IMF Working Paper

The Impact of Bailouts on the Probability of Sovereign Debt Crises: Evidence from IMF-Supported Programs

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INTERNATIONAL MONETARY FUND

IMF Working Paper

African Department

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January 2019

Abstract

This paper studies the role of IMF-supported programs in mitigating the likelihood of subsequent sovereign defaults in borrowing countries. Using a panel of 106 developing countries from 1970 to 2016 and an entropy balancing methodology, we find that IMF-supported programs significantly reduce the likelihood of subsequent sovereign defaults. This finding is robust to different specifications of the entropy balancing and alternative identification strategies. Our results suggest that a country that signs a program with the IMF, typically experiences a slight improvement in its sovereign credit rating and a decrease in both government debt-to-GDP and fiscal deficit-to-GDP.

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I. INTRODUCTION

Rising debt to risky levels has been pointed as one of the major challenge for many countries, especially those in the developing world. According to IMF (2018), global debt reached a record pick of 225 percent of world GDP in 2016, an increase of 12 percentage points of GDP compared to the previous pick at the onset of the 2007 financial crisis. The report highlighted public debt as an important driver of the increased global debt. While high government debts expose countries to rollover risks and to a sudden tightening of international financial conditions—and therefore subsequent debt crises—an important policy question is whether, the Fund, in its mandate of providing financial support mechanisms to member countries that are experiencing actual or potential macroeconomic problems through bailout mechanisms, can help mitigate the occurrence of such subsequent crises. In this paper, we study the role of bailouts in mitigating the likelihood of subsequent sovereign defaults in developing countries, taking IMF-supported programs as an example.

In theory, the mechanisms through which IMF-supported programs can have an impact on sovereign debt crises is not obvious. IMF loans may affect sovereign defaults through a number of conflicting channels (Jorra, 2012). A first mechanism may arise from the consequences of liquidity provision, particularly in a context of an illiquid government. If a government is facing a temporary liquidity shortage, having a rescue from the Fund may have a direct impact on its liquidity constraint and help avoid a potential self-fulfilling crisis (Fischer, 1997). In addition to mitigating the liquidity constraint, the Fund support may also have a catalytic effect on other official and private investors through restoring confidence, thus helping to mobilize capital from other sources (Dhonte, 1997; Fisher, 1997; Bird and Rowlands, 2002; Tirole, 2002; Morris and Shin, 2006; Saravia, 2010). However, the catalytic effect on private lenders may come at a cost in the long-run if the government accumulates a higher level of private debt (Fink and Scholl, 2016). Second, IMF-supported programs may affect debt crises through the policy adjustment channel. If countries do not pay for the consequences of their policy actions because of an insurance provided by the Fund—through emergency loans that are somewhat cheaper than market conditions—this may create a moral hazard since countries may be more reluctant to undertake painful fiscal adjustments. A moral hazard may particularly arise if the Fund fails to differentiate between temporary and

permanent liquidity crises (Vaubel, 1996; Dreher, 2004). Finally, a third mechanism, linked somewhat to the previous one, is the role of conditionalities in IMF programs that may help rebuild a stable and sustainable macroeconomic position, including an improved fiscal position. Consequently, the question of whether IMF-supported programs have a positive or a negative effect on the likelihood of occurrence of debt crises is an empirical question.

This paper analyzes the impact of bailouts on the probability of sovereign debt crises, taking IMF-supported programs as an example. The empirical assessment relies on a large and representative panel of 106 developing countries over the period 1970-2016. We address the common issue of identification in IMF program evaluation using different strategies. In our benchmark approach, we employ the entropy balancing methodology, a generalization of conventional matching methods proposed by Hainmueller (2012), and recently used by Neuenkirch and Neumeier (2016) to study the impact of U.S. sanctions on poverty, and by Balima (2017) to analyze the effect of domestic sovereign bond market participation on financial dollarization. While the relative performance of entropy balancing—compared to alternative methods—will be closely discussed in detail in the methodological section, this method allows to identify the impact of Fund-supported programs by comparing program and nonprogram countries that are as similar as possible in terms of observable characteristics, after purging for country- and time-specific factors. In robustness checks, we also employ an instrumental variable approach and conventional matchings. Our instrumental variable strategy uses two political variables—borrower's ties with the Fund major shareholders at the United Nations General Assembly and previous executive elections—as external instruments for a country decision to sign a program with the Fund. The matching approaches employ propensity scores matching and bias-corrected matching to deal with the selection bias in Fund program adoption.

The main finding in this paper indicates that IMF-supported programs significantly reduce the likelihood of subsequent sovereign defaults by around 1.3 percentage points. This estimated coefficient is economically meaningful given that the unconditional probability of experiencing a sovereign default is 3.5 percentage points in our sample. We demonstrate that our finding is particularly robust to different specifications of the entropy balancing and the use of additional identification strategies including an instrumental variable approach and conventional matchings. Moreover, we find that a country that signed a program with the Fund

experienced a slight improvement in its sovereign credit rating, and a decrease in both government debt-to-GDP and fiscal deficit-to-GDP during the program period compared to the period before. This suggests that (i) the liquidity provision channel and catalytic role, (ii) the role of government adjustment effort, and (iii) the conditionality channel may be at work. Our results are in line with the theoretical model of Corsetti et al. (2006) that shows that a lending support not only has an impact on the likelihood and the possible incidence of a crisis, but also prompts the borrowing government to implement desirable policies and reforms.

The rest of the paper is as follows. Section 2 discusses the existing literature. Section 3 presents our benchmark empirical methodology. Section 4 describes the data. Section 5 reports the baseline result while section 6 follows with the robustness checks. Section 7 provides some potential explanations of the result. Finally, a summary is presented in section 8.

II. LITERATURE REVIEW

Existing theoretical literature on this issue, starting from Eaton and Gersovitz (1981), focuses more broadly on bailout programs by International Financial Institutions (IFIs) in models of strategic sovereign defaults (Zettelmeyer, 2000; Corsetti et al., 2006; Boz, 2011; Fink and Scholl, 2016). Zettelmeyer (2000) uses a static co-ordination game model and suggests that limited rescue packages can have counterproductive effects in the short run by providing investors the opportunity to exit. Corsetti et al. (2006) provide an opposite view. Using a model in which a crisis can be the outcome of fundamental shocks and self-fulfilling panics, they show that partial bailout conditional on policy adjustment by the debtor country can restore investors' confidence and therefore reduce the incidence of crises. Their model also shows that liquidity support can tilt the government's incentives to implement desirable but costly policies and reforms. Boz (2011) shows that sovereigns borrow more from private sector creditors compared to IFIs—even if the interest rates charged by the latter are significantly lower—because they can strategically default on private debt, whereas IFI's debt contracts are enforceable. Fink and Scholl (2016) formalize a dynamic stochastic model of sovereign debt and default with endogenous participation rates in bailout programs, and calibrate the model to Argentina. They show that bailouts lower the likelihood of a sovereign default in the short run, and restore confidence of private lenders through increasing their willingness to provide

new credit to the borrowing government. In their framework, the government then takes advantage of the catalytic effect induced by bailouts—lower interest rates, larger capital supply—and accumulates more private debt. As a result, the risk of default increases in the long run.

On the empirical side, the literature is however relatively sparse. A notable exception is Jorra (2012) who analyzes the effect of IMF bailouts on the probability of subsequent sovereign defaults. Using a sample of 57 developing economies, he finds that IMF-supported programs increase the probability of subsequent sovereign defaults by approximately 1.5-2 percentage points. The author stresses that his result cannot be attributed to an endogeneity bias or a lack of compliance with IMF conditionality, as his empirical specification explains simultaneously sovereign defaults and program participation. Apart from Jorra (2012), previous empirical studies analyzing the direct association between bailouts in the context of IMF lending programs and crises focus on three types of crises: sudden stops, currency crises, and banking crises (Eichengreen et al., 2008; Dreher and Walter, 2010; Papi et al., 2015). Eichengreen et al. (2008) examine the impact of IMF-supported programs on the incidence of sudden stops in capital flows. After corrected for the non-random assignments of IMF programs, they find that IMF credit reduces the likelihood of sudden stops—particularly for countries with strong fundamentals—through the stabilizing effect of liquidity insurance. Dreher and Walter (2010) employ a panel of 68 countries over the period 1970-2002. They show that IMF involvement decreases a country's risk of experiencing a currency crisis through the presence of the Fund itself rather than money disbursements or compliance with conditionality. Finally, in a recent paper, Papi et al. (2015) focus on banking crises, using a large panel of 113 developing countries over the period 1970-2010. The empirical assessment concludes that, after correcting for endogeneity issues, countries which signed IMF-supported programs are less likely to experience a banking crisis.

