European Bank
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Cross-border spillovers from reducing non-performing loans

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Summary

Authorities in many countries recently deployed policies to reduce non-performing loans (NPL). This paper sheds light on the effectiveness of such policies. Using data on ownership of subsidiaries of foreign banks in Emerging Europe, we first show that changes in NPLs have an impact on NPLs of banks' foreign affiliates. The transmission is driven primarily by the workings of internal capital markets and application of consolidated supervision and, to some extent, by the exchange of knowledge within banking groups. We then use a novel dataset on policies deployed to address high levels of NPLs in a large number of countries over the period 1990-2015 and bank-level data to assess the impact of various NPL policies on bank affiliates operating in foreign jurisdictions. The reduced-form difference-in-difference identification strategy exploits the arguably exogenous timing of introduction of policies in foreign jurisdictions. Establishment of asset management companies (AMCs) with the view to develop a secondary market for impaired loans is found to have positive impact on foreign bank affiliates' NPL reduction. AMCs are estimated to be associated with a 12-20 percent per annum reduction in the stock of NPLs over several years. The social benefits of policies to reduce NPLs may be larger than previously thought – on account of positive cross-border spillovers.

Keywords: non-performing loans, cross-border spillovers, consolidated supervision, asset management companies

JEL Classification Number: G21, G33, G38, O40

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1. Introduction

A decade after the global financial crisis of 2008-09 balance sheets of banks in many advanced economies and emerging markets remained clogged by non-performing loans (NPLs) – broadly understood as loans that are at least 90 days in arrears. Persistence of NPLs after the 2008-09 crisis has brought the issue of NPL resolution to the forefront of policy debate, with countries from Italy to India belatedly putting forward packages aiming to reduce NPL ratios. Such packages may include establishment of Asset Management Companies (AMCs) specialising in dealing with NPLs, provision of public sector funds for bank recapitalisation with the view to facilitate management and write-off of NPLs, changes to loans classification and provisioning rules and amendments to tax treatments of NPLs, among others.

Financial sector shocks and policy changes have been shown to affect banks across borders. Foreign bank affiliates respond to financial shocks in home territories of parent banks (Peek and Rosenberg, 1997, 2000; Schnabl, 2012; Cerutti and Claessens, 2017) reflecting the workings of internal capital markets of banking groups (De Haas and Van Lelyveld, 2010; Ongena et al., 2013). Macroprudential measures can also significantly affect behaviour of bank affiliates abroad (Aiyar et al., 2014a, 2014b; Ongena et al., 2013; Berrospide et al., 2017) and monetary policy is transmitted internationally (Hills et al., 2017).

This paper investigates whether changes in NPLs affect foreign affiliates of banks and evaluates cross-border effects of policies aimed at reducing NPLs. The estimates of such cross-border effects are of major interest for two reasons.

First, policy packages aimed at reducing NPLs tend to be costly, at least in the short-to-medium term. Cross-border spillovers of such policies imply higher welfare benefits of policy actions. In certain setting, for instance in the context of the European Union (EU), such cross-border effects can be internalised in decision making strengthening the case for more forceful (and, perhaps, more centralised) approach to addressing high NPLs.

Second, cross-border estimates can be seen as the lower bound of the effectiveness of NPL policies in the jurisdiction where they are deployed. Coupled with information on the magnitude of transmission of changes in NPLs within banking groups these estimates also shed light on direct impact of NPL policies. Estimating the effectiveness of NPL policies within jurisdictions with precision is difficult (see Balgova et al., 2017) and much of the

evidence to date is based on case studies of various episodes (see Baudino and Yun, 2017, for a recent summary of lessons learned). The use of policies in response to high and rising NPLs and the timing of such policies is arguably non-random. As a result, effective policies adopted early in the crisis may look ineffective due to the severity of economic downturn, and vice versa.

In contrast, estimates of cross-border effects of NPL reductions exploit arguably exogenous variation in deployment of policies. Identification comes from comparing evolution of NPLs in domestic banks and in affiliates of foreign banks in the same year in the same jurisdiction. This approach accounts for the relevant differences in macroeconomic conditions and policy environments across countries and across time.

To estimates transmission of changes in NPLs from parent to subsidiary banks we use detailed information on bank owners in Central and South-Eastern Europe (CESEE) based on De Haas et al. (2015). To estimate cross-border effects of policies aimed at reducing NPLs, we use a novel dataset on policy actions in a large number of countries over the period 1990-2015 and bank-level data from Bankscope database. This dataset is combined with bank-level data on ownership of banks (Claessens and van Horen, 2015).

The paper contributes to two distinct strands of literature. The first, briefly touched upon above, examines cross-border transmission of various financial sector shocks through bank ownership networks. This paper extends the analysis of cross-border policy spillovers by looking specifically at evolution of non-performing loans and a broader set of policy measures. The second strand looks at the aftermaths of the banking crises and, more specifically, at approaches to dealing with the overhang of non-performing loans in the banking sector and their effectiveness.

The analysis reveals that a one percent reduction in the stock of NPLs is associated with a 0.6 of a percentage point reduction in the stock of NPLs of a subsidiary bank operating in a foreign jurisdiction when NPL levels are high (above the median for the sample). This transmission appears to be driven largely by the workings of internal capital markets within banking groups and consolidated supervision and, to some extent, by the transfer of knowledge in the area of NPL resolution.

As a result of this transmission, policies aimed at reducing NPLs can have detectable cross-border effects. In particular, the establishment of Asset Management Companies (AMCs)

specialising in dealing with NPLs has an impact on NPL resolution in banks' foreign affiliates. This impact does not appear to be enhanced by public sector bailouts in the foreign jurisdiction. We estimate that establishment of AMCs in the jurisdiction of a parent bank reduces the stock of NPLs on the balance sheets of foreign subsidiary banks by an additional 12 percent per annum compared with domestic banks in the same jurisdiction. In contrast, financial sector bailouts not accompanied by the establishment of AMCs appear to have a weak impact on NPL ratios, if any. Changes in loan classification stringency, revisions to provisioning rules or macroprudential policy tightening do not appear to have significant cross-border effects on NPL ratios or credit availability.

The rest of the paper is structured as follows. Section 2 discusses the adverse economic effects associated with high NPLs as well as financial sector policies that can help reduce NPL ratios. Section 3 explores possible transmission of such policies across borders. Section 4 estimates the impact of changes in NPLs on NPLs of banks' foreign affiliates. Section 5 examines the cross-border effects of various policies aimed at reducing NPLs and infers their likely effectiveness in the domestic jurisdiction. It also revisits possible cross-border transmission channels of NPLs in the context of the results of empirical analysis. Section 6 concludes.

2. Policies to reduce NPLs and their potential cross-border effects

2.1. Adverse effects of non-performing loans

High ratio of non-performing loans to total loans tends to have a negative impact on bank lending and economic activity. High NPLs require greater loan loss provisions, reducing capital resources available for lending, denting bank efficiency and profitability (see Berger and DeYoung, 1997; Keeton and Morris, 1987; Salas and Saurina, 2002; Jimenez and Saurina, 2005). The NPL exposure focuses bank's internal resources on loan recovery work, including repossession of collateral and its disposal. These efforts are costly (Townsend, 1979) and come at the expense of expanding business.

Undercapitalised banks may take excessive risk in a gamble to boost profitability (Jensen and Meckling, 1976), which may exacerbate the NPL problem further. Recent studies find a positive correlation between banks' leverage ratios or loan-to-asset ratios and NPLs (Klein, 2013; Garrido et al., 2016). High NPLs ultimately predict bank failures (Gonzales-Hermosillo et al., 1997).

High NPLs may also result in a misallocation of resources in an economy. Zombie lending – channelling new credit predominantly to the troubled companies – may help to prevent second-round business failures but at the expense of starving more productive parts of the economy of credit (see Peek and Rosengren, 2005; Caballero et al., 2008). Breaking this vicious cycle requires large capital injections (Giannetti and Smirnov, 2013). Reducing NPLs can thus be associated with a sizable growth dividend (see Balgova et al., 2017).

2.2. Dealing with non-performing loans

Recognising adverse effects of NPLs policymakers adopted a number of measures aimed at accelerating NPL reductions. The first step is to transparently assess the quality of bank assets and build up provisions against expected losses. Relying on banks' voluntary efforts in this area may not be sufficient and regulators may need to guide banks with respect to loan classification and provisions as well as assist banks with developing special capacity to deal with NPLs. When judicial capacity to deal with NPLs case-by-case is lacking, creating a sound legal framework for timely corporate restructuring is crucial. For instance, centralised out-of-court debt workout programmes were actively used in Korea, Thailand, Indonesia and Malaysia in the 1990s (Woo, 2000).

In this paper, we consider five types of financial sector policies that can influence NPL ratios: 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, which are discussed in turn.

2.2.1. Asset management companies

Establishment of "bad banks" or asset management companies encourages development of a secondary market for NPLs. It enables commercial banks to transfer NPLs to a specialised entity at a fair (market) value. The AMCs can securitise and resell impaired loans 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. AMCs have additional advantages: unlike individual banks, they may internalise the effect of foreclosure on value of housing collateral in the portfolio (Favara and Giannetti, 2017), enjoy economies of scale and are not subject to bank capital regulation).

AMCs were deployed, for instance, in Sweden and Mexico in the 1990s (Macey, 1999; Krueger and Tornell, 1999). AMCs established following the Asian financial crisis assembled assets valued at up to 20 percent of GDP and achieved a significant degree of value recovery (Fung et al., 2004). In 2016, the Italian government reached a deal with the European Union (EU) to attach a government guarantee to a subset of NPLs. Such guarantees help to bridge the difference between the asking price of NPLs and the price potential buyers are willing to pay that arises due to asymmetric information (see Avgouleas and Goodhart, 2017, for a recent discussion of issues related to the design of AMCs).

Reflecting information asymmetry and high risks, majority of AMCs are funded publicly. In other cases, banks establish internal AMCs ring-fencing own funds for a special workout unit. Internal AMCs have the same objective – to maximise recovery value from a portfolio of impaired assets. Occasionally, deposit insurance funds are directly used to acquire non-performing assets. Such instances are less common, however, as this approach may weaken the ability of deposit insurers to perform their core duties.

