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Abstract

This paper assesses whether and how setting up a sovereign wealth fund has a buffer effect against currency crises. Using an innovative dynamic logit panel model framework and a unique dataset covering 34 emerging countries over the period 1989–2019, we empirically show that sovereign wealth funds reduce the occurrence of currency crises. This result is robust to different econometric specifications, alternative definitions of sovereign wealth funds, controlling for currency crisis risk factors, and income level sampling. Our findings have important implications for financial stability and for policy-makers, who could further exploit the potential of sovereign wealth funds to better manage foreign exchange risks.

Keywords: Currency Crisis, Sovereign Wealth Funds, Financial Stability

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1. Introduction

Currency crises have always been part of the history of emerging countries. However, crises in the last decade have renewed the interest of both policymakers and academics in the threats of currency turmoil. The list of emerging countries hit by currency crises has grown since 2014: Ghana and Russia in 2014, Brazil and South Africa in 2015, and Argentina, the Democratic Republic of the Congo, Egypt, Nigeria, Turkey and Venezuela since 2016. Some of these crises were directly related to the commodity price plunge of 2014–2016, but regardless of their origins, these currency crises had disastrous consequences.

However, emerging economies have not been equally affected. For instance, the impact was sharper for some commodity exporters (Stocker et al., 2018). Among them, countries with a floating exchange rate and a high foreign currency liquidity buffer recovered more quickly than others (Grigoli et al., 2019). Furthermore, Koh (2017), Mohaddes and Raissi (2017) and Eldredge (2019) argue that sovereign wealth funds (hereafter SWFs) cushioned the negative effects of commodity price volatility.

The underlying idea is that assets held by SWFs can support foreign reserves retained by central banks. This rationale has been supported by some international organizations, such as the International Monetary Fund (IMF). Specifically, for economies with relatively poor, high government debt institutions, the IMF advocates managing international reserves to prevent currency crises as an alternative to fiscal or currency policies (Collyns and Kincaid, 2003). In this vein, a potential policy to prevent the occurrence of currency crises or mitigate their effects could be the creation of an SWF,

which may improve the management of international reserves. As the purpose of these state-owned funds is to manage excess foreign exchange reserves arising from either natural resource reserves (e.g., oil rents in oil-exporting countries, such as Gulf countries) or trade surpluses (such as those in in Asian countries, e.g., China, Singapore, Hong Kong, South Korea and Malaysia), they can act as a support for foreign reserves detained by central banks. Establishing an SWF could improve liquidity management, especially for commodity-exporting countries, which would mitigate the transmission of trade shocks to the real exchange rate and consequently reduce the emergence or magnitude of currency crises (Aizenman and Riera-Crichton, 2014).

Hence, SWFs should play a role in mitigating currency crises, especially for resource-rich countries, where SWFs can help inhibit the transmission mechanism between commodity terms of trade shocks and the real effective exchange rate. Surprisingly, studies of the stabilizing role of SWFs in the foreign exchange market is scarce. Previous contributions have focused mainly on the impact of SWFs on stock markets, and no empirical study has examined whether and how establishing an SWF buffers against currency crises. To fill this gap in the literature, we investigate the impact of SWFs on currency crises using a unique dataset covering 34 emerging countries over a period of 31 years. The first objective is to test the relationship between the existence of SWFs and the likelihood of a future currency crisis, controlling for the exchange rate regime and six other currency risk factors selected from the recent literature. We follow the related literature and use a binary response model for panel data to investigate the relationship between the occurrence of a currency crisis and the presence of an SWF. The dependent

variable is a currency crisis dummy variable extracted from the crisis database of Laeven and Valencia (2020) and extended by Nguyen et al. (2022). The independent variables include a set of currency crisis factors related to the recent contributions of Ilzetzki et al. (2019), Jemović and Marinković (2021), and Eijffinger and Karataş (2023). From an econometric perspective, we estimate a dynamic logit panel model with fixed effects as in Candelon et al. (2014). This approach allows us to account for the existence of intertemporal links between crises (Falcetti and Tudela, 2006) and postcrisis bias (Bussiere and Fratzscher, 2006). The second objective of this paper is to test the impact of SWFs on the role played by currency crisis factors. To this end, we introduce a nonlinear version of the initial model in the spirit of Shen and Hsu (2022).

Our contributions to the literature are twofold: (i) assessing whether SWFs reduce currency crises and (ii) investigating how they impact the roles of other macroeconomic risk factors. To account for the extreme heterogeneity among SWFs, we distinguish them with respect to i) their objectives (stabilization, saving/pension, development, and reserve investment funds) and ii) the origin of their funding by considering only commodity-based funds that are more concerned with currency crises. Finally, our empirical findings are estimated via an original model that enriches the empirical econometric literature.

Without anticipating our results, we find that setting up an SWF reduces the probability of future currency crises. This result is robust to different SWF definitions and income level sampling methods. We also find that SWFs dampen the impact of changes in both international reserves and exports.

These results confirm that SWFs can support central bank reserves during financial turmoil. This point is crucial for policymakers, who could further exploit the potential of SWFs to better manage foreign exchange risks.

The remainder of this paper is organized as follows. Section 2 presents the literature on SWFs and their role in financial stability. Section 3 introduces a binary response panel model framework, which is extended by a nonlinear econometric model. Section 4 describes the data and presents a preliminary analysis of the descriptive statistics. Section 5 reports our empirical results and robustness checks. Then, we highlight some financial stability implications in Section 6. Finally, we summarize our findings in Section 7.

2. Related literature

2.1. The role of SWFs in financial stability

There is little consensus on the definition of SWFs , which explains the wide variety of definitions given by authors . This lack of consensus reflects the fact that these funds form a heterogeneous group of investors grouped together in the SWF category. However, funds differ in their sources and sizes of assets, organizational structure, governance, risk factors and objectives. A unanimously accepted definition is given by the International Monetary Fund: *"Sovereign wealth funds are government-owned investment funds set up for a variety a macroeconomic purposes"* (IMF, 2008). Therefore, the IMF defines SWFs as government-investment funds based on their objectives: (i) macrostabilization funds designed to mitigate volatile commodity prices; (ii) savings/pension funds aimed at sharing across future generations and financing pensions; (iii) reserve investment funds intended to reduce the

opportunity cost of holding excess foreign reserves to search for investment policies with higher returns; and (iv) development/economic support funds aimed at supporting the domestic economy. SWFs can also be classified into two main categories based on their source of funding: commodity funds and noncommodity funds funded by excess foreign currency reserves due to commodity exports, trade surpluses or public pension assets Aggarwal and Goodell (2018).

Because of increasing oil prices, financial globalization and sustained large global imbalances, SWFs have continued to grow since 2007. SWFs are now among the worldâs largest institutional portfolio investors, with resources estimated at more than USD 12.6 trillion in assets under management in February 2024. There are currently 176 SWFs in existence, most of which are sponsored by non-Western countries, and this growth even suggests that they are a fashion phenomenon (Amar et al., 2018). While the size and rapid growth of SWFs suggest that they have become major players in the world, buying large stakes in companies and exposing the government to sectors they may otherwise be unable to access, their objectives and behavior are not well understood. In terms of investment strategy, SWFs can behave like other institutional investors participating in the financial market with the aim of profit maximization, or they can also act as vehicles for home states by serving the political agenda of the home state and pursuing foreign policy goals. In the latter case, SWFs must be considered political and not economic actors with nonpecuniary motives, such as domestic concerns (development of the national economy, maximization of employment levels), and/or strategic international political and military goals, such as foreign

investments designed to control sources of raw materials, technology or other strategic resources (Megginson et al., 2021; Amar et al., 2022).

SWFs have recently been the focus of much top-tier empirical research, as summarized in surveys by Megginson and Fotak (2016), Fotak et al. (2018), Bahoo et al. (2020) and Megginson et al. (2023). These state-owned funds play an important role in macroeconomic management and global financial stability, implying the need for close coordination with other macroeconomic and financial policies. The policy objectives of SWFs vary depending on the broad macrofiscal objectives that they aim to address.

During past crises, SWFs have been used as a bailout tool to provide exceptional support to their home economies (Raymond, 2010). In the aftermath of the global financial crisis, SWFs were considered to play a stabilizing role in the financial system. Beck and Fidora (2008) and Gomes (2008) point out that SWFs can act as counterweights to financial turmoil because of their large size, investment horizon and countercyclical behavior. Furthermore, Ciarlone and Miceli (2016) link this positive impact to the contrarian investment behavior of SWFs, which is related to their long-term investment strategy. In other financial market subsegments, Bertoni and Lugo (2014) show that SWFs can have a positive effect on the credit default swap market. In contrast to previous empirical results, Ghouma and Ouni (2022) find a negative effect of SWF ownership on the bond market. In addition, Bortolotti and Fotak (2020) and Hasse et al. (2023) highlight that SWFs can exhibit different investment behaviors during financial crises and recessions, questioning the stabilization effect of SWFs on stock and bond markets.

SWFs were designed to be a temporary buffer for the accumulation of

foreign reserves, with the goal of mitigating Dutch disease, sparking domestic development, and absorbing fiscal shocks due to commodity price shocks (Amar et al., 2018). When a country is dependent on its natural resources, a boom in commodity prices or the discovery of a new natural resource can lead to inflation and an appreciation of the real exchange rate, which then damages the nonresource tradable sector. An SWF that allows the proceeds of the fiscal surplus to leave the domestic economy may prevent the occurrence of Dutch disease.

2.2. SWFs and currency crises

Foreign reserves held as part of SWFs can be an important part of policies intended to smooth external shocks in the domestic economy, such as currency crises in emerging markets (Aizenman et al., 2012). There are several reasons why establishing an SWF can i) mitigate the transmission of trade shocks to the real exchange rate and, consequently, ii) reduce the emergence or magnitude of currency crises.

