The Greek Economic Crisis and the Banks

by

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Abstract

In this paper we review the Greek economic crisis focusing on the banking system. Bank-sovereign linkages were strong during the crisis: banks' liquidity problems before the sovereign crisis spilled over to the real economy, and more importantly the sovereign's default rendered all Greek banks insolvent because of their positions in government bonds. The Greek banking system was put back on its feet through a series of recapitalizations, following which industry concentration became the highest in Europe. Banks were slow to reduce non-performing loans (NPLs), which peaked at 48.9% of gross loans, because of their limited capital buffers. Government guarantees for securitizations were finally the key for NPLs to decline close to European averages. Banks' capital buffers have improved through internal profitability but remain below European averages. Lending to the real economy is low but recovering, and banks' exposure to the sovereign is again increasing.

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1. Introduction

The economic crisis that Greece experienced from 2008 onward was one of the deepest and most protracted globally in the past half-century. Real GDP per capita declined from €22,500 in 2007 to €16,830 in 2014, a cumulative drop of 25.2%. During that period, the unemployment rate rose from 8.4% to 26.5%.[2] Recovery has been sluggish as well: real GDP per capita was essentially flat from 2014 to 2016, and grew cumulatively by only 5.2% over the next three years.

The economic crisis was accompanied by a sovereign crisis and a banking crisis. Greece restructured its public debt in 2012, lowering the debt's face value from €205.6bn to €98.5bn, a drop of 52.1% in relative terms.[3] Greece's sovereign default was the largest in world history, and so was the bailout package that Greece received by other Eurozone (EZ) countries and the International Monetary Fund (IMF). Greece's default rendered all Greek banks insolvent. The four largest banks were recapitalized, and the remaining ones were either resolved or recapitalized, and then transferred to the four large banks. That process was completed in July 2013, with €38.9bn of public funds and €3.1bn of private funds, and was followed by additional smaller recapitalizations. The recapitalizations did not prevent non-performing loans (NPLs) from reaching astronomical levels and remaining there for many years. NPLs reached 39.5% of all loans at the end of 2013, kept rising until 2016 and remained above 40% of all loans until the end of 2019.

In this paper we provide an in-depth account of the banking side of the Greek crisis.[4] We describe the accumulation of debt during the credit boom that preceded the crisis, and the bank-sovereign loop in the credit bust that ensued. We also explain why NPLs on banks' balance sheets remained so high for so long, and which policies were key to reducing them. We argue that the Greek crisis is an informative case study for important issues going beyond Greece, such as the bank-sovereign loop and deficiencies in the EZ architecture, the

[2] The data on real GDP come from Eurostat and the data on unemployment from the World Bank.
[3] See Zettelmeyer, Trebesch and Gulati (2013).
[4] Banks dominate financial intermediation in Greece. Insurance companies, investment funds and capital markets play a smaller role. For an overview of the Greek financial system and the outcomes that it generates, see Haliassos, Hardouvelis, Tsoutsoura and Vayanos (2017). See also Meghir, Pissarides, Vayanos and Vettas (2020) and Hardouvelis and Magginas (2022) for reform proposals covering all parts of the Greek financial system.

perils of government influence in bank lending decisions, and the trade-offs involved in recapitalizing a weak banking system when fiscal resources are severely limited.

Section 2 examines the period from the mid-1990s until 2007, when the global financial crisis started. During that period the Greek economy was growing fast partly because of sound economic policies, and partly because EZ entry and the anticipation of that outcome lowered interest rates. Financial liberalization and low interest rates triggered a boom in private credit. The boom was especially pronounced in consumer credit and was associated with a decline in private savings and an increase in external debt.

Section 3 examines the period from 2007 until July 2013, which is when the first and largest recapitalization of Greek banks was completed. That period can be divided into two phases. During the first phase, which lasted until September 2009, the global financial crisis affected banks worldwide. Greek banks were significantly affected, primarily through a liquidity channel. Their liquidity problems spilled over into the real economy and stretched the sovereign's finances, which were already quite stretched. During the second phase, the worst of the global financial crisis was over, but the EZ sovereign crisis began. Greece lost market access in May 2010 and embarked in drastic fiscal consolidation as part of its bailout program. Its default in 2012 rendered all Greek banks insolvent because they were holding large positions in Greek government bonds, partly as the result of government pressure. The destructive effects of the bank-sovereign loop continued over the subsequent years.

Section 4 examines the three main recapitalizations of Greek banks: the first and largest recapitalization, which was completed in July 2013; a second recapitalization, which took place in April and May 2014 with only private funds; and a third recapitalization, which took place in November 2015 with public and private funds, after a bank run and the imposition of capital controls earlier in that year. The first and second recapitalizations were successful in transforming a banking system in which all banks were insolvent into one where banks were solvent and partly owned by private investors. Yet, banks remained fragile, with limited capital buffers. Moreover, and perhaps partly to render banks more profitable and robust, the recapitalization-and-resolution program was designed to render the industry heavily concentrated: only four main banks were left in operation, and industry concentration became the highest in Europe.

Section 5 examines the evolution of bank capital and credit since the third recapitalization. During the recapitalization-and-resolution program, a centralized "bad bank," which could have gathered NPLs from all other banks, was not created. Instead, the four main banks formed their in-house workout units, which were effectively internal bad banks. The banks were slow to reduce NPLs, mainly because of their limited capital buffers. Inefficient bankruptcy laws, which prevented the speedy resolution of NPLs and encouraged strategic default and a non-payment culture, exacerbated the problem. NPLs peaked at 48.9% of gross loans in March 2016. They started declining in earnest only in 2020, when the Greek government put in place a guarantee program to support banks' securitization of NPLs packages. As of December 2021, NPLs are in the single digits in two of the four banks. Banks' capital buffers are significantly improved, partly through internal profitability. Lending to the real economy is low, although it picked up speed during the pandemic, partly due to the loan guarantees by the state. The banks' exposure to the sovereign is again increasing.

Section 6 draws lessons that were learned from the Greek crisis. The crisis illustrates the destructive effects of the bank-sovereign loop and the perils of banks holding large portfolios of domestic government bonds. It also reveals broader deficiencies in the EZ's architecture that caused the loop to be so severe, and suggests policies to address them. The crisis illustrates additionally the trade-offs involved in recapitalizing a weak banking system when fiscal resources are severely limited. It shows, in particular, that government guarantees in NPL securitizations can be an effective way to clean up banks' balance sheets.

2. Financial Liberalization and the Credit Boom

Greece embarked in a significant program of financial liberalization starting in the late 1980s. Until that time, the state and the central bank (Bank of Greece -- BoG) had significant influence over the allocation of credit across and within sectors or the economy. The state could influence the allocation of credit towards specific firms by influencing the banks,

almost all of which were state-controlled. State control of the banks resulted in a significant misallocation of credit, as evidenced by the large fraction of NPLs.[5]

Financial liberalization followed similar steps to those undertaken earlier by other European Union (EU) countries. Restrictions on lending rates and deposit rates were removed during the period 1987-1993. Foreign-exchange controls were lifted in 1994. The independence of the BoG from the state was strengthened in 1997. Some state-controlled banks were privatized during the 1990s and the privately-controlled banking sector grew, partly because of entry by new players. State-controlled banks accounted for about 60% of deposits in 1998, down from 79% in 1993 and 88% in 1985. The new private banks were mostly Greek-owned, and foreign presence remained small. Foreign entry was more significant in the years following the adoption of the Euro and before the crisis.

During the period 1998-2008, Greece experienced rapid economic growth. Its GDP grew at 6.8% in nominal terms, compared to 4.1% in the EZ. The corresponding numbers in real terms were 3.5% and 2.1%. The economic boom was accompanied and partly caused by a credit boom.[6] Figure 1 plots credit (loans and debt securities) granted by Greek banks to Greek households, non-financial corporations, and the government, as a fraction of GDP, from 1998 onward.

[5] The costs of state control of the banking system have been documented in, e.g., La Porta, Lopez-de-Silanes, and Shleifer (2002), Barth, Caprio and Levine (2004), Khwaja and Mian (2005) and Bertrand, Schoar, and Thesmar (2007). Honohan (1999) provides an account more specific to Greece and compares its financial liberalization experience to that of Portugal.

[6] The IMF 2007 Country Report 07/27 on Greece (page 9) quantifies the impact of three demand stimuli on Greece's economic growth between 1995-2005: private credit, government spending, and EU transfers. According to the report, private credit became the dominant stimulus from 2001 onwards.

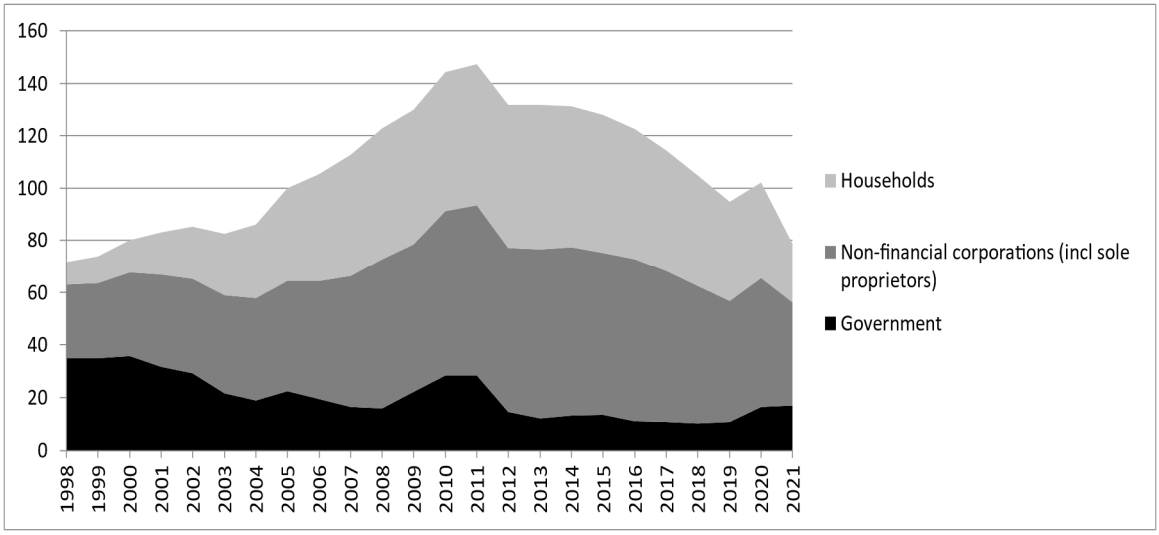

Figure 1: Bank credit as percent of GDP in Greece, by category. The data come from the Bank of Greece (BoG), are year-end and cover the period 1998-2021.

Total credit increased from 71.6% of GDP in 1998 to 122.8% in 2008. The increase resulted from two opposite trends. Credit to the government decreased, from 35.1% of GDP in 1998 to 15.9% in 2008, as the adoption of the Euro made it easier for the Greek government to borrow abroad. That decrease was more than compensated by an increase in credit to the private sector, from 36.5% of GDP in 1998 to 106.9% in 2008. The increase in private-sector credit was especially pronounced for credit to households (consumer loans and housing loans), which rose from 8.6% to 50.1%.

Figure 2 compares the credit boom for Greece to that in Ireland, Portugal, Spain and the EZ. Private-sector loans as percent of GDP were lower in Greece than in the other countries both in 1998 and in 2008. This reflects Greece's lower level of financial development. Greece's credit boom was partly a catch-up with the other countries. In 1998, private-sector loans as percent of GDP in Greece stood at 43.4% of the EZ average and at 40.6% of the average across Ireland, Portugal and Spain. In 2008, the corresponding figures were 74% and 47.3%. Greece's catch-up can be seen more starkly by computing the growth rate of private-sector credit between 1998 and 2008. The growth rate was higher in Greece than in the other three countries, and more than triple than in the EZ.