However, the empirical assessment of IMF-supported programs and sovereign defaults—Jorra (2012)—is not immune of criticisms. First, since the paper focuses only on 57 developing countries, the finding, somewhat, may face criticism regarding its external validity. In fact, given that the Fund is an organization of 189 countries, a broader assessment of its impact in preventing (or not) debt crises may rely on a representative sample of its member States. Second, and in relation to the previous point, Jorra's definition of a debt crisis is taken

from Standard and Poor's, and therefore excludes countries not rated by this rating agency. Third, while Jorra's empirical identification uses a version of Heckman two step approach, such a strategy may be subject to inconsistent estimates if collinearity problems prevail (Puhani, 2002). Finally, given the above evidence from Eichengreen et al. (2008), Dreher and Walter (2010), and Papi et al. (2015), a natural question emerges. Why should IMF involvement lower the likelihood of sudden stops, currency crises and banking crises, while increasing the risk of sovereign defaults?

III. METHODOLOGY

The objective of this paper is to analyze the role of bailouts in mitigating the likelihood of subsequent sovereign debt crises (SDC) in borrowing countries, taking IMF-supported programs as an example. Our challenge is to establish a causal link running exclusively from a Fund program implementation to the occurrence of a SDC. As stressed by Bird (2001) and Dreher and Walter (2010), empirical studies of the impact of IMF programs commonly faced the problem of counterfactual and endogeneity. On the one hand, it is hard to properly predict the outcome that would have emerged without a program and therefore to quantify the impact induced by the program participation. On the other hand, countries tend to turn to the Fund during times of economic downturn—in particular when a crisis is looming down—due to the Fund's mandate of international lender of last resort. A number of previous studies aimed at dealing with these issues usually employ a version of Heckman (1979) two-step estimator or an instrumental variable approach (Przeworski and Vreeland (2000), Hardoy (2003), Barro and Lee (2005), Conway (2006), Jorra (2012). Other studies also use conventional matching methodologies (Mumssen et al., 2013; Gunduz, 2016).

In this paper, we employ the entropy balancing methodology—a generalization of conventional matching methods proposed by Hainmueller (2012)—to overcome the counterfactual and endogeneity issues with regard to the adoption of an IMF program. This methodology has been recently used by Neuenkirch and Neumeier (2016) to assess the impact of U.S. sanctions on poverty, and by Balima (2017) to analyze the effect of domestic sovereign bond market participation on financial dollarization. Entropy balancing allows to identify the impact of IMF-supported programs by comparing program and nonprogram countries that are

as similar as possible in terms of observable characteristics, after purging for country- and time-specific factors. In particular, entropy balancing has some advantages over other treatment effect estimators or regression analyses (Hainmueller, 2012). Its most important attractive feature is to allow obtaining a high degree of covariate balance between program and nonprogram groups by creating a synthetic control group that is as close as possible to the program group.[1] A second advantage is that, compared for instance to simple regression-based approaches (namely difference-in-difference) or conventional matching methods (including propensity scores matching and bias-corrected matching), entropy balancing is fairly versatile in the sense that its use does not require specifying an empirical model for the adoption of an IMF program. This feature makes it possible to minimize potential problems of misspecification, multicollinearity, or wrong choice of the functional form. A third advantage is that, compared to conventional matching where the control units are either discarded or matched, entropy balancing uses a more flexible reweighting scheme. It reweights units with the goal of achieving balance while keeping at the same time the weights as close as possible to the base weights to avoid a loss of information. Finally, while conventional matching methods and pooled probit rely on the conditional independence assumption—that is, conditionally on the vector of observable covariates, the treatment is independent of unobservable factors—using the entropy balancing allows considering the panel dimension of the data by controlling for country and time specific factors in its second step of the regression analysis.[2] While our preferred method is the entropy balancing, later in the paper, we also employ a battery of alternative identification strategies including instrumental variable approach and conventional matching methodologies, to validate our findings.

The entropy balancing approach is based on the idea that the adoption of an IMF-supported program represents the treatment and the occurrence of a SDC represents the outcome variable. The units of observations are country-year observations; observations with

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[1]Hainmueller (2012), in a Monte Carlo simulation, compares the performances of entropy balancing to other alternative impact assessment methodologies, including propensity score matching and genetic matching. He concludes that entropy balancing outperforms these alternative methodologies in terms of estimation bias and mean square error.

[2] Some previous studies including Jorra (2012) use a pooled probit due to the incident parameter problem resulting from applying a least square dummy variable estimator to a model with a binary dependent variable.

(without) a program represent the treatment (control) group. The measure of interest we wish to estimate is the well-known average treatment effect on the treated, τ, defined as

$$\tau = E\left[SDC_{(1)} \middle| P = 1\right] - E\left[SDC_{(0)} \middle| P = 1\right] \qquad (1)$$

where $SDC_{(.)}$ is the outcome variable measuring the occurrence of a sovereign debt crisis. P indicates if the unit of observation is subject to the treatment *IMF-supported program* ($P = 1$) or not ($P = 0$). Consequently, $E\left[SDC_{(1)} \middle| P = 1\right]$ is the probability of experiencing a sovereign default during the program period and $E\left[SDC_{(0)} \middle| P = 1\right]$ is the counterfactual outcome for countries that signed programs, that is, the likelihood of experiencing a sovereign default in program countries if they had not adopted programs. Given that we cannot observe the last one, we need to identify an appropriate proxy. If the adoption of a program was a random event, we can easily identify τ by comparing SDC in program and nonprogram countries. However, as discussed earlier, the decision to request a program from the Fund is rather endogenous to several macroeconomic variables. For this reason, we can compare—after purging for some specific factors—program and nonprogram units that are as close as possible with respect to observables characteristics that meet these two conditions: (i) they are correlated with a country decision to sign a program with the Fund and (ii) they are associated with the occurrence of a SDC. Under the condition that the nonprogram units are similar as possible to the program units, difference in SDC is caused by the adoption of an IMF-supported program. With these remarks, the above equation can then be rewritten as follows

$$\tau = E\left[SDC_{(1)} \middle| P = 1, X = x\right] - E\left[SDC_{(0)} \middle| P = 0, X = x\right] \qquad (2)$$

where $X = x$ is a vector of observables covariates that may affect both the decision to sign a program and the likelihood of experiencing a default, as described in the data section below. $E\left[SDC_{(1)} \middle| P = 1, X = x\right]$ is the likelihood of a default occurrence for program units, and $E\left[SDC_{(0)} \middle| P = 0, X = x\right]$ is the expected likelihood of experiencing a default for the synthetic control units.

Practically, to estimate τ with the entropy balancing, we follow the following two consecutive steps. A first step computes weights for nonprogram units. These weights may satisfy pre-specified balanced constraints involving sample moments of observable

characteristics, *X*. Following Neuenkirch and Neumeier (2016), we choose the balance constraints that impose equal covariate means across program and nonprogram groups. By doing so, we want to ensure that the nonprogram group contains, on average, units not subject to a program that are as similar as possible to the program units. In the robustness exercises, we will also bring the 2nd and the 3rd moments into the list of the balanced constraints. A second step uses the weights from the first step in a regression analysis where SDC is the dependent variable and IMF-supported program dummy is the main explanatory variable. We then estimate the average treatment effect of IMF programs on SDC, τ. In the second step, we also control for the entropy balancing covariates as well as time and regional specific effects—as in a randomized experiment—to increase the efficiency of the estimates.

IV. DATA

We use a large panel dataset covering 106 developing countries over the period 1970-2016. We focus exclusively on developing countries to reduce the scope for parameter instability owing to difference in structural and institutional conditions in program and nonprogram countries (Dicks-Mireaux et al., 2000). The dependent variable is a dummy indicating the occurrence of a sovereign debt crisis. This variable is taken from the database on government debt in default developed by the Credit Rating Assessment Group (CRAG) of the Bank of Canada, the latest version of the database is provided by Beers and Mavalwalla (2017). We do prefer to use this database due, on the one hand, to its relative comprehensiveness and, on the other hand, to the frequency of occurrence of sovereign defaults, compared to existing concurrent database including Laeven and Valencia (2013). The Bank of Canada's CRAG database has been recently used by Eichengreen (2015), Reinhart and Trebesch (2016) and Reusens and Croux (2017). In a robustness check, we also use Laeven and Valencia database. CRAG database compiles a comprehensive global dataset of official government debt on defaults and the stock of arrears with official creditors using different sources including international and regional organizations (i.e., the Asian Development Bank, the IMF, the Paris Club, the World Bank, and the IBRD's annual financial statements) and academic authors.[3] In particular, CRAG database gathers previously published data sets compiled by various public

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[3] Academic sources include Suter (1992), Beers and Chambers (2006), Tudela et al. (2011), Das et al. (2012), Tweedie et al. (2012), Cruces and Trebesch (2013).

and private sector sources together with new information, which makes it one of the most comprehensive dataset on sovereign defaults currently available. Consistent with previous literature on sovereign defaults (Reinhart and Rogoff, 2010; Cruces and Trebesch, 2013), a default is defined when a debt service is not paid on the due or within a specified grace period, or when payments are not made within the time frame specified under a guarantee or absent an outright payment default. However, given that the final resolution with creditors following a sovereign default can be very lengthy, we follow Reinhart and Rogoff (2010) and consider only the first year of default as a crisis year. By doing so, we identify 115 sovereign debt crises in our sample, the first event occurs in 1976 and the last in 2016. The average number of crises per year is about two events, with some picks occurring in 1980, 1985, 1998, 2008, and 2013.

