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Unveiling the drivers of portfolio equity and bond investment in the European Union: The interplay of tax havens and gravity factors

CAMARERO Mariam *(University Jaume I and INTECO)*
MUÑOZ Alejandro *(University of València)*
TAMARIT Cecilio *(University of València and INTECO)*

Website:
https://infer-research.eu/

Contact:
publications@infer.info

Unveiling the drivers of portfolio equity and bond investment in the European Union: The interplay of tax havens and gravity factors*

Mariam Camarero †, Alejandro Muñoz ‡and Cecilio Tamarit [a§]

Abstract

This paper examines the determinants of portfolio equity and bond investment in the European Union. We estimate the impact of different drivers typical of the gravity model developed by Okawa and van Wincoop (2012). A notable aspect of our study is that it accounts for the effects of tax havens through the recent database of Coppola et al. (2021). Another distinctive trait of our paper is that we model bilateral and multilateral resistance measured as financial restrictions between the country pair (bilateral) and relative to the rest of the world (multilateral). Our findings suggest that gravity variables (distance, economic size, and resistance), as well as historical links and global risk, explain portfolio holdings allocation. Our extended gravity model also captures the positive effect of government quality and financial development on portfolio equity and bonds. Given the differences in nature and risk between assets, we also compare the results for portfolio equity and bonds; we find that while portfolio equity is more mobile, portfolio debt tends to be invested in neighboring countries; more specifically, EU debt tends to remain in the EU. Our results also suggest that portfolio equity is more affected by global risk and multilateral financial restrictions. Finally, our comparative analysis using the IMF CPIS database (constructed under the residence principle) shows that not accounting for tax havens underestimates the gravity and fundamental factors explaining portfolio equity and bonds holdings investment.

Keywords: Gravity, cross-border asset holdings; global frictions; international finance.

JEL classification: F36; F41; G11; G15.

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†University Jaume I and INTECO, Department of Economics, Campus de Riu Sec, E-12080 Castellón (Spain). ORCID: 0000-0003-4525-5181

‡University of València, Department of Applied Economics II, Av. dels Tarongers, s/n Eastern Department Building E-46022 Valencia, (Spain).

§[a]*Corresponding author:* University of València and INTECO, Department of Applied Economics II, Av. dels Tarongers, s/n Eastern Department Building E-46022 Valencia, (Spain). email: Cecilio.Tamarit@uv.es ORCID: 0000-0002-0538-9882

1 Motivation

Capital mobility is a key issue in international macroeconomics. Baele et al. (2004) outline three widely accepted interrelated benefits of financial integration: higher efficiency, more growth potential, and better risk-sharing opportunities.[1] To reap the benefits of these favorable effects, impediments to capital mobility began to be dismantled in the US and the UK in the 1970s, and other developed countries followed suit in the 1980s.

In the EU, this liberalization process also started in the 1980s and the beginning of the 1990s following the Single Market initiative, which implied full capital mobility by 1992 after the Maastricht Treaty (OECD, 2011). The process continued with the creation of the European passport for financial services and the Financial Services Action Plan starting in 1999, the Lamfalussy process from 2001, and the Larosière Report in 2009 (Larosiere, 2009), which enshrined the vision of a single rulebook and resulted in the creation of the European supervisory authorities.

The creation of the EU has significantly impacted the cross-border allocation of capital in bonds and equity portfolios within its member countries. The EU integration process created a single market for financial services, facilitating cross-border investment and increasing market efficiency. One of the key developments in the EU integration process has been the creation of the Eurozone. The adoption of the euro has accelerated financial integration between member states, eliminated currency exchange risks, and reduced transaction costs for cross-border investments. Harmonizing financial regulations is another important factor contributing to integrating capital markets within the EU is harmonizing financial regulations. The EU has implemented a range of directives and regulations to create a level playing field for financial markets, including the Markets in Financial Instruments Directive (MiFID) and the Capital Requirements Directive (CRD). These directives have helped to harmonize financial regulations and reduce regulatory barriers to cross-border investment.

The growth of cross-border financial institutions, such as investment banks and asset managers, has also facilitated the integration of capital markets within the EU. These institutions have expanded their operations across multiple member states, creating a pan-European financial services network that has made it easier for investors to access and invest in different markets.

As a result of these developments, the cross-border allocation of capital in bonds and equity portfolios within the EU has increased significantly. According to data from the European Central Bank (ECB, 2022), the share of cross-border holdings in euro-denominated bonds and equities has risen steadily since introducing the euro in 1999. For example, in 2020, cross-border holdings accounted for approximately 54% of the outstanding euro-denominated bonds and 22% of the euro-

[1] Banking Union and capital markets integration have complementary stability implications for the risk absorption capacity of the euro area. While banking integration strengthens the intertemporal risk-sharing channel, which is very effective against temporary shocks, capital market integration facilitates the absorption of structural shocks that affect permanent income via risk dispersion and diversification from the cross-border holding of assets (Kalemli-Ozcan et al., 2003).

denominated equities.

However, since the Great Recession of 2007-2008, financial markets have experienced a series of severe drawbacks regarding the ongoing process of globalization. In the case of the euro area, the risk is derived from market fragmentation, excessive sovereign debt, and uncertainty caused by the fears of an eventual break-up of the European Monetary Union (EMU). The ECB has been carrying out measures[2] to fight market fragmentation since the beginning of the financial crisis and the subsequent sovereign crisis (2010-2012) and COVID-19 pandemics (2020-2022). Despite its efforts, the issue is far from being over. Nowadays, high inflation is a novel feature in the economic situation that makes the fight against financial fragmentation more arduous. In this sense, market fragmentation entails risk premia for sovereign bonds, interbank market disconnect, lower cross-border capital flows, and asymmetric monetary policy transmission.

Another salient feature of the financial integration process is the increasing importance of tax havens. There is a growing and relatively recent literature studying the pivotal role of tax havens in analyzing capital mobility in its different forms. Examples are, among others, Hines and Rice (1994); Desai et al. (2006); Gravelle (2009); Hines (2010). A more recent prominent example is Santacreu (2023), which investigates the determinants of international technology licensing in a dynamic structural gravity equation and accounts for the increasing importance of tax havens. Global companies have been increasingly issuing securities through cross-border affiliates in tax havens to avoid capital controls, reduce tax loads, or improve their access to global capital markets with better financial conditions or longer maturities. Indeed, given their growing relevance, an analysis of capital mobility drivers cannot be performed without adequately treating these tax havens.

According to the 6th Edition of Balance of Payments and International Investment Position Manual (IMF, 2009), the functional categories used for financial transactions and position are: a) Direct investment (FDI), b) portfolio investment (both equity and bonds), c) financial derivatives[3] and employee stock options, d) other investment and e) reserve assets. In this paper, we focus our analysis on portfolio equity and bond stocks. In contrast to other types of investment (such as FDI[4]), portfolio investment usually has less decision power in the company's operational management. However, it provides easy access to the financial markets, liquidity, and flexibility.

This paper assesses the drivers of portfolio equity and bonds stocks in the EU's aftermath of the Great Recession and the European debt crisis, covering the sample period 2007-2017. To the best of our knowledge, no studies jointly address drivers of portfolio investments using the gravity equation, in which resistance variables are modeled through financial restrictions and the existence of tax havens is taken into account. This is especially true in the case of the EU.

[2]For example, the Securities Market Programme (SMP) between 2010 and 2012, the Outright Monetary Transactions (OMT) from 2012 onward, and the Public Sector Purchase Programme (PSPP) since 2015. With the outbreak of the COVID-19 crisis, the ECB launched the Pandemic Emergency Purchase Programme (PEPP). See Baglioni (2024), Ch.4, for an overview

[3]Other than reserves.

[4]Equity can be classified as FDI or portfolio. Ownership of 10 percent of the voting power of an enterprise by a non-resident investor is taken as evidence of a direct investment relationship.

We contribute to the literature in different respects. First, unlike most previous studies, we use a recent database put together by Coppola et al. (2021) that accounts for the role of financial intermediaries that issue assets through tax havens. Consequently, the database re-maps portfolio stock to the actual source and destination countries. This is a crucial improvement compared to traditional databases for portfolios (for example, the IMF CPIS database) built under the residence principle. Properly addressing the role of tax havens is particularly relevant for some types of assets with a significant presence, such as portfolio equity.

Second, another singular characteristic of this paper is that we estimate the gravity equation following a theoretical model specifically developed by Okawa and van Wincoop (2012) for financial markets. In doing so, we model bilateral and multilateral resistance with financial restrictions between the country pair and relative to the rest of the world. By doing so, we provide a more comprehensive analysis of the determinants of cross-border asset trade holdings. This might help researchers and policymakers better understand the complex dynamics underlying these assets. We also perform a robustness check to ensure our results remain robust to model specifications. We use different variables to model first, bilateral and multilateral resistance and second, historical links.

Finally, as a comparison exercise, we perform the analysis using the IMF (CPIS) database built under the residence principle and compare the results with the ones obtained with the Coppola et al. (2021) database.

The remainder of the paper is organized as follows: in section 2, we present the stylized facts and the role of tax havens that justify our paper; in section 3, we review the empirical literature on the subject. Section 4 summarizes the data and econometric methodology used. Section 5 discusses the empirical results. Finally, section 6 concludes.

2 The relevance of tax havens for portfolio investments: some stylized facts

The large and growing capital flows of securities have long been an essential subject for research in international finance. Yet, the literature accounting for the importance of tax havens' among the motives and incentives behind these flows is relatively scarce. This is due to a lack of reliable data quantifying the inflows and outflows across years and countries and information on investors, issuers, and asset types. This situation has recently changed. Fresh papers like Damgaard et al. (2019) for the case of FDI and Coppola et al. (2021) and Beck et al. (2024) for portfolio investment provide data to document the increasing role of tax havens. These offshore centers with enormous inward and outward positions blur statistics on international investments. To solve this problem, these new databases account for offshore investment and financing vehicles in tax havens remapping from a residence to a nationality basis.

A tax haven is a jurisdiction that offers individuals, businesses, or financial intermediaries more favorable regulations and low or no tax liability. Economic, political, and legal factors largely

drive the existence of tax havens. From an economic perspective, tax havens serve as attractive destinations for individuals and businesses seeking to reduce their tax burden.

During the 1960s and 1970s, the persistence of outdated and distorting regulations in the financial sectors of industrial countries played a significant role in the emergence of offshore banking and the proliferation of Offshore Financial Centers (OFCs), more commonly known as *tax havens*. In this text, we are going to use indistinctly both terms.

In the early 1970s, Luxembourg in Europe started attracting investors from Germany, France, and Belgium. This was primarily due to its low-income tax rates, absence of withholding taxes for non-residents on interest and dividend income, and strict banking secrecy rules. Similarly, the Channel Islands and the Isle of Man presented similar investor opportunities. Moving to the Middle East, Bahrain emerged as a significant hub for collecting the region's oil surpluses during the mid-1970s. It achieved this by enacting banking laws and offering tax incentives to facilitate the establishment of offshore banks. In the Western Hemisphere, the Bahamas and the Cayman Islands provided comparable facilities to attract investors.

Towards the end of the 1990s, the appeal of offshore banking began to shift for financial institutions in industrial countries. Factors such as reserve requirements, interest rate controls, and capital controls diminished significantly, while the tax advantages continued to exert a strong influence. Moreover, major industrial countries like the United States and Japan started offering similar incentives within their jurisdictions. Consequently, the relative appeal of OFCs for traditional banking has diminished for industrial countries, although the tax advantages associated with asset management have gained significance. Presently, banking operations within OFCs are primarily conducted by branches and subsidiaries of banks incorporated elsewhere, primarily in major countries and larger emerging market economies.

In the corporate context, financial services offered by OFCs can generate a large amount of inward and outward capital flows. Hence, these jurisdictions have also been recently referred to as investment hubs, distorting the statistics as significant drivers of cross-border investments. Indeed, we can find a systematic overestimation of foreign financial operations in specific jurisdictions classified as OFCs. Intermediaries located in tax havens make it more challenging to determine the origin of portfolio investments. Indeed, assigning the origin of investments can be challenging when financial intermediaries in tax havens are involved. This is because tax havens are often used as investment conduits, making it difficult to determine the trustworthy source of the funds. By their very nature, tax havens are designed to offer secrecy and confidentiality to individuals and businesses. Therefore, the investment's origin, ownership, and control may be hidden behind a web of shell companies and other legal entities. An investment may be routed through an intermediate country for various reasons, such as to take advantage of favorable tax treaties or lower tax rates. However, this routing can also make it difficult to determine the true source of the funds, as the investment may have been sourced from another country entirely.