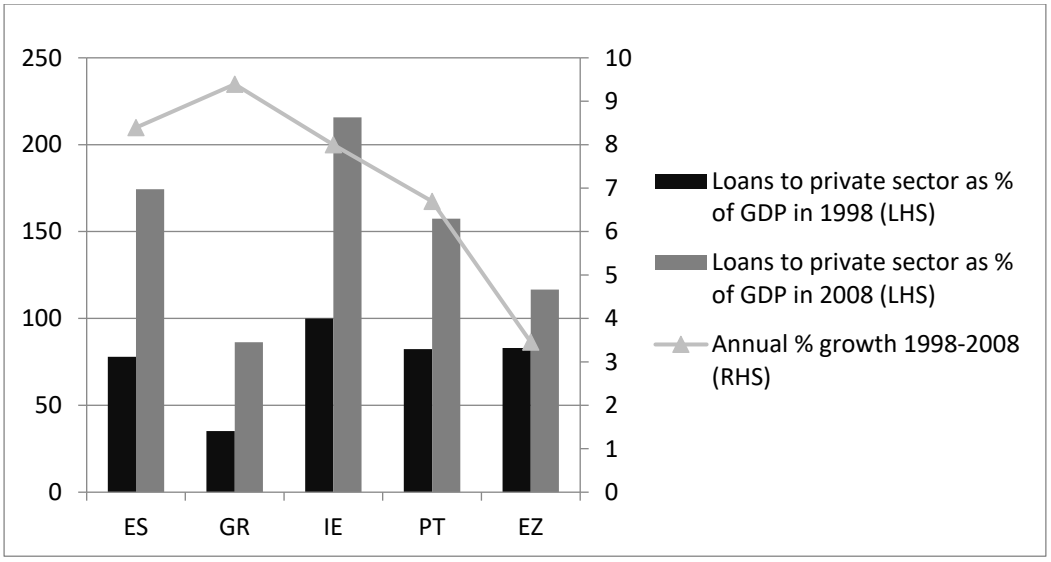

Figure 2: The credit boom in Greece (GR), Ireland (IE), Portugal (PT), Spain (ES) and the Eurozone (EZ). The data come from the ECB, are monthly, and are sampled in December. The left-hand side y-axis reports private-sector loans as percent of GDP, and the right-hand side y-axis reports the annual growth rate of that quantity. The EZ average is computed by dividing EZ loans by EZ GDP.

The growth in private credit was partly a consequence of Euro adoption because interest rates decreased sharply. The decline in interest rates started in the mid-1990s in anticipation of Greece joining the Euro. The effects of Euro adoption on private credit were magnified by the financial reforms that took place in the 1990s. For example, consumer credit was limited in the 1990s, but grew rapidly as lending restrictions were gradually lifted. Lifting these restrictions, in combination with Euro adoption, allowed the market for household credit in Greece to develop and reach a size closer to EZ levels.

The increase in household credit was associated with a reduction in private-sector savings. Lower private savings were, in turn, associated with an increase in the current account deficit and a worsening in Greece's net international investment position (NIIP). In that sense, financial liberalization was one of the drivers of the rapid increase in Greece's external debt.

Greece's NIIP was negative since the 1970s, but remained a relatively small fraction of GDP until the late 1990s. It subsequently increased sharply: from 19.3% in 1998 to 99.9% in 2007. Greece's current account deficit experienced a similar sharp rise: from 5.3% of GDP in 1998 to 15.9% in 2007.

The increase in Greece's external debt and current account deficit in the years after Euro entry is often attributed to high government deficits. While government deficits are part of the explanation, they cannot be the full explanation because they were even higher in the 1980s when external debt and the current account deficit were low.

The missing part of the explanation lies the behavior of private-sector savings. Private savings dropped sharply from the mid-1990s: from 26.1% of GDP in 1995, they decreased to an average of 16.4% during the period 2000-2007. That average was lower than in Ireland, Portugal and Spain, and significantly below the EU average of 20.8%. Private savings became insufficient to finance private-sector investment, let alone the sum of private investment and the government's deficits, which were rising in the 2000s.[7]

3. The Credit Crunch and the Bank-Sovereign Loop

The credit boom turned into a crunch starting in late 2008. As in other EZ countries, the crunch involved a bank-sovereign loop. Problems of Greek banks spilled over to the Greek state because (i) the state had to recapitalize the banks and provide them with guarantees, and (ii) a drop in bank lending caused a slowdown in the economy and hence a decline in the state's tax revenues. Conversely, problems of the Greek state spilled over to Greek banks by reducing the value of (i) the banks' portfolio of Greek government bonds and (ii) the guarantees that the state had provided for bank loans and deposits.

To describe how the bank-sovereign loop manifested itself in Greece, we divide the crisis period into two phases: the global financial crisis, in Section 3.1, and the EZ sovereign crisis., in Section 3.2. We identify the beginning of the EZ sovereign crisis with October 2009 because of the Greek elections and the subsequent announcement by the new government that the deficit was much larger than the previous estimate.[8] We end Section 3.2 in July 2013, which is when the first recapitalization of Greek banks was completed. Dividing the

[7] For a more extensive analysis of the macroeconomics of the Greek credit boom and bust, see Gourinchas, Philippon and Vayanos (2017), Meghir, Pissarides, Vayanos and Vettas (2017) and Chodorow-Reich, Karabarbounis and Kekre (2019).

[8] The Greek elections took place on October 4th. On October 19th, the Greek Finance Minister announced at the Eurogroup that the deficit was expected to be 12.5%, up from the original estimate of 6%.

crisis into the two phases allows us to separate the spill-over effects of the bank-sovereign loop, since spill-overs from the state to the banks mainly occurred during the second phase.

3.1 First Phase of the Credit Crunch: Global Financial Crisis

The global financial crisis started in earnest in August 2007, when BNP Paribas suspended withdrawals from three of its hedge funds exposed to US subprime loans. It reached its peak in the Fall of 2008, with the bankruptcy of Lehman Brothers. In Figure 3 we compare how the crisis affected Greek banks and their counterparts in other countries. We plot the value of a stock-market index composed from banks around the world and an index composed by Greek banks. We normalize both indices to 100 on 31 December 2003, and plot their values during the subsequent period.

Between the beginning of August 2007 and the end of September 2009, the Greek index dropped by 46.9%, while the global index dropped by 45.8%. Therefore, the global financial crisis had almost the same impact on Greek banks as on the average bank around the world. At the same time, Greek banks were more sensitive than the average bank to intermediate ups and downs during the crisis: they experienced a larger drop from August 2007 until the Lehman bankruptcy, and a larger rise from that event until September 2009. This excess sensitivity suggests that Greek banks were more vulnerable to a global economic slowdown than the average bank.

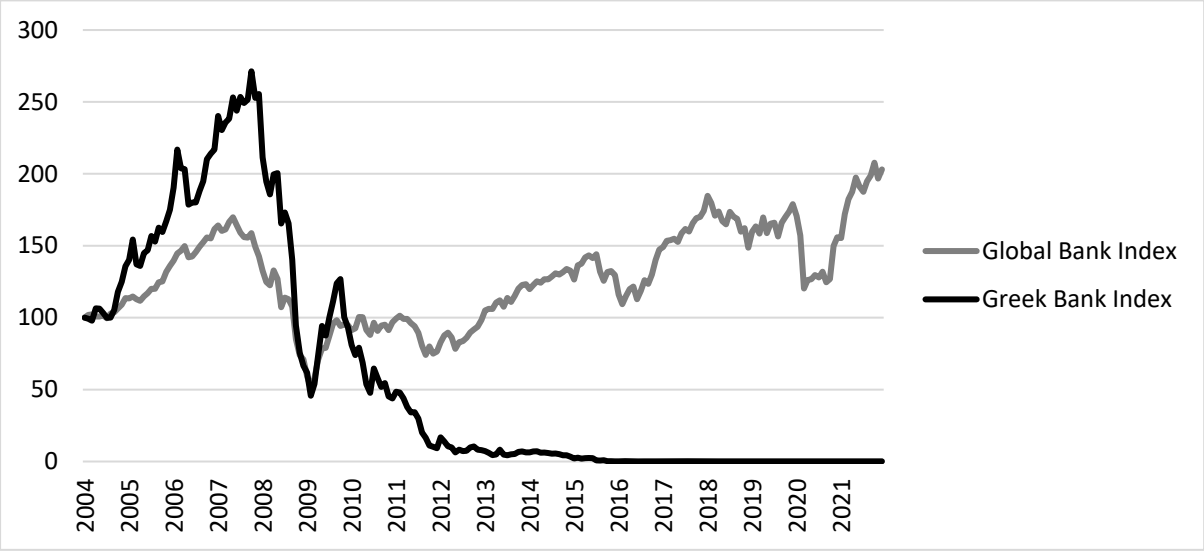

Figure 3: Performance of Greek bank index and a global bank index. The global bank index is FTSE All-World Banks F3AWB3E, and the Greek bank index is FTSE Greece Banks F3GRB3L(PI). The data come from Datastream. Indices are normalized to 100 on 31 December 2003.

The global financial crisis could have affected Greek banks through a solvency channel or a liquidity channel. One piece of evidence that helps distinguish between the two channels is that from August 2007 to December 2007 the Greek bank index rose (by 3%), while most other national bank indices dropped and so did the global bank index (by 14.6%). During that stage of the crisis, the concern was primarily about US subprime exposure. The rise of the Greek index suggests that Greek banks were not holding US subprime products, consistent with anecdotal evidence. The global financial crisis affected Greek banks primarily through the liquidity channel, i.e., a difficulty in rolling over interbank loans.

Figure 4 plots the liability structure of the aggregate of Greek banks from 2000 onward. Greek banks had become increasingly dependent on interbank loans in the later stage of the credit boom: interbank borrowing was 11.9% of total liabilities on average during 2000-2006, and 17.5% during 2007-2008. On the other hand, deposits were 70.2% of total liabilities on average during 2000-2006, and 63.9% during 2007-2008. The reduction in deposits is consistent with the decline in private savings.

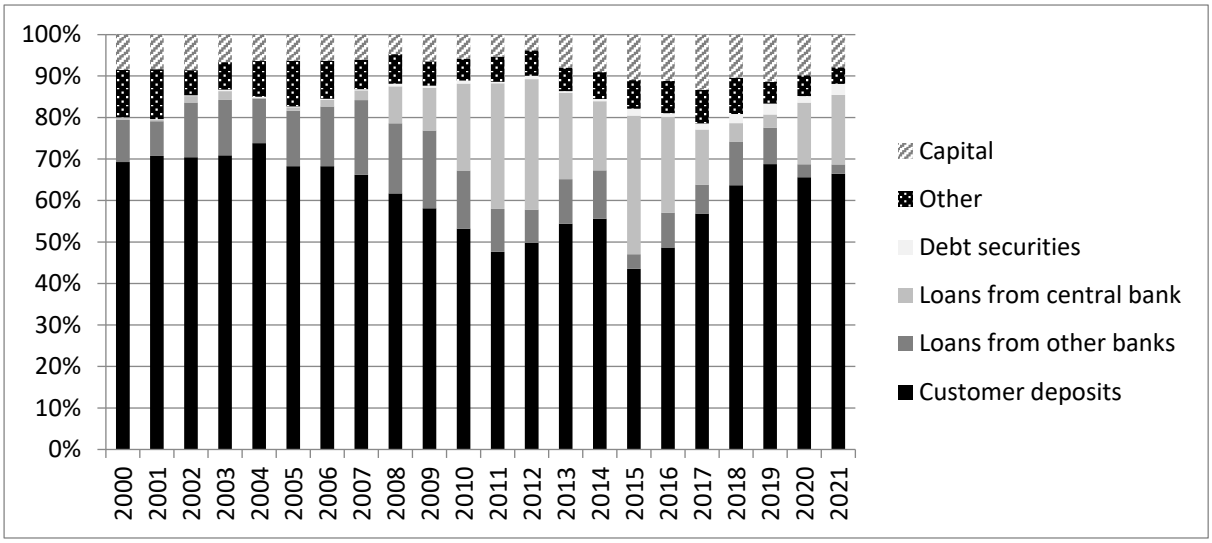

Figure 4: Liability structure of Greek banks. The data come from the BoG, are year-end and cover the period 2000-2021.

Figure 5 plots interbank borrowing and domestic deposits of Greek banks in absolute terms (€bn) rather than as percent of liabilities. Interbank borrowing and domestic deposits peaked in the Fall of 2009, as the EZ sovereign crisis began. But while the rise of deposits was smooth until then, interbank borrowing fell temporarily in the Fall of 2008, reflecting the funding difficulties that Greek banks experienced during the peak of the global financial crisis.

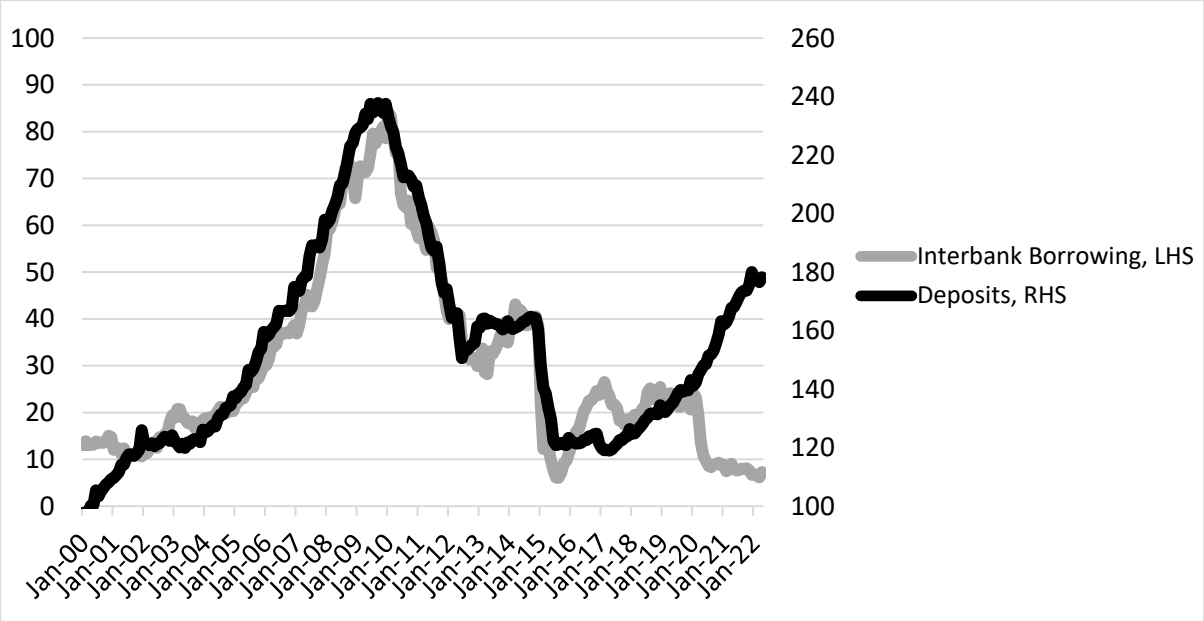

Figure 5: Interbank borrowing and domestic deposits of Greek banks, in €bn. The data come from the BoG, are monthly and cover the period 2000-2022.