First, reserve accumulation in an SWF limits the opportunity cost of reserves, which imposes a fiscal cost and sterilization to mitigate the inflationary consequences of hoarding reserves. This means that the objective of stabilizing the real exchange rate can be relegated to the SWF, which has a higher risk tolerance, thus allowing the government to withdraw its funds in the event of speculative attacks or trade shocks on commodities to avoid sharp currency depreciations or devaluations in a fixed regime that lead to a currency crisis. Second, the aim of the stabilization fund is to stabilize commodity price volatility –a factor that can explain the emergence of currency crises. As outlined by Bodart and Carpantier (2023), a 10% de-

crease in global commodity price indices leads to an increase of approximately 7% in the number of currency crises in resource-rich countries. Countries specializing in natural resources are extremely dependent on the prices of these natural resources, and their volatility and stabilization funds can act as buffer mechanisms, benefiting from budget surpluses in good years and covering budget deficits in times of uncertainty and market shocks (López, 2023). When commodity prices fall, the fiscal deficits and external debt of commodity-exporting countries increase. To address these concerns, policymakers can decide to save a portion of the surplus income in an SWF to protect the national currency in the case of depreciation or a speculative attack. Additionally, policymakers can decide to save a share of the gains from a boom in commodity prices in an SWF aimed at stabilizing the fiscal impact of fluctuating commodity prices and smoothing boom or bust cycles. Hence, such an SWF can lower the likelihood of a currency crisis during commodity price crashes. Third, in emerging resource-dependent countries, natural resource rents are often related to waste and corruption and, consequently, to external debt increases, capital outflows and the depletion of central banks' international reserves. When central banks run out of international reserves, they are no longer able to defend the currency peg by purchasing all of their liabilities in urgent situations, which results in sharp currency depreciation or devaluation. An SWF that is separate from the central bank could enable improved management of natural resource rents and international reserves, which should limit the risk of currency crises.

Finally, since the global financial crisis, SWFs have been used to support their home economies, particularly during the pandemic (Boubakri et al.,

2023). Countries with an SWF have sufficient fiscal capacity and thus high liquidity to increase spending and respond to emergencies. The SWFs are directly involved in the government's policy response and in supporting local companies. This is clearly the case for savings funds, which act as liquidity providers during crisis periods. The injection of liquidity by this type of fund during crises can prevent banking and/or debt crises, which can also lead to currency crises by contagion.

3. Methodology

3.1. Using a fixed-effects dynamic panel logit model

We study the determinants of currency crises in emerging markets by estimating a binary response model that links our binary currency crisis indicator to a set of explanatory variables. The use of a discrete model is justified by the nature of currency crises, which are sporadic events with a particular date assigned. Berg and Pattillo (1999) were the first to estimate the probability that a currency crisis occurs at time t with a simple probit model by using a set of macroeconomic variables to improve the quality of the regression. The model takes the following form:

$$Pr_{t-1}(y_t = 1) = F(\pi_t) = F(x_{t-1}\beta) \text{ for } t = 1, 2, ..., T, \tag{1}$$

where T represents the number of time series observations. The dependent variable y_t is a $[t-1]$ vector, x_{t-1} is a $[(t-1) \times k]$ matrix that represents explanatory variables, k is the number of explanatory variables, β is a $[k]$ vector that contains the set of estimated coefficients, and F(.) is a transformation

function.[1]

Kumar et al. (2003) advocate for the use of logit rather than probit models. They argue that the distribution of the underlying latent variable is more fat-tailed in logit models than in probit models. This point is important in the case of a currency crisis, as the underlying latent variable is assumed to generate the discrete event. In other words, when studying currency crises, logit models are preferable to probit models because logit models are based on a logistic distribution that is more appropriate for modeling rare events. Therefore, in our case, $F(.)$ is a logistic c.d.f. for the logit model.

In contrast to many previous studies that use static logit models, we treat currency crises as dynamic events by estimating the probability at time $t-1$ that the economy will experience a currency crisis at time t. The discrete variable y_t takes a value of 1 if there is a currency crisis at time t and 0 otherwise. A currency crisis is a function of a continuous latent variable, π_t, which is a function of vectors of explanatory variables, x_{t-1}, and parameters, β:

$$y_t = \begin{cases} 1 & \text{if } \pi_t > 0 \\ 0 & \text{if } \pi_t \leq 0 \end{cases} . \tag{2}$$

The econometric approach developed by Kumar et al. (2003) was improved by Chauvet and Potter (2005) and Kauppi and Saikkonen (2008). These authors improve the econometric specification by adding a latent continuous stochastic process, a coefficient associated with the error term, and a lagged dependent variable. Indeed, if a country is in crisis at time t because

[1] F(.) is a Gaussian c.d.f. for the probit model and a logistic c.d.f. for the logit model.

of the persistence of a currency crisis, then the probability of the country remaining in crisis during the following period must be impacted accordingly. Then, a dynamic binary model takes the following form:

$$Pr_{t-1}(y_t = 1) = F(\pi_t) = F(x_{t-1}\beta + \alpha y_{t-1} + \delta\pi_{t-1}), \text{ for } t = 1, 2, ..., T. \quad (3)$$

The parameters are the same as those defined in Eq. (1). Compared to Eq. (1), the innovation in Eq. (3) consists of the addition of the lagged index variable π_{t-1} and the lagged dependent variable y_{t-1}—with their associated coefficients δ and α. To resume the discussion of Kauppi and Saikkonen (2008), the first model is a static logit model with two restrictions: $\alpha = \delta = 0$ (Model 1). In this case, only the exogenous macroeconomic variables affect the future occurrence of a crisis. The second and third models are dynamic and include either a lagged value of the binary variable y_{t-1} with a restriction on $\delta = 0$ (Model 2) or a lagged index π_{t-1} with a restriction on $\alpha = 0$ (Model 3). Finally, the last dynamic model combines the two preceding cases and includes both a lagged binary variable y_{t-1} and a lagged index π_{t-1} (Model 4). The model that minimizes the Bayesian information criterion (BIC) is chosen as the best model.

Furthermore, we follow Candelon et al. (2014) and estimate the four models in a panel setting as in Eq. (4).

$$Pr_{t-1}(y_{i,t} = 1) = F(\pi_{i,t}) = F(x_{i,t-1}\beta + \alpha y_{i,t-1} + \delta\pi_{i,t-1} + \eta_i), \\ \text{for } t = 1, 2, ..., T, \text{ and } i = 1, 2, ..., N, \quad (4)$$

where N is the number of countries in the panel and η_i is a country fixed effect for controlling unobserved heterogeneity and potential bias.

However, the panel approach may have constraints. The assumption of homogeneity of all of the parameters may be too restrictive despite the presence of fixed effects capturing nonobserved heterogeneity. In the last few years, heterogeneous panels have been the main focus of attention in the literature. Many studies have examined slope homogeneity and poolability in panel data. Recent approaches to address heterogeneous logit panel regressions are related to the existence of homogeneous subgroups (Hasse and Lajaunie, 2022; Ando and Bai, 2023). While it is interesting to use a clustering approach, such as the "regional model" of Van den Berg et al. (2008), i.e., estimating subgroups by geographical area (see also Candelon et al., 2014), nonlinear econometrics provide interesting tools.

In this paper, we introduce a nonlinear logit panel model to explore the impact of SWFs during currency crises. Inspired by the approach proposed by Shen and Hsu (2022), we adapt the econometric framework of Candelon et al. (2014) to a nonlinear panel setting. Specifically, we use the SWF dummy as an indicator variable in the same way that Hansen (2000) and, more recently, Seo and Shin (2016) use an estimated threshold for sample splitting. In particular, we estimate a model integrating both the whole sample and the countries in the SWF subsample. This representation offers more precise estimates and straightforward interpretations than the approach in the seminal work of Hansen (1999). If a coefficient associated with countries with an SWF is significant, then it indicates a particular behavior of those countries . If the coefficient is not significant, then it suggests that

these countries behave similarly to countries without an SWF. In a sense, this approach is in line with the approach used in papers that test for slope heterogeneity or clusters in logit panels, such as those in Hasse and Lajaunie (2022) and Ando and Bai (2023).

More formally, we have

$$Pr_{t-1}(y_{i,t}=1) = F(\pi_{i,t}) = F(x_{i,t-1}\beta + \alpha y_{i,t-1} + \delta\pi_{i,t-1} + \mathbb{1}_{SWF}[x_{SWF,i,t-1}\beta + \alpha y_{SWF,i,t-1} + \delta\pi_{SWF,i,t-1}] + \eta_i), \quad \text{for } t=1,2,...,T, \text{ and } i=1,2,...,N, \quad (5)$$

where $\mathbb{1}_{SWF}$ is the SWF dummy, which plays the role of an indicator variable.

3.2. Estimation and correction

Candelon et al. (2014) show that the four different alternatives of the model presented in Eq. (4) can be estimated in the same exact maximum likelihood (EML) framework as in Kauppi and Saikkonen (2008). The log-likelihood function has the following general form:

$$\text{LogL}(\theta,\eta_i) = \sum_{i=1}^{N} \text{LogL}_i(\theta,\eta_i) \quad (6)$$

$$= \sum_{i=1}^{N}\sum_{t=1}^{T}[y_{i,t}\log(F(\pi_{i,t}(\theta,\eta_i))) + (1-y_{it})\log(1-F(\pi_{i,t}(\theta,\eta_i)))]. \quad (7)$$

In addition, they use the correction by Carro (2007) to address the problem of incidental parameters (see also Naceur et al., 2019). Other empirical

works, such as Hasse and Lajaunie (2022), use the correction in Driscoll and Kraay (1998) in the spirit of Kauppi and Saikkonen (2008), who use the correction in Newey and West (1987) in their univariate analysis.

Other estimation methods have been used in the recent literature, such as generalized linear models (GLMs) (e.g., Fokianos and Moysiadis, 2017; Hasse and Lajaunie, 2022; Vrontos et al., 2021). GLMs assume that the mean μ of an observation of y_t is related to the predictor variables through a link function and a linear predictor model, i.e., $g(\mu) = x_{t-1}\beta$, where $g(\mu)$ is the link function. In the case of a logit regression model, the link function $g(\mu)$ is the logit transformation: $g(\mu_t) = ln(F(\pi_{I,t})/(1 - F(\pi_{i,t})))$, where $F(\pi_{i,t})$ is the probability of a currency crisis.

Finally, both the exact maximum likelihood (EML) and GLM frameworks are still appropriate in the case of a nonlinear dynamic logit regression (see Eq. 5) because the indicator variable is a given dummy variable (i.e., it is not a threshold endogenously estimated as in Shen and Hsu (2022)).

