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IMF programs and sensitivity to external shocks: an empirical application

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This paper assesses that participation of countries in IMF programs significantly diminishes their vulnerability to external shocks. Currently, one of the primary purposes of the IMF is to ensure global stability. As such, the Fund has the responsibility of advising member countries on the financial and economic policies that promote stability, helping to avoid crises and smoothing the adjustment to exogenous shocks. We employ a Bayesian Vector Autoregressive model to obtain a measure for the exposure of countries to external shocks. We then use an Instrumental Variable approach and we show that participation in the IMF arrangements has a significant impact in decreasing the sensitivity to exogenous shocks. Despite the criticism concerning the effects of the IMF loans on the economy of the recipient country, our results provide clear evidence that the Fund is efficient in helping member countries to build a strong economic resilience. These results are of considerable interest since shocks and crises are a systematic feature of the global economy which affects both developing and developed countries.

JEL Classification*:* F33, C11, C13, C3, E3
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1 Introduction

The last two decades have seen a profound acceleration of international transactions. The collapse of the Berlin Wall and the increased salience of global capital flows pushed the IMF to undertake much wider and weighty interventions in global domestic politics.

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Today the Fund is one of the most important international organization in the global system and it exerts greater influence than practically any other international organization in history. Until recently, around four out of five members of the Fund have used its resources at least once.

The nature of the IMF‘s activities range from providing financial assistance to countries that face short-term trade fluctuations or balance of payment problems, to offering financial and advisory support to members dealing with economic transition, or even helping countries hit by natural disasters etc...

As specified in the IMF official site, today the main purposes of the Fund‘s lending activity are to:

• smooth the adjustment to various shocks helping the member country to avoid disruptive economic events or even sovereign default

• help unlock other financing since IMF programs can serve as a signal that the country is implementing sound macroeconomic policies

• help prevent crisis

In a world where shocks and crises have increased their frequency, the need for countries to protect themselves from external shocks has become more urgent. As such, addressing the macroeconomic vulnerability has turned into one of the main aspects of the IMF‘s agenda.

A recurrent question in connection with the Fund-supported programs is whether such programs are effective in reaching their objectives. There has been a considerable body of research on the impact of the IMF programs on the domestic economy of the borrower country. Mostly, these studies have focused on the effects of the Fund‘s lending on economic growth, inflation and the balance of payments of the member country. More recent contributions also try to adequately address the self-selection problem, one of the most important methodological issues encountered in the IMF programs evaluation studies.

Very little attention has been paid, however, to the effects that participation in IMF programs has on the macroeconomic vulnerability of the loan-recipient member. A limited literature on the subject is restricted to a small group of countries (Kirejev 2000). Considering that shocks and crises have become a systemic feature of the global economy, it is important to assess the Fund‘s efficiency in minimizing the reversals of such events and ensuring a more resilient path of growth for its members.

The purpose of this paper is to empirically evaluate the impact of the participation in IMF programs on the sensitivity of the borrower country to external shocks. The methodology employed is a Bayesian estimation of a vector autoregressive model (hereafter BVAR), combined with an Instrumental Variable Regression in the final part of the study. In order to conduct our analysis, an unbalanced panel of 167 countries is used, whose time dimension ranges from 10 to 55 years of quarterly observations, depending on the availability of the data for each individual. Over the last decade, we have learned that the sensitivity to external shocks and macroeconomic vulnerability is a characteristic of both developed and developing countries, hence we include in our study as many countries as possible.

The main result of the paper is that IMF participation significantly decreases the vulnerability of the member countries to adverse exogenous shocks. It is interesting to note that the magnitude of the point estimates increases considerably when the issue of the self-selection is addressed by instrumenting the participation in the IMF loans with the size of the IMF quota.

There are several contributions that our study brings to the literature. To the best of our knowledge, Kirejev (2000) is the only work aiming at evaluating the impact of participation in the IMF arrangements on the vulnerability of countries to external shocks. However, he restricts his attention to 18 Arabic countries. We try to fill this gap by including in our sample almost all countries of the world (167 countries). In addition, compared to Kirejev (2000) we employ a different model and a different identification strategy. Instead of a Panel VAR model with Cholesky decomposition for the shock identification, in the current work we use a BVAR model with sign restrictions, a more appropriate methodology for the highly heterogeneous data. Furthermore, the large sample enabled us to construct a second database and test the statistical significance of the BVAR results in a regression analysis.

The structure of the paper is as follows. Section 2 presents a brief review of the existing literature regarding the macroeconomic vulnerability, the IMF programs evaluation and the external sources of business cycle fluctuations. Section 3 introduces the methodology employed, i.e. the BVAR and the shock identification strategy, followed by the data description in section 4. Section 5 includes a comparative analysis of the results derived in the previous section. Specifically, we provide descriptive evidence regarding the difference in the average variance decomposition (obtained from the estimation of the BVAR model) for countries under IMF program and those not under IMF program, distinguishing between high-income countries, middle-income countries and low-income countries. In section 6, employing the average variance decomposition as a proxy for the sensitivity to external shocks, we construct a new database and we test the hypothesis of whether participation in IMF programs significantly reduces a member sensitivity‘s to non-domestic shocks. In order to overcome the endogeneity issue of IMF loans, we instrument the IMF participation with the size of the IMF quota and voting affinity in the United Nations General Assembly. In the last section, we conduct two robustness checks. Aiming at verifying the robustness of our results to the identification strategy employed, we run a sensitivity analysis in which the shocks are identified through the Cholesky decomposition instead of the original sign restrictions strategy. Finally, in order to test the suitability of US shocks as global external shocks, we replicate the entire empirical exercise replacing the USA block with World variables.

2 Motivation and related literature

The increasing frequency of global financial and economic shocks and the negative effects of such shocks determined the countries to focus on protecting themselves from these reversals and ensuring a resilient pattern of growth. Consequently, addressing the macroeconomic vulnerability has become a key aspect of the policymakers' agenda across

the world.

As mentioned in Seth and Ragab (2012), in the literature the concept of vulnerability is approached from both the macroeconomic and microeconomic perspectives. If the first approach focuses on the effect of shocks on the economic growth, the second one is concerned with the effects of shocks on the well-being of individual households. In this work, we limit our attention on the macroeconomic perspectives of vulnerability.

The literature on macroeconomic vulnerability can be divided into two main groups. The first one addresses the macroeconomic vulnerability exclusively in relation to financial crises and focuses on how macroeconomic imbalances such as mismatching in asset prices or exchange rates can lead to a financial crisis, be it a currency, debt or banking crisis. The credibility of policies to correct such imbalances and the strength of the financial sector are additional factors that influence the macroeconomic stability. The studies in this group try to identify indicators of macroeconomic vulnerability that serve as signals for financial crises.

The second group of studies on macroeconomic vulnerability focuses on the structural conditions and transmission channels of the exposure to economic and financial shocks which usually has a negative impact on economic growth. This concept was initially proposed by Briguglio in the context of Small Island Developing States, extended further on to a framework applicable to most of the countries (Briguglio 1995, Briguglio et al. 2009) to finally materialize in an Economic Vulnerability Index (Briguglio 1997).

In the Economic Vulnerability Index (Briguglio 1997), five structural macroeconomic characteristics of an economy are considered to increase its exposure to crises, namely:

- economic openness
- trade concentration
- peripherality
- dependence on strategic imports
- dependence on foreign sources of finance

Briguglio and Galea (2003) went beyond the identification and analysis of the structural determinants of the macroeconomic vulnerability and shifted their attention to a complementary and crucial concept, the economic resilience. Following Briguglio (2009), we define the economic resilience as the policy-induced ability of an economy to recover from external adverse shocks and to benefit from the positive shocks. Put differently, the resilience is the role of policy in mitigating macroeconomic vulnerability and it aims to explain why some countries that appear to be very exposed to external shocks still manage to achieve impressive levels of economic development. For example, although its high vulnerability, Singapore succeeded in building resilience through appropriate economic policies. In an attempt to build a resilience index, Briguglio (2009) hypothesized that the variables affecting the economic resilience can be divided into 4 categories:

- macroeconomic stability

- microeconomic market efficiency
- good governance
- social development

In the first category, we can find variables such as fiscal deficit ratio to GDP, inflation, external debt ratio to GDP, etc. Concerning the market efficiency an essential characteristic is the speed of adjustment of prices to achieve equilibrium after a shock. Measuring market efficiency is not an easy task and it should include variables which express to what extent market operate freely, competitively and efficiently across countries. The good governance refers broadly to the rule of law and the security of the property rights while the social development is related to the progress of educational and health system.

The concept of economic resilience is extremely important for our analysis as it represents one of the target areas of IMF agenda. To be more specific, the Fund is aiming to assist members in building a strong economic resilience and hence decrease their sensitivity to external shocks. Therefore, we expect that IMF programs should act as a shield against exogenous adverse shocks, and this is the hypothesis we want to test in the current analysis. In the next paragraph, we will briefly review the empirical literature related to our work.

A large number of studies evaluate the effects of IMF programs. As suggested by Haque and Khan (1998), an important question often raised in relation to the Fund programs is whether such programs are efficient in terms of improving the current account balance, increasing international reserves, lowering inflation and raising the growth rate. Typically, these studies are conducted using different methodologies (for example Before-After, With-Without or Instrumental Variable approach etc.) aiming to solve the issue of self-selection of countries into IMF arrangements.