For the empirical analysis data on AMCs is taken from the Building Better Bad Banks project by Hallerberg and Gandrud (2015). Where the data on AMC closure is not available, an AMC is assumed to have a life span of 8 years, the mean across the sample. The database contains information on 139 AMCs (109 public, 20 internal, 8 backed by deposit insurance and 2 unclassified) across 62 countries during the period 1990-2016. Examples of public AMCs include UK Asset Resolution Ltd, the Bank Asset Management Company in Slovenia, the Asset Management Corporation of Nigeria and the Korean Asset Management Company. The use of AMC covers all years of our observations, regions and level of country development.

2.2.2. Public bank recapitalisation

Public funds can also be used to directly recapitalise ailing banks. Such bailouts enhance banks' ability to provision non-performing exposures, write them off or sell them at a discount. Policy packages often combine establishment of AMCs with the use of public funds for bank bailouts. In the long term, government interventions can exacerbate moral hazard: banks counting on a potential bailout may take greater risks (Dam and Koetter, 2012). Our analysis is focused on the short-term effect of bailouts on bank NPLs and abstracts from their possible negative implications over the longer term.

The data on financial sector bailouts is taken from Bova et al. (2016) and covers 95 interventions, both during systemic banking crisis and stand-alone cases, spanning 66 countries. Estimates of fiscal cost of recapitalisation (available for 83 of those episodes) average 9.4 percent of GDP. The dataset also records public bailouts and recapitalisations in the non-financial sector (for instance, with respect to public-private partnerships, subnational governments or state-owned enterprises) which are used in placebo test.

2.2.3. Macroprudential policies

The third block of policies comprises macroprudential measures. These measures target behaviour of financial institutions through limits on leverage, maximum interbank exposures, risk concentration ratios, capital surcharges on systemically important financial institutions or reserve requirements. Macroprudential measures can also target borrowers by limiting loan-to-value or debt-to-income ratios. While macroprudential tightening may limit build-up of NPLs over the economic cycle their short-term impact on the stock of existing NPLs is likely to be limited. The long-term impact is also debated as tightening in one area, for instance mortgage lending, can prompt banks to take extra risks in other areas such as corporate lending or securities trading (Acharya et al., 2017).

The data on macroprudential policies come from Cerutti et al. (2015). The database covers 119 countries from 2000 to 2013 and identifies 135 cases of macroprudential tightening in 76 countries. The cases of macroprudential loosening are limited to Bulgaria in 2008 and Serbia in 2013 and are not explored further.

2.2.4. Changes in loan classification and provisioning stringency

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

Data on stringency of loan classification and provisioning is taken from Barth et al. (2014). 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). The data comes from surveys of 127 central banks conducted in 1999, 2003, 2007 and 2011 (values are carried forward in other years). The indicator ranges from 4 months to over 3 years, with an average of 18 months. The provisioning stringency is proxied

by the sum of the minimum required provisions as loans become substandard, doubtful and loss (this sum averages 120 percent).

This list of policies is not exhaustive. Examples of other relevant measures include changes in tax treatments of NPLs that remove disincentives in terms of writing bad loans off for banks and borrowers, judicial and legal reforms to accelerate the foreclosure process and improvements in out-of-court resolution mechanisms (see ECB, 2017). At the same time, the five types of measures outlined above account for a bulk of actions historically taken to reduce NPL ratios. One or more of these measures were deployed in close to 90 percent of cases of high NPLs as identified in Balgova et al., 2017.

3. Cross-border transmission of NPL policies

3.1. Cross-border transmission of financial sector policies

Various spillover effects of financial-sector policies have been documented by earlier studies. For instance, foreign bank affiliates have been shown to respond to financial shocks in home territories of parent banks (Peek and Rosenberg, 1997, 2000; Schnabl, 2012) reflecting the workings of internal capital markets of banking groups (De Haas and Van Lelyveld, 2010; Ongena et al., 2013). This response tends to be partial, affected by frictions in internal capital markets (Cerutti and Claessens, 2017). It is higher when foreign affiliates are financed by intra-group funding rather than by local deposits (De Haas and Van Lelyveld, 2014). As a result, foreign banks can be a stabilising force with respect to local shocks in a host economy yet amplify the transmission of global shocks (De Haas et al., 2015).

Macroprudential measures significantly affect behaviour of bank subsidiaries abroad. Conversely, changes to macroprudential regulation and capital requirements may have little impact on lending behaviour of foreign-owned banks operating in a jurisdiction where such changes are introduced (Aiyar et al., 2014a, 2014b; Ongena et al., 2013; Berrospide et al., 2017).

Several transmission channels may similarly give rise to cross-border transmission of policies aimed at reducing banks' NPL ratios. The main potential channels – the workings of internal capital markets, consolidated supervision, and transfer of knowledge on how to work with impaired exposures – are discussed in turn.

3.2. Internal capital markets

Parent banks and foreign subsidiaries are linked through internal capital markets enabling banking groups to reallocate capital with the view to maximise growth opportunities and better manage solvency risk at the holding level. In addition, liquidity can be injected in subsidiaries through short-term or long-term loans. Capital and liquidity can flow internally in both directions. When positions of parent banks are strong, they tend to support their subsidiaries at times of adverse shocks in host economies. Conversely, when parents experience an adverse shock, lending in subsidiaries tends to be negatively affected as parents refocus their resources on the home markets (the so-called *substitution effect*, see De Haas and Lelyveld, 2010).

An adverse NPL shock experienced by a parent bank is likely to propagate to its subsidiary through the funding substitution effect. This weakens the ability of the subsidiary to deal with NPLs through timely provisioning and write-offs. In some circumstances, the incentives of subsidiary's management to improve performance may be reduced, while adverse incentives to take on extra risk may become stronger.

A successful policy designed to reduce NPL ratios can put this chain into reverse. Availability of bailout funds in the parent's jurisdiction or sales of NPLs to AMCs can free up capital resources that are, in turn, redistributed through internal capital markets. The resulting *support effect* enhances subsidiary's ability to address NPLs and strengthens management incentives to pursue strong financial results. In addition, NPL resolution at the parent bank level may free up management resources to focus on performance of subsidiaries.

3.2. Consolidated supervision

Over time, global financial markets have become increasingly complex and intertwined. In response, bank supervisors moved to supervision regimes on consolidated basis, whereby supervisors examine the prudential risks of an institution and all its international establishments, including branches and subsidiaries. This holistic view gives home country supervisors indirect oversight over banks' subsidiaries operating in foreign jurisdictions. The principles of consolidated supervision were formalised by the Basel Committee on Banking Supervision in Concordat in 1975 (Goodhart, 2011) with further refinements in 1983 and 1992 when the Minimum Standards for supervisory cooperation between Basel member countries were established.

The guidance and moral suasion that supervisors use to address high and rising NPL ratios can apply to the supervised subsidiaries. For example, NPL Guidance first issued by the European Central Bank's (ECB) Single Supervisory Mechanism in March 2017 and by the European Commission in March 2018 is applicable to all significant institutions including their international subsidiaries and branches. The guidance also calls for harmonisation of NPL definitions at a group level. It is not legally binding but high-NPL banks deviating from the reduction targets may see additional capital add-ons imposed (ECB, 2017b).

In sum, consolidated supervision both imposes additional implicit costs associated with NPLs in subsidiaries and prompts banks to harmonise approaches to dealing with NPLs across the banking groups. Under certain circumstances, a parent bank burdened with high NPLs and operating in an economy with a relatively weak growth outlook (such as Greece or Italy in the mid-2010s) may find it more cost-effective to prioritise NPL reduction in its subsidiaries abroad.

3.4. Transfer of knowledge and management expertise

The existence of multi-national banking corporations can be partially explained by the value of replicating certain practices and techniques in foreign markets. Such replication involves flow of information from the parent to the subsidiary. The competitive allocation of resources through internal markets and use of common technological platforms foster such knowledge transfer (Ozsomer and Gencturk, 2003; Ambos and Ambos, 2009).

The transfer of knowledge is common in credit risk management (for example, when it comes to credit scoring). It extends to dealing with impaired exposures – in terms of identifying substandard loans, monitoring collateral valuation, modelling provisions and making decisions about sales of non-performing assets at a discount, repossession or loan write-offs. If a parent bank adopts new ways of managing NPLs such as sales to AMCs, subsidiary banks may follow the new practice.

The extent of successful knowledge transfer may depend on the value of knowledge (which may be higher when NPLs are high), motivation to share knowledge (which may be enhanced in the presence of consolidated supervision), richness of transmission channels (for instance, the extent of IT integration) and absorptive capacity of the knowledge acquirer. The latter may be higher where subsidiary staff are offered regular trainings by the parent (see Gupta and Govindarajan, 2000, for a general discussion of knowledge transfer).

4. Identifying cross-border spillovers from changes in the stock of NPLs

4.1. Data

To test whether changes in NPLs may be transmitted across borders within banking groups we match international parent banks and subsidiary banks operating in Central, Eastern and Southern-Eastern Europe (CESEE) using the dataset compiled by De Haas et al. (2015). In this dataset, we observe 468 banks that are subsidiaries of global parent banks and 1,834 domestic banks in the region between 1999 and 2010. Parent banks come from a total of 43 countries.

The data on ownership are combined with data from bank balance sheets and income statements as reported in Bankscope. We use a panel of 27,500 banks located in 190 countries. For these banks we observe NPL ratio over the period 1990-2015. We exclude banks with less than US$100,000 in total assets, those that report multiple financial statements within the same calendar year and those whose core activity does not include granting credit. Descriptive statistics are reported in Table 1 Panel A.

Under the Basel definition a loan is classified as non-performing when a borrower is 90 days or more behind on their contractual payments or whenever a debtor is considered "unlikely to pay its credit obligations to the banking group in full, without recourse by the bank to actions such as realizing the security". The exact definition can vary from country to country and certain jurisdictions may not report the quality of loans meaningfully. At the same time, consistent underreporting of NPLs in certain emerging markets, if anything, would lead to the extent of transmission of true changes in NPLs being underestimated in our analysis.