4. Data and preliminary analysis

Our objective is to investigate the empirical relationship between SWFs and future currency crises. Following the majority of the literature, we focus on emerging countries because these countries are more concerned about such crises than are advanced countries and the determinants of currency crises vary across emerging and advanced economies. Dynamic panel data are clearly the most appropriate framework, as we aim to combine both cross-sectional and time series dimensions. Specifically, this approach is relevant because we aim to control the impact of currency risk factors on the explanatory power of SWFs. Furthermore, we choose a balanced panel framework: our specific contribution is to investigate the homogeneity of this relationship across SWF/country subsamples via a nonlinear method that requires balanced panel data.

4.1. Currency crisis data

In general, currency crises are defined as episodes in which one or several economies experience substantial exchange rate depreciation during a short period. The causes of such currency collapses can differ, as illustrated by the 1997 Asian currency crisis and the 2008 global financial crisis . The literature often categorizes currency crises as first-, second- or third-generation relative to their causes. The first-generation models of Krugman (1979) are related to the exchange rate regime and fiscal policy. Recurrent fiscal deficits leading to higher debt and falling foreign reserves are identified as currency crisis factors. The second-generation models dismiss fiscal factors and posit that pessimistic anticipation of future deficits can trigger a currency crisis (Burnside et al.,

2001). The third-generation models involve the financial sector (Kaminsky and Reinhart, 1999), extending the causes of currency crises to the banking and industrial sectors; in emerging economies, devaluations and balance sheet exposures play key roles in currency crises. The empirical literature does not provide a single definition of what constitutes a sharp depreciation of the exchange rate or a currency collapse. Consequently, defining a currency crisis can be difficult. According to Frankel and Rose (1996), a currency crisis is identified when the nominal dollar depreciation of a currency against the US dollar is at least 25% a year. Using the same definition, Laeven and Valencia (2020) propose adjusting the threshold to 30% and requiring that the change in the exchange rate be greater than the change in the previous year by at least 10 percentage points. Doing so avoids treating exchange rate depreciation as an independent crisis. They also allow for a three-year window around the first date of a currency crisis to avoid counting the same currency crisis. The authors use end-of-period exchange rates, which may be criticized because these rates ignore crises that ended before the last date of the crisis. For their part, Eichengreen et al. (1995) and Frankel and Rose (1996) use the average exchange rate, which can lead to the late detection of some currency crises.

Our definition of a currency crisis is taken from Nguyen et al. (2022), who define a currency crisis as the nominal depreciation of a domestic currency against the US dollar by at least 30% a year and at least 10% greater than the previous year's change by using both the average and end-of-period exchange rates.

Table 1 provides a list of countries and their levels of income and re-

source classification. This country classification is based on the World Bank classification commonly used in the literature.[2]

Currency crisis dates are extracted from the database in Nguyen et al. (2022), which provides an extended and updated panel dataset from Laeven and Valencia (2020). Table 1 shows that some countries, such as Algeria, Brazil, Malawi, Nigeria, Sierra Leone and Zambia, have experienced several successive currency crises and are low-income countries.

The dummy variable $CC_{i,t}$, used as a dependent variable, is built such that $CC_{i,t} = 1$ if country i experiences a currency crisis at time t and 0 otherwise.

4.2. SWF data

We conducted a comprehensive search for all existing SWFs in emerging countries. For these funds, we used several data sources: SWFI, SWF reports, Global SWF [3], and IFSWF [4]. In addition, we used Liang and Renneboog (2020)'s dataset and the official websites of SWFs to determine the declared objectives of SWFs.

Table 2 reports the list of existing SWFs in the sample of countries listed in Table 1 and presents the compiled list of SWFs along with pertinent information such as their respective countries, name, inception year, declared objectives, funding sources, and assets under management (AuM).

[2]See the World Bank's website: `https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups`.

[3]See Global SWF's website: `https://globalswf.com/`

[4]See International Forum of Sovereign Wealth Funds' website: `https://www.ifswf.org/`

Table 1: Data description

Country	Level of Income	Resource Rich country	Currency Crises
Algeria	Lower middle income	yes	1990, 1991, 1994
Botswana	Upper middle income	yes	2001
Brazil	Upper middle income	no	1989, 1990, 1992, 1993, 1999, 2002, 2008, 2015
China	Upper middle income	no	1994
Egypt	Lower middle income	no	1989, 1990, 1991, 2003, 2016, 2017
Eswatini	Lower middle income	no	2001, 2008, 2015
Gambia	Low income	no	2002, 2003
Guyana	High income	yes	1989, 1991
Honduras	Lower middle income	no	1990
India	Lower middle income	no	1991
Indonesia	Upper middle income	yes	1997, 1998, 2000
Jamaica	Upper middle income	no	1991, 1992, 1993, 1994
Kenya	Lower middle income	no	1993
Lebanon	Lower middle income	no	1990, 1992
Lesotho	Lower middle income	no	2001, 2008, 2015
Madagascar	Low income	yes	1994, 2004
Malawi	Low income	no	1992, 1994, 1997, 1998, 2000, 2012, 2015, 2016
Malaysia	Upper middle income	no	1997, 1998
Mauritania	Lower middle income	yes	1992, 1993
Mexico	Upper middle income	yes	1994, 1995
Nicaragua	Lower middle income	no	1990
Nigeria	Lower middle income	yes	1989, 1992, 1999, 2016
Papua New Guinea	Lower middle income	yes	1997, 1998
Peru	Upper middle income	yes	1989, 1990
Philippines	Lower middle income	no	1997, 1998
Seychelles	High income	no	2007, 2008
Sierra Leone	Low income	yes	1989, 1990, 1995, 1997, 1998, 1999
Solomon Islands	Lower middle income	no	1997, 2002
South Africa	Upper middle income	no	2001, 2008, 2015
Thailand	Upper middle income	no	1997
Trinidad and Tobago	High income	yes	1993
Uganda	Low income	yes	1991
Uruguay	High income	no	1989, 1990, 2002
Zambia	Lower middle income	yes	1989, 1990, 1991, 1992, 1996, 1998, 2000, 2009, 2015

Notes: This table provides each country data including the level of income, the resource classification and the dates of currency crises. The dataset covers 34 emerging markets over the period 1989 to 2019.

Among the 34 countries in our sample, 15 have at least one SWF, and three have more than one (China, Mexico, and Nigeria). Sixty percent of these funds are designated as commodity funds. Furthermore, 60.7% have at least one macrostabilization objective.

Our first purpose is to test whether having an SWF is associated with a lower risk of future currency crises. To do so, we use a dummy variable to indicate the presence or absence of at least one SWF^{Global} in a given country. The dummy variable $SWF_{i,t}^{Global}$ is built such that $SWF_{i,t}^{Global} = 1$ if country i has an SWF at time t and 0 otherwise.

To take into account the heterogeneity of funds according to their objectives, we then aim to test whether macrostabilization (SWF^{MS} hereafter), savings (SWF^{SV} hereafter), development (SWF^{DV} hereafter), and reserve investment (SWF^{RI} hereafter) funds play different roles. Like Liang and Renneboog (2020), we use the IMF's definition as revised by Petrova et al. (2011) and the SWF Institute to classify SWFs according to their investment objectives.[5] These dummies proxy a binary effect that may shift the probability of a future currency crisis if their estimates are significant.

4.3. Macroeconomic factors

Following Candelon et al. (2014), we select a set of distinct macroeconomic variables as currency crisis factors: the one-year growth rate of international reserves, the broad money to total reserves ratio, the one-year

[5]We use the database furnished by Liang and Renneboog (2020), which has been enriched by adding information for the SWFs of Egypt, Guyana, Mexico, Nigeria, South Africa and Uganda (see appendix).

Table 2: List of Sovereign Wealth Funds

Country	SWF Name	Inception year	Purpose	Origin	AuM (Billions USD)
Algeria	Revenue Regulation Fund	2000	Macrostabilisation	Oil & Gas	16,347
Botswana	Pula Fund	1994	Reserve Investment	Diamonds & Minerals	3,491
Brazil	Sovereign Fund of Brazil	2008	Macrostabilisation, Saving, Development	Non-Commodity	NA
China	SAFE Investment Company	1997	Macrostabilisation	Non-Commodity	1,090,000
	China Investment Corporation	2007	Reserve Investment	Non-Commodity	1,350,000
Egypt	Sovereign Fund of Egypt	2018	Reserve Investment	Non-Commodity	12,000
Guyana	Guyana Natural Resource Fund	2019	Macrostabilisation, saving, developement	Gold & Bauxite	1,413
Malaysia	Khazanah Nasional	1993	Reserve Investment, Development	Non-Commodity	29,168
Mauritania	National Fund for Hydrocarbon Reserves	2006	Macrostabilisation, Saving	Oil & Gaz	159
Mexico	Mexico Budgetary Income Stabilization Fund	2000	Macrostabilisation	Oil & Gaz	1,265
	Oil Revenues Stabilization Fund of Mexico	2000	Macrostabilisation	Oil	NA
	Fondo Mexicano del Petroleo	2014	Macrostabilisation, Development	Oil & Ga	1,145
Nigeria	Nigeria Sovereign Investment Authority	2012	Reserve Investment, Development	Oil	2,422
	Bayelsa Development and Investment Corporation	2012	Macrostabilisation, Saving, Development	Non-Commodity	NA
	Lagos State Wealth Fund	2016	Reserve Investment	Oil	NA
Papua New Guinea	Papua New Guinea Sovereign Wealth Fund	2011	Macrostabilisation, Saving, Development	Gas	NA
Peru	Peru Fiscal Stabilization Fund	1999	Macrostabilisation	Non-Commodity	4
South Africa	Royal Bafokeng Holdings	2006	Reserve Investment	Non-Commodity	2,707
Trinidad and Tobago	Heritage and Stabilization Fund	2007	Macrostabilisation, Saving	Oil	5,623
Uganda	Petroleum Investment Fund Uganda	2015	Macrostabilisation, Saving	Oil	120

Notes: This table shows for each SWFs, the inception year, declared purpose, origin, and assets under management, at April 2024.

growth rate of imports, the one-year growth rate of exports, and the real interest rate. In addition, we include two variables to take into account the exchange regime and the exchange rate misalignment. Following Bodart and Carpantier (2023), we include a dummy variable REG such that $REG_{i,t} = 1$ if country i is in a floating exchange rate regime at time t and 0 otherwise (we use the currency regime classification in Ilzetzki et al. (2019)). Finally, we include the real exchange rate misalignment as in Holtemöller and Mallick (2013), which we compute using the approach in Rodrik (2008) (see Demir and Razmi (2022) for further details). As in Beck and Fidora (2008), we distinguish between external and financial sector variables.