The same funding difficulties can be seen in Figure 6, which plots the liquidity assistance to Greek banks by the European Central Bank (ECB). Loans by the ECB were administered either directly ("ECB funding") with a low interest rate and stringent collateral requirements, or indirectly via the BoG as emergency liquidity assistance ("ELA funding"), with a significantly higher interest rate and less stringent collateral requirements that included state guarantees.

Figure 6 shows a sharp increase in ECB liquidity assistance to Greek banks during the peak of the global financial crisis: direct loans rose from €6.3bn in March 2008 to €48.1bn in March 2009. That increase was large relative to other EZ countries. Greece ranks second largest across an available sample of ten EZ countries in percentage increase in ECB funding from

March 2008 to March 2009 (Cyprus 2259%, Greece 669%, Ireland 251%), largest in increase in ECB funding as percent of bank assets (Greece 8.6%, Ireland 5.1%, Cyprus 4%), and third largest in increase in ECB funding as percent of GDP (Ireland 52.8%, Cyprus 29%, Greece 17.6%).[9]

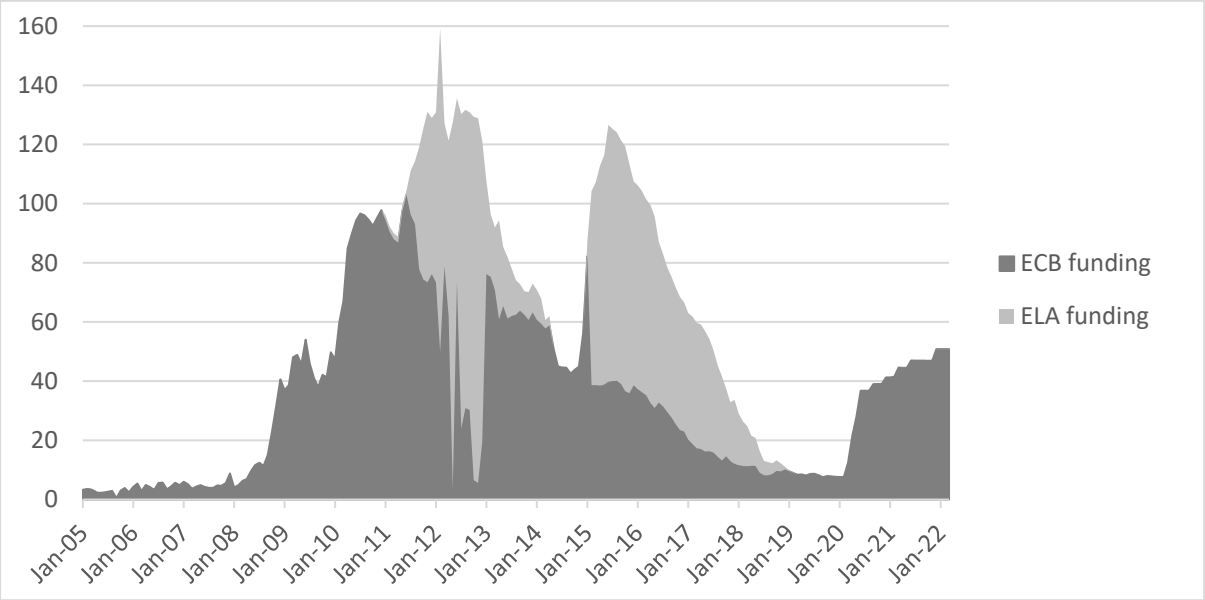

Figure 6: Liquidity assistance to Greek banks by the ECB, in €bn. The data come from the BoG, are monthly and cover the period 2005-2022.

The funding difficulties of Greek banks appear to have spilled over to the real economy as early as in the first half of 2009. This can be seen in the "Access to Finance" Flash Eurobarometer survey, conducted by the European Commission and the ECB. This survey concerns small and medium firms. In the 2009 edition of the survey, which was carried out in June-July 2009, 39% of Greek firms replied that their most pressing problem was access to finance. This was by far the highest percentage in the EU; the second highest was 23% for Spain. By contrast, in the earlier edition of the survey, which was published in 2005, the percentage of Greek firms reporting that access to loans was easy or very easy was the fourth highest in the EZ. Thus, the credit cycle in Greece appears to have started going in reverse in early- to mid-2009, before the sovereign crisis started.

[9] The sample consists of Belgium, Cyprus, Finland, Germany, Greece, Ireland, Italy, Luxembourg, Portugal and Spain.

An economic slowdown caused by a drop in bank lending is one of the bank-to-state spill-over channels of the bank-sovereign loop. A second such channel is that the state incurs a cost to recapitalize banks and provide them with guarantees. That channel was also at play in Greece, but to a lesser extent than in most other countries. The Greek government, , passed a law in December 2008 that provided three types of support to the banks: (i) banks were offered the right to sell preferred shares to the state in exchange for acquiring government bonds, (ii) banks were offered state guarantees on their interbank borrowing, and (iii) banks were offered government bonds that they could use as collateral for interbank borrowing. [10] These measures amounted for €5bn, €15bn, and €8bn, respectively, and hence for a total of €28bn. Approved state support to Greek banks in 2008 was 12% of GDP. This ratio was lower than in most EZ countries, e.g., it was 208.6% in Ireland, 77.66% in Belgium, 22.39% in Spain, 22.04% in Germany, 17.65% in France, and 11.63% in Portugal. It did, however stretch the sovereign's finances, which were already quite stretched.

The main conclusions from our analysis of the first phase of the credit crunch are: (i) the global financial crisis had a significant impact on Greek banks, mainly through an impaired access to funding, (ii) Greek banks were more vulnerable to funding shocks than the average EZ bank, and (iii) the funding problems of Greek banks spilled over into the real economy and helped set the credit cycle into reverse.

3.2 Second Phase of the Credit Crunch: EZ Sovereign Crisis

The sovereign crisis hit Greek banks harder than their counterparts in most other EZ countries. Between the beginning of October 2009 and the end of February 2013, the Greek bank index lost 94.9% of its value, while the EZ index lost 44.4%. The largest drops occurred for Cyprus (95%), Greece, and Ireland (94.2%), followed by Portugal (77.7%) and Italy (62%).

The sovereign crisis affected Greek banks mainly through the solvency channel: the restructuring of the Greek government debt (Public Sector Involvement, abbreviated as PSI) reduced dramatically the value of Greek government bonds that banks held. During the

[10] The Greek government's decision followed a EZ-level decision, made in an emergency summit meeting in Paris on 12 October 2008, to support the EZ banking sector. https://www.reuters.com/article/us-financial-europe-text-idUSTRE49B36Y20081012

2012 PSI, old Greek government bonds with face value €199.2bn were exchanged for new long-term Greek government bonds with face value €62.4bn plus cash-equivalent notes issued by the European Financial Stability Facility (EFSF) with face value €29.7bn. Greek banks were hit hard by the PSI because their sovereign bond portfolio consisted almost exclusively of Greek bonds, as shown in Figure 7.

The solvency problems of Greek banks generated liquidity problems: banks faced difficulties financing themselves in the market for retail deposits, as the guarantee by the government lost its value, and in the interbank market. These solvency and liquidity problems reflect state-to-bank spill-over channels of the bank-sovereign loop.

Figures 4 and 5 illustrate the liquidity problems of Greek banks. Figure 4 shows that interbank borrowing dropped from 18.7% of total liabilities in the end of 2009 to 8% in the end of 2012, and deposits dropped from 58.1% to 49.8%. Figure 5 shows that between the end of 2009 and April 2012, which is when the PSI was concluded, interbank borrowing dropped from €78.6bn to €40.7bn (a drop of 48.2%) and domestic deposits dropped from €237.5bn to €166bn (a drop of 30.1%).

The resulting funding needs were covered by loans from the ECB. Figure 4 shows that ECB loans increased from 10.3% of total liabilities in the end of 2009 to 31.4% in the end of 2012. These trends reversed somewhat in 2013 and 2014, but became even more pronounced in 2015.

Figure 6 provides a breakdown between direct loans and ELA. Direct loans, which averaged €44.2bn in 2009 rose to an average of €95.4bn in the second half of 2010 and €93.4bn in the first half of 2011. During that period, ELA was essentially zero. Direct loans declined in the Fall of 2011 and even further during 2012. Liquidity assistance rose during that period, however, because of a sharp rise in ELA. The sum of direct loans and ELA reached a peak of €159.2bn in February 2012. ELA was wound down during 2013, as the economy stabilized, and reached zero in May 2014, but increased again in 2015.

Column No	1	2	3	4	5	6	7	8
	CT1 capital, 12/2011	PSI loss	Provisions for PSI, 06/2011	Credit loss projections	Loan loss reserves, 06/2011	Capital generation	Target CT1 capital, 12/2014	Capital needs
NBG	7.29	-11.74	1.65	-8.37	5.39	4.68	8.66	9.76
Eurobank	3.52	-5.78	0.83	-8.23	3.51	2.90	2.60	5.84
Alpha	4.53	-4.79	0.67	-8.49	3.12	2.43	2.03	4.57
Piraeus	2.62	-5.91	1.01	-6.28	2.57	1.08	2.41	7.34
Emporiki	1.46	-0.59	0.07	-6.35	3.97	0.11	1.15	2.48
ATEbank	0.38	-4.33	0.84	-3.38	2.34	0.47	1.23	4.92
Postbank	0.56	-3.44	0.57	-1.48	1.28	-0.32	0.90	3.74
Millennium	0.47	-0.14	0.00	-0.64	0.21	-0.08	0.23	0.40
Geniki	0.37	-0.29	0.07	-1.55	1.31	-0.04	0.15	0.28
Attica	0.37	-0.14	0.05	-0.71	0.27	0.02	0.25	0.40
Probank	0.28	-0.30	0.06	-0.46	0.17	0.15	0.18	0.28
New Proton	0.06	-0.22	0.05	-0.48	0.37	0.03	0.12	0.31
FBB	0.15	-0.05	0.00	-0.29	0.17	-0.03	0.12	0.17
Panellinia	0.08	-0.03	0.00	-0.12	0.05	-0.03	0.04	0.08
Total	22.12	-37.73	5.86	-46.83	24.73	11.38	20.06	40.54

Table 1: Calculation of the capital needs of Greek banks, in €bn. The data are from Chart I.1 from the Report on the Recapitalization and Restructuring of the Greek Banking Sector, published by the BoG in December 2012. For each row, the quantities in the first seven columns add up to the capital needs in the last column. The following quantities are reported in the first seven columns: (1) core tier 1 capital as of December 2011, (2) losses on Greek government bonds and other loans to the Greek state during the PSI, (3) provisions that banks had set aside to meet these losses, (4) projected losses in private-sector loans, (5) provisions that banks had set aside to meet these losses, (6) projected addition to capital due to earnings during the period 2012-2014, (7) target core tier one capital as of December 2014.

The solvency problems that Greek banks experienced during the sovereign crisis can be summarized in Table 1, which was used by the BoG to determine the banks' capital needs. We start by describing the aggregate numbers, which are in the last row, and turn to the numbers for individual banks later in this section.

The aggregate core tier 1 (CT1) capital in the Greek banking sector was €22.12bn as of December 2011. Greek banks experienced total losses of €37.73bn in their holdings of Greek

government bonds and other loans to the Greek state. To meet these losses, they had set aside provisions of €5.86bn. Thus, the banks' net-of-provision losses from Greece's sovereign default were €31.87bn. These losses wiped out completely the capital of the banks, and made it negative. In addition, there were projected losses on private-sector loans, due to the recession in Greece. These losses were projected to be €22.10bn, net of provisions (losses were €46.83bn and provisions were €24.73bn). Table 1 makes it clear that Greece's sovereign default bankrupted its banking system.