4.2. Cross-border spillovers within banking groups

The following specification is used to estimate cross-border transmission of changes in NPLs:

$$\Delta \ln(NPL)_{i,t} = \beta_1 F_{i,t-1} x\, \Delta \ln(NPL)^{PB}_{i,t-1} + \beta_2 F_{i,t-1} x\, NPLR^{PB}_{i,t-1} + \beta_3 F_{i,t-1}\, x\, TCR^{PB}_{i,t-1} + \gamma Z_{i,t-1} + \theta F_{i,t}\, x\, MF^{F}_{f,t} + \delta_i + \delta_{dt} + \varepsilon_{it} \quad (1)$$

Where the dependent variable is the change in the logarithm of the stock of NPLs of bank *i*, located in country *d* in year *t.* Bank *i* may be owned by a parent bank operating in foreign

country *f*. Effectively the dependent variable captures the percentage change in the stock of NPLs. On the right-hand side, the foreign-ownership dummy ($F_{i,t-1}$) is interacted with the (lagged) logarithm change in NPL stock of the parent bank ($\Delta \ln(NPL)^{PB}_{i,t-1}$), the NPL ratio of the parent bank ($NPLR\,^{PB}_{i,t-1}$) and its total capital ratio ($TCR\,^{PB}_{i,t-1}$).

The approach broadly follows estimation of cross-border spillovers in lending in De Haas and Van Lelyveld (2014) and Allen et al. (2014). The set of bank-level control variables $Z_{i,t-1}$, include the (lagged) non-performing loans ratio, return on average assets, change in bank's total assets, the change in bank's total deposits and the total capital ratio, in addition to bank fixed effects (δ_i). Some specifications also include a set of macro-economic factors in the foreign jurisdiction *F* ($MF^F_{i,t}$) such as inflation, growth in GDP per capita and a change in the ratio of investment to GDP. Bank fixed effects control for bank time-invariant heterogeneity. Except in cases where bank ownership changed, they also subsume country fixed effects thus accounting for time-invariant differences between countries such as the origin of the legal system. The specifications also include a set of country-year fixed effects, δ_{dt}, to control for time-varying macro factors that affect both domestic- and foreign-owned banks in the same jurisdiction *d*. Standard errors are clustered at the domestic country level.

The results reported in Table 3 point to an association between the changes in NPL stock of subsidiary banks and those of their parents, as well as parent's NPL ratio. This association is much stronger in the case of parent banks with high NPL ratios and is absent in the case of parent banks with low NPLs (see Table 4)[1]. To estimate these effects separately we interact the log changes in the stock of NPLs of the parent with the dummy variables that take the value of one if parent's NPL ratio is above (below) the 5 percent threshold. We choose the 5 percent cut-off point since it is commonly considered by supervisors as an indication of excessive risk taking. It is close to the median for the entire sample of banks although, applied to parent banks, the dummy takes the value of 1 in approximately one fifth of cases.

$$\begin{aligned}\Delta\ln(NPL)_{i,t} = {} & \beta_1 F_{i,t-1}\, x\, \Delta\ln(NPL)^{PB}_{i,t-1}\, x\, high\ NPLR\,^{PB}_{i,t-1} \\ & + \beta_2 F_{i,t-1} x\, \Delta\ln(NPL)^{PB}_{i,t-1}\, x\, low\ NPLR\,^{PB}_{i,t-1} + \beta_3 F_{i,t-1} x\, NPLR\,^{PB}_{i,t-1} \\ & + \beta_4\, F_{i,t-1}\, x\, TCR\,^{PB}_{i,t-1} + \gamma Z_{i,t-1} + \theta F_{i,t}\, x\, MF^F_{f,t} + \delta_i + \delta_{dt} + \varepsilon_{it} \qquad (2)\end{aligned}$$

[1] The results are similar when the split into high-NPL and low-NPL category is based on the NPL ratios of subsidiary banks.

Where parent bank NPL ratios exceed 5 percent, a one percentage point reduction in the NPL stock of a parent bank is associated with an approximately 0.6 of a percentage point reduction in the stock of NPLs of the subsidiary; the corresponding coefficient is statistically significant at the 5 percent level (and at the one percent level in most specifications). Inclusion of domestic country-year fixed effects provides assurances that this result is not driven by the economic cycle, which equally affects domestic banks. We discuss possible channels underpinning the estimated cross-border transmission in section 5.5 later on.

The coefficients on control variables are by and large intuitive. The stock of NPLs is more likely to decline significantly if the NPL ratios are higher to start with and if the bank is more profitable, as reflected in the higher return on assets. The opposite is true for the level of NPL ratio of the parent bank: higher NPL ratios of the parent are associated with greater increases in NPLs of subsidiaries.

5. Identifying cross-border effects of NPL policies

5.1. Identification strategy

Having established that changes in NPLs spill over to banks' subsidiaries abroad, we can use this finding to estimate the effectiveness of policies targeting reductions in NPLs – by looking at the cross-border impact of such policies.

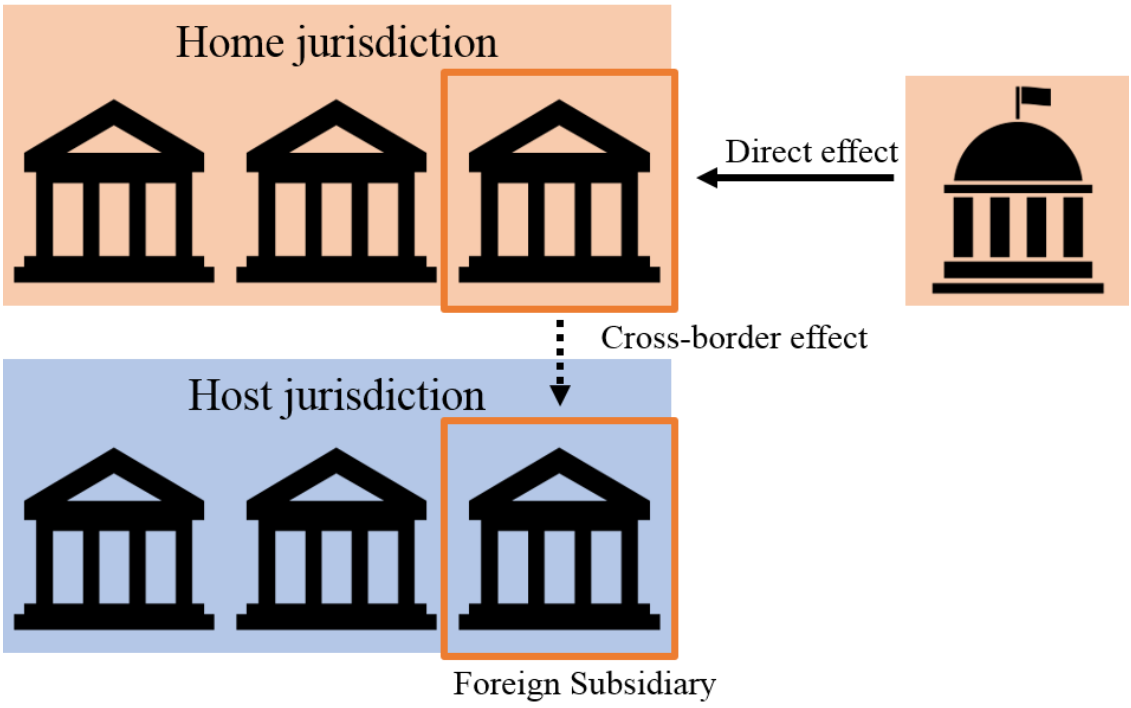
A straightforward way to estimate the impact of NPL policies on NPL ratios involves linking country-level outcomes (the average NPL ratio of a banking system) or bank-level outcomes (a bank's NPL ratio) to adoption of specific policies using country-year or bank-year data. When interpreting these estimates, it is important to acknowledge that policymakers' decision to intervene, the timing of intervention and the choice of policy instrument are likely to be non-random, influenced by external circumstances. The estimates of the effect of policies may thus be subject to endogeneity bias. For instance, if a certain policy comes into effect late in the economic cycle, on the back of improving economic conditions, its impact may be overestimated. If policies are adopted at the height of a crisis when the health of the financial sector is deteriorating rapidly, their impact may be underestimated. In this sense, evaluating NPL policies is akin to evaluating a medical intervention to treat a serious illness.

In contrast, when estimating cross-border effects of measures aimed at reducing NPLs, we look at an exogenous source of timing of adoption of various policies. In particular, we focus on the performance of foreign-owned banks and policy changes in jurisdictions where the

corresponding parent holding bank operates. We compare changes in behaviour of foreign-owned subsidiaries with changes in behaviour of locally-owned banks operating in the same jurisdiction as well as subsidiaries of foreign banks whose parents are not affected by a certain policy intervention. The two groups of banks are subject to the same set of economic conditions and domestic policy environment – except some foreign-owned banks are also indirectly exposed to changes in policy and economic environment affecting their parents.

The introduction of policies targeting NPL reduction in the home country where a parent bank operates may have a *direct* effect on behaviour of banks in that jurisdiction and a *cross-border effect* on NPLs of subsidiary banks located in a foreign jurisdiction (see Figure 1 for a schematic representation). In a typical host country, we find foreign-owned subsidiaries with parents located in different home jurisdictions that are subject to different policy environment. For example, the Greek banking sector in 2005 comprised 32 domestic banks and 4 foreign subsidiaries with parents located in Cyprus, Germany, France and Portugal. At the same time, Greek banks owned subsidiaries in nine jurisdictions ranging from South Africa to Bulgaria. Such multiplicity of cross-border links strengthens the difference-in-difference identification strategy.

Figure 1. Identification strategy



5.2. Basic empirical specification

The analysis can be performed on a large sample of banks where we do not observe exact ownership links beyond the country of origin. Data on foreign ownership of banks in this larger sample is taken from Claessens and van Horen (2015). A bank is identified as foreign-owned when at least 50 percent of bank's shares are held by foreigners. The corresponding foreign policy in regressions is set to reflect the policy changes in the home country of the largest foreign shareholder. The ownership data is available for 5,102 banks in 140 countries. In approximately 9 percent of cases foreign ownership status of a bank changed during 1995-2013.