Table 3 summarizes the data and reports the variables' respective names, descriptions, codes, sources, and references.

The size of our dataset and the choice of macroeconomic variables are constrained by data limitations. For replicability purposes, the list of missing data and the procedure used to address them, as well as some arbitrage

Table 3: Variable description and sources

Variable	Code	Sector	Source / Reference
Currency Crisis	CC		Nguyen et al. (2022)
Sovereign Wealth fund	SWF		Sovereign Wealth Fund Institute
One-year growth rate of international reserves	IRG	External	International Monetary Fund
M2 to foreign reserves	$M2G$	External	International Monetary Fund
One-year growth rate of imports	IMG	External	United Nations Conference on Trade and Development
One-year growth rate of exports	EXG	External	United Nations Conference on Trade and Development
Real Interest Rate	RIR	Financial	World Bank
Exchange Rate Regime	REG	Financial	Ilzetzki et al. (2019)
Exchange Rate Misalignment	MIS	Financial	Authors' own calculation

Note: This table shows each country-level variable's name, code, and source / reference.

tactics, are detailed in Appendix A.

4.4. Preliminary analysis

Stylized facts about currency crises are reported in Table 4. Specifically, our dataset includes 96 episodes of currency collapses identified among our panel of 34 emerging economies during 1989–2019. Our dataset includes 14 crises in Asia, 56 in Africa, and 24 in Latin America. When we split our panel of countries into those without an SWF and those with at least one SWF during the period, countries with no SWF were more subject to currency crises than countries with at least one SWF during the period[6] (i) Fifty-eight percent of the currency crises recorded between 1989 and 2019

[6]We do not treat countries with one or more funds differently. In the literature, some empirical contributions use a dummy that takes values other than 0 or 1. For instance, crisis dummies can take a value of 2 for a particularly important crisis. In our case, however, it is not possible to do the same, as SWFs with different objectives are not substitutable.

occurred in countries with no SWF, and 42% occurred in countries that set up an SWF during this period. The number of currency crashes falls by 7% when we consider the period after the creation of the fund. (ii) The average number of crises per country is 2.95 for countries without an SWF and 0.47 for countries that created an SWF. These differences between the two groups of countries are identical at the regional level. Table 4 also reports data on the number of currency crises in emerging countries by distinguishing between countries with fixed and those with floating exchange rate regimes. We find that the number of currency crises was greater in countries with flexible exchange rates than in those with fixed exchange rates. However, considering the exchange rate regime does not change our results for countries with an SWF, which had fewer crises.

The above evidence suggests that the establishment of an SWF may play a key role in preventing currency crashes , which is the topic of our formal investigation in the next sections.

5. Empirical analysis

In this empirical analysis, we examine in three steps whether and how SWFs reduce the occurrence of currency crises. First, we investigate the relationship between the lagged SWF dummy and the currency crisis indicator in an international balanced panel. Our main objective is to assess whether (i) having a fund enables a country to reduce the occurrence of such crises and whether (ii) the role of such a fund in financial stability depends on its objective. Consistent with previous studies, we use a binary model framework, preferring a logit model to a probit model, as in Candelon et al. (2014) and,

Table 4: Currency crises statistics

	All countries	Countries with at least one SWF		Countries without SWF
		Before SWF creation	after SWF creation	
WORLD	34	15	15	19
Number of crises	96	33	7	56
Number of crisis/number of countries	2.82	2.20	0.47	2.95
ASIA	8	3	3	5
Number of crises	14	3	2	9
Number of crisis/number of countries	1.75	1.00	0.67	1.80
AFRICA	16	7	7	9
Number of crises	56	16	4	36
Number of crisis/number of countries	3.50	2.29	0.57	4.00
LATIN AMERICA	9	5	5	4
Number of crises	24	14	1	9
Number of crisis/number of countries	2.67	2.80	0.20	2.25
OTHER COUNTRIES	1			1
Number of crises	2			2
Number of crisis/number of countries	2			2
FLOAT FX REGIME	664 obs	164 obs	139 obs	361 obs
Number of crises	58	18	7	33
Number of crisis/number obs	0.087	0.110	0.050	0.091
Number of crisis/number year	1.871	0.581	0.226	1.065
FIXED FX REGIME	390 obs	121 obs	72 obs	197 obs
Number of crises	38	19	2	17
Number of crisis/number obs	0.10	0.16	0.03	0.09
Number of crisis/number year	1.23	0.61	0.06	0.55

Notes: This table reports the number of crisis by region.

more recently, Jemović and Marinković (2021) and Bodart and Carpantier (2023). Our secondary objective is to assess how SWFs reduce the occurrence of currency crises. We then test the impact of SWFs on fundamentals across countries via a nonlinear econometric specification to estimate this impact on the role of currency crisis factors. Finally, we report robustness checks that replicate our results on two subsamples related to commodity SWFs and low-income countries.

5.1. SWFs reduce currency crises

Using this augmented logit model, we run several regressions to estimate various binary model specifications: a static logit model (Model 1), a dynamic logit model including the lagged crisis dummy y_{t-1} (Model 2), a dynamic logit model including the lagged index π_{t-1} (Model 3), and a dynamic logit model including both the lagged crisis dummy and the lagged index (Model 4), as described in Equation (5). Compared to the econometric framework of Kauppi and Saikkonen (2008), we extend each model by adding several macroeconomic variables, as in Candelon et al. (2014).

The results reported in Table 5 show that the lagged binary coefficients are highly positively significant. This means that the probability of being in a currency crisis at time $t-1$ is strongly related to the probability of being in a currency crisis at time t. In other words, if a country experienced a crisis in the past, the probability of observing another crisis may depend on that previous crisis occurrence. The statistical significance of the lagged variable confirms the necessity of taking into account the effect of crisis persistence, as in Candelon et al. (2014) and Jemović and Marinković (2021). The results presented in Table 5 also show that currency crises react to changes in

Table 5: Estimation results of the panel logit models – Model selection

Model	(1)	(2)	(3)	(4)
IRG_{-1}	-0.0396	-0.0380	-0.0269	-0.0380
	(0.0406)	(0.0435)	(0.0248)	(0.0372)
$M2G_{-1}$	0.0037	0.0030	0.0045*	0.0030
	(0.0028)	(0.0030)	(0.0024)	(0.0027)
IMG_{-1}	0.0024	0.0034	0.0032	0.0025
	(0.0059)	(0.0066)	(0.0052)	(0.0060)
EXG_{-1}	-0.0107*	-0.0074	-0.0101**	-0.0070
	(0.0056)	(0.0056)	(0.0044)	(0.0051)
RIR_{-1}	0.0018	0.0045	0.0012	0.0028
	(0.0036)	(0.0038)	(0.0058)	(0.0048)
MIS_{-1}	-0.0002	-0.0001	-0.0003**	-0.0002
	(0.0002)	(0.0002)	(0.0001)	(0.0002)
REG_{-1}	-1.0703**	-0.6181	-0.7169**	-0.4350
	(0.4480)	(0.4228)	(0.2823)	(0.3482)
CC_{-1}		1.2436***		1.2612***
		(0.3268)		(0.3277)
ID_{-1}			0.1162	0.1599
			(0.4572)	(0.5021)
		Relevant Statistics		
BIC	827.569	811.391	832.247	830.1035
$Pseudo - R^2$	0.1329	0.1688	0.1287	0.1397
Fixed-Effects:				
Country	Yes	Yes	Yes	Yes
Time	No	No	No	No
$\#Observations$	1054	1054	1054	1054

Notes: This table reports the estimates obtained from static and dynamic logit models (1)–(4) for a panel of 34 countries covering the period from 1989 to 2019 at an annual frequency with one lag. The dependent variable is the currency crisis dummy. The results are computed using R 3.6.0 (RCoreTeam, 2020) and the *ews* (*v0.2.0*; Hasse and Lajaunie 2021) package. The full reproducible code is available on CRAN. We report the Bayesian (BIC) information criteria together with the McFadden pseudo R-squared for each specification. Standard errors are reported in parentheses below the estimates. Labels $***$, $**$ and $*$ indicate significance at 99%, 95% and 90% levels, respectively.

macroeconomic variables included in the model. Most of these variables are indeed significant determinants of a crisis one year later in Models (1) and (3). Specifically, the coefficients of the exchange rate regime index are negative and significant, as in Holtemöller and Mallick (2013): the greater the flexibility of the exchange rate regime, the lower the likelihood of a currency crisis. In addition, the coefficients associated with exports are negative and significant, as in Candelon et al. (2012) and Ferdous et al. (2022).[7] Following Candelon et al. (2012, 2014), we select the best econometric specification on the basis of the BIC criterion.[8] Specifically, we select Model (2), which includes an intercept, the lagged macroeconomic variables and the lagged crisis indicator, as the most adequate dynamic specification. The next steps of the empirical study focus on this econometric specification.

We now extend the previously selected model (Model 2) by adding the SWF dummy. In addition, we distinguish between currency crisis factors that are external variables and currency crisis factors that are financial sector variables. In all models, we use the correction in Driscoll and Kraay (1998) for cross-sectional dependence.[9] The results are reported in Table 6, where the first two columns indicate the regression results obtained using external and

[7]These coefficients are not significant in Models (2) and (4), which implies that the lagged dependent variable captures all of the information, as discussed in Candelon et al. (2014)

[8]As noted in Hasse and Lajaunie (2022), the pseudo-R^2 measure can also be used as a goodness-of-fit measure to guide the choice of the model and the optimal lag orders for explanatory variables. See also Kauppi and Saikkonen (2008).

[9]Based on a univariate analysis, previous empirical studies have instead used the correction in Newey and West (1987, 1994).

financial macroeconomic variables, respectively, and the last column indicates the global model.

