilibrium paths of private assets abroad of domestic residents (32), total external debt (33), and the cumulative current account (31).[25] As we can see the paths of these variables conform to those we documented in Section 2: the increase in private assets abroad equals the gap between the increase in total debt and the cumulative current account.

[25] In this Figure we set $\lambda = 0.1$, β =0.01, r=0.01, n=3, and L_0=1000000.

Persistence of the Current Account Deficit. The GIPS's current accounts have remained persistently negative since the onset of the sudden stop, as shown in Figure 5. This pattern stands in contrast to the typical jump in the current account from deficit to surplus in the wake of a sudden-stop.

In the equilibrium of our model, the current account deficit does not disappear in the wake a sudden stop because none of its components is affected by the sudden stop. First, groups' consumption is unaffected because (i) it is financed out of their private assets abroad and (ii) the equilibrium rate of return perceived by each group is unaffected by the sudden-stop: it equals β both before and after the shift from the good to the bad state. Notice that even though the date of the sudden stop is uncertain, the equilibrium consumption policy (22) does not prescribe a jump at the time of the sudden stop. This is because the set of investment-opportunities of the groups is not affected by the sudden-stop: the strategies are functions of the shadow variable L_t, which in equilibrium does not jump at the time of the private capital inflow reversal. At time *0* groups know the loan amounts they will be able to get over the entire horizon, and they also know that loans may vanish asymptotically if $\lambda > n\beta$. It is immaterial to the groups whether those loans are financed by foreign investors–supported by a systemic bailout guarantee–or directly by the NCB.

Second, interest payments on national debt are the same with and without a sudden stop. Those interest payments are financed by borrowing from other NCBs rather than foreign investors. Third, interest income on private asset abroad is unaffected. Lastly, in our model the private competitive sector's current account remains unchanged because it is de-linked from the interest-group's sector, by construction. This feature of the model can be modified if one would like to generate a faster improvement in the current account.

6 The Target2 Mechanism as a Systematic Bailout Guarantee

The spread between GIPS and German bond yields contracted to almost zero after the introduction of the Euro. After the 2008 crisis, these spreads jumped to levels not observed

since the early 1990s. In the equilibrium of our model, such spread contraction reflects the likelihood of a bailout guarantee rather than fundamentals. In our setup, the Target2 mechanism is an essential part of the bailout guarantee. Ex-ante, Target2 ensures investors that if a sudden-stop were to occur, the NCB would have the ability to increase credit to domestic financial institutions without facing the constraint imposed by the availability of international reserves. Ex-post, Target2 allows for the bailout orchestrated by the NCB to take place without generating a speculative attack on its international reserves, as is typical of emerging markets' crises.

Typically, when there is a sudden-stop, i.e., a private capital flow reversal, and the NCB responds by jacking up credit to domestic financial institutions to avoid a meltdown, it experiences a drain on its international reserves. Often such policy ends with a speculative attack on the NCB's reserves and a Balance of Payments crisis. The Target2 mechanism eliminates such constraint on domestic credit creation. It allows the NCB to lend funds to domestic banks without risking a loss in international reserves. This is because as agents send the newly created liquidity to other Eurozone countries via Target2, there is an increase in the Target2 liabilities of the NCB rather than a run-down of its international reserves.

Because, in principle, Target2 liabilities are open-ended, the NCB can offer a open-ended NCB backstop to banks. In the absence of such an open-ended NCB backstop, banks would be forced to liquidate their assets at fire-sale prices. The resulting large capital losses might bankrupt many banks. In contrast, if instead of attempting to sell their assets in the market at fire-sale prices, banks use them as collateral to borrow from the NCB, banks do not have to recognize any capital losses at present and so a meltdown does not occur.[26]

Because domestic assets are transferred to the NCB's balance sheet rather than sold in the market, investors are able to sell their domestic assets without incurring major capital losses. This is point (i) above. Because domestic banks do not go bust, as they can borrow from the NCB, they can roll-over domestic loans and even extend new credit. This transfer avoids a collapse in aggregate spending, which in turn prevents the abrupt elimination of the current account deficit typically observed in a sudden-stop.

In order to link the increase in GIPS Target2 liabilities to the funding of domestic ex-

[26] See Schneider and Tornell (2004) for a formal treatment of this feedback-loop mechanism.

penditure and the bailout of investors, consider the back-of-the-envelope calculation in the table below. We approximate the former with the cumulative current account deficit (i.e., the excess of spending over national income), and the latter with the reduction in the claims of French and German banks on the GIPS. As we can see, between 2009:I and 2012:I, the Target2 liabilities of the GIPS increased approximately €680bn. Meanwhile, over this period the GIPS's current account deficit is around €370bn and the net outflows of French and German banks is around €370bn. Notice that the repatriation of capital by GIPS residents is tiny during this period (around €5bn).

Taget2 and the Bailout (2009-2012)

$\underbrace{\uparrow \text{Target2 GIPS liabilities}}$	$\rightarrow$	$\underbrace{\downarrow \text{French \& German banks' claims on GIPS}}$
€680bn		€280bn
		$\underbrace{\text{Cumulative Current Account deficit of GIPS}}$
		€370bn
		$\underbrace{\downarrow \text{Gross GIPS residents' private assets abroad}}$
		€5bn

The preceding calculations indicate that the sharp increase in the GIPS's Target2 liabilities is not simply directed to finance the excess of spending over income in the GIPS. A big share can be adjudicated to German and French Banks. This fact would suggest that some groups in northern Europe are benefiting from the abrupt increase in Target2 liabilities. A political-economy analysis would therefore suggest that there should not be a unanimous opposition to Target2 in countries with high Target2 claims on the Eurosystem, like Germany. Interestingly, in her speech after wining her party's nomination for a third term, Mrs. Merkel said "We have brought Germany through the crisis stronger than the country was when it began." Referring to the same event, Joachim Poss, a senior lawmaker of the opposition party SPD, said "With her speech at the Party convention, Frau Merkel has shown once again that she is the guardian angel of the high earners and the wealthy."[27]

Importantly, notice that even if one observes low Target2 balances in a particular country,

[27] Quoted in the Wall Street Journal, December 5, 2012 "Merkel Launches Bid for Third Term."

one should not conclude that the Target2 mechanism plays no role. To the contrary, it plays an essential role because it acts as a systematic bailout guarantee. First, it helped fuel the lending boom: the possibility that Target2 liabilities could jump supports the demand of foreign investors for domestic bonds and also the near-zero interest rate spreads between GIPS's bonds and German Bunds prior to 2008. Second, in the wake of the sudden stop the Target2 mechanism has also played an essential stabilizing role: its presence ensures investors and depositors that they will be able to transfer funds to other Eurozone countries at an exchange rate of one. Without it banks would risk a run on deposits and the NCB would risk a speculative attack.