Ultimately, the difficulties in assigning the origin of investments due to financial intermediaries located in tax havens result from the complex and often opaque nature of the global financial system. Despite the efforts of tax authorities and international organizations to improve transparency and tackle tax avoidance, these difficulties will persist and continue to pose challenges for tax authorities worldwide. While cross-border and offshore banking has been at the core of the Basel Committee's work since the mid-1970s, OFCs have more recently become a significant target of the Financial Action Task Force (FATF)[5] and OECD because some are increasingly viewed as offering money laundering and tax evasion opportunities and raising obstacles to anti-corruption investigations.

In the following paragraphs, we aim to give an overview of the stylized facts and the role played by tax havens in both the global portfolio markets and the European Union (EU). This analysis will provide valuable insights into the significance of tax havens in shaping the international financial landscape.

In Figure 1, using data from the IMF (CPIS) database under the residence principle, we present the share of tax havens in total portfolio equity and bonds between 2001 and 2020[6]. Figure 1 reveals several notable trends: first, the proportion of tax havens in portfolio equity has steadily risen, reaching 35%. Second, this ascent accelerated following the onset of the global financial crisis in 2007-2008. Third, while the weight of tax havens in portfolio bonds initially increased until the financial crisis, it subsequently declined, attributed to the debt-focused nature of the crisis. Last, comparing tax havens' weight in portfolio bonds and equity reveals greater significance in the equity domain. This disparity arises as portfolio bonds encompass corporate and sovereign bonds, which cannot be issued through intermediaries in tax havens[7].

Turning our attention to the European Union, Figure 2 illustrates the proportion held by EU tax havens (Cyprus, Ireland, Luxembourg, Malta, and the Netherlands)[8]. Notably, there is a consistent upward trajectory in the share of tax haven countries concerning portfolio equity, accounting for 65% of the total weight. In contrast, the presence of EU tax havens remains relatively stable in portfolio bonds, fluctuating between 18% and 22%. These findings underscore the enduring significance of tax havens within the European Union.

Subsequently, we separately focus on the EU investment patterns concerning portfolio equity and bonds. Due to data availability constraints, our analysis is segmented between an aggregate of the Euro Area (EA) and individual non-Euro Area countries[9]. The first column of Table 1 shows the

[5]FATF members include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, China, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States, the European Commission, and the Gulf Cooperation Council. Observer members are Argentina, Brazil, and Mexico. The FATF Secretariat is based at the OECD.

[6]The tax havens classified as such are listed in Table A3.

[7]For instance, Germany's government cannot issue sovereign bonds through a Cayman Islands-based affiliate.

[8]While not officially designated as tax havens, these countries function as intermediaries between investment sources and final destinations, thus qualifying as tax havens for this paper.

[9]We refer to the seven non-EA members of the EU: Bulgaria, the Czech Republic, Denmark, Hungary, Poland, Romania, and Sweden, alongside the UK. These countries maintain their national currencies, though all, except Denmark (and the UK before Brexit), are obligated to adopt the euro once they fulfill the euro convergence criteria

percentage of portfolio equity investment by each EU country (or the EA aggregate) within the EU. Notably, EU countries predominantly invest in other EU nations, except the United Kingdom, accounting for only 26% of investments. Correspondingly, the second column of the Table delineates the percentage of EU equity investment located within the EA, which typically ranges between 80-90%, except for Denmark and Sweden, where the rate is marginally lower.

When we split the EU portfolio equity investment position by issuer country (Figure 3) in the pie chart on the left, the first salient feature is that the US is the leading destination country (22% of total equity investment), followed by 4 EU countries (Germany, France, United Kingdom, and Ireland). In fact, 78% of total investment is concentrated in eleven countries. For comparability, we report the same information in the right-hand side chart using the IMF CPIS database under the residence principle (Figure 3). This shows that the pattern is very similar to that of non-EU countries (US, Japan, Switzerland). However, at first sight, a striking feature is that Luxembourg, under the residence principle, gathers 20% of the total EU equity investment position but does not have any relevant role under the nationality principle. This highlights the relevance of properly re-mapping assets issued by tax havens according to the actual destination country. Second, other tax havens are now included among the most relevant destinations (Cayman Islands). Third, Germany and France have a lower weight in the sample, given that many of their investments are channeled through Luxembourg.

Concerning portfolio bond investment, its distribution by countries following the nationality principle is illustrated in the pie chart on the left (Figure 4). Like equity investments, EU countries predominantly allocate their portfolio bonds within the EU, particularly within the Euro Area (EA). Notably, the United States holds a percentage comparable to Germany's regarding investment volume, with Germany being the primary EU destination. Note that 59% of EU portfolio bonds are concentrated in just six countries. For enhanced comparability, in the pie chart on the right of Figure 4, we include EU portfolio bond investment by issuer country using the IMF CPIS database under the residence principle. Here, a significant increase in the prominence of the United States and tax havens such as the Netherlands, Ireland, and Luxembourg, along with other offshore centers categorized within the "rest of the world" group, is evident. Consequently, some portfolio bonds issued in EU tax havens are ultimately located in Germany, France, Italy, and Spain.

Given the above facts, it becomes apparent that cross-border EU investment has a strong bias[10]. The United Kingdom has been an outlier, as its investment outside the EU is larger than within the area (especially for portfolio equity investment). For the specific case of portfolio bonds, there is a downward trend in the percentage of investment in other EU countries, which implies that the EU bias has decreased.

Summing up, tax havens have become critical players in the global financial system for facilitating cross-border capital flows. Since the outbreak of the financial crisis in 2007-2008, the role of tax

[10]This fact has already been highlighted in the literature; see section 3.

havens has become even more vital. Being mere conduits between the source country and the final destination, it is crucial to consider the role of tax havens better to understand a country's actual international financial position. Small financial centers like Luxembourg, Switzerland, and the Cayman Islands often serve as intermediaries for cross-border investment flows. These centers provide various services, including fund administration, custody, and asset management. They usually have favorable tax and regulatory environments that make them attractive to investors and financial intermediaries [11]. They provide access to a broader range of investment opportunities and can help investors manage their portfolios more effectively. They also help to reduce transaction costs and improve market efficiency by providing liquidity and price discovery. However, financial intermediaries in tax havens can face challenges when gathering accurate and reliable statistics. This is because they often operate across multiple jurisdictions and may not have access to the same data sources or reporting standards. In addition, some financial intermediaries may be less transparent than others, making it difficult to assess the quality of their data or the risks associated with their investments. Another issue with financial intermediaries in tax havens is that they may be subject to less stringent regulatory oversight, which can create opportunities for regulatory arbitrage and make it more challenging to track cross-border investment flows.

Recent studies have delved into analyzing the limited information reliability of the statistics on capital allocation when tax havens are not accounted for. Avdjiev et al. (2016) highlighted the increasing discrepancies between databases assembled under the residence principle. Bertaut et al. (2019) compare the U.S. TIC data[12] under both residence and nationality, arguing that the residence principle is increasingly uninformative given the complexity of the multinational firms' financial operations[13]. Although the role of tax havens has received recent attention, there is still relatively scarce empirical literature on the subject. Lane and Milesi-Ferretti (2011) assessed the role of small financial centers in the international financial system and highlighted their relevance. Dharmapala (2008) and Dharmapala and Hines (2009) analyzed the role of tax havens in the global financial markets and why countries become tax havens. Rose and Spiegel (2007) focused on the causes and consequences of OFCs and concluded that proximity to those OFCs leads to a more competitive domestic banking system and greater overall financial depth.

More specifically, Lane and Milesi-Ferretti (2018) highlights the increasing relevance of financial intermediaries in tax havens in the global capital markets. This role is also evident in other areas like Asia-Pacific (Black and Munro, 2010) or North America (Tørsløv et al., 2022). Tax havens also play a significant role in cross-border European Union (EU) allocation. While the EU has a highly integrated financial market, small financial centers like Luxembourg, Ireland, and Malta have emerged as essential intermediaries in cross-border investment flows, particularly in fund

[11] Financial intermediaries located in tax havens play a crucial role in the cross-border allocation of assets because they have the expertise and resources to navigate complex markets, manage risk, and facilitate transactions

[12] The Treasury International Capital (TIC) reporting system is the U.S. government's source of data on capital flows into and out of the United States, excluding direct investment, and the resulting levels of cross-border claims and liabilities.

[13] Damgaard et al. (2019) used new data to estimate global FDI and allocate real investment to ultimate investor economies. The authors found that phantom investments without economic substance account for 40 percent of global FDI, and reallocating those investments increases explanatory power.

management and securitization. Milesi-Ferretti et al. (2010) signal a significant gap in identifying holders of euro area portfolio given the role of financial centers in small euro area countries (Ireland and Luxembourg).

In conclusion, empirical studies suggest that tax havens play an important role in cross-border capital allocation in the EU, particularly in fund management, securitization, and real estate finance. These intermediaries have become crucial for cross-border investment flows, and their impact on the distribution of capital flows is influenced by a range of factors, including regulatory frameworks, tax regimes, and the availability of skilled labor. However, the challenge of gathering accurate and reliable data on cross-border investment flows remains a crucial issue in this area of research, and their inclusion in asset allocation modeling depicts new avenues for empirical research.

3 Literature review and theoretical foundation

The study of portfolio investment drivers has witnessed a significant evolution over the years as researchers seek to unravel the complexities underlying investors' decision-making processes in the global financial landscape. This section aims to critically examine the existing literature on empirical models for portfolio investment drivers, focusing on the transition from earlier push-pull models to the contemporary prominence of the gravity model.

Historically, the early literature on portfolio investment was often characterized by push-pull frameworks that attempted to explain capital flows based on a limited set of factors. While informative, these models were inherently reductionist and failed to capture the multifaceted nature of investment decision dynamics. The push-pull paradigm essentially conceptualized capital flows as a consequence of a few primary factors, such as interest rate differentials, economic growth differentials, and political stability. While these variables undoubtedly play crucial roles, early models showed limited predictive power and explanatory scope (Koepke, 2019).

Over time, the need for more comprehensive frameworks has become more evident. The gravity model has emerged as an alternative approach in portfolio investment research, offering a more sophisticated and empirically robust framework for analyzing the drivers of cross-border capital flows. Its appeal lies in its ability to capture the gravitational forces that govern investor behavior, acknowledging that larger, proximate economies exert a stronger pull on capital. This gravitational perspective enhances the model's explanatory power and provides a more realistic representation of the interconnected global financial system (Portes and Rey, 2005; Coeurdacier and Martin, 2009). This section explores the key contributions and limitations of the early push-pull models and the contemporary gravity model, which we implement in our empirical exercise.

3.1 Push-pull models

The push-pull framework originates in the empirical literature that studied international capital flows since the early nineties and looked for the drivers or factors that attract foreign capital to one particular country, even if no specific motivation comes from economic theory. As Koepke (2019) mentions, the role of external versus domestic drivers is compatible with modern portfolio theory, where we can find the theoretical foundation for portfolio diversification, as rational investors care about two main factors: expected returns and risk.

From an empirical point of view, the waves of capital flows that happened in the 1980s and 1990s generated this academic interest, according to Forbes and Warnock (2012). The seminal papers, like Calvo et al. (1993, 1996) and Fernandez-Arias (1996), focused on developing countries and, specifically, Latin America, that received during these decades substantial capital inflows with origin in more mature economies. The question was whether these flows were "pushed" by the adverse conditions in the developed countries or "pulled" by attraction factors of the host countries[14]. These seminal papers mostly found evidence favoring the external side (push factors). Since then, many researchers have studied asset trade flows by distinguishing between "push" and "pull" factors that influence them. Caballero et al. (2008) and Mendoza et al. (2009) propose models that differ in the approach to risk, and both emphasize pull or internal factors.