We estimate a reduced-form model where NPL policies can have an impact on bank affiliates abroad. The dependent variable in the basic model (equation 3) is the change in the logarithm of stock of NPLs for bank *i* between years *t – 1* and *t.* As before, bank *i* operates in domestic jurisdiction *d* but may be owned by a parent bank operating in a foreign jurisdiction *f*. The specification further includes interaction terms between the foreign ownership dummy ($F_{i,t}$) and a set of dummy variables capturing policies in place in the home jurisdiction *f* of the respective parent banks in year *t* (denoted $POL^{F}_{f,t}$). For instance, an AMC dummy variable is equal to one if an asset management company was in operation in the past 3 years in the jurisdiction of the parent holding bank. The coefficients on these interaction terms (β) capture the cross-border effects of policies on the subsidiaries of foreign parent banks.

$$\Delta \ln(NPL)_{i,t} = \beta \;\; F_{i,t} \; x \; POL^{F}_{f,t} + \lambda F_{it} + \gamma Z_{i,t-1} + \theta F_{i,t} \; x \; MF^{F}_{f,t} + \delta_i + \delta_{dt} + \varepsilon_{it} \qquad (3)$$

Bank fixed effects, δ_i, subsume foreign ownership except for banks that changed ownership during the sample period. The coefficient on the foreign ownership dummy thus reflects the average movement in the stock of NPLs upon a bank changing ownership from domestic to foreign or vice versa. Domestic country-year fixed effects, δ_{dt}, capture both changes in demand for credit and any changes in domestic policies that apply to all banks.

In this difference-in-difference approach only foreign banks are eligible for treatment (having a parent subjected to certain policies aimed at reducing NPL levels). Reassuringly, we find no large systematic difference between NPL ratios in domestic and foreign-owned banks (see Table 1 Panel B). In both groups of banks, average NPL ratios evolved in similar ways and reached similar levels (see Figure 2).

5.3. Results

The estimation first distinguishes between three mutually exclusive policy scenarios: establishment of an asset management company (AMC); use of public funds to recapitalise banks (bailouts); and a combination of the two policies (see Table 1 Panel C for a summary of incidence of various policies in the sample).

Establishment of AMCs in the parent bank's jurisdiction is associated with a statistically significant reduction in the NPL of subsidiary banks – the stock of NPLs declines by around 12 percentage points (see Table 5). The effect does not increase if the introduction of AMCs in a foreign jurisdiction is packaged with provision of bank bailouts. In some specifications the effect in fact becomes smaller, with weaker statistical significance – possibly because bailouts come with the pressure to ringfence the use of public funds for domestic purposes reducing the extent of cross-border transmission. In the absence of AMCs, the provision of bailouts is associated with a small and statistically insignificant reduction in the stock of NPLs.

The differences in estimated effects of bailouts in the presence and in the absence of AMCs are insightful, assuming that any pressure to ringfence public funds for domestic use is comparable in both scenarios. In the absence of structural reforms aimed at creating market for distressed debt, bailouts may do little to strengthen incentives for resolving non-performing loans. In some circumstances, bailouts may encourage greater provisioning (and thus recognition) of bad debts in the hope of increasing the amount of public funds being made available. Furthermore, bailouts may also encourage banks to pursue riskier new borrowers in search of higher upside expecting the downside risk to be limited. The overall impact on NPLs may thus be ambiguous. As this study focuses on relatively short-term impact of various financial sector policies, no inference can be made about the long-term effects of financial sector bailouts on banks' risk appetite.

The cross-border effects of asset management companies on NPLs appear to be strongest one year after a policy is adopted, with effects gradually becoming weaker. The results reported in Figure 3 are obtained by estimating specification allowing for dynamic lags; the specification is otherwise similar to equation (3).

When it comes to changes in NPLs, we do not find any significant cross-border effects of changes in loan classification, provisioning stringency or macroprudential tightening (see

Table 6). This might reflect the propensity of international banking groups to apply stricter loan classification and provisioning standards than the minimum required by the regulation.

5.4. Discussion: Inference about the domestic effects

The estimated cross-border effects could be seen as the lower bound of the domestic effect of various policies on NPL ratios – due to the fact that any cross-border transmission is partial. Some back-of-envelope estimates may further give us some sense of a possible magnitude of the underlying domestic effect of asset management companies. Establishment of AMCs is estimated to be associated with a 12 percent per annum reduction in the stock of NPLs of foreign affiliates. From estimation in the previous section, such a reduction corresponds to a 15 to 20 percent reduction in the NPL ratio of a parent bank, on average (based on transmission coefficients in the range of 0.6 to 0.8). In other words, the introduction of AMC would need to lower the NPL ratio of domestic banks by 15-20 percent per annum (over a three-year window) to induce the observed cross-border spillovers.

In principle, cross-border policy transmission could surpass the domestic effect in a case where AMCs purchases a significant amount of NPLs from the balance sheet of a bank subsidiary abroad. Anecdotal evidence suggests that such a situation is unlikely to arise in practice, not least because AMC's comparative advantages in dealing with problem loans do not easily extend to foreign jurisdictions[2].

5.5. Transmission channels

Next, we discuss evidence regarding possible transmission channels underpinning cross-border spillovers from an NPL reduction. First, we note that the coefficient on the parent bank total capital ratio in our estimations (Table 3) is negative and statistically significant, consistent with the presence of the internal capital markets channel: higher capitalisation of the parent enables subsidiary banks to tackle non-performing assets more actively, as discussed in section 3. In particular, an extra one percentage point in terms of parent's capitalisation is associated with an extra 5 percentage point reduction in the stock of NPLs of a subsidiary.

[2] For example, Ireland's National Asset Management Agency was set up to purchase NPLs exclusively from Irish domestic banks. NAMA's 2017 financial statement show that 83 percent of loans on its balance sheet are backed by collateral from Ireland, 12 percent from the UK and 5 percent from the rest of the world. Spain's SAREB portfolio consists exclusively of loans backed by collateral in Spain, as reported in its 2017 annual statements.

To shed light on the existence of the consolidated supervision channel we investigate if the spillover effect is stronger when parent banks reside in member countries of the Basel Committee for Banking Supervision (BCBS). The holistic supervisory approach at the heart of the BCBS work is based on the banking supervisors' multinational cooperation. It requires multinational banks to apply consistent approach to NPL recognition and management across their subsidiaries. If a parent bank is domiciled in a country where the banking supervisor is a member of BSBC, its foreign subsidiaries are subjected to indirect supervision in the home jurisdiction. The membership of the Basel committee grew from 11 economies in the 1990s to subsequently include the European Union as well as 18 jurisdictions outside the EU. In the empirical specification (equation 2) the variables of interest are additionally interacted with the dummy variable for BCBS membership.

The results, reported in Table 7, are consistent with consolidated supervision playing an important role in facilitating cross-border transmission of changes in NPLs. In particular, the effect is present for subsidiaries of parents with high NPL ratios and located in the Basel-member countries. The effect is approximately two times smaller, and is statistically insignificant, for subsidiaries of non-Basel parent banks (again, conditioning on parents' high NPL ratios).

Testing for the transfer of knowledge channel relies on assumptions about observable traits of bank pairs that are associated with greater likelihood of transfer of knowledge taking place. One such trait is the physical distance (Ambos and Ambos, 2009) as higher cost of travel, time difference and cultural differences make it harder for bank staff to communicate. On the other hand, distance should have limited, if any, impact on the consolidated supervision and internal markets transmission channels. In the empirical analysis the distance is measured between capital cities and the largest cities in banks' jurisdictions, weighted by relative population size, using the CEPII dataset. Its logarithm is interacted with the change in the stocks of NPLs of parent banks.

The transmission of changes in NPLs is estimated to be somewhat weaker with distance (see Table 8) although the role of the distance is not very pronounced. The results are similar if interactions with dummy variables for long and short distances are included instead. Similar results (available on request) can also be obtained by using common language and (or) common colonial history as a measure of cultural proximity that may facilitate exchange of

information while having no bearing on consolidated supervision or internal capital markets. In sum, transfer of knowledge appears to play some role, albeit possibly limited.

On balance, the evidence is consistent with the cross-border effects of changes in NPLs being driven primarily by the workings on internal capital markets, application of consolidated supervision and, to some extent, exchange of knowledge within banking groups.

5.6. Robustness checks

To further address concerns that the results may be driven by common economic cycle, or perhaps global policy coordination, we run a series of robustness checks. These checks probe the three key building blocks of our estimation strategy: the cross-border linkages, the identification of policies aimed at reducing non-performing assets and the timing of these policies.

In the first exercise, foreign-owned banks are randomly assigned their parents' domiciles, keeping the frequency of home-host country pairs in the dataset unchanged. The results of the exercise yield no statistically significant cross-border spillovers of NPL policies (see Table 9) confirming that actual ownership linkages matter for cross-border spillovers and such spillovers are not a product of global policy coordination or common trends.

Another placebo test preserves the actual ownership linkages but uses bailouts of subnational government, state-owned enterprises, private-public partnership (PPPs) and other types of non-financial-sector bailouts reported in Bova et al. (2016) in lieu of financial sector bailouts when constructing a measure of policy intervention. We observe 195 such non-financial recapitalisations in 40 countries (excluding instances of disaster relief). The non-financial government bailouts, as predicted, have no meaningful international spillover effect on NPL ratios, the estimates being several times lower than for financial sector bailouts (see Table 10).

Having established that ownership linkages and the definition of policies play a meaningful role in driving the results we do the same for the timing of policies. In particular, we create "placebo" policies that were enacted two years earlier than in reality. Reassuringly, the cross-border effects of, say, placebo asset management companies are statistically insignificant and several times smaller than the properly estimated effects. This also suggests that introduction of policies to address high levels of NPLs is not commonly anticipated by banks.