7 Voracity Effect in the Eurozone

Here, we use the equilibrium of our model to asses the effect of ECB policy changes on the bond issuance of powerful groups and NCB credit expansion. As we described in Section 2, the ECB can indirectly relax the constraints on periphery NCBs that face a capital flow reversal and a large increases in yields in several ways: (i) By relaxing the criteria for acceptable collateral, and in this way allow an NCB to grant more credit to banks. Banks in turn can use this extra credit to buy domestic bonds and in this way reduce the yield on domestic bonds; (ii) the SMP program that authorizes the purchase of bonds in the secondary market; (iii) the outright monetary transactions program (OMT) that aims at imposing a ceiling on interest rates by committing to an open-ended policy of purchasing unlimited amounts of bonds; (iv) ELAs can be used when there is no more eligible collateral; and (5) the quantitative easing program started in 2015.

The equilibrium of our model can help rationalize a situation in which an announcement of greater ECB generosity to give governments a window of opportunity to adjust and reform, might instead induce more fiscal appropriation. That is, more borrowing by the rent-seeking groups in our model economy. Our model shows that, to the extent that there is divided fiscal control within countries, a tragedy-of-the-commons equilibrium arises within each country. In such equilibria, policies that would be helpful in a unitary framework (where the country's central authorities internalize the consequences of their actions) generate the

opposite response in a divided control setup. This is because each group–individually–has no incentive to reduce bond issuance–equivalently, its fiscal appropriation. If group i were to do so, then other groups might appropriate what group i did not appropriate. So why bother! Furthermore, the properties of the equilibrium characterized in Proposition 4.1 imply that groups will respond with more appropriation following the announcement of a more generous ECB stance. The implicit assumption here is that heads of government do not have total control over quasi-fiscal appropriations, but simply preside over democracies influenced by powerful groups.

In terms of our model, an increase in the ECB's generosity (or its willingness to intervene in the future in case of a liquidity squeeze) can be represented by an increase in the growth rate of available NCB credit (λ). Algebraically, to see the effects on equilibrium fiscal appropriation let's consider an unexpected permanent increase in λ, which is announced at time $t = 0$. This increase in λ leads to an increase in a groups' fiscal appropriation, but does not affect the groups' consumption

$$\frac{\partial \hat{g}_{i,t}}{\partial \lambda} = \frac{1}{n-1} L_t > 0, \qquad \frac{\partial \hat{c}_{i,t}}{\partial \lambda} = 0.$$

Thus,

Proposition 7.1 (Ineffectiveness of Greater ECB Generosity) *Along an interior equilibrium, an ECB shift into a more generous policy stance towards the periphery is completely squandered:*

- *An increase in the availability of credit that an NCB can extend to financial institutions (higher λ) results in higher bond issuance and higher capital outflows from the periphery.*
- *Neither groups' consumption nor welfare increase.*

That is, the ECB's more generous stance is reflected in a more inefficient political economy environment in the periphery. The equilibrium strategies call for groups to be more fiscally voracious. So much so that the groups' consumption opportunities do not increase! As a result, groups' consumption remains unchanged and the entire increase in ECB generosity is simply reflected in more private assets abroad (i.e., capital outflows).

To see the intuition for why the change in λ does not affect the groups' consumption, rewrite equilibrium consumption (22) as follows

$$\hat{c}_{i,t} = [1+\beta]\left[1-\frac{1}{\delta}\right][L_t + b_{i,t}] = \left[\frac{1+\beta}{\delta}\right]^t [L_0 + b_{i,0}] \tag{34}$$

A group's consumption increases only if higher λ leads to an increase in the total assets to which the group has access: $L_t + b_{i,t}$. Even though the direct effect of higher λ is to increase the growth rate of L_t (because $L_{t+1} = (1+\lambda)L_t - \sum_{i=1}^{n} g_{i,t}$), higher λ also leads to a more than proportional increase in bond issuance $\sum_{i=1}^{n} \Delta g_{i,t}$. The net result is a fall in the growth rate of NCB available credit from the ECB. Algebraically, since $\hat{L}_{t+1} = \left[1 + \frac{n\beta - \lambda}{n-1}\right]\hat{L}_t$, the growth rate of $\hat{L}_t$ is decreasing in λ

$$\frac{\partial\left(\hat{L}_{t+1}/\hat{L}_t\right)}{\partial\lambda} = -\frac{1}{n-1} < 0.$$

Even though each group increases its appropriation rate–and so it accumulates more private assets abroad ($b_{i,t}$ increases)–in equilibrium its wealth fails to increase because of the fall in the growth rate of L_t. It follows from (32) that the future path of group's total assets is unaffected by λ

$$\hat{b}_{i,t} + \hat{L}_t = [b_{i,0} + L_0]\left[\frac{1+\beta}{\delta}\right]^t$$

Therefore, higher λ does not improve the groups' consumption possibilities.

To confirm that all the direct benefits of greater ECB generosity are dissipated and that groups' welfare does not improve, substitute consumption policy (34) in utility function (3). As we can see, the group i's value function is independent of λ.

$$V_i(0) = \frac{\delta}{\delta - 1}\left[\log(L_0 + b_{i,0}) + \frac{1}{\delta - 1}\log\left(\frac{1+\beta}{\delta}\right)\right]$$

The result that the greater ECB generosity is completely dissipated by greater bond issuance–essentially fiscal voracity–captures the lay person's view that more bailouts to a country do not necessarily help the majority of its citizens.

We would like to note that the analysis we have done in this section is about adjustment, not about structural reform. That is, throughout this paper rent-seeking groups keep their power to extract resources from the economy via loans that enjoy bailout guarantees. Furthermore, along the equilibrium path there is no breakup from the currency union.

8 Conclusions

We have argued that in and of itself, the implicit risk-sharing mechanism at work in the Eurozone is welfare improving. However, as a by-product, common-pool problems have developed, which may have lead to capital flight.

The model we have presented should be considered only as a building block in a more elaborate political-economy analysis of the Eurozone. In particular, the model is designed to account for phenomena such as the simultaneous accumulation of gross private assets abroad and unsustainable gross national debt. While the model can be used to analyze the effects of Eurozone policy on *adjustment*, it is silent on the issue of structural reform.[28] Furthermore, the model leaves out several aspects of the Eurozone crisis such as nominal rigidities. Finally, our setup is consistent with the view that austerity measures undertaken by the GIPS have struck disproportionately at the poor.

[28] I consider the issue of reform in Ranciere and Tornell (2018).

References

[1] Benhabib, J. and R. Radner, 1992, "Joint Exploitation of a Productive Asset: A Game Theoretic Approach," *Economic Theory.*

[2] Calvo, G., 1987, "Balance of Payments Crises in a Cash-in-advance Economy," *Journal of Money, Credit and Banking.*

[3] Garber, Peter, 1998, "Notes on the Role of Target in a Stage II Crisis", NBER Working Paper, 6619.

[4] Krugman, P., 1979, "A Model of Balance of Payments Crises," *Journal of Money, Credit and Banking.*

[5] Obstfeld, M., 1984, "Balance of Payments Crises and Devaluation," *Journal of Money, Credit and Banking.*

[6] Ranciere, R. and A. Tornell, 2018, "Reform From Within," mimeo.