Concerning the variables included in each category, the push factors more frequently considered in the literature are global risk aversion, the interest rates of country j (often called the "mature" economy), and output growth in country j. As for the pull factors, domestic output growth (in country i), asset returns and country risk indicators are the prominent ones. Many empirical papers have analyzed capital flows from this perspective and studied the role of the different drivers. Koepke (2019) surveys the literature that has focused on emerging countries. He concludes that push factors, such as global risk aversion and external interest rates, are the main drivers of portfolio equity and bond flows, not banking. Pull factors, such as domestic output growth, asset returns, and country risk, matter for all flows but most for banking.

The empirical literature based on this approach still flourishes, and after the global financial crisis, the interest was extended to other countries, including the US. In this vein, also going beyond emerging countries, Sarno et al. (2016) assess the contribution of push and pull factors to the variation of bond and equity flows from the US to 55 other countries. They concluded that push factors account for 80% of the total variation. Koepke and Paetzold (2020) provide an analytical overview of the primary data sources used in the literature and extend the 34 papers studied by Koepke (2019) to 88 papers by flow component and frequency, also focusing on pull vs. push factors. The authors summarize the main results in the literature by type of flow and sample frequency. For the portfolio case, the results suggest that push factors are the main drivers of capital mobility,

[14]For example, a country with a well-developed financial sector and high-interest rates may attract cross-border investment due to its level of financial development, which is a pull factor. At the same time, investors in another country may be seeking to diversify their portfolios, which is a push factor that could drive them to invest in assets from the first country.

followed by a combination of both push and pull factors. Finally, Lopez and Stracca (2021) finds that global factors have played a significant role in driving capital inflows after Covid 19. Shifts in risk appetite have also had a significant effect, and the distinctions between advanced economies and some emerging economies are blurring.

3.2 A gravity approach to cross-border asset mobility

Economics commonly uses gravity models to model trade flows between countries or regions. These models are based on the principle that trade volume between two locations is directly proportional to the product of their economic sizes and inversely proportional to the distance between them. The literature on gravity equations applied to asset trade flows existed before its theoretical foundations were confirmed as a generalization of the trade literature equivalent. Early applications successfully explained cross-border trade in various financial assets, including stocks, bonds, and other financial assets. Overall, the literature on gravity models of asset trade flows provides a valuable framework for understanding the patterns and determinants of cross-border financial transactions.

Over the past few decades, the gravity model's application has expanded to elucidate the international co-movements of portfolio investment, as demonstrated by scholars such as Portes and Rey (1998). The initial financial gravity model was formulated by Martin and Rey (2004) and later adapted by Coeurdacier and Martin (2009) for trade in Arrow-Debreu securities with transaction costs[15]. However, two papers by Rey can be considered the link between the push-pull literature and the gravity equation applied to capital inflows. First, Hau and Rey (2006) develop a structural model of capital allocation to address the push-pull issue. They found that geographic and cultural proximity to potential trading partners was essential in explaining portfolio diversification. Second, Portes and Rey (2005) apply the gravity equation to asset transactions using panel data on bilateral gross cross-border equity flows for 14 countries between 1989 and 1996. Their results stress the relevance of market size and trading cost (regarding information and transaction technology) and show weak support for diversification.

In the same vein, Lane and Milesi-Ferretti (2008) use a gravity model to examine the determinants of international equity holdings and derive the gravity equation in a multi-country extension of the Obstfeld and Rogoff (2000) model relating bilateral international portfolio with goods and services trade. They found that the size of the source country's equity market, the host country's economy, and the degree of financial development in both countries were significant factors in explaining equity flows. Aviat and Coeurdacier (2007) combine the gravity approach applied to international trade in goods with international asset portfolios and find that they are both reinforcing. They use a gravity model and conclude that only trade in goods has an actual gravity structure, and the effect of distance on asset holdings comes through trade.

[15] An Arrow-Debreu security is a contract that agrees to pay one unit of a numeraire (a currency or a commodity) if a particular state occurs at a specific time in the future and pays zero numeraire in all the other states.

However, this initial group of papers was a natural extension of the gravity approach used in trade to explain the cross-border allocation of investments without formalizing the gravity model for financial assets. Okawa and van Wincoop (2012) have established additional theoretical foundations for the financial gravity model. They were the first to provide such a theoretical foundation and argue that, under certain conditions, it is possible to derive a gravity equation for asset trade. They avoid inconsistencies with the theory of some applied work (such as the incorrect introduction of source and destination fixed effects or the inclusion of variables with no theoretical justification). What they obtain is closely related to the gravity equation for trade: bilateral financial positions depend on relative barriers, that is, multilateral resistance, faced by the source and destination countries. Two conditions are necessary: first, the equivalent to trade separability, that is, that the decisions about overall demand for assets are separable from the portfolio allocation across assets, and second, that asset demand depends on relative prices.

They derive the model from a static portfolio choice framework with $N + 2$ assets. Investors can invest in N country-specific risky assets, and the gravity equation applies to them. These assets can be equity, bonds, or bank holdings, but they use "equity" to refer to any of them. K_i is the supply of the asset in country i, which can be considered the country's capital stock. Asset returns are affected not only by country-specific factors but also by global innovations (shocks). In addition to the N country-specific risky assets, there is also a risk-free asset (with return R_f) and another asset whose return is R_g and perfectly correlates with the global shock. The global asset is crucial to derive the gravity equation, as it allows the agents to hedge the global risk factor so that the only risks that matter are the country-specific.

The agents choose consumption and portfolio allocation among the $N + 2$ assets. Thus, in country j, α_{ij} is the fraction invested in country i equity, whereas α_{gj} and α_{fj} are the fractions invested in the global and the risk-free asset, respectively. Okawa and van Wincoop (2012) introduce international financial frictions derived from information asymmetries about the country-specific return components. Differences in language and regulation and better access to information make domestic agents more informed than foreigners. From the perspective of agents in country j, innovations of asset i or ϵ_i have zero mean and variance $\tau_{ij}\sigma_i^2$ for $i \neq j$. This is a crucial point, as the main difference between the gravity equation in goods and asset trade is that the latter involves risk. Equity portfolio shares or α_{ij} will depend on the ratio of the expected excess return and the variance of excess return[16] Global components are removed, as the global risk can be separately hedged.

Okawa and van Wincoop (2012) defines a variable p_i as proportional to the risk-return ratio. The higher p_i, the lower the demand for the asset. This variable is endogenous, as it depends on the expected excess return, then in equilibrium, adjusts to clear equity markets. In equilibrium $\alpha_{ij} = 1/\tau_{ij}p_i$, being τ_{ij} the bilateral frictions. Thus, they interpret $\tau_{ij}p_i$ as the "price" faced by agents of country j investing in country i. In aggregated terms, total equity claim X_{ij} by country j on country i can be written as:

[16]See Okawa and van Wincoop (2012) for further details and the algebraic solution.

$$X_{ij} = \frac{P_j}{\tau_{ij} p_i} E_j \tag{1}$$

where P_j are aggregate prices and E_j are total equity holdings from country j. Moreover, $E_j = \sum_{i=1}^{N} \alpha_{ij} W_j$, where W_j is total wealth in country j. Equation (1) is important in this context, as bilateral asset demand depends on a relative price: the risk-return ratio of country i equity relative to an overall price index.

Then, they obtain the gravity equation by combining the demand equation above with the market clearing equations. The asset market clearing condition is $\sum_{j=1}^{N} X_{ij} = S_i$, where S_i is country i equity supply. As $S = E = \sum_{j=1}^{N} E_j = \sum_{i=1}^{N} S_i$, the solution for p_i is $p_i = \frac{S}{S_i} \frac{1}{\Pi_i}$, where $\frac{1}{\Pi_i} = \sum_{j=1}^{N} \frac{P_j}{\tau_{ij}} \frac{E_j}{E}$. Having all this in mind, the gravity specification they obtain is the following:

$$X_{ij} = \frac{S_i E_j}{E} \frac{\Pi_i P_j}{\tau_{ij}} \tag{2}$$

By analogy to gravity in trade, bilateral financial positions are governed by two forces: the combined financial mass of country pairs, and relative frictions that limit the volume of transactions. Some coefficients have a different interpretation in the context of finance. Then, in the gravity equation, bilateral financial holdings depend on the product of the variables that measure economic size divided by relative financial frictions. This specification is the asset equivalent to the demand-side gravity as proposed by Anderson and Van Wincoop (2004) and revised recently by Yotov (2022).

They propose to use stock market capitalization in the destination country and total investment stock in the source country as size variables[17]. In the absence of transport costs, the term τ_{ij} relates to transaction and information costs[18]. Relative friction is the bilateral financial friction divided by the product of the two (source and destination) multilateral resistance terms. As in the case of trade flows, bilateral asset holdings are affected not merely by the bilateral friction τ_{ij}, but also by the relative friction $\frac{\tau_{ij}}{\Pi_i P_j}$. Okawa and van Wincoop (2012) call Π_i and P_j multilateral resistance variables, as they measure average financial frictions. This can be interpreted as follows: given the size factor $S_i E_j / E$, relative financial friction (information asymmetries) drives bilateral asset holdings. For example, an increase in the financial friction of 1% raises the country-specific variance by the same amount, and the portfolio share invested in this country is also reduced by 1% (assuming unitary elasticity). Thus, a source country j will allocate more of its equity to countries where the bilateral resistance τ_{ij} is low compared to the average P_j relative to all destination countries. In addition, the relative financial friction is also affected by the multilateral resistance of the destination country Π_i. If this term is high, country i faces financial frictions with many source countries. To return to equilibrium in financial equity E_i, it will offer a low price or a higher expected return. In this case, any friction τ_{ij} will raise X_{ij}.

[17] Generally, in the financial gravity equation, GDP is either replaced or supplemented by market capitalization as a regressor. Market capitalization may possess superior explanatory capability in forecasting financial cross-border flows.

[18] As in Portes and Rey (2005) for equity holdings, and in Buch (2005) for cross-border banking.

The primary inference drawn by Okawa and van Wincoop (2012) is that not all empirical studies that apply the gravity model to international asset flows align seamlessly with the associated theoretical framework. Investors do not make efficient use of the opportunities for geographical diversification available to them, given their access to diverse capital markets worldwide; instead, they are invested to an exaggerated extent in their respective home markets. The factors that explain this *home bias* are only partly related to investor behavior and partly institutional. Therefore, a robust specification of the explanatory factors focusing on investor preferences encompasses size, frictions, and asymmetries as fundamental components. Additionally, multilateral resistance terms, akin to their role in the goods trade equivalent, are deemed crucial. Moreover, other additional factors that may contribute to improving the explanatory power of the empirical specification include *institutional and regulatory factors* and *political factors*.

More recently, Pellegrino et al. (2022) introduced a novel theoretical framework, drawing inspiration from Eaton and Kortum (2002). Their model encompasses numerous bilateral frictions that significantly influence investor utility. Within this economic framework, some investors prefer specific foreign investment opportunities, a tendency influenced by bilateral factors such as shared language, cultural proximity, and bilateral investment taxes. Pellegrino et al. (2022) model a vector comprising measures of bilateral distances, where τ_{ij} represents the tax incurred by investors in country j who invest in country i. Again, this model resorts to a gravity empirical formulation explaining international asset investment allocation.

In the empirical literature, the most popular formula combines a gravity approach with the traditional analysis of pull-push factors. In Brei and von Peter (2018) the role of distance remains substantial for banking, where transport costs (information frictions) play a role as a common driver. Galstyan and Lane (2013) show that the size of the initial bilateral holding, gravity variables, and institutional linkages help to explain adjustment essentials. This last element's importance has recently been underscored by Binder et al. (2024). Similarly, Cavallaro and Cutrini (2019) developed a model with a quality-based differentiation of assets. Other additional factors can also be relevant drivers for capital allocation. First, Forbes and Warnock (2012)'s results point out that global factors (especially global risk) are associated with extreme capital flows (stop and retrenchment) and contagion episodes, but pull factors and capital controls are less important though[19]. Second, Chitu et al. (2014) using data on US investors' holdings of foreign bonds documented a *history effect* in which the historical pattern of holdings continues to influence holding today. Third, more recently, Galstyan et al. (2016) has shown how the results obtained can be sector-dependent, suggesting that a more granular-level analysis may be more informative.