Greek banks' exposure to domestic government bonds was higher than the EZ average but comparable to that in some other EZ countries. The comparison is shown in Figure 7. The exposure of banks in each EZ country to domestic government bonds is calculated as of December 2010, based on the stress tests that the European Banking Authority (EBA) conducted at that time and reported in July 2011.

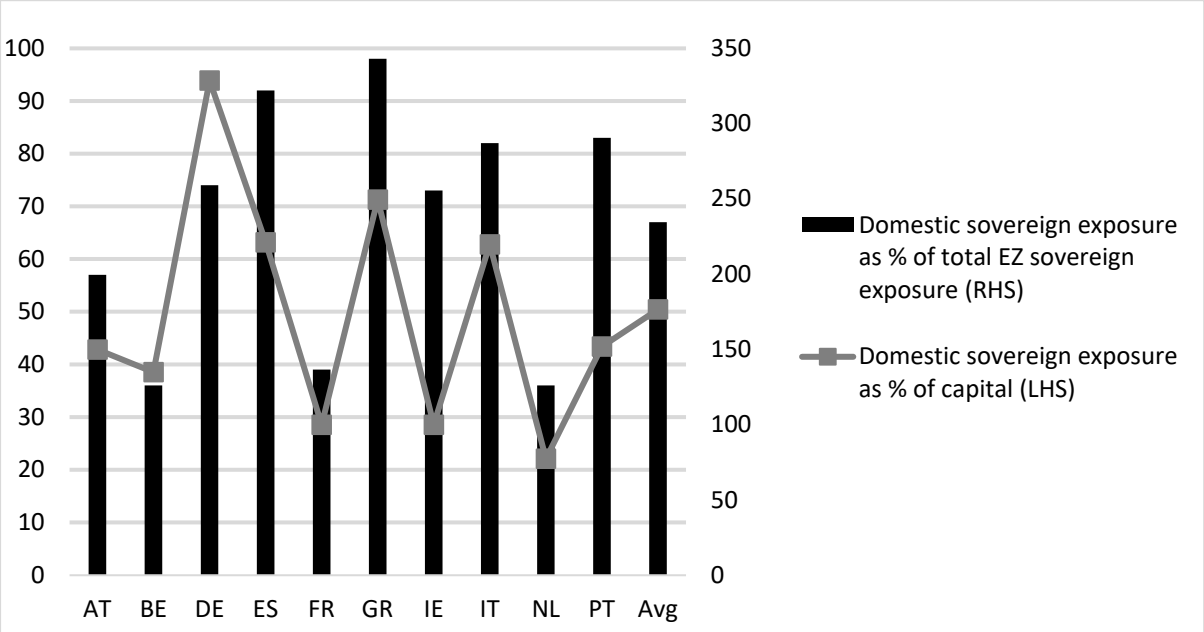

Figure 7: Holdings of government bonds by domestic banks. The data come from the 2010 EBA stress tests, as reported in Chart 5 and Table 1 in Merler and Pisani-Ferry (2012). The left-hand side y-axis reports domestic sovereign exposure as percent of total EZ sovereign exposure, and the right-hand side y-axis reports domestic sovereign exposure as percent of capital. The average is a simple average across the countries in the figure.

As of 2010, Greek banks held 98% of their EZ government-bond portfolio in Greek government bonds. This percentage was highest across countries, and hence the

government-bond portfolio of Greek banks was the most "home-biased". Adjusting for the size of the government-bond portfolio as fraction of capital, the exposure of Greek banks to domestic bonds was 250% of their capital. That was second-highest after Germany (329%), with Spain (221%) and Italy (220%) coming next.

Greek banks' exposure to domestic bonds may have seemed benign before the crisis. Indeed, during 2002-2007, yields on Greek government bonds were comparable to their German counterparts: the yield spread between Greek and German ten-year government bonds averaged around 25 basis points. The low spread reflected the financial market's expectation that default by EZ countries was unlikely.

The yield spread rose significantly in 2008 and continued rising in 2009 and 2010. An exposure to the Greek government bonds during these years reflected more substantial risk-taking. Why did Greek banks maintain a significant exposure to domestic bonds?

One hypothesis is that the banks were pressured by the government to buy its bonds. Moreover, this pressure became stronger during the crisis because the government had greater difficulty financing itself. Greek banks' holdings of domestic bonds indeed increased during 2009-2010 as Figure 1 shows.[11] An alternative hypothesis is that banks were hedging the risk of Euro exit: domestic bonds would be redenominated in the new domestic currency under Euro exit, but so would bank deposits.[12]

According to the government-pressure hypothesis, domestic exposure should be larger for state-controlled banks than for privately-controlled banks because the government has more influence on the former. Table II.1 in the Recapitalization Report of the Bank of Greece confirms that this is indeed the case: holdings of Greek government bonds and other loans to the Greek state were 303% of capital for the aggregate of state-controlled banks (National Bank of Greece, ATE Bank, Postbank) and 171% for the aggregate of privately-controlled banks (Eurobank, Alpha Bank, Piraeus, Emporiki, Millenium, Geniki, Attica, Probank, Proton, FBB, Panellinia).

[11] Figure 1 shows a steep rise in Greek banks' loans to the Greek government as percent of GDP between 2008 and 2010. Loans to the government include Greek government bonds.
[12] See Battistini, Pagano, and Simonelli (2014) for tests of the two hypotheses on EZ-wide data.

The losses on Greek government bonds and the projected losses on private-sector loans rendered the Greek banking system insolvent not only on aggregate but also at the level of each individual bank. Indeed, as shown in Table 1, the losses net of provisions for each bank (sum of columns 2 to 5) exceeded the bank's capital (column 1), even taking into account projected future profitability (column 6).[13]

The solvency and liquidity problems of Greek banks spilled over to the real economy. Between 2007 and 2014, real GDP per capita declined by 25.2%, the unemployment rate rose from 8.4% to 26.5%, and investment as percent of GDP declined from 25.7% to 11.6%. The economic contraction was partly due to the massive fiscal consolidation: a primary deficit of 10.3% of GDP in 2009 turned into a primary surplus of 0.4% in 2014. The credit crunch played an important role as well, as estimates from DGSE models indicate.[14]

The main conclusions from our analysis of the second phase of the credit crunch are (i) losses on Greek government bonds and loans due to Greece's sovereign default bankrupted the Greek banking system, (ii) Greek banks suffered from the default because they were holding large positions in Greek government bonds, which may have been the result of government pressure, and (iii) Greek banks required large-scale liquidity assistance from the ECB to remain in operation.

4. The Recapitalizations and the New Supervisory Landscape

Because Greek banks became insolvent during the sovereign crisis, public intervention was needed. Public intervention took the form of resolution and recapitalization. In both cases, no haircut on depositors and other debtholders was imposed. Liquidation and haircuts were ruled out because they were viewed as destabilizing (although they were implemented later in Cyprus). Because depositors and other debtholders did not take any losses, and because

[13] In addition to their PSI losses, Greek banks were forced to sell to the Greek state at a substantial discount in late 2012 some of the bonds they had acquired from the PSI a few months earlier. The sale was part of a government debt buyback. During the buyback, government bonds with face value €31.9bn were retired at a cost of €11.3bn (Zettelmeyer, Trebesch and Gulati (2013)).

[14] Gourinchas, Philippon and Vayanos (2017) estimate that Greek GDP would have been higher by 9% in 2013 if Greek banks had not faced solvency and liquidity problems, and investment would have been higher by 33%. Fakos, Sakellaris and Tavares (2022) estimate that the credit crunch accounted for 9–36% of the drop in corporate investment in Greece, after controlling for changes in investment opportunities and uncertainty.

their claims were larger than bank assets, resolution and recapitalization required public funds. Public funds came in the form of a €50bn loan from the European Financial Stability Fund (EFSF), which later morphed into the European Stability Mechanism (ESM).[15]

4.1 First and Second Recapitalization

There were three main recapitalizations of Greek banks. In this section we describe the first—and largest—recapitalization, which was completed in July 2013, and a second recapitalization which took place in April and May 2014. In section 4.2 we focus on the period following the SYRIZA-ANEL election in January 2015. During that period, a bank run took place, followed by the imposition of capital controls and a third recapitalization.

During the period leading to July 2013, the largest four banks were recapitalized and most of the remaining ones were resolved. The largest four banks were Alpha Bank, Eurobank, National Bank of Greece (NBG), and Piraeus Bank. The agreed procedure for recapitalizing them was that the state and private investors would buy shares in the recapitalized entities, but private investors would receive additionally warrants for each share that they bought. Warrants are rights to buy additional shares at a pre-specified exercise price and are valuable because of the possibility that the share price increases above the exercise price.

The introduction of warrants allowed private investors to enter the recapitalization in better terms than the state. Warrants thus functioned as a covert subsidy to private investors from the state. A state subsidy to private investors was necessary because the banks were insolvent.[16]

An additional feature of the recapitalization procedure was that if private investors could buy 10% or more of the shares in a bank, then they could exert full control, except for major

[15] https://www.esm.europa.eu/about-us/efsf/before-the-esm

[16] To illustrate this point with a simple example, suppose that private investors contribute €1bn worth of shares in a recapitalization of a bank and receive a subsidy worth €0.6bn by the state, e.g., through warrants. Suppose also that the state contributes €9bn. The total capital raised is €10bn and private investors own 10% of the bank. If prior to the recapitalization the bank's deposits and other debt obligations exceeded assets by €X bn, then the bank would be worth €10-X bn after the recapitalization, and the total gain of private investors would be €10%*(10-X)+0.6-1 bn, i.e., their stake in the bank, plus the subsidy, minus the amount they invested. If X=6, i.e., the bank was under water by €6bn prior to the recapitalization, then private investors just break even (despite having received a subsidy). If the bank was underwater by less than €6bn (X<6) then private investors earn a rent, and if the bank was underwater by more than €6bn (X>6) then private investors do not enter.

decisions such as capital increases and mergers. The 10% requirement was introduced in an effort to reduce state control of the banking system.

Out of the four large banks, three raised more private capital than the required 10%: Alpha with 12%, NBG with 11.1%, and Piraeus with 19.7%. Eurobank could not raise the required 10% and became fully controlled by the state. The total amount of public funds that were used was €25.5bn: €4bn for Alpha, €5.8bn for Eurobank, €8.7bn for NBG, and €7bn for Piraeus. The total amount of private capital that was raised was €3.1bn: €0.6bn for Alpha, €1.1bn for NBG, and €1.4bn for Piraeus.[17] The sum of public plus private capital raised for each bank is the same as the corresponding number in Table 1.[18]

Most remaining banks were either resolved or were recapitalized and then transferred to the four large banks, with the process being essentially completed by July 2013. The only exception was Attica Bank, which managed to raise the required capital. The public funds used in this process were €13.4bn. Hence, out of the €50bn of public funds that were made available, a total of €38.9bn were used for recapitalization and resolution.

Resolution was not used in a large scale in Greece, in contrast to Ireland and Spain, because it requires more public funds than recapitalization.[19] An additional reason was that loans of Greek banks were less homogeneous than loans of their Irish and Spanish counterparts, many of which were in real estate. Lack of homogeneity implies fewer economies of scale in forming a bad bank to sell the loans.[20]

The first recapitalization resulted in a drastic increase in the concentration of the Greek banking system. Figure 8 plots, for all EU countries, the share of banking-system assets held by the five largest banks. In 2013 the five largest banks in Greece held 94% of banking-system assets, the highest share among all EU countries, up from 67.7% in 2007. The increase in concentration between 2007 and 2013 was largest in Greece (26.3%), followed

[17] The numbers are from the Jan-Jun 2013 report of the Hellenic Financial Stability Fund (HFSF), the agency in charge of bank recapitalizations.
[18] Piraeus is an exception, as the sum exceeds the number in Table 1 by €1.1bn. Piraeus required more capital because it absorbed the Greek branches of the Cypriot banks and the good bank formed after the resolution of ATE Bank.
[19] Under resolution, public funds must be used to replace the bad loans in the good banks' balance sheet. While the state earns a return when the bad loans are eventually sold off, it provides a transfer to depositors because taking the bad loans out of the good banks' balance sheet makes the banks safer for depositors.
[20] See, for example, page 51 in the IMF 2013 Country Report No. 13/155 on Greece.

by Spain (15.2%). The increase in concentration facilitated bank recapitalization by raising the profit margins and earnings of the banks.[21]

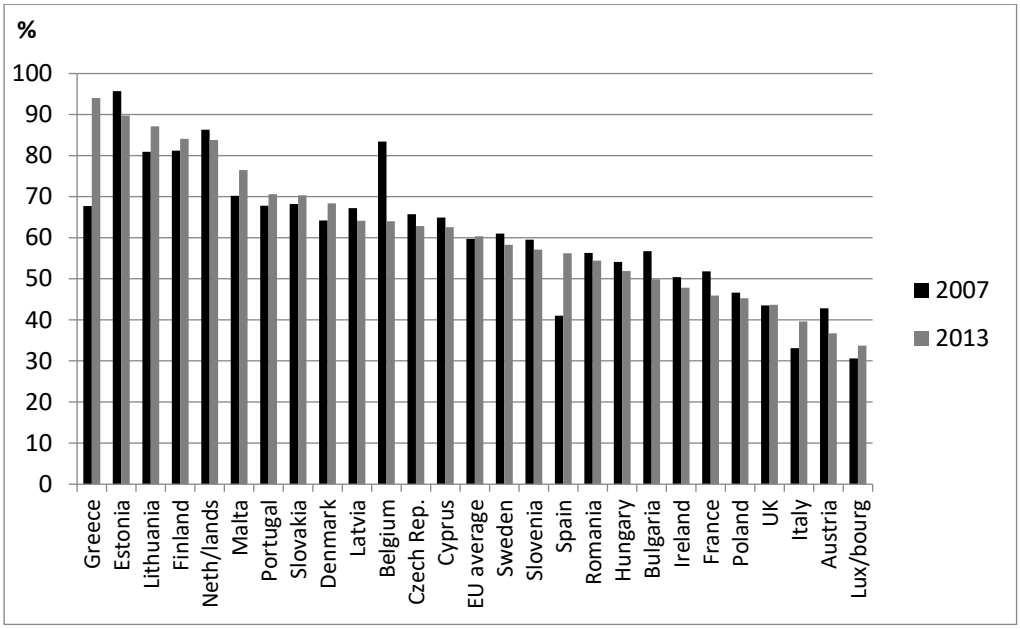

Figure 8: Share of banking-system assets held by the five largest banks. The data come from the ECB. The EU average is a simple average across the countries in the figure.

