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# The case of financial and banking integration of Central, Eastern and South Eastern European countries: a gravity model approach

Léonore Raguideau-Hannotin*

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**Abstract**

The motivation of this article is to better understand the determinants of international banking integration of non-Euro CESEE EU Members. One stylized fact for these economies is the building up of external financial vulnerabilities since the beginning of the Transition period, with a large weight of cross-border banking, particularly with the European Union. In relation with the literature on the impact of gross financial flows on financial stability, we therefore estimate the long-term historical, geographical and cultural determinants of cross-border banking claims with a bilateral financial gravity model. We then analyze the impact of domestic (pull), foreign (push) and global factors using the gravity framework. Our results first show that cross-border banking in these economies is significantly driven by geographical proximity and common historical links, particularly with EU Member States. Second, we find that banking sector health variables are more significant as push factors, while structural banking system variables are more significant as pull factors. These results provide evidence in favor of an impact of European banking systems on financial liabilities in this region, in relation with the very high level of EU ownership of banking assets. Finally, US global liquidity factor matters more than exchange rate stability, which points towards policy dilemma effect in the region.

*JEL Classification*: F34, F36, C23, O52

*Keywords*: Gravity model, cross-border banking, Central Eastern and South Eastern European countries, European Union, push factors

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# Contents

# 1 Introduction

Benefits and costs of international financial liberalization, defined as the opening of the capital account to international capital, for developing and emerging economies, have been a debate in the literature since the start of the globalization period in the 1970-80s, with renewed interest after the Balance-of-Payments (BoP) and currency crises in the 1990s[1](Agénor, 2001; Calvo, 2005; Kose et al., 2006; Prasad et al., 2007; Rodrik and Subramanian, 2009). Kose et al. (2006) conclude that the beneficial effects are conditional to the initial macroeconomic conditions in destination countries ("pull" factors, as opposed to "push" factors related to conditions in origin countries) and to the composition of incoming capital flows. On the downside, high capital mobility ultimately raises the risks of a sudden stop (defined as a contraction of capital flows with a large surprise element, that is function of domestic vulnerabilities (Calvo, 2005)).

After the Global Financial Crisis (GFC), literature has focused on the destabilizing impact of gross capital flows on these economies, so that inward flows and outward flows, both from domestic and international investors, are considered to assess financial vulnerabilities. In their seminal research article, Forbes and Warnock (2012) identify four capital flows events depending on their origin: surges and stops for gross inflows; flights and retrenchments for gross outflows. Rey (2013) also found evidence in favor of a Global Financial Cycle of capital flows, linked to both monetary conditions in the USA and to changes in risk aversion. This global factor implies less domestic monetary policy autonomy and transforms monetary policy trilemma into a dilemma.

Given this background, Non-Euro Central Eastern and South Eastern European (CESEE) countries[2] are good candidates for research on financial vulnerabilities in the context of large international capital flows. These countries have followed a strong path of financial internationalization during the 1990s and the 2000s (Arvai, 2005), with capital restrictions lifted with EU accession[3] and subsequent economic and financial integration within the Economic and Monetary Union (EMU). Figure 1 shows a continued deterioration of CESEE countries' net external positions, followed by an improvement for most of them after the GFC. In relation with these external developments and three decades of financial crises[4], many indicators identified in the literature (Ghosh et al., 2014) as financial vulnerabilities sore in CESEE countries (excessive private credit growth, currency mismatch in domestic balance-sheets and Non-Performing Loans, to name a few). Systemic risks materialized during the GFC but were circumvented by the

[1] Mexico peso crisis (1994), Asian crisis (1997), Russian crisis (1998) and Brasilian real crisis (1999)

[2] Bulgaria, Croatia, the Czech Republic, Hungary, Poland and Roumania; referred to as CESEE or CESEE-6 countries in this research work

[3] Chinn and Ito (2006) de jure financial openness indices equal Euro area Member States' ones.

[4] The transition period from communism in the 1990s led to sovereign defaults and systemic banking crises, followed by currency crises (Laeven and Valencia, 2018; Reinhart et al., 2008). The 2000s were mostly characterised by sudden stops (Forbes, 2012), followed by the GFC and domestic banking and BoP crises in the 2010s.

European Bank Coordination "Vienna" Initiative (EBCI), a public and private informal multilateral initiative launched in November 2008 in order to stabilize CESEE countries' financial systems. Banking groups, home and host countries and International Financial Institutions (IFIs) committed to maintaining capital and liquidity exposure in CESEE countries and avoided massive banking deleveraging during the GFC.

The motivation of this article is therefore to better understand the determinants of international financial integration of CESEE countries, particularly through cross-border banking, in order to formulate policy recommendations that counterbalance the building up of financial vulnerabilities (such as capital controls, restrictions on Foreign Direct Investment -FDI-, macro prudential policies, early participation to the Banking Union or ultimately, the adoption of the Euro). This motivation is supported by the fact empirical literature on international capital flows does not provide comprehensive answer regarding the impact of pull, push and global factors specifically on CESEE economies.

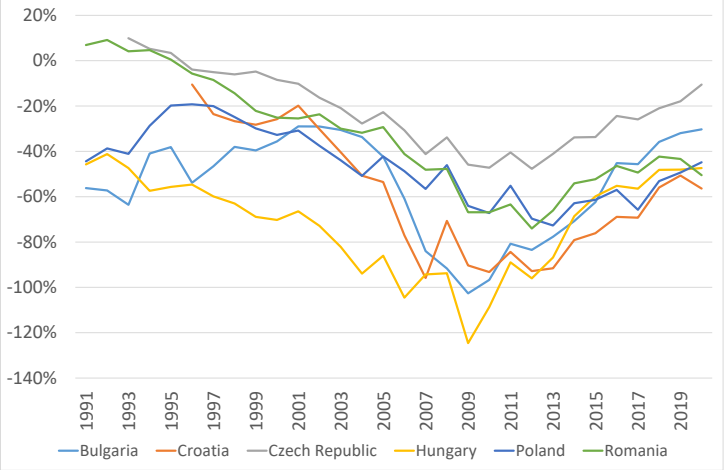


Figure 1: Ratio of Net Foreign Assets to Domestic GDP (in %) - 1990-2020

Data source: External Wealth of Nations -EWN- Mark II database (see Lane and Milesi-Ferretti (2017)) and author's calculations from IMF IIP database.