6. Conclusion and policy implications

This paper investigated whether changes in NPL stocks spill over to banks' foreign affiliates and whether policies trying to reduce the level of non-performing loans have cross-border spillover effects. The analysis reveals that a one percent reduction in the stock of NPLs is associated with an approximately 0.6 of a percent reduction in NPLs of a subsidiary bank operating in a foreign jurisdiction. This transmission appears to be driven largely by the workings of internal capital markets within banking groups, consolidated supervision and, to some extent, by the transfer of knowledge in the area of NPL resolution.

As a result of such transmission, policies aimed at reducing NPLs can have cross-border effects. In particular, the introduction of Asset Management Companies with the view to develop a secondary market for distressed debt is associated with a sizable reduction in the stock of NPLs of foreign affiliates of parent banks, where parent banks are based in the jurisdiction in which a policy package is implemented. The stock of NPLs in a foreign affiliate bank falls by an additional 12 percentage points per annum compared with the stock of NPLs of locally-owned banks operating in the same jurisdiction. The cross-border effect of the introduction of AMCs does not appear to become stronger in the presence of public bailouts in the jurisdiction of the parent banks.

To the best of our knowledge, this is the first paper to find evidence of positive international spill-overs due to establishment of AMCs. In contrast, the analysis did not find evidence of significant cross-border spillovers of other policies deployed to address the problem of high and persistent NPL ratios – including financial sector bailouts not accompanied by establishment of AMCs, changes to the stringency of loan classification, revision to provisioning rules and macroeconomic tightening.

The estimated effects are averages across various designs of AMCs. A relatively small sample size and lack of more detailed data do not permit us to make inference about the importance of the institutional setup of asset management companies or their specific features. The findings are nonetheless highly relevant for the policy debate in the EU on the potential establishment of a pan-European AMC. In particular, they suggest that the returns to deploying measures to address NPLs may be higher than previously thought on account of sizable cross-border spillovers.

The results are also indicative of the lower bound of effectiveness of various NPL policies in terms of reducing NPLs within the jurisdiction where they are deployed. In particular, deployment of an AMC appears to be associated with an approximately 12 to 20 percent reduction in the NPL ratio of banks operating in the jurisdiction (12 being the estimated indirect effect 20 being the higher-end estimate of the domestic effect that would induce the estimated cross-border effect).

This estimate, even if imprecise, is valuable as direct estimates of the effectiveness of policies aimed at reducing NPLs may be subject to large biases on account of non-random timing of the adoption of NPL policies while the direction of any such bias is ambiguous as it, in turn, depends on the timing and speed of adoption of various policy measures.

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Appendix

Table 1. Panel A - Descriptive statistics for full sample.

Variable	N	Mean	Std. Dev	Min	Max
NPLR, %	267,508	3.21	5.37	0	32.73
ΔNPL stock, %	205,497	0.12	0.90	-2.59	3.32
ROAA, %	384,333	0.85	1.74	-6.52	10.19
Δ Total assets, %	347,992	0.08	0.25	-7.91	8.42
Δ Deposits, %	344,310	0.08	0.35	-11.32	11.87
Total capital ratio, %	247,582	21.51	39.30	-747.38	993.90
Total assets, mln $	386,486	11793	92606	0.1	3807892
Foreign - CESEE	20,698	0.19	0.40	0	1
Foreign – full sample	44,757	0.31	0.46	0	1

Panel B – Descriptive statistics by ownership type in the full sample.

	Domestic banks		Foreign banks		T-test	
Variable	N	Mean	N	Mean	Δ	t-value
NPLR, %	18617	6.36	7458	6.80	-0.43	-3.96***
ΔNPL stock, %	15460	0.14	6036	0.16	-0.02	-1.71
ROAA, %	30550	1.07	13956	1.02	0.05	2.24*
Δ Total assets, %	27601	0.12	12701	0.12	0.00	0.49
Δ Deposits, %	27429	12.55	12652	12.61	-0.05	-0.17
Total capital ratio, %	16208	17.73	6654	22.97	-5.24	-15.79***
Total assets, mln $	30710	32,277	14047	8,870	23,407	17.29***

Panel C Policies targeting NPLs

NPL policy type	Number of observations	Number of countries
Asset Management Company	853	62
Public	740	58
Internal	83	10
Deposit guarantee scheme	111	6
Bank bailouts	279	66
Macroprudential policy tightening	254	119
Tightening loan classification stringency	74	64
Tightening provision stringency rules	60	53

Table 2 – Description of variables used and sources

Variable	Description	Source
NPLR	Ratio of non-performing loans to gross loans, %	Bankscope
ΔNPL stock	The change in logarithm of total stock of non-performing loans in the t-1, %	Bankscope
ROAA	Return on average assets, %	Bankscope
Δ Total assets	Percentage increase in total assets, %	Bankscope
Δ Deposits	Percentage increase in total deposits, %	Bankscope
TCR	Total capital ratio over RWA, %	Bankscope
Total assets	Total assets, US$ mln	Bankscope
High NPLR	Dummy variable equal to one when NPL ratio exceeds 5%, zero otherwise	
Foreign - CESEE	Dummy variable equal to one when the bank has foreign owner, zero otherwise	DeHaas et al. (2015)
Foreign	Dummy variable equal to one when the bank has foreign owner, zero otherwise	Claessens and Van Horen (2015)
AMC only	Dummy variable equal to one when AMC was in use in the past 3 years and was not assisted by bailout, zero otherwise	Hallerberg and Gandrud (2014)
Bailout only	Dummy variable equal to one when financial recapitalisation of bank was in use in the past 3 years and was not assisted by AMC, zero otherwise	Bova et al. (2016)
AMC and Bailout	Dummy variable equal to one when AMC was in use in the past 3 years and was assisted by bailout, zero otherwise	
Macroprudential tightening	Dummy variable equal to one when macroprudential policy index increased, zero otherwise	Cerutti et al. (2015)
Loan classification tightening	Dummy variable equal to one when number of days before which a loan needs to be classified as non-performing went down, zero otherwise	Barth et al. (2014)
Loan provisioning tightening	Dummy variable equal to one when loan provisioning requirements became more stringent, zero otherwise	Barth et al. (2014)
Basel	Dummy variable equal to one when the parent bank is located in a country that belongs to Basel Committee of Banking Supervision, zero otherwise	
Distance	Distance between biggest cities in two countries, weighted by the city's population share	CEPII
Inflation	Percentage increase in CPI	IFS
ΔGDP	Percentage increase in gross domestic product per capita at PPP	IFS
ΔInvestment	Percentage increase in gross capital formation over GDP	IFS

Figure 2 The time trend in NPL for domestic- and foreign-owned banks in the full sample