Information on our treatment variable, IMF-supported programs, is drawn from a database maintained by the Fund's Strategy, Policy and Review Department called "Fund Arrangements since 1952". This database provides information on the years in which a program started and ended. Consistent with previous works on IMF programs (Dreher and Walter, 2010; Jorra, 2012; Papi et al., 2015), we define a dummy variable taking 1 if a country had any type of IMF-supported program during the previous five years, because reforms may take some time to be implemented under IMF-supported programs.[4] Appendix 1 lists countries that have signed at least a program in our sample together with the number of programs, and Appendix 2 reports the list of countries in the present analysis.

Regarding the control variables, our baseline regressions include similar covariates as Jorra (2012). In the robustness check, we will introduce a battery of additional covariates to ensure that the result is not driven by a specific choice of covariates. Our baseline covariates consist of the following: the GDP growth rate, the ratio of reserves to imports, the ratio of debt service to exports, the external debt to GDP ratio, and a variable capturing parliamentary democracies. Contrary to Jorra (2012), we did not include the five-year US treasury constant maturity interest rate since our main regressions do include year dummies that capture more broadly time specific factors, including the US treasury interest rate. Consistent with previous findings, we expect the first two variables and the last one to be negatively correlated the

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[4] In a non-reported regression, we also focus exclusively on agreed Stand-by-Arrangements (SBA) and Extended Fund Facility (EFF) as in Jorra (2012) and find a consistent result.

probability of a sovereign default, while debt service and external debt may be positively correlated. [Appendix 3] presents the sources and definitions of data used in this paper.

A first insight of the relationship between IMF-supported programs and SDC can be gauged by comparing the unconditional and the conditional probabilities of a SDC occurrence in our sample of analysis. In Table 1, the unconditional probability of a sovereign default—that is the number of crises divided by the number of non-missing country-year observations—is 3.5 percentage points (pp), compared to a conditional probability—i.e. the probability of experiencing a debt crisis conditional on having signed an IMF program during the past five years—of 2.7 pp. This simple correlation suggests that countries that have signed programs with the Fund have, roughly speaking, 0.8 pp lower probability of experiencing a debt crisis compared to countries in our sample. Building on this first insight, we therefore dig deeper into the analysis in the next section.

Table 1: Conditional and unconditional probabilities of a debt crisis in the sample of analysis.

	Conditional	Unconditional	Difference
Sovereign debt crisis	0.027	0.035	0.008

Note: This table presents the conditional and the unconditional probabilities of the occurrence of a sovereign debt crisis in our sample. The conditional probability is defined as the probability of experiencing a default, conditional on having signed at least an IMF-supported program during the past five years. The unconditional probability is the number of crises divided by the number of non-missing country-year observations.

V. BASELINE RESULTS

Table 4 presents the estimated impact of IMF-supported programs on SDC using the entropy balancing. Before getting into the estimate of the treatment effect, we focus on the performances of the entropy balancing in building a fairly close counterfactual of nonprogram units. Tables 2 and 3 present the sample means of matching covariates before and after weighting used to estimate the impact of IMF-supported programs on SDC. The evidence in Table 2 suggests that countries that adopted at least a program during the past five years (column [1]) differ from countries that did not (column [2]). Indeed, countries that signed a program have (i) lower real GDP growth—although the difference is not statistically significant, (ii) higher debt service-to-GDP, (iii) lower reserves-to-imports, (iv) higher external debt-to-GDP, and (v) lower parliamentary democracy, compared to countries that did not. However, the results in Table 3 clearly show that no significant difference appears between program and nonprogram countries after having created the balanced sample using the

covariate moments. The non-statistically significant difference between the two groups strongly demonstrates the effectiveness of the entropy balancing method in building a perfect balance between the treated and the control groups for estimating the treatment impact of a program adoption.

Table 2: Descriptive statistics before weighting.

Variables	[1] IMF-Supported Programs	[2] No IMF-Supported Programs	[3] = [2] - [1] Difference	t-test	p-value
Real GDP growth$_{t-1}$	4.073	4.161	0.088	0.443	0.658
Debt service-to-exports$_{t-1}$	19.500	17.030	-2.470	-2.541	0.011
Reserves-to-imports$_{t-1}$	31.250	37.330	6.080	5.027	0.000
External debt-to-GDP$_{t-1}$	70.190	46.860	-23.330	-11.494	0.000
Parliamentary Democracy	0.128	0.173	0.046	3.644	0.000
Observations	1,652	1,616			

Notes: This Table presents the pre-weighting sample means of the matching covariates for country-year observations where IMF-supported programs where in place (the treatment group) in column [1] and country-year observations where no IMF-supported programs were in place (the potential control group) in column [2]. Column [3] reports the differences in means between treated and control group, and the corresponding t-test statistics and p-values.

Table 3: Descriptive statistics after weighting.

Variables	[1] IMF-Supported Programs	[4] No IMF-Supported Programs	[5] = [4] - [1] Difference	t-test	p-value
Real GDP growth$_{t-1}$	4.073	4.077	0.004	-0.023	0.982
Debt service-to-exports$_{t-1}$	19.500	19.390	-0.110	0.092	0.927
Reserves-to-imports$_{t-1}$	31.250	31.830	0.580	-0.577	0.564
External debt-to-GDP$_{t-1}$	70.190	69.420	-0.770	0.211	0.833
Parliamentary Democracy	0.128	0.132	0.004	-0.325	0.745
Observations	3,268	3,268			

Notes: This Table presents the sample means matching covariates after weighting across the treated IMF-supported programs group in column [1] and the synthetic control group obtained from entropy balancing in column [4]. Column [5] shows the differences in means, the t-test statistics and the associated p-values.

Coming to the main finding in Table 4, column [1] reports the result excluding the matching covariates in the second step of the entropy balancing. Column [2] brings the covariates to the regression. Columns [3] and [4] control for year and regional fixed-effects, respectively. Finally, column [5] gathers the covariates, and year and regional fixed-effects into the second step regression. The result is strong and robust. Irrespective of the specification, the estimated effect of IMF-supported programs is negative and statistically significant. The magnitude of the coefficient varies between 1.3 pp and 1.5 pp, and is 1.3 pp in our preferred specification that controls for the covariates, as well as year and regional fixed-effects. Unlike Jorra (2012), our finding suggests that IMF lending programs significantly reduce the

likelihood of subsequent sovereign defaults by 1.3 pp. This estimate is economically meaningful given that the unconditional probability of experiencing a sovereign default is 3.5 pp in our sample.

Table 4: IMF-supported programs and sovereign debt crises—Baseline results.

	[1]	[2]	[3]	[4]	[5]
IMF-supported programs$_{t-1,t-5}$	-0.0138 **	-0.0143 **	-0.0150 **	-0.0135 **	-0.0135 **
	(0.0063)	(0.0066)	(0.0067)	(0.0066)	(0.0067)
Covariates in the second step	No	Yes	Yes	Yes	Yes
Year fixed effect in the second step	No	No	Yes	No	Yes
Regional fixed effect in the second step	No	No	No	Yes	Yes
Observations	3,268	3,182	3,182	3,182	3,182

Notes: This Table presents the effect of IMF-supported programs on sovereign debt crises obtained by weighted least squares regressions. The treatment variable is the presence of IMF-supported programs. The outcome variable is the occurrence of a sovereign debt crisis. The control variables include one-year lagged values of real GDP growth, debt service-to-exports, reserves-to-imports, external debt-to-GDP, and parliamentary democracy. Column [1] reports the result without the matching covariates in the second step of the entropy balancing. Column [2] brings the covariates to the regression. Columns [3] and [4] control for year and regional fixed-effects, respectively. Finally, column [5] gathers the covariates, and year and regional fixed-effects into the second step regression. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

VI. ROBUSTNESS CHECKS

Our previous finding shows that the presence of an IMF-supported program lowers the probability of subsequent sovereign defaults in program countries, compared to nonprogram countries. In the following, we perform a large set of robustness exercises to ensure that this finding is not sensitive to alternative specifications and alternative identification strategies. In performing these robustness checks, we focus our attention on the sign and the statistical significance of our principal variable of interest—IMF-supported programs.