[7] Sachs, J., A. Tornell and A. Velasco, 1996, "The Collapse of the Mexican Peso: What Have we Learned?" *Economic Policy*: 13-63.

[8] Sinn, H.W. and T. Wollmershäuser, 2011, "Target Loans, Current Account Balances and Capital Flows. The ECB's Rescue Facility", CESifo Working Paper 3500.

[9] Steinkamp, S., A. Tornell and F. Westermann, 2017, "The Euro Area's Common Pool Problem Revisited: Has the Single Supervisory Mechanism Ameliorated Forbearance and Evergreening?" mimeo.

[10] Tornell, A. and P. Lane, 2000, "The Voracity Effect," *American Economic Review.*

[11] Tornell, A. and A. Velasco, 1992, "The Tragedy of the Commons and Economic Growth: Why Does Capital Flow from Poor to Rich Countries?," *Journal of Political Economy*, vol. 100(6), pages 1208-31.

[12] Tornell, A. and A. Velasco, 2000, "Fixed versus. Flexible Exchange Rates: Which Provides More Fiscal Dsiscipline?" *Journal of Monetary Economics.*

[13] Tornell, A. and F. Westermann, 2011, Eurozone Crisis, Act II: Has the Bundesbank Reached its Limit?" *VOXeu.org*

[14] Tornell, A. and F. Westermann, 2012a, "The Tragedy-of-the-Commons at the European Central Bank and the Next Rescue Operation," *VOXeu.org*

[15] Tornell, A. and F. Westermann, 2012b, "Europe Needs a Federal Reserve, *The New York Times*, June 20.

Appendix. Data sources and Definitions

Target2 balances. Source is European Central Bank.

Domestic Credit. Sources are the National Central Banks balance sheets.

Current account, Financial account, and Capital account. The source is the Balance of Payments Statistics from the IMF.

Official Rescue Financial Flows. We obtain it from the IMF Balance of Payments Statistics by adding:
(+) Supplementary Items, Other Investment: (+) Other Debt Instruments: Net Incurrence of Liabilities, General Government (with Fund Record). Source: BFOLOGFR_BP6_USD IMF BOP.
(+) Supplementary Items, Other Investment: Other Debt Instruments: Net Incurrence of Liabilities, Central Bank (with Fund Record). Source: BFOLOCBFR_BP6_USD IMF BOP.

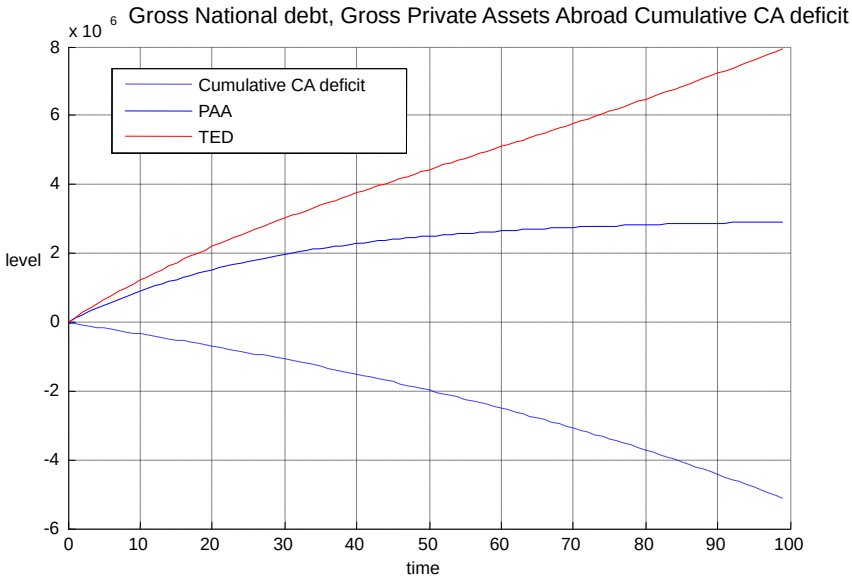
Private Financial & Other Flows. We define it as Financial Account – Official Capital Flows.

Private Assets Abroad. We obtain it from the IMF Balance of Payments statistics by adding: (+) Financial Account, Net Lending (+) / Net Borrowing (-) (Balance from Financial Account), Direct Investment, Net Acquisition of Financial Assets, Equity and Investment Fund Shares. Source: BFDAE_BP6_USD IMF BOP.

(+) Financial Account, Net Lending (+) / Net Borrowing (-) (Balance from Financial Account), Direct Investment, Net Acquisition of Financial Assets, Debt Instruments, Direct Investor in Direct Investment Enterprises. Source: BFDADD_BP6_USD IMF BOP.
(+) Financial Account, Portfolio Investment, Net Acquisition of Financial Assets, Equity and Investment Fund Shares. Source: BFPAE_BP6_USD IMF BOP.
(+) Financial Account, Portfolio Investment, Net Acquisition of Financial Assets, Debt Securities, Deposit-taking Corporations Except Central Bank. Source: BFPADC_BP6_USD IMF BOP.
(+) Financial Account, Portfolio Investment, Net Acquisition of Financial Assets, Debt Securities, Other Sectors. Source: BFPADO_BP6_USD IMF BOP.
(+) Financial Account, Other Investment, Other Equity, Net Acquisition of Financial Assets, Debt Instruments, Deposit-taking corporations except the Central Bank. Source: BFOADDC_BP6_USD IMF BOP.
(+) Financial Account, Other Investment, Other Equity, Net Acquisition of Financial Assets, Debt Instruments, Other Sectors. Source: BFOADO_BP6_USD IMF BOP.

Total External Debt. We obtain it from the IMF Balance of Payments statistics by adding:
(+) Financial Account, Net Lending (+) / Net Borrowing (-) (Balance from Financial Account), Direct Investment, Net Incurrence of Liabilities, Debt Instruments. Source: BFDLD_BP6_USD IMF BOP.
(+) Supplementary Items, Other Investment: Other Debt Instruments: Net Incurrence of Liabilities (with Fund Record). Souce: BFOLOFR_BP6_USD IMF BOP.
(+) Financial Account, Portfolio Investment, Net Incurrence of Liabilities, Debt Securities. Source: BFPLD_BP6_USD IMF BOP.

Claims of Foreign Banks. We add the external loans and deposits of reporting banks vis-à-vis individual countries. The source is the BIS.