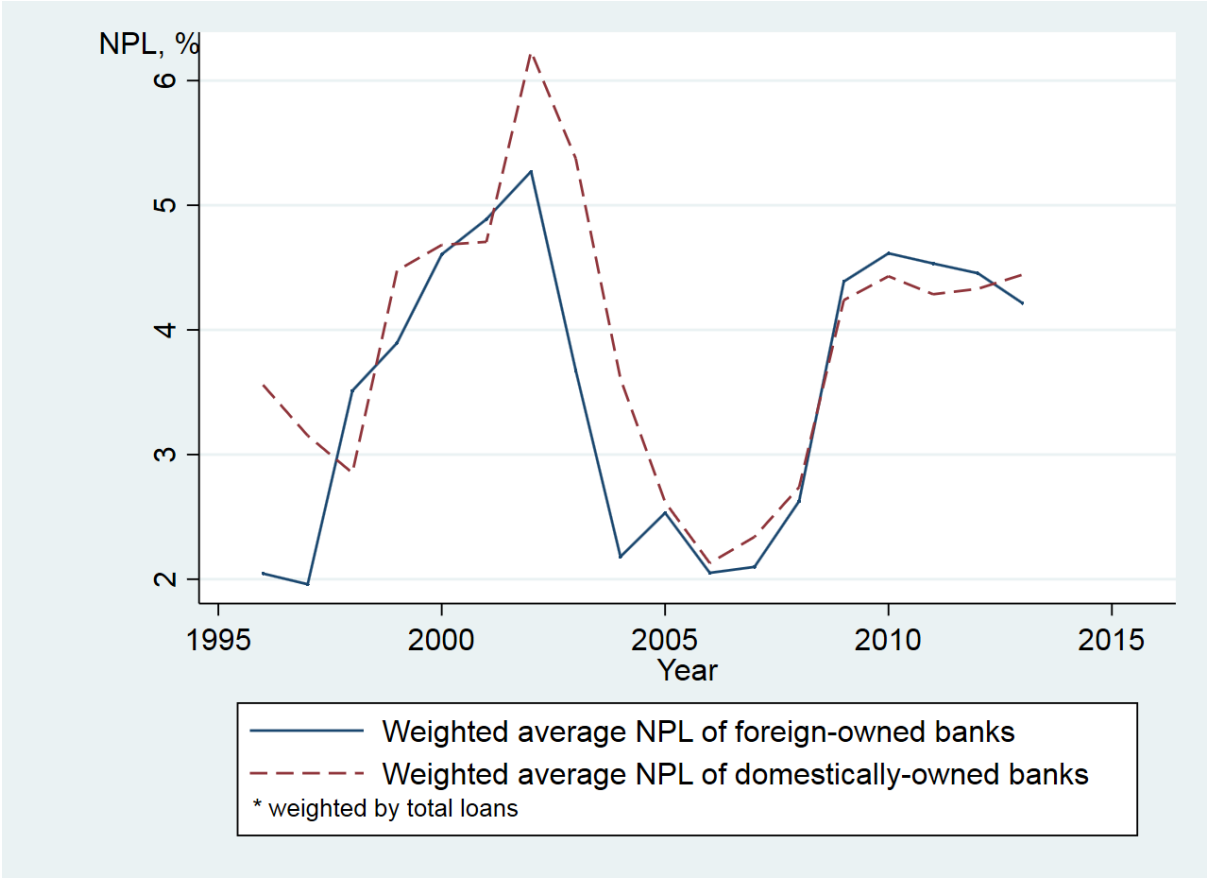


Table 2 Transmission of NPLs from parent to subsidiary

	(1)	(2)	(3)	(4)	(5)
			ΔNPL stock		
Foreign x Δ NPL $stock_{t-1}^{PB}$	0.398*	0.427*	0.393	0.314	0.302
	(0.204)	(0.210)	(0.272)	(0.216)	(0.244)
Foreign x $NPLR_{t-1}^{PB}$	0.0969***	0.107***	0.0987***	0.0800***	0.0891***
	(0.0301)	(0.0232)	(0.0239)	(0.0257)	(0.0270)
Foreign x Total Capital $Ratio_{t-1}^{PB}$	-0.0419**	-0.0566***	-0.0561***	-0.0536***	-0.0508***
	(0.0187)	(0.0146)	(0.0120)	(0.0176)	(0.0168)
$NPLR_{t-1}$	-0.115***	-0.120***	-0.0941***	-0.0950***	-0.0939***
	(0.0209)	(0.0210)	(0.00959)	(0.00624)	(0.00678)
$ROAA_{t-1}$		-0.0692***	-0.0710***	-0.105***	-0.103***
		(0.0155)	(0.0145)	(0.0305)	(0.0297)
$\Delta T.assets_{t-1}$		0.0948	0.0226	0.474	0.546*
		(0.0736)	(0.108)	(0.285)	(0.297)
$\Delta Deposits_{t-1}$		-0.133***	-0.0569	-0.327	-0.380*
		(0.0226)	(0.0504)	(0.220)	(0.204)
TCR_{t-1}				-0.00166	-0.000159
				(0.00638)	(0.00678)
Foreign x $Inflation^{F}$			0.981		2.113
			(2.355)		(3.806)
Foreign x ΔGDP^{F}			-0.916		-0.621
			(1.971)		(1.672)
Foreign x $\Delta Investment^{F}$			-0.0192		0.0178
			(0.523)		(0.578)
Observations	3641	2901	1429	982	933
R-squared	0.339	0.381	0.460	0.570	0.572
Adjusted R-squared	0.049	0.056	0.153	0.290	0.286
Bank FE	Yes	Yes	Yes	Yes	Yes
Domestic country-Year FE	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes the observation of 2107 unique banks located in 47 countries from CESEE region over the 1999-2010 period. All columns include the three interactions between foreign-ownership dummy and the parent bank lagged change in the stock of NPLs, NPL ratio and total capital ratio. Columns 2-5 include lagged bank controls. Columns 4 and 5 include additionally lagged total capital ratio. Columns 3 and 5 include foreign country macro controls.
Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Table 3 Transmission of NPLs from parent to subsidiary – breakdown

	(1)	(2)	(3)	(4)	(5)
			ΔNPL stock		
Foreign x Δ NPL stock$_{t-1}^{PB}$ x low NPLR$_{t-1}^{PB}$	0.126	0.122	0.151	0.0247	0.0465
	(0.273)	(0.287)	(0.304)	(0.322)	(0.310)
Foreign x Δ NPL stock$_{t-1}^{PB}$ x high NPLR$_{t-1}^{PB}$	0.690***	0.746***	0.723**	0.583**	0.621***
	(0.173)	(0.186)	(0.269)	(0.211)	(0.207)
Foreign x NPLR$_{t-1}^{PB}$	0.0943***	0.103***	0.0957***	0.0756***	0.0842***
	(0.0281)	(0.0228)	(0.0236)	(0.0260)	(0.0264)
Foreign x Total Capital Ratio$_{t-1}^{PB}$	-0.0438**	-0.0571***	-0.0574***	-0.0532***	-0.0512***
	(0.0165)	(0.0133)	(0.0109)	(0.0163)	(0.0152)
NPLR$_{t-1}$	-0.115***	-0.120***	-0.0942***	-0.0951***	-0.0941***
	(0.0208)	(0.0209)	(0.00958)	(0.00619)	(0.00676)
ROAA$_{t-1}$		-0.0691***	-0.0710***	-0.105***	-0.101***
		(0.0154)	(0.0146)	(0.0316)	(0.0304)
ΔT.assets$_{t-1}$		0.101	0.0376	0.468	0.542*
		(0.0742)	(0.108)	(0.283)	(0.293)
ΔDeposits$_{t-1}$		-0.139***	-0.0728	-0.337	-0.382*
		(0.0229)	(0.0506)	(0.217)	(0.198)
TCR$_{t-1}$				-0.00180	-0.000594
				(0.00636)	(0.00681)
Foreign x Inflation^{F}			1.574		3.049
			(2.360)		(3.869)
Foreign x ΔGDP^{F}			-0.886		-0.878
			(2.042)		(1.683)
Foreign x ΔInvestment^{F}			0.186		0.305
			(0.492)		(0.594)
Observations	3641	2901	1429	982	933
R-squared	0.340	0.382	0.461	0.572	0.574
Adjusted R-squared	0.050	0.057	0.155	0.292	0.288
Bank FE	Yes	Yes	Yes	Yes	Yes
Domestic country-Year FE	Yes	Yes	Yes	Yes	Yes

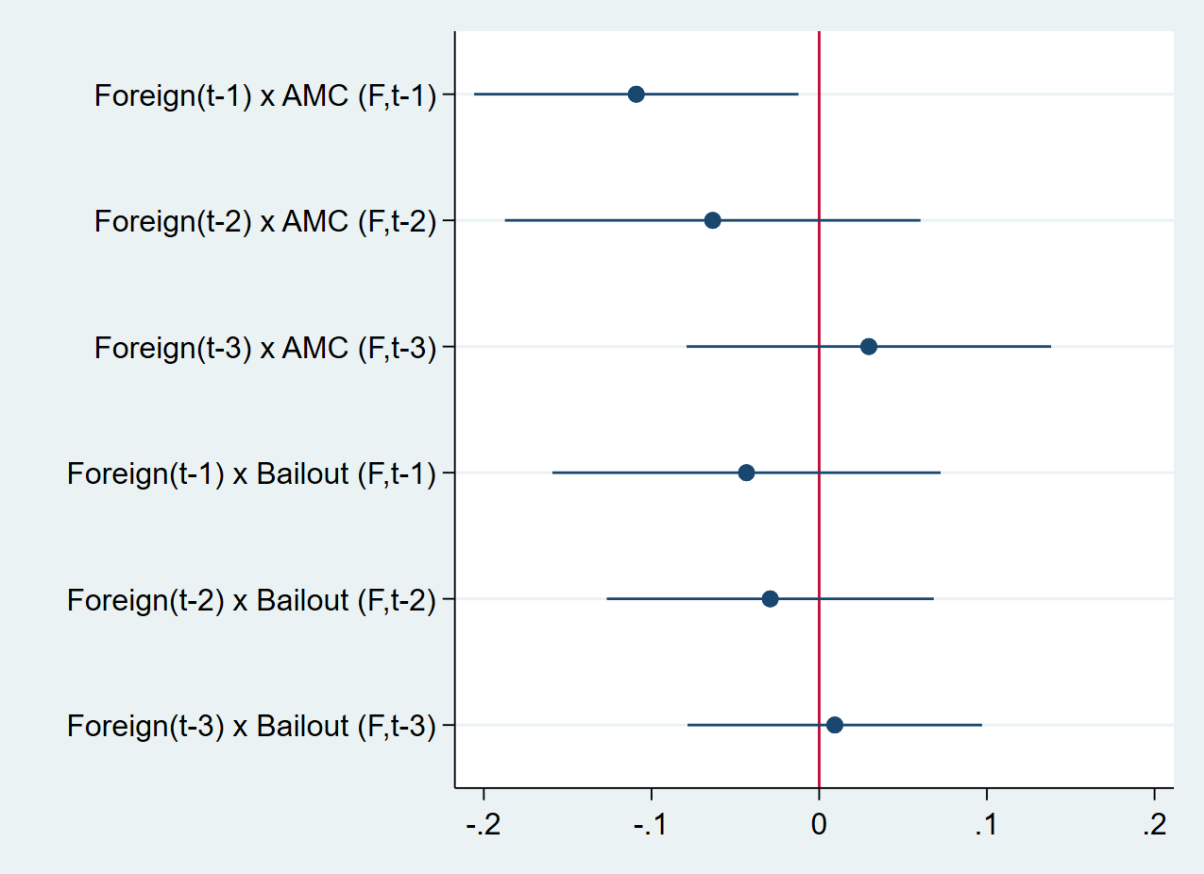
Notes: The dependent variable in all regressions is the logarithm of total non-performing loans at time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes the observation of 2107 unique banks located in 47 countries from CESEE region over the 1999-2010 period. All columns include the triple interactions between foreign-ownership dummy, the parent bank lagged change in the stock of NPLs and the dummy variable for high (low) NPL ratio of the parent in addition to double interactions between foreign ownership dummy and lagged parent bank NPL ratio and total capital ratio. Columns 2-5 include lagged bank controls. Columns 4 and 5 include additionally lagged total capital ratio. Columns 3 and 5 include foreign country macro controls. Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Table 4 Cross-border policy effect

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔNPL stock					
Foreign x AMC only^F	-0.0482	-0.0813*	-0.137**	-0.0719*	-0.144***	-0.119**
	(0.0450)	(0.0452)	(0.0610)	(0.0424)	(0.0540)	(0.0544)
Foreign x Public Bailout only^F	-0.0612	-0.0578	-0.0543	-0.00941	-0.0488	-0.0350
	(0.0453)	(0.0391)	(0.0448)	(0.0364)	(0.0535)	(0.0550)
Foreign x AMC and Public Bailout^F	-0.138***	-0.133**	-0.176***	-0.0478	-0.107*	-0.0867
	(0.0498)	(0.0570)	(0.0632)	(0.0500)	(0.0632)	(0.0615)
$ROAA_{t-1}$		0.0266***	0.0270***	-0.0125**	-0.028***	-0.026***
		(0.00642)	(0.00626)	(0.00605)	(0.0104)	(0.00960)
$\Delta T.assets_{t-1}$		0.154***	0.148***	0.0422	0.0867	0.103
		(0.0530)	(0.0518)	(0.0452)	(0.0738)	(0.0752)
$\Delta Deposits_{t-1}$		0.0562**	0.0572**	0.0264	-0.0130	-0.0207
		(0.0271)	(0.0267)	(0.0250)	(0.0586)	(0.0595)
$NPLR_{t-1}$				-0.056***	-0.059***	-0.059***
				(0.00339)	(0.00368)	(0.00364)
TCR_{t-1}					0.000617	0.000387
					(0.00133)	(0.00145)
Foreign x Inflation^F		-0.125	-0.208	-0.104	-0.500	
		(0.367)	(0.370)	(0.361)	(0.811)	
Foreign x ΔGDP^F		-1.498**	-1.575**	-1.624**	-1.089	
		(0.746)	(0.774)	(0.687)	(0.708)	
Foreign x ΔInvestment^F		0.246	0.272	0.194	0.328*	
		(0.191)	(0.192)	(0.165)	(0.186)	
Foreign	0.137***	0.187***		0.135***	0.206***	0.155**
	(0.0468)	(0.0504)		(0.0492)	(0.0777)	(0.0734)
Observations	20672	18426	18426	18426	12199	12375
R-squared	0.320	0.330	0.332	0.405	0.442	0.440
Adjusted R-squared	0.123	0.127	0.124	0.225	0.257	0.256
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Domestic Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Foreign Country FE			Yes			