6.1. Alternative specifications

We perform alternative specifications as follows. First, we want to know if the result is affected when we exclude domestic arrears from our baseline definition of SDC, given that such arrears may often reflect a strategic behavior between the governments and their local suppliers. The new regressions excluding domestic arrears are reported in columns [1]-[5] of Table 5. Consistent with the previous finding, the estimated coefficients remain negative and statistically significant.

Our second robustness check consists of using an alternative database of sovereign defaults. Columns [6]-[10] of Table 5 report the regressions using the well-known Laeven and

Valencia database. While the number of sovereign defaults is relatively low in Laeven and Valencia (38 events compared to 115 events in CRAG database), interestingly, we find that our conclusion does not change. The estimated effect of IMF-supported programs dummy is negative, statistically significant, and of comparable magnitude compared to the baseline estimate.

Third, the result remains robust to the use of alternative lag structures of IMF-supported programs. Columns [1] and [2] of Table 6 use more restrictive lag structures and define the treatment variable equal 1 if a country adopted at least a program in the previous 3 and 4 years, respectively.[5] Columns [3] and [4] opt for more flexible definitions: the treatment variable equal 1 if the country signed a program in the previous 6 and 7 years, respectively. We find that using different lag structures does not affect our main conclusion, since the estimated treatment effect does not change significantly.

Fourth, we look for the potential role of the recent financial crisis. In column [5] of Table 6, we exclude the period 2008-2010 from the analysis to isolate the impact of the recent financial crisis. As show in column [5], excluding the period 2008-2010 does not affect our main conclusion: the estimated effect of IMF-supported programs is still negative and statistically significant.

Fifth, we want to know if the result holds for additional specified moment conditions of the reweighted data obtained from the entropy balancing. In column [6] of Table 6, we reweighted the control units to satisfy the balance constraints that the 1st and the 2nd moments—means and variances—match the corresponding moments of the treated units. Analogously, in column [7] of Table 6, the reweighting scheme considers the 1st, the 2nd, and the 3rd moments—means, variances, and skewness—of the control units. The estimated effects reported both columns remain negative and statistically significant suggesting that using additional moment conditions confirms the previous finding.

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[5] These results as well as those for the remaining alternative specification checks are based on our preferred specification that controls for the covariates, and year and regional fixed-effects in the second step of the entropy balancing.

The final alternative specification check consists of controlling for a large set of control variables that may affect both a country likelihood of signing an IMF program and experiencing a sovereign default. The additional covariates—borrow from previous literature on the IMF interventions and debt crises—cover different macroeconomic dimensions including the real economy state (real GDP per capita), the external sector (trade openness to GDP, current account balance to GDP), monetary condition (inflation rate), financial development (capital openness index, private credit to GDP, and sovereign CDS market dummy), and macroeconomic instability (GDP growth volatility, banking crisis dummy, and currency crisis dummy). All these covariates are lagged by a year to overcome the issue of reverse causality. As reported in Table 7, we find that after controlling for these additional covariates, the main conclusion does not change.

6.2. Alternative identification strategies

Is the previous result robust to alternative identification strategies? In the following, we provide an answer to this question using an instrumental variable approach as well as conventional matchings.

6.2.1. Instrumental variable approach

The instrumental variable (IV) approach has been widely used in previous works on IMF-supported programs (Barro and Lee, 2005; Eichengreen et al., 2008; Dreher and Walter, 2010; Papi et al., 2015). The challenge with the IV approach obviously consists of identifying variables that affect the likelihood of program participation but do not affect sovereign default other than through the effect on signing or not a program. We instrument IMF lending programs using two political variables. First, previous studies on political influences on the Fund show that borrowers that have closer ties with the Fund major shareholders, as reflected by their voting behavior at the United Nations General Assembly (UNGA), are more likely to have successful negotiations and better terms with the IMF (Thacker, 1999; Barro and Lee, 2005; Dreher and Walter, 2010; Papi et al., 2015). We follow this literature and use the UNGA affinity index, that is the fraction of time a country vote in line with the Fund main shareholders, as a first instrument for signing a program with the Fund. To ensure that our IV result is not driven by the definition of the IMF main shareholders, we consider separately

these three groups of shareholders: the USA, the G5, and the G7. We then compute the average affinity index for each group, using three categories of vote data (approval of an issue, abstention, and disapproval of an issue) and focusing exclusively on important UNGA votes, as declared by the U.S. State Department. In so doing, the UNGA affinity index is a good instrument if it is uncorrelated with a sovereign default. Of course, a potential violation of the above exclusion restriction may arise when a default occurs as the result of poor creditworthiness arising from cut of foreign aid. Such a violation may be more likely given that voting behavior at UNGA has been widely accepted in the related literature as a reliable indicator of the political motivation of aid (Alesina and Dollar, 2000; Alesina and Weber, 2002; Gates and Hoeffler, 2004; Fink and Redaelli, 2011; Dreher and Sturm, 2012; Dreher et al., 2015). To overcome this issue, we also provide estimates controlling for foreign aid.

The second instrument exploits the established fact that the likelihood of engaging in a program with the Fund is more likely following the introduction of a new administration (Przeworski and Vreeland, 2000; Vreeland, 2002; Harrigan et al, 2006; Papi et al, 2015). We use a dummy variable identifying executive election years as an instrument. The underlying philosophy is that governments are more willing to seek an agreement with the Fund at the beginning of their terms in office in order to reduce the potential negative effect of IMF's conditionality, if a program is signed later, on their chances of getting reelected.

Finally, given that we are interested in the impact of IMF-supported programs in the previous five years $(t - 1, t - 5)$, we follow Papi et al. (2015) and build our instrumental variable, UNGA affinity score, as the average over the five-year period $(t - 6, t - 10)$ prior the five-year used to construct our program dummy. In the same vein, the second instrument—executive election—takes the value of 1 if the country experienced an executive election in the period $(t - 6, t - 10)$.

The result of the IV approach estimated using a probit model is reported in Tables 8 and 9. Table 8 uses the UNGA affinity score and executive election as instruments. Columns [1]-[6] of Table 8 present the probit regression using the conditional maximum-likelihood estimator, while columns [7]-[12] of Table 8 use the Newey two-step estimator. For each estimator, we report two regressions for each group of shareholders (G7, G5, and USA): one

excluding and one including regional fixed effects. In Table 9, we reproduce the regressions of Table 8 by controlling for total foreign aid received.[6]

Before we examine the result of our main variable of interest—IMF-supported program—let us focus on the relevance and the validity of the instruments used. In each column of Tables 8 and 9, we report the first stage IV results—that are the estimated parameters of the instruments and the F-tests. Two interesting points emerged. First, the coefficients of our instruments are statistically significant at the 1 percent level with the signs consistent with the theory. Consistent with the above discussion, countries that vote in line with the IMF main shareholders at the UNGA and those that had election in the previous years are more likely to sign a program with the Fund. Second, the F-tests of the first stage regressions are higher than 10, with respect to the golden rule of Staiger & Stock (1997). These two facts confirm that our instruments are relevant. In addition, each column reports the Hansen test for over-identification restrictions. Irrespective of the regression, the p-values of the Hansen test are larger than the conventional level, meaning that the over-identification restrictions are respected. Consequently, we can conclude that our instruments for IMF lending programs are relevant and valid. We then move to the main finding.

In Tables 8 and 9, the coefficient of IMF-supported programs is negative and statistically significant, even if the magnitude of the coefficient is smaller compared to the estimate from the entropy balancing. The IV results confirm the entropy balancing finding that IMF lending programs statistically and economically reduce the probability of subsequent sovereign defaults.

