Reducing non-performing loans: Stylized facts and economic impact

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Abstract[4]

Using newly collected data on non-performing loan (NPL) in more than 190 countries over 27 years as well as policies aimed at dealing with NPLs, this paper presents stylized facts about episodes of high NPLs and NPL reduction episodes. A combination of asset management companies and public funds made available for recapitalisation is shown to be more effective in terms of resolving NPLs. A typical policy-assisted NPL reduction episode starts with a sharp drop in the stock of NPLs while in later years a greater contribution to the decline in NPL ratio comes from revived credit growth. This profile enables us to focus on specific events – sharp drops in NPL ratios – and their aftermaths, using cases of persistently high NPLs as a control group. Using matching analysis, we estimate that reductions in NPLs are associated with extra growth in excess of 1.5 percentage points per annum over several years.

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1. Introduction

The global financial crisis brought the problem of non-performing loans (NPLs) into the spotlight of policy debate from India to Italy. In contrast with earlier experiences, NPLs continue clogging balance sheets of banks in many countries almost a decade after the 2008-09 global financial crisis. Both emerging markets and advanced economies have been affected: in Greece, close to half of loans were non-performing as of 2016, in Italy more than 15 percent.

Yet surprisingly little is known about the "anatomy" of a typical case of high non-performing loans and trajectory of NPL reduction. This contrasts with rich literature on typical aftermaths of a financial crisis (see, for instance, Reinhart and Rogoff, 2014), a currency crisis (for instance, Hong and Tornell, 2005) or fiscal consolidation episodes (see, for instance, Alesina et al., 2015).

The evidence on effectiveness (or lack thereof) of various policies in dealing with NPLs is equally scarce. The policy debate has been largely informed by case studies, including the United States in the 1980s (the savings and loans crisis) as well as the Nordic countries, Japan, Mexico, Korea and South-East Asia in the 1990s (see, for instance, Kliengebel, 2000; Calomiris e al., 2004; Macey, 1999; Krueger and Tornell, 1999; Woo, 2000; Fung et al., 2004; Jonung, 2009; Hoshi and Kashyap, 2010). Baudino and Yun (2017) provide a useful recent summary of lessons learned from various case studies. The debate in Europe has also been strongly influenced by competition policy considerations and the perceived need to minimize state aid provided to the banks. While insightful, case studies do not reveal how and whether various policies worked in an *average* case where they were attempted.

The evidence on macroeconomic effects of NPLs is extensive but is primarily qualitative. A loan several months, or years, overdue is a burden for both the lender and the borrower. For a debtor, an NPL traps valuable collateral and the unresolved debt makes it more difficult to obtain new funding and make investment (see, for instance, Bernanke et al., 1999). On the bank side, NPLs tie up capital, contract credit supply, distort allocation of credit and worsen market confidence (for instance, Kwan and Eisenbeis, 1995; Cucinelli, 2015; Jorda, Schularick and Taylor, 2013; Peek and Rosengren, 2000, 2005; Caballero et al., 2008). Estimates of the overall macro-level impact of high NPLs, on the other hand, are few and

predominantly derived from vector auto-regression (VAR) complicating causal interpretation of the findings (Nkusu, 2011; Espinoza and Prasad, 2010; Klein, 2013).

This paper contributes to the literature by closing these three gaps. It distils key stylised facts about instances of high NPL levels since 1990 in a large global sample as well as about policies deployed to reduce NPLs. It looks at how such policies related to the trajectories of NPLs providing insights into relative effectiveness of various policies. And it uses an event study approach to estimate the impact of reducing NPLs on economic growth. The impact analysis is complicated by the fact that NPLs themselves are often a reflection of an economic downturn, while fast economic growth can lead to a swifter drop in the NPL ratio. Our paper tackles the issue of causality by focusing on the cases of sharp reductions in NPLs. It uses matching technique to compare the aftermaths of such sharp reductions with plausible counterfactuals based on episodes where high NPLs persisted. This approach also enables us to focus specifically on NPL reductions as opposed to combining positive and negative changes in NPL ratios as is customary in VAR analysis.

The paper also contributes to the literature on the economic impact of debt relief. An event study by Reinhart and Trebesch (2016) finds that episodes of sovereign debt relief are associated with extra annual growth dividend of up to 5 percentage points. NPL reductions are conceptually similar as they stem from restructuring or writing off a large number of smaller (and typically private-sector) liabilities. We show that NPL reductions can have real effects of comparable (if somewhat smaller) magnitude.

All three parts of the analysis draw on a novel database of NPL ratios, episodes of high NPLs and policies used in the context of high NPLs. The dataset on NPLs splices bank-level data from Bankscope covering 90 percent of banks by assets and country-level data. The policy database draws on various existing databases as well as narrative evidence collected from various policy reports.

Construction of NPL episodes draws on the methodology used in the literature on the impact of fiscal consolidation (for instance, Beetsma et al.,2014; Guajardo et al., 2014; and Alesina et al., 2015). These studies employ narrative evidence to identify cases of fiscal consolidation, distinguish between expenditure-based and tax-based episodes and analyse the differential impact of fiscal consolidations on consumer confidence, output and other macroeconomic indicators.

The data reveal that NPLs are not just a by-product of (well-studied) crisis episodes: cases of high NPLs can be linked to a systemic banking, currency or sovereign debt crisis only in around 40 percent of NPL cases. NPL levels seen in the mid-2010s are not exceptional by historical standards. But if in the past cases of high NPLs tended to be of more "acute" nature while, they have recently become more "chronic". An average NPL reduction episode starts only once NPL ratio exceeds 21 percent (median value). A successful NPL reduction episode typically builds on a policy action that leads to a significant drop in the stock of NPLs, while in later years a greater contribution to the decline in NPL ratio comes from revived credit growth. Reductions kick-started predominantly by a credit boom are rare (less than 10 percent of the total) and occur mainly in countries with low debt-to-GDP ratios (the median value of 15 percentage points).

A combination of asset management companies and public funds made available for recapitalisation is shown to be more effective in terms of resolving NPLs. Using matching analysis, we estimate that reductions in NPLs are associated with extra growth in excess of 1.5 percentage points per annum over several years. This growth differential is reflected in faster investment growth in countries that reduced NPLs.

The rest of the paper is organised as follows. Section 2 reviews the literature on the complex relationship between non-performing loans and the real economy, and briefly outlines various types of policies used to reduce NPLs. Section 3 presents the data on NPL ratios and NPL policies and discusses stylised facts about a typical case of high NPLs and a typical episode of NPL reduction around the world. Section 4 discusses the link between financial sector policies and NPL reductions. Section 5 focuses on instances of sharp reductions in NPL ratios and uses matching analysis to estimate the economic impact of these reductions employing instances of high and persistent NPLs to construct plausible counterfactuals. It also discusses the overall results and illustrates various findings with a case study. Section 6 concludes.

2. Non-performing loans and the economy

Drawing on the existing literature, this section outlines the interlinkages between non-performing loans and economic performance. On the one hand, macroeconomic environment and bank-specific factors affect loan performance. On the other hand, high concentration of non-performing loans has a negative impact on the economy, slowing down the creation of new credit and worsening market expectations. This section examines both of these channels

in turn and reviews measures that can be deployed to facilitate a reduction in the stock of non-performing loans.

2.1. Determinants of non-performing loans

Factors driving NPLs fall into two broad groups: macroeconomic conditions (such as inflation, interest rate and real GDP growth) and bank-specific factors (capital ratios, quality of risk management). A wealth of papers document both.

GDP growth stands out as a key driver of NPLs. In a dynamic panel setting, Beck, Jakubik and Piloiu (2013) show that while the interest rate and share prices influence the NPL ratio, the growth rate of GDP has the greatest explanatory power. In a similar vein, Espinoza and Prasad (2010) document how lower economic growth and higher interest rates trigger an increase in non-performing loans for banks in the Gulf States. Using panel autoregressive distributed lag model, Mohaddes et al. (2017) argue that a sustained growth above 1.2 percent per annum in an advanced economy like Italy could half NPL ratio over a period of around 5 years.

Other studies have found significant relationships between asset quality and macroeconomic environment in countries such as Greece (Louzis, Vouldis and Metaxas, 2012), Spain (Salas and Saurina, 2002), Italy (Quagliariello, 2009) and Mexico (Blavy and Souto, 2009). Nkusu (2011) arrives at similar conclusions in a panel of 26 advanced economies. Klein (2013) extends these results for Central, Eastern and South-Eastern Europe, pointing out that bank-specific factors play a crucial role alongside the wider macroeconomic situation.