λ = 0.1, r=0.01, β = 0.01, n= 3, L(0) = 1000000

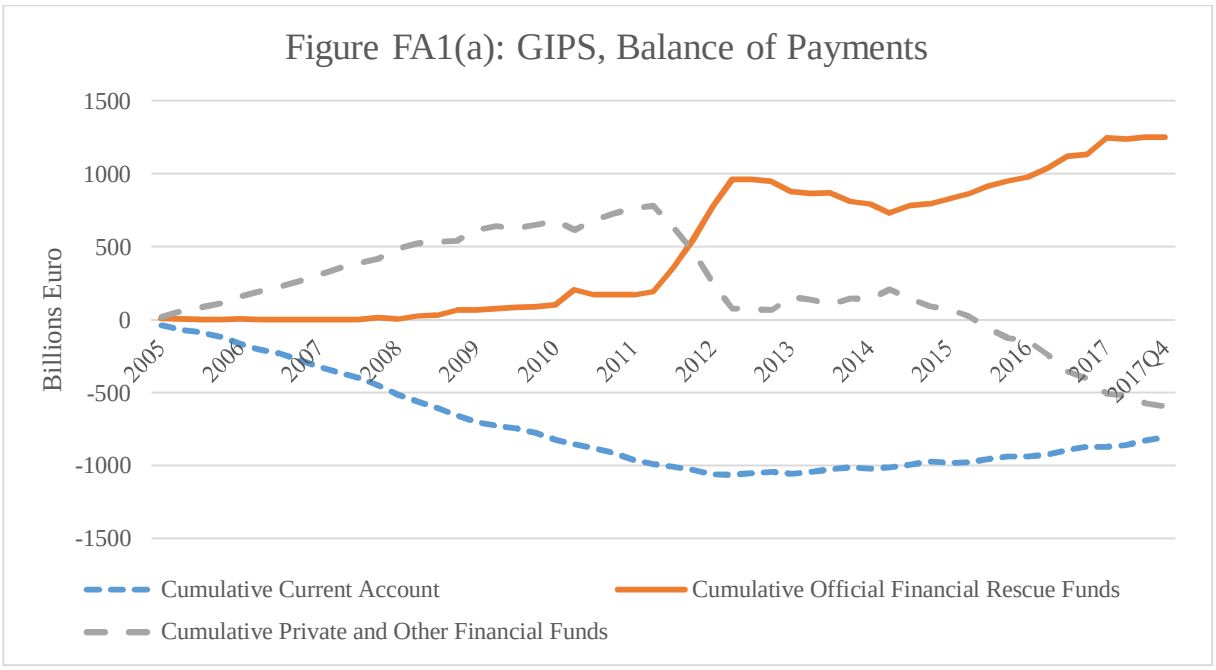


Figure FA1(a): GIPS, Balance of Payments
Billions Euro
1500
1000
500
0
-500
-1000
-1500
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2017Q4
Cumulative Current Account
Cumulative Official Financial Rescue Funds
Cumulative Private and Other Financial Funds

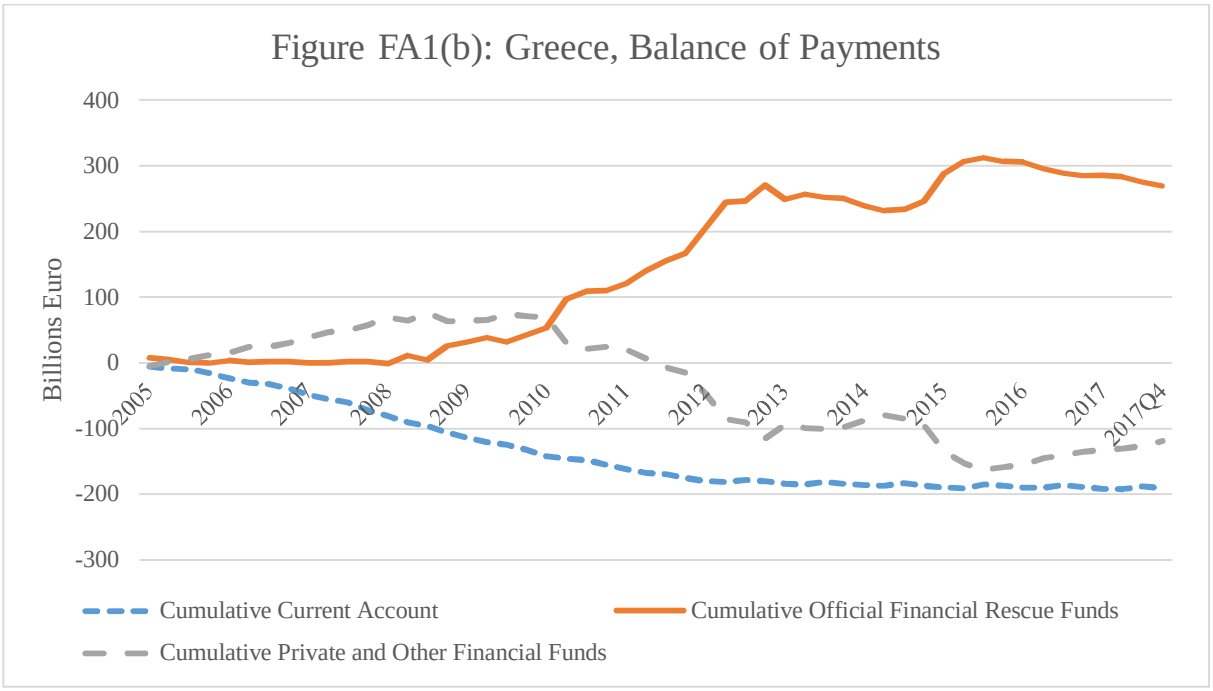


Figure FA1(b): Greece, Balance of Payments
Billions Euro
400
300
200
100
0
-100
-200
-300
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2017Q4
Cumulative Current Account
Cumulative Official Financial Rescue Funds
Cumulative Private and Other Financial Funds