6.2.2. Conventional matchings

The negative impact of IMF lending programs on the probability of subsequent sovereign defaults is also validated using two different methods of conventional matching: propensity score matching (PSM) and bias corrected matching (BCM). Both approaches consist of

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[6] We do prefer controlling for total foreign aid since the decision to vote or not to vote in line with the USA, the G5, or the G7—knowing that these countries might adjust their development aid consequently—may not be independent from the expected change of behavior of other donors. However, in unreported regression, we also control for aid from the USA, the G5, or the G7 and find the results consistent.

comparing a program country observation with a counterfactual nonprogram country observation that have a similar probability of having a program. Under the PSM or the BCM approach, the probability to sign a program is estimated in a first step for each country-year observation based on a vector of observable variables. The treatment effect of IMF-supported programs is then computed in a second step based on the first step estimated probabilities and using different varieties of defining the perfect counterfactual—the matching algorithms. Following Lin and Ye (2007), and Balima et al. (2017), we implement the PSM using these varieties: the N-nearest-neighbor (with N=1, 2, 3), the radius matching (with a radius of 0.005, 0.01 and 0.05), the kernel matching, the local linear matching, and the stratification matching.[7] The BCM differs from the PSM, in the way that it relies on estimating a regression function only on the nonprogram group to predict the missing potential outcomes (see Abadie and Imbens (2006) for more discussions). In implementing the BCM, we consider the number of matched, n varying between 1 and 10.

The results of the PSM and the BCM are reported in Tables 10 and 11, respectively. The results confirm the negative impact of IMF lending programs on the likelihood of subsequent defaults. Indeed, the estimated treatment effects are negative and statistically significant in both Tables.

VII. POTENTIAL EXPLANATIONS

This section aims at shedding some light on the mechanisms behind the results. In particular, we test the relevance of these three transmission channels discussed in the introduction of the paper: (i) the liquidity provision channel and catalytic role, (ii) the role of government adjustment effort, and (iii) the role of conditionality. The liquidity provision channel and catalytic role, largely discussed in the literature, is usual tested by looking at the behavior of government bond yields or private capital flows following IMF intervention (Brealey and Kaplanis, 2004; Mody and Saravia, 2006; Eichengreen et al., 2006). The adjustment effort is

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[7] The nearest-neighbor matches a program country observation with the N nearest neighbor nonprogram country observations using the estimated probability. The radius matching compares program and nonprogram observations using a threshold metric of distance. The kernel matching uses an inversed weight to match program and nonprogram units, while the local linear approach follows the kernel matching but does include a linear term in the weighting function. Finally, the stratification matching uses several strata to increase the quality of the comparison and to estimate the treatment effect. For a discussion between these varieties of PSM, see Caliendo and Kopeinig (2008).

usually tested through the behavior of policy outcomes, before and during program times. Finally, the conditionality channel is accessed by comparing the differential impact for program countries where the proportion of IMF loans that were agreed but left undrawn at the end of the program is larger than 25 percent or not, assuming that having drawn at least 75 percent of the agreed loans reflects compliance with IMF's conditionality (Killick, 1995; Dreher and Walter, 2010, Papi et al, 2015).

In this paper, we take another way to test the relevance of the above transmission channels. We access the liquidity provision channel and catalytic role through annual changes in sovereign credit rating provided by notations agencies, using data from the three international credit rating agencies (Standard and Poor's, Moody's, and Fitch).[8] Existent Empirical evidence suggest that a country credit rating is an important determinant of its international capital market access and the terms of that access (Reinhart, 2002; Kaminsky and Schmukler, 2002; Gande and Parsley, 2005; Pukthuanthong-Le et al., 2007). If IMF-supported programs help solve liquidity shortage and restore confidence, this might also result in an improvement in the borrowing country credit rating.[9] Finally, the government adjustment effort and the conditionality channels are conjointly tested by looking at the behavior of government debt-to-GDP and fiscal balance-to-GDP. We believe that government debt or fiscal balance may be a good proxy for measuring the borrowing government effort and the role of conditionalities because, on the one hand, they are the main fiscal policy variables in the short and the long run, and, on the other hand, changes in these two outcomes may directly capture IMF conditionalities on fiscal targets in particular given that the Fund programs usually include some fiscal measures.[10]

To test for the conditionality channel, several studies use the proportion of loans that were agreed but left undrawn (Killick, 1995 and Dreher, 2003). We do not follow the literature for three main reasons. First, completion—as measured by the proportion of loans undrawn—

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[8] Following Sy (2002), we use a linear transformation to convert ratings into a discrete variable. Appendix 4 details the numerical transformation.

[9] We do opt to use credit rating rather than bond yields since data on the latter is not available for a large majority of countries in our sample. By using annual changes in sovereign credit rating, a negative change means a rating downgrade while a positive change reflects a rating upgrade.

[10] By using credit ratings, government debt, and fiscal balance, we make the distinction between domestic channels (debt and fiscal balance), and international capital market channels (credit ratings).

might not be a good proxy for policy implementation (Conway, 1994; Killick, 1995; Bird, 2001). For instance, it may be that a country meets all the quantitative criteria, indicative targets and structural benchmarks but decides not to draw all the loans agreed with the Fund. In that case, using the proportion undrawn may underestimated the degree of completion. It may be also that a country fails to implement the agreed criteria but still complete the program. This may be so when the failure results from unexpected developments outside of the government control that deviate slightly the program from its initial objectives. In such a scenario, the program may be readjusted, or simply canceled if a large deviation emerges. It may be also that noncompliance arises because the economic situation of the borrower has improved before the program expiration and he decided to put down the program. In this last case, the program status may remain uncompleted due to good news—that is the borrowing country economic success. Second, data availability on IMF loans agreed but left undrawn is very limited, making cautious the interpretation of any derived empirical analysis (Dreher, 2006). And last but not least, IMF-supported programs usually include a fiscal adjustment plan, in particular when a debt distress is looming down (Independent Evaluation Office, 2007; Fink and Scholl, 2016).[11] Consequently, the borrower fiscal outcomes may change if the program criteria have been met, making fiscal outcome variables some reliable measures for the borrower's compliance with conditionality.

We assess these transmission channels following Neuenkirch and Neumeier (2016). In particular, we compute the mean of the above transmission channel variables for (a) the program group for observations where at least a program has been in place during the past five years, (b) the program group focusing exclusively on observations for which no program has been implemented during the past five years, and (c) the synthetic control group obtained via entropy balancing. The results reported in Table 12 indicate on the one hand that the synthetic control group computed from our entropy balancing differs from the program group before program implementation. Indeed, the former is characterized by a rating downgrade as shown by the negative variation in credit rating (-0.06 notch vs. -0.01 notch), a higher debt-to-GDP ratio (63.9 percent vs. 59.8 percent), and a lower fiscal balance-to-GDP (-3.0 percent vs. -2.7

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[11] For instance, the Independent Evaluation Office (2007) pointed out that adjustments in the public sector that affect the government spending and tax revenues are the main structural conditions in IMF-supported programs.

percent). On the other hand, the implementation of IMF-supported programs has been accompanied by a significant decrease of the above outcomes. The change in sovereign credit rating turns form a downgrade (-0.06 notch) to an upgrade (0.04 notch), and the difference is statistically significant (t = -1.78; p-value = 0.07). Regarding debt-to-GDP, the program group moves from 63.9 percent prior to the program implementation, to 58.4 percent during the treatment period, and the difference is also statistically significant (t = 1.99; p-value = 0.04). Finally, a similar picture emerges from the fiscal balance, which improves from -2.96 percent before the program to -2.45 percent during the program, the difference being statistically

Table 12: Transmission channels

	[1] Change in sovereign credit rating	[2] Government debt-to-GDP	[3] Fiscal balance-to-GDP
Treated group			
before an IMF-supported program$_{t-1,t-5}$	-0.06	63.93	-2.96
during an IMF-supported program$_{t-1,t-5}$	0.04	58.43	-2.46
Control group	-0.01	59.84	-2.70

Notes: This Table presents the transmission channels of the effect of IMF-supported programs on the probability of subsequent sovereign debt crises.

significant (t = -1.87, p-value = 0.06). In addition, Table 12 also points out that the treatment group experiences a more favorable change in sovereign credit rating and a lower debt and fiscal deficit ratios during the treatment period compared to the synthetic control group. These findings lead us to conclude that the improvements in sovereign credit rating, debt, and fiscal deficit are some channels through which IMF-supported programs decrease the probability of subsequent debt crises in program countries, compared to nonprogram countries.

VIII. CONCLUSION

In this paper, we analyze the role of bailouts in mitigating the likelihood of subsequent sovereign defaults in developing countries, taking IMF-supported programs as an example. We contribute to the literature on the impacts of bailouts in several grounds, including (i) drawing upon a large sample of 106 developing countries, (ii) using a comprehensive database on defaulted government debt, and (iii) properly taking into account the endogeneity of the IMF's presence in a country.