2.2. Non-performing loans, new lending and economic performance

High ratio of non-performing loans to total loans impacts banks' lending in several ways. A bank plagued with a high stock of NPLs is likely to prioritise internal consolidation and improving assets quality over provision of new credit. A high NPL ratio requires greater loan loss provisions, reducing capital resources available for lending and denting bank profitability. It is found to be a significant predictor of bank failures (Gonzales-Hermosillo et al., 1997; Lu and Whidbee, 2013; Barr et al., 1994). Where banks avoid failure, NPLs impact negatively on a bank's cost structure and efficiency (Maggi and Guida, 2009) and their

willingness to lend (Cucinelli, 2015). As the NPL ratio increases, banks become more risk-averse in their lending (Leon and Tracey, 2011; Hou and Dickinson ,2007).[5]

Bank lending is in turn crucial for the health of the economy as it tends to underpin both business expansion and working capital leading real GDP growth at major turning points of the business cycle (for example, Jorda, Schularick and Taylor, 2013). Lending standards are often relaxed during economic booms and tightened once the cycle turns, amplifying the impact of an economic downturn on credit volumes and quality (Rajan, 1994; Ruckes, 2004). A credit crunch serves as a transmission mechanism from greater creditor risk-aversion to weaker demand, which in turn can lead to business failures and a further increase in non-performing loans, making banks even more reluctant to lend. Such vicious liquidity spirals were observed, for instance, after the 1995 crisis in Mexico (Krueger and Tornell, 1999) and after the 1997 crisis in Indonesia (Agung et al., 2001). Delays in the recognition of loan losses can further exacerbate cyclicality of lending (Beatty and Liao, 2011).

An overhang of non-performing loans can also result in a misallocation of resources in an economy with strong bank-business interlinkages. When banks channel most of new credit to the troubled sectors and companies ("zombie lending"), they help to prevent second-round business failures but at the expense of diverting funds away from the more productive parts of the economy. This way, the lending disruption on the back of high NPLs compromises the country's long-run growth prospects (see Peek and Rosengren, 2005; Caballero et al., 2008). Large capital injections in banks are required to break this vicious circle (Giannetti and Smirnov, 2013).

In sum, to estimate the causal relationship from NPLs to economic performance cross-country studies must circumvent the problem of simultaneous causation. The most common approach builds on vector autoregressive (VAR) models where identification of the impact of NPLs relies on assumptions about the ordering of the variables within the VAR system. Although studies use different samples and dependent variables, they typically find a negative and significant impact of rising NPL ratios on GDP growth and employment. Such effects tend to persist for several years after the initial NPL shock (Nkusu, 2011; Espinoza and Prasad, 2010) and can also be seen when it comes to employment, at least in Emerging Europe in the aftermath of the 2008-09 financial crisis (Klein, 2013). Kaminsky and Reinhart

[5] Some studies question the causal nature of the link between NPLs and lending. Accornero et al. (2017) argue that in Italy NPLs and lack of credit growth have both been manifestations of poor business conditions.

(1999) further find that a large increase in the NPL ratio serves as a reliable predictor of financial crises.

2.3. Dealing with non-performing loans

When it comes to resolving NPLs, identifying the problem is the first step. Banks need to transparently and credibly assess the quality of their assets and build up provisions against expected losses. A credible guidance to markets can help to restore market confidence damaged by rising NPLs.

Relying on banks' voluntary efforts to resolve NPLs may not be sufficient even when NPLs are recognised. The regulator may guide banks as to the optimal use of their capital buffers and determine target loan loss provisions. Banks may need to develop special capacity to deal with NPLs – another area where the regulator may step in.

Creating a good legal framework for corporate restructuring and timely disposal of NPLs is crucial, in particular when judicial capacity to deal with NPLs case-by-case is lacking (see Laeven and Laryea, 2009). Centralised out-of-court debt workout programme were actively used by governments in Korea, Thailand, Indonesia and Malaysia in the 1990s (Woo, 2000); Serbia adopted a consensual restructuring framework for debt of small enterprises in 2012.

We further consider five types of financial sector policies targeting reduction in NPL ratio: the establishment of an asset management companies, provision of bailouts to the financial sector (for instance, public funds for bank recapitalisation), changes to macroprudential regulation, changes to loan classification and changes to provisioning stringency.

The first type of policies encourages development of a secondary market for NPLs. One option is to create a "bad bank" or asset management companies (AMCs) that enable commercial banks to transfer NPLs from their balance sheets to a specialised entity at a fair (market) value. The AMCs can in turn securitise the impaired loans and resell them in a secondary market, use their expertise to partially recover bad loans or initiate foreclosure with the view to monetise collateral attached to bad loans.

This route was followed for example in Sweden and Mexico in the 1990s (Macey, 1999; Krueger and Tornell, 1999). Similarly, public or private asset management companies created in the aftermath of the Asian financial crisis assembled assets valued at up to 20 percent of GDP and achieved a significant degree of value recovery (Woo, 2000; Fung et al., 2004).

More recently, in 2016, the Italian government reached a deal with the EU allowing it to attach a government guarantee to a subset of the €350m of NPLs. Such guarantees help to bridge the difference between the asking price of NPLs and the price potential buyers would be willing to pay, a gap that often remains large in cases where weak contract enforcement creates strong asymmetry of information (Garrido et al., 2016).

Majority of AMCs globally are publicly funded. Alternatively, banks may establish internal AMCs by ring-fencing funds for a special internal workout department. Internal AMCs have the same objective as public AMC: to recover maximum value from a portfolio of impaired assets. In a few cases, governments directly used deposit insurance funds to acquire non-performing assets. This option is, however, less popular as it may compromise the ability of deposit insurers to perform their core function.

Alternatively, public funds can be used to recapitalise ailing banks directly. Such bailouts allow for full provisioning of non-performing exposures and their write-off or sale at discounted prices. Policy packages often combine establishment of AMCs with the use of public funds.

The third block of policies are macroprudential measures that target behaviour of financial institution through limits on leverage, maximum interbank exposures, concentration ratios, capital surcharges on systemically important financial institutions, reserve requirements or similar parameters. Macroprudential measures can also target borrowers by imposing limits on loan-to-value or debt-to-income ratios.

Changes in the stringency of loan classification stringency and provisioning may also have an impact on NPL resolution. Forcing banks to recognise and fully provision NPLs generally strengthens incentives to resolve or write-off non-performing assets. At the same time, a change towards stricter loan classification may actually result in an increase in *reported* NPL ratios.

This list of policies is not exhaustive but it accounts for a major bulk of actions historically taken to reduce NPL ratios. Examples of other measures include changes in tax treatments of NPLs that remove disincentives to write non-performing loans off for banks and borrowers.

3. An anatomy of NPL reductions

3.1. Constructing data on NPL ratios

In this section we present key stylized facts about episodes of high non-performing loans and NPL reductions. A non-performing loan is a loan where the full repayment of the principal and interest is no longer expected. Typically, the principal or interest would be at least 90 days in arrears, although the precise definition of an NPL loan varies across jurisdictions. This complicates international comparisons. In the absence of a universally applied definition of NPL, however, there is little a researcher can do to remedy the situation.

As this paper primarily focuses on changes in non-performing loans within each country, different definitions should not bias the results as long as country-specific approaches to classifying NPLs do not undergo major changes. The dataset inevitably lacks episodes where regulatory forbearance results in NPLs being severely underreported. In countries practicing "directed lending", this would often be the case. In that sense, the stylized facts about NPL reduction episodes and any estimates of economic impact of lower NPLs should be viewed as conditional on the authorities willing to recognize the NPL problem in the first place.

Our source of data on country level non-performing loans is the World Development Indicators (WDI) database of the World Bank cross-checked with the New Dataset on Financial Structure and Development (Beck et al., 2000, updated) and complemented with bank-level information available in Bankscope, aggregated to the country level. The initial country-level dataset is an unbalanced panel covering 134 countries over the period 1997-2016. The data are then cross-checked against a bank-level database, Bankscope, and extended with additional observations. Bankscope reports the NPL ratio for banks in 190 countries since 1980, with a significantly more complete coverage for the period 1990-2015. Bankscope database covers approximately 90 percent of bank assets (see Cunningham, 2001).