As for the EU, some distinctive characteristics can be drawn about drivers and obstacles to an efficient capital allocation in the area. Lane (2006) examines bilateral international bond portfolio for

[19]The literature on capital controls and cross-border portfolio allocation in bonds and debt is relatively sparse. However, several studies have examined this issue in recent years. Some studies, like Binici et al. (2010) or Nispi Landi and Schiavone (2021), find a strong effect, while others find that capital controls are effective in the short run but have no lasting effects (Boero et al., 2019) or depending on the type of countries (Bricongne et al., 2021).

the euro area. His empirical results support the euro-area bias and currency unions' impact on financial integration. Lane and Milesi-Ferretti (2008), using data on international equity holding for 2001, found that bilateral equity holding is linked to bilateral trade in goods and services and informational proximity. They also found a euro-area bias according to underlying fundamentals. Schmidt and Zwick (2015) analyze the link between different measures of uncertainty and extreme capital flows for 12 euro area countries. They find that country-specific risk factors are essential in periods of extreme capital flows. Coeurdacier and Martin (2009) and De Santis and Gérard (2009) analyzed the determinants of cross-border asset trade, focusing on the impact of the euro and finding evidence of a home bias. They show that the European Monetary Union eased equity and bond market access. Heckemeyer (2022) argues that different national tax systems bring barriers to cross-border business in the European Single Market. Finally, a series of studies have investigated how boom-bust cycles have affected the behavior of gross and net capital flows (Lane, 2013; De Santis and Gérard, 2009; Afonso et al., 2022) and how capital market integration has affected business cycle synchronization for the European Union (Beck, 2021).

In summary, the literature on gravity models and asset trade flows has identified several essential determinants of cross-border asset trade. While there is some variation across studies, overall, the evidence suggests that economic size, distance, interest rates, exchange rates, and financial development all play a significant role in explaining the patterns and determinants of cross-border asset trade flows. Language barriers, regulatory variations, and institutional differences also exacerbate information asymmetry.

In the next Section, we present our empirical model. The empirical specification is grounded in theoretical models that produce gravity equations, emphasizing information asymmetries and disparities in institutional quality. These econometric specifications are sufficiently flexible to incorporate transaction costs, which we interpret in the context of the level of development in capital markets and friction in information. Subsequently, we utilize this model to formulate a testable equation for bilateral trade in equity and bonds, aligning with the relevant literature mentioned earlier.

4 Data and econometric methodology

One common issue in the literature on tax havens is the challenge of gathering accurate and reliable data on cross-border investment flows. As noted earlier, financial intermediaries in tax havens may be subject to less stringent reporting standards, making it more challenging to track cross-border investment flows. However, recent efforts by the EU (in particular, the European Central Bank) to improve data collection and reporting standards have helped to address this issue (Beck et al., 2024).

In portfolio databases, two common principles for identifying an investor's origin are the residence and nationality principles. The residence principle is based on an investor's physical location. Under this principle, an investor's origin is determined by the country in which they reside. This

principle is relatively simple to apply; however, it does not consider the investor's nationality, which may be essential for tax purposes or other legal reasons.

Under the residence principle, commonly used databases are the IMF Coordinated Portfolio Investment Survey (CPIS) for portfolio investment and Finflows, which also covers other types of flows/stocks (FDI and other investments, including banking transactions), following the methodology proposed by Hobza and Zeugner (2014). Both databases report the bilateral position between the investor and the security issuer. Lane and Milesi-Ferretti (2018) elaborated a database for external assets and liabilities, including portfolio equity and debt; however, this database does not show the counterpart. To overcome the limitations of the residence principle, Coppola et al. (2021) have recently published a database under the nationality principle.

In this paper, we use the database developed by Coppola et al. (2021) of bilateral portfolio equity and bonds[20]. The authors re-map traded securities issued by firms in tax havens with their issuer's ultimate parent and then restate bilateral investment positions. Traditional databases are built under the residence principle; by contrast, Coppola et al. (2021) database re-maps bilateral portfolio investment under the nationality principle. Under the residence principle, security is associated with the immediate location of the issuer. Given the uptrend relevance of tax havens as crucial players in international capital markets, traditional databases based on the residence principle fail to identify the true origin when financial intermediaries in tax havens are involved.

In summary, the Coppola et al. (2021) database works as follows: A Swedish company issues security through its affiliate in Luxembourg (tax haven). A German agent acquires the security. Once capital is collected in Luxembourg, it is transferred to the Swedish company in Sweden by FDI. Under the residence principle, they will be recorded as two separate transactions: first, a security is issued by Luxembourg and acquired by a German agent, and second, FDI is transferred from Luxembourg to Sweden. Economic factors do not drive this transaction, and the economic analysis of global capital mobility may be distorted. In contrast, a nationality-based database re-maps the transaction and identifies a direct transaction between a Swedish company in Sweden and a German agent[21].

Table A1 shows the EU equity portfolio investment in equity securities issued by global tax havens.[22] As noted above, the position data using the residence principle comes from the FMI CPIS, whereas the one on nationality principle has been obtained from the database by Coppola et al. (2021). The nationality principle re-maps the transaction, removing the tax havens's role and identifying the investment's source and final destination. Coppola et al. (2021) database re-mapped between 27% and 35% of total stock portfolio equity issued through any tax haven. In table A2, we include the US investments in equity securities issued by EU tax havens. Remarkably, a relevant percentage

[20]The authors use three different methodologies: *fund holdings*, *issuance* and *enhanced fund holdings*. We use the *issuance* methodology because it covers all the countries of interest and their counterparts.

[21]For an in-depth understanding of the database, see Coppola et al. (2021).

[22]The list of tax havens is reported in table A3.

(peaking in 2015 at 52%) of US equity portfolio investments in the EU tax havens needs to be re-mapped. These facts highlight the relevance of properly considering the tax havens' role in analyzing global capital mobility.

The database by Coppola et al. (2021) on bilateral portfolio equity and bonds stock identifies the investor and the issuer countries for the period 2007 to 2017[23]. The EU 28 countries are a central pillar of our sample[24]. Therefore, we include all the bilateral portfolio stocks in which at least one EU country is involved, either on the investor or issuer side. Thus, our analysis covers all portfolio stocks where EU countries participate: first, EU investments in non-EU countries; second, non-EU investments in EU countries; and third, EU investments in other EU countries. Data availability has constrained the sample period. The European Monetary Union is considered a block in the Coppola et al. (2021) database when acting as an investor since mutual funds are concentrated in Luxembourg and Ireland but collect investments from the rest of the countries in the European Union. Individual countries are instead kept as separate entries when on the issuer side.

The variables described below and in Table 2 have been chosen to specify a gravity model for cross-country bilateral portfolio stocks following the theoretical model developed by Okawa and van Wincoop (2012). In particular, size, distance, country dummies, and multilateral resistance terms are all included in the specification. In this paper, we set a scenario in which several groups of variables explain bilateral international portfolio stock. First, the main **gravity variables**, that is, *distance* between issuer and investor countries, as well as their respective *GDPs* to account for economic size; second, **additional gravitational variables** commonly used in the literature are included in extended specifications, such as *common official language*, *colonial links* and *euro area membership*. Moreover, to be consistent with the gravity model by Okawa and van Wincoop (2012), we include **resistance** or barriers in the form *bilateral financial restrictions* faced by investor j when investing in issuer i and *multilateral resistance* defined as the relative position of bilateral barriers relative to average barriers with the rest of the world. In particular, bilateral resistance[25] is measured as financial restrictions in the investor and the issuer country, respectively.

In contrast, multilateral resistance is the average global financial restrictions once the countries i and j have been excluded. We also include a **global risk** or uncertainty variable for comparison. Finally, two additional variables capture, respectively, the **quality of the regulator** and **financial development** in the countries involved. The complete list of variables used in this paper and their sources can be seen in Table 2.

Our paper estimates the gravity model (2) using the PPML estimator. The following equation can

[23]See the complete sample list in tables A4 and A5.

[24]The UK is included in the sample since it was part of the EU during the period.

[25]Bilateral resistance/barriers faced by investor country j when investing in the issuer country i is given by the individual financial restrictions. However, financial restrictions in the investor country must allow capital to be invested abroad. Financial restrictions in the issuer country must enable foreign capital to be invested in national assets.

represent the empirical model:

$$X_{ijt} = \exp[\gamma_1 Z_{ijt} + \gamma_2 W_{ij}] x \epsilon_{ijt} \tag{3}$$

where X_{ijt} represents the portfolio stock (country j) to the issuer country i. Moreover, Z_{ijt} is a vector of gravity variables related to the elements mentioned previously in equation (2): the economic mass of the investor and the issuer country, bilateral and multilateral resistance as well as other variables also included in the model with temporal dimension (financial development, global risk, and regulator quality). In addition, W_{ij} includes the gravity time-invariant control variables, such as distance, common language, euro-area membership, and colonial links. γ_1 and γ_2 are vectors of parameters. Lastly, $\epsilon_{j,it}$ is a white noise error with zero mean and constant variance.

We start our analysis with the most straightforward gravity equation (that we call **model I** in Tables 3 to 8), which includes distance, the two countries' GDP (size) and bilateral and multilateral resistance to asset trade (to measure financial restrictions or resistance). Our baseline specification is the one derived from the theoretical model.

$$\begin{aligned}\text{Portf}_{ij,t} = \beta_1 \ln(\text{dist}_{ij}) + \beta_2 \ln(\text{GDP}_{i,t}) + \beta_3 \ln(\text{GDP}_{j,t}) + \beta_4(\text{KOFEcGIdf}_{i,t}) + \beta_5(\text{KOFEcGIdf}_{j,t}) + \\ \beta_6(\text{KOFEcGIdf(RoW)}_{ij,t})\end{aligned} \tag{4}$$

where "Portf" is the portfolio definition adopted (either equity or bonds), "dist" stands for distance, and "KOFEcGIDF" is the KOF index of "de facto" economic globalization (defined in Table 1), that captures bilateral resistance (for countries i and j), whereas "KOFEcGIdf(RoW)" is the multilateral version.

We gradually augment the gravity equation from the baseline specification by adding other potential explanatory factors. First, **(Model II)** includes "Global risk" in the form of VIX (CBOE volatility index) for equity and the World Uncertainty Index for bonds. The theoretical model assumes that agents can hedge global risk by choosing among their portfolio assets correlated with global risk. Given the negative impact of risk and uncertainty in preventing capital mobility, this variable captures any remaining global risk.

In **Model III** we add a dummy (Euro area pair) that takes the value 1 when the two countries are euro area members to capture any potential euro area bias.[26] The following specification, **Model IV**, contains global risk and the euro area pair dummy. **Model V** augments the previous specification with an additional gravity control dummy that takes the value of 1 if both countries share the same official language to capture historical links. Except for global risk, **Models I to V** follow

[26]It would have also been interesting to include a dummy that identifies if both countries are European Union countries; however, given that the sample always contains one European Union country, there is not much sample left to estimate that model.

the conventional gravity model of Okawa and van Wincoop (2012); however, in the following two models, **VI** and **VII**, respectively, we extend the gravity equation to capture the potential effect on portfolio holdings of the quality of government and financial market development. Lastly, **Model VIII** includes all the variables.

According to the theory, portfolio choices are expected to negatively affect distance, as remote countries tend to invest less in each other. However, economic size is expected to affect portfolio holding allocation positively. For the case of the resistance variables, two opposite effects are at play; first, we should expect a negative impact from bilateral resistance since this implies an increase of financial restrictions between the two countries; concerning the financial restrictions from the rest of the world, an increase would have a positive effect, given that more restrictions in the rest of the world relative to the investor and issuer countries would make more difficult for both countries to trade with the rest of the world than between them. The risk variable is expected to hurt portfolio holdings invested in each other, given the negative role that risk/uncertainty plays on capital mobility. Euro area pair dummy is expected to be positive due to the Euro area bias observed in section 2. The literature on gravity also suggests a positive effect on historical links. Finally, we expect a positive impact on government quality and financial development.

We conduct various robustness checks to ensure the reliability of our findings. Initially, we employ alternative variables to assess the bilateral and multilateral resistance, utilizing the KOF indicators. These alternatives replace the previous variables with the average between the *de facto* and *de jure* measures. Second, we substitute the variable used to measure historical links (Common official language) with a variable that captures whether the countries have ever had a colonial relationship (Colony). Finally, concerning the database, an additional robustness check is in order. The data we use comes from a new database that re-maps the portfolio holdings channeled by tax havens and identifies the final country destination following the nationality principle. Therefore, we next compare these results (using the same specifications above) using instead the portfolio positions that can be obtained from the IMF (CPIS) database, built under the residence principle.