Our result indicates that IMF-supported programs significantly reduce the likelihood of subsequent sovereign debt crises by about 1.3 percentage points. We provide evidence that

this finding is particularly robust to different specifications as well as the use of alternative identification strategies including an instrumental variable approach and conventional matchings. Moreover, we provide suggestive evidence that (i) the catalytic role and the liquidity provision channel, (ii) the role of government adjustment effort, and (iii) the conditionality channel may be at work. In particular, we find that a country that signed a program with the Fund experienced a slight improvement in its sovereign credit rating, and a decrease in both government debt-to-GDP and fiscal deficit-to-GDP during the program period compared to the period before. Our results are in line with the theoretical model of Corsetti et al. (2006) that shows that a lending support not only has an impact on the likelihood and the possible incidence of a crisis, but also prompts the borrowing government to implement desirable policies and reforms.

Our results have some policy implications. Although the adoption of an IMF-supported program can be perceived as having a short term political cost related to fiscal consolidation, the empirical results of this paper show that IMF interventions yield long term benefits by helping avoid the costs of sovereign default—such as reputational costs, international trade exclusion costs, costs to the domestic economy through the financial system, and political costs to the authorities—mentioned in the literature (Borensztein and Panizza, 2009).

To conclude, while our paper provides suggestive transmission channels, future research could further disentangle the effects of these different channels. For instance, it would be interesting to assess how different types of IMF-supported programs compare in their stabilization role and also study how programs that involve IMF disbursements compare to those that require only IMF advice.

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Table 5: IMF-supported programs and sovereign debt crises—Robustness checks, alternative specifications.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
IMF-supported programs$_{t-1,t-5}$	-0.0144 **	-0.0150 **	-0.0157 **	-0.0142 **	-0.0143 **	-0.0171 ***	-0.0160 ***	-0.0107 ***	-0.0159 ***	-0.0104 ***
	(0.0063)	(0.0065)	(0.0067)	(0.0065)	(0.0067)	(0.0045)	(0.0043)	(0.0039)	(0.0043)	(0.0039)
Covariates in the second step	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Year fixed effect in the second step	No	No	Yes	No	Yes	No	No	Yes	No	Yes
Regional fixed effect in the second step	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Observations	3,268	3,182	3,182	3,182	3,182	2,991	2,990	2,990	2,990	2,990

Notes: This Table presents the effect of IMF-supported programs on sovereign debt crises obtained by weighted least squares regressions. The treatment variable is the presence of IMF-supported programs. The outcome variable is the occurrence of a sovereign debt crisis. The control variables include one-year lagged values of real GDP growth, debt service-to-exports, reserves-to-imports, external debt-to-GDP, and parliamentary democracy. Columns [1]-[5] define sovereign debt crises excluding domestic arrears. Columns [6]-[10] use Laeven and Valencia (2013) database. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: IMF-supported programs and sovereign debt crises—Robustness checks, alternative specifications.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]
	3-Year	4-Year	6-Year	7-Year	Excluding 2008-2010	Additional specified moment conditions	
IMF-supported programs$_{t-1,t-5}$	-0.0151 **	-0.0144 **	-0.0124 *	-0.0156 **	-0.0136 **	-0.0112 *	-0.0112 *
	(0.0065)	(0.0066)	(0.0069)	(0.0070)	(0.0069)	(0.0066)	(0.0067)
Covariates in the second step	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect in the second step	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effect in the second step	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,182	3,182	3,182	3,182	2,989	3,182	3,182

Notes: This Table presents the effect of IMF-supported programs on sovereign debt crises obtained by weighted least squares regressions. The treatment variable is the presence of IMF-supported programs. The outcome variable is the occurrence of a sovereign debt crisis. The control variables include one-year lagged values of real GDP growth, debt service-to-exports, reserves-to-imports, external debt-to-GDP, and parliamentary democracy. Columns [1]-[4] use alternative lag structures of IMF-supported programs. Column [5] excludes the period 2008-2010 from the analysis to isolate the impact of the recent financial crisis. Columns [6] and [7] use additional specified moment conditions of the reweighted data obtained from the entropy balancing. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: IMF-supported programs and sovereign debt crises—Robustness checks, additional control variables.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
	Real GDP per capita	Trade openness-to-GDP	Current account balance-to-GDP	Kaopen	Inflation rate	Private credit-to-GDP	Sovereign CDS dummy	GDP growth volatility	Banking crisis	Currency crisis
IMF-supported programs$_{t-1,t-5}$	-0.0156 **	-0.0151 **	-0.0139 *	-0.0139 *	-0.0172 **	-0.0161 **	-0.0154 **	-0.0166 **	-0.0160 **	-0.0159 **
	(0.0071)	(0.0073)	(0.0071)	(0.0073)	(0.0077)	(0.0080)	(0.0071)	(0.0074)	(0.0070)	(0.0071)
Covariates in the second step	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect in the second step	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effect in the second step	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,049	2,951	2,821	2,893	2,734	2,925	3,087	2,879	3,087	3,087

Notes: This Table presents the effect of IMF-supported programs on sovereign debt crises obtained by weighted least squares regressions. The treatment variable is the presence of IMF-supported programs. The outcome variable is the occurrence of a sovereign debt crisis. The baseline control variables include one-year lagged values of real GDP growth, debt service-to-exports, reserves-to-imports, external debt-to-GDP, and parliamentary democracy. Additional control variables are included in the regressions, as indicated at the top of each column. Robust standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 8: IMF-supported programs and sovereign debt crises—Robustness checks, instrumental variable approach.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
	G7		G5		USA		G7		G5		USA	
	Maximum likelihood estimator						Two-step estimator					
IMF-supported Programs$_{t-1,t-5}$	-1.1715***	-1.3648***	-1.2065***	-1.3943***	-1.1179***	-1.3154***	-1.2700***	-1.5511***	-1.3222***	-1.6004***	-1.1922***	-1.4673***
	(0.2888)	(0.2649)	(0.2766)	(0.2627)	(0.3279)	(0.2872)	(0.3093)	(0.3494)	(0.3089)	(0.3579)	(0.3258)	(0.3510)
Marginal effect	-0.0058	-0.0035	-0.0051	-0.0034	-0.0071	-0.0042						
Real GDP growth$_{t-1}$	-0.0330***	-0.0279**	-0.0330***	-0.0279**	-0.0338***	-0.0288**	-0.0358***	-0.0317**	-0.0363***	-0.0321**	-0.0361***	-0.0321**
	(0.0110)	(0.0113)	(0.0110)	(0.0113)	(0.0112)	(0.0116)	(0.0130)	(0.0136)	(0.0130)	(0.0136)	(0.0129)	(0.0136)
Debt service-to-exports$_{t-1}$	0.0046***	0.0045***	0.0047***	0.0045***	0.0044***	0.0044***	0.0050***	0.0051***	0.0051***	0.0052***	0.0047***	0.0049***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0013)	(0.0014)	(0.0012)	(0.0013)	(0.0013)	(0.0014)	(0.0012)	(0.0013)
Reserves-to-imports$_{t-1}$	-0.0053*	-0.0048*	-0.0054*	-0.0049*	-0.0053*	-0.0047	-0.0058**	-0.0055**	-0.0059**	-0.0056**	-0.0057**	-0.0053**
	(0.0029)	(0.0029)	(0.0029)	(0.0028)	(0.0031)	(0.0030)	(0.0023)	(0.0024)	(0.0023)	(0.0025)	(0.0023)	(0.0024)
External debt-to-GDP$_{t-1}$	0.0007	0.0010	0.0008	0.0010	0.0006	0.0008	0.0008	0.0011	0.0008	0.0011	0.0007	0.0009
	(0.0010)	(0.0009)	(0.0010)	(0.0009)	(0.0010)	(0.0009)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Parliamentary Democracy	-0.2634	-0.2521	-0.2648	-0.2538	-0.2716	-0.2613	-0.2859	-0.2865	-0.2911	-0.2914	-0.2897	-0.2915
	(0.2092)	(0.2250)	(0.2072)	(0.2237)	(0.2113)	(0.2244)	(0.2418)	(0.2754)	(0.2438)	(0.2773)	(0.2403)	(0.2734)
Constant	-1.4212***	-1.6599***	-1.3868***	-1.6372***	-1.4601***	-1.6892***	-1.5420***	-1.8866***	-1.5239***	-1.8801***	-1.5572***	-1.8843***
	(0.2032)	(0.3197)	(0.1991)	(0.3170)	(0.2262)	(0.3305)	(0.1557)	(0.3076)	(0.1551)	(0.3084)	(0.1641)	(0.3072)
	First stage regressions											
Proximity with G7$_{t-6,t-10}$	0.5987***	0.5543***					0.5978***	0.5537***				
	(0.0314)	(0.0347)					(0.0318)	(0.0338)				
Proximity with G5$_{t-6,t-10}$			0.6326***	0.5907***					0.6310***	0.5896***		
			(0.0324)	(0.0373)					(0.0333)	(0.0366)		
Proximity with USA$_{t-6,t-10}$					0.7028***	0.6776***					0.7028***	0.6779***
					(0.0422)	(0.0450)					(0.0412)	(0.0432)
Executive election$_{t-6,t-10}$	0.2587***	0.2389***	0.2729***	0.2432***	0.2703***	0.2534***	0.2592***	0.2391***	0.2739***	0.2437***	0.2702***	0.2531***
	(0.0199)	(0.0210)	(0.0194)	(0.0209)	(0.0201)	(0.0208)	(0.0189)	(0.0200)	(0.0186)	(0.0200)	(0.0191)	(0.0199)
Regional dummies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Wald test of exogeneity (p-value)	0.010	0.000	0.000	0.000	0.030	0.000	0.000	0.000	0.000	0.000	0.020	0.000
Wald test (chi2)	62.43	122.28	66.79	123.76	56.12	115.49	43.18	46.47	43.4	45.32	41.32	46.31
Wald test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	2,700	2,489	2,700	2,489	2,700	2,489	2,700	2,489	2,700	2,489	2,700	2,489