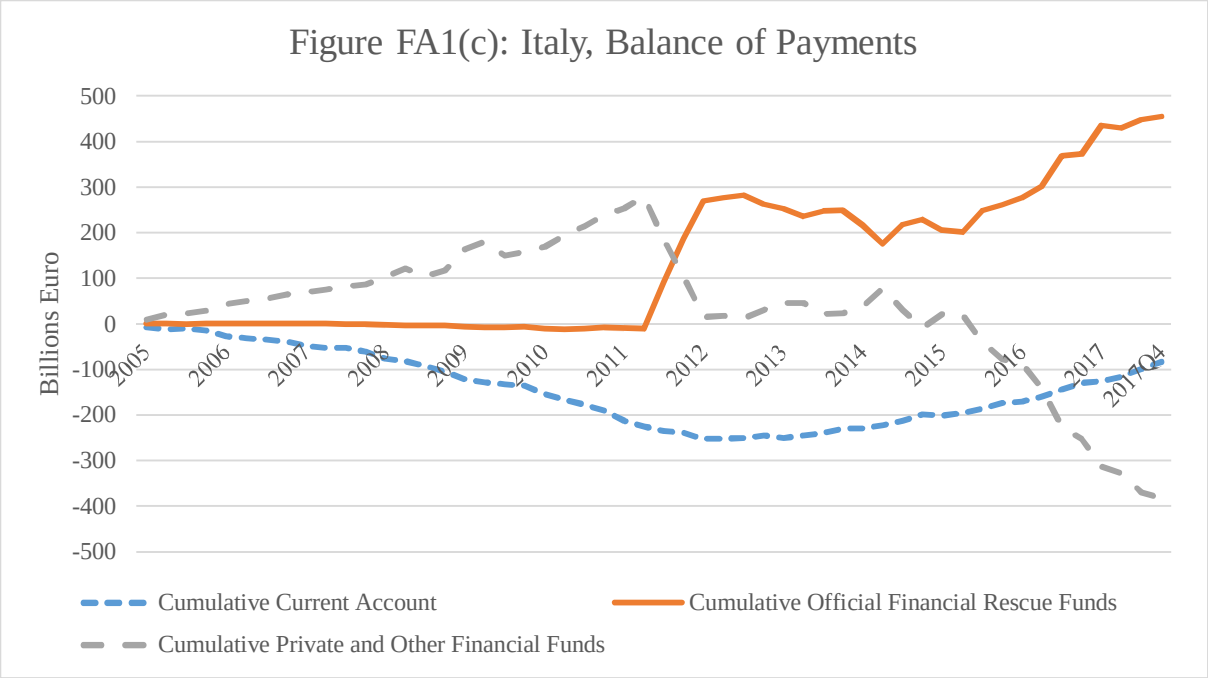


Figure FA1(c): Italy, Balance of Payments
Billions Euro
500
400
300
200
100
0
-100
-200
-300
-400
-500
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2017Q4
Cumulative Current Account
Cumulative Official Financial Rescue Funds
Cumulative Private and Other Financial Funds

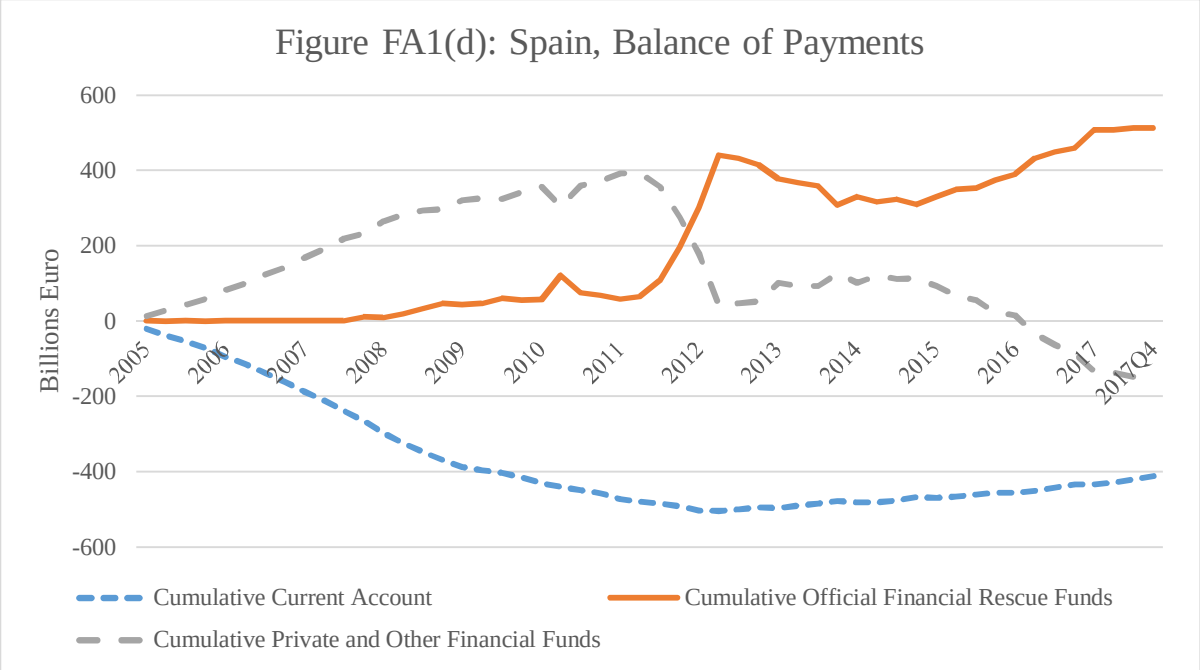


Figure FA1(d): Spain, Balance of Payments
Billions Euro
600
400
200
0
-200
-400
-600
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2017Q4
Cumulative Current Account
Cumulative Official Financial Rescue Funds
Cumulative Private and Other Financial Funds

Fig CA1(a). Current Account Response to Sudden-Stops

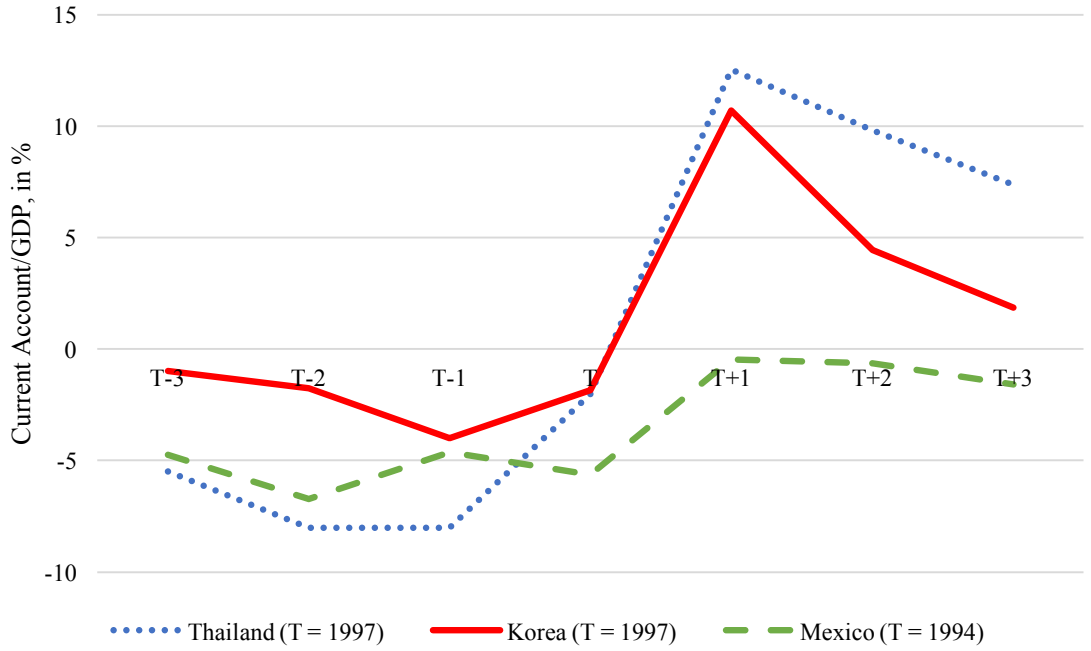
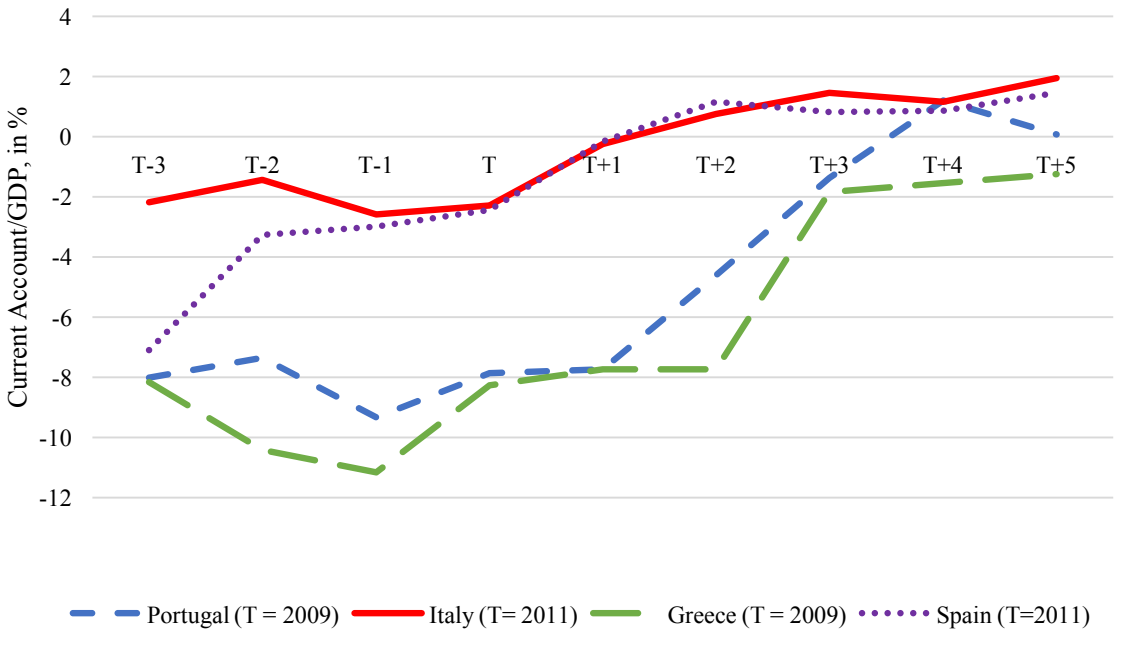