The econometric methodology used in this paper is the Poisson Pseudo Maximum Likelihood (PPML) estimator developed by Santos Silva and Tenreyro (2006). The PPML is superior to the OLS estimator due to its ability to deal with heteroskedasticity and zeros stocks/flows. The gravity equation is estimated using the multiplicative form with two-way clustered standard errors[27]. The RESET test is also obtained for each model to test for potential omitted variables[28].

[27]The econometric analysis has been performed using ppmlhdfe Stata command developed by Correia et al. (2020).

[28]The null hypothesis of the RESET test is that the model does not suffer from misspecification. The rejection of the RESET test's null will imply that the model cannot be interpreted.

5 Results

5.1 Portfolio equity estimations

In this section, we discuss the results[29] and start with portfolio equity holdings as shown in Table 3. The first column (Model I) is our baseline specification under the nationality principle, and the following columns include additional variables and controls to the specification, as discussed above. The first five specifications are closer to the theoretical model, and we discuss them first. Concerning distance, the sign is negative, as expected (between -0.28 and -0.18): as countries are further away, they tend to invest less in each other. In this sense, the distance variable can also be interpreted as a proxy for information asymmetries as well as cultural differences, including the "euro area pair" dummy aimed to capture the euro bias (Model III onward). We find a significant positive effect (from 0.51 to 0.68), which confirms a strong euro area bias, congruent with the stylized facts described in section 2. Moreover, when we include the euro area pair dummy, the distance effect decreases because euro area countries are also nearer; hence, the euro area dummy absorbs part of the distance variation.

Regarding economic size, both investor and issuer GDP sizes show a significant and positive coefficient larger than one, implying that large countries tend to invest more in each other. Concerning the role of the resistance terms, in the case of bilateral resistance (KOFEcGIdf Investor and issuer), the two variables show the correct (negative) sign in all the models and statistical significance. Thus, capital mobility is enhanced if financial restrictions are low in investors' and the issuers' countries. According to our results, if financial restrictions increase on the investor or the issuer side, the portfolio equity invested in both countries would decrease between -2% and -5%. The Multilateral resistance term (KOFEcGIdf RoW) is significant in most specifications. It has a positive sign, meaning that the more financial restrictions in the rest of the world relative to bilateral financial restrictions between countries pairs, the more portfolio equity holdings there are between countries i and j. The impact of multilateral resistance varies among models, being much more relevant in the specifications that do not include government quality and financial development[30]. Second, the impact of multilateral resistance on portfolio equity holdings is much larger than bilateral resistance. This result has further implications for portfolio equity allocation since it implies that if financial restrictions in the rest of the world decrease, the investor country would reallocate portfolio investments from the issuer country elsewhere. Therefore, if average financial restrictions in the world decrease, we should expect risk sharing to improve. Third, multilateral resistance is non-significant when global risk is not included in the specification (Models I and III). Concerning global risk, its impact is negative and significant in all the models where it is included, highlighting the relevance and downside effect of global risk to portfolio equity holdings. The historical links measured by the common language dummy are significant and have a positive sign in all the specifications that

[29] The coefficients of the logged regressors (distance and GDPs) are elasticities; therefore, they will be interpreted directly. However, the regressors not in logs (i.e., the rest of the variables) are semi-elasticities. For their correct interpretation, they should be transformed using the following formula $(exp(\beta) - 1)^*100$.

[30] Models I to V.

include them.

Lastly, we extend the gravity specification to analyze the role played by the quality of institutions (government in this case) and financial development on portfolio equity holdings. The specification in column VI includes the regulatory quality of investor and issuer countries: both variables are positive and significant; that is, the ability of the government to formulate and implement sound policies and regulations encourages portfolio investment between countries. Similar results are obtained in model VII, which includes financial development in countries i and j measured as the depth, access, and efficiency of their financial institutions and markets. The two variables are significant and have a positive sign. However, despite all the variables of the model having the expected sign and being significant, the RESET test is rejected. Finally, we include in column VIII all the variables considered up to now, and we find that only financial development in the issuer country has a positive and significant impact. In contrast, the quality of government of the issuer becomes insignificant. The rest of the variables have the expected sign and are significant.

For robustness, we have also estimated the same specifications using the IMF (CPIS) database, where data are obtained under the residence principle (Table 4) and, therefore, when the role of tax havens is not adequately addressed. The analysis under the residence principle differs from the nationality data in several respects: First, distance and size are less relevant under the residence principle, not only in statistical significance but also in the value of the smaller parameters. Second, the coefficients for bilateral resistance are similar in size. However, they are not significant when we extend the gravity specification to include institutional quality and financial development (Models V, VII and VIII)[31]. Third, we have also found that the parameter of multilateral resistance is much smaller under the residence principle[32]. These differences may be explained by measurement problems in the dependent variable that reduce the impact and significance of the gravitational variables. Concerning the specifications that contain the variables of the extended specification (global risk, euro area pair, historical links) as well as regulatory quality and financial development, the value of the parameters is unaffected.

Finally, using the re-mapped database under the nationality principle, we do an additional robustness check (Table 5) regarding the explanatory variables. We modify our choices for resistance and historical links. First, we use the "de facto" KOF index instead of the "de iure" version to measure bilateral resistance. Second, instead of the dummy "common official language," we use "colony" (that is, a variable that takes the value 1 when the issuer and investor countries maintain a colonial link) to capture the historical ties. Distance has a lower impact on the gravity variables than in our baseline specifications analysis (Table 3). In contrast, economic size and the resistance terms are similar in magnitude and statistical significance. We also obtained similar results for the global risk variable, the euro pair dummy, regulatory quality, and financial development.

Regarding historical links, we can observe that they have a positive impact in both analyses. How-

[31] Except for KOFEcGIdf investor in Model VII.
[32] Except for Model VIII.

ever, we obtain a lower effect using the variable "colony," probably because common language may be a more appropriate measure for integrating capital markets than goods markets. Nevertheless, the robustness check confirms that our main conclusions remain robust when we use different variables to measure resistance/barriers and historical links.

5.2 Portfolio bonds estimations

The second part of our analysis is focused on portfolio bond holdings. As for portfolio equity, we start with the database built under the nationality principle (Table 6). All the specifications show that distance has a negative effect, as expected, ranging from -0.47 to -0.77. As in the case of portfolio equity holdings, distance can also be interpreted as a proxy for information asymmetries as well as cultural differences. As we did in the case of equity, we include a euro area pair dummy to assess the relevance of the euro area bias (columns II and IV onward) for portfolio bond holdings that we find to be strong, in line with the stylized facts described in section 2. Moreover, including the euro area pair dummy reduces the effect of distance, as euro area countries are neighbors. Hence, the euro area dummy absorbs part of the variation formerly attributed to distance.

Regarding economic size, both investor and issuer GDPs are significant and larger than one. We also find that the parameter of the issuer size slightly decreases when we extend our baseline specification to add quality to government and financial development. However, the coefficient is still large and significant. Regarding bilateral resistance, both investor and issuer coefficients are significant in the baseline and global risk specifications (from Model I to IV) and are in line with expectations. Financial restrictions reduce capital mobility, and we find a negative coefficient that ranges between -2% and -5%. In addition, financial restrictions on the issuer side (KOFEcGIdf issuer) are not statistically significant when we extend the baseline specification to include government quality and financial development (Models VI, VII, and VIII). However, in these models, the sign of multilateral resistance is positive, as expected, meaning that more financial restrictions in the rest of the world relative to bilateral financial restrictions between i and j increases the bond holdings between them. Also, in this case, the impact of multilateral resistance varies among specifications, with a higher impact when government quality and financial development are not included. Second, the effect of multilateral resistance on portfolio bond holdings is much larger than the bilateral resistance. This result has further implications for portfolio bond allocation as it implies that if financial restrictions in the rest of the world decrease, the investor country would reallocate portfolio investments from the issuer country elsewhere. Therefore, as in the case of portfolio equity holdings, if average financial restrictions in the world decrease, we should expect an improvement in risk sharing. When looking at global risk, we can observe that the impact is negative and significant in the baseline specification (from I to IV), pointing out that global risk has not been entirely hedged and has a negative effect on bond holdings. Concerning the euro area bias, the effect is large and very significant, and, as in the case of equity, the coefficient of distance lowers its size when the euro dummy is in the specification.

Concerning historical links (common language), they are not significant in the case of portfolio bonds. The impact of the quality of government and financial development on portfolio bond holdings is also significant in the case of bonds. Models VI and VIII confirm the role of regulatory quality. Similar results are obtained when we add financial development (Model VII) so that countries with higher financial development have a positive and significant impact. However, looking at Model VIII, we can see that the financial growth in the investor country is not significant. In contrast, the quality of government maintains its relevance in the two countries.

Next, we estimate the same specifications for bond holdings using the IMF (CPIS) database, obtained under the residence principle. The results are presented in Table 7. We find that, first, the gravitational variables distance and economic size are highly significant, but the coefficients are smaller. Moreover, the parameters of bilateral resistance maintain their value compared with the nationality data. Still, they are insignificant when we include the regulatory quality in the specification (columns VI and VIII). Multilateral resistance maintains its value along the different specifications, in a similar magnitude as in the nationality data. This variable is significant and correctly signed in specifications II, III, and IV concerning global risk. Still, its sign becomes positive once government quality and financial development are included in the specification (contrary to logic and theory). The euro area dummy is significant in all the Models (III to VIII), but the coefficient size is smaller than under the nationality principle. Finally, financial development and quality of government are significant in all instances, as in previous cases. Still, their presence in the specifications reduces the value of the GDP parameters (for example, in column VI, the coefficient of GDP issuer decreases from 0.93 to 0.74 once we account for the quality of government).

In conclusion, the gravity models estimated for equity and bonds portfolio holdings differ depending on the principle (residence or nationality) applied to obtain the data. When the nationality principle is used, the results are more coherent with the theoretical model. Therefore, correctly remapping portfolio holdings channeled through tax havens is crucial. This conclusion is particularly true for the gravity variables, for which the nationality analysis outperforms the residence analysis.

Finally, we complete the analysis of portfolio bond holdings by doing an additional robustness check (Table 8). As in the case of portfolio equity, we use the alternative definition of the KOF index for bilateral resistance and the dummy "colony" instead of the common language as an additional gravity variable. Compared with the results in Table 6, the baseline specification I maintains the parameters' sign, magnitude, and significance. Similar results were also obtained for global risk, euro area dummy, regulator quality, and financial development. In contrast, there is a difference concerning the variable that represents the historical links: we now find a positive and significant impact of the dummy "colony." We should bear in mind that "common language" was not relevant in specifications VI to VIII. Our robustness check confirms that our main conclusions remain robust when we use different variables to measure resistance. Still, we can improve the estimation by using an alternative definition of the historical links.

5.3 Portfolio equity vs. bonds

The last phase entails an examination of the differences and similarities within our assessments of portfolio equity and bond analyses based on the results obtained with the nationality principle database of Coppola et al. (2021). This is also a topic of interest since they are totally different assets in terms of nature and risk. When comparing our results, some differences become apparent. First, distance and the euro bias are more relevant for portfolio bonds than equity. Portfolio debt tends to be invested in neighboring countries; more specifically, EU debt tends to remain in the EU. This fact is even more critical for countries in the euro area. Moreover, we also find that multilateral resistance is less relevant for portfolio bonds, as EU investors have an EU bias. Thus, this provides isolation from the rest of the world, and the effect of financial restrictions outside of the EU becomes less relevant. Regarding economic size, both for equity and bonds, it is a relevant gravity factor explaining portfolio holdings. Bilateral resistance has a similar role for the two types of assets, pointing out the need for lower bilateral financial restrictions in both the investor and issuer to improve trade in financial assets. Global risk is relevant for equity and bonds, but the effect is more significant in portfolio equity, possibly due to the heightened variability in portfolio equity yields compared to bonds. Moreover, portfolio bond holdings tend to be invested in neighboring countries, where global risk may have a much-limited impact. Historical links are positive in both cases, but their role is more evident for portfolio equity. Lastly, better government quality and financial development promote trade in portfolio equity and bonds.