The combined dataset is constructed using a splicing procedure based on de la Fuente Moreno (2014). The new spliced $\widehat{NPL^s}$ time series for each country is estimated by extending the WDI series backward when Bankscope measure is available. We preserve the last WDI observation and use growth rate of Bankscope NPL to retropolate the spliced NPL. We then use the ρ coefficient to adjust for differences in levels inferred from the cross-country databases and from Bankscope. The new spliced NPL measure is equal to:

$\widehat{NPL_t^S} = NPL_t^{WDI} + \hat{d}_t^m$ for $1990 \leq t \leq T$, where T is the linking year, when first country-level NPL data are available while Bankscope data are also available for preceding years. The mixed splicing distance measure is given by $\hat{d}_t^m = d_T \rho^{\frac{T-t}{t}}$ with a convergence coefficient $\rho = 0.3$. The average distance between the two time series at the linking point is defined by $d_T = \ln(\frac{NPL_T^{WDI}}{NPL_T^{BS}})$. Only observations with NPL within the 0 to 100 percent range are preserved.

In addition to extending time coverage for 134 countries that report at least one year of WDI data, we use the average difference between WDI and Bankscope to update the NPL data for 60 countries with observations available in Bankscope only. First, we calculate the average distance between WDI and Bankscope data at all linking points $\bar{d}_T$. Second, we update the Bankscope measure as follows: $\widehat{NPL_t^S} = \exp[\ln(NPL_t^{BS}) + \bar{d}_T]$.

The resulting dataset comprises 3,537 country-year observations in 194 countries between 1990 and 2016. Chart 1 illustrates the splicing procedure for Argentina, with WDI and Bankscope series exhibiting similar trends. Chart 2 summarises the procedure for the average NPL ratio across the entire sample.

3.2. Evolution of NPLs over time

The (unweighted) average NPL ratio across all countries jumped in the 1990s and peaked at almost 12 percent in 1999, in the immediate aftermath of the Asian and Russian crises (Chart 3). It then started declining swiftly and was further pushed down by the credit boom in the run-up to the global financial crisis. It bottomed out at around 5 percent in 2007. The pattern is similar for the median.

In the aftermath of the global financial crisis the average quality of bank assets deteriorated less quickly than in the 1990s, with a jump of 2 percentage points between 2007 and 2009. However, rather than declining afterwards, the average NPL ratio has resumed an upward drift, exceeding 8 percent by 2014. As a percentage of GDP, average NPLs plateaued at around the peak levels reached briefly in 1998-99.

In other words, the magnitude of today's NPL problem is not unprecedented. Yet if in the past NPL episodes appeared to be of "acute" nature, the more recent episodes tend to be "chronic", slowly but steadily building up as economic growth and credit expansion slow down.

Furthermore, only 40 to 48 percent of instances of high NPL ratio (exceeding 7 percentage points) can be linked to a banking, currency or sovereign debt crisis that occurred between 1990 and 2012 based on the data reported by Laeven and Valencia (2012). The opposite is also true: 38 percent of banking crises were followed by high NPLs while the majority were not. This highlights the value of analysing the episodes of high NPLs in historical perspective as these are more than just by-products of the (relatively well-studied) crises.

All in all, cases of elevated NPLs have been common: 165 out of 190 countries in the dataset experienced NPL ratios in excess of 7 percent at some point (the baseline analysis uses a 7 percent threshold for high NPL ratios, a ratio that is around 2.5 percentage points above today's median; alternative thresholds are used as robustness checks).

3.3. Data on policies addressing high NPLs

The database also puts together information on various policies aimed at resolving NPLs and adopted across countries. Data on asset management companies is taken from the Building Better Bad Banks project by Hallerberg and Gandrud (2015). A dummy variable is equal to one if an AMC was operating in the past 3 years. Where the data on AMC closure is not available, an AMC is assumed to have an average life span in the sample -- 8 years. The database contains information on 139 cases of AMCs (109 public, 20 internal, 8 backed by deposit insurance and 2 unclassified) across 62 countries during the period 1990-2016.

The data on financial sector bailouts is taken from Bova et al. (2016) and covers bailouts during systemic banking crises as well as stand-alone interventions. The database includes 95 recorded cases of financial sector bailouts across 66 countries. For 83 of those episodes, the data includes estimated fiscal costs of recapitalisation, averaging 9.7 percent of GDP.

Cerutti, Claessens and Laeven (2015) are our source of data on changes in macroprudential policies. We use the positive changes in the values of the macroprudential policy index (MPI) as an indication of regulation being tightened (in other words, the dummy variable is coded one when MPI increased and zero otherwise). The database covers 119 countries from 2000

to 2013, with 135 cases of macroprudential tightening in 76 countries. In contrast, the instances of macroprudential loosening are limited to Bulgaria in 2008 and Serbia in 2013.

The stringency of loan classification is proxied by the total number of days of delinquency after which a loan is classified as sub-standard, doubtful or lost (combining the three categories), building on Barth et al. (2001, updated 2014). The data comes from surveys of 127 central banks conducted in 1999, 2003, 2007 and 2011 (with values in between extrapolated). The average loan classification measure is 18 months, ranging from 4 months to over 3 years across countries.

The provisioning stringency (taken from the same source) is proxied by the sum of the minimum required provisions as loans become substandard, doubtful and loss (this sum averages 120 percent).

The data points constructed from the above sources were cross-checked against, and complemented with, narrative evidence regarding policy response, if any, in instances when NPL ratios were high. The narrative evidence was collected by looking at published case studies, newspaper articles, reports of governments and international organisations.

3.4. Episodes of high NPLs and NPL reductions

In our analysis of NPL reductions we look at sustained drops in NPLs that over a number of years amounted to a reduction of 7 percentage points or more. For each such occurrence we record the length of the period of reduction, from the first year in which the NPL ratio is smaller than in the preceding year to the last year in which the ratio does not exceed the value in the preceding year. Occasionally, the NPL ratio increases briefly before falling again. Such occurrences are not considered to break an NPL reduction period as long as they are limited to a single year and involve a relatively small increase in NPL ratio (of less than 1.6 percentage points). Countries that suffer from recurrent NPL problems may have multiple NPL reduction periods (assumed to be independent draws from the same data-generating process). We identify 104 episodes when NPL ratios above 7 percent persisted for four years or more and 178 episodes of NPL reduction. A typical episode of high and persistent NPLs lasts for 6 years, with NPL ratio rising by 1.5 percentage points a year, although some episodes stretched to up to 17 years and remained ongoing as of 2016 (see Table 1).

Some sort of policy action was taken in almost all instances of high NPLs and policy packages typically combined multiple types of measures discussed above. Of these, state

support has been the most widespread (Chart 4). In fact, introduction of AMCs was accompanied by the use of public funds in 36 percent of cases as public recapitalisation can facilitate creation of secondary market for NPLs as well as tightening of provisioning or classification rules. And while much of the policy debate centres on the establishment of market for distressed debt, with reference to the experiences of the Nordic countries in the early 1990s and South-East Asia in the late 1990s, recapitalisation packages have been more often accompanied by straight debt write-offs (implemented in around 60 percent of such episodes) than by creation of AMCs or bad banks. In Europe, developed secondary NPL markets are largely limited to Ireland and Spain, with attempts to set one up in Greece (see ECB, 2017).

If policy measures were successful and a significant reduction in NPLs was achieved, the NPL ratio broadly followed an average profile shown in Chart 5. At first, a country's NPL ratio rises fast as growth of performing credit slows down and eventually turns negative. Once the ratio peaks (at a median value of 21 percent), the NPL ratio drops equally fast. During the first two years this drop is strongly driven by the reduction in the stock of non-performing assets (the numerator of the ratio). As credit growth resumes, from years 3 onwards the declines in NPL ratio become primarily driven by the growing denominator of the ratio. A typical NPL reduction episode lasts for five years and NPL ratio eventually declines to a median level of 4.4 percent – comparable to 3.5 percent average ratio in countries that do not experience high NPLs (see Table 2).

The following formula can be used to compute the relative contributions of the decline in NPL stock and credit growth to the overall magnitude of a reduction in NPL ratio:

$$loans\ share = \frac{-overall\ loans\ growth}{overall\ NPL\ growh - overall\ loans\ growth} * 100 \quad (1)$$

The calculation is equivalent to comparing the hypothetical reduction in NPL ratio that would have been achieved holding initial stock of NPLs constant with the one that would have been achieved holding the stock of total credit constant. The median contribution of credit growth at the start of an NPL reduction episode turns out to be 20.4 percent. In other words, a drop in NPLs is considerably more likely to be followed by a revival in credit growth than the other way round.

In some instances, NPL reductions were kick-started predominantly by credit growth (for example, in Bangladesh in the 2000s). However, such occurrences are rare: credit growth

contributed more than 70 percent to the initial drop in NPL ratio in less than 10 percent of cases. Furthermore, these instances are concentrated in countries with shallow financial sectors, with a median credit-to-GDP ratio of 15 percent compared with 45 percent in countries where high NPLs persist. In sum, a strong upturn in credit growth is a theoretically possible but empirically improbable solution to most of today's instances of high NPLs.