The consolidation of banking-system assets within the four large banks meant that presence by foreign banks was reduced essentially to zero.[22] Entry by foreign banks was difficult to achieve given the risks in Greece and the pressure on Eurozone banks to de-lever. Yet, the first recapitalization could have been an opportunity to promote such entry, especially given the extensive evidence that entry by foreign banks into a crisis-hit banking system can be

[21] Karadima and Louri (2020) find an additional and related advantage of concentration. Non-performing loans (NPLs) generated during the crisis were reduced faster in EZ countries with more concentrated banking industries, possibly due to economies of scale in NPL management.

[22] The share of banking-system assets held by domestic banks was 99% in Greece as of 2013, up from 78.2% in 2007. (Foreign banks Credit Agricole, Millenium, and Societe Generale exited Greece during the crisis by selling their subsidiaries.) As of 2013, Germany and Sweden had a 100% share, followed by France, Greece, and Spain with 99%, Italy with 94%, Portugal with 92%, Cyprus with 89%, and the UK with 84%. The EU average was 59%. (This is a simple average rather than GDP-weighted.) The data are from the ECB.

beneficial.[23] Entry by strategic long-term investors, which could have some of the same beneficial effects, did occur, however, especially in the case of Eurobank.

In the spring of 2014, a second recapitalization was required because of increased projected losses on private-sector loans. That recapitalization was covered entirely by private funds. The total amount raised across the four large banks was €8.3bn. Eurobank raised the largest amount, €2.9bn, and returned to majority private ownership: private investors held a total stake of 64.6%, up from almost zero in July 2013. Private investors' stakes in Alpha, NBG, and Piraeus were raised to 30.1%, 42.8%, and 32.7%, respectively.

The first and second recapitalizations were successful in transforming a banking system in which all banks were insolvent into one where banks were solvent and partly owned by private investors. At the same time, banks remained fragile and vulnerable to a worsening in the economic situation. This can be seen by examining the composition of core equity tier 1 (CET1) capital, and its evolution after the recapitalizations.

On December 2013, the CET1 capital of the four large banks was €26.9bn. This was comfortably higher than the target in Table 1, which was €15.7bn, and indeed the Basel capital ratios of the four large banks ranged from 11.2% to 15.9%, which were well above the minimum 4.5% required. Yet, these high numbers provide a false sense of comfort. First, there was a significant risk that losses on private-sector loans could exceed the projected values, and hence banks would need to increase provisions by taking away from capital. Second, a significant fraction of CET1 capital (€11.1bn out of the €26.9bn) was in the form of deferred tax assets (DTA), which reflect projected tax savings from losses that banks realized in the past and could carry forward to apply against future profits. DTA constitute an inferior form of bank capital because they involve uncertain cashflows. Indeed, the tax savings inherent in DTA accrue to banks only when they are profitable. Moreover, these savings are contingent on the state not modifying the tax code.

The risk that banks would need to increase provisions because of larger-than-projected losses on private-sector loans is well illustrated by the developments during 2014. In

[23] Calomiris, Klingebiel, and Laeven (2012) report on such evidence from Argentina, Mexico, and other developing countries.

December 2014, the CET1 capital of the four large banks was €28.6bn. During that year, banks had raised €8.3bn of new private capital and increased their DTA by €4.5bn. Yet, the increase in CET1 capital relative to December 2013 was only €1.7bn (=€28.6bn-€26.9bn), much smaller than €12.8bn (=€8.3bn+€4.5bn). This was mainly because, following the Asset Quality Review (AQR) and the stress tests of the Single Supervisory Mechanism (SSM) in the Summer of 2014, banks had to increase substantially their provisions against projected losses on private-sector loans.

DTA have remained large after 2014. Revised Basel rules, however, required banks to stop counting most DTA towards CET1 capital: by 2019, only up to 10% of DTA could count towards CET1 capital. Following similar initiatives in Italy, Spain, and, later, Portugal, the Greek government passed a law in October 2014 allowing Greek banks to convert DTA into deferred tax credits (DTC). DTC are covered by a state obligation that if banks realized losses in a given year and hence could not use the tax savings, the state would inject the corresponding amount of capital in the banks and would receive bank equity in return. Because of the state obligation, regulators agreed to continue counting DTC-converted DTA towards CET1 capital. Out of €15.6bn DTA that the four large banks reported in December 2014, €12.8bn had been converted into DTC. The conversion of DTA into DTC has been continuing after 2014, and DTC remain a major part of Greek banks' CET1 capital in 2022.

Figure 9 summarizes the above developments by plotting the dynamics of CET1 capital, DTA, DTC, and provisions for the aggregate of the four large banks. DTA started rising in 2010. DTC rose rapidly in late 2014, as banks converted DTA into DTC. DTC have been a major part of banks' CET1 capital since then. Provisions rose rapidly between 2012 and 2015 because of larger-than-projected losses on private-sector loans. They have been declining since 2015 as banks have been realizing the losses.

Requiring banks to raise more capital during the first and second recapitalizations could have reduced their fragility. The public funds that were made available for the recapitalizations were limited, however. This was partly because of the limited fiscal capacity of the Greek state: the public funds to recapitalize the banks were lent to Greece by the ESM. Even if more funds had been made available, they might still have been insufficient given the large economic and political risks that lied ahead. The events in the first half of 2015 illustrated those risks.

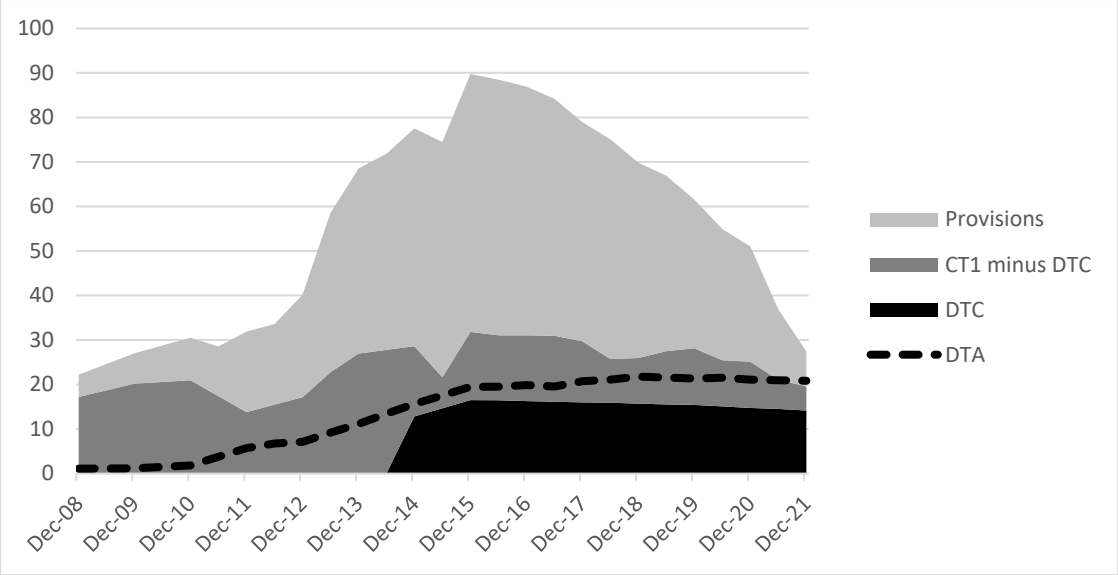

Figure 9: Deferred tax credits (DTC), deferred tax assets (DTA), core equity tier 1 (CET1) capital, and provisions aggregated across the four large banks (Alpha, Eurobank, NBG, and Piraeus), in €bn. The numbers come from banks' balance sheets. CET1 capital is the sum of the black and dark grey.

4.2 Bank Run, Capital Controls, and Third Recapitalization

The election of January 2015 brought into power a government formed by the SYRIZA and ANEL parties, both of which had opposed the provisions of the bailout program. A lengthy negotiation with the troika during the first half of 2015 generated uncertainty about whether Greece would continue with the bailout program or default and exit the Euro. That uncertainty drove depositors to withdraw money from Greek banks and reduced drastically banks' access to the interbank market. Figure 4 shows that interbank borrowing dropped from 11.6% of total liabilities in the end of 2014 to 2.4% in June 2015, and deposits dropped from 55.6% to 43.1%.[24] Figure 5 shows that between the end of 2014 and June 2015, interbank borrowing dropped from €38.6bn to €7.7bn (a drop of 80.1%) and domestic deposits dropped from €160.3bn to €122.2bn (a drop of 23.7%).

The resulting funding needs were covered by loans from the ECB. Figure 4 shows that ECB loans increased from 16.6% of total liabilities in the end of 2014 to 38.8% in June 2015. Figure 6 shows that ELA increased from zero at the end of 2014 to €86.8bn in June 2015.

[24] The data in Figure 4 are year-end. The data for June 2015 (not reported in Figure 4) are broadly similar to those for December 2015.

The sum of direct loans and ELA reached a peak of €126.6bn in that month. The substitution of direct loans by ELA was mainly due to the ECB lifting the waiver of minimum credit requirements for Greek government bonds because of the uncertainty over the completion of the bailout program. Without the waiver, Greek banks could not borrow directly from the ECB using Greek government bonds as collateral and had to resort to ELA, a costlier form of financing.

Following the announcement of a referendum to approve a new bailout agreement, on June 28, 2015, there was a renewed flight on deposits. The refusal of the ECB to increase the loan limit (which was already stretched due to the lifting of the waiver and the lack of collateral by Greek banks) resulted in the imposition of capital controls and a daily limit of €60 for withdrawal of bank deposits.[25]

A comparison with the double election of May and June 2012, when interbank borrowing and deposits had reached their previous minima, is useful. In June 2012, interbank borrowing accounted for 8.9% of bank liabilities, deposits accounted for 50.1%, and ECB loans accounted for 33%. The drain on banks' liquidity was thus not as severe as in June 2015.

The deposit flight in the first half of 2015, the imposition of capital controls, and the overall weakening of the economy, increased the projected losses on private-sector loans. It also lowered the value of the collateral on these loans, which was typically in the form of real estate. In response to these developments, the SSM decided to conduct a new AQR and perform new stress tests specifically for the four large Greek banks, a year after a similar exercise had been conducted by the ECB on all large European banks, and a year before the SSM was due to conduct the second such exercise. The AQR, conducted during the third quarter of 2015, required the four large banks to acknowledge an additional combined capital loss of €9.6bn relative to the AQR of the previous year. This brought CET1 capital down to €16.2bn, most of which was in the form of DTA. Banks were required to raise €13.7bn of new capital, €3.7bn of which had to come from private investors and

[25] Capital controls affect primarily cross-border transactions. No limits were imposed on eelectronic payments or other debit or credit card payments inside the country. Also, later on, the €60 daily limit became a €420 weekly limit, i.e., individuals could withdraw the full amount of €420 once a week. Artavanis, Paravisini, Robles, Seru and Tsoutsoura (2022) analyze the drivers of deposit withdrawals during 2014 and 2015.

conversions of debt into equity, and €10bn from either private investors or public funds. By contrast, following the AQR of the previous year, the four large banks were allowed to continue operating in the fourth quarter of 2014 without having to raise new capital.