Note: This table presents the impact of IMF-supported programs on the probability of subsequent sovereign debt crises using an instrumental variable approach. The instruments are UNGA affinity score and executive election. Columns [1]-[6] present the probit regression using the conditional maximum-likelihood estimator, while columns [7]-[12] use the Newey two-step estimator. For each estimator, we report two regressions for each group of shareholders (G7, G5, and USA): one excluding and one including regional fixed effects. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9: IMF-supported programs and sovereign debt crises—Robustness checks, instrumental variable approach controlling for ODA-to-GDP.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
	Maximum likelihood estimator						Two-step estimator					
IMF-supported Programs$_{t-1,t-5}$	-1.2435***	-1.3862***	-1.2726***	-1.4122***	-1.1942***	-1.3379***	-1.3770***	-1.5901***	-1.4249***	-1.6353***	-1.2987***	-1.5055***
	(0.2705)	(0.2537)	(0.2593)	(0.2497)	(0.3057)	(0.2769)	(0.3163)	(0.3512)	(0.3159)	(0.3574)	(0.3314)	(0.3540)
Marginal effect	-0.0045	-0.0038	-0.0039	-0.0036	-0.0057	-0.0045						
Real GDP growth$_{t-1}$	-0.0327***	-0.0270**	-0.0328***	-0.0271**	-0.0336***	-0.0280**	-0.0362***	-0.0310**	-0.0368***	-0.0314**	-0.0365***	-0.0315**
	(0.0109)	(0.0111)	(0.0109)	(0.0111)	(0.0111)	(0.0114)	(0.0132)	(0.0137)	(0.0132)	(0.0137)	(0.0132)	(0.0137)
Debt service-to-exports$_{t-1}$	0.0047***	0.0043***	0.0047***	0.0043***	0.0045***	0.0042***	0.0052***	0.0050***	0.0053***	0.0050***	0.0049***	0.0048***
	(0.0013)	(0.0013)	(0.0014)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0012)	(0.0013)
Reserves-to-imports$_{t-1}$	-0.0057**	-0.0049*	-0.0057**	-0.0050*	-0.0057*	-0.0049*	-0.0063***	-0.0057**	-0.0064***	-0.0058**	-0.0062***	-0.0055**
	(0.0029)	(0.0028)	(0.0029)	(0.0028)	(0.0030)	(0.0029)	(0.0023)	(0.0024)	(0.0024)	(0.0024)	(0.0023)	(0.0024)
External debt-to-GDP$_{t-1}$	0.0013	0.0013	0.0014	0.0013	0.0012	0.0012	0.0015	0.0015	0.0015	0.0015	0.0013	0.0013
	(0.0008)	(0.0009)	(0.0008)	(0.0009)	(0.0008)	(0.0009)	(0.0013)	(0.0013)	(0.0012)	(0.0013)	(0.0013)	(0.0013)
Parliamentary Democracy	-0.3150	-0.2627	-0.3169	-0.2638	-0.3215	-0.2726	-0.3492	-0.3014	-0.3559	-0.3056	-0.3497	-0.3068
	(0.2055)	(0.2221)	(0.2036)	(0.2211)	(0.2076)	(0.2216)	(0.2475)	(0.2763)	(0.2498)	(0.2782)	(0.2457)	(0.2744)
ODA-to-GDP$_{t-1}$	-0.0240	-0.0151	-0.0239	-0.0149	-0.0236	-0.0149	-0.0266*	-0.0173	-0.0268*	-0.0173	-0.0257*	-0.0168
	(0.0162)	(0.0148)	(0.0159)	(0.0147)	(0.0164)	(0.0148)	(0.0137)	(0.0144)	(0.0138)	(0.0144)	(0.0136)	(0.0142)
Constant	-1.2426***	-1.5955***	-1.2111***	-1.5780***	-1.2819***	-1.6183***	-1.3774***	-1.8305***	-1.3598***	-1.8282***	-1.3941***	-1.8211***
	(0.2011)	(0.3134)	(0.1962)	(0.3086)	(0.2229)	(0.3262)	(0.1668)	(0.3124)	(0.1663)	(0.3129)	(0.1745)	(0.3121)
	First stage regressions											
Proximity with G7$_{t-6,t-10}$	0.5945***	0.5499***					0.5933***	05492***				
	(0.0320)	(0.0348)					(0.0321)	(0.0341)				
Proximity with G5$_{t-6,t-10}$			0.6305***	0.5913***					0.6285***	0.5900***		
			(0.0329)	(0.0376)					(0.0336)	(0.0368)		
Proximity with USA$_{t-6,t-10}$					0.6934***	0.6642***					0.6930***	0.6643***
					(0.0430)	(0.0451)					(0.0416)	(0.0435)
Executive election$_{t-6,t-10}$	0.2701***	0.2506***	0.2843***	0.2551***	0.2826***	0.2659***	0.2708***	0.2510***	0.2855***	0.2558***	0.2827***	0.2658***
	(0.0200)	(0.0212)	(0.0194)	(0.0211)	(0.0202)	(0.0210)	(0.0192)	(0.0203)	(0.0189)	(0.0203)	(0.0193)	(0.0202)
Regional dummies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Wald test of exogeneity (p-value)	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.010	0.000
Wald test (chi2)	77.73	131.27	82.97	134.11	69.85	122.64	119.09	81	120.37	80.64	109.37	78.16
Wald test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	2,659	2,448	2,659	2,448	2,659	2,448	2,659	2,448	2,659	2,448	2,659	2,448

Note: This table presents the impact of IMF-supported programs on the probability of subsequent sovereign debt crises using an instrumental variable approach. The instruments are UNGA affinity score and executive election. Each regression controls for foreign aid. Columns [1]-[6] present the probit regression using the conditional maximum-likelihood estimator, while columns [7]-[12] use the Newey two-step estimator. For each estimator, we report two regressions for each group of shareholders (G7, G5, and USA): one excluding and one including regional fixed effects. Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 10: IMF-supported programs and sovereign debt crises—Robustness checks, propensity scores matching.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	Nearest neighbor matching			Radius matching			Local linear matching	Kernel matching	Stratification matching
	N = 1	N = 2	N = 3	r = 0.005	r = 0.01	r = 0.05			
IMF-supported programs$_{t-1,t-5}$	-0.0217 **	-0.0223 ***	-0.0221 ***	-0.0215 ***	-0.0231 ***	-0.0212 ***	-0.0221 ***	-0.0214 ***	-0.0220 ***
	(0.0086)	(0.0086)	(0.0086)	(0.0060)	(0.0059)	(0.0054)	(0.0069)	(0.0055)	(0.006)
Total observations	2,991	2,991	2,991	2,991	2,991	2,991	2,991	2,991	2,991

Notes: This Table presents the effect of IMF-supported programs on sovereign debt crises using propensity scores matching. The treatment variable is the presence of IMF-supported programs. The outcome variable is the occurrence of a sovereign debt crisis. The covariates include one-year lagged values of real GDP growth, debt service-to-exports, reserves-to-imports, external debt-to-GDP, and parliamentary democracy. Bootstrapped standard errors based one 500 replications are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 11: IMF-supported programs and sovereign debt crises—Robustness checks, bias corrected matching.