Our research question is to estimate the long-term determinants of cross-border banking claims in the CESEE-6 region over the 1990-2019 period. The choice of cross-border banking as our focus for empirical research is supported by several stylized facts evidenced in a separate research work that we summarize here below.[5] First, we show that the external funding mix of CESEE countries is based on FDI and External Debt, with a very strong but evolving EU investor and creditor countries' base. Second, even though FDI account for the largest source of external liabilities for CESEE countries,

[5] Available on demand

we find that real bilateral FDI positions are difficult to identify on an ultimate risk basis because of the overwhelming weight of International Financial Centers (namely Ireland, Luxembourg and the Netherlands) that act as third-party countries intermediating funds through Special Purpose Entities. On the contrary, cross-border banking, which is the second source of external dependence for these countries, does not suffer from such identification problem while it shares Balance-Of-Payments' reporting by residence principle. Third, while we document a recent increase in Portfolio Debt liabilities during the 2010s, available data does not allow us to perform a long-term empirical analysis.

Since geographic determinants seem to matter in the financial and banking integration processes, our empirical strategy is based on a financial gravity model, derived from the trade gravity model in Anderson and van Wincoop (2003) and developed by Okawa and van Wincoop (2012). It allows to analyze bilateral determinants of financial flows from a geographical, historical and cultural perspective. To the best of our knowledge, our paper fills a gap in the empirical literature that has not estimated such model for CESEE countries as destination countries alone. For this purpose, we use a bilateral unbalanced panel dataset based on Bank of International Settlements (BIS) Locational Banking Statistics (LBS) and estimate a multiplicative gravity model with a non linear estimator, with several specifications being estimated sequentially. Another contribution of this paper is to use country-specific banking variables, that act both as pull (domestic) and push (external) factors, together with global factors.

Our results point out that cross-border banking in CESEE economies is significantly driven by geographic and historical links, particularly with EU Member States. We find that domestic banking variables are more significant as push than pull factors over the longest estimation period. They provide evidence in favor of an impact of foreign banking systems on financial liabilities in this region. US global liquidity factor also has significant impact on cross-border banking claims. In terms of policy impacts, results show that EU integration is a key determinant of cross-border banking claims for CESEE countries and some evidence of a positive impact of the Vienna Initiative. These results are robust to various specifications, sets of country and countrypair fixed effects. Our article proceeds as follows: Section 2 reviews some facts on banking sectors and cross-border banking claims in the CESEE countries, in the context of large external debt. Section 3 reviews the literature on bilateral financial integration and gravity models. Section 4 presents the empirical strategy with a focus on specifications, estimators and variables selection. Section 5 details our results and Section 6 reviews our robustness estimations of distance and EU membership effects. Section 7 concludes.

## 2 External Debt, foreign bank ownership and cross-border banking

As evidenced in Figure 8 (in Appendix 1.A) representing the historical evolution of external assets and liabilities per country between 1991 and 2020, External Debt is the second most important source of external funding for CESEE countries. It is the sum of Portfolio Debt and Other Investment Debt (the latter subcategory being comprised of loans and deposits, trade credit and pension schemes). South Eastern European countries (Bulgaria, Croatia and Romania) and Poland share the highest proportion of external debt amongst their regional peers, mostly as Other Investment and representing in average 45% of their financial international liabilities. Central European countries (the Czech Republic and Hungary) are less dependent on external debt (30% in average of total financial liabilities), with an increasing ratio of Portfolio Debt over Other Investment liabilities.

Cross-border banking's weight in CESEE countries is supported by the fact their banking sector assets are controlled by non-domestic banks. This stylized fact is a legacy from banking sectors' privatization waves at the beginning of the transition period and is particularly true for Bulgaria, the Czech Republic and Croatia. Foreign banks control between 43% and 91% of total assets, whereas at European Union level, foreign banks control 21% of domestic banking assets in average as of 2019 (Figure 7 in Appendix 1.A). Furthermore, in terms of geographic scope, as emphasized by Hüttl and Schoenmaker (2016), 55% to 78% of foreign banks' assets in CESEE countries originate in the Banking Union.

Given the weight of Other Investment in external financial vulnerabilities, we analyze the evolution of cross-border banking liabilities and use the BIS Locational Banking Statistics database. It captures outstanding claims and liabilities of internationally active banks located in 44 reporting countries against counterparties residing in more than 200 countries.[6] It should be highlighed that CESEE countries are not LBS-reporting countries. Reporting is based on the residency principle of the Balance-of-Payments, which means that outstanding banking claims of BIS reporting banks capture intercompany loans but exclude foreign loans denominated in local currency. Data is reported since 1977 by CESEE main creditor countries, but we start our analysis at the beginning of the transition period from socialism in 1989 for the following reasons. First, there may exist some possible reporting reliability problems during the 1977-1989 period; second, Croatia and the Czech Republic were independent States only in 1991 and 1993, respectively.

In terms of volumes, aggregated outstanding banking claims of BIS reporting banks into the 6 CESEE countries, represented in Figure 2, have increased by 630% during the 2000s in the region (from USD 50 bn in 2002 to USD 365 bn in 2008) and have been

[6] The LBS currently capture 95% of all cross-border interbank flows.

almost halved since the GFC (in 2019, they stand at USD 235 bn). As a comparison, EU banks' exposure to EU Member States have increased by 300% over the 2000s period. Cross-border banking evolution at domestic level in Figure 3 is more contrasted with three types of country dynamics after the GFC: a very strong deleveraging in Hungary and Romania; a smaller one in Bulgaria, Croatia and Poland; a doubling of outstanding banking claims in the Czech Republic after 2016.[7] This deleveraging process after the GFC is a stylized fact for the European Union banking sector and has been analyzed at intra-European Union level (see for instance Bouvatier and Delatte (2015); Emter et al. (2019)).