Two of the four banks raised all the required capital from private investors. The four banks combined raised €5.3bn from private investors and converted €2.7bn of bonds into stocks. Hence, approximately €8bn from the required €13.7bn were raised from private sources. Later, in early 2016, one of the banks sold its Turkish subsidiary, hence reducing further the need for state support.

In November 2015, prior to the third recapitalization, existing capital was valued at €0.7bn. This constituted a large loss for previous private investors, who had invested a total of €11.4bn in the banks in the first and second recapitalizations. It also constituted a large loss for the state, which had injected €25.5bn (although about half of that amount was a loss from the outset because it was necessary to bring the banks back to solvency).

After the third recapitalization, the state's stake in the four large banks shrank considerably. In early 2016, the State owned 11% of Alpha Bank, 2.4% of Eurobank, 40.4% of NBG, and 26.4% of Piraeus. Prior to the third recapitalization, these stakes were 66.3%, 35.4%, 57.2%, and 66.9%, respectively.

4.3 The New Supervisory Landscape

The recapitalizations of Greek banks, together with the changes in bank regulation in the EZ, established a new supervisory landscape for Greek banks. The key players are the Hellenic Financial Stability Fund (HFSF), which represents the interests of the Greek state as a large shareholder in the banks, the EFSF and the ESM, which lent the €50bn to the Greek state to recapitalize or resolve the banks, the European Commission and especially the EU Directorate-General for Competition, and the SSM, which was established in November 2014 to supervise all systemic banks in the EZ.

The HFSF put in place rules aiming at improving governance of Greek banks and reducing the scope for political interference. The process began in the summer of 2013 when the HFSF signed a Relationship Framework Agreement (RFA) with each of the four large banks.

In November 2015, shortly before the third recapitalization, further steps were taken. Law 4340/2015 established eligibility criteria for bank board members and chairs of board committees. Individuals were eligible to be appointed as independent board members if they had not held managerial positions in Greek banks in the previous ten years. Eligibility for becoming chairperson of the Audit, Risk, Governance and Nominations, and Human Resource Committees was along similar lines. A cooling off period of four years was introduced before individuals who held prominent positions in government could become executives or board members. Boards had to always include an HFSF representative. These measures reflected an attempt by the troika to reshuffle the governance of Greek systemic banks and change the status quo. They excluded, however, almost all domestic Greeks with banking experience from becoming independent board members.

The HFSF has taken important additional initiatives on corporate governance, such as the repeated assessment of board members and members of board committees. By 31/12/2017, 59% of board members and 73% of non-executive board members had been replaced. The participation of independent board members, which was uncommon until recently in Greece, renewed the make-up of board membership, with beneficial effects. Law 4941/2022 eased some of the restrictions for board membership, particularly for domestic Greeks. The restriction of not being involved with Greek banks in the previous ten years was reduced to three years.

The participation of the Greek state in the first recapitalization, which was decided in February 2012, activated the EU DG for Competition. Since then, DG Competition has been involved in the strategic choices of the four large banks. It has been putting pressure on the banks to sell their foreign subsidiaries along with non-core businesses such as insurance, hotels, leasing, etc. In the two systemic banks that were financed by the state in the third recapitalization, the pressure turned into a clear obligation.

The SSM has tightened the provisioning standards for non-performing exposures (NPEs) across all European banks. NPEs are a broader definition of NPLs, introduced to describe more accurately bank loans of dubious quality.[26] The tightening of provisioning standards

[26] NPEs include traditional NPLs, which are 90 days past due loans, denounced loans, and Unlikely to Pay (UtP) exposures. The latter are defined as "non-performing" under qualitative criteria, even though they are either being repaid or are less than 90 days past due. UtP exposures mainly consist of loans that are being repaid but

for NPEs is important for Greek banks because their NPEs are high. In March 2018, the SSM announced that for loans without collateral, provisions should reach 100% of the face value of the loan for loans over two years past due. For loans with collateral, provisions should be 40% of the face value of the loan at the end of the third year past due, with this percentage rising to 55% at the end of the fourth year, 70% at the end of the fifth year, 85% at the end of the sixth year and 100% at the end of the seventh year.

5. Non-Performing Exposures and Capital Ratios

While the three recapitalizations provided banks with much-needed capital, banks remained fragile. CET1 capital consisted primarily of DTA and DTC. Moreover, banks had to keep shifting new profitability into provisions instead of CET1 capital, to account for higher-than-projected losses on private-sector loans. Given banks' fragility, the resolution of NPEs involved difficult trade-offs. On one hand, rapid resolution could lead to the closure of inefficient firms and the reallocation of capital to more efficient firms. On the other hand, rapid resolution could reduce bank capital significantly, requiring further recapitalizations.

In this section we examine how the above trade-offs were addressed and how NPEs were resolved. Section 5.1 describes the evolution of NPEs over time. Section 5.2 describes the legislative efforts to address NPEs by reforming bankruptcy laws for firms and households. Section 5.3 describes the incentives that banks were given to clean up their NPE portfolios, and the way in which the process unfolded. Section 5.4 describes the current state of the banks, and how they managed to muddle through and strengthen their balance sheets in the years after the three recapitalizations.[27]

5.1 NPEs and their Evolution Over Time

Figure 10 shows the evolution of domestic NPEs as percent of total domestic gross loans from 2002 to 2021.[28] NPEs were declining slightly until 2008. In September 2009, a few

have been recently rescheduled by the bank (usually going back at least 12 months and at most 36 months) to facilitate the borrower.

[27] For a more extensive analysis of the NPEs and capital ratios of Greek banks, see Hardouvelis (2021).

[28] The NPE series is constructed by the BoG as the merger of two separate series. Until the third quarter of 2014, NPEs are the sum of NPLs, which are 90 days past due loans, and loans that have been restructured over the past 12 months. From the fourth quarter of 2014 onward, NPEs are as defined and calculated by the SSM.

weeks before the Greek crisis erupted, NPEs were €22.9bn or 8.8% of loans. Two and a half years later, in March 2012, when the PSI was finalized, NPEs had shot up to €58.2bn or 24.9% of loans. NPEs continued rising fast, and peaked at €107.2 bn or 48.9% of loans in March 2016. From then on, they started declining, initially slowly, and more rapidly since the end of 2019.

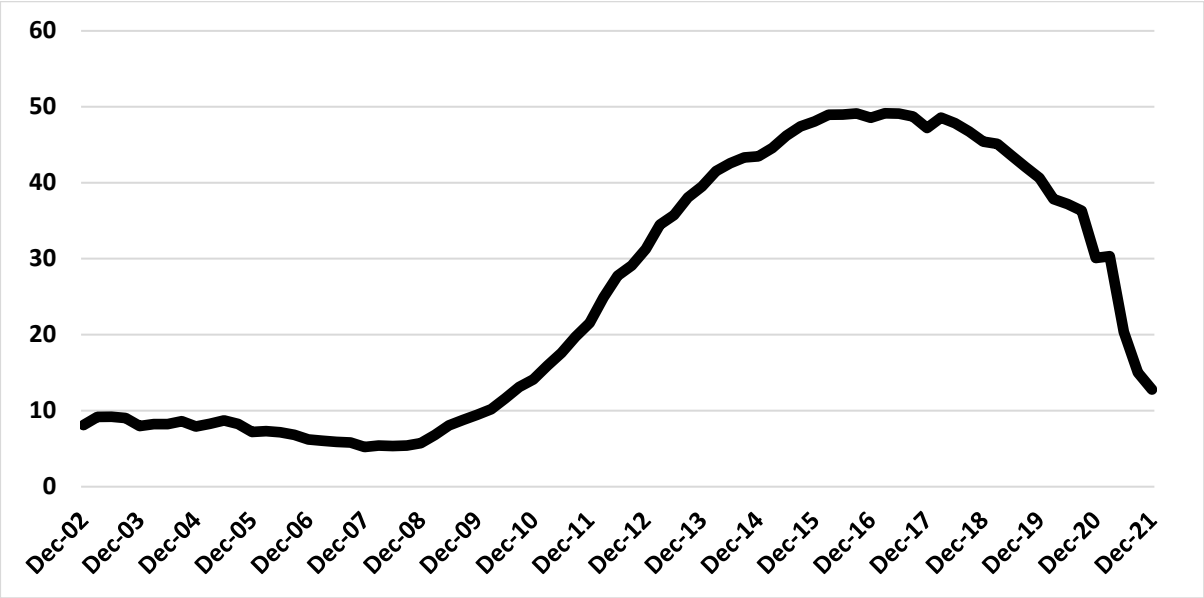

Figure 10: Domestic NPEs as percent of total domestic gross loans GDP in Greece. The data come from the Bank of Greece (BoG), are quarterly and cover the period 2002-2021.

The sharp rise in NPEs reflected the severity of the economic recession that Greece experienced. With GDP per capita declining by 26.3% between 2007 and 2014, and unemployment rising from 8.5% to 26.6%, many households and firms were genuinely unable to meet their debt obligations. Strategic default, whereby borrowers can meet their debt obligations but choose not to do so, rose as well, however. Out of first-home mortgage defaults, 37% were estimated to be strategic.[29]

NPEs remained high as percent of loans for a long period because of several reasons. One reason had to do with inefficient bankruptcy laws, which prevented the speedy resolution of NPEs and encouraged strategic default and a non-payment culture (Section 5.2). A second reason had to do with banks' incentives to extend-and-pretend: because banks had relatively little capital and much of the capital was in the form of DTC, they had incentives to roll-over the debts of non-viable borrowers rather than insisting on their speedy resolution

[29] See Artavanis and Spyridopoulos (2022).

(Section 5.3). The share of highly indebted non-viable firms ("zombie firms") in Greece was 26% in 2016, representing around 28% of total lending.[30] Banks weak incentives to resolve NPEs were compounded by the lack of an organized secondary market for loans, due in part to the lack of a legal framework for the operation of debt servicing companies. [31] A final reason why NPEs remained high as percent of loans for a long period is that loans themselves (the denominator in the NPE ratio) was shrinking during most of the period from 2009 to 2021 because of the economic contraction.

5.2 Bankruptcy Laws and their Reform

Bankruptcy laws became an important political issue because of the large number of firms and individuals affected. Bankruptcy laws also became an important determinant of banks' balance sheets because NPEs were a large fraction of bank assets.

Greece entered the recession with inadequate bankruptcy laws. The laws were inadequate for handling bankruptcy even in normal times, let alone during a systemic crisis when large numbers of households and firms were defaulting on their loans. The practical application of the laws was problematic as well.

On corporate bankruptcies, liquidation of the assets of a firm in distress was an inefficiently slow procedure, during which a large part of the assets' economic value was destroyed. Corporate bankruptcy laws required that all the claims of creditors against the firm had to be verified before the firm's assets could be sold. Verification could take years because creditors might raise objections against each other's claims. Additionally, the auction process through which the assets were sold was complicated and opaque. This discouraged participation by interested buyers and benefitted insiders. Finally, the bankruptcy

[30] The data come from the PwC study "10 Years of Crisis: A Smaller but Unreformed Corporate Economy ". The study examines companies with revenues above EUR €10mn. The total number of these companies is 2817, and 745 are classified as 'zombie' or 'almost zombie' based on their financial resilience and size.
[31] For example, the framework for the establishment and operation of servicing companies was originally defined in 2016 by the Act of the Executive Committee of the Bank of Greece (82 / 8.3.2016), following the enactment of Law 4354/2015.

administrators in charge of selling the assets often had limited experience, as bankruptcy law required that administrators were selected randomly from the local bar association.

Restructuring of a firm in distress was also inefficient. A judge had to decide whether a reorganization plan proposed by a firm was viable before authorizing that it served as a basis for negotiations between the firm and its creditors. A hearing took four months, and more time was required for a decision. A better alternative would have been to grant automatically a short stay period during which a reorganization plan could be negotiated between the firm and its creditors, and then to have the plan ratified by the judge. An additional source of inefficiency was that the state and employees had seniority over all other creditors. That was inefficient because the state had little flexibility to renegotiate its claims and little expertise in designing and monitoring reorganization plans. The same was true to a lesser extent for employees. Because of these considerations, firms were liquidated even in cases where reorganization would have been more efficient. Out of the 3500 largest Greek firms that have experienced problems since the beginning of the crisis, only around 100 opted for restructuring (Article 106 of the Bankruptcy Code) as of 2020.

On personal bankruptcies, Greece entered the crisis without a fully-fledged personal bankruptcy framework. The government sought to address the problem with Law 3869/2010 ("Law for Over-Indebted Households" enacted in 2010). According to that law, a household in distress had to first negotiate debt relief with its creditors. If negotiations failed, then the case was referred to a judge. If the household's debts were unsecured, then the household's primary residence would be protected up to a given value, but all other assets could be liquidated to repay the debts. For debts that were secured against the household's primary residence, relief could be granted so that these debts represented no more than 80% of the residence value. The exact amounts were up to the judge's discretion and took into account factors such as employment or health status. The law did not constitute a fully-fledged personal bankruptcy framework because some types of debts were not covered. For example, debts to the state were excluded, and were effectively given more senior status.