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes 5102 unique banks located in 111 countries over the 1995-2013 period. All columns include the interactions between foreign-ownership dummy and policy dummy, equal to one when the policy was in place in the parent's jurisdiction between *t-3* and *t-1*. Columns 2-6 include lagged bank controls. Columns 2-5 include foreign country macro controls. Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Column 3 includes also foreign country fixed effect in place of foreign ownership dummy. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Figure 3 Dynamic policy effects from t-1 to t-3



Notes: The results come from regression of dynamic cross-border policy spillovers analogous with equation (3). The navy dots visualise the coefficients on the $F_{i,t-x}\ x\ POL^{F}_{f,t-x}$ interaction term and the bars represent corresponding 95% confidence intervals. The results are corresponding to column (2) of Table 5 where the policy dummies are included dynamically.
The dependent variable is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The regression includes 16059 bank-year observations and yields R^2 of 0.332 (Adjusted R^2 0.123). The regression includes the dynamic interactions between foreign ownership dummy at time *t-x* and policy dummy equal to one when the specified policy was in place at time *t-x* in the parent's country of jurisdiction (*x=1,2,3*). The policy choice is limited to AMC and Bailouts without further split into exclusive AMC and those assisted by Bailouts for simplicity. The controls include lagged return on assets, growth of total assets, growth of deposits and further foreign macro controls: inflation, GDP growth and investment growth. The regression includes bank and domestic country-year fixed effects. Standard errors clustered at domestic country level.

Table 5 Cross-border policy effects - regulation

	(1)	(2)	(3)	(4)	(5)	(6)
			ΔNPL stock			
Foreign x	-0.0323	-0.0299	-0.0235	-0.0441	-0.0510	-0.0626
Tightening loan classification^{F}	(0.0522)	(0.0502)	(0.0576)	(0.0441)	(0.0716)	(0.0726)
Foreign x	0.0898	0.0463	0.0773	0.0549	0.117	0.163**
Tightening provision stringency^{F}	(0.0719)	(0.0819)	(0.0928)	(0.0794)	(0.0901)	(0.0803)
Foreign x	0.0428	0.0182	0.0108	0.00827	-0.00795	-0.0180
Macroprudential tightening^{F}	(0.0389)	(0.0372)	(0.0376)	(0.0358)	(0.0414)	(0.0405)
$ROAA_{t-1}$		0.0258***	0.0264***	-0.0128**	-0.028***	-0.028***
		(0.00659)	(0.00643)	(0.00613)	(0.0104)	(0.0104)
$\Delta T.assets_{t-1}$		0.156***	0.153***	0.0395	0.0921	0.0982
		(0.0547)	(0.0535)	(0.0460)	(0.0761)	(0.0753)
$\Delta Deposits_{t-1}$		0.0586**	0.0595**	0.0295	-0.0111	-0.0130
		(0.0275)	(0.0269)	(0.0248)	(0.0601)	(0.0598)
$NPLR_{t-1}$				-0.057***	-0.060***	-0.060***
				(0.00336)	(0.00362)	(0.00363)
TCR_{t-1}					0.000578	0.000708
					(0.00134)	(0.00136)
Foreign x Inflation^{F}		0.141	0.0851	0.168	-0.0537	
		(0.380)	(0.386)	(0.449)	(0.903)	
Foreign x ΔGDP^{F}		-1.543**	-1.636**	-1.790***	-1.034	
		(0.756)	(0.777)	(0.680)	(0.769)	
Foreign x ΔInvestment^{F}		0.307	0.322	0.282	0.357	
		(0.206)	(0.205)	(0.177)	(0.226)	
Foreign	0.134***	0.144***		0.130***	0.149**	0.130**
	(0.0450)	(0.0470)		(0.0429)	(0.0632)	(0.0633)
Observations	20229	18182	18182	18182	12097	12193
R-squared	0.321	0.330	0.332	0.406	0.443	0.441
Adjusted R-squared	0.123	0.127	0.124	0.225	0.258	0.257
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Domestic Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Foreign Country FE			Yes			

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes 5102 unique banks located in 111 countries over the 1995-2013 period. All columns include the interactions between foreign-ownership dummy and policy dummy, equal to one when the policy was in place in the parent's jurisdiction between *t-3* and *t-1*. Columns 2-6 include lagged bank controls. Columns 2-5 include foreign country macro controls. Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Column 3 includes foreign country fixed effect in place of foreign ownership dummy. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Table 6 Transmission channel - consolidated supervision

	(1)	(2)	(3)	(4)	(5)
			ΔNPL stock		
Foreign x Δ NPL $stock_{t-1}^{PB}$ x low $NPLR_{t-1}^{PB}$ x Basel=0	-0.366	-0.357	-0.436	-0.491	-0.359
	(0.439)	(0.554)	(0.557)	(0.873)	(0.850)
Foreign x Δ NPL $stock_{t-1}^{PB}$ x low $NPLR_{t-1}^{PB}$ x Basel=1	0.376	0.359	0.428	0.230	0.209
	(0.245)	(0.226)	(0.281)	(0.201)	(0.231)
Foreign x Δ NPL $stock_{t-1}^{PB}$ x high $NPLR_{t-1}^{PB}$ x Basel=0	0.0929	0.162	0.304	0.378	0.501
	(0.299)	(0.294)	(0.261)	(0.255)	(0.339)
Foreign x Δ NPL $stock_{t-1}^{PB}$ x high $NPLR_{t-1}^{PB}$ x Basel=1	0.858***	0.904***	0.823**	0.609**	0.633***
	(0.281)	(0.274)	(0.302)	(0.235)	(0.218)
Foreign x $NPLR_{t-1}^{PB}$	0.0811**	0.0887***	0.0797***	0.0642*	0.0752**
	(0.0298)	(0.0263)	(0.0243)	(0.0332)	(0.0335)
Foreign x Total Capital $Ratio_{t-1}^{PB}$	-0.040**	-0.052***	-0.051***	-0.048***	-0.047**
	(0.0162)	(0.0129)	(0.0109)	(0.0165)	(0.0169)
$NPLR_{t-1}$	-0.12***	-0.120***	-0.094***	-0.095***	-0.094***
	(0.0210)	(0.0210)	(0.00959)	(0.00618)	(0.00676)
$ROAA_{t-1}$		-0.069***	-0.071***	-0.105***	-0.101***
		(0.0154)	(0.0145)	(0.0309)	(0.0301)
$\Delta T.assets_{t-1}$		0.0944	0.0187	0.430	0.521*
		(0.0735)	(0.114)	(0.303)	(0.305)
$\Delta Deposits_{t-1}$		-0.130***	-0.0533	-0.310	-0.363*
		(0.0267)	(0.0545)	(0.224)	(0.204)
TCR_{t-1}				-0.00165	-0.000254
				(0.00656)	(0.00698)
Foreign x $Inflation^{F}$			1.867		3.088
			(2.380)		(3.762)
Foreign x ΔGDP^{F}			-0.0974		-0.514
			(2.253)		(1.674)
Foreign x $\Delta Investment^{F}$			0.100		0.253
			(0.482)		(0.555)
Observations	3641	2901	1429	982	933
R-squared	0.340	0.383	0.463	0.573	0.575
Adjusted R-squared	0.050	0.057	0.156	0.292	0.286
Bank FE	Yes	Yes	Yes	Yes	Yes
Domestic country-Year FE	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans at time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes the observation of 2107 unique banks located in 47 countries from CESEE region over the 1999-2010 period.