6 Conclusions

Following a gravity approach, this paper studies the drivers of portfolio equity and bonds involving any EU 28 countries as a counterpart from 2007 to 2017. Our approach considers the role of tax havens in our analysis by using a recent database by Coppola et al. (2021) that re-maps portfolio stock to the ultimate partner (nationality principle), in contrast to the traditional databases built under the residence principle. We have applied the gravity equation based on the model proposed by Okawa and van Wincoop (2012) in which bilateral and multilateral resistance to trade in assets are modeled as financial restrictions. We estimate, using PPML, a baseline specification of the gravity equation, including distance, size, and bilateral and multilateral resistance. We then extend the specification by including global risk and other gravity control variables, such as historical links and a euro area pair dummy. We also extend our baseline to capture the potential role of quality of government and financial development on portfolio holdings. For comparability, we also repeated our analysis using the IMF (CPIS) database to assess the differences when the presence of tax havens is not accounted for in the data.

The main contributions of our analysis are: first, the main drivers of capital mobility for portfolio equity and bonds stocks are analyzed using a novel database that re-maps portfolio stocks to remove the financial intermediaries located in tax havens and focus on the final destination of the transactions. Second, we follow the theoretical gravity model proposed by Okawa and van Wincoop

(2012) instead of augmenting the gravity equation with push-pull variables that usually lack theoretical foundations. Third, we measure bilateral and multilateral resistance as financial restrictions between the investor and issuer countries (bilateral restrictions) and financial restrictions relative to the rest of the world (multilateral resistance). To our knowledge, previous gravity literature applied to asset trade does not account for resistance. Fourth, we compare our results using the IMF-CPIS database, which does not account for tax havens in asset trade. Finally, we focus on the main drivers of portfolio equity and bond positions for all the EU countries when they act as issuers or investors with the rest of the world or among them.

Regarding our first and second contributions, the stylized facts show that tax havens are increasingly relevant in portfolio equity stock. This fact has been even more marked since the financial crisis. For the specific case of portfolio bond positions, tax havens have deviated between 14% and 19% of the total amount[33]. The increasing relevance of tax havens in asset markets constitutes this paper's primary motivation and contribution and adds value to a new strand of the literature.

Concerning our portfolio equity results, we find first that gravitational variables are significant and show the correct expected signs, such as the negative effect of distance and the attraction of mass, as large countries (in terms of economic size) tend to invest more between them. Bilateral resistance harms equity holdings as more financial restrictions deter investments between country pairs. By contrast, multilateral resistance, measured as financial restrictions in the rest of the world, has a positive impact, meaning that more financial restrictions in the rest of the world will increase asset trade between the two countries. Second, global risk remains relevant and does not seem to have been hedged as predicted by the model. Additional gravity variables also show the expected sign and relevance: historical links and the euro area dummy are positive, with evidence of euro bias (as observed in the stylized factors in section 2). Third, both are also significant when we extend our traditional gravity equation to include regulator quality and financial development.

Regarding portfolio bonds, we also confirm the relevant role of the gravitational variables in our baseline specification and the euro bias. Economic size, as well as multilateral resistance, have a positive effect on portfolio bonds. The impact of global risk and bilateral resistance is negative. Historical links are significant, but only when the chosen variable is "colony." Lastly, we also find that regulatory quality and financial development positively impact portfolio bonds.

However, portfolio equity and bonds are two different assets in nature and risk. We have found that distance and the euro area pair dummy are more relevant for bonds, probably because portfolio bonds tend to be bought from neighboring issuing countries. Thus, EU debt tends to remain in the EU, particularly in euro-area countries. In contrast, portfolio equity seems to have much more international mobility, but even in this case, we find evidence favoring a euro-area bias. In this vein, given that portfolio equity is more mobile than bonds, this asset is more sensitive to financial restrictions in the rest of the world and to global risk. Despite the differences, we also found

[33] 18% and 23%, when we focus only on the EU tax havens.

similarities, such as the role of historical links, institutional quality, and financial development.

We repeated our analysis using the IMF (CPIS) database built under the residence principle for comparability. We obtained essential differences in the gravity variables for portfolio equity and bonds. Distance (probably due to the intermediary role of tax havens) is found to be much less significant under the residence principle. Similar conclusions are obtained for economic size. Regarding the resistance variables, bilateral financial restrictions are similar to nationality analysis, whereas multilateral resistance's role is much more limited under the residence principle. Using the residence data, we also find some inconsistencies in the global risk variable for portfolio bonds. The differences observed above point to the relevance of addressing the role of tax havens, as ignoring them blurs the actual effect of the gravity variables on explaining portfolio holdings.

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Figures

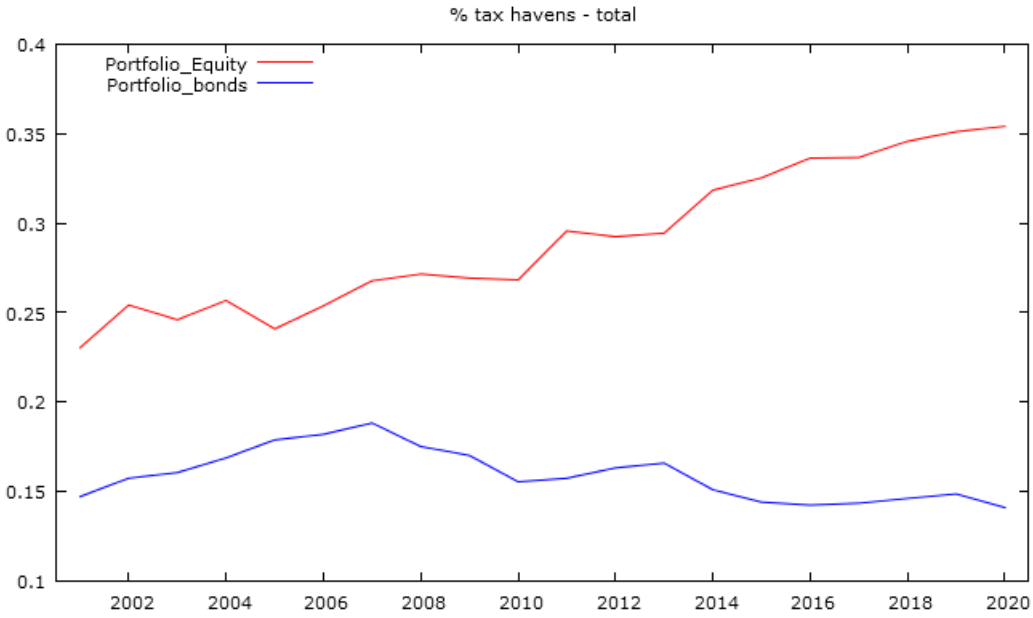


Figure 1: World tax havens

Notes: (a) Data obtained from the IMF (CPIS) database (residence principle); (b) Tax havens included in the graph are listed in table A3.

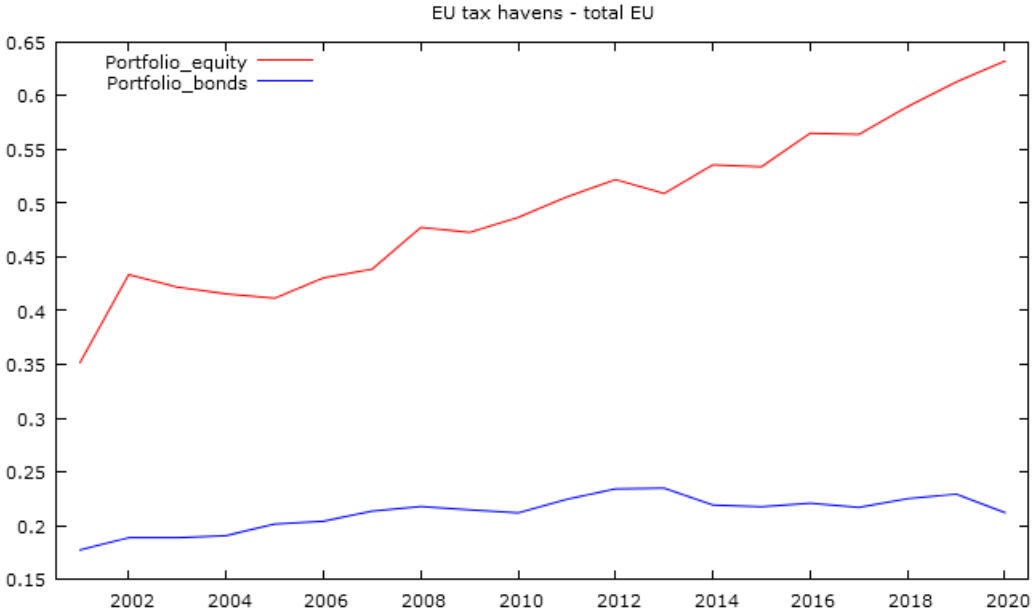
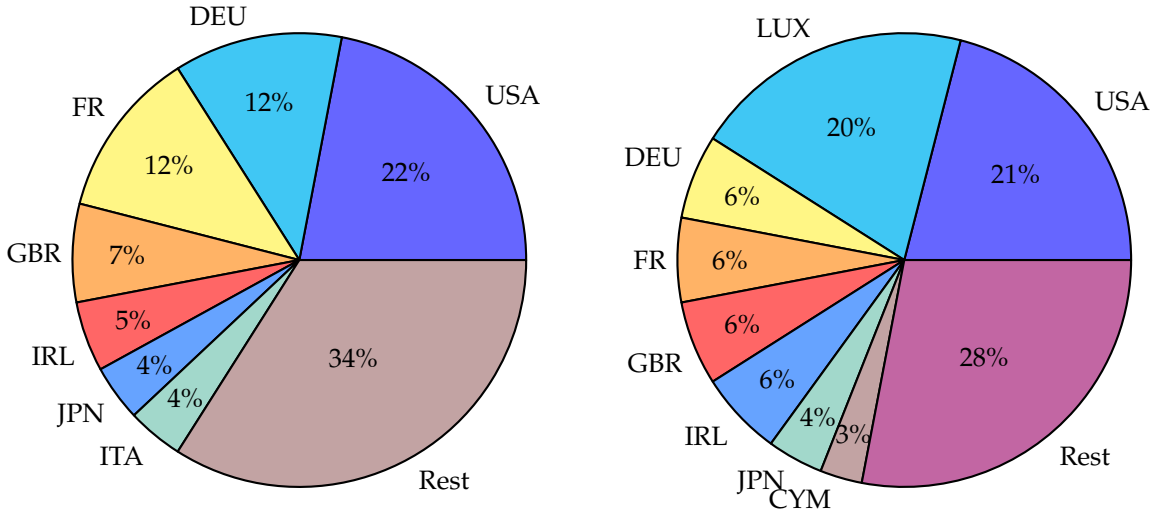


Figure 2: Total EU tax havens

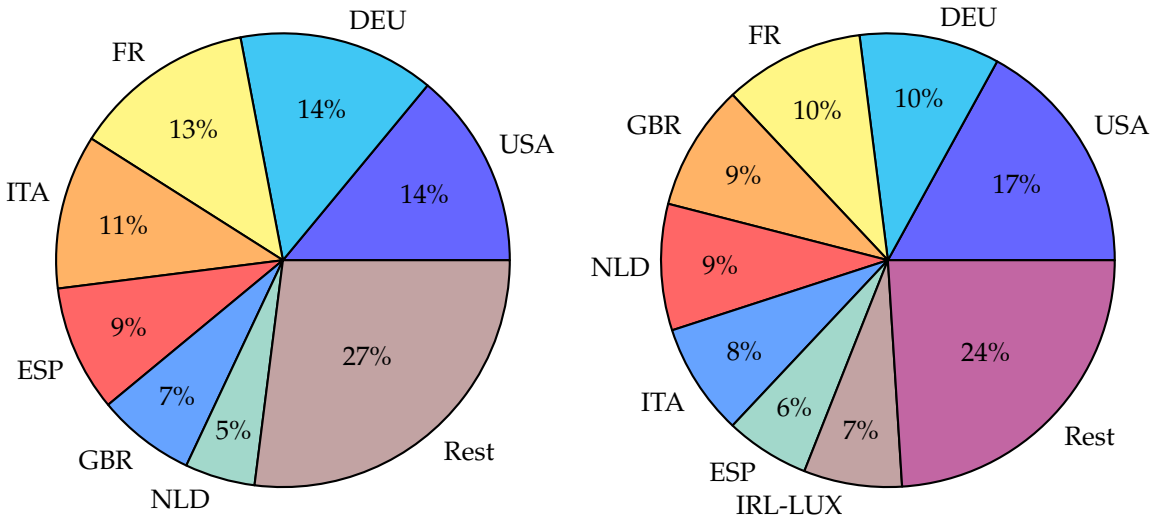
Notes: (a) Data obtained from the IMF (CPIS) database (residence principle); (b) EU tax havens: Cyprus, Ireland, Luxembourg, Malta, Netherlands.