3.5. Episodes of sharp drops in NPL ratio and the estimation strategy

The analysis of the economic impact of policy-assisted NPL reductions can exploit the fact that a typical episode starts with a sharp drop in NPL ratio typically accounted for by a drop in the stock of NPLs, followed by a phase of more gradual reduction. Focusing specifically on the episodes that contain a "steep" initial phase can help to better identify the causal impact of a drop in NPL ratio on *subsequent* rather than *concurrent* economic performance.

Overall, in 143 cases (close to 80 percent of the total number) a drop of at least 5 percentage points in the NPL ratio occurs within a single year at the start of an NPL reduction episode. In 75 of these cases at least a 10 percentage point reduction occurs within a single year. And in further 38 episodes a 10 percentage point drop happens within two years. Only in six cases the steep drop occurs towards the middle or the end of an episode rather than at the start. The baseline analysis focuses on the episodes that feature a 5 percentage point drop in a single yea at the start of an episode or a ten percentage point drop over two years (the events of interest in our study). The strategy is to compare these episodes with otherwise similar cases where NPL ratios failed to come down.

The analysis proceeds in two steps. First, we look at the link between various policies and the NPL trajectory, including the likelihood of observing a sharp drop in NPL ratio. This exercise complements a separate study by Plekhanov and Skrzypinska (2017) who identify statistically and economically significant relationship between financial sector policies and NPL reductions by looking at the impact of policy measures in a given jurisdiction on NPLs of subsidiary banks operating in other jurisdictions compared with NPLs of other banks in host countries.

Second, we look at the impact of a sharp drop in NPLs on economic outcomes by comparing evolution of economic indicators after a sharp drop in NPLs with economic outcomes during episodes of high and persistent NPLs that are similar in terms of their initial characteristics.

The rationale for the two-step approach (schematically presented in Chart 6) is the likely absence of the direct impact of NPL resolution policies on growth, investment or other outcome variables. Financial sector policies can target NPL levels. Reductions in NPLs may, in turn, affect economic outcomes by removing the burden of non-performing assets from the balance sheets or banks and corporates and boosting business confidence.

4. The link between NPL policies and NPL reductions

4.1. Effect of various policies on NPLs

We start by looking at the link between various policies and NPL reductions. We are specifically interested in how policies are related to the events used later to identify the impact of NPL reductions on economic outcomes. In particular, we look at (i) the likelihood of a sharp drop in NPLs within three years of a policy being put in place and (ii) the magnitude of the subsequent NPL reduction, conditional on a sharp drop occurring. For this reasons, we estimate the following two-part model:

$$P(SRD_{c,t} = 1) = \Phi(\beta_0 + \gamma Policy_{c,t} + \lambda X_{c,t} + \varepsilon_{c,t}) \quad (2)$$

$$SR_{c,t} | [SRD_{c,t} = 1] = \beta_1 + \mu Policy_{c,t} + \delta X_{c,t} + \nu_{c,t} \quad (3)$$

The first stage links the likelihood of a sharp drop in NPL ratio in country *c* and time period *t* to a vector of policy dummy variables (*Policy*). These variables take a value of one if a corresponding policy was in operation at some point during the preceding three years. The set of control variables *X* includes the initial value of the NPL ratio and macroeconomic variables such as the logarithm of GDP per capita at purchasing power parity (PPP), growth of GDP per capita, consumer price inflation and an index capturing the strength of insolvency resolution frameworks. The sample is restricted to instances of NPL ratio above 7 percent.

The second stage links the magnitude of a sharp drop in NPLs (*SR*) conditional on a sharp drop taking place (*SRD* = 1) to the set of policy variables and controls defined above. The model is estimated as a two-part model following the framework of Belotti et al. (2015). This framework assumes a gamma distribution of the size of the overall reduction in NPLs conditional on achieving a sharp reduction and an identity link function. The choice of the two-part model approach is dictated by the fact that we do observe all changes in NPLs (unlike, for instance, in Heckman selection framework) but we are specifically interested in

the link between policies and events defined as sharp reductions in NPL ratio. The results are reported in Table 3.

The use of asset management companies is associated with a statistically and economically significant increase in the likelihood of achieving a sharp drop in NPLs. NPL reductions in the presence of AMCs are, on average, around 3 to 5 percentage points larger than could be otherwise expected. Provision of financial sector bailouts, on the other hand, has no significant impact and, if anything, somewhat reduces the likelihood of a sharp drop in NPL ratio.

As macroprudential tightening is designed to work as a countercyclical tool to prevent build-up of NPLs (see, for instance, Bruno e al., 2017), it has little detectable impact in a situation when NPL ratios are already high. If anything, it may be associated with lower reductions in NPLs as macroprudential tightening may limit options for refinancing and restructuring of existing exposures.

Higher initial NPL ratios are associated with larger NPL reductions provided one is achieved. NPL reductions are more likely to occur in lower-income economies that experience higher growth. Countries with better insolvency resolution framework and more efficient judiciaries are less likely to be in a situation of high NPLs (see Cerulli et al., 2017). Indeed, NPLs average 5.7 percent in the quartile of countries with the strongest frameworks versus 8.7 percent in the bottom quartile of countries. At the same time, once NPLs rise, countries with better insolvency resolution frameworks are less likely to experience large reductions in NPLs – perhaps because a strategy of holding on to problematic exposures and seeking resolution looks more attractive.

4.2. Policies as a package

While estimates point towards relative effectiveness of AMCs and ineffectiveness of bailouts, in almost 40 percent of cases these policies were combined as a package. Indeed, effective market for NPLs may necessitate relatively low prices associated with transfer of non-performing assets leaving banks with capital shortfalls. Higher transfer prices, on the other hand, may require higher injections of capital into AMCs.

To check for any complementarities between the use of AMCs and public funds for recapitalisation, the exercise is repeated distinguishing between three types of interventions: AMC only, provision of bailouts in the absence of AMCs or a combination of AMCs and

public funds made available for recapitalisation. The first two columns in Table 4 report estimates for the likelihood of a sharp drop in NPLs, as before. The dependent variable in the last two columns is now the reduction in NPL ratio over the course of an episode, irrespective of whether a sharp reduction event occurred (the results using two-part model are similar).

Public bailouts have no significant impact on NPLs, in line with earlier estimates, while AMCs are associated with a higher likelihood of a sharp drop in NPLs and a greater magnitude of a reduction in NPLs. However, the effect of AMCs on both the likelihood and the magnitude of NPL reduction is estimated to be around 2.5 times greater if AMCs are used in conjunction with public funds being available for recapitalisation. We do not find any significant effects of changes in loan classification and provision stringency (results are available upon request).

5. The economic impact of NPL reductions

5.1. Methodology

With the relationship between financial sector policies and reductions in NPL ratios in mind, this section, in turn, investigates the link between falling NPL ratios and economic outcomes. Our methodology aims to deal with both the reverse causality running from higher economic growth to lower NPL ratios and non-random nature of episodes of NPL reductions, linked to non-random nature of adoption of NPL policies.

To provide a better insight into causal relationship, we focus on the aftermaths of sharp drops in NPLs (the treatment group, $SD_i = 1$). To alleviate concerns about countries' selection into the group of NPL reduction episodes, we use matching to produce plausible counterfactuals. In particular, the control group are episodes of high and persistent NPLs ($SD_i = 0$). The matching takes into account a set of variables X available for each episode i. These include GDP growth and inflation during the year of the sharp drop (year zero) as rising prices may help to inflate the burden of non-performing debt away. In various specifications we also match on GDP per capita at PPP, GDP growth during the preceding year, the public debt-to-GDP ratio (that may affect availability of fiscal space to implement policy packages), private sector credit-to-GDP ratio (capturing the level of financial development), the NPL ratio, investment-to-GDP ratio and unemployment rate. We focus on five economic outcomes (y): growth of GDP per capita, investment growth, growth of exports, consumption growth, and unemployment rate. We are interested in estimating the average treatment effect on the

treated (ATT), the expected difference between the observed outcomes in the treatment group y_{1i} and the counterfactual economic outcomes that would have occurred in the treatment group in the absence of treatment y_{0i}:

$$ATT = E[y_{1i} - y_{0i} \mid SD_i = 1] \quad (4)$$

To calculate the ATT, we draw on kernel propensity score matching with a common support requirement (Rosenbaum and Rubin, 1983) by estimating differences conditional on a set of observed covariates X:

$$E[y_{1i} - y_{0i} \mid SD_i = 1] = E[E(y_{1i}|X_i, SD_i = 1) - (y_{0i} \mid X_i, SD_i = 0)| SD_i = 1] \quad (5)$$

For each episode from a treatment group, the algorithm selects a set of episodes from the control group which resemble closest the treated episodes, based on the estimated propensity to belong to the treatment group conditional on the set of economic characteristics X. The weights attached to control observations are inversely related to the distance in terms of the estimated propensity scores. Under the assumption that the conditioning variables capture all the relevant differences between the treatment and control groups, this procedure creates a valid estimate of the causal effect of reduction in NPL ratios (ATT).