Table 6: Estimation results of the panel logit models – Macro-control variables and sectors

Model	External Sector	Financial Sector	Global
SWF_{-1}^{Global}	-1.4343***	-1.2869***	-1.2562***
	(0.1720)	(0.1382)	(0.1276)
IRG_{-1}	0.0116**		0.0107**
	(0.0047)		(0.0062)
$M2G_{-1}$	0.0047***		0.0057***
	(0.0008)		(0.0008)
IMG_{-1}	-0.0005		-0.0017
	(0.0025)		(0.0024)
EXG_{-1}	-0.0128***		-0.0130***
	(0.0020)		(0.0021)
RIR_{-1}		-0.0220***	-0.0241***
		(0.0034)	(0.0034)
MIS_{-1}		-0.0004***	-0.0004***
		(0.0001)	(0.0001)
REG_{-1}		-1.4393***	-1.4487***
		(0.2380)	(0.2297)
CC_{-1}	0.9544***	0.5451***	0.3747**
	(0.1041)	(0.1811)	(0.1518)
		Relevant Statistics	
BIC	832.758	801.211	817.396
$Pseudo - R^2$	0.0134	0.0548	0.0605
Fixed-Effects:			
Country	Yes	Yes	Yes
$\#Observations$	1054	1054	1054

Notes: This table reports the estimates obtained from a dynamic logit model with a lagged binary variable for a panel of 34 countries over the period of 1989–2019 with one lag, and annual frequency. The dependent variable is the currency crisis dummy. The independent variables include a SWFs dummy and seven currency crisis factors. We report the Bayesian (BIC) information criteria together with the McFadden pseudo R-squared for each specification. The Driscoll and Kraay (1998) correction is applied such that standard errors are robust to heteroscedasticity and autocorrelation. Standard errors are reported in brackets below the estimates. $***$, $**$ and $*$ report significance at 99%, 95% and 90%.

The results are reported in Table 6, where the first two columns indicate the regression results obtained using external sector and financial sector variables, respectively. The last column reports the results of a regression of the model with all of these macroeconomic variables. The results indicate that

the coefficient of the lagged SWF dummy is negative and highly significant in all specifications. This means that the existence of an SWF in a country is associated with a lower probability of a future currency crisis. The significance of the SWF dummy is robust to the inclusion of macrovariables in each specification.

Concerning external sector indicators, as in Table 5, we find that the coefficients of the exchange rate regime index and exports are negative and significant, as expected. Similarly, the coefficients of the ratio of M2 to international reserves are positive and significant, as in Jemović and Marinković (2021), which means that this ratio is expected to increase before a crisis. We find, however, that an increase in international reserves increases the likelihood of currency crises, as the coefficient is significant and positive, which is not the expected sign and contrasts with the literature. We can interpret this result by the fact that the 34 emerging countries in our sample are all commodity exporters and, consequently, have higher international reserves from natural resource rents. This counter-intuitive result may also be explained by the fact that we use annual growth rate of exchange reserves (and not the level) as in Candelon et al. (2014).

Regarding financial sector indicators, as expected, the real interest rate is inversely proportional to the emergence of a currency crisis. High real interest rates are likely to limit capital outflows, which reduces the probability of experiencing a currency crash. As expected, the real exchange rate is significant and negative: the more undervalued the RER is, the less likely a speculative attack is. Similarly, we find that the smaller the deviations from equilibrium are, the lower the likelihood of an impending crisis, as in

Holtemöller and Mallick (2013). Finally, as expected, we find that countries with flexible exchange rate regimes have reduced probabilities of experiencing future currency crises.

We now extend the previous model by adding four SWF dummies related to SWFs' objectives. As described above, we aim to distinguish between SWFs depending on their objectives. In all models, we use the SWF dummy (hereafter SWF^{Global}) to capture the average effect of SWFs, while the other dummies capture the specific effects of each possible objective of SWFs. The results are reported in Table 7, where the first column indicates the regression results obtained using the dummy SWF^{Global} and the other columns indicate the regression results obtained using the dummies SWF^{MS}, SWF^{SV}, SWF^{DV}, and SWF^{RI}.

The results reported in Table 7 indicate that the SWF^{MS} and SWF^{SV} estimates are negative and significantly different from 0. The coefficients related to SWF^{MS} and SWF^{SV} displayed in Columns (2) and (3) are negative, meaning that the additional effect linked to the presence of a macrostabilization or savings fund is associated with a lower probability of a future currency crisis. In contrast to these results, the estimates in Columns (4) and (5) indicate that the effects of savings and reserve investment funds are nonsignificant and marginal, respectively. The SWF^{DV} estimate is not significant, whereas the SWF^{RI} estimate is positive and significant. However, this coefficient must be interpreted in light of the related SWF^{Global}, which is also significant and negative. Evaluating the effect of reserve investment funds in relation to the effect of all SWFs, it appears that the impact of

Table 7: Estimation results of the panel logit models - SWFs' objectives

Model	(1)	(2)	(3)	(4)	(5)
SWF_{-1}^{Global}	-1.2562***	0.4006	-0.9450***	-1.1978***	-2.9552***
	(0.1276)	(0.2677)	(0.1324)	(0.1563)	(0.3652)
SWF_{-1}^{MS}		-3.3182***			
		(0.5163)			
SWF_{-1}^{SV}			-1.1156***		
			(0.2643)		
SWF_{-1}^{DV}				-0.1898	
				(0.4329)	
SWF_{-1}^{RI}					3.6946***
					(0.6621)
IRG_{-1}	0.0107**	0.0081**	0.0094**	0.0105**	0.0081**
	(0.0052)	(0.0038)	(0.0046)	(0.0046)	(0.0037)
$M2G_{-1}$	0.0057***	0.0055***	0.0057***	0.0057***	0.0055***
	(0.0008)	(0.0007)	(0.0008)	(0.0008)	(0.0007)
IMG_{-1}	-0.0017	-0.0016	-0.0018	-0.0017	-0.0017
	(0.0024)	(0.0025)	(0.0025)	(0.0025)	(0.0025)
EXG_{-1}	-0.0130***	-0.0130***	-0.0130***	-0.0130***	-0.0125***
	(0.0021)	(0.0021)	(0.0020)	(0.0021)	(0.0021)
RIR_{-1}	-0.0241***	-0.0237***	-0.0243***	-0.0241***	-0.0236***
	(0.0034)	(0.0031)	(0.0033)	(0.0033)	(0.0021)
MIS_{-1}	-0.0004***	-0.0004***	-0.0004***	-0.0004***	-0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
REG_{-1}	-1.4487***	-1.4748***	-1.4607***	-1.4567***	-1.4587***
	(0.2297)	(0.2223)	(0.2256)	(0.2266)	(0.2252)
CC_{-1}	0.3747**	0.3208**	0.3707**	0.3731**	0.3084**
	(0.1518)	(0.1428)	(0.1501)	(0.1497)	(0.1409)
			Relevant Statistics		
BIC	817.396	816.179	823.487	824.328	814.415
$Pseudo - R^2$	0.0605	0.0701	0.0587	0.0574	0.0728
Fixed-Effects:					
Country	Yes	Yes	Yes	Yes	Yes
$\#Observations$	1054	1054	1054	1054	1054

Notes: This table reports the estimates obtained from a dynamic logit model with a lagged binary variable for a panel of 34 countries over the period of 1989–2019 with one lag, and annual frequency. The dependent variable is the currency crisis dummy. The independent variables include five SWFs dummies and seven currency crisis factors. The first columns indicates the regression results obtained with the SWF^{Global} dummy only, whereas the four other columns indicate the regression results obtained with the SWF^{MS}, the SWF^{SV}, the SWF^{DV} and the SWF^{RI} dummies, respectively. We report the Bayesian (BIC) information criteria together with the McFadden pseudo R-squared for each specification. The Driscoll and Kraay (1998) correction is applied such that standard errors are robust to heteroscedasticity and autocorrelation. Standard errors are reported in brackets below the estimates. $***$, $**$ and $*$ report significance at 99%, 95% and 90%.

reserve investment funds is only marginal.

On the one hand, macrostabilization funds, referred to as rainy-day funds, promote high liquidity through a substantial 90% allocation to public stocks and bonds (Megginson et al., 2021, 2023). Stabilization funds are designed to smooth boom and bust cycles to stabilize the fiscal impact of commodity price fluctuations in commodity-extracting countries, as is the case for Trinidad and Tobago. On the other hand, saving foreign assets in such a fund may contribute to the country's development and help to mitigate not only Dutch disease but also the probability of future currency crises. When commodity prices are high for a prolonged period and there is a risk of inflation, stabilization funds sometimes grow beyond what is necessary for stabilization purposes and can then be converted into savings funds, as is the case in Russia.[10] If the main objective of savings funds is to safeguard resources for the future by pursuing long-term investments with 2% of their portfolios directed toward private markets, then they also act as liquidity providers during crisis periods. In this way, as reported by Bortolotti and Fotak (2020) and López (2023) during the COVID-19 crisis, they divested and supported their domestic economies. This refers to the implicit agreement of SWFs to support their economies (Boubakri et al., 2023). As stabilization funds, SWFs can therefore reduce or mitigate the occurrence of currency crises. In contrast, the aim of development funds is to combine a financial goal with an economic mission by using returns to invest in the development of the domestic

[10] As the fund's assets continue to grow beyond the level necessary for stabilization, the national authorities may review the objectives and redefine the structure of the fund to broaden its purpose.

economy. As development funds are less liquid and are generally set up with low initial investments, they may have an insignificant role in reducing the probability of a currency crisis. Finally, reserve investment funds aim to reduce the negative carrying costs of earning higher returns on ample reserves by pursuing higher returns from equity and alternative investments abroad, such as Gulf Cooperation Council SWFs. The effect of reserve investment funds on the occurrence of currency crises should also be marginal.

5.2. The impact of SWFs on currency crisis factors

In the second step, we estimate how an SWF impacts the likelihood of a currency crisis by distinguishing countries that have an SWF from those that do not. To do so, a nonlinear logit panel is considered (see Eq. (5)). This approach could be related to Shen and Hsu (2022), who split the panel logit model as a function of a threshold variable, as in Hansen (1999). In contrast to the literature, we use a nonlinear dynamic logit panel model in the spirit of Hansen (2000). In other words, instead of considering a model including countries with and without SWFs, we estimate a model in which both the whole sample and the countries with SWFs are integrated, as in Eq. (5). The results are displayed in Table 8.