Fig CA1(b). Current Account Response to Sudden-Stops



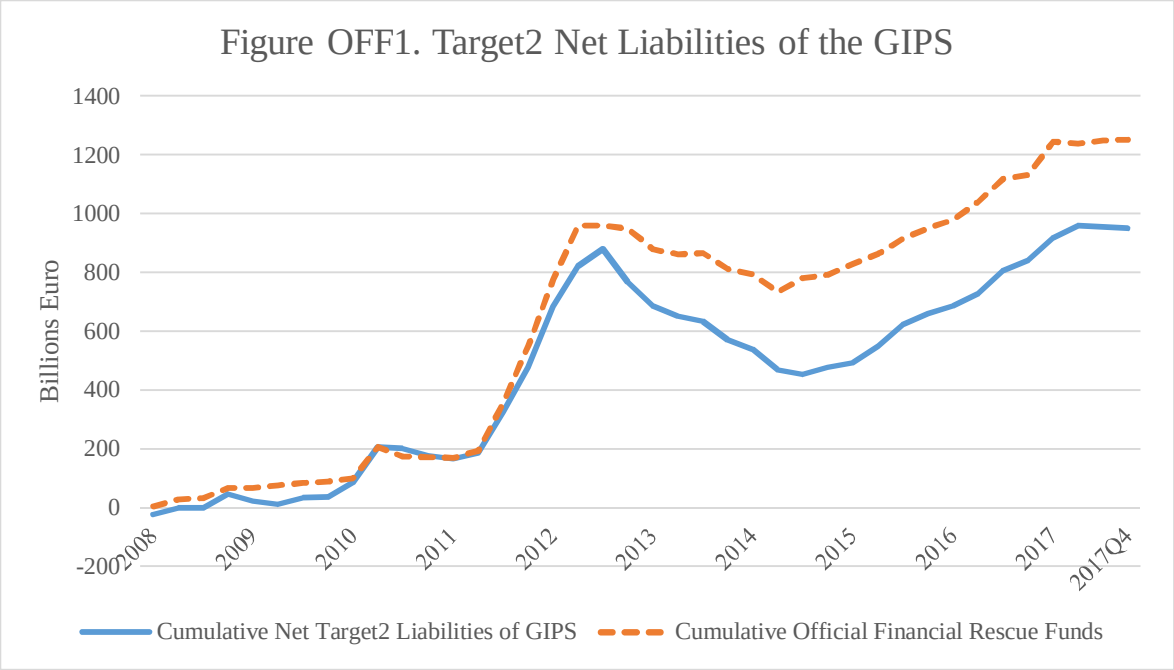


Figure OFF1. Target2 Net Liabilities of the GIPS
1400
1200
1000
800
600
400
200
0
-200
Billions Euro
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2017Q4
Cumulative Net Target2 Liabilities of GIPS
Cumulative Official Financial Rescue Funds