The results of most of the cross-country empirical studies point out that IMF programs lead to improvement in the current account balance and the balance of payment. Regarding the growth, it seems that there is a negative impact on output in the short run but over time growth starts to rise. Several studies also indicate that inflation falls but this result is mainly not statistically significant (Conway 1994, Barro and Lee 2005, Easterley 2005, Dreher 2006).

Similarly, IMF‘s role in catalyzing private capital flows has received considerable attention in the literature (Bird and Rowlands 2002). It is worth recalling that a key element of IMF mission it is precisely to restore the investor‘s confidence. Still, the empirical results are mixed. For example, Edwards (2006) shows that IMF programs generate net outflows of portfolio while Jensen (2004) finds similar effects for foreign direct investments. Eichengreen and Mody (2000) find evidence that IMF lending decreases bond spread while Cottarelli and Giannini (2002) find little evidence that IMF lending decreases bond spreads. It is clear that there is not much consensus about the effects of the IMF arrangements on the recipient country.

On the other side, over the last 50 years, macroeconomists have been concerned with the business cycle fluctuation and their sources. Scholars have tried to shed some light on the question of which source (external vs internal) contributes more to the cyclical

fluctuations and to identify the transmission channel. For example, Ahmed and Park (1994) examine the impact of external and country-specific shocks on output, inflation and trade balance of each of the seven OECD countries. Kim (2001) using VAR models finds that US expansionary monetary policy shocks lead to booms in the non-U.S. G-6 countries. Canova (2005) analyzes whether and how US shocks are transmitted to eight Latin American countries and he finds that US disturbances explain an important portion of the Latin America variability and the monetary channel plays a more important role compared to the trade channel.

Georgiadis (2015) assesses that global spillovers from identified US monetary policy shocks have relevant output effects to the rest of the world, which are larger than the effects in the domestic US economy for many countries, depending on country characteristics such as the country‘s trade integration, financial openness, exchange rate regime, labour market rigidities, etc. Moreover, Georgiadis (2015) suggests that policymakers could mitigate their economic vulnerabilities to US monetary policy with adequate policies that impact on these characteristics.

Kirejev (2000) builds a bridge between the different strands of the above-mentioned literature. He employs a Panel VAR to examine the impact of external and domestic shocks on macroeconomic dynamics of the Arab countries. He then compares the impact of these shocks on countries while under IMF program or not. His main findings are that on average, IMF program countries are less vulnerable to adverse exogenous shocks than non-program countries. We recall that IMF arrangements provide additional liquidity to the borrower country but requires also the implementation of sound macroeconomic policies which affect the dynamics of countries under IMF program, and, therefore, their capacity to filter the external shocks into the domestic economy.

Following Canova (2005), in the first part of this work we propose a similar model aiming to test the difference in the sensitivity to exogenous shocks for countries under IMF arrangement and not.

Summing up, in a context where shocks and crises increase in frequency, evaluating the performance of an important global actor such as IMF, in helping countries to protect themselves against adverse exogenous shocks it is a subject of topical interest and relevance.

We conclude this section by highlighting several channels through which IMF arrangements can help a country increase its economic resilience. To begin with, IMF lending should act as an income insurance against adverse shocks (Vaubel 1983). Furthermore, IMF lending programs consist of a given amount of financing and a set of economic policy adjustments (i.e. “conditionality”) that the borrower must implement. The money should alleviate restructuring the economy (even if not always verified in practice) while the conditions to be implemented and the policy advice (IMF staff provide to the borrower), should increase the economic resilience and implicitly decrease the risk of external shocks.

Hence, all else equal we expect participation in IMF programs to have a negative and significant impact on the sensitivity to external shocks of the borrower country.

3 Methodology and model specification

In order to study the sensitivity to external shocks of almost all countries of the world, it is preferred a multi-country model where contemporaneous and lagged inter-dependencies among countries are accounted for. In the current analysis, this task is not possible for different reasons. First of all, the quality and availability of data among the 167 countries analyzed are highly heterogeneous. Second, many of the countries examined experienced episodes of hyperinflation, exchange and currency crises and modeling the corresponding domestic time series is hardly possible.

3.1 Model selection

Following Canova (2005) we will proceed on a bilateral basis, with the external block which is fixed among countries on one side and one domestic country at a time on the other. The external block includes 3 US variables, namely US GDP, US CPI inflation and Federal Reserve Interest rate plus the world oil price inflation while the domestic block includes from 2 to 6 variables (GDP, CPI inflation, Trade, Interest rate, Reserve, Exchange rate) depending on the data availability. In this way, we simplify a lot the model and any correlation between the US and the domestic country is expected to be unidirectional.

However, any sort of possible feedback within countries, others than US is excluded from the analysis. In order to test our hypothesis that participation in IMF arrangements reduces the external vulnerability, we break the estimation process in two parts. First, we focus on the external block and we identify the structural shocks. Then we set up a model for the domestic economies, taking as exogenous the estimation of the external block shocks, and finally, we measure the external vulnerability with the forecast error variance decomposition which captures how much of the variability in the domestic variables is explained by the structural shocks identified in the external block.

Therefore we consider a bivariate block VAR model:

$$\begin{bmatrix} y_t \\ w_t \end{bmatrix} = \begin{bmatrix} A(L)_{11} & 0 \\ A^i(L)_{21} & A^i(L)_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ w_{t-1} \end{bmatrix} + \begin{bmatrix} e_t \\ \epsilon_t \end{bmatrix} \tag{1}$$

where y_t represents the external block of variables and w_t represents the domestic variables and $(e_t\ \epsilon_t\ )' \sim (0, \Sigma_i)$, Σ_i =blockdiagonal $\{\Sigma_e, \Sigma_\epsilon\}$.

Finally, let the structural model be described by the underlying formula:

$$\begin{bmatrix} A_0 & 0 \\ G_0^i & H_0^i \end{bmatrix} \begin{bmatrix} y_t \\ w_t \end{bmatrix} = \begin{bmatrix} B(L)_{11} & 0 \\ B^i(L)_{21} & B^i(L)_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ w_{t-1} \end{bmatrix} + \begin{bmatrix} u_t \\ v_t \end{bmatrix} \tag{2}$$

where $(u_t v_t)' \sim (\ 0, \mathrm{I})$.

Table 1: Sign restriction summary

	Y	π	R	oil	oil-π
Non-oil supply side	-	+	x	x	-
Real demand	+	+	+	x	x
Monetary policy	-	-	+	x	x
Oil	-	+	x	x	+

3.2 Identification strategy

To identify the VAR model correctly and allow for meaningful interpretation of the variance decomposition we need to assign a number of restrictions on the coefficients. The strategy we adopt is to combine sign restrictions method (for the external block) with the Cholesky decomposition (for the domestic block).

Sign restrictions is a powerful tool for the identification of the structural shocks (see Uhlig 2004) and allows us to disentangle the 'supply', 'demand', 'monetary policy' and 'oil ' shocks. The sign restrictions are imposed on the contemporaneous impact matrix.

Following Barnett, Groen and Mumtaz (2010) we assume that a real oil price shock decreases the US GDP, increases inflation and increases real oil price inflation while a negative supply shock generates an increase in US inflation, decreases the US output and leads to a fall in real oil price inflation. This last effect is caused by the fact that this shock is assumed to push up the general price inflation more than the increase in the nominal oil price inflation because the negative supply shock implies a decrease in production capacity which in turn depresses the demand for energy. We also assume that a demand shock moves output, inflation and interest rate in the same direction while a restrictive monetary policy leads to a rise in the interest rate and a decrease in both output and inflation.

Put differently, we need to find A_0 in (2), as a 4x4 matrix , such that $A_0'A_0$=$\sum$ and A_0=Q$\tilde{A}$, where $\widetilde{A}$ is the result of the Cholesky decomposition of the $\sum_e$ while Q is the result of a QR decomposition of a standard normal 4x4 matrix K.

Once we obtained the matrix A_0 the form:

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \tag{3}$$

we need to check if it complies with the assumed signs and if it does we use it to calculate the variance decomposition and impulse response functions.

In table 1 an 'x' indicates that there is no restriction on the response of a variable to a schock, while '+/-' indicates positive/negative response.

As we already mentioned, the domestic block variables is identified through Cholesky decomposition which consists in obtaining an upper triangular matrix 6x6 such that its square is equal to Σ_ϵ. Hence our matrix has the form:

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ 0 & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ 0 & 0 & a_{33} & a_{34} & a_{35} & a_{36} \\ 0 & 0 & 0 & a_{44} & a_{45} & a_{46} \\ 0 & 0 & 0 & 0 & a_{55} & a_{56} \\ 0 & 0 & 0 & 0 & 0 & a_{66} \end{bmatrix} \tag{4}$$

Causal ordering of the variables used in this work (GDP/IP[1], CPI inflation, Trade, Interest rate, Reserve, Exchange rate) stems from both Canova (2005) and Eichenbaum and Evans (1995).

The identification strategy implies that a shock to the domestic GDP has a contemporaneous effect on all the other domestic variables but is not affected by none of them (except for the variables in the external block). Similarly, a shock to the domestic CPI inflation influences all the other domestic variables apart from the GDP but is affected only by a shock to domestic GDP and external block variables and so on.