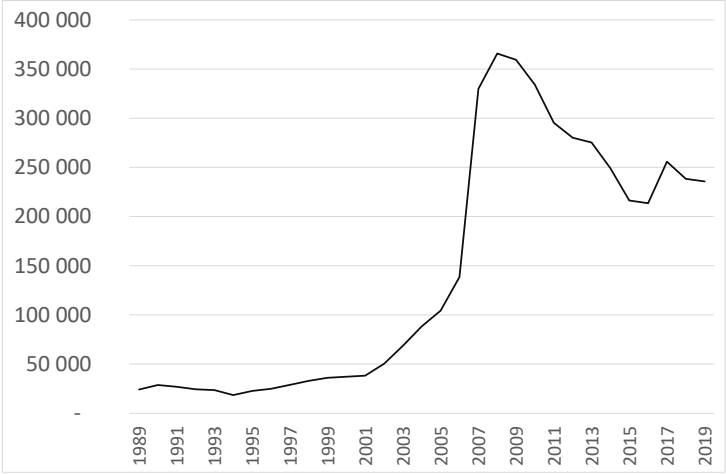


Figure 2: Total outstanding claims of BIS reporting banks (1989-2019)

Source: BIS LBS, in millions USD, all instruments, all sectors, all currencies, no exchange rate adjustment

We now analyze bilateral banking positions of international banks to understand the evolution of CESEE countries' foreign creditor countries. Figure 4 analyzes four landmark dates (1999-Q1: Launch of Euro; 2004-Q1: End of accession phase to the European Union for the Czech Republic, Hungary and Poland; 2008-Q2: Quarter preceding the Global Financial Crisis and 2018-Q4: 10 years after the beginning of the GFC). The 1999-2008 period is characterized by the rise of European Union countries as creditor countries, particularly Austria (with an overwhelming USD 132 bn total outstanding claims in the region at period end, almost twice the second largest position held by Germany, which was the leading creditor at the beginning of the 2000s), followed by France, the UK, Ireland, the Netherlands, Belgium, Luxembourg, the US (that held significant cross-border claims at that time) and Japan. These countries grew

[7] If we consider loans and deposits only, international banking sector liabilities have been divided by two. Country situations are heterogeneous though: cross-border banking flows reversal has been very pronounced for Bulgaria, Croatia, Hungary and Romania, and much less pronounced for the Czech Republic and Poland.

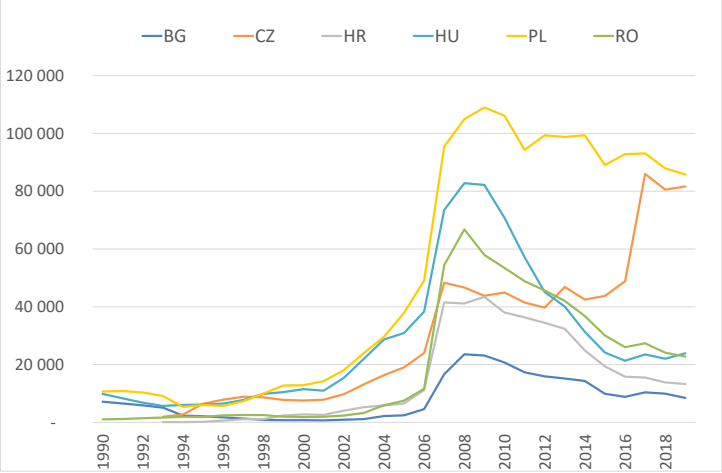


Figure 3: Outstanding claims of BIS reporting banks by country (1989-2019)
Source: BIS Locational Banking Statistics, in millions USD, all instruments, all sectors, all currencies

from an average of USD 2bn to USD 20bn outstanding claims in eight years. Luxembourg and the Netherlands have a lower rank compared to their dominant positions in FDI and their aggregated positions account for 9% of total outstanding banking claims. Nordic countries' cross-border banking exposure into the CESEE-6 region is very small compared to their positions in Baltic countries.

Since the GFC, we can see that both Austria and Germany have kept their first and second creditor positions both during the 2008-2012 GFC and Sovereign Debt Crisis period, and during the 2012-2018 banking deleveraging process period. There has been a diversification of creditor countries' base, particularly from Asia, but with small volumes only. The USA hold almost no banking positions in the region. Greece, Italy and Spain have started to report their positions in 2007 and 2014 respectively: Italy particularly stands out with an outstanding claims position comparable with Belgium. If European Union countries' relative ranking have not changed much during the 2008-2012 period, France and Belgium have less deleveraged than their peers during the 2012-2018 period and now hold the third and fourth creditor rankings within the region. Finally, cross-border banking diversification outside the European Union seems rather on hold, with positions quite deleveraged.

We can conclude that creditor countries' base for cross-border banking claims in the CESEE-6 region comprises many European Union countries, but not only. Creditor countries' base and rankings noticeably evolve over time.