The practical application of the law was problematic. A key problem was court delays. Most hearings were scheduled five or more years after the household applies for protection.

Given that household assets were protected from creditors until the hearing, the incentives to apply for protection were strong even for households who could make the debt payments. This gave rise to strategic defaults. Incentives for strategic defaults were strengthened by a ban on liquidations of primary residences even in cases where such liquidations have previously been authorized by the courts.

Corporate and personal bankruptcy laws changed frequently during the crisis. The most comprehensive reform was enacted in 2020 (Law 4738/2020 "Debt Settlement and Second Opportunity Code"). On corporate bankruptcy, the new law made liquidation and restructuring procedures faster and more efficient. It allowed liquidation of a firm's assets to be done in parallel rather than after the verification of the creditors' claims. It also introduced an out-of-court settlement mechanism, according to which if firms and creditors agreed on a lower debt burden, then claims by the state were reduced automatically.

On personal bankruptcy, the new law introduced an integrated bankruptcy framework covering all types of debts. It made the out-of-court settlement mechanism available to households, and to prevent abuse of the mechanism, it allowed creditors to access information about all of a debtor's assets when the debtor used the mechanism. Under the new law, bankruptcy fully discharged debtors from their debts within a period of a few years and was accompanied by the liquidation of the debtors' assets. Debtors were allowed to continue living in their primary residence provided that they paid a rent to the new owner. Debtors had the right to repurchase their primary residence after 12 years. Under the new law, the state no longer supported debtors with measures such as foreclosure moratoria. The state could instead support the poorest debtors more directly and efficiently, through a housing benefit.

5.3 Banks' Actions and Incentives to Reduce NPEs

When designing the first recapitalization of Greek banks, policymakers decided not to create a centralized "bad bank", as Ireland and Spain had done a few years earlier. Such a bank in Greece could have gathered bad loans from the four large banks that were recapitalized and from the remaining banks that were transferred to the four large banks. Policymakers allowed instead the four large banks to form their in-house workout units. These were

effectively internal bad banks, separated from the banks' other divisions. Three out of the four large banks, Alpha, Eurobank and Piraeus, moved their workout units to separate companies, which were later sold to international loan servicing companies. The banks kept a 20% stake in each case: Alpha in Cepal, Eurobank in DoValue, and Piraeus in Intrum.

A centralized bad bank was not created in Greece for the same reasons as why resolution was not used at a large scale. Forming a bad bank required public funds, and these were limited, partly because of the limited fiscal capacity of the Greek state. Moreover, loans of Greek banks were less homogeneous than loans of their Irish and Spanish counterparts, implying smaller economies of scale in selling them. Nevertheless, a small bad bank, named PQH, was formed in 2016 within the BoG, by gathering under the same roof the bad-bank components of all the banks that were resolved. Before 2016, separate liquidators had been put in place for each of those banks.

The four large banks used two approaches to reduce NPEs: (1) deal directly with borrowers, and (2) securitize or sell loan portfolios. The first approach was time-consuming for the banks. Banks could reduce their NPEs faster with the second approach.

The first sales took place in 2019, were small, and involved portfolios of uncollateralized consumer loans. The process accelerated in 2020, after the Ministry of Finance enacted Law 4649/2019. According to that Law, known as "Hercules," an asset protection scheme was set up carrying a guarantee by the Greek state for the senior tranche of bank securitizations. Hercules was modelled after the Italian GACS scheme (Garanzia Cartolarizzazione Sofferenze), which had been in force since 2016. Hercules was originally designed in 2018 by the HFSF and further modified in the Fall of 2019 to be applicable to a country with a lower credit rating than Italy's.[32]

Under Hercules, a Special Purpose Vehicle (SPV) was set up to purchase the NPEs and was financed using notes in three different credit quality tranches. The junior (equity) and mezzanine tranches were sold to investors at market prices. The senior tranche was

[32] The detailed proposal of the HFSF to the Ministry of Finance was submitted in November 2018. See HFSF Annual Financial Report 2019, p. 11 (https://hfsf.gr/wp-content/uploads/2021/02/hfsf_ENG_booklet_single_210x297_1-97_Jul-20_03082020-FINAL.pdf)

typically retained by the securitizing bank and carried a guarantee by the Greek state. The state received a fee for its guarantee, which was proportional to the risk of the senior tranche. That risk also embodied Greek sovereign risk, as reflected in the sovereign CDS term structure. The securitization could include both NPEs and performing loans.

The first package of securitizations, Hercules-I, involved NPEs worth around €30bn in face value, with the state offering guarantees up to €12bn. It was fully utilized by the banks in 2020-2021. A second package, Hercules-II, followed in April 2021. As of March 2022, €18.5bn of guarantees have been granted (€6.5bn of which under Hercules-II), corresponding to NPEs of over €50bn. Another €5bn of NPEs are expected to come to the market under Hercules-II in 2022.

Banks did not take decisive actions to reduce their NPEs until 2020 because of two main constraints: they had relatively little capital, and much of the capital was in the form of DTC. To illustrate these constraints, suppose that a non-performing loan is entered with a book value of €100 in a bank's balance sheet and the bank keeps a provision of €45 against losses on this loan. Suppose next that the loan is securitized or sold at a price of €40. The bank suffers an accounting loss of €15, equal to the difference between the loss of €60 that it incurred and the provision of €45 that it kept. The loss of €15 is an accounting rather than a financial loss in the sense that the sale did not change the loan's market value but forced the bank to acknowledge that the loan's value in its balance sheet exceeded the market value by €15. Nevertheless, the loss of €15 lowers the bank's earnings, thus reducing the bank's profitability and the bank's capital.

The reduction in capital is problematic for the bank because the bank's capital requirement can be violated and the bank can be forced by the regulator to issue new equity, diluting the existing shareholders. The reduction in profitability is also problematic for the bank because the bank's annual profitability can become negative and trigger the DTC. According to the DTC legislation, the Greek state would participate in a share capital increase that would restore the loss in earnings, diluting the existing shareholders.

Banks bypassed the capital constraint by bidding for time and generating capital through earnings. From 2016 to 2021, the sum of annual pre-provision earnings of the four large

banks amounted to €25bn. That was used almost entirely to increase provisions. Earnings were high partly because of the high concentration of the banking industry after the first (and subsequent) recapitalizations, shown in Figure 9.

In addition to generating capital through earnings, banks raised capital by issuing equity. Alpha raised €0.8bn in June 2021 and Piraeus raised €1.38bn in April 2021. Eurobank received a capital infusion of €0.9bn in February 2019 by merging with Grivalia, its real-estate subsidiary which had accumulated large capital gains. NBG was the only bank that did not raise capital, partly because it generated €1.5bn in trading income from its Greek government bond portfolio.

Banks bypassed the DTC constraint by using an accounting trick, known as "hive-down" and approved by the regulator. A simplified description of the hive-down is as follows. The balance sheet of a bank is re-allocated to two banks, B_{bad} and B_{good}. B_{bad} holds all NPEs to be securitized on the asset side, and capital on the liability side. B_{good} holds all the banking activities, the banking license, and the DTC. When the securitization is completed, the loss from the sale of the NPEs impacts B_{bad}. Since B_{good} is not affected, the DTC are not activated.

Eurobank and its advisers conceived the hive-down and announced it in November 2018, simultaneously with Eurobank's planned merger with Grivalia. The merger was welcomed as a vote of confidence on the government's economic policy because it channelled the profits of Grivalia to an entity within the country. The hive-down allowed Eurobank to leap ahead of its competitors in the NPE cleanup through a large securitization, named "Cairo," without issuing new equity. Had the hive-down not occurred and the DTC been triggered, HFSF's shareholding of Eurobank would have increased to over 30%.

Alpha and Piraeus soon followed Eurobank's example, using hive-downs in their large securitizations. NBG was the only large bank that did not resort to a hive-down in its large securitization, named "Frontier", as it generated enough earnings to provision for the transaction.

5.4 Bank Capital and Profitability as of End-2021

Table 2 summarizes the balance sheet and income statement of each of the four large banks as of 31 December 2021. The information for each bank is at the group level, i.e., includes all of the bank's subsidiaries.

Total gross loans across the four banks are €150.6bn (Line 5). NPEs are approximately 15bn, implying an NPE ratio of 10%. For two of the banks the NPE ratio is about 7% and for the other two is about 13%. Adjusting for the provisions booked for the IFRS-9 stage 3 loans (€6.2bn) yields net uncovered NPEs across the four banks equal to €8.8bn or 5.8% of loans. Clearly, compared to 2016, when the NPE ratio had peaked at 48.9%, Greek banks in 2022 are in a much better position.[33] Note, however, that performing loans are significantly lower than deposits: the average ratio across the four banks is 64.9%. Greek banks are conservative in giving out new loans because they still need to strengthen their balance sheets.

Cash & Reserves across the four banks are large and equal to €56.7bn (Line 2). Most of that amount is borrowed from the ECB through the LTRO program and appears on the liabilities side as well (Line 10a). Banks have an incentive to borrow because the ECB charges a negative interest rate (-1%). Banks can borrow at that rate if they do not contract their credit to the private sector. Net lending indeed grew in Greece during 2020-2021.

Investment Securities across the four banks are also large and equal to €49.9bn (Line 3). Their size is the mirror image of the relatively small size of loans. Most Investment Securities are government bonds, and about half are Greek government bonds. Since Cash & Reserves and most Investment Securities carry zero regulatory risk weight, Risk-Weighted Assets (RWA) are a relatively small fraction of total assets. RWA are €142.1bn, less than 50% of total assets.

Greek government bonds constitute a smaller fraction of the government bond portfolio of Greek banks than they did in 2010 (Figure 7). Nevertheless, the exposure of banks to the

[33] All four banks claimed in their 2021 annual financial statements that they planned to bring their NPE ratios close to the European average by 2024. Moreover, two of the four banks may be allowed by the ECB to distribute dividends in 2023 out of 2022 earnings.

sovereign remains significant, creating conditions for the bank-sovereign loop to occur again. Indeed, in addition to the €26.5bn of Greek government bonds that Greek banks are holding, there are €18.5bn of state guarantees for senior tranches from Hercules securitizations, plus €3.1bn of state guarantees for bank loans given prior to 2007 to vulnerable social groups, plus €1.8bn of state guarantees on bank loans given during the pandemic from the Hellenic Development Bank and €1.6bn from the EIB.[34]

DTA across the four banks are large and equal to €20.8bn (Line 4) because banks carry forward large losses in their government bond portfolio (from the PSI) and their loan portfolio. Most DTA formed until 2016 were transformed into DTC, and it is DTC that presently count as capital. DTC, presented on the liabilities side of the balance sheet (Line 14a), are €14.1bn across the four banks. DTC remain a major part of CET1 capital, at 72.4%.

About two thirds of bank liabilities are deposits (Line 9). Table 2 also presents a detailed analysis of the banks' capital (Lines 11b, 13, 14). The sum of CET1 capital across the four banks is €19.5bn or 13.7% of RWA. The CET1/RWA ratio is transitional because after the SSM tightened provisioning standards for NPEs in March 2018, banks were allowed to subtract the full amount of the new provisions from their capital gradually over time, until 2023. The fully loaded CET1/RWA ratio, which will materialize in two years and represents regulatory capital if the 2023 rules were to apply in 2021, is projected to be 11.9% across the four banks. It ranges from 14.9% to 8.6% across the banks.[35]

Banks have issued bonds (Line 11), partly to count as Tier II capital. All four banks have Tier II debt, which is equal to €3.7bn across the four banks, bringing total capital up to €23.2bn. Banks have also issued bonds that do not count as capital. The main motive is not related to

[34] Hellenic Republic Public Debt Bulletin, March 2022.

[35] Capital requirements were lowered during the pandemic and are expected to go back to pre-pandemic levels at the end of 2022. The pandemic waiver was offered by the ECB in 2020. Without a waiver, the minimum CET1/RWA ratio for Greek banks would have been 11.19% at the end of 2021. The 11.19% threshold is calculated as follows: The Pillar 1 requirement is 4.5%, to which are added: (1) P2R (Pilar 2 Requirement) of 1.69%, (2) P2G (Pillar 2 Guidance) of 2.0%, (3) CCB (Capital Conservation Buffer) of 2.50%, and (4) OSII (Other Systemically Important Institutions) of 0.50%. (For Eurobank the P2G is slightly lower.) The waiver is 4.50% (= 2% (P2G) plus 2.50% (CCB)) as of June 2022 and reduces the minimum CET1/RWA ratio from 11.19% to 6.69%. Table 2 shows that two of the four banks would have met the minimum CET1/RWA ratio even without a waiver and with a fully loaded CET1/RWA ratio.

funding needs but to the Minimum Requirement of own funds and Eligible Liabilities (MREL) imposed by the Single Resolution Board (SRB).