Therefore, combining (4) and (5) our final identification matrix has the form:

$$\begin{bmatrix} + & + & + & X & a_{1,5} & a_{1,6} & a_{1,7} & a_{1,8} & a_{1,9} & a_{1,10} \\ - & + & X & - & a_{2,5} & a_{2,6} & a_{2,7} & a_{2,8} & a_{2,9} & a_{2,10} \\ - & - & + & X & a_{3,5} & a_{3,6} & a_{3,7} & a_{3,8} & a_{3,9} & a_{3,10} \\ - & + & X & - & a_{4,5} & a_{4,6} & a_{4,7} & a_{4,8} & a_{4,9} & a_{4,10} \\ 0 & 0 & 0 & 0 & a_{5,5} & a_{5,6} & a_{5,7} & a_{5,8} & a_{5,9} & a_{5,10} \\ 0 & 0 & 0 & 0 & 0 & a_{6,6} & a_{6,7} & a_{6,8} & a_{6,9} & a_{6,10} \\ 0 & 0 & 0 & 0 & 0 & 0 & a_{7,7} & a_{7,8} & a_{7,9} & a_{7,10} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{8,8} & a_{8,9} & a_{8,10} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{9,9} & a_{9,10} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & a_{10,10} \end{bmatrix} \tag{5}$$

3.3 Model estimation

In order to estimate our model, we use Bayesian methods. In particular, we use Gibbs sampling to simulate draws from the posterior distribution. We recall that Gibbs sampling is a Markow chain Monte Carlo simulation method for approximating joint and marginal distributions by sampling from conditional distributions.

In Bayesian VAR analysis the choice of the prior may be problematic. In our model we want to impose small open economy restrictions which implies that shocks to the domestic economy do not affect the external variables, hence we want to treat the coefficients of some variables differently from those of other variables. For this purpose, an appropriate prior is the Independent Normal Inverse Wishart prior. This prior involves setting the

[1]for countries where quarterly GDP was not available we used industrial production index instead

prior for the VAR coefficients and the error covariance independently. To be more specific, in equation (1) and (2), we want to impose that the matrices A_{12} and B_{12} are both zero (assumption already included in the formulas). The independent Normal Wishart prior allows us to incorporate these restrictions into the VAR model by imposing a prior mean for all coefficients equal to zero and the covariance of this prior as a diagonal matrix which takes value 1 for all elements except for the elements corresponding to A_{12} and B_{12}. The elements corresponding to these coefficients are set to a very small number, therefore, the prior mean of zero is imposed very tightly for them.

Concerning the other coefficients, we impose the Minnesota prior by adding T_d dummy observations. As shown in Bandura et al. (2009), appending Y_d (on the left-hand side) and X_d (on the right-hand side) dummy observations to the system (2) is equivalent to imposing the normal inverted Wishart prior

$$B_0 = ({X'}_d X_d)^{-1} X'_d Y_d \tag{6}$$

$$S_0 = (Y_d - X_d B_0)'(Y_d - X_d B_0) \tag{7}$$

In other words, as mentioned in Blake and Mumtaz (2012), a regression of Y_d on X_d gives the prior mean for the VAR coefficients and sum of squared residuals give the prior scale matrix for the error covariance matrix. The prior is of the normal inverse Wishart form:

$$p(B \diagdown \Sigma) \sim N(B_0, \Sigma \otimes (X'_d X_d)^{-1}) \tag{8}$$

$$p(\Sigma) \sim IW(S_0, T_d - K) \tag{9}$$

where T_d is the length of the artificial data and K denotes the number of regressors in each equation.

To sum up, we combine the Normal Independent Wishart prior with the dummy observations approach in order to impose the small open economy assumption, i.e. that domestic economy variables have no impact on the external block variables while for the other coefficients we match the Minnesota moments. Given this, the posterior distributions for our VAR parameters are:

$$M^* = (H^{-1} + \Sigma^{-1} \otimes X^{*'} X^*)^{-1} (H^{-1} B_{prior} + \Sigma^{-1} \otimes X^* X^* B_{OLS}) \tag{10}$$

$$V^* = (H^{-1} + \Sigma^{-1} \otimes X'^* X^*)^{-1} \tag{11}$$

where H is the variance-covariance matrix of the prior and incorporates the small open economy assumption, Σ is the posterior covariance matrix obtained with the Gibbs sampling algorithm, B_{prior} is the prior mean, and $\mathrm{X}^*, Y^*$are obtained by appending the

dummy variables to the original data. Moreover, B_{OLS} is also calculated using $X^*$and Y^*.

Another critical choice for our analysis is the correct lag-selection and the prior tightness. Given the quarterly frequency of the data, we tested the system for a lag length up to four. Our model selection procedure involves the estimation of models with L= 1,....4 and λ= 0.1,....0.5 and then selecting the VAR with the highest marginal likelihood, where L is the number of lags and $\lambda$is the parameter governing the overall prior tightness (see Carriero et. al 2010).

An important characteristic of our estimation procedure is that in order to capture the differences in the variance decomposition for countries under IMF arrangement or not, we distinguish between two regimes: the first one corresponds to periods when the domestic economy is under IMF program and the second one corresponds to periods when the country is not under IMF program. For countries with both regimes, we will have two types of coefficients and two types of variance decomposition function while for the other countries we will have either only IMF regime or Non-IMF regime. Among the 167 analyzed countries, 77 have both regimes, 45 have only IMF regime and the remaining 45 have only the Non-IMF regime.

Given the high heterogeneity in data availability and quality, we adjusted the model accordingly for each country. To be more specific, both the range of time and the number of variables vary among countries. We tried to stick to the original model when possible, but where data was very poor we reduced the number of domestic variables and excluded the oil inflation shock from the external block. Out of 167 countries, 70 countries have the complete model with 4 shocks and 6 domestic variables, while for the rest of countries we employed models with 3 shocks (US shocks) and 2 to 4 domestic variables, depending on the data quality and availability. Trying to minimize as much as possible the effect of the heterogeneity in the model-structure on our results, in the comparative analysis, we focus on the average impact of external shocks on the domestic economy.

4 Data

In order to test our hypothesis that participation in IMF lending programs decreases the sensitivity of the borrower country to the external shocks, we constructed an original time series database of quarterly observations for 167 countries from 1957 to 2014 employing three different sources[2]. For the external block series, we used the Federal Reserve Economic data (http://research.stlouisfed.org) while for the domestic variables we combined Global Financial Data (www.globalfinancialdata.com) with International Financial Statistics database (www.imf.org). The sample period differs across countries depending on data availability and it typically covers the last 45 years for developed countries, the last 20 years for most of the developing countries and the last 10 years for few countries with poor data availability.

We divide our observations into two main categories, external block data and domestic block data. The external data contains the source of external shocks and comprises a

[2]see appendix for a complete list of the countries analyzed

Table 2: Summary of countries by income group

Income group	N.
High-income: non-OECD	20
High-income: OECD	32
Low-income	24
Lower middle-income	44
Upper middle-income	47

measure of the real activity (log of US GDP), US CPI inflation (%) and the Federal Fund Rates (%) and the oil price inflation (%) . The domestic economy dynamics are captured by the log of real activity (GDP or Industrial production index), CPI inflation (%), a trade measure (log of the exports/imports ratio), interest rate (%), reserves (log) and exchange rates. Following Canova (2005), all the series are detrended and seasonally adjusted using the X-12 ARIMA routine (except for the interest rates series).

The order of the variables in the model is very important in our analysis considering that we use Cholesky decomposition for the shock identification for the domestic block and in the sensitivity analysis section.

Summarizing, the variables enter our model in the following way:

$$\begin{bmatrix} GDP_{US}(log * 100) \\ CPI_{US}(\%) \\ R_{US} \\ Oil_{Inflation}(\%) \\ GDP_{domestic}(log * 100) \\ CPI_{domestic}(\%) \\ Trade_{domestic}(log(Exp/Imp) * 100) \\ R_{domestic} \\ Reserve_{domestic}(log) \\ Exchange_{domestic} \end{bmatrix} \tag{12}$$

Another useful distinction for our study is the country classification by income group and how our results vary among these groups. It is interesting to analyze whether the sensitivity to external shocks and the effects of IMF arrangements differ across high, middle and low income-countries (see Table 2).

5 Results

5.1 Comparative analysis

In order to conduct our empirical analysis, we estimate the model separately for each country in the 167 sample of countries (see Appendix). Macroeconomic dynamics of the

Table 3: Average variance decomposition by IMF program participation

	Mean	Mean	Median	Median	5% prct	5% prct	95% prct	95% prct
Q	NO IMF	IMF	NO IMF	IMF	NO IMF	IMF	NO IMF	IMF
1	8.46064	7.08386	7.42043	6.01623	2.65312	1.79082	17.75771	14.41658
4	12.9038	8.35675	6.60074	5.46962	1.98202	1.43832	39.04623	23.07413
8	11.2242	7.45171	6.28656	5.14183	1.86849	1.39737	33.70261	18.74024
20	10.6154	7.16195	6.14898	4.80931	1.85911	1.39857	32.89787	17.88853
40	10.5125	7.10537	6.14826	4.67687	1.84599	1.38735	32.15143	17.80401

domestic economies under IMF program and not, have been summarized by the forecast error variance decomposition. We recall that the variance decomposition captures the impact of a shock on a generic variable j to variable i in horizon h. The sum of the variance decomposition shocks on all variables in the model to a generic variable j equals to 1. Using Bayesian methods to estimate our model, we obtain a distribution for the variance decomposition. In order to have a meaningful interpretation of the results we use the median of the variance decomposition distribution. Regarding the forecast horizon we provide the variance decomposition 1, 4, 8, 20 and 40 quarters ahead.