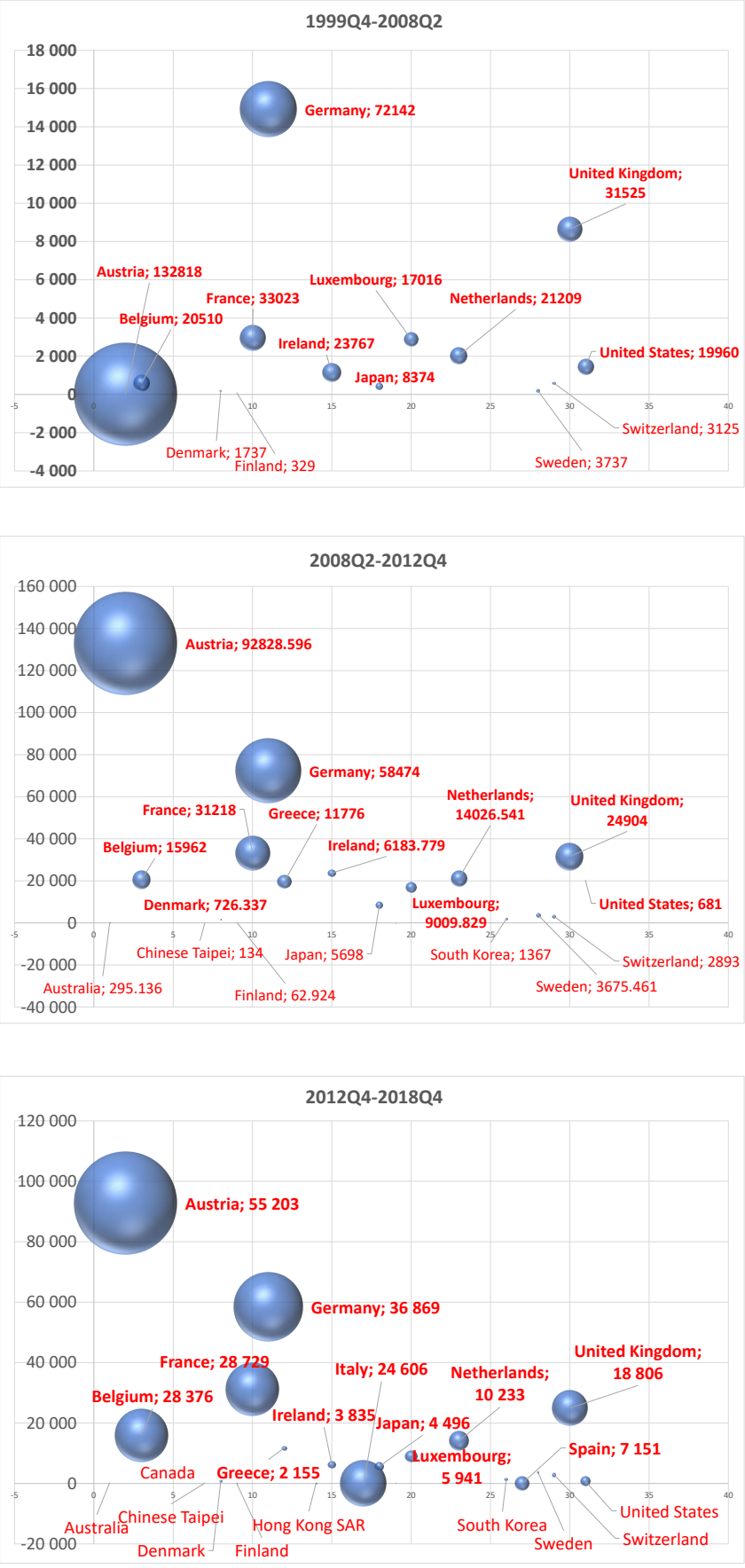


Figure 4: CESEE-6: Evolution of foreign creditor countries
Source: BIS Locational Banking Statistics; in USD million; start and end dates indicated in titles. Bubble size indicates country ranking (with outstanding banking claims indicated in red) at period end; left hand scale indicates banking claims at period start.

## 3 Literature review

Our research paper is related to four strands of literature for which we review first seminal papers before focusing on our contribution to current research on CESEE countries.

A first strand of literature explores the global and regional dynamics of international investment flows and draws conclusions in terms of geographical concentration of creditor or investors countries' risk. As opposed to our research work that focuses on Non-Euro CESEE EU Members, these studies usually include a larger scope of CESEE countries[8] as a subset of countries in larger empirical studies on the European Union or on Emerging countries.

Lane and Milesi-Ferretti (2017) assess the global dynamics of cross-border holdings of financial assets and liabilities since the GFC over 210 economies, for the 1970–2015 period: amongst other conclusions, they emphasize the fact that portfolio investment has gained momentum over banking loans since the GFC. They find future financial integration of developing countries is likely to be a regional phenomenon. Milesi-Ferretti et al. (2010) study the great retrenchment in international capital flows during the GFC using a large panel of 75 Developed and Emerging economies (inclusive of 15 CESEE countries): based on regressions of gross capital and banking inflows, they find that sudden stops were more severe for Emerging countries with pre-GFC larger net liabilities in debt instruments, faster GDP growth and large private credit. Closer to our countries of interest, Bakker and Gulde (2010) review some stylized facts about the 2003-2008 external position deterioration of 9 EU New Member States. Using BIS Locational Banking Statistics data, they show that the external positions of European reporting banks have exploded in these countries and have fueled the credit boom through local lending from their subsidiaries. Lane and Milesi-Ferretti (2007) examine the evolution of the external positions of CESEE countries between 1994 and 2004 within a large European study, by type of investment, and proceed with a bilateral analysis of financial liabilities for each investment category. They show that geographical proximity is an important driver of direct investment and banking claims in CESEE countries, with Western banks and countries outweighing other regions in that respect.

Our research article also contributes to a second strand of literature, that has recently used financial gravity models to assess determinants of cross-border banking flows. To the best of our knowledge, we fill a gap in the literature by focusing on CESEE-6 countries as receiving countries. Gravity models have been extensively used in international economics since the 1960s to analyze the determinants of bilateral trade flows. As explained in Head and Mayer (2013), by analogy with the gravity force equation, gravity equations are a model of bilateral interactions in which size and distance effects

[8] Countries analyzed often comprise Slovakia, Slovenia and the Baltic countries- Estonia, Latvia and Lithuania. In some cases, Ukraine, Russia, Turkey are also included in the CESEE region.

enter multiplicatively. There exist as many variants to the gravity equation as possible explanatory and control variables entering it. The trade gravity modelling has spilled over the international finance and banking literature, in the context of research interest on the role of gross capital flows in the building up of financial vulnerabilities (Borio and Disyatat, 2015; Forbes and Warnock, 2012). Important theoretical contributions for the financial gravity models include Martin and Rey (2004); Okawa and van Wincoop (2012); Portes and Rey (2005). The role of distance both in trade and banking flows is analyzed in Brei and von Peter (2018). Comparing several estimators on extended datasets for both types of international flows, they find that distance is significant when setting cross-border transactions against domestic ones.

Closer to our regional scope, gravity models have been recently estimated to analyze the retrenchment of cross-border banking flows in Europe. Bouvatier and Delatte (2015) estimate financial gravity equations using BIS Consolidated Banking Statistics between 14 European Union origin countries and 186 receiving countries over the 1999-2012 period. They find that the international banking integration of the Euro area has been cyclical since 1999, with a peak in 2006 and a reversal since. This decline is not a correction of previous overshooting but a market disintegration. Emter et al. (2019) estimate a gravity model between 2008 and 2015 on cross-border loans and deposits from BIS LBS between 15 European Union origin countries and 28 EU receiving countries, using indicators of banking stability, prudential policy and bank levies. They show that there is a significant link between deteriorating asset quality (Non-Performing Loans) and the decline in cross-border banking transactions within the European Union since the GFC. In European Central Bank (2016), a standard gravity model is estimated to analyze change in cross-border portfolio investments within Euro area countries before and after the Sovereign Debt Crisis in 2012. Authors find evidence of a sudden stop accompanied by a flight to quality within the Euro area.