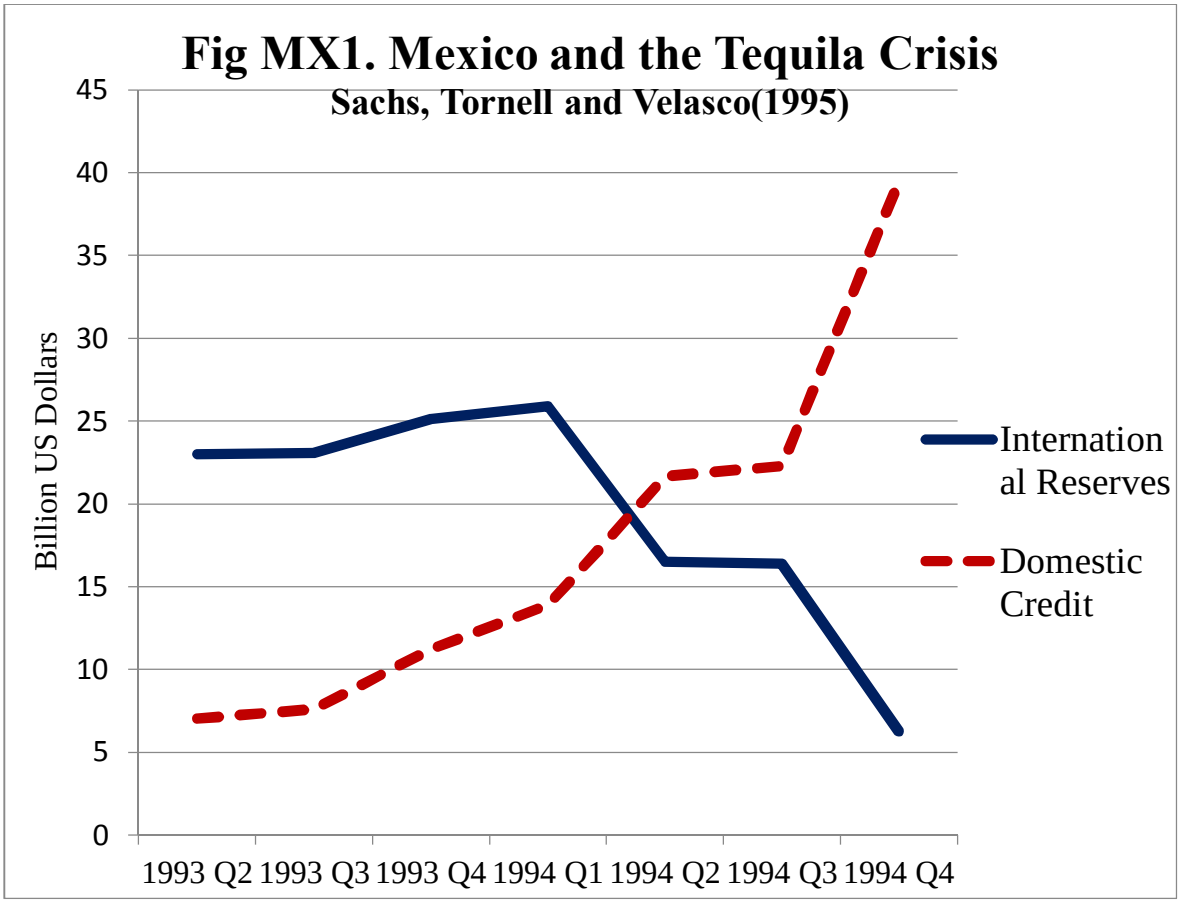


Fig MX1. Mexico and the Tequila Crisis
Sachs, Tornell and Velasco(1995)
45
40
35
30
25
20
15
10
5
0
Billion US Dollars
1993 Q2
1993 Q3
1993 Q4
1994 Q1
1994 Q2
1994 Q3
1994 Q4
International Reserves
Domestic Credit

Figure TG1(a). Target2 Net Liabilities and NCB Domestic Credit, GIPS

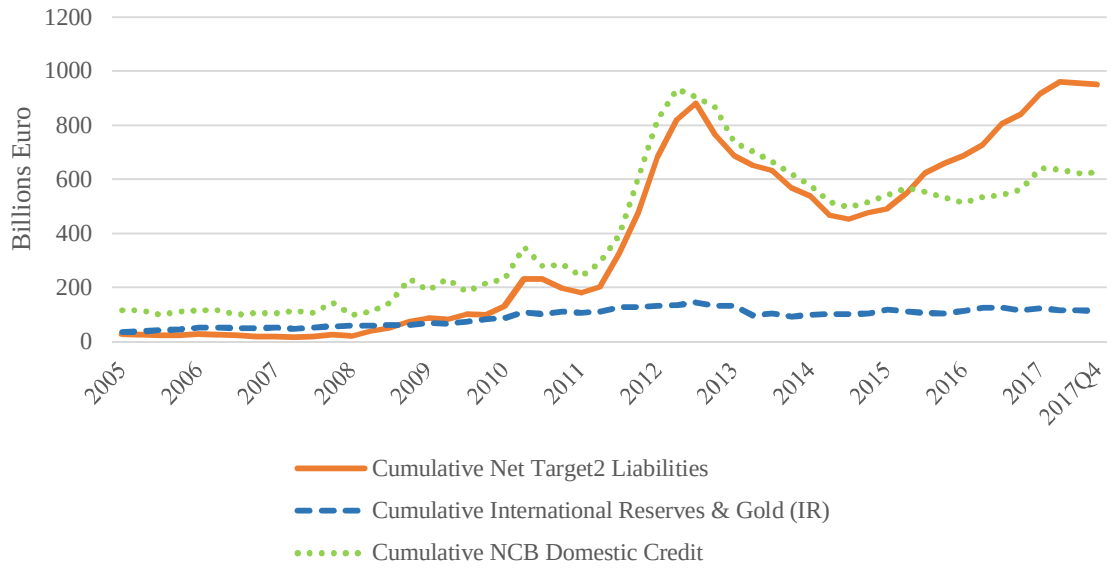
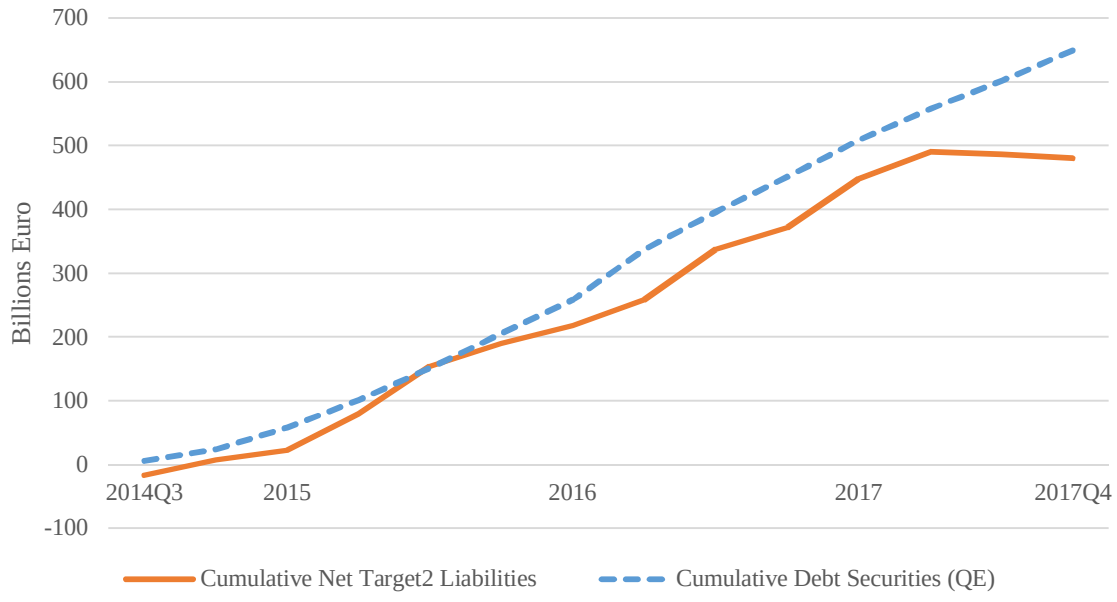