Given the heterogeneity in the data availability and quality and in the number of domestic variables employed in the study of each single country, in order to have comparable results among countries, we focus on the average impact of the external shocks on the domestic variables. Therefore, we restrict our attention only to the exogenous shocks effects on the domestic variables. Thus, we calculate the average impact of external shocks on the domestic variables .

In Table 3 we present the average across countries of the variance decomposition by IMF program participation for 5 different time horizons, i.e. 1, 4, 8, 20 and 40 horizons ahead. The mean of the sample of countries not under IMF program is always greater than its matching value in the group under IMF program. If in the first quarter the difference is around 1.5%, after one year the difference increases to 4.5 % and then stays around 3% for the medium and long-run forecast horizons. Therefore, on average, countries under IMF program experience a smaller sensitivity to external shocks compared to the countries not under IMF arrangement. Regarding the first quarter horizon, the difference observed should be interpreted as the ability of countries to filter exogenous shocks, while the difference in the other forecast horizons signals the better capacity of the IMF group countries to recover from adverse exogenous shocks. The order of magnitude is preserved also when we consider the median of the results and the same conclusions can be drawn when focusing on the 5 and 95 percentiles.

In the next graph we split the countries into income-based groups. Using World Bank income classification, we obtain 5 categories of countries: High-Income OECD, High income Non-OECD , Low-income, Lower-middle income and Upper-middle income.

Table 4: Average variance decomposition by country group

Q	Country group	NO IMF	IMF
1	High-Income:OECD	7.81269	11.76528
8	High-Income:OECD	12.66859	8.59872
40	High-Income:OECD	11.61318	8.54161
1	High-Income:non-OECD	8.6763	11.58385
8	High-Income:non-OECD	8.37996	9.68091
40	High-Income:non-OECD	8.20721	8.98475
1	Low -income	9.06413	3.64066
8	Low-income	4.72437	3.66155
40	Low-income	4.66688	3.47926
1	Lower middle-income	7.08792	5.3954
8	Lower middle-income	10.23458	6.12104
40	Lower middle-income	9.62306	5.62749
1	Upper middle-income	9.50927	7.35017
8	Upper middle-income	13.32759	9.95218
40	Upper middle-income	12.44774	9.64606

The advanced OECD countries have a smaller mean for the IMF group, except for the first quarter while for non-OECD it is exactly the opposite, i.e. the group under IMF has a higher sensitivity to external shocks. The interpretation of these results needs a bit more consideration. It was previously stated that a major issue in the analysis of IMF program effects is the self-selection of countries into the programs. Members recur to IMF loans when they face economic difficulties. The higher external vulnerability for Non-OECD countries while under IMF compared to the group without IMF loan might be due to the self-selection issue. This effect (higher exposure for countries under IMF program) is not verified in the case of OECD group which include the most developed countries where many of them are also part of the European Union, hence, they benefit from an enhanced protection.

Focusing on the Low-income group, the IMF results are slightly smaller for all time-horizons, but the values in both groups are much below the average. One would expect low-income countries to exhibit higher vulnerability, but we remind that the exposure to external shocks depends, among other things, on the country‘s openness, trade intensity, and financial development. Hence, a low-income country less integrated into the global financial markets will be less exposed to the external shocks (Georgiadis 2015).

Regarding the middle-income countries (upper and lower), the sensitivity to exogenous shocks is smaller for the group under IMF arrangement. The difference goes from 2% in the first quarter and stays around 3-4 % in the medium and long-run horizons. It is interesting that for the upper-middle income group the values are systematically greater than for the lower middle-income one. This effect may be explained by the higher financial

integration (of the upper-income group) which is associated with stronger spillover effects (Edwards 2007a).

Finally, in Fig.1, we report the spillover effects of averaged external shocks on the single country. In order to keep track of the impact of IMF programs on the vulnerability to external shocks, in the first map of Fig.1, we introduce the average over time of the intensity of participation in IMF's lending programs.[3] The magnitude of the results is indicated in the legend. The second and the third map present the vulnerability to external shocks after 1 quarter and respectively after 8 quarters.[4] From the first map we learn that African countries, Turkey, Pakistan and some East European countries are the most indebted with the Fund, followed by Latin America, China, Russia and India, while almost all the developed countries have small or null participation in the IMF arrangements.

In the second map, it is easy to visualize the negative relation between the IMF intensity and the vulnerability to external shocks[5]. Some of the most affected countries by shocks to US economy and the crude oil price are Canada, Russia, the Baltic countries , Saudi Arabia, Iran, Afghanistan, and Oman. The results are in line with our expectations considering that these countries are the major oil exporters while the US is one of the major oil importers, thus shocks to US economy and to the oil price impact on the aforementioned countries through two channels. For Canada, the geographic proximity to US also plays an important role. Additionally, Saudi Arabia, Iran, and Canada have null participation in IMF programs while Russia and Afghanistan have high exposure but medium participation into the Fund's programs. The African countries exhibit a high IMF participation and a very small sensitivity to the external shocks. However, we need to bear in mind that this low external sensitivity might be related to the fact that low- income countries are less integrated into the global market thus less exposed to exogenous shocks. Regarding the Latin America countries, a medium-high participation in IMF programs corresponds to a medium-high exposure to shocks. Considering the geographical proximity and the tight links of these countries to the US, without IMF presence we might have observed a much higher external vulnerability.

If we focus instead on the second and third map we can say something more about the short term and medium term impact of the global shocks. There is a consistent increase in the magnitude of the spillovers effects when we move from short to medium term (shocks need time to propagate among countries). Apart for the value increment, there are small differences regarding the African and Latin America countries, while Canada and China completely absorbed the shocks after 8 quarters. The opposite effect is observed for India and South Africa who experienced a small effect of the shocks in the first period but in the medium term are highly affected.

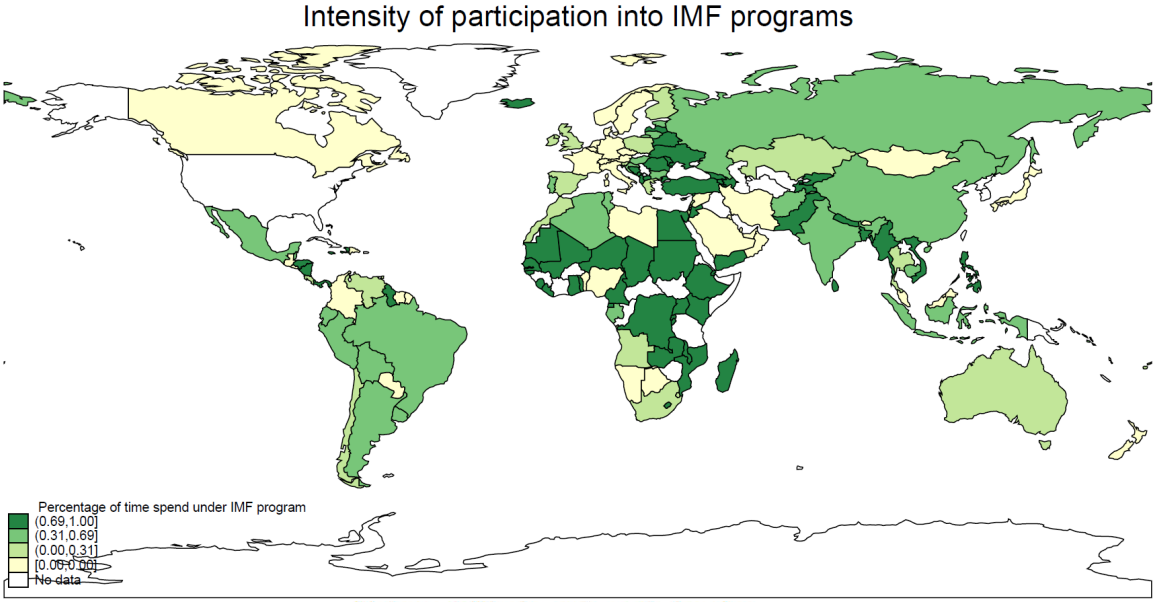
Summing up, the results of the Bayesian VAR model estimation confirm our hypothesis that on average countries under IMF program show less vulnerability to external