The subscript SWF refers to estimates associated with countries with an SWF. Thus, it is possible to test whether a country with an SWF is less exposed to a currency crisis and whether it is more sensitive to a peculiar crisis factor. Similarly, we note that the coefficients of IRG_{SWF}, EXG_{SWF}, IMG_{SWF} and RIR_{SWF} are negative and significant. This result can be interpreted as follows: the roles of these currency crisis indicators are less

Table 8: Estimation results of the nonlinear panel logit model

	External Sector	Financial Sector	Global
		Full sample	
IRG_{-1}	0.0145**		0.0105***
	(0.0057)		(0.0045)
$M2G_{-1}$	0.0051***		0.0057***
	(0.0009)		(0.0008)
IMG_{-1}	0.0034*		-0.0001
	(0.0020)		(0.0021)
EXG_{-1}	-0.0110***		-0.0114***
	(0.0026)		(0.0025)
RIR_{-1}		-0.0214***	-0.0234***
		(0.0034)	(0.0034)
MIS_{-1}		-0.0004***	-0.0004***
		(0.0001)	(0.0001)
REG_{-1}		-1.3882***	-1.4006***
		(0.2652)	(0.2491)
$CC{-}1$	1.1368***	0.5646***	0.4097***
	(0.1720)	(0.2171)	(0.2103)
		Countries with a SWF	
$IRG_{SWF,-1}$	-0.1086***		-0.0604**
	(0.0194)		(0.0209)
$M2G_{SWF,-1}$	-0.0088		0.0015
	(0.0074)		(0.0071)
$IMG_{SWF,-1}$	-0.0208***		-0.0076
	(0.0037)		(0.0102)
$EXG_{SWF,-1}$	-0.0056		-0.0271**
	(0.0079)		(0.0130)
$RIR_{SWF,-1}$		-0.0579***	-0.0568***
		(0.0140)	(0.0167)
$MIS_{SWF,-1}$		-0.0001	-0.0034
		(0.0015)	(0.0051)
$REG_{SWF,-1}$		-1.1218	-0.6973
		(0.7112)	(0.8976)
$CC_{SWF,-1}$	-1.2609	0.0615	-0.1659
	(1.1129)	(1.2759)	(1.4864)
		Relevant Statistics	
BIC	865.220	822.758	864.336
$Pseudo - R^2$	0.006	0.0444	0.0415
Fixed-Effects:			
Country	Yes	Yes	Yes
$\#Observations$	1054	1054	1054

Notes: This table reports the estimates obtained from a nonlinear dynamic logit model with a lagged binary variable for a panel of 34 countries over the period of 1989–2019 with one lag, and annual frequency. The dependent variable is the currency crisis dummy. The independent variables include a SWFs dummy and seven currency crisis factors. We report the Bayesian (BIC) information criteria together with the McFadden pseudo R-squared for each specification. The Driscoll and Kraay (1998) correction is applied such that standard errors are robust to heteroscedasticity and autocorrelation. Standard errors are reported in brackets below the estimates. $***$, $**$ and $*$ report significance at 99%, 95% and 90%.

important for countries with an SWF, which means that an SWF buffers the impact of these macrovariables during a currency crash. More precisely, IRG_{SWF} now has the expected sign (negatively significant), which means that an increase in international reserves decreases the likelihood of currency crises in countries with an SWF. This result can be explained by the fact that an SWF holding foreign exchange reserves can support the central bank in the event of a currency crisis. Countries with an SWF should have better foreign-exchange reserve management, thus mitigating the transmission of trade shocks to the real exchange rate and consequently reducing the emergence or magnitude of currency crises.

These currency crisis indicators play a less important role for countries with an SWF, which means that an SWF buffers the impact of these macrovariables during a currency crash. This result can be explained by the fact that an SWF holding foreign exchange reserves can act as a substitute for the central bank in the event of a currency crisis. Countries with an SWF should have better foreign-exchange reserve management, especially commodity exporting countries, mitigating the transmission of trade shocks to the real exchange rate and consequently reducing the emergence or magnitude of currency crises. This statement is in line with the results of Aizenman et al. (2012), who find that inflation-targeting countries give up the use of reserves to buffer against shocks to commodity terms of trade, relegating this role to SWFs. In the same way, as the aim of an SWF for a commodity-exporting country is to stabilize the fiscal impact of fluctuating commodity prices and smooth boom or bust cycles, the existence of an SWF should limit the occurrence of currency crises when commodity prices fall.

5.3. Robustness checks

As a robustness check, we replicate this first empirical study in two steps. First, we restrict the SWF sample to only commodity SWFs. Indeed, SWF samples are not homogeneous: the countries having a commodity fund should be more impacted by currency crises as explained above. Our previous experiments examining the roles of different objectives (i.e., macrostabilization and development funds) do not consider the differences in sources of funding between SWFs with. Therefore, we first focus on commodity SWFs, which are most concerned with currency crises as explained above. Second, we restrict the initial data sample to the subsample of low- and lower-middle-income countries, as in Naceur et al. (2019) and Hasse and Lajaunie (2022). Indeed, as argued by Van den Berg et al. (2008) and Candelon et al. (2014), pooling all available countries into a single panel model should be supplemented by studying the existence of statistical or economic clusters.

Table 9 reports the results of the models for commodity SWFs, and Table 10 reports the results for the samples of low- and lower-middle-income countries. Compared to the previous results on the role of SWFs in reducing currency crises and the role of macroeconomic factors, there are some differences between the results in Tables 8 and 9. First, the variable IRG_{SWF} is now insignificant, which means that international reserve level for a country having a commodity fund does not impact the probability of future currency crises, which can be explained by the fact that countries having a commodity fund are rich in natural resources and therefore generally have abundant foreign exchange reserves. We find that the misalignment coefficient for countries with a commodity SWF is positive and significant, as in Holtemöller and

Mallick (2013). At last, contrary to the results in Table 9, where the variable REG_{SWF} is not significant, in Table 10, this variable becomes negative and significant when we restrict the sample to countries with a commodity SWF, indicating that countries with a flexible exchange rate regime and a commodity SWF reduce the probability of having future currency crashes

When we restrict the initial data sample to the subsample of low- and lower-middle-income countries, our results in Table 10 differ slightly. Interestingly, we find that the coefficient of the lagged currency crisis for low-income countries with an SWF is negative and significant, meaning that for these countries, the persistence of the currency crisis is weaker than that for countries without an SWF, justifying the important role played by these funds in low-income countries or in countries that are more sensitive to currency crises.

Overall, the main results of the role of SWFs in reducing currency crises are robust to alternative SWF definitions and subsamples.

6. Policy implications

Our empirical results indicate that the presence of an SWF in a given emerging economy reduces the probability of future currency crises in that economy. Furthermore, the channels through which SWFs reduce this risk in emerging markets are linked to three macroeconomic variables, namely, (i) international reserves, (ii) exports, and (iii) the real interest rate.

Hence, our findings have crucial policy implications. On the one hand, we provide empirical evidence that SWFs can be a valuable tool for reducing the vulnerability of emerging economies to currency crises. On the other hand,

Table 9: Estimation results of the nonlinear panel logit models - Commodity SWFs

	External Sector	Financial Sector	Global
		Full sample	
IRG_{-1}	0.0161*		0.01525
	(0.0083)		(0.0108)
$M2G_{-1}$	0.0036***		0.0048***
	(0.0008)		(0.0011)
IMG_{-1}	-0.0175***		-0.0207***
	(0.0043)		(0.0040)
EXG_{-1}	0.0006		0.0008
	(0.0018)		(0.0018)
RIR_{-1}		-0.0304***	-0.0329***
		(0.0069)	(0.0067)
MIS_{-1}		-0.0023***	-0.0025***
		(0.0006)	(0.0006)
REG_{-1}		-0.8457**	-0.7551**
		(0.3811)	(0.3551)
$CC{-}1$	0.9294***	0.8109***	0.5648***
	(0.1291)	(0.1668)	(0.1918)
		Countries with a Commodity SWF	
$IRG_{SWF,-1}$	-0.1311		-0.2025
	(0.1458)		(0.1475)
$M2G_{SWF,-1}$	0.0024*		0.0017
	(0.0014)		(0.0021)
$IMG_{SWF,-1}$	0.0298***		0.0318***
	(0.0049)		(0.0046)
$EXG_{SWF,-1}$	-0.0246***		-0.0261***
	(0.0024)		(0.0035)
$RIR_{SWF,-1}$		0.0219***	0.0160**
		(0.0062)	(0.0073)
$MIS_{SWF,-1}$		0.0017***	0.0019***
		(0.0015)	(0.0051)
$REG_{SWF,-1}$		-1.8313**	-1.8969**
		(0.8728)	(0.8976)
$CC_{SWF,-1}$	0.1427	-0.4312**	-0.4525
	(0.2638)	(0.1927)	(0.3501)
		Relevant Statistics	
BIC	862.547	821.241	855.751
$Pseudo - R^2$	0.0019	0.0468	0.0548
Fixed-Effects:			
Country	Yes	Yes	Yes
$\#Observations$	1054	1054	1054

Notes: This table reports the estimates obtained from a nonlinear dynamic logit model with a lagged binary variable for a panel of 34 countries over the period of 1989–2019 with one lag, and annual frequency. The dependent variable is the currency crisis dummy. The independent variables include a commodity SWFs dummy and seven currency crisis factors. We report the Bayesian (BIC) information criteria together with the McFadden pseudo R-squared for each specification. The Driscoll and Kraay (1998) correction is applied such that standard errors are robust to heteroscedasticity and autocorrelation. Standard errors are reported in brackets below the estimates. $***$, $**$ and $*$ report significance at 99%, 95% and 90%.