Finally, Herrmann and Mihaljek (2011) study determinants of external positions of BIS reporting banks in a panel of 45 Developed and Emerging countries (inclusive of CESEE-6 countries) from 1993 to 2008, using a gravity modelling inclusive of country fixed effects only. They find that healthier banking sectors, more rigid exchange rate regimes and stronger financial integration contributed to the stability of cross-border bank flows for these countries compared to other Emerging regions.

Our paper also extends the literature strand that assesses the determinants of capital flows in the CESEE-6 countries. Regarding the determinants of international capital flows, literature over the past twenty-five years highlights the potential importance of both "pull" and "push" factors in determining international capital flows, starting from the seminal paper of Calvo et al. (1993). Pull factors refer to country-specific characteristics of recipient countries, whereas push factors refer to external conditions: they may be characteristics from the creditor countries or global factors. Forbes and Warnock

(2012) summarize the key findings of this literature in terms of broad classes of factors usually found significant in explaining capital flows. In terms of push factors, they highlight the importance of global liquidity conditions, risk aversion, interest rates and changes in economic growth in advanced economies. In terms of pull factors, financial determinants such as financial openness of the recipient countries, together with the size and vulnerabilities of financial systems are also found to be significant. Moreover, macroeconomic factors of the recipient countries such as fiscal positions, exchange rate regimes, real interest rates and changes in domestic growth play a role in the development of capital flows. Empirical findings are quite dependent on the period and countries analyzed: Koepke (2019) performs a qualitative meta-analysis of 40 studies to assess the most significant pull and push factors for non-resident capital flows in Emerging countries. He finds stronger evidence in favor of pull factors' impact on banking flows, with a positive relationship with domestic output growth and asset return indicators and a negative relationship with country risk indicators.

Specifically to the CESEE countries, some empirical articles focus on pull and push determinants of cross-border banking claims, that are reviewed in Table 15. Three of these studies find a significant role of Non Performing Loans and Return on Equity both as pull and push factors. The VIX index as a proxy for global aversion is also found significant. Brana and Lahet (2012) study the links between foreign banks' presence and lending stability in CESEE countries between 2000 and 2008. Using a ACP methodology, they find that foreign bank presence is associated with the financial development of receiving economies, together with some performance indicators of their financial systems. Using an econometric approach, they find that foreign banks' presence is determined by pull factors and by EU integration. Global factors have also been identified as determinants of capital flows in the CESEE countries in some studies. Eller et al. (2016) show, using a variance decomposition model, that the largest share of capital flows' volatility in CESEE-12 countries between 1994 and 2014 is explained by global financial factors, extracted from a list of macroeconomic and financial variables. In International Monetary Fund (2014), global liquidity indices are significant determinants of cross-border banking flows as well.

By using a gravity-consistent estimation framework, our research paper contributes to this literature by assessing the impact of three types of international investment determinants sequentially: push, pull and global factors.

Finally, our research article is related to a fourth strand of post-GFC literature that focuses on parent funding shocks' impact on the lending of their affiliates and on Vienna Initiative's policy impact on such transmission.[9] This strand of literature participates to the debate on costs and benefits of foreign banks' presence in terms

[9]The importance of both borrower's balance-sheet and lending channels as transmission channels of liquidity crises to the financial system during the GFC - and their role in amplifying the liquidity shock and triggering a full-scale financial crisis- has been analyzed in Brunnermeier (2009).

of credit supply and financial stability, particularly after the GFC (Claessens and Van Horen, 2015). An older contribution (Agénor, 2001) highlights that amongst other benefits, foreign banks' presence in Emerging economies can increase efficiency (because of enhanced competition) and stability of the domestic banking system (by offering an alternative to domestic depositors during periods of instability). It can also stimulate the development of domestic supervisory and legal framework. The process of concentration may nevertheless create a monopoly power that could generate a lower volume of credit creation.

The following studies assess the impact on foreign banks' presence on local credit growth, using either macro or microeconomic cross-border banking data and usually find a positive impact of the Vienna Initiative that has moderated lending decline through subsidiaries in CESEE countries. Cetorelli and Goldberg (2011) analyze the bank balance-sheet channel of a USD funding shock on both local and international banking claims' growth between 17 Developed origin countries and 94 Emerging destination countries using Consolidated Banking Statistics. They find the Vienna Initiative has had a mitigation impact on local claims' decline in the aftermath of the GFC. De Haas et al. (2012) study the link between banks' ownership and credit growth during the 2008-2009 GFC, within the context of the Vienna Initiative, using bank-level data. They find that foreign banks participating in the Vienna Initiative have been stable lenders. Temesvary and Banai (2017) analyze lending behaviour between foreign subsidiary and parent banks in Central and Eastern European countries post-GFC based on bank-level data, depending on their participation to Vienna Initiatives and proportion of foreign-currency denominated loans. They find that both Non Performing Loans and parent capitalization are determinants of lending growth, together with a positive impact of the VI 1 on lending. This literature's results emphasize the impact of policy initiative in preventing negative impacts of foreign banks' presence on local or cross-border credit growth during periods of financial stress.

# 4 Empirical strategy

Our empirical strategy consists in estimating a gravity model to assess the determinants of cross-border banking claims in CESEE countries. Main methodological references on gravity models (drawing from the international trade literature) are Bacchetta et al. (2012); Baldwin and Taglioni (2006); Eichengreen and Irwin (1998); Head and Mayer (2013); Santos Silva and Tenreyro (2006); Yotov et al. (2016).