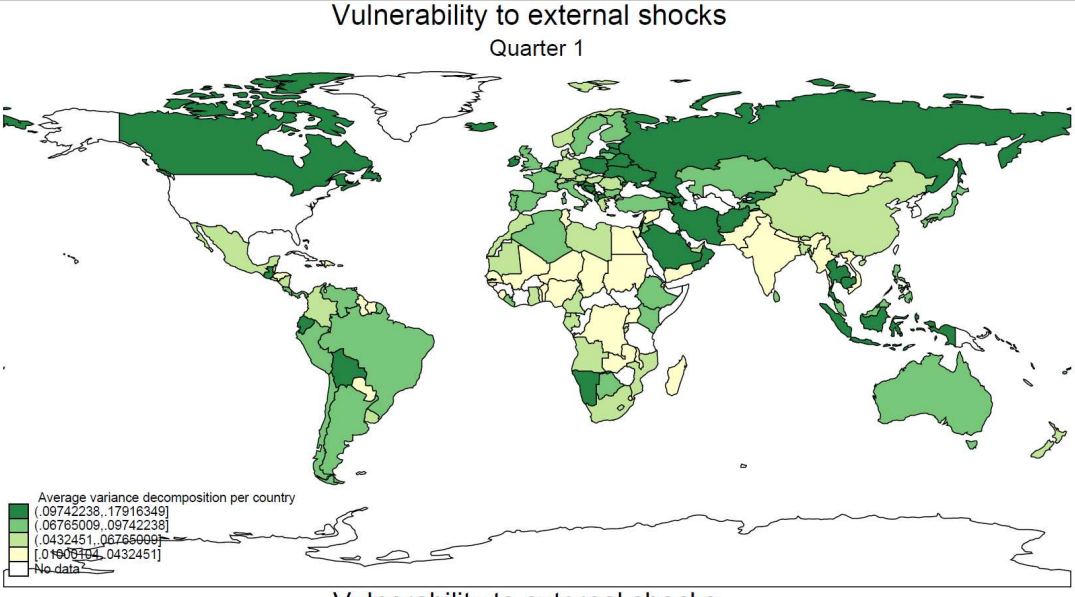
[3]The range of time differs across countries hence, this map should not be considered as a general distribution of the IMF loans over time, but related to this specific exercise.

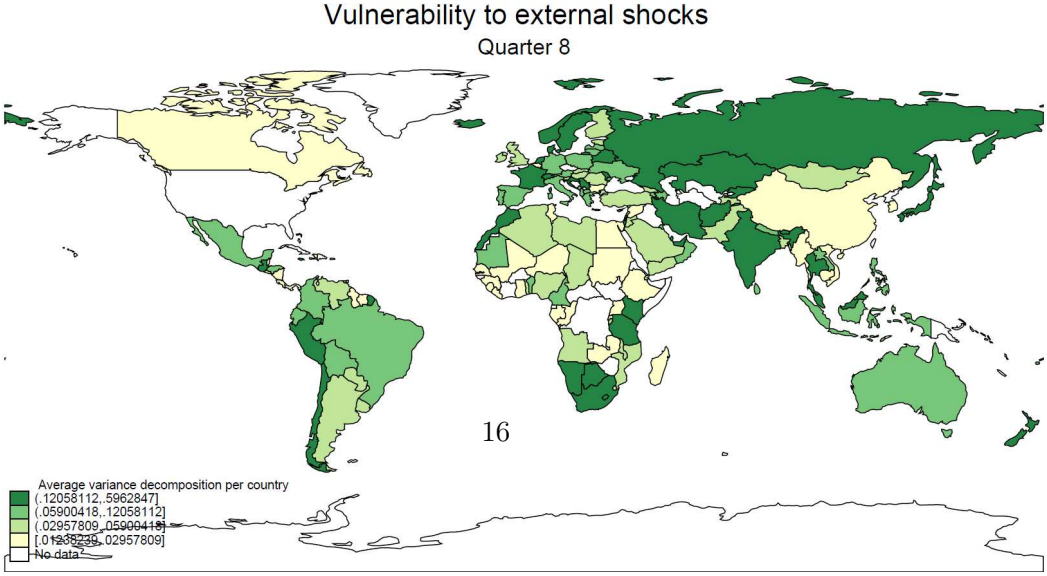
[4]The results for Quarter 20 and 40 are very similar to the Quarter 8

[5]Notice the inverse relation of the color intensity in the first two maps

Figure 1: Vulnerability to external shocks and participation into IMF programs







shocks. The observed difference varies from 1.5% in the short run to 3 to 4 % in the medium and long run. When we classify the countries in income-based groups, we learn that being under IMF arrangement is still associated with a lower contagion effect. Additionally, advanced economies highly integrated into the global markets are subject to higher exposure to shocks compared to less integrated low-income countries. The results are verified also at the country level as we have seen in the Fig.1

6 Correlation vs. causation in the IMF program participation

The analysis conducted in the previous section leads to the conclusion that for countries under fund-supported programs, a smaller sensitivity to external shocks is observed. However, not much can be said about the direction of causality of the previous results. In order to refine our conclusions and shed some light on the effects of the IMF programs on the macroeconomic vulnerability, in this section, we consider a cross-sectional regression approach. The variance decomposition obtained in the previous section is used as a proxy for the external vulnerability while the regressors are time averages of a set of country characteristics and a strategic variable capturing the IMF participation. Hence, we want to estimate the following model:

$$v_i^h = \alpha + \beta_1 X_i + \beta_2 IMF_i + \varepsilon_i \tag{13}$$

where $v^h{}_i$ is the variance decomposition of country i, for the time-horizon h[6]. For countries that experience both regimes, with and without program,we take the average on both left-hand side and right-hand side of (13) in order to avoid the selection on the dependent variable. We are left , thus, with 167 observations for each of the 5-time horizons considered. X_i is a vector of control variables that are considered to be determinants of the external vulnerability (Briguglio 1997,Collier and Goderis 2008, Georgiadis 2015, Loyaza and Raddatz 2007). X_i includes GDP per capita, FDI (% of GDP), trade (% of GDP) and Chinn -Ito index (KOPEN) of financial openness[7] . Data on Chinn-Ito index comes from web.pdx.edu, while all the other variables are taken from World Bank official site.

Regarding our strategic variable, the IMF participation, we propose two different specifications. The first one is a dummy variable which takes the value 1 if the country has ever been under IMF program and 0 otherwise. In the second specification, IMF is a measure of the intensity of participation in Fund‘s supported arrangements and is calculated as the percentage of time spent under IMF program in the range of time considered

[6] h can take the values 1,4,8,20,40 representing short (1,4), medium (8,20) and long run (40) term horizons

[7] The Chinn-Ito index (KAOPEN) is an index measuring a country's degree of capital account openness. The index was initially introduced in Chinn and Ito (Journal of Development Economics, 2006). KOPEN is based on the binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).

for each country, and it can take values that go from 0 (no IMF program at all) to 1 (under IMF program for the entire time horizon considered) .

In order to assess whether IMF loans tend to decrease the vulnerability to external shocks, we have to sort out the direction of causality. Barro and Lee (2005) specify that in evaluating programs that respond to the economic health of a country, it is necessary to distinguish between the economic effects of the programs and the effects of the economic conditions on the probability and size of the programs. It would not be fair to charge IMF also for the pre-existing bad economic conditions.

Ideally, to solve the causality issue we would need an experiment in which we observe a random assignment of IMF loans, without considering a country‘s economic conditions. Since this kind of experiment is quite unlikely, in order to overcome the selection issue, following Barro and Lee (2005) we propose an instrumental variable approach.

Aiming to obtain an unbiased estimator for β_2 in (13) we instrument IMF participation with the size of a country‘s quota at the IMF. We also tried to use Voting Affinity with the US in the United Nations General Assembly as an instrument for IMF program participation, but it was not significant in the first stage estimation and we dropped it.

We argue that within the Fund, members are divided into two main categories, debtors, and creditors. The advanced countries hold around 50% of the quotas and they are the creditors, with almost no use of IMF‘s resources since 1978. Therefore, higher quota implies higher probability of being in the category of the creditors and consequently decreases the probability of participating in IMF arrangements. We expect our instrument to be significant and negative in the first stage regression. Additionally, in the light of our previous results we are able to say that we do not expect any direct link between the IMF quota and the vulnerability to exogenous shocks. It is true that larger countries get larger quotas, but quotas are very persistent over time, hence the concept of economically large is much related to the rules set out in 1944 reason why there are IMF members with unusually high or low current quotas relative to their economic size. For example, Barro and Lee (2005) finds that the most over-weighted quotas are United Kingdom, France, Russia, Venezuela while the most under-weighted ones are China and South Korea. We have seen in section 5 that advanced economies are also exposed to spillover and contagion effects, thus, the exclusion restriction for our instrument should not be violated.

We are aware that Barro and Lee (2005) employ the size of the IMF quota as an instrument for IMF participation suggesting a positive impact of the IMF quota on the probability of receiving the loan but they present a different scenario. First of all, they use a panel data hence the time dimension allows them to observe the evolution over time of the participation into the Fund‘s programs for each country in the sample, while we employ a cross section of time-averaged variables. Second, they consider the participation in an IMF program as a joint decision between a member country and the IMF, hence, they control for the economic difficulties experienced by countries that determine the need of the loan, such as banking crises, currency crises, etc. They finally claim that if a loan is needed, having a higher IMF quota means higher voice within the Fund and it therefore, increases the probability of receiving the loan. We use a simpler approach and

we sustain that in the last 35 years the main shareholders of the Fund (the creditors), did not make much use of its financial resources, the reason why we expect higher quota to be associated with less probability of being under an IMF-supported loan.