Table 10: Estimation results of the nonlinear panel logit models – Low- and lower-middle-income countries

	External Sector	Financial Sector	Global
		Full sample	
IRG_{-1}	-0.3961		-0.4103*
	(0.2765)		(0.2383)
$M2G_{-1}$	-0.0021		-0.0021*
	(0.0018)		(0.0015)
IMG_{-1}	0.0095***		0.0073*
	(0.0035)		(0.0037)
EXG_{-1}	-0.0130***		-0.0120***
	(0.0030)		(0.0026)
RIR_{-1}		-0.0179***	-0.0180***
		(0.0042)	(0.0040)
MIS_{-1}		-0.0018***	-0.0018***
		(0.0003)	(0.0003)
REG_{-1}		-1.5549***	-1.5350***
		(0.1581)	(0.1622)
$CC{-}1$	0.9007***	0.32319**	0.2996**
	(0.1525)	(0.1560)	(0.1353)
		Countries with a SWF	
$IRG_{SWF,-1}$	-10.6910***		15.039***
	(1.9198)		(1.7832)
$M2G_{SWF,-1}$	-0.1108***		-0.1861***
	(0.0217)		(0.0190)
$IMG_{SWF,-1}$	-0.0120**		-0.0517***
	(0.0055)		(0.0101)
$EXG_{SWF,-1}$	0.0114		-0.5701***
	(0.0133)		(0.0457)
$RIR_{SWF,-1}$		-0.3964***	-0.8477***
		(0.0650)	(0.1175)
$MIS_{SWF,-1}$		-0.0001***	0.0025***
		(0.0156)	(0.0007)
$REG_{SWF,-1}$		-24.2307***	-22.7550***
		(2.3935)	(1.6288)
$CC_{SWF,-1}$	-13.936***	-16.6000***	-32.3290***
	(1.1513)	(1.8181)	(1.8767)
		Relevant Statistics	
BIC	536.355	511.015	539.546
$Pseudo - R^2$	0.0119	0.4212	0.0466
Fixed-Effects:			
Country	Yes	Yes	Yes
$\#Observations$	620	620	620

Notes: This table reports the estimates obtained from a nonlinear dynamic logit model with a lagged binary variable for a panel of 20 low- and lower-middle-income countries over the period of 1989–2019 with one lag, and annual frequency. The dependent variable is the currency crisis dummy. The independent variables include a SWFs dummy and seven currency crisis factors. We report the Bayesian (BIC) information criteria together with the McFadden pseudo R-squared for each specification. The Driscoll and Kraay (1998) correction is applied such that standard errors are robust to heteroscedasticity and autocorrelation. Standard errors are reported in brackets below the estimates. $***$, $**$ and $*$ report significance at 99%, 95% and 90%.

our findings indicate that information related to SWFs should be included in early warning systems (EWSs) for supervision purposes.

The economic variables identified as being impacted by the presence of SWFs are linked to the mechanisms by which those SWFs are a tool for financial stability. First, by accumulating savings in an SWF, an emerging economy builds a buffer against financial shocks. Such a financial buffer allows these countries to tap into these reserves during economic recessions or currency depreciation to stabilize their economies. Thus, SWF investments can help manage foreign currency inflows from exports. Instead of directly converting foreign currency inflows to the local currency, some inflows can be held in foreign reserves. This capitalization reduces pressure on the local currency and helps control inflation, another factor in currency crises.

From an institutional perspective, a closer link could be established between central bank reserves and SWFs to ensure automatic repayments to the central bank in the case of foreign exchange market pressures. This would create a mechanism for SWFs to tap into central bank reserves during periods of crisis with the obligation to replenish those reserves when tensions subside. This concept, known as the substitution effect, is explored by Aizenman and Riera-Crichton (2014) and further discussed by Bodart and Carpantier (2023). On a national level, this substitution effect could be formalized through the implementation of macroprudential regulations. These regulations would outline the specific conditions under which SWFs can access central bank reserves and the requirements for repayment. By institutionalizing this process, policymakers could create a more predictable and controlled system for managing liquidity during currency crises.

7. Conclusion

In this paper, we empirically show that setting up an SWF reduces the occurrence of crises. Based on the econometric framework of Candelon et al. (2014), we use a dynamic logit panel regression to estimate the relationship between SWFs and currency crises. Then, in line with Hasse and Lajaunie (2022) and Ando and Bai (2023), we investigate the potential heterogeneity of this relationship between SWFs and currency crises. To do so, we replicate our experiment considering the objectives of SWFs (i.e., macrostabilization, savings/pension, reserve investment, or development funds). Then, we propose an innovative approach based on a nonlinear dynamic logit panel model to capture the impact of SWFs on currency crisis factors. From this perspective, our work is related to Shen and Hsu (2022). Our contributions to the literature are twofold. First, we empirically show that the presence of an SWF reduces the probability of future currency crises. We also show that this result is mainly driven by macrostabilization SWFs. Second, we highlight that the buffer effect of an SWF is related to several currency crisis factors, mainly international reserves, exports and the real interest rate. Our results are robust to alternative definitions of SWFs (i.e., commodity SWFs) and to income level subsampling (i.e., low-income countries).

Policymakers can exploit these findings to mitigate such painful events. The relationship between central bank reserves and SWFs could be tightened to ensure mechanical repayment in the event of tension in the foreign exchange market. At the national level, this substitution effect, which has been identified by Aizenman and Riera-Crichton (2014) and discussed by Bodart and Carpantier (2023), could be institutionalized by implementing

macroprudential regulation. At an international level, the Santiago Principles and the OECD Guidance on Sovereign Wealth Funds could promote such a substitution effect to provide better protection against crises.

Finally, the increase in the implicit liabilities of SWFs during the COVID-19 shock (Bortolotti and Fotak, 2020) highlights the positive role played by these funds in financial stability (Boubakri et al., 2023). SWFs act as a shield against currency crises but could also play a significant role in banking and debt crises (Eijffinger and Karataş, 2023). Hence, future research could further investigate the regulatory framework of SWFs and include twin and triple crises to generalize our findings about the role of SWFs in financial stability.

References

Aggarwal, R., Goodell, J.W., 2018. Sovereign wealth fund governance and national culture. International Business Review 27, 78–92.

Aizenman, J., Edwards, S., Riera-Crichton, D., 2012. Adjustment patterns to commodity terms of trade shocks: The role of exchange rate and international reserves policies. Journal of International Money and Finance 31, 1990–2016.

Aizenman, J., Riera-Crichton, D., 2014. Liquidity and foreign asset management challenges for Latin American countries. National Bureau of Economic Research - WP No. w20646 .

Amar, J., Lecourt, C., Carpantier, J.F., 2022. GCC sovereign wealth funds: Why do they take control? Journal of International Financial Markets, Institutions and Money 77, 101494.

Amar, J., Lecourt, C., Kinon, V., 2018. Is the emergence of new sovereign wealth funds a fashion phenomenon? Review of World Economics 154, 835–873.

Ando, T., Bai, J., 2023. Large-scale generalized linear models for longitudinal data with grouped patterns of unobserved heterogeneity. Journal of Business & Economic Statistics 41, 983–994.

Bahoo, S., Alon, I., Paltrinieri, A., 2020. Sovereign wealth funds: Past, present and future. International Review of Financial Analysis 67, 101418.

Beck, R., Fidora, M., 2008. The impact of sovereign wealth funds on global financial markets. Intereconomics 43, 349–358.

Berg, A., Pattillo, C., 1999. Predicting currency crises: The indicators approach and an alternative. Journal of International Money and Finance 18, 561–586.

Van den Berg, J., Candelon, B., Urbain, J.P., 2008. A cautious note on the use of panel models to predict financial crises. Economics Letters 101, 80–83.

Bertoni, F., Lugo, S., 2014. The effect of sovereign wealth funds on the credit risk of their portfolio companies. Journal of Corporate Finance 27, 21–35.

Bodart, V., Carpantier, J.F., 2023. Currency crises in emerging countries: The commodity factor. Journal of Commodity Markets 30, 100287.

Bortolotti, B., Fotak, V., 2020. Sovereign wealth funds and the covid-19 shock: Economic and financial resilience in resource-rich countries. BAFFI CAREFIN Centre Research Paper .

Boubakri, N., Fotak, V., Guedhami, O., Yasuda, Y., 2023. The heterogeneous and evolving roles of sovereign wealth funds: Issues, challenges, and research agenda. Journal of International Business Policy , 1–12.

Burnside, C., Eichenbaum, M., Rebelo, S., 2001. Prospective deficits and the Asian currency crisis. Journal of Political Economy 109, 1155–1197.

Bussiere, M., Fratzscher, M., 2006. Towards a new early warning system of financial crises. Journal of International Money and Finance 25, 953–973.

Candelon, B., Dumitrescu, E.I., Hurlin, C., 2012. How to evaluate an early-warning system: Toward a unified statistical framework for assessing financial crises forecasting methods. IMF Economic Review 60, 75–113.

Candelon, B., Dumitrescu, E.I., Hurlin, C., 2014. Currency crisis early warning systems: Why they should be dynamic. International Journal of Forecasting 30, 1016–1029.

Carro, J.M., 2007. Estimating dynamic panel data discrete choice models with fixed effects. Journal of Econometrics 140, 503–528.

Chauvet, M., Potter, S., 2005. Forecasting recessions using the yield curve. Journal of Forecasting 24, 77–103.

Ciarlone, A., Miceli, V., 2016. Escaping financial crises? Macro evidence from sovereign wealth funds' investment behaviour. Emerging Markets Review 27, 169–196.

Collyns, M.C., Kincaid, M.G.R., 2003. Managing financial crises: recent experience and lessons for Latin America. International Monetary Fund.

Demir, F., Razmi, A., 2022. The real exchange rate and development theory, evidence, issues and challenges. Journal of Economic Surveys 36, 386–428.

Driscoll, J.C., Kraay, A.C., 1998. Consistent covariance matrix estimation with spatially dependent panel data. Review of Economics and Statistics 80, 549–560.

Eichengreen, B., Rose, A.K., Wyplosz, C., 1995. Exchange market mayhem:

The antecedents and aftermath of speculative attacks. Economic Policy 10, 249–312.

Eijffinger, S.C., Karataş, B., 2023. Three sisters: The interlinkage between sovereign debt, currency, and banking crises. Journal of International Money and Finance 131, 102798.

Eldredge, C.D., 2019. Capability and need: a framework for understanding why states create sovereign wealth funds. The World Economy 42, 1495–1519.

Falcetti, E., Tudela, M., 2006. Modelling currency crises in emerging markets: A dynamic probit model with unobserved heterogeneity and autocorrelated errors. Oxford Bulletin of Economics and Statistics 68, 445–471.

Ferdous, L.T., Kamal, K.M.M., Ahsan, A., Hong Thuy Hoang, N., Samaduzzaman, M., 2022. An early warning system for currency crises in emerging countries. Journal of Risk and Financial Management 15, 167.