## 4.1 Specifications

### 4.1.1 Traditional versus structural gravity

Traditional equation is not derived from a structural model but from Newton's law of universal gravitation. It formulates that international trade between two countries is proportional to the product of their sizes (here, approximated by their GDP sizes) and inversely proportional to trade frictions. By analogy to the trade model, we write the multiplicative form of this law, adapted to financial assets holdings such as external positions of BIS- reporting banks from Reporting Country i to Counterparty Country j at time t (noted $IC_{ij,t}$):

$$IC_{ij,t} = G \times \frac{Y_{i,t}Y_{j,t}}{dist_{i,j}^2} \tag{1}$$

With $Y_{i,t}$ and $Y_{j,t}$ origin and destination countries GDP at time t, G the gravitational constant and $dist_{i,j}$ the bilateral distance between two countries. If we log-linearize this model for estimation purposes, with $\epsilon_{ij,t}$ i.i.d. errors with zero mean and constant variance:

$$\ln IC_{ij,t} = \ln G + \alpha_0 \ln Y_{i,t} + \alpha_1 \ln Y_{j,t} - 2\beta_0 \ln dist_{i,j} + \epsilon_{ij,t} \tag{2}$$

As shown below, this specification suffers from omitted variable bias that has been resolved by structural models.

The multiplicative structural gravity model in Anderson and van Wincoop (2003) includes a gravitational time-varying term $G_{i,j,t}$. With same notations:

$$\begin{aligned} IC_{ij,t} &= G_{i,j,t} \times \frac{Y_{i,t}Y_{j,t}}{T_{ij}^{\sigma-1}} \\ T_{ij} &= dist_{i,j}^{\rho} \exp^{\omega' Z_{ij}} \end{aligned} \tag{3}$$

$T_{ij}$ are the trade bilateral frictions between origin coutry i and destination country j at time t (with $\sigma$ the elasticity of substitution, $Z_{i,j}$ a vector of k bilateral gravity variables and its associated k-vector of parameters $\omega$) and $G_{i,j,t}$ the product of two multilateral resistance time-varying terms (in trade gravity model, it is a function of market potential of origin country i and price index of destination country j at time t).

Okawa and van Wincoop (2012) derive the financial gravity equation for bilateral portfolio asset holdings (equity and bonds) from the same assumptions as in Anderson and van Wincoop (2003), adapted to financial holdings. They find bilateral holdings are driven by the same three factors as for the trade gravity equation: first, a size factor (based on respective holdings and supply of financial assets from country i and country j), a bilateral and asymetric information friction (replacing the trade frictions) and a relative financial friction between countries (based on two financial multilateral resistance terms, from country i and country j's perspectives).

Multilateral resistance terms are critical in both models and have therefore to be accounted for in empirical models to insure estimation is unbiased (all the more in panel studies where they are time-varying). Since they are unobservable (or quite difficult to assess), empirical literature uses a combination of origin country i, destination country j and countrypair fixed effects (Baldwin and Taglioni, 2006; Yotov, 2012). We develop herebelow the three types of fixed effects that correct the omitted variable bias.

#### 4.1.2 Correction of the omitted cost-related variable bias with fixed effects

First, country time-invariant fixed effects (TI FE) constitute a partial correction for the omitted variable bias since $G_{i,j,t}$ varies over time: they account only for the cross-section correlation between omitted terms and explanatory variables, not for the time series bias. This model does not allow the inclusion of country-specific time-invariant variables because country fixed effects make their identification impossible.

If we log-linearize Model 3 and replace the relative friction term by individual country TI FE, with same notations as previously, with vectors of origin and destination countries time-invariant fixed effects $\delta_i, \gamma_j$ and time fixed effects $\mu_t$ (to account for unobserved time heterogeneity, particularly time-varying price effects), we get the following econometric specification:

$$\ln IC_{ij,t} = \alpha_0 \ln Y_{i,t} + \alpha_1 \ln Y_{j,t} + \rho(1-\sigma) \ln dist_{i,j} + (1-\sigma)\omega' Z_{ij} + \delta_i + \gamma_j + \mu_t + \epsilon_{ij,t} \quad (4)$$

or, with GDP adjustment on the left-hand side (to insure unit elasticities with GDPs):

$$\ln(\frac{IC_{ij,t}}{Y_{i,t}Y_{j,t}}) = \rho(1-\sigma) \ln dist_{i,j} + (1-\sigma)\omega' Z_{ij} + \delta_i + \gamma_j + \mu_t + \epsilon_{ij,t} \quad (5)$$

Using the exponential function to estimate the multiplicative form of the gravity equation, with $IC_{ij,t}$ in levels, we find the following specification:

$$IC_{ij,t} = \exp^{(\alpha_0 \ln Y_{i,t} + \alpha_1 \ln Y_{j,t} + \rho(1-\sigma) \ln dist_{i,j} + (1-\sigma)\omega' Z_{ij} + \delta_i + \gamma_j + \mu_t)} \times \epsilon_{ij,t} \tag{6}$$

Second, country time-varying fixed effects (TV FE) are an alternative and correct the full omitted variable bias. It is noticeable that in this case, country time-varying variables are not identified but captured directly by TV FE. We write first in log-linearized format, then convert back into the multiplicative format, with $\delta_{i,t}$ and $\gamma_{j,t}$ the TV FE:

$$\ln IC_{ij,t} = \rho(1-\sigma) \ln dist_{i,j} + (1-\sigma)\omega' Z_{ij} + \delta_{i,t} + \gamma_{j,t} + \mu_t + \epsilon_{ij,t} \tag{7}$$

$$IC_{ij,t} = \exp^{(\rho(1-\sigma) \ln dist_{i,j} + (1-\sigma)\omega' Z_{ij} + \delta_{i,t} + \gamma_{j,t} + \mu_t)} \times \epsilon_{ij,t} \tag{8}$$

Specifications 7 and 8 are suited to get unbiased estimates of gravity coefficients, particularly the distance effect.