Table 5 presents the results of the linear regression model for the two different measures of the participation into IMF programs, IMF, and IMFintensity. The dependent variable is the log of the average variance decomposition for five forecast horizons. We recall that IMF is a dummy taking value 1 if the country has ever had an IMF loan and 0 otherwise while IMFintensity captures the amount of time spent under an IMF program in the range of time considered. Except for the first quarter, IMF dummy variable is always negative and significant at 95% level suggesting that countries that had at least 1 IMF loan exhibit smaller vulnerability to external shocks. Regarding the second specification, the IMFintensity coefficient is negative and significant all the time at 99% level for all horizons. Hence, a longer period under IMF programs corresponds to a smaller vulnerability to exogenous shocks.

These results support the idea that the IMF arrangements act as a shield against spillover and contagion effects. In line with the previous literature, in the control group, the most important variables are the index of financial integration (KOPEN), positive and significant and the trade intensity (Trade) which is negative and significant. Giorgiadis (2015) points out that trade integration is a crucial determinant of the business cycle synchronization and spillovers, but it could also dampen the effects of exogenous shocks by rendering current account reversals in response to adverse US monetary policy shocks, or it could mitigate the effects on growth once the current account reversal took place. Moreover, if the expenditure effect associated with a rise in exports to the US in response to the appreciation of the US currency, prevails on the expenditure-reducing effect caused by an increase in the global interest rate, more integrated economies in global trade should be less sensitive to spillover effects. Financial integration (here captured by the financial openness) is associated in the literature with more sudden stops and current account reversals (Edwards 2007a; Calvo et al. 2008). The negative consequences are more severe in financially integrated and open economies, hence financial integration may be associated with greater contagion effects as reflected in our results (Edwards 2004, 2007a). Regarding the control variables, only two of them are significant and just for the first quarter, showing that these variables effect the ability of a country to avoid and filter the exogenous shocks, but not the capacity to recover once the adverse effects occurred, while the IMF intensity has a negative and significant impact in all horizons.

However, the last results do not consider the endogeneity issue. In Table 6 we present the results of the IV regression where our strategic variable, in both specifications, IMF, and IMFintensity, is instrumented by the size of the IMF quota.

In the first stage regression the IMF quota is always significant at 95% for the first specification and at 99% for the second specification hence the relevance of our instrument is verified. Following, the IV regression results reinforce our hypothesis that IMF arrangements enhance the capacity of members to protect themselves against the adverse exogenous shocks. The sign of the coefficients is almost unchanged. IMF and IMFintensity are significant at 95% and respectively 99% level and as expected, we gain a lot in

Table 5: OLS regression results

VARIABLES	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMF	0.0829	-0.337**	-0.323**
	(0.106)	(0.165)	(0.161)
KOpen	0.00453***	0.00223	0.00230
	(0.00105)	(0.00171)	(0.00167)
logGDP	0.0424	-0.0213	-0.0279
	(0.0458)	(0.0652)	(0.0621)
logTrade	-0.184***	-0.0834	-0.0812
	(0.0426)	(0.0622)	(0.0601)
logFDI	0.0507	0.0140	0.0340
	(0.0441)	(0.0734)	(0.0695)
Constant	-2.774***	-2.279***	-2.405***
	(0.344)	(0.508)	(0.489)
Observations	161	161	161
R-squared	0.179	0.061	0.064

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMFintensity	-0.258**	-0.551***	-0.558***
	(0.123)	(0.186)	(0.180)
KOpen	0.00316***	0.00165	0.00164
	(0.000960)	(0.00172)	(0.00169)
logGDP	0.0436	-0.00545	-0.0123
	(0.0428)	(0.0644)	(0.0607)
logTrade	-0.168***	-0.0604	-0.0576
	(0.0428)	(0.0643)	(0.0619)
logFDI	0.0783*	0.0290	0.0507
	(0.0422)	(0.0747)	(0.0702)
Constant	-2.668***	-2.424***	-2.539***
	(0.339)	(0.502)	(0.481)
Observations	161	161	161
R-squared	0.199	0.089	0.096

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: IV regression results

VARIABLES	(First stage) IMF	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMF		-1.279*	-3.361**	-3.321**
		(0.716)	(1.692)	(1.688)
KOpen	-0.00420***	-0.00166	-0.0115	-0.0113
	(0.000779)	(0.00380)	(0.00872)	(0.00871)
logFDI	0.0617	0.167*	0.272	0.290
	(0.0442)	(0.0988)	(0.242)	(0.237)
logTrade	0.0163	-0.155**	-0.0197	-0.0179
	(0.0373)	(0.0636)	(0.123)	(0.120)
logGDP	-0.0325	0.00756	-0.0986	-0.105
	(0.0300)	(0.0608)	(0.125)	(0.124)
IMFquota	-0.0678**			
	(0.0299)			
Constant	0.876***	-1.792***	-0.0981	-0.243
	(0.280)	(0.653)	(1.436)	(1.438)
Observations	161	161	161	161
R-squared	0.215			

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(First stage) IMFintensity	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMFintensity		-0.968***	-2.542***	-2.512***
		(0.373)	(0.878)	(0.875)
KOpen	-0.00338***	0.000445	-0.00598	-0.00585
	(0.000712)	(0.00199)	(0.00433)	(0.00432)
logFDI	0.0481	0.135**	0.187	0.206
	(0.0411)	(0.0643)	(0.155)	(0.148)
logTrade	0.0481	-0.130**	0.0480	0.0489
	(0.0314)	(0.0521)	(0.0996)	(0.0965)
logGDP	0.00390	0.0529	0.0206	0.0132
	(0.0327)	(0.0458)	(0.0971)	(0.0931)
IMFquota	-0.0897***			
	(0.0246)			
Constant	0.382	-2.542***	-2.070***	-2.191***
	(0.241)	(0.383)	(0.705)	(0.684)
Observations	161	161	161	161
R-squared	0.224	0.021		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

the magnitude of the point estimates. If in the linear regression model, a 1 % increase in the IMF participation decreases the sensitivity to external shocks by approx. 0.3% for the first specification and respectively 0.5% for the second one, in the IV regression, correcting for the endogeneity, a 1% increase in the IMF participation intensity has a negative impact of 3% respectively 2.5%, which represents a considerable increase. Hence, IMF programs do well in helping countries build a strong protection against exogenous shocks, especially in terms of recovering from the negative reversals once they occurred.

To sum up, our main conclusion is that participation in IMF programs has a significantly negative effect on the vulnerability to external shocks, thus, we are able to assess that IMF is very efficient in smoothing the adjustment to various shocks and helping countries to avoid spillover and contagion effects. The results are enhanced when we use a reasonable instrument for participation in IMF arrangements to correct for the endogeneity issue.

7 Robustness checks

In this section, we test the robustness of our results by conducting two different analyzes. In the first subsection, we run a sensitivity analysis in which we replace our preferred identification strategy (sign restriction) with the standard identification strategy represented by the Cholesky decomposition. In the second subsection, we reproduce both the BVAR and the regression analysis using World variables (instead of US variables) to capture the external shocks.

7.1 Sensitivity analysis

In order to preclude that our results derive from the identification strategy employed for the exogenous shocks, we consider a specification of the BVAR model in which both the external and domestic shocks are identified through the Cholesky decomposition. If in the sign restriction results, the variance decomposition of the most affected countries was between 9-18%, with Cholesky the correspondent interval becomes 11-22%. Variables enter the model as in (12), thus domestic shocks still have no impact on the external variables, while US GDP impacts on all variables in the model, but is affected only by its own shock, followed by US inflation, Federal Reserve Rate and finally the oil inflation shocks.

The results using Cholesky decomposition are similar to the ones obtained using the sign restriction identification strategy (see Appendix). We conclude the subsection by assessing that for countries under IMF arrangement, spillover and contagion effects are less intense for the group without the program and our results are robust to the identification strategy employed.

7.2 World shocks robustness analysis

In this subsection, we test the appropriateness of US shocks as global exogenous shocks, hence, we replace the US variables with World variables. We, therefore, use only world

shocks in the external block. Consequently, instead of US GDP, US CPI and US Interest rate we will now use World GDP, World CPI, and World Interest rate. All world variables are obtained from the IFS database, at quarterly frequency since 1970. We adjusted the database accordingly and dropped 10 additional countries. The results of the BVAR analysis (see Appendix) support our hypothesis that countries under IMF program are on average less sensitive to World shocks compared to countries not under IMF program. At the country level, as expected (given the geographical proximity and trade links with the US), the Latin American countries are slightly less sensitive to world shocks compared to US shocks. The same anticipated effect is verified also for the Middle East oil exporters if we consider that US is one of the major oil importers. On the other side, China is highly vulnerable to world shocks but not to US shocks. The regression analysis reinforce the negative and significant impact of participation into IMF programs on the exposure to adverse external shocks.

Summing up, we can assess that our results are robust to the identification strategy employed and the shocks to US economy are an appropriate measure for the exogenous shocks.

8 Concluding remarks

IMF has been a relevant actor in shaping the global economy since the end of the World War II and its role and objectives evolved together with the global system. Nowadays, one of the Fund‘s primary purposes consists in “advising member countries on economic and financial policies that promote stability, reduce vulnerability to crises, and encourage sustained growth and high living standards” (www.imf.org). However, very little empirical literature analyzed the efficiency of the Fund in helping countries to reduce the vulnerability to external shocks and this limited literature focused on a small number of countries.