Figure 3: EU portfolio equity investment position by issuer country



Notes: (a) The nationality principle position (left chart) comes from Coppola et al. (2021); (b)The residence principle (right chart) position has been obtained from the IMF (CPIS) database; (c) Croatia is only included in the Coppola et al. (2021) database on the investor but not on the issuer side. (d) CYM= Cayman Islands, DEU = Germany, FR = FRANCE, GBR = United Kingdom, IRL = Ireland, ITA = Italy, JPN = Japan, LUX = Luxembourg, NLD = The Netherlands, USA = United States. (f) CYM has been rounded up to 3% to fit into the pie chart (actual = 2,2%).

Figure 4: EU portfolio bond investment position by issuer country



Notes: (a) The nationality principle position (left chart) comes from Coppola et al. (2021); (b)The residence principle (right chart) position has been obtained from the IMF (CPIS) database; (c) Croatia is only included in the Coppola et al. (2021) database on the investor but not on the issuer side; (d) DEU = Germany, ESP = Spain, FR = FRANCE, GBR = United Kingdom,IRL = Ireland, ITA = Italy, LUX = Luxembourg, NLD = The Netherlands, USA = United States.

Tables

Table 1: EU portfolio equity investment position

Investor	Issuer EU - Investor EU	Issuer Euro Area - Investor EU
Euro area members	61%	84%
Non-members of Euro area		
Bulgaria	71%	93%
Czech Republic	82%	92%
Denmark	40%	64%
Hungary	78%	86%
Poland	64%	89%
Romania	95%	94%
Sweden	47%	76%
United Kingdom	26%	91%

Notes: (a) Data obtained from Coppola et al. (2021), under the nationality principle; (b) Croatia is only included in the Coppola et al. (2021) database on the investor but not on the issuer side. (b) Data covers the full sample period (2007-2017).

Table 2: List of variables

Variables	Definition	Source
Dependent variable		
Portfolio equity stock	Portfolio equity stock between investor and issuer countries.	Coppola et al. (2021)
Portfolio bond stock	Portfolio bond stock between investor and issuer countries.	Coppola et al. (2021)
Gravity variables		
Distance	Distance between the most populated cities of each country in km. EMU (investor) values are the average of individual EMU countries.	CEPII
Economic size	Investor and issuers GDP (constant 2015 USD). Millions.	World bank open data
Multilateral resistance		
Bilateral financial friccions	Economic Globalization de facto index (KOFEcGIdf). The index ranges between 1 (lowest openness level) and 100 (highest openness level). Economic frictions are the difference between frictionless economic openness (100) minus the actual country value. For robustness check, we also use the KOFEcGI index, an average of the Economic Globalization de facto and de jure indices. EMU (investor) values are the average of individual EMU countries.	Gygli et al. (2019) and Dreher (2006)
Multilateral financial friccions	Also based on KOFEcGIdf as above. Ranges between 1 and 100. For the multilateral measure, we use the world average, excluding investor and issuer countries. For robustness check, we use the KOFEcGI index. EMU (investor) values are the average of individual EMU countries.	Gygli et al. (2019)
Resistance-barriers variables		
Global uncertainty/risk (equity)	CBOE Volatility Index (VIX).	FRED database
Global uncertainty/risk (bonds)	World Uncertainty Index (WUI). The index is divided by 1.000.	Ahiret al.(2022)

Notes: CEPII=Centre d'Etudes Prospectives et d'Informations Internationales, IMF=International Monetary Fund, WGI=Worldwide Governance Indicators.

Table 2: List of variables. Cont.

Variables	Definition	Source
Additional gravity variables		
Euro area pair	Takes value of 1 when both investor and issuer are EZ members.	Own calculations
Common language	Takes value of 1 when both share common official or primary language.	CEPII
Colony	Takes value of 1 if the two countries have ever had a colonial link	CEPII
Institutional quality		
Regulatory quality framework	Regulatory quality: perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Index between -2.5 (poor) and 2.5 (strong quality). The index is multiplied by 10. EMU (investor) values are the average of individual EMU countries.	WGI
Financial development quality		
Financial development	Measures depth, access, and efficiency of the country's financial institutions and markets. The Financial Development index is an aggregate of the financial institutions index and the Financial Markets index. Ranges between 0 (no financial development) and 1 (full). In %. EMU (investor) values are the average of the individual EMU countries.	IMF dataset

Notes: CEPII=Centre d'Etudes Prospectives et d'Informations Internationales, IMF=International Monetary Fund, WGI=Worldwide Governance Indicators.

Table 3: PPML estimation results. Portfolio equity data.

Variable and group	I	II	III	IV	V	VI	VII	VIII
Gravity								
ln (Dist)	-0.28***	-0.28***	-0.18**	-0.18**	-0.19**	-0.19**	-0.15**	-0.20***
ln (GDP) investor	1.15***	1.20***	1.10***	1.14***	1.17***	1.13***	1.16***	1.14***
ln (GDP) issuer	1.20***	1.20***	1.20***	1.19***	1.14***	1.00***	0.91***	0.89***
Bilateral resistance								
KOFEcGIdf investor	-0.04***	-0.04***	-0.04***	-0.04***	-0.04***	-0.03***	-0.05***	-0.03***
KOFEcGIdf Issuer	-0.05***	-0.05***	-0.05***	-0.05***	-0.04***	-0.02***	-0.03***	-0.02***
Multilateral resistance								
KOFEcGIdf RoW	0.05	0.49***	0.05	0.55***	0.38***	0.21***	0.21***	0.21***
Other resistance variables								
Global risk	-	-0.05***	-	-0.06***	-0.04***	-0.04***	-0.03***	-0.04***
Additional gravity variable								
Euro area pair	-	-	0.51**	0.57***	0.68***	0.91***	1.00***	0.97***
Common language	-	-	-	-	1.14***	0.73***	0.65***	0.64***
Government quality								
Regulator quality investor	-	-	-	-	-	0.09***	-	0.10***
Regulator quality issuer	-	-	-	-	-	0.06***	-	0.02
Financial development								
Financial development investor	-	-	-	-	-	-	0.02***	0.00
Financial development issuer	-	-	-	-	-	-	0.03***	0.03***
N observations	31.495	31.495	31.495	31.495	31.495	31.495	29.376	29.376
RESET test (Chi^2)	2.73	3.87	1.76	2.36	5.93	5.98	9.07*	6.23

Notes: (a) *, ** and *** denote significance at the 10%, 5% and 1% levels; (b) Dist stands for bilateral distance, KOFEcGIdf RoW is the KOFEcGIdf index calculated for the Rest of the World; (c) Chi^2 refers to the RESET test. * denotes rejection of the null hypothesis of correct model specification at 1% significance.

Table 4: PPLM estimation. Portfolio equity data - IMF

Variable and group	I	II	III	IV	V	VI	VII	VIII
Gravity								
ln (Dist)	-0.22**	-0.22***	-0.13	-0.13	-0.08	-0.22***	-0.11	-0.22***
ln (GDP) investor	0.93***	0.92***	0.93***	0.93***	0.86***	0.63***	0.55***	0.48***
ln (GDP) issuer	0.78***	0.78***	0.79***	0.79***	0.72***	0.51***	0.41**	0.37**
Bilateral resistance								
KOFEcGIdf investor	-0.05***	-0.05***	-0.05***	-0.05***	-0.04***	0.01	-0.02**	0.01
KOFEcGIdf Issuer	-0.05***	-0.04***	-0.05***	-0.04***	-0.04***	0.01	-0.01	0.01
Multilateral resistance								
KOFEcGIdf RoW	-0.04	0.11***	-0.03	0.11***	0.08***	0.14***	0.20***	0.22***
Other resistance variable								
Global risk	-	-0.02***	-	-0.02***	-0.02***	-0.04***	-0.05***	-0.05***
Additional gravity variables								
Euro area pair	-	-	0.52**	0.52**	0.57**	0.79***	1.02***	1.08***
Common language	-	-	-	-	1.34***	1.15***	1.05***	0.96***
Government quality								
Regulator quality investor	-	-	-	-	-	0.14***	-	0.10***
Regulator quality issuer	-	-	-	-	-	0.12***	-	0.07***
Financial development								
Financial development investor	-	-	-	-	-	-	0.05***	0.04***
Financial development issuer	-	-	-	-	-	-	0.05***	0.04***
N observation	28.638	28.638	28.638	28.638	28.638	28.638	27.496	27.496
RESET test (Chi^2)	4.63	4.30	3.41	3.14	1.83	1.38	0.01	0.04

Notes: (a) *, ** and *** denote significance at the 10%, 5% and 1% levels; (b) Dist stands for bilateral distance, KOFEcGIdf RoW is the KOFEcGIdf index calculated for the Rest of the World; (c) Chi^2 refers to the RESET test. * denotes rejection of the null hypothesis of correct model specification at 1% significance.

Table 5: PPLM estimation. Portfolio Equity data - robustness check

Variables and group	I	II	III	IV	V	VI	VII	VIII
Gravity								
ln (Dist)	-0.18**	-0.19**	-0.07	-0.07	-0.10	-0.16*	-0.12*	-0.18**
ln (GDP) investor	1.11***	1.15***	1.06***	1.10***	1.11***	1.08***	1.09***	1.10***
ln (GDP) issuer	1.09***	1.09***	1.10***	1.10***	1.06***	1.00***	0.90***	0.88***
Bilateral resistance								
KOFEcGI investor	-0.07***	-0.07***	-0.07***	-0.07***	-0.07***	-0.04***	-0.07***	-0.04***
KOFEcGI Issuer	-0.07***	-0.07***	-0.07***	-0.06***	-0.06***	-0.03***	-0.04***	-0.03***
Multilateral resistance								
KOFEcGI RoW	0.06	0.43***	0.10**	0.59***	0.37***	0.14***	0.21***	0.18***
Additional resistance variable								
Global risk	-	-0.03***	-	-0.04***	-0.03***	-0.02***	-0.03***	-0.03***
Other gravity variables								
Euro area pair	-	-	0.56***	0.64***	0.70***	0.90***	0.97***	0.97***
Colony	-	-	-	-	0.75***	0.53***	0.37**	0.38**
Government quality								
Regulator quality investor	-	-	-	-	-	0.08***	-	0.08**
Regulator quality issuer	-	-	-	-	-	0.04***	-	0.01
Financial development								
Financial development investor	-	-	-	-	-	-	0.02***	0.00
Financial development issuer	-	-	-	-	-	-	0.03***	0.03***
N observation	31.387	31.387	31.387	31.387	31.387	31.387	29.376	29.376
RESET test (Chi^2)	1.60	2.96	1.40	2.77	6.90*	8.40*	5.84	5.46

Notes: (a) *, ** and *** denote significance at the 10%, 5% and 1% levels; (b) Dist stands for bilateral distance, KOFEcGIdf RoW is the KOFEcGIdf index calculated for the Rest of the World; (c) Chi^2 refers to the RESET test. * denotes rejection of the null hypothesis of correct model specification at 1% significance.