5.2 Results of the matching analysis

Sharp reductions in NPL ratio are associated with extra GDP growth of more than 1.5 percentage points per annum over several years (compared with the cases of high and persistent NPLs, see Table 5). The growth effect kicks in around 2 years after the start of the episode and peaks around year 4; the differentials are statistically significant in most years and cumulatively over the episode, notwithstanding a small sample size.

These growth differentials accumulate over time when it comes to the level of GDP per capita (see Chart 7). The trajectories of output for the treated and controls are similar up and including the year when a sharp drop in NPLs occurs with a stark divergence in paths from year two onwards, exceeding 12 percentage points by year 5.

Stronger growth appears to be underpinned by rebounding investment. The estimated differences in investment growth between the treatment and control group are large (Chart 7) and statistically significant in most years and specifications. The impact on exports is more volatile and appears to be weaker than on investment or consumption, possibly due to

exporters' ability to access credit against international receivables and their lower sensitivity to domestic credit conditions.

5.3. Example: The case of the Philippines

The case of the Philippines provides a useful illustration of various estimated relationships. Following the Asian crisis of 1997, the Philippines experienced several years of high and persistent NPLs: the NPL ratio jumped to 12.4 percent in 1998 and climbed further peaking at 27.7 percent in 2001.

A policy package aimed at cleaning up bank balance sheets included introduction of AMCs supported by availability of bailout funds and other measures. In particular, the Special Asset Management Companies Law of 2002 created the legal basis for operation of private AMCs, and introduced tax and other incentives for setting such vehicles up. At the same time, it limited to 5 percent a bank's ownership of any AMCs that purchases assets from its balance sheet (Fung et al., 2004) thus increasing the likelihood of a genuine market for non-performing assets being created. In addition, the Privatisation and Management Office was established in 2001 to deal with government's banking assets. Financial sector recapitalisation funds provided by the government are estimated to have totalled 13.2 percent of GDP (Laeven and Valencia, 2012).

The introduction of the policy package was followed by a sharp drop in NPL ratio (which fell to 14.6 percent at end-2002). NPL eventually declined to 5.6 percent in 2007, representing an overall NPL reduction of 22 percentage points over a six-year episode.

Economic growth picked up from an average of 2.5 percent in 1998-2001 to 3.6 percent in 2002 (the year of the initial sharp drop in NPL ratio) to the average of 5.7 percent over the subsequent five-year period (2003-07).

5.4. Discussion

If the links between policy packages and NPL reductions are strong and reductions in NPL ratios yield large growth dividends, why have measures to reduce NPLs not been deployed on a larger scale? In part, this may be because policies that are found to have been effective in dealing with NPLs – such as a combination of AMCs and use of bailout funds – are costly. On average, they are estimated to have cost around 10 percent of GDP. Some of these funds

may be eventually recovered, for instance in the form of return on public shareholding in banks or AMCs, others may be written off.

Even so, from a social perspective the net present value (NPV) of future gains in GDP appears to clearly justify the initial fiscal cost. If future output is discounted at 8 percent, an assumption based on the cost of funding for an emerging market with a modest credit rating, the infinite-horizon NPV of additional output is estimated at more than 40 percent of today's GDP (this calculation conservatively assumes that only 20 percent of the difference in output between an NPL reduction scenario and a high-NPL scenario persists after year 6). Stricter assumptions may yield lower estimates but the NPV of associated extra taxes exceeds the initial fiscal outlay in most calculations.

At the same time, the balance of cost and benefit may be less straightforward over a horizon of up to 4 years – the length of a typical electoral cycle. The NPV of extra output generated over this period is between 4 and 9 percent of today's GDP, depending on how fast NPL ratio responds to the policy package. This highlights why policies aimed at reducing NPLs – similarly to long-term infrastructure projects – may not always be politically attractive even if their life-cycle socio-economic benefits are convincingly documented.

In addition, there is a stochastic element to this calculation: NPL policies raise the likelihood of a sharp drop in NPLs but their success is not guaranteed and depends on the design and implementation of the policy package. Centralised solutions to the overhang of NPLs involving well-capitalized state-backed bad banks or asset management companies require strong administrative capacity and appropriate legal regimes. In some cases the authorities' administrative – rather than fiscal – may be a binding constraint.

5.5. Robustness checks

We run a series of robustness checks. The first set of checks excludes episodes of NPL reduction where credit growth made a sizable contribution at the start of an episode. Credit growth contribution exceeded 80 percent only in 6 cases and in further 9 cases it ranged between 70 and 80 percent (the corresponding specifications are presented in columns (1) and (2) of Table 6). The results also hold for stricter requirements with respect to contribution made by the initial drop in the stock of NPLs.

The second set of checks use various permutations of variables on which episodes are matched, as well as their lagged valued. These include the NPL ratio, investment-to-GDP

ratio, private credit-to-GDP ratio and the unemployment rate as well as the Worldwide Governance Indicators as a proxy for the quality of institutions (political stability, rule of law, regulatory quality), selected questions from the World Bank's Bank Regulation and Supervision Survey that look at the asset quality and provisioning rules, and the World Bank Doing Business indicators of the depth of the credit market, ease of insolvency proceedings and the strength of legal rights (extended sets of results are available upon request).

We also test the robustness with respect to the magnitude of NPL ratio reduction used to identify various episodes. The baseline analysis uses a 7 percent cutoff for episodes of high and persistent NPLs and a 7 percentage point drop for episodes of NPL reductions. The results are qualitatively similar if higher cut-offs are used, for instance 15 percent (see Column 5).

A stricter definition can also be applied to the sharp drops in NPLs at the start of the episodes used as the treatment group. A 7 percentage point drop in the first year (or a 10 percentage point drop over two years) leaves up to 90 treated episodes satisfying the common support requirement. The estimated growth differentials are, if anything slightly higher than those reported in Table 5 (see Table 7).

6. Conclusion

The paper constructed a novel panel dataset of NPL ratios since 1990 covering more than 190 countries as well as a novel dataset of financial sector policies targeting NPL reductions. Having identified episodes of high NPLs and NPL reductions, the analysis covered the "anatomy" of a typical episode of high NPLs, the effectiveness of policies aimed at reducing NPLs, and the impact of sharp drops in NPL ratios on economic growth and other economic outcomes.

The analysis shows that episodes of high NPLs are more than just by-products of (relatively well-studied) crises: only 40 to 48 percent of cases of high NPLs can be linked to a banking crisis, currency or a sovereign debt crisis. NPL levels seen in the 2010s are not exceptional by historical standards. But if in the past instances of high NPLs were of "acute" nature, today's malaise is more "chronic", with NPLs building up slowly and persisting. Episodes of high NPLs typically last for 6 years while NPL reductions tend to start after NPL ratio surpasses 21 percent.

Countries tend to eventually adopt packages of measures aimed at resolving NPLs. What appears to work best is a combination of availability of public funds (bailouts) and establishment of specialised asset management companies (a market-based solution). This package is 2 to 3 times more likely to achieve a fast and large reduction in NPLs than introduction of AMCs as a stand-alone measure while financial sector bailouts in the absence of AMCs have no statistically or economically significant impact on NPLs, at least within a three-year window.

A typical NPL reduction episode starts with a sharp drop in NPL ratio driven primarily by falling stock of NPLs. Occasionally credit expansions results in a rapid fall in NPL ratio – but such cases are rare and are predominantly found in shallow financial sectors (with a median credit-to-GDP ratio of 15 percentage points).

Once a steep drop in NPLs occurs, economic growth improves by more than 1.5 percentage points a year over several years. This is reflected in higher investment growth. The estimated effect is of similar order of magnitude compared with the growth impact of sovereign debt restructurings estimated by Reinhart and Trebesch (2016).

From a medium-to-long-term perspective, returns to policies aimed at reducing NPLs are high. Yet high upfront fiscal costs combined with the delayed onset of benefits may make the proposition insufficiently attractive to politicians with short electoral horizons. In other cases, administrative capacity required to implement a coordinated policy package and develop a secondary market for NPLs may be a binding constraint.