Trying to fill part of this gap we proposed a BVAR model considering a sample of 167 countries for a range of time that roughly goes from 1957-2014, but varies among countries depending on the data availability and quality. In this empirical exercise, we focused on the forecast error variance decomposition with the purpose of measuring how much of the variability in the domestic economy (for each country in the sample) is explained by 4 exogenous shocks, namely a demand shock, a non-oil supply shock, a monetary policy shock and crude oil price inflation.

The results of this analysis show that countries under Fund-supported loans exhibit a smaller sensitivity to exogenous shocks compared to countries without IMF program and the difference. Moreover, it seems that advanced economies and oil exporter countries present a higher exposure to contagion and spillover effects than very low-income countries which are not much integrated into the global economy.

We then used the variance decomposition results as a proxy for the sensitivity to external shocks in a Linear Regression Model and finally in an Instrumental Variable Regression that provided us with the main results of the current study. In order to run the last empirical analysis, we constructed a new database containing some coun-

try characteristics that in the previous literature are considered as determinants of the external exposure. Additionally, we included two measures of participation in the IMF programs, namely IMF, a dummy equal to 1 if ever under IMF program and IMF Intensity, which represents the percentage of time spend under IMF arrangement during the analyzed time horizon. In order to correct for the endogeneity of IMF loans, in the final regression, we instrumented the IMF participation with the size of the IMF quota.

The results of the linear regression showed that IMF participation significantly decrease the external vulnerability of a member country, and when we corrected for the selection issue the point estimates maintained the sign and significance and considerably increased in magnitude, confirming the hypothesis that IMF loans act as a shield against exogenous shocks.

We concluded our work with a robustness check section. Specifically, we conducted a sensitivity analysis where we employed the Cholesky decomposition instead of sign restriction for the identification strategy. Finally, we reproduced the complete empirical analysis replacing the US variables with world variables aiming at testing the suitability of US shocks as global external shocks.

The bottom line is that even if IMF is a much-criticized institution and many studies claim that IMF programs tend to have adverse economic consequences, our analysis shows that IMF is doing a pretty good job in helping member countries to smooth the adjustment to shocks and build a strong economic resilience.

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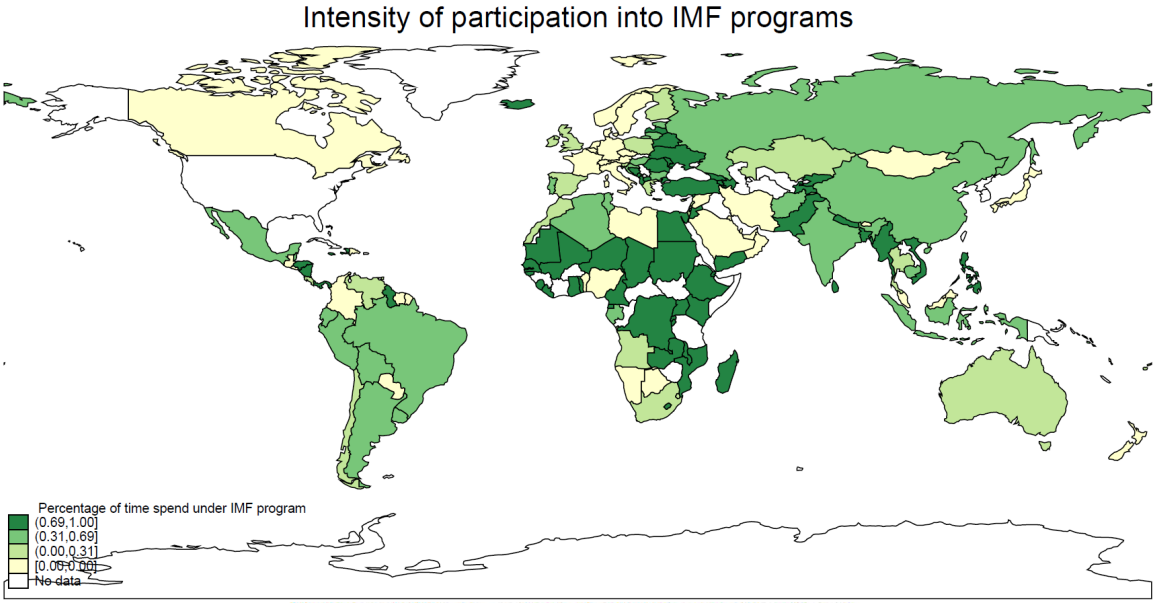
Country list

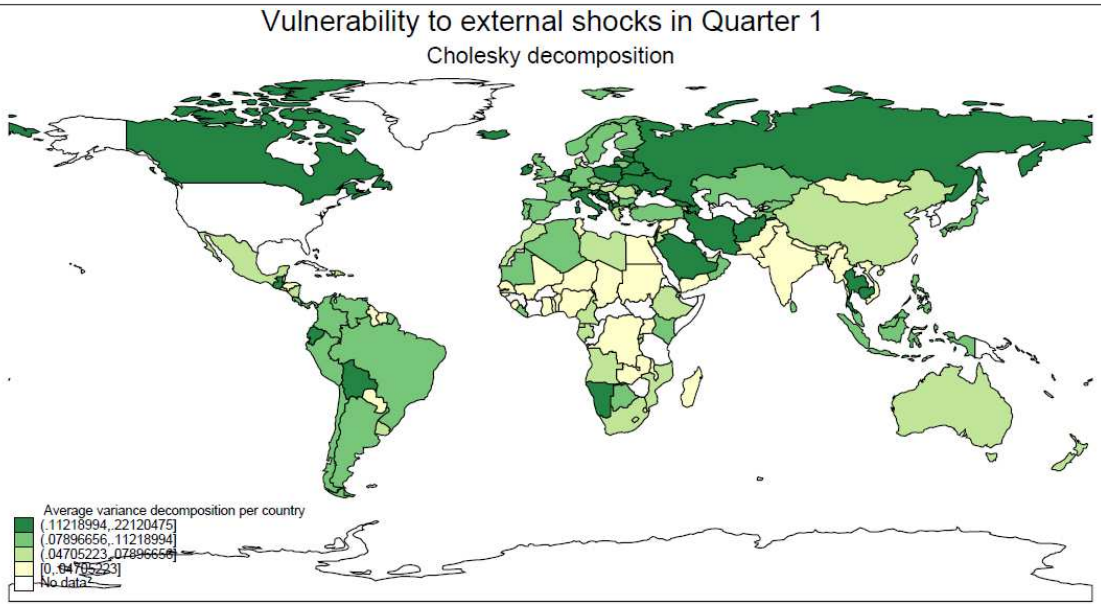
Afghanistan
Albania
Algeria
Angola
Antigua and Barbuda
Argentina
Armenia
Australia
Austria
Azerbaijan
Bangladesh
Barbados
Belarus
Belgium
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Brunei
Bulgaria
Burundi
Caboverde
Cambodia
Cameroon
Canada
Chad
Chile
China
Colombia
Comoros
Congo
Congo republic
Costa Rica
Cote Ivoire
Croatia
Cyprus
Czech Republic
Denmark
Djibouti
Dominican Republic
Ecuador
Egypt
El Salvador
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Gambia
Georgia
Germany
Ghana
Greece
Grenada
Guatemala
Guinea
Guinea Bissau
Guyana
Haiti
Honduras
Hungary
Iceland
India
Indonesia
Iran
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Korea
Kuwait
Kyrgyz
Lao
Latvia
Lebanon
Lesotho
Liberia
Libya
Lithuania
Luxembourg
Macedonia
Madagascar
Malta
Mauritania
Mauritius
Mexico
Micronesia
Moldova
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Oman
Pakistan
Panama
Paraguay
Peru
Philippines
Poland
Portugal
Qatar
Romania
Russia
Rwanda
Samoa
San Marino
Sao Tome
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Singapore
Slovak Republic
Slovenia
Solomon Islands
St. Lucia
St. Vincent
Sudan
Suriname
Swaziland
Sweden
Switzerland
Syria
Tajikistan
Tanzania
Thailand
Timor Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Uganda
Ukraine
United Arab Emirates
United Kingdom
Uruguay
Vanuatu
Venezuela
Vietnam
Yemen
Zambia

Table 7: Variance decomposition by country group with Cholesky identification strategy

Q	Country group	NO IMF	IMF
1	High Income:OECD	9.4148	13.91025
8	High Income:OECD	19.02575	8.96848
40	High Income:OECD	17.59862	8.95485
1	High Income:non-OECD	9.73354	12.89591
8	High Income:non-OECD	9.86187	10.5823
40	High Income:non-OECD	9.64069	9.80399
1	Low income	9.62398	3.96015
8	Low income	4.83997	3.8367
40	Low income	4.79841	3.63157
1	Lower middle income	7.92054	6.09507
8	Lower middle income	13.24129	7.04538
40	Lower middle income	12.60843	6.39306
1	Upper middle income	10.78725	8.10063
8	Upper middle income	16.48499	11.67991
40	Upper middle income	15.54378	11.34588

Figure 2: Vulnerability to external shocks and participation in IMF programs- Cholesky decomposition