Table 6: PPLM estimation. Portfolio Bonds data

Variables and groups	I	II	III	IV	V	VI	VII	VIII
Gravity								
ln (Dist)	-0.77***	-0.77***	-0.47***	-0.47***	-0.47***	-0.48***	-0.50***	-0.53***
ln (GDP) investor	1.37***	1.36***	1.11***	1.10***	1.11***	1.10***	1.16***	1.15***
ln (GDP) issuer	1.14***	1.14***	1.12***	1.12***	1.13***	0.97***	0.84***	0.81***
Bilateral resistance								
KOFEcGIdf investor	-0.05***	-0.05***	-0.04***	-0.04***	-0.04***	-0.02***	-0.04***	-0.03***
KOFEcGIdf Issuer	-0.03***	-0.03***	-0.02***	-0.02***	-0.02***	0.00	0.00	0.01
Multilateral resistance								
KOFEcGIdf RoW	0.25***	0.22***	0.24***	0.22***	0.22***	0.12***	0.14***	0.10***
Additional resistance variable								
Global risk	-	-0.01***	-	-0.01***	-0.01***	-0.00	0.00	0.00
Other gravity variables								
Euro area pair	-	-	1.40***	1.40***	1.40***	1.63***	1.59***	1.60***
Common language	-	-	-	-	-0.02	-0.08	0.10	0.06
Government quality								
Regulator quality investor	-	-	-	-	-	0.07***	-	0.06***
Regulator quality issuer	-	-	-	-	-	0.07***	-	0.03*
Financial development								
Financial development investor	-	-	-	-	-	-	0.02***	0.01
Financial development issuer	-	-	-	-	-	-	0.04***	0.03***
N observations	31.495	31.495	31.495	31.495	31.495	31.468	29.376	29.376
RESET test (Chi^2)	2.81	2.76	1.70	1.69	2.07	0.86	0.74	1.07

Notes: (a) *, ** and *** denote significance at the 10%, 5% and 1% levels; (b) Dist stands for bilateral distance, KOFEcGIdf RoW is the KOFEcGIdf index calculated for the Rest of the World; (c) Chi^2 refers to the RESET test. * denotes rejection of the null hypothesis of correct model specification at 1% significance.

Table 7: PPML estimation. Portfolio Bonds - IMF

Variables and group	I	II	III	IV	V	VI	VII	VIII
Gravity								
ln (Dist)	-0.48***	-0.48***	-0.28***	-0.29***	-0.26***	-0.35***	-0.31***	-0.39***
ln (GDP) investor	0.78***	0.79***	0.80***	0.80***	0.78***	0.57***	0.51***	0.43***
ln (GDP) issuer	0.94***	0.94***	0.95***	0.95***	0.93***	0.74***	0.73***	0.67***
Bilateral resistance								
KOFEcGIdf investor	-0.04***	-0.04***	-0.04***	-0.04***	-0.04***	0.00	-0.02***	0.00
KOFEcGIdf Issuer	-0.03***	-0.03***	-0.03***	-0.03***	-0.03***	0.01	-0.01**	0.01
Multilateral resistance								
KOFEcGIdf RoW	0.20***	0.18***	0.20***	0.18***	0.17***	0.12***	0.14***	0.11***
Other resistance variable								
Global risk	-	-0.01***	-	-0.01***	-0.01***	0.00**	0.01***	0.02***
Other gravity variables								
Euro area pair	-	-	0.97***	0.97***	1.01***	1.20***	1.28***	1.38***
Common language	-	-	-	-	0.61***	0.55***	0.40**	0.37**
Government quality								
Regulator quality investor	-	-	-	-	-	0.13***	-	0.10***
Regulator quality issuer	-	-	-	-	-	0.10***	-	0.06***
Financial development								
Financial development investor	-	-	-	-	-	-	0.04***	0.03***
Financial development issuer	-	-	-	-	-	-	0.04***	0.03***
N observations	29.604	29.604	29.604	29.604	29.604	29.588	29.398	29.398
RESET test (Chi^2)	0.27	0.30	0.12	0.14	0.01	0.09	1.68	2.09

Notes: (a) *, ** and *** denote significance at the 10%, 5% and 1% levels; (b) Dist stands for bilateral distance, KOFEcGIdf RoW is the KOFEcGIdf index calculated for the Rest of the World; (c) Chi^2 refers to the RESET test. * denotes rejection of the null hypothesis of correct model specification at 1% significance.

Table 8: PPML estimation. Portfolio Bonds - robustness check

Variables and group	I	II	III	IV	V	VI	VII	VIII
Gravity								
ln (Dist)	-0.71***	-0.70***	-0.37***	-0.37***	-0.40***	-0.45***	-0.51***	-0.54***
ln (GDP) investor	1.34***	1.34***	1.08***	1.08***	1.03***	1.02***	1.08***	1.08***
ln (GDP) issuer	1.09***	1.09***	1.09***	1.09***	1.08***	1.03***	0.86***	0.85***
Bilateral resistance								
KOFEcGI investor	-0.07***	-0.07***	-0.06***	-0.06***	-0.05***	-0.03**	-0.05***	-0.03**
KOFEcGI Issuer	-0.04***	-0.04***	-0.03***	-0.04***	-0.03***	-0.01	-0.01	0.00
Multilateral resistance								
KOFEcGI RoW	0.23***	0.20***	0.32***	0.30***	0.28***	0.16***	0.18***	0.14***
Additional resistance variable								
Global risk	-	-0.02***	-	-0.01***	-0.01***	-0.01*	-0.00	-0.00
Other gravity variables								
Euro area pair	-	-	1.46***	1.45***	1.60***	1.76***	1.72***	1.73***
Colony	-	-	-	-	0.33**	0.35**	0.31**	0.30**
Government quality								
Regulator quality investor	-	-	-	-	-	0.05***	-	0.05**
Regulator quality issuer	-	-	-	-	-	0.03*	-	0.01
Financial development								
Financial development investor	-	-	-	-	-	-	0.01***	0.02
Financial development issuer	-	-	-	-	-	-	0.03***	0.03***
N observation	31.387	31.387	31.387	31.387	31.387	31.378	29.376	29.376
RESET test (Chi^2)	4.32	4.34	1.02	0.99	1.15	0.87	0.57	0.57

Notes: (a) *, ** and *** denote significance at the 10%, 5% and 1% levels; (b) Dist stands for bilateral distance, KOFEcGIdf RoW is the KOFEcGIdf index calculated for the Rest of the World; (c) Chi^2 refers to the RESET test. * denotes rejection of the null hypothesis of correct model specification at 1% significance.

Appendix A Additional information

Table A1: EU portfolio equity investment in world tax havens

Year	Residence princ. position	Nationality princ. position	%
2007	1.278.723	895.089	30%
2008	712.057	507.016	29%
2009	990.563	672.263	32%
2010	1.126.968	727.875	35%
2011	1.046.592	682.021	35%
2012	1.284.487	860.362	33%
2013	1.554.568	1.055.663	32%
2014	1.563.544	1.063.716	32%
2015	1.547.207	1.093.138	29%
2016	1.682.982	1.228.221	27%
2017	2.295.295	1.639.746	29%

Notes: (a) Tax havens included in the table are listed in table A3; (b) residence principle position data comes from the IMF CPIS, whereas Nationality principle position data comes from the database by Coppola et al. (2021).

Table A2: USA portfolio equity investment in EU tax havens

Year	Residence princ. position	Nationality princ. position	%
2007	216.360	174.337	19%
2008	97.031	79.987	18%
2009	196.728	131.029	33%
2010	232.155	144.959	38%
2011	216.822	137.157	37%
2012	275.693	166.405	40%
2013	459.257	278.643	39%
2014	555.426	297.192	46%
2015	654.096	314.308	52%
2016	634.047	329.483	48%
2017	758.898	425.398	44%

Notes:
(a) EU tax havens are Cyprus, Ireland, Luxembourg, Malta, and Netherlands. (b): residence principle position data comes from the IMF CPIS, whereas nationality principle position data comes from the database by Coppola et al. (2021).

Table A3: List of tax havens

Country	**Country**
Aruba	Saint Kitts and Nevis
Anguilla	Lebanon
Andorra	Liberia
Netherlands Antilles	Saint Lucia
Antigua and Barbuda	Liechtenstein
Bahrain	Luxembourg
Bahamas	Macao
Belize	Monaco
Bermuda	Maldives
Barbados	Marshall Islands
Cook Islands	Malta
Costa Rica	Montserrat
Curaçao	Mauritius
Cayman Islands	Niue
Cyprus	Netherlands
Djibouti	Nauru
Dominica	Panama
Micronesia, Federated States of	Singapore
Guernsey	San Marino
Gibraltar	Seychelles
Grenada	Turks and Caicos Islands
Hong Kong	Tonga
Isle of Man	Saint Vincent and the Grenadines
Ireland	Virgin Islands, British
Jersey	Vanuatu
Jordan	Samoa

Source: Coppola et al. (2021)

Table A4: Countries in the sample. Equity

Investor	**Period**
Argentina, Bahrain, Bermuda, Brazil, Bulgaria, Canada, Cayman Islands, Chile, Colombia, Costa Rica Czech Republic, Denmark, Egypt, European Monetary Union, Hong Kong, Hungary, Iceland, India Indonesia, Israel, Japan, Kazakhstan, Korea, Republic of, Kuwait Lebanon, Macao Malaysia, Mauritius, Mexico, New Zealand, Pakistan, Panama, Philippines, Poland Romania, Russian Federation, Singapore, South Africa, Sweden, Switzerland, Thailand Turkey, Ukraine, United Kingdom, United States, Uruguay	2007-2017
Mongolia	2010-2017
Bolivia	2011-2017
Saudi Arabia	2013-2017
Bangladesh, Belarus, Honduras, Norway	2014-2017
Albania, China, Peru	2015-2017
Macedonia	2016-2017
Australia	2017

Issuer	**Period**
Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin Bermuda, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Cayman Islands, Central African Republic Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Côte d' Ivoire, Croatia, Cyprus, Czech Republic Denmark, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Grenada Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland India, Indonesia, Iran, Islamic Republic of, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan Kenya, Kiribati, Korea, Republic of, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Latvia, Lebanon Lesotho, Liberia, Libya, Lithuania, Luxembourg, Macao, Macedonia, Madagascar, Malawi, Malaysia Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Federated States of Moldova Republic of, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palau, Panama, Papua New Guinea Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles Sierra Leone, Singapore, Slovakia, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, Sudan, Suriname Swaziland, Sweden, Switzerland, Syrian Arab Republic, Tajikistan, Tanzania, United Republic of, Thailand, Togo Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, United Arab Emirates United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu, Vietnam, Yemen, Zambia, Zimbabwe	2007-2017
Eritrea	2007-2011
Djibouti	2013-2017

Table A5: Countries in the sample.Bonds

Investor	**Period**
Argentina, Bahrain, Bermuda, Brazil, Bulgaria, Canada, Cayman Islands, Chile, Colombia, Costa Rica, Czech Republic, Denmark Egypt, European Monetary Union, Korea, Republic of, Kuwait, Lebanon, Macao, Malaysia, Mauritius, Mexico New Zealand, Pakistan, Panama, Philippines, Poland, Romania, Russian Federation, Singapore, South Africa Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay	2007-2017
Bahamas	2007-2014
Barbados	2007-2015
Mongolia	2010-2017
Bolivia	2011-2017
Saudi Arabia	2013-2017
Bangladesh, Belarus, Honduras, Norway	2014-2017
Albania, China, Peru	2015-2017
Australia	2017
Bahrain	2007-2011
Aruba, United Kingdom	2007-2016
Macedonia	2016-2017

Issuer	**Period**
Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan Bahamas, Bahrain, Bangladesh, Belgium, Belize, Benin, Bermuda, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Cayman Islands Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Democratic Republic of the Cost Rica, Croatia, Cyprus Czech Republic, Denmark, Dominica, Dominican Republic, Ecuador, Egypt, El salvador, Equatorial Guinea, Côte d'Ivoire Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guinea, Guinea-Bissau Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Islamic Republic of, Iraq, Ireland, Israel, Italy Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kiribati, Korea, Republic of Kuwait, Kyrgyzstan, Lao People's Dem. Republic Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Luxembourg, Macao, Macedonia, Madagascar, Malawi, Malaysia, Maldives Mali, Malta, Marshall Islands, Mauritius, Mexico, Micronesia, Moldova, Mongolia, Morocco, Mozambique, Myanmar Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palau, Panama, Papua New Guinea Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Singapore, Seychelles, Sierra Leone Slovakia, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, Sudan, Suriname, Sweden, Switzerland, Syrian Arab Republic Tajikistan, Tanzania, United Republic of, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu, Vietnam, Yemen, Zambia, Zimbabwe	2007-2017
Djibouti	2013-2017
Eritrea	2007-2011