Overall, the findings can be viewed as both good and bad news for the economies burdened with non-performing loans. The good news is that policy packages can be effective in terms of reducing the NPLs and lower NPL burden is, in turn, associated with significant economic benefits in the medium term. Past episodes of high NPLs provide valuable insights into package of measures that can help banks and corporations clean their balance sheets. The not-so-good news come from the anatomy of the past NPL episodes. A successful NPL resolution may be particularly challenging when the malaise is more chronic than acute, debt levels are high, the use of public funds for recapitalisation is restricted and political horizons are short.

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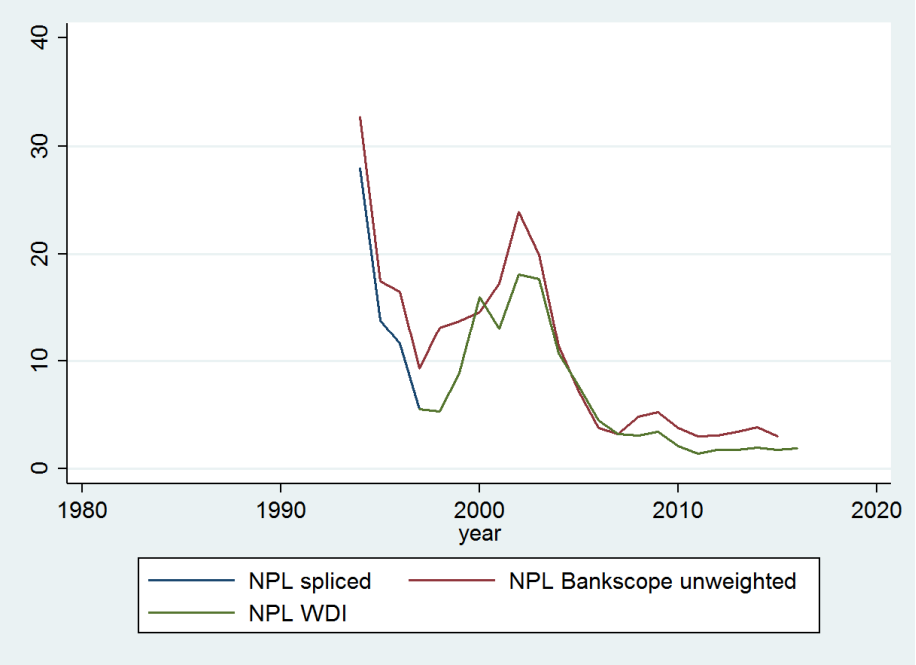
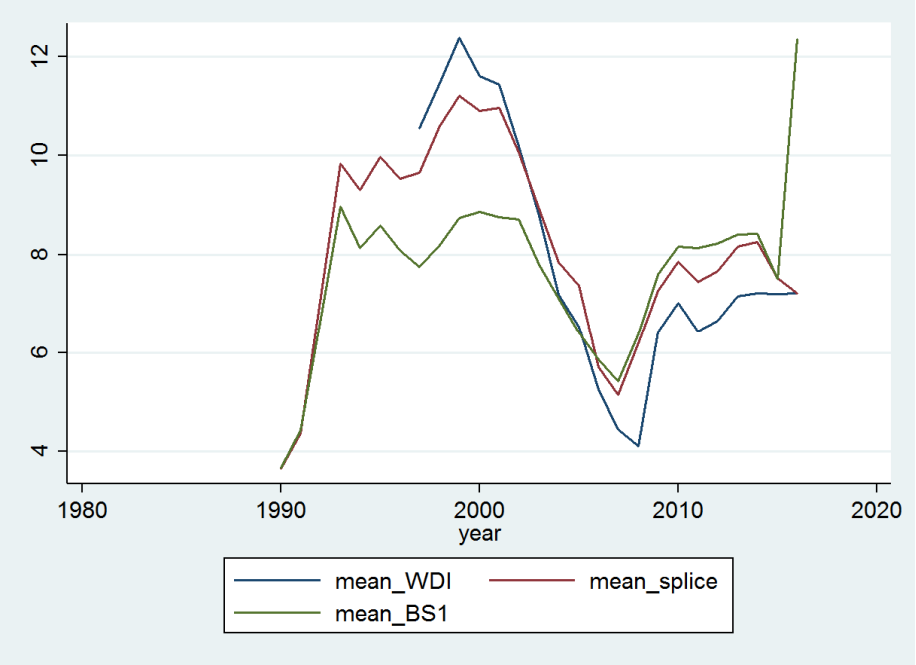
Chart 1. Data splicing: An example for Argentina



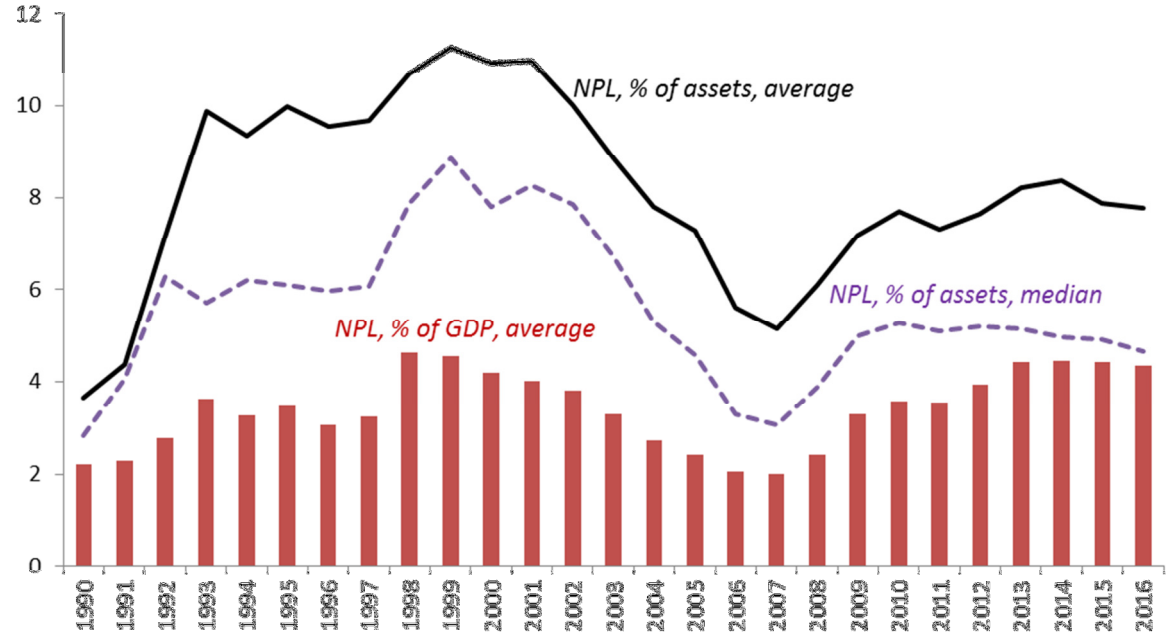
Note: The chart presents NPL series based on cross-country data, bank-level data and spliced.

Chart 2. Data splicing: Average rates for the sample



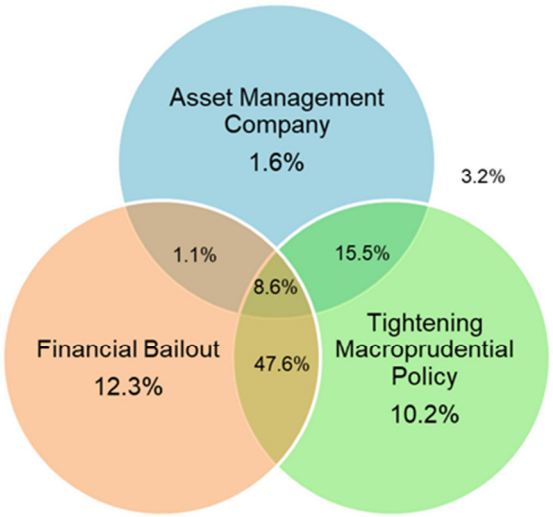
Note: The chart presents NPL series based on cross-country data, bank-level data and spliced, averages across all countries.

Chart 3. Average and median NPL ratios



Note: Simple averages or medians across all countries in the sample.