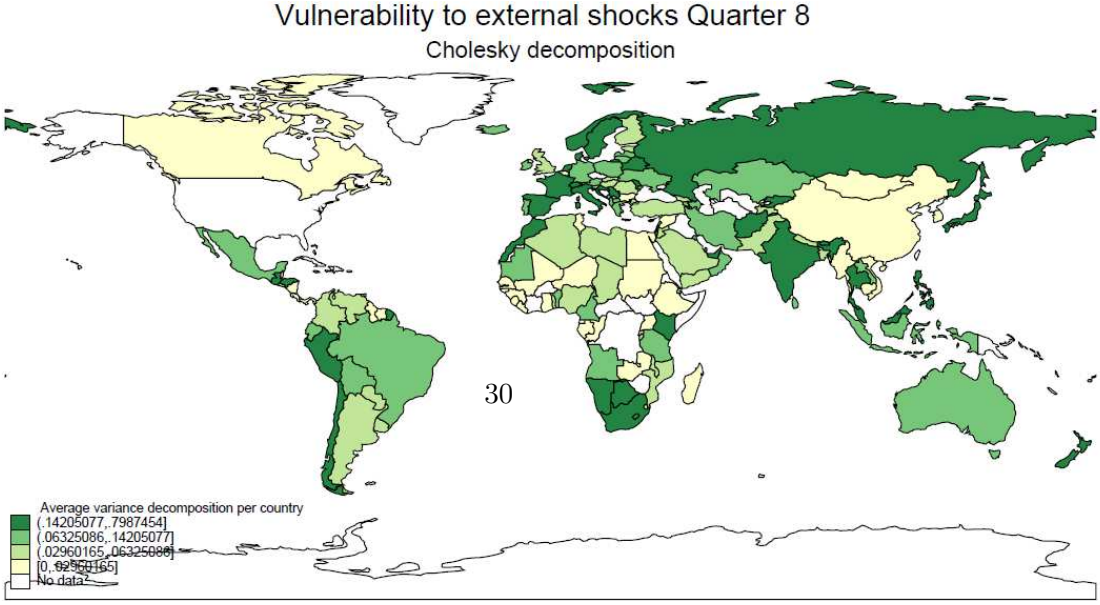


Figure 3: Vulnerability to external shocks and participation into IMF programs- World shocks

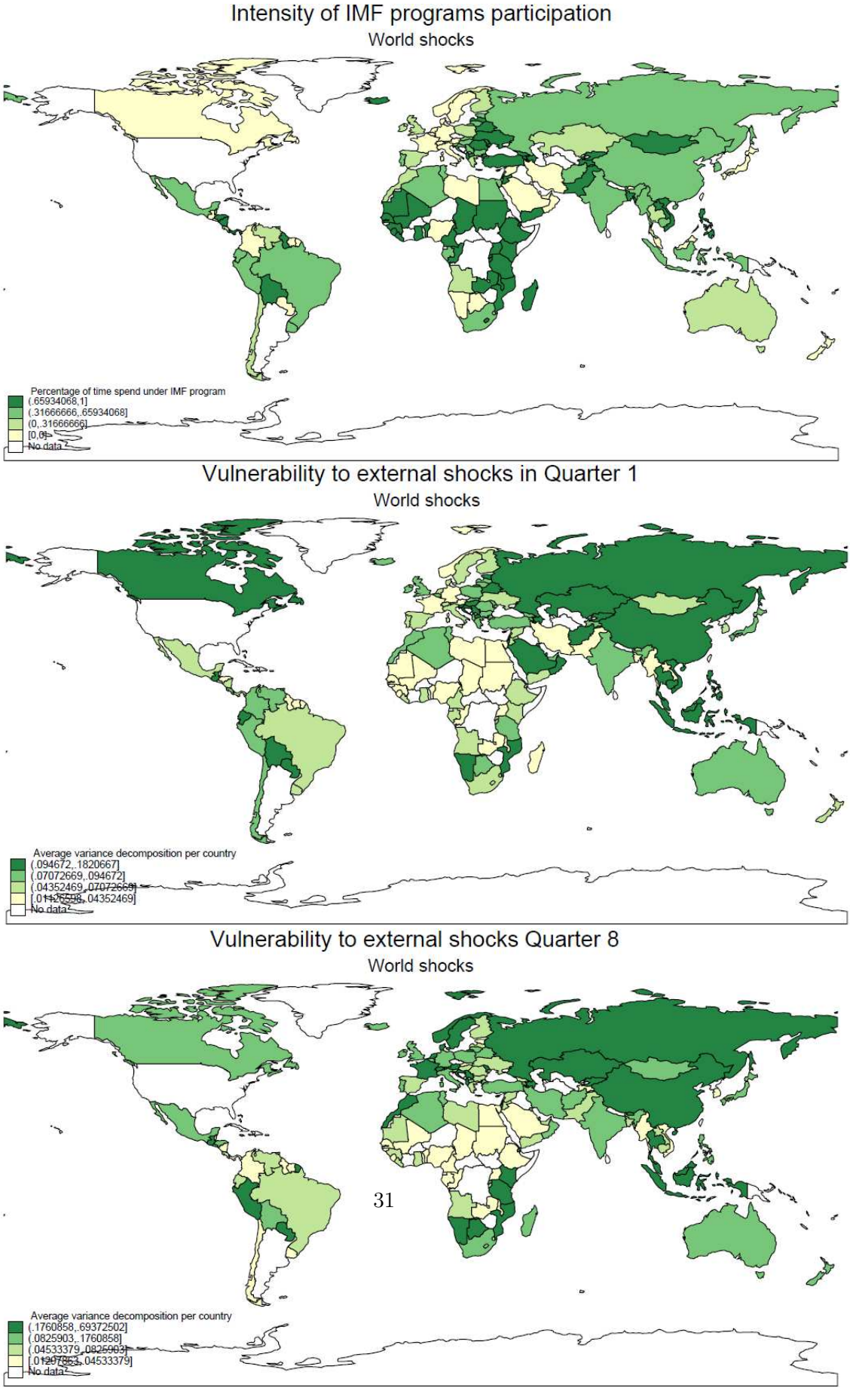


Table 8: World OLS results

VARIABLES	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMF	0.183*	-0.352*	-0.328*
	(0.107)	(0.179)	(0.177)
KOpen	0.00559***	0.00350*	0.00342*
	(0.00108)	(0.00199)	(0.00198)
logGDP	0.0545	-0.0231	-0.0254
	(0.0363)	(0.0750)	(0.0736)
logTrade	-0.0941**	0.00726	0.00210
	(0.0446)	(0.0730)	(0.0724)
logFDI	0.0815*	0.0956	0.102
	(0.0421)	(0.0715)	(0.0706)
Constant	-3.433***	-2.734***	-2.776***
	(0.305)	(0.535)	(0.535)
Observations	157	157	157
R-squared	0.199	0.080	0.076

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMFintensity	-0.319***	-0.588***	-0.575***
	(0.118)	(0.209)	(0.206)
KOpen	0.00371***	0.00270	0.00257
	(0.00100)	(0.00198)	(0.00196)
logGDP	0.0585*	-0.00514	-0.00811
	(0.0346)	(0.0789)	(0.0771)
logTrade	-0.0710*	0.0317	0.0264
	(0.0408)	(0.0744)	(0.0732)
logFDI	0.132***	0.114	0.122*
	(0.0415)	(0.0729)	(0.0718)
Constant	-3.329***	-2.887***	-2.918***
	(0.284)	(0.529)	(0.526)
Observations	157	157	157
R-squared	0.219	0.104	0.103

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: World IV results

VARIABLES	(First stage) IMF	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMF		-0.908	-2.272	-2.135
		(0.970)	(1.541)	(1.515)
KOpen	-0.00353***	0.00138	-0.00391	-0.00356
	(0.000857)	(0.00396)	(0.00677)	(0.00665)
logFDI	0.0824*	0.199*	0.302	0.297
	(0.0445)	(0.120)	(0.224)	(0.216)
logTrade	0.0243	-0.0656	0.0575	0.0493
	(0.0376)	(0.0553)	(0.0922)	(0.0887)
logGDP	-0.0224	0.0377	-0.0527	-0.0533
	(0.0313)	(0.0488)	(0.105)	(0.101)
IMFquota	-0.0668**			
	(0.0320)			
Constant	0.649**	-2.887***	-1.773*	-1.873**
	(0.274)	(0.599)	(0.955)	(0.941)
Observations	157	157	157	157
R-squared	0.173			

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(First stage) IMFintensity	(Q1) average(log)	(Q8) average(log)	(Q40) average(log)
IMFintensity		-0.684	-1.711**	-1.607**
		(0.564)	(0.795)	(0.793)
KOpen	-0.00324***	0.00237	-0.00144	-0.00124
	(0.000715)	(0.00228)	(0.00389)	(0.00387)
logFDI	0.0623	0.167**	0.222	0.221*
	(0.0414)	(0.0696)	(0.136)	(0.131)
logTrade	0.0547*	-0.0502	0.0959	0.0855
	(0.0312)	(0.0496)	(0.0942)	(0.0922)
logGDP	0.0120	0.0662*	0.0188	0.0139
	(0.0310)	(0.0392)	(0.0945)	(0.0910)
IMFquota	-0.0887***			
	(0.0254)			
Constant	0.237	-3.315***	-2.842***	-2.877***
	(0.223)	(0.286)	(0.565)	(0.553)
Observations	157	157	157	157
R-squared	0.240	0.171		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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