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
	N = 1	N = 2	N = 3	N = 4	N = 5	N = 6	N = 7	N = 8	N = 9	N = 10
IMF-supported programs$_{t-1,t-5}$	-0.0133 *	-0.0140 **	-0.0147 ***	-0.0137 ***	-0.0137 ***	-0.0135 ***	-0.0135 ***	-0.0137 ***	-0.0135 ***	-0.0131 ***
	(0.0083)	(0.0063)	(0.0053)	(0.0053)	(0.0051)	(0.0051)	(0.0050)	(0.0049)	(0.0050)	(0.0050)
Z-statistic	-1.59	-2.23	-2.77	-2.59	-2.66	-2.61	-2.69	-2.78	-2.67	-2.63
Observations	2,991	2,991	2,991	2,991	2,991	2,991	2,991	2,991	2,991	2,991

Notes: This Table presents the effect of IMF-supported programs on sovereign debt crises using bias corrected matching. The treatment variable is the presence of IMF-supported programs. The outcome variable is the occurrence of a sovereign debt crisis. The covariates include one-year lagged values of real GDP growth, debt service-to-exports, reserves-to-imports, external debt-to-GDP, and parliamentary democracy. The number of matched *N* varies between 1 and 10. Heteroskedasticity-consistent standard errors are reported in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Appendix 1: List of countries having signed at least an IMF-supported program during the sample period.

Country	Country	Country	Country	Country
Afghanistan	Colombia	Haiti	Mongolia	St. Vincent and the Grenadines
Albania	Comoros	Honduras	Morocco	Sudan
Algeria	Congo, Rep.	India	Mozambique	Tajikistan
Angola	Costa Rica	Indonesia	Nepal	Tanzania
Armenia	Djibouti	Jamaica	Nicaragua	Thailand
Azerbaijan	Dominica	Jordan	Nigeria	Tunisia
Bangladesh	Dominican Republic	Kazakhstan	Pakistan	Turkey
Belarus	Ecuador	Kenya	Panama	Uganda
Belize	Egypt, Arab Rep.	Kyrgyz Republic	Papua New Guinea	Ukraine
Bolivia	El Salvador	Lao PDR	Paraguay	Vietnam
Bosnia and Herzegovina	Ethiopia	Lesotho	Peru	Yemen, Rep.
Brazil	Fiji	Liberia	Philippines	Zambia
Bulgaria	Gabon	Macedonia	Rwanda	Zimbabwe
Burundi	Gambia	Madagascar	Samoa	
Cabo Verde	Georgia	Malawi	Sao Tome and Principe	
Cambodia	Ghana	Maldives	Serbia	
Cameroon	Grenada	Mauritania	Sierra Leone	
Central African Republic	Guatemala	Mauritius	Solomon Islands	
Chad	Guinea	Mexico	South Africa	
China	Guyana	Moldova	Sri Lanka	

Appendix 2: List of countries in the sample.

Afghanistan	Chad	Guatemala	Malaysia	Rwanda	Ukraine
Albania	China	Guinea	Maldives	Samoa	Vanuatu
Algeria	Colombia	Guyana	Mauritania	Sao Tome and Principe	Vietnam
Angola	Comoros	Haiti	Mauritius	Serbia	Yemen, Rep.
Armenia	Congo, Rep.	Honduras	Mexico	Sierra Leone	Zambia
Azerbaijan	Costa Rica	India	Moldova	Solomon Islands	Zimbabwe
Bangladesh	Djibouti	Indonesia	Mongolia	South Africa	
Belarus	Dominica	Iran, Islamic Rep.	Montenegro	Sri Lanka	
Belize	Dominican Republic	Jamaica	Morocco	St. Lucia	
Bhutan	Ecuador	Jordan	Mozambique	St. Vincent and the Grenadines	
Bolivia	Egypt, Arab Rep.	Kazakhstan	Myanmar	Sudan	
Bosnia and Herzegovina	El Salvador	Kenya	Nepal	Swaziland	
Botswana	Eritrea	Kyrgyz Republic	Nicaragua	Syrian Arab Republic	
Brazil	Ethiopia	Lao PDR	Nigeria	Tajikistan	
Bulgaria	Fiji	Lebanon	Pakistan	Tanzania	
Burundi	Gabon	Lesotho	Panama	Thailand	
Cabo Verde	Gambia	Liberia	Papua New Guinea	Tonga	
Cambodia	Georgia	Macedonia	Paraguay	Tunisia	
Cameroon	Ghana	Madagascar	Peru	Turkey	
Central African Republic	Grenada	Malawi	Philippines	Uganda	

Appendix 3. Variables: sources and definitions.

Variable	Source	Definition
Sovereign debt crisis	Dummy equal to one for country-year observations in which there a sovereign default, and zero otherwise.	Bank of Canada Credit Rating Assessment Group (CRAG), Laeven and Valencia (2013)
IMF-supported programs$_{t-1,t-5}$	Dummy equal to one for countries that signed an IMF-supported program in the previous five-year period, and zero otherwise.	Fund Arrangements since 1952 database
Real GDP growth	Real GDP growth rate	
Debt service-to-exports	Ratio of debt service on external debt to exports of goods and services	
Reserves-to-imports	Ratio of total reserves minus gold to imports of goods and services	
External debt-to-GDP	Ratio of external debt stocks to GDP	
Real GDP per capita	Real GDP per capita	
Trade openness-to-GDP	Sum of exports and imports of goods and services measured as a share of GDP.	World Development Indicators
Current account balance-to-GDP	Sum of net exports of goods and services, net primary income, and net secondary income as a share of GDP.	
Inflation rate	Annual percentage change of the consumer price index	
Private credit-to-GDP	Domestic credit to private sector as a share of GDP	
Government debt-to-GDP	General government gross debt as a share of GDP	
Fiscal balance-to-GDP	General government net lending/borrowing as a share of GDP	
Parliamentary democracy	Dummy signaling a parliamentary form of government in a democratic system	Cruz et al. (2016) Database of Political Institutions (DPI), and Polity IV Project database
Capital openness index	Chinn-Ito de jure measure of capital mobility	Chinn, Ito (2006) updated
Change in sovereign credit rating	Year on year change in long-term foreign-currency government debt rating	Standard and Poor's, Moody's, and Fitch
Sovereign CDS market dummy	Dummy equal to one for country-year observations in which there a sovereign credit default swaps market, and zero otherwise.	Markit database
GDP growth volatility	Volatility of the real GDP growth using a five-year moving average	Authors' computations based on World Development Indicators
Banking crisis dummy	Dummy equal to one for country-year observations in which there a banking crisis, and zero otherwise.	Laeven and Valencia (2013)
Currency crisis dummy	Dummy equal to one for country-year observations in which there a currency crisis, and zero otherwise.	
Proximity with G7$_{t-6,t-10}$	Fraction of time a country vote in line with G7 countries at the UNGA between t-6 and t-10	
Proximity with G5$_{t-6,t-10}$	Fraction of time a country vote in line with the USA at the UNGA between t-6 and t-11	Bailey et al. (2015)
Proximity with USA$_{t-6,t-10}$	Fraction of time a country vote in line with G5 countries at the UNGA between t-6 and t-12	
Executive election$_{t-6,t-10}$	Dummy equal to one if the country had at least an executive election between t-6 and t-10	Cruz et al. (2016) Database of Political Institutions (DPI)

Appendix 4. Linear conversion of Standard and Poor's, Moody's and Fitch ratings.

Rating Grade	Risk level	Standard and Poor's	Moody's	Fitch Ratings	Linear conversion
Investment grade	Highest quality	AAA	Aaa	AAA	21
	High quality	AA+	Aa1	AA+	20
		AA	Aa2	AA	19
		AA-	Aa3	AA-	18
	Strong payment capacity	A+	A1	A+	17
		A	A2	A	16
		A-	A3	A-	15
	Adequate payment capacity	BBB+	Baa1	BBB+	14
		BBB	Baa2	BBB	13
		BBB-	Baa3	BBB-	12
	Likely to fulfill obligations, ongoing uncertainly	BB+	Ba1	BB+	11
		BB	Ba2	BB	10
		BB-	Ba3	BB-	9
Speculative grade	High credit risk	B+	B1	B+	8
		B	B2	B	7
		B-	B3	B-	6
		CCC+	Caa1	CCC+	5
		CCC	Caa2	CCC	4
		CCC-	Caa3	CCC-	3
	Very high credit risk with possibility of recovery	CC	Ca	CC	2
		C	C	C	1
		DDD	DDD	DDD	0
		DD	DD	DD	0
		RD	RD	RD	0
	Default	SD	RD	RD	0

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