Third, countrypair time-invariant fixed effects $\theta_{ij}$ capture the countrypair unobserved heterogeneity, control for bilateral information frictions and addresses the issue of endogeneity of policy variables (Baier and Bergstrand, 2005). In this case, country pair time-invariant characteristics such as the set of standard gravity variables are not identified. We can also add country-specific time-varying fixed effects so that the model does not have omitted variable bias (neither would in this case time-variant country variables be identified). We can write with $X_{ij,t}$ a vector of bilateral time-varying variables and $\beta$ its associated vector of parameters:

$$\ln IC_{ij,t} = \beta' X_{ij,t} + \delta_{i,t} + \gamma_{j,t} + \mu_t + \theta_{ij} + \epsilon_{ij,t} \tag{9}$$

$$IC_{ij,t} = \exp^{(\beta' X_{ij,t} + \delta_{i,t} + \gamma_{j,t} + \theta_{ij} + \mu_t)} \times \epsilon_{ij,t} \tag{10}$$

Specifications 9 and 10 allow to estimate the impact of institutional variables (such as the European Union dual membership). If we exclude time-varying country fixed effects from Equation 10 and augment it with $X_{i,t}$ and $X_{j,t}$ the vectors of time-varying country determinants of banking claims for the origin countries and destination countries, respectively, we have the following augmented gravity specification:

$$\ln IC_{ij,t} = \alpha_0 \ln Y_{i,t} + \alpha_1 \ln Y_{j,t} + \nu' X_{i,t} + \chi' X_{j,t} + \theta_{ij} + \mu_t + \epsilon_{ij,t} \tag{11}$$

$$IC_{ij,t} = \exp^{(\alpha_0 \ln Y_{i,t} + \alpha_1 \ln Y_{j,t} + \nu' X_{i,t} + \chi' X_{j,t} + \theta_{ij} + \mu_t)} \times \epsilon_{ij,t} \tag{12}$$

### 4.2 Estimator

As emphasized by Santos Silva and Tenreyro (2006) for log-linearized constant elasticity models such as the structural gravity model, the error properties (their conditional distribution) are modified in such a way that OLS estimates become inconsistent if error homoscedasticity condition does not hold. Hence, nonlinear estimators should be used. Alternatives to Ordinary Least Squares estimator have been extensively analyzed for trade gravity equations (Gómez-Herrera, 2013; Shepherd, 2012). The Poisson Pseudo Maximum Likelihood (PPML) estimator is consistent under quite general forms of error heteroscedasticity. Under the assumption that conditional variance of the Data Generating process is proportional to its conditional mean, PPML estimator's consistency relies on conditional expectation's correct specification "only". Ramsey's RESET specification test may therefore be used (Santos Silva and Tenreyro, 2006). Accordingly to the initial assumption, PPML estimator assigns the same weights to all observations (because weight does not depend on variance). We therefore use the Poisson Pseudo-Maximum-Likelihood estimator for the specifications derived from the multiplicative models 6, 8, 10, 12. This estimator is non linear and has a lot of properties that are suited for three-dimensional data such as gravity datasets. Methodological reference is Santos Silva and Tenreyro (2006), further extended in 2011.[10] First, there is no requirement on the Data Generating Process distribution (no need for data to be Poisson-distributed) for the estimator to be consistent. Second, PPML estimator takes into account the zeros in the banking claims matrix as opposed to the log-linearized model (no selection bias inherent with unbalanced data- Carrère (2006) for another possible correction methodology). Third, it supports both individual and country pair explanatory variables at the same time since it is a non linear estimator.[11] Finally, PPML estimator supports time-invariant or time-varying fixed effects by origin and destination countries together with time-invariant countrypair fixed effects.

Even though the use of fixed effects is strongly justified by theoretical backgrounds, we nevertheless perform an Hausman (1978) specification test between individual random or fixed effects. It is a challenge to perform such test for the gravity equation due to the following reasons. First, even if we assume that errors satisfy the homoscedasticity condition (which they usually do not), bilateral gravity variables are not identified in the fixed effects model on bilateral data. We therefore perform a modified version of the Hausman test that is robust to intra-individual error correlation (based on bootstrap error clustering) on Specification 12 inclusive of banking variables (as developed hereafter) and countrypairs TI FE: we reject the null hypothesis of random effects at 5%.

[10] We use the ppml Stata function developed by authors for our estimations.

[11] Potential collinearity issues on explanatory variables should therefore be treated specifically (Variance Inflation Factor analysis on linear regression).

### 4.3 Choice of variables and database construction

In our financial gravity model, our bilateral dependent variable (noted "q" in our Result tables) is Reporting Country i's outstanding banking claims on counterparties resident in Counterparty Country j, from BIS Locational Banking Statistics (by residence). These claims include intercompany loans but not foreign subsidiaries' lending in local currency. Precisely, we use external positions of BIS-reporting banks in USD, all instruments, all currencies, all sectors and without exchange rate adjustment. In order to have the longest estimation period, we use annual or annualized data. We nevertheless exclude the pre-transition period and start the analysis in 1990.

In order to assess the determinants of cross-border banking, we use three types of variables that can be identified in the empirical model just specified: first, bilateral variables, comprised of gravity variables (time-invariant) and institutional variables (either time-varying or dummy variables); second, individual variables (country-specific), comprised of financial variables mostly related to banking sector and individual controls (either time-varying or dummy); third, global factors.

If we first turn to bilateral gravity variables, three main facts have to be highlighted.

First, many candidate variables for financial gravity models are common with the trade gravity models, even though the bilateral frictions are not the same. For instance, geographical distance is the main variable accounting for bilateral frictions in both models: in the financial gravity model, it is a proxy for unobservable informational asymmetries whereas it accounts for natural trade barriers in the trade gravity model. Another example relates to cultural distance: variables initially included in trade models allow to extend the distance analysis to cultural and language barriers. For financial gravity models, cultural distance variables such as language, legal or regulatory differences are included to account for unobservable financial frictions generated by information frictions (Okawa and van Wincoop, 2012).

Second, despite these similarities, the financial gravity literature has further investigated informational and transactional frictions by testing additional variables' significance. Chitu et al. (2012) find that common language, legal common origins, sibling and colonial relationships are significant variables. Heuchemer et al. (2009) construct bilateral cultural and legal variables, based on Euclidian distance and find that they are more significant than political variables. They also highlight the role of financial systems' interconnection in explaining financial flows. Finally, Portes and Rey (2005) have included distance, insider trading indices, number of phone calls and financial development indices (credit-to-GDP ratio) in their model. Third, regarding the use of financial variables such as asset returns or return correlations, Okawa and van Wincoop (2012) emphasize that they should not be included in the financial gravity model.