Figure TG1(b). Target2 Net Liabilities and QE, GIPS



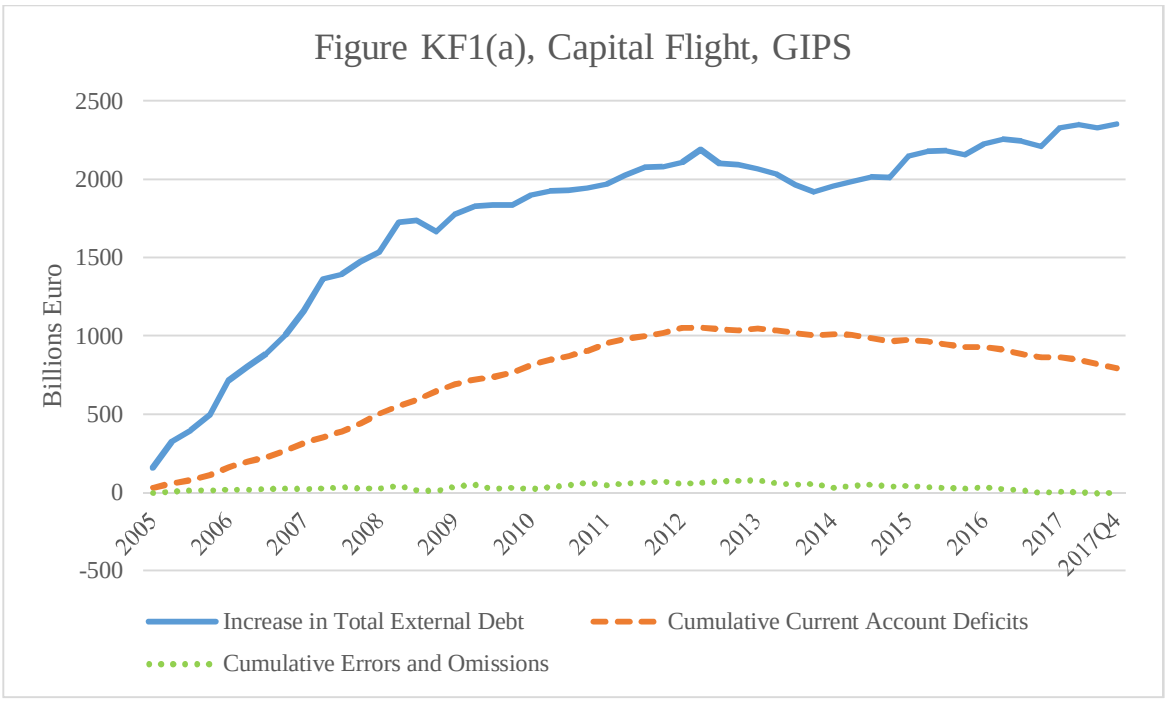


Figure KF1(a), Capital Flight, GIPS
Billions Euro
2500
2000
1500
1000
500
0
-500
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2017Q4
Increase in Total External Debt
Cumulative Current Account Deficits
Cumulative Errors and Omissions

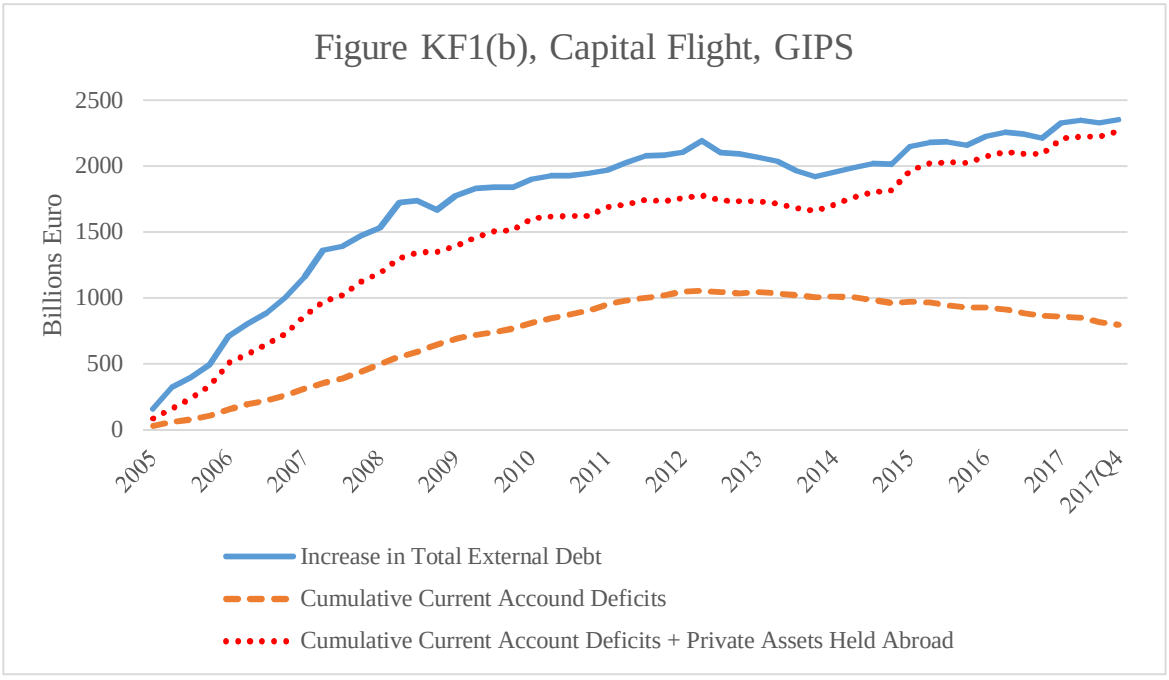


Figure KF1(b), Capital Flight, GIPS
Billions Euro
2500
2000
1500
1000
500
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2017Q4
Increase in Total External Debt
Cumulative Current Accound Deficits
Cumulative Current Account Deficits + Private Assets Held Abroad

Figure FGNL1.

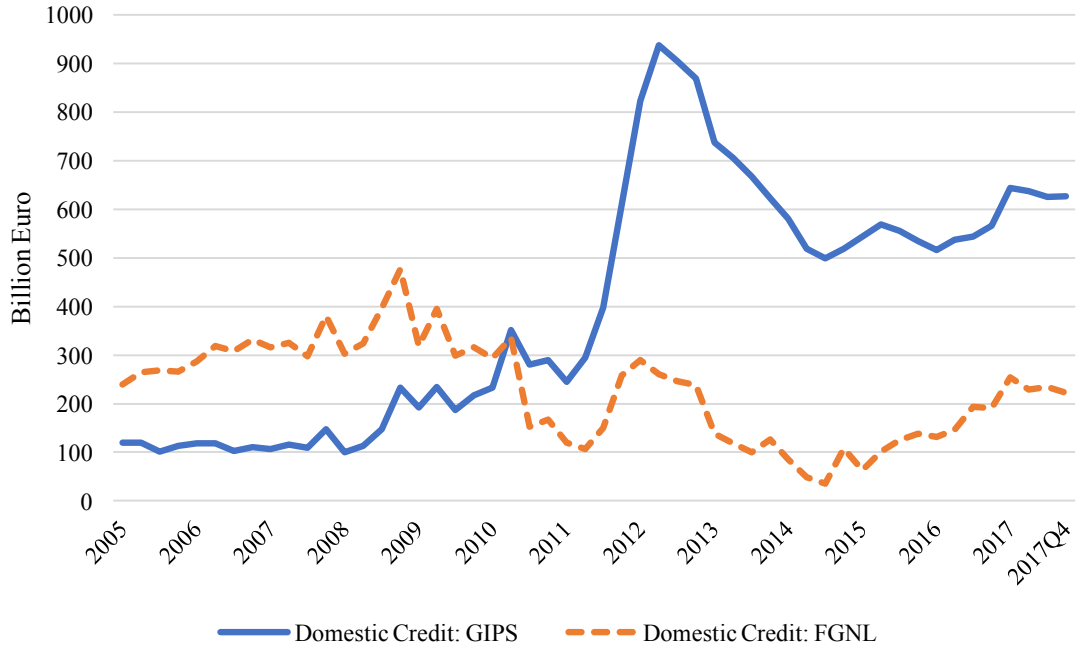


Figure FGNL 2.