Fokianos, K., Moysiadis, T., 2017. Binary time series models driven by a latent process. Econometrics and Statistics 2, 117–130.

Fotak, V., Gao, X., Megginson, W.L., et al., 2018. A financial force to be reckoned with? an overview of sovereign wealth funds. The Oxford handbook of sovereign wealth funds , 16–62.

Frankel, J.A., Rose, A.K., 1996. Currency crashes in emerging markets: An empirical treatment. Journal of International Economics 41, 351–366.

Ghouma, H.H., Ouni, Z., 2022. SWF investments and debt maturity of target firms: An international evidence. Finance Research Letters 46, 102312.

Gomes, T., 2008. The impact of sovereign wealth funds on international financial stability. Bank of Canada Discussion Paper No. 2008/14.

Grigoli, F., Herman, A., Swiston, A., 2019. A crude shock: Explaining the short-run impact of the 2014–16 oil price decline across exporters. Energy Economics 78, 481–493.

Hansen, B.E., 1999. Threshold effects in non-dynamic panels: Estimation, testing, and inference. Journal of Econometrics 93, 345–368.

Hansen, B.E., 2000. Sample splitting and threshold estimation. Econometrica 68, 575–603.

Hasse, J.B., Lajaunie, Q., 2021. EWS: Early Warning System. R package version 0.2.0 .

Hasse, J.B., Lajaunie, Q., 2022. Does the yield curve signal recessions? New evidence from an international panel data analysis. The Quarterly Review of Economics and Finance 84, 9–22.

Hasse, J.B., Lecourt, C., Siagh, S., 2023. Institutional stock-bond portfolios rebalancing and financial stability. AMSE Working Paper .

Holtemöller, O., Mallick, S., 2013. Exchange rate regime, real misalignment and currency crises. Economic Modelling 34, 5–14.

Ilzetzki, E., Reinhart, C.M., Rogoff, K.S., 2019. Exchange arrangements entering the twenty-first century: Which anchor will hold? The Quarterly Journal of Economics 134, 599–646.

IMF, 2008. Sovereign Wealth Funds - a Work Agenda. Policy Papers .

Jemović, M., Marinković, S., 2021. Determinants of financial crises - an early warning system based on panel logit regression. International Journal of Finance & Economics 26, 103–117.

Kaminsky, G.L., Reinhart, C.M., 1999. The twin crises: the causes of banking and balance-of-payments problems. American Economic Review 89, 473–500.

Kauppi, H., Saikkonen, P., 2008. Predicting US recessions with dynamic binary response models. The Review of Economics and Statistics 90, 777–791.

Koh, W.C., 2017. Oil price shocks and macroeconomic adjustments in oil-exporting countries. International Economics and Economic Policy 14, 187–210.

Krugman, P., 1979. A model of balance-of-payments crises. Journal of Money, Credit and Banking 11, 311–325.

Kumar, M., Moorthy, U., Perraudin, W., 2003. Predicting emerging market currency crashes. Journal of Empirical Finance 10, 427–454.

Laeven, L., Valencia, F., 2020. Systemic banking crises database II. IMF Economic Review 68, 307–361.

Liang, H., Renneboog, L., 2020. The global sustainability footprint of sovereign wealth funds. Oxford Review of Economic Policy 36, 380–426.

López, D., 2023. Swf 3.0: How sovereign wealth funds navigated covid-19 and changed forever. Journal of International Business Policy , 1–16.

Megginson, W.L., Fotak, V., 2016. Rise of the fiduciary state: A survey of sovereign wealth fund research. A collection of reviews on savings and wealth accumulation , 163–212.

Megginson, W.L., Lopez, D., Malik, A.I., 2021. The rise of state-owned investors: Sovereign wealth funds and public pension funds. Annual Review of Financial Economics 13, 247–270.

Megginson, W.L., Malik, A.I., Zhou, X.Y., 2023. Sovereign wealth funds in the post-pandemic era. Journal of International Business Policy , 1–23.

Mohaddes, K., Raissi, M., 2017. Do sovereign wealth funds dampen the negative effects of commodity price volatility? Journal of Commodity Markets 8, 18–27.

Naceur, S.B., Candelon, B., Lajaunie, Q., 2019. Taming financial development to reduce crises. Emerging Markets Review 40, 100618.

Newey, W.K., West, K.D., 1987. Hypothesis testing with efficient method of moments estimation. International Economic Review , 777–787.

Newey, W.K., West, K.D., 1994. Automatic lag selection in covariance matrix estimation. The Review of Economic Studies 61, 631–653.

Nguyen, T.C., Castro, V., Wood, J., 2022. A new comprehensive database of financial crises: Identification, frequency, and duration. Economic Modelling 108, 105770.

Petrova, I., Pihlman, J., Kunzel, M.P., Lu, Y., 2011. Investment objectives of sovereign wealth funds: a shifting paradigm (No. 11-19). International Monetary Fund.

Raymond, H., 2010. Sovereign wealth funds as domestic investors of last resort during crises. International Economics 123, 121–159.

RCoreTeam, 2020. R: A language and environment for statistical computing .

Rodrik, D., 2008. The real exchange rate and economic growth. Brookings Papers on Economic Activity 2008, 365–412.

Seo, M.H., Shin, Y., 2016. Dynamic panels with threshold effect and endogeneity. Journal of Econometrics 195, 169–186.

Shen, C.H., Hsu, H.H., 2022. The determinants of Asian banking crises - application of the panel threshold logit model. International Review of Finance 22, 248–277.

Stocker, M., Baffes, J., Some, Y.M., Vorisek, D., Wheeler, C.M., 2018. The 2014-16 oil price collapse in retrospect: sources and implications. World Bank Policy Research Working Paper .

Vrontos, S.D., Galakis, J., Vrontos, I.D., 2021. Modeling and predicting

US recessions using machine learning techniques. International Journal of Forecasting 37, 647–671.

Appendix A. Database Design

Our study aims to assess the role played by sovereign wealth funds (SWFs) in mitigating currency crises, focusing exclusively on emerging countries. We compiled data from 1989 to 2019, with observations taken on an annual basis. In addition to our dependent variable, "currency crises", and our central variable of interest, "SWFs", our database encompasses seven control variables identified in the empirical literature.

The first stage of our work was dedicated to building a balanced and coherent database. This process commenced with the selection of all emerging countries that experienced at least one currency crisis during the specified period. Subsequently, we employed specific data filtering criteria: (i) no more than 10 consecutive missing data points and (ii) no more than 1 consecutive missing data point at the beginning of each time series. These criteria resulted in a final dataset comprising 34 emerging countries.

To deal with missing data issues, we complemented our dataset using additional sources, including IMF reports and data from national banks. This meticulous approach revealed data gaps, which are concisely summarized in Table A.11, providing a comprehensive overview of missing values for each variable across countries. Then, to handle any remaining data gaps, we employed the Kalman filter technique. This robust tool utilizes available observed data to generate informed estimations for missing components, treating missing values as unobserved segments in our dataset. Additionally, in cases in which a single value was missing at the beginning of a series, we implemented the strategy of replicating the value at time $t + 1$.

The choice of this approach was deliberate and aligned with our utilization

of a balanced panel framework to ensure that we accommodated potential selection bias. The code for generating the missing values using the Kalman filter is available upon request.

Finally, we detail the procedure used to extend the database of Liang and Renneboog (2020). Indeed, the objectives of SWFs from Egypt, Guyana, Mexico, Nigeria, South Africa and Uganda are missing for various reasons: (i) these countries are not included in their study, or (ii) the objectives of the SWFs are not reported in their databases. We complemented our dataset using additional sources, including data from the IFSWF website and data from the SWFs' official websites. This meticulous approach revealed the data gaps. Table A.12 concisely summarizes these gaps and provides a comprehensive overview of the missing values of each objective across the SWFs.

Table A.11: Missing macroeconomic data per country

Country	Interest rate	International reserves	M2 to foreign reserves	Export Growth	Import Growth
Algeria					
Botswana					
Brazil					
China					
Egypt					
Eswatini					
Gambia	2016, 2017		2015, 2016		
Guyana					
Honduras					
India					
Indonesia				2003	2003
Jamaica					
Kenya					
Lebanon	1989		2018, 2019		
Lesotho					
Madagascar	1989				
Malawi					
Malaysia					
Mauritania			1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004		
Mexico	1993		1991, 1992		
Nicaragua					
Nigeria					
Papua New Guinea					
Peru					
Philippines					
Seychelles	1989				
Sierra Leone					
Solomon Islands					
South Africa					
Thailand	2003, 2004				
Trinidad and Tobago					
Uganda			2019		
Uruguay					
Zambia		1993, 1994	1992		

Notes: This table shows the missing data per country in the sample.

Table A.12: Missing SWFs data per country

Country	SWF Name	Purpose	Sources
Egypt	Sovereign Fund of Egypt	"The fund is a private investment fund established in 2018 to shape, manage, and perfect opportunities for investment in Egypt's state-owned assets Egypt."	SWF's Website
Guyana	Guyana Natural Resource Fund	"The objectives of the NRF are to: 1. ensure that volatility in natural resource revenues do not lead to volatile public spending; 2. ensure that natural resource revenues do not lead to a loss of economic competitiveness; 3. fairly transfer natural resource wealth across generations to ensure that future generations benefit from natural resource wealth; 4. use natural resource wealth to finance national development priorities, including any initiative aimed at realizing an inclusive green economy."	IFSWF
Mexico	Mexico Budgetary Income Stabilization Fund	"The objective of the Fund is to lessen the effects on public finances of changes in the level of oil revenues derived from sudden variations in international oil prices."	IFSWF
Nigeria	Lagos State Wealth Fund	"Lagos State Wealth Fund are less focused on short-term liquidity and more on creating value for future generations."	Cleary Gottlieb
South Africa	Royal Bafokeng Holdings	"We aim to build a diversified, growth-orientated investment portfolio for the RBN, to protect and grow the capital base over time, and to deliver the yield necessary to enable the fund to meet its inter-generational community development objectives."	SWF's Website
Uganda	Petroleum Investment Fund Uganda	"The fund act as buffer for smoothening government expenditures in periods for which government revenue collected from oil is low, saving oil rent for future generations given the non-renewable nature and benefiting other sectors."	eprcug.org

Notes: This table lists the sources that enabled us to fill in the missing information on the declared objectives of SWFs.