Group Level December 2021 (€mn)	Eurobank	NBG	Alpha	Piraeus	Total
1. Assets	77,852	83,958	73,356	79,790	314,956
1a. Risk Weighted Assets (RWAs)	39,789	34,727	35,333	32,207	142,056
2. Cash & reserves	13,515	15,827	11,803	15,519	56,664
3. Investment Securities	11,316	15,251	10,640	12,678	49,885
of which:					
3a. Greek Government bonds	5,322	7,692	5,239	8,200	26,453
4. Deferred Tax Assets (DTA)	4,422	4,912	5,428	6,070	20,832
5. Gross Loans	40,815	32,093	39,201	38,492	150,601
of which:					
5a. Non-Performing Exposures (NPEs)	2,775	2,257	5,120	4,860	15,012
NPEs over Gross Loans (%)	6.8%	7.0%	13.1%	12.6%	10.0%
Performing Loans / Deposits	71.5%	55.8%	72.6%	60.7%	64.9%
6. Total Provisions (Deducted from Gross Loans), of which:	(1,872)	(1,709)	(2,383)	(1,971)	(7,935)
6a. Provisions for IFRS-9 stage 3 loans	(1,391)	(1,179)	(1,931)	(1,705)	(6,206)
Coverage rate (Provisions/NPE)	69.2%	77.2%	46.5%	40.5%	52.9%
7. Other Assets	9,656	17,584	8,667	9,002	44,909
P&L Key Figures					
i. Net Interest Income	1,321	1,212	1,376	1,410	5,319
ii. Net Fee & Commission Income	456	287	400	399	1,542
iii. Trading & Other Income	128	404	174	721	1,427
iv. Operating Expenses (OpEx)	(876)	(783)	(1,008)	(874)	(3,541)
v. Pre–Provision Income (PPI) = [(i) + (ii) + (iii) – (iv)]	1,029	1,120	942	1,656	4,747
8. Liabilities and Net Worth	77,852	83,958	73,356	79,790	314,956
9. Total Deposits	53,168	53,493	46,970	55,442	209,073
10. Due to Banks (Total)	12,636	14,731	13,984	14,865	56,216
of which:					
10a. Eurosystem Funding	11,749	11,600	13,000	14,500	50,849
11. Debt Securities in issue (Total)	2,552	991	2,593	1,906	8,042
of which:					
11a. Senior Preferred Bonds	1,052	500	900	500	2,952
11b. Tier II Debt	948	400	1,000	1,400	3,748
12. Other Liabilities	3,861	8,971	3,729	1,774	18,335

13. Total Equity	**5,635**	**5,772**	**6,080**	**5,803**	**23,290**
14. Regulatory Capital CET1	**5,436**	**5,853**	**4,662**	**3,582**	**19,533**
CET1/RWAs (%)	**13.7%**	**16.9%**	**13.2%**	**11.1%**	**13.7%**
Fully loaded CET1/RWAs (%)	**12.7%**	**14.9%**	**10.8%**	**8.6%**	**11.9%**
of which: 14a. Deferred Tax Credit (DTC)	**3,547**	**4,116**	**2,891**	**3,582**	**14,136**
DTC/CET1 (%)	**65.3%**	**70.3%**	**62.0%**	**100.0%**	**72.4%**
15. Total Regulatory Capital: Row (11b) + Row (14) – regulatory adjustments	**6,386**	**6,077**	**5,676**	**5,073**	**23,212**
Total Regulatory Capital/RWAs (%)	**16.0%**	**17.5%**	**16.1%**	**15.8%**	**16.3%**
16. Capital Cushion ≡ Row(14)+ Row(6) – Row (5a)	**4,533**	**5,305**	**1,925**	**693**	**12,456**
17. Texas Ratio ≡ Row(5a)/[Row(14)+ Row(6)]	**38.0%**	**29.8%**	**72.7%**	**87.5%**	**54.7%**

Table 2: Balance Sheet and Income Statement of the Four Large Greek Banks in €mn as of 31 December 2021. The data come from banks' annual financial statements & presentations and are at the bank group level, in €mn and as of 31 December 2021. Pre-Provision Income (PPI) is calculated on recurring Operating Expenses for all banks, i.e., excluding voluntary exit schemes, restructuring costs and other one-off costs. Total Equity is an accounting balance sheet item without any regulatory adjustments**.** It includes equity attributable to shareholders, non-controlling interests, and hybrid securities.

Table 2 finally examines whether banks could sustain an extreme shock of full (100%) losses on their NPEs and the collateral attached to them. Capital would remain positive for all four banks (Line 16). Line 17 expresses the result as a Texas ratio. The numerator is Line (5a), the size of NPEs, and the denominator is the available regulatory capital CET1 plus the available provisions to burn in case of an extreme shock. Texas ratios for all four banks are below 100%.

6. Lessons Learned

We conclude this paper by drawing lessons from the Greek crisis.

Bank-sovereign loop and EZ architecture. One lesson from the crisis concerns the destructive effects of the bank-sovereign loop and the perils of banks holding large positions in domestic government bonds. The Greek crisis provides a textbook illustration of these effects, as shown in Section 3. The severity of the bank-sovereign loop may have been difficult to anticipate before the crisis, as the financial market did not expect EZ countries to default. Post-crisis, however, EZ governments and banks should recognize the loop's destructive effects and adjust their actions. Governments should not rely excessively on their banking systems for financing, and banks should limit their exposures to domestic government securities. Banks' exposures have been increasing, however, in several EZ countries, including Greece. In Greece the increase has been partly due to the state guarantees for the NPL securitizations, as shown in Section 5.

The bank-sovereign loop is related to broader deficiencies of the EZ architecture, which the Greek crisis helped illustrate. Monitoring of government finances by EU bodies did not prevent Greece from accumulating a large government debt relative to its current and potential GDP, and from running large government deficits. Monitoring by the financial market was also ineffective as Greece could borrow at rates comparable to those of Germany during 2002-2007. The market offered such rates because it expected that default by a EZ country was unlikely. That expectation may have been due to irrational optimism. It may also have been due to a rational belief that the EZ would not allow a default by one of its members because of the systemic consequences that the default could have on the EZ and the global financial system.

While Greece was allowed to default, the protracted process through which default occurred provides information about the default's systemic consequences and the rationale for believing that default was unlikely. When the crisis hit, a large fraction of Greek government debt was held by EZ banks: both Greek banks as shown in Table 7, and banks in other EZ countries such as France and Germany. A restructuring of Greek debt was ruled out when Greece was first shut out of the financial market in 2010 because of the bank losses and potential knock-on effects it could trigger. Debt restructuring took place only in 2012, after foreign banks had the time to reduce their exposure to Greek debt, and after bailout loans were given to the Greek government to repay all debt maturing until that time.

The timing of Greece's debt restructuring was a subject of intense disagreement between the IMF and the European institutions (European Commission, ECB), with the former arguing for an early restructuring in 2010 and the latter arguing for delay or no default. The delay left Greece with a higher debt burden than if debt restructuring had occurred in 2010. It also created uncertainty about Greece's economy and membership of the Euro, which was damaging for the banks and for corporate investment.

The Greek crisis suggests that a superior approach to limit debt accumulation is to improve the market's incentives to monitor and to price government bonds commensurately with their default risk. This can happen through a combination of policies that include: (a) the introduction of a standardized bankruptcy mechanism for EZ governments, (b) the disclosure at regular intervals and in a standardized format of information about EZ governments' fiscal situation, (c) changes in bank regulation so that debt of EZ sovereigns is not treated as risk free but commensurately to its credit rating, and (d) the issuance of a safe asset in Euros in large quantity.

Policy (c) would ensure that banks do not hold large non-diversified positions in bonds of fiscally weak EZ countries. That would, in turn, ensure that default by these countries does not have systemic consequences and can be allowed to happen without excessive delay and bailouts to private investors as in the case of Greece. Policies (a) and (b) would, in turn, ensure that the market has incentives to monitor and can price government bonds commensurately with their default risk. Policy (d) would ensure that a Euro-denominated safe asset in sufficiently large supply can be made available to the banks to make up for their lack of investment in bonds of fiscally weak countries. The riskless asset can be, for example, the senior tranche of a GDP-weighted package of EZ government bonds, as per the European Safe Bonds (ESBies) proposal, or a Eurobond financed by joint taxation, as the bonds issued by the European Commission in response to the pandemic.[36] Implementation of Policies (a)-(d) requires careful consideration of their distributional implications and of the financial stability risks to banks and sovereigns during the transition.

[36] For a presentation and analysis of these policy proposals, see Benassy-Quere, Brunnermeier, Enderlein, Farhi, Fratzscher, Fuest, Gourinchas, Martin, Pisany-Ferry, Rey, Schnabel, Veron, Weder di Mauro and Zettelmeyer (2018). For a presentation and analysis of the ESBies proposal, see Brunnermeier, Garicano, Lane, Pagano, Reis, Santos, Thesmar, Van Nieuwerburgh and Vayanos (2016).

NPL reduction and bank recapitalization. Another lesson from the crisis concerns the reduction of NPLs. NPLs of Greek banks rose rapidly during the crisis, reaching 39.5% of all loans at the end of 2013. NPLs kept rising until 2016 and remained above 40% of all loans until the end of 2019. During most of that period, Greek banks faced significant pressure by the regulator to reduce their NPLs, acknowledge their losses, and increase their capital and provisions. NPLs started declining in earnest, however, only when banks could rely on state guarantees to securitize the NPLs, during 2020 and 2021. Securitizations caused NPLs held by the banks to decline dramatically: NPLs dropped to 12.8% of all loans at the end of 2021. Thus, state involvement, in the form of the guarantees, was key for NPLs to decline. Since the guarantees strengthen bank-sovereign linkages and could be fiscally costly, they need to be managed carefully, considering the overall exposure of the banks to the state.

A related issue is how best to recapitalize a weak banking system. While that issue has attracted significant academic and policy attention, the Greek crisis differs from many other episodes because fiscal resources were severely limited. Indeed, the Greek state had defaulted when the recapitalizations were being designed, and the public funds for the recapitalizations were lent to Greece by the ESM. It was partly because of the fiscal limitations that Greek banks remained fragile after the recapitalizations, that the Greek banking system became heavily concentrated, and that a centralized bad bank was not created. Because of these features of the recapitalizations, Greek banks did not make a significant dent to their stock of NPLs for several years, and new lending was anaemic. Perhaps these outcomes were unavoidable given the fiscal limitations and the effort to keep banks in private hands. Yet, and with the benefit of hindsight, the available fiscal resources could have been used earlier to provide the state guarantees for the NPL securitizations, given how successful the securitizations turned out to be in reducing the NPLs held by the banks.

Prospects for the Greek economy and Greek banks. A final issue is whether the adjustment programs strengthened the Greek economy, and what the prospects are for the economy and the banks. The structural reforms undertaken during the three adjustment programs have been bearing some fruit. Greece has been able to run primary surpluses until the

pandemic and the energy crisis. Bank NPLs have declined to almost single digits, and a much-improved bankruptcy code has been legislated, as discussed in Section 5. Productivity- and growth-enhancing structural reforms have led to significant improvements in competitiveness, as reflected in international indicators (World Bank, OECD, IMD). The improvements in competitiveness have rendered the economy more open: Greek exports of goods and services have risen to 41% of GDP in 2021 from 22% in 2010. This increase is not only driven by services such tourism and shipping. Indeed, goods have played an important role, rising to 22% to GDP in 2021 from 9.5% in 2010. Moreover, the fraction of exported goods in manufacturing and high technology has increased.

At the same time, problems remain. Additional structural reforms are needed across the economy to increase labour force participation, corporate investment, and total factor productivity. Increasing Greece's potential growth rate is necessary to deal with the large debt burden. This is especially so because the debt will gradually transition from being held by foreign public institutions to being held by private investors, who will be requiring market rates.

Greek banks have staged an impressive recovery from the depths of the crisis, but still need to strengthen their balance sheets and profitability. Some of the banks' profitability challenges are global. One global challenge is competition from Fintech and Big-tech firms, which seek to penetrate lucrative activities of banks, such as credit cards and payment services, but are not subject to the same strict restrictions as banks.[37] Another global challenge is tighter regulation, such as the Minimum Requirement on Eligible Liabilities (MREL), which requires banks to issue bonds even when they do not need the extra liquidity or the liquidity can be raised more cheaply through low-cost deposits. Other challenges are Greece-specific. Some local challenges reflect scars from the crisis, such as the divestment from high-growth countries outside Greece, and shortages of qualified staff, who left the banks for other jobs during the crisis. Other local challenges include high operating costs and the loss of large Greek firms to the corporate bond market.

[37] An example of a challenger bank in Greece is Viva. It has a presence in electronic payments in 23 European countries. In August 2020 Viva bought a banking license in Greece and in January 2022 JP Morgan acquired a stake of 49% in Viva. Hence, Viva has strong financial backing and is likely to expand its activities into lending across Europe.

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