All columns include the quadruple interactions between foreign-ownership dummy, the parent bank lagged change in the stock of NPLs, the dummy variable for high (low) NPL ratio of the parent and parent's country Basel Committee membership. Additional double interactions are included between foreign ownership dummy and lagged parent bank NPL ratio and total capital ratio. Columns 2-5 include lagged bank controls. Columns 4 and 5 include additionally lagged total capital ratio. Columns 3 and 5 include foreign country macro controls. Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Table 7 Transmission channel - Transfer of knowledge through distance

	(1)	(2)	(3)	(4)	(5)
			ΔNPL stock		
Foreign x Δ NPL $stock_{t-1}^{PB}$	1.175	1.434**	1.328**	1.282***	1.312***
	(0.741)	(0.641)	(0.544)	(0.450)	(0.423)
Foreign x Δ NPL $stock_{t-1}^{PB}$ x Log Distance	-0.101	-0.139	-0.137	-0.144*	-0.147*
	(0.115)	(0.106)	(0.0970)	(0.0810)	(0.0809)
Foreign x $NPLR_{t-1}^{PB}$	0.109***	0.111***	0.0983***	0.0771***	0.0869***
	(0.0313)	(0.0254)	(0.0244)	(0.0261)	(0.0274)
Foreign x Total $Capital\ Ratio_{t-1}^{PB}$	-0.0439**	-0.055***	-0.057***	-0.0479**	-0.051***
	(0.0205)	(0.0146)	(0.0118)	(0.0180)	(0.0166)
$NPLR_{t-1}$	-0.115***	-0.121***	-0.094***	-0.095***	-0.094***
	(0.0211)	(0.0210)	(0.00934)	(0.00691)	(0.00686)
$ROAA_{t-1}$		-0.068***	-0.071***	-0.107***	-0.103***
		(0.0161)	(0.0146)	(0.0294)	(0.0297)
$\Delta T.assets_{t-1}$		0.0693	0.0169	0.467	0.524*
		(0.0766)	(0.108)	(0.299)	(0.304)
$\Delta Deposits_{t-1}$		-0.121***	-0.0536	-0.334	-0.370*
		(0.0224)	(0.0499)	(0.232)	(0.209)
TCR_{t-1}				-0.000818	-0.000512
				(0.00721)	(0.00694)
Foreign x $Inflation^{F}$			0.904		1.971
			(2.372)		(3.874)
Foreign x ΔGDP^{F}			-0.834		-0.559
			(2.017)		(1.731)
Foreign x $\Delta Investment^{F}$			-0.0959		-0.0452
			(0.528)		(0.585)
Observations	3606	2869	1427	961	931
R-squared	0.338	0.381	0.461	0.576	0.573
Adjusted R-squared	0.047	0.054	0.154	0.296	0.286
Bank FE	Yes	Yes	Yes	Yes	Yes
Domestic country-Year FE	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes the observation of 2107 unique banks located in 47 countries from CESEE region over the 1999-2010 period. All columns include the three interactions between foreign-ownership dummy and the parent bank lagged change in the stock of NPLs, NPL ratio and total capital ratio. Additional triple interaction between foreign dummy, change in parent bank lagged change in the stock of NPLs and the logarithm of weighted distance between parent's and subsidiary's countries biggest cities. Columns 2-5 include lagged bank controls. Columns 4 and 5 include additionally lagged total capital ratio. Columns 3 and 5 include foreign country macro controls. Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Table 9. Placebo test - random assignment of parent countries

	(1) ΔNPL stock		(2) ΔNPL stock
Foreign x AMC only^{RF}	-0.0197	Foreign x	-0.0146
	(0.0512)	Tightening loan classification^{RF}	(0.0495)
Foreign x Public Bailout only^{RF}	-0.0148	Foreign x	0.0132
	(0.0542)	Tightening provision stringency^{RF}	(0.0625)
Foreign x AMC and Public Bailout^{RF}	-0.0262	Foreign x	0.00176
	(0.0457)	Macroprudential tightening^{RF}	(0.0348)
$ROAA_{t-1}$	0.0266***	$ROAA_{t-1}$	0.0246***
	(0.00649)		(0.00665)
$\Delta T.assets_{t-1}$	0.158***	$\Delta T.assets_{t-1}$	0.149***
	(0.0533)		(0.0545)
$\Delta Deposits_{t-1}$	0.0551**	$\Delta Deposits_{t-1}$	0.0588**
	(0.0274)		(0.0275)
Foreign x Inflation^{F}	-0.0906	Foreign x Inflation^{F}	-0.148
	(0.350)		(0.404)
Foreign x ΔGDP^{F}	-1.335*	Foreign x ΔGDP^{F}	-1.418*
	(0.724)		(0.766)
Foreign x $\Delta Investment^{F}$	0.223	Foreign x $\Delta Investment^{F}$	0.237
	(0.188)		(0.209)
Foreign	0.149***	Foreign	0.150***
	(0.0509)		(0.0477)
Observations	18426	Observations	18124
R-squared	0.329	R-squared	0.331
Adjusted R-squared	0.126	Adjusted R-squared	0.126
Bank FE	Yes	Bank FE	Yes
Domestic Country-Year FE	Yes	Domestic Country-Year FE	Yes

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes 5102 unique banks located in 111 countries over the 1995-2013 period. Foreign-owned banks are randomly assigned their parents' domiciles, keeping the frequency of home-host country pairs in the dataset unchanged.

Column (1) corresponds to Table 5 (Column 2) and Column (2) corresponds to Table 6 (Column 2) with the random parent country assignment. Both columns include the interactions between foreign-ownership dummy and policy dummy, equal to one when the policy was in place in the randomly assigned foreign jurisdiction between t-3 and *t-1*. The regressions include lagged bank controls, foreign-ownership dummy and foreign country macro controls. Table 2 gives detailed variable description. Both columns include bank and domestic country-year fixed effects. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Table 10. Placebo test - timing of policies moved arbitrarily 2 years earlier

	(1)	(2)	(3)	(4)	(5)
			ΔNPL stock		
Foreign $_{t+2}$ x AMC $_{t+2}$ ^{F}	0.0522	0.0593	0.0656	0.00952	0.0165
	(0.0438)	(0.0508)	(0.0411)	(0.0489)	(0.0481)
Foreign $_{t+2}$ x Public Bailout $_{t+2}$ ^{F}	-0.0134	-0.0188	0.00967	0.0184	0.0141
	(0.0444)	(0.0423)	(0.0397)	(0.0649)	(0.0645)
$ROAA_{t-1}$	0.0198**	0.0209***	-0.0190**	-0.038***	-0.038***
	(0.00799)	(0.00785)	(0.00754)	(0.0135)	(0.0132)
$\Delta T.assets_{t-1}$	0.127**	0.117*	0.0350	0.199**	0.207**
	(0.0619)	(0.0625)	(0.0498)	(0.0877)	(0.0871)
$\Delta Deposits_{t-1}$	0.0351	0.0416	-0.00544	-0.136*	-0.130*
	(0.0398)	(0.0414)	(0.0350)	(0.0721)	(0.0704)
$NPLR_{t-1}$			-0.060***	-0.066***	-0.065***
			(0.00453)	(0.00540)	(0.00531)
TCR_{t-1}				0.000347	0.000525
				(0.00178)	(0.00175)
Foreign x Inflation^{F}	0.212	0.0642	0.123	0.110	
	(0.341)	(0.375)	(0.367)	(1.058)	
Foreign x ΔGDP^{F}	-1.511*	-1.530*	-1.856**	-1.501**	
	(0.846)	(0.881)	(0.767)	(0.753)	
Foreign x ΔInvestment^{F}	0.118	0.136	0.0563	0.192	
	(0.188)	(0.190)	(0.158)	(0.167)	
Foreign	0.114*		0.108*	0.0991	0.0988
	(0.0580)		(0.0552)	(0.0748)	(0.0687)
Observations	12949	12949	12949	8559	8682
R-squared	0.366	0.369	0.439	0.481	0.480
Adjusted R-squared	0.144	0.141	0.242	0.281	0.282
Bank FE	Yes	Yes	Yes	Yes	Yes
Domestic Country-Year FE	Yes	Yes	Yes	Yes	Yes
Foreign Country FE		Yes			

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes 5102 unique banks located in 111 countries over the 1995-2013 period. All columns include the interactions between foreign-ownership dummy and policy dummy, equal to one when the policy was in place in the parent's jurisdiction at time *t+2*. Columns 1-5 include lagged bank controls. Columns 1-4 include foreign country macro controls. Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Column 2 includes also foreign country fixed effect in place of foreign ownership dummy. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01

Table 11. Placebo test - non-financial sector bailout

	(1)	(2)	(3)	(4)	(5)
			ΔNPL stock		
Foreign x Placebo Bailout^F	0.0181	0.0105	0.00241	-0.0253	-0.0182
	(0.0350)	(0.0364)	(0.0355)	(0.0442)	(0.0431)
$ROAA_{t-1}$	0.0262***	0.0266***	-0.0118*	-0.0288**	-0.0286**
	(0.00676)	(0.00661)	(0.00630)	(0.0114)	(0.0114)
$\Delta T.assets_{t-1}$	0.150***	0.150***	0.0365	0.0770	0.0791
	(0.0537)	(0.0534)	(0.0457)	(0.0771)	(0.0762)
$\Delta Deposits_{t-1}$	0.0611**	0.0590**	0.0273	-0.00598	-0.00741
	(0.0271)	(0.0272)	(0.0249)	(0.0614)	(0.0614)
$NPLR_{t-1}$			-0.056***	-0.060***	-0.060***
			(0.00352)	(0.00388)	(0.00388)
TCR_{t-1}				0.000352	0.000463
				(0.00135)	(0.00137)
Foreign x Inflation^F	0.190	0.0840	0.169	0.807	
	(0.359)	(0.361)	(0.455)	(1.280)	
Foreign x ΔGDP^F	-1.030	-1.199	-1.587**	-0.536	
	(0.774)	(0.780)	(0.737)	(0.656)	
Foreign x ΔInvestment^F	0.152	0.175	0.133	0.212	
	(0.235)	(0.222)	(0.189)	(0.228)	
Foreign	0.0811		0.0695	0.107	0.123
	(0.0502)		(0.0490)	(0.0711)	(0.0747)
Constant	0.0688***	0.0895***	0.480***	0.486***	0.482***
	(0.0171)	(0.00946)	(0.0254)	(0.0371)	(0.0373)
Observations	17655	17655	17655	11816	11856
R-squared	0.329	0.330	0.404	0.442	0.442
Adjusted R-squared	0.127	0.124	0.224	0.256	0.256
Bank FE	Yes	Yes	Yes	Yes	Yes
Domestic Country-Year FE	Yes	Yes	Yes	Yes	Yes
Foreign Country FE		Yes			

Notes: The dependent variable in all regressions is the logarithm of total non-performing loans in time *t* divided by total non-performing loans at time *t-1*, winsorised at 1st and 99th percentile. The observation unit is at bank-year level. Sample includes 5102 unique banks located in 111 countries over the 1995-2013 period. All columns include the interactions between foreign-ownership dummy and policy dummy, equal to one when the bailout of non-financial sector was in place in the parent's jurisdiction between time *t-3* and *t-1*. Columns 1-5 include lagged bank controls. Columns 1-4 include foreign country macro controls. Table 2 gives detailed variable description. All columns include bank and domestic country-year fixed effects. Column 2 includes also foreign country fixed effect in place of foreign ownership dummy. Standard errors clustered at domestic country level. * p<0.10 ** p<0.05 *** p<0.01