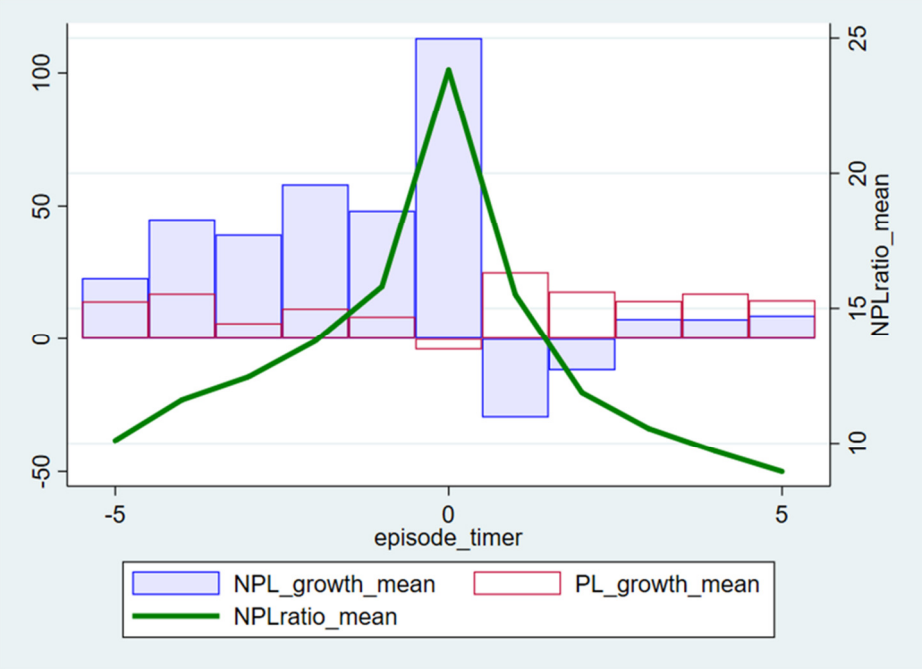
Chart 4. Overlap between various types of policy measures



Source: Authors' calculations.

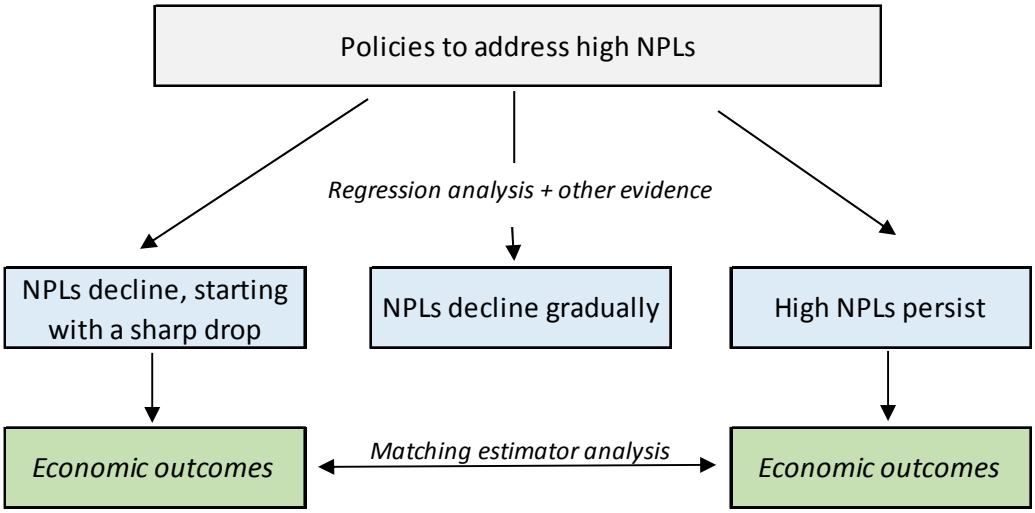
Note: Calculation across all episodes of high NPLs and NPL reduction.

Chart 5. A typical pattern of NPL reduction



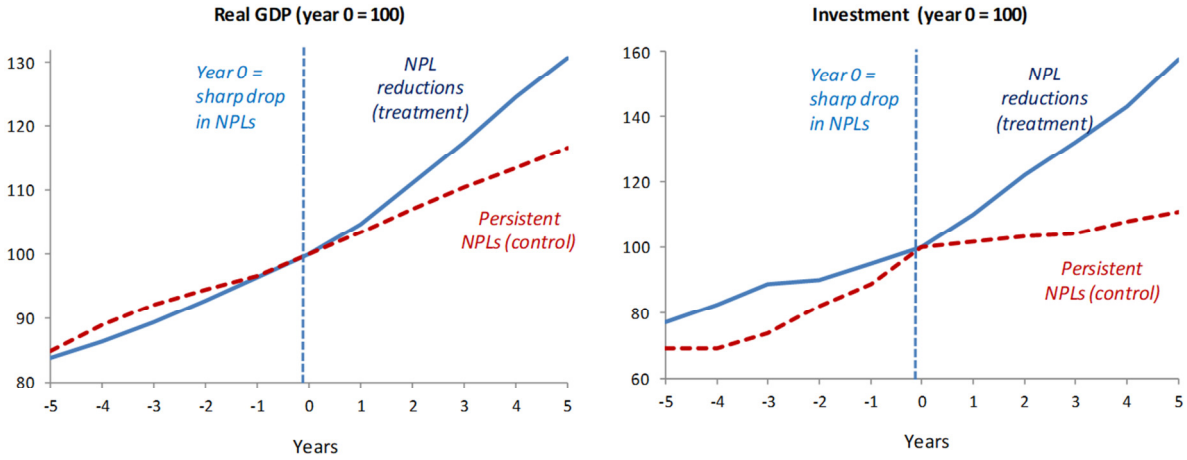
Note: The chart shows average values of selected indicators over the course of an NPL reduction episode which starts in year 1.

Chart 6. Two-stage approach



Note: The chart summarizes the analytical framework adopted in the paper.

Chart 7. Output trajectories with and without NPL reduction (year 0 = 100).



Note: Based on the matching estimator where the treated group are cases of high NPLs where a sharp reduction in NPL ratio occurs in year 0; the control group are cases where high NPLs persist. Propensity score kernel matching with common support, on economic growth in year 0, the level of NPLs and a number of other variables.

Table 1. Characteristics of episodes of high NPLs

	Mean	St. dev.	Median	Min	Max
High and persistent NPLs					
Length	5.9	2.0	5.5	4.0	17.0
Initial NPL ratio	11.4	5.3	9.5	7.0	42.4
Change in NPL ratio	8.1	8.5	6.8	-6.7	37.0
NPL ratio at the end	19.5	9.9	18.0	7.0	59.8
NPL reduction episodes					
Length	5.8	3.3	5.0	2.0	15.0
Initial NPL ratio	24.0	13.8	21.2	8.0	95.3
Change in NPL ratio	-17.4	10.9	-14.2	-69.4	-7.1
NPL ratio at the end	6.7	7.5	4.4	0.1	66.4

Note: NPL reduction episodes have a minimum drop in NPL ratio of 7 percentage points; episodes of high and persistent NPLs have a minimum duration of 4 years.

Table 2. Average values for selected variables, by episode type

	Reductions in NPL ratio			*High and persistent NPLs*	*NPLs not high*
	All	*With a sharp drop*	*Other*		
NPL ratio (start)	23.92	25.90	13.77	11.37	3.50
NPL ratio (end)	6.64	7.22	3.68	19.45	3.56
GDP per capita at PPP (start)	13,137	11,591	20,816	15,433	19,980
GDP growth (start)	3.02	3.36	1.31	3.11	4.24
Public debt, % GDP (start)	64.19	66.96	53.54	54.20	48.72
Inflation, % (start)	7.19	7.40	6.21	4.72	4.86
Private sector credit, %GDP (start)	31.09	26.79	51.29	45.44	55.30
Annual GDP growth	5.51	5.85	4.46	2.90	3.66
Annual investment growth	9.49	10.40	6.73	4.75	5.12
Annual consumption growth	5.07	5.50	3.78	2.79	3.99
Export growth	7.98	8.59	6.12	5.64	4.70
Unemployment rate (start)	9.76	9.97	8.72	9.61	8.80
Unemployment rate (end)	8.75	9.06	7.22	10.23	8.12
Number of episodes	178	149	29	104	144

Note: Averages in percent across all years in an episode, unless otherwise indicated. NPL reduction episodes have a minimum drop in NPL ratio of 7 percentage points; episodes of high and persistent NPLs and no high NPLs have a minimum duration of 4 years.

Table 3. Effectiveness of NPL targeting policies (two-part model)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Sharp drop in NPLs (dummy)			Drop in NPLs, % points		
	1st stage probit			2nd stage GLM		
NPL, initial level	-0.0568***	-0.0506***	-0.0813***	0.161***	0.166***	0.115
	(0.00476)	(0.00501)	(0.00875)	(0.0541)	(0.0612)	(0.0989)
Asset management company	0.482***	0.472***	0.626***	4.749***	3.420***	2.786*
	(0.0947)	(0.101)	(0.162)	(1.018)	(1.059)	(1.495)
Public bailout funds	-0.228	-0.222	-0.210	3.179	3.573	4.612
	(0.140)	(0.153)	(0.247)	(1.991)	(2.239)	(3.033)
Macroprudential tightening	0.114	0.124	-0.329	-2.491	-4.159**	-2.936
	(0.186)	(0.201)	(0.259)	(1.691)	(1.737)	(2.309)
GDP per capita, at PPP, log	-0.0835***	-0.0925**	0.0957	-2.659***	-1.397**	-2.018***
	(0.0319)	(0.0472)	(0.0676)	(0.298)	(0.542)	(0.777)
GDP per capita growth	6.381***	8.742***	9.008***	10.71	19.04	49.64***
	(0.794)	(1.049)	(1.472)	(6.727)	(11.66)	(15.45)
Inflation, %		0.0370	3.958***		7.391	14.28
		(0.103)	(1.121)		(7.018)	(14.33)
Advanced economy		0.0145	-0.0878		-4.009***	3.358
		(0.126)	(0.209)		(1.415)	(2.265)
Insolvency resolution index			-0.00736**			-0.159***
			(0.00367)			(0.0333)
Observations	1472	1248	645	597	503	277
Pseudo R^2	0.152	0.152	0.238			

Note: Columns (1) to (3) report probit results of the two-part model. The sample is restricted to observations with NPL ratios above 7%. Columns (4) to (6) report second-stage GLM results conditional on initial NPL level exceeding 7% and a sharp drop in NPLs having been achieved. All specifications include a constant. Standard errors in parentheses. *, ** and *** denotes statistical significance at the 10%, 5% and 1% levels, respectively.

Table 4. Impact of policies: Complementarity of AMCs and bailouts

	(1)	(2)	(3)	(4)
Dependent variable	*Sharp drop dummy*		*Change in NPLs over episode*	
Model	*Probit*	*Probit*	*OLS*	*OLS*
NPLs,	-0.0451***	-0.0511***	0.738***	0.761***
initial level	-0.00834	-0.0081	-0.0636	-0.0588
Asset management	0.350*	0.353*	-4.801**	-4.843**
company, only	-0.21	-0.206	-2.31	-2.191
Public bailout	0.25	0.203	0.576	-0.139
funds, only	-0.403	-0.334	-4.258	-3.509
AMC and bailout	0.688***	0.642***	-7.124**	-6.987***
	-0.254	-0.24	-2.821	-2.595
GDP per capita	-0.00484	-0.000814	0.0958	0.084
at PPP, log	-0.00682	-0.00561	-0.0737	-0.0599
GDP per capita growth	3.803**	3.947***	-8.168	-11.39
	-1.669	-1.392	-11.6	-10.32
Inflation	-0.0986		0.337	
	-0.141		-1.081	
Advanced economy	-0.458*	-0.432*	3.267	2.865
	-0.248	-0.225	-2.703	-2.399
Observations	358	425	358	425
Pseudo R^2 / Adj. R^2	0.123	0.130	0.280	0.292

Note: The dependent variable in columns (3)-(4) is the total change in NPL over the duration an episode; only episodes with initial NPL ratios above 7% are included. All specifications include a constant. Standard errors in parentheses. *, ** and *** denotes statistical significance at the 10%, 5% and 1% levels, respectively.

Table 5. Matching estimates of the impact of sharp NPL reductions on economic outcomes

	Year 1 ATT	Year 2 ATT	Year 3 ATT	Year 4 ATT	Year 5 ATT
GDP	1.5494 **	2.2533 ***	2.3302 ***	2.5816 ***	1.9256 ***
growth	*0.6628*	*0.6322*	*0.5644*	*0.5576*	*0.5362*
Investment	5.8939 **	7.2393 **	8.3875 ***	3.2911	5.0874 **
growth	*2.9136*	*3.5613*	*2.3094*	*3.0110*	*2.4332*
Consumption	3.4227 **	2.5834 ***	2.8758 ***	3.8572 ***	3.2166 ***
growth	*1.3575*	*0.9329*	*0.9809*	*0.9979*	*1.1195*
Export	0.2252	1.9826	4.3524 **	0.7069	1.6161
growth	*2.1521*	*1.8629*	*1.9067*	*1.9040*	*2.1541*
Unemployment	-2.7412 **	-2.6630 **	-2.4264 **	-2.1411 **	-2.0667 **
rate	*1.1056*	*1.1095*	*1.0794*	*1.0632*	*1.0418*
Controls	99	102	108	114	119
Treated	117	116	110	108	107

Note: Standard errors in italics. *,** and *** denote statistical significance at the 10, 5 and 1% level, respectively. Treatment group are episodes of NPL reduction starting with a sharp drop in NPLs of at least 5 percentage points (in year zero). Control group are cases of high and persistent NPLs. Propensity score kernel matching with common support. Matched on growth in years 0, GDP per capita, the level of NPLs, public debt to GDP and inflation.

Table 6. Matching estimates of the average impact of sharp NPL reductions on economic outcomes in years 2-4: robustness checks

	(1) *Excl credit-driven*	(2) *Excl more credit-driven*	(3) *Extended sets of matching variables*	(4)	(5) *Using 15% for high NPLs*
GDP	2.6890 ***	2.3643 ***	2.5527 ***	2.8142 ***	2.1194 ***
growth	*0.5391*	*0.4710*	*0.7278*	*0.5362*	*0.5617*
Investment	8.0922 ***	7.9085 ***	8.5992 ***	6.5318 ***	8.4458 ***
growth	*2.5205*	*2.1929*	*2.8923*	*1.3078*	*2.7883*
Consumption	2.5956 ***	2.4508 ***	1.3846 **	2.6520 ***	2.4577 ***
growth	*0.5744*	*0.5384*	*0.6910*	*0.5253*	*0.7129*
Export	2.2868	2.5190 **	3.8848 **	1.4000	2.1280
growth	*1.5017*	*1.2462*	*1.8837*	*1.4066*	*1.5641*
Unemployment	-2.6139 **	-2.6898 **	1.3037	-2.5168 *	-1.7965
rate	*1.2295*	*1.1772*	*1.9076*	*1.3257*	*1.4174*
Controls	88	95	85	88	88
Treated	76	41	69	67	91

Note: Standard errors in italics. *,** and *** denote statistical significance at the 10, 5 and 1% level, respectively. Treatment group are episodes of NPL reduction starting with a sharp drop in NPLs of at least 5 percentage points (in year zero). Control group are cases of high and persistent NPLs. Propensity score kernel matching with common support. Specifications (3) additionally matches on NPL ratio, investment-to-GDP ratio, private credit-to-GDP ratio and the unemployment rate. Specification (4) uses lags of selected variables in lieu of their values in year zero.

Table 7. Matching estimates of the average impact of sharp NPL reductions on economic outcomes with a stricter definition of sharp reductions

	Year 1		Year 2		Year 3		Year 4		Year 5	
	ATT		ATT		ATT		ATT		ATT	
GDP	1.3671	**	2.5075	***	2.4953	***	3.2112	***	2.3796	***
growth	*0.6811*		*0.6527*		*0.6977*		*0.5934*		*0.5906*	
Investment	8.6906	**	8.9437	**	7.2978	***	4.8172		7.3113	***
growth	*3.5837*		*4.3375*		*2.6941*		*3.4223*		*2.6407*	
Consumption	2.6888	**	2.6143	**	2.5038	**	4.1829	***	3.3704	***
growth	*1.0553*		*1.076*		*1.0524*		*1.0891*		*1.1416*	
Export	0.0844		3.7294	*	3.5284		1.3223		3.0499	
growth	*2.3896*		*2.1428*		*2.2938*		*2.1846*		*2.0739*	
Unemployment	-3.0567	**	-3.0135	**	-2.9464	**	-2.4682	**	-2.1289	**
rate	*1.1435*		*1.1569*		*1.1379*		*1.1153*		*1.0818*	
Controls	99		102		108		114		119	
Treated	90		89		84		83		82	

Note: Standard errors in italics. *,** and *** denote statistical significance at the 10, 5 and 1% level, respectively. Treatment group are episodes of NPL reduction starting with a sharp drop in NPLs of at least 7 percentage points (in year zero) or 10 percentage points over two years. Control group are cases of high and persistent NPLs. Propensity score kernel matching with common support.