Given this background, our selection of variables first encompasses Gross Domestic Products that account for the mass effect of the gravity equation and are also a con-

trol for demand shocks. Second, our time-invariant candidate variables to account for informational frictions are geographic distance, the existence of a common border (contiguity or adjacency) and common legal origins. Other variables dealing with cultural barriers such as common language, ethnicity or religion are either null or not used in financial gravity models. Third, historical proximity is a key feature for the CESEE countries, as some of them share a common history as sibling countries (two colonies of the same empire- for instance Greece, Bulgaria and Romania that were part of the former Ottoman empire) or an imperial subordination relationship (for instance Austria with the Czech Republic within the former Habsburg empire). We therefore include two historical variables (colony, sibling) that account for this effect. Nevertheless, two countries may share both a border and a common history: to discriminate the effects of history and geography, we have therefore created three independent variables (History, Adjacency, Mixed) as indicated in Table 1 and used them in regressions. Finally, we include a Regional Trade Agreement -RTA- as a control for trade-related flows in our financial gravity model. All gravity variables come from the CEPII Gravity Database, except GDP for which we use the constant 2010 USD GDP series from the World Bank World Development Indicators (WDI) database.[12]

Table 1: Candidate bilateral gravity variables

| Gravity variable | Description | Expected sign |
|---|---|---|
| ldistw | Log of population-weighted cross-border distance | - |
| contig | Dummy for contiguity (common border) | + |
| colony | Dummy for pair ever in colonial or imperial relationship | + |
| sibling | Dummy for pair ever in sibling relationship | + |
| History | contig=0 and (sibling=1 or colony=1) | + |
| Adjacency | contig=1 and (sibling=0 or colony=0) | + |
| Mixed | contig=1 and (sibling=1 or colony=1) | + |
| comleg_posttrans | Dummy for common legal origins, post transition | + |
| fta_wto | Dummy for Regional Trade Agreement | + |
| real_gdp_o_growth | GDP (constant 2010 USD) reporting country (annual growth) | + |
| real_gdp_d_growth | GDP (constant 2010 USD) counterparty country (annual growth) | + |

Source: CEPII Gravity Database and WB WDI

In terms of gravity variables selection, we first assessed gravity variables' multicolinearity with cross-correlation analysis. Average bilateral correlations are low (Appendix 1.C), with highest absolute average correlation of 20% between distance on the one hand and History, Adjacency and Mixed variables on the second hand. Moreover, Variance Inflation Factor analysis for main specifications (Appendix 1.E) does not indicate a multicolinearity problem. We then proceed with a standard variable selection process using Stepwise Regression, by excluding insignificant variables and adding sig-

[12] We first used the GDP series in current US dollars, because as indicated in Baldwin and Taglioni (2006), time dummies included in the model partial out the implicit conversion factors between US dollars in different years. Nevertheless, applying a single exchange rate transformation does not account for currency crises in Bulgaria and the Czech Republic, and large inflation rates.

nificant ones. As indicated in the empirical model specification, these variables are identified without omitted variable bias in a gravity modelling setting that includes country time-invariant or time-varying fixed effects (Specifications 6 and 8).

Table 2 summarizes our choice of individual, global and institutional variables that we detail here below. Regarding individual financial variables, that are potential time-varying determinants of banking integration, our selection comprises variables identified as significant in empirical literature. Individual variables are used both as pull or push factors, which means we have in the same specification a variable for the Reporting (origin) Country i (labelled with an "_o") and the Counterparty (destination) Country j (labelled with an "_d"). As indicated in the empirical model specification, these variables are identified in a gravity modelling setting within which bilateral gravity effects are accounted for by countrypair time-invariant fixed effects (Specification 12).

We first include the following banking sector health variables, with an expected negative sign: binary variable for banking crises calculated by Laeven and Valencia (2008, 2018), the ratio of Non Performing Loans over total loans, bank regulatory capital to risk-weighted assets (capital adequacy ratio). Regarding the capital adequacy ratio, since risk-based capital requirements were the first prudential instrument put in place to avoid excessive build up of leverage in the banking industry (now complemented by leverage ratios following Basel III implementation), we expect a countercyclical so a negative impact on cross-border banking claims both in origin and destination countries. We also include variables reflecting the characteristics of domestic banking systems: domestic private credit to GDP ratio (as a proxy for financial leverage) and bank concentration. The bank concentration variable is used as a proxy for foreign banks' presence for CESEE destination countries, since for most of them, the three largest commercial banks are not domestic.[13] In line with Section 3, we expect a negative impact of this variable for CESEE countries since we control for policy effect by including an institutional dummy for Reporting Country i's participation to the Vienna Initiative 1 (VI). We also expect a negative impact of banking concentration index in origin countries, mainly from lower credit supply effect coming from lower competition. Data source for these variables is the World Financial Development (WFD) database from the World Bank and start in 1996.

To capture the effects of exchange rate arrangements on capital flows, we use the Aizenman et al. (2008) Exchange Rate Stability Index by country, which is one of the trilemma indices (with values between 0 and 1, 1 indicating exchange rate fixity). Finally, individual controls reflect CESEE countries' integration level into the international trade in merchandises and the international productive investment at country level: we use FDI volumes and the ratio of merchandises exports and imports over GDP (in current USD) from World Bank WFD. Cross-correlations are reported in Appendix 1.D.

[13] We do not include a foreign bank presence variable because of lack of data since 2014.

Regarding global factors, we use both liquidity and risk aversion variables. As global liquidity variables, we use first, the US Ted spread that reflects liquidity conditions' difference between risk-free and interbank markets;[14] second, the US monetary base growth rate as a proxy for the extension of global liquidity conditions. This selection of US variables is based on Cerutti et al. (2017) that investigate the relationship between cross-border banking flows and global liquidity conditions over a panel of 77 countries over the 1990-2012 period. They find that the most relevant G4 financial conditions are uncertainty, US monetary policy (particularly the slope of the yield curve) and funding conditions for global banks (leverage and TED spreads), while short-term interest rates and growth in monetary aggregates are not very robust to explain cross-border banking claims. Regarding risk aversion, we use a global factor index estimated by Miranda-Agrippino et al. (2020). It is a Global Financial Cycle estimate obtained by a dynamic factor model (described in Miranda-Agrippino and Rey (2020)) to a panel of worldwide risky asset prices. This global factor can be interpreted as reflecting market volatility and aggregate risk aversion in global markets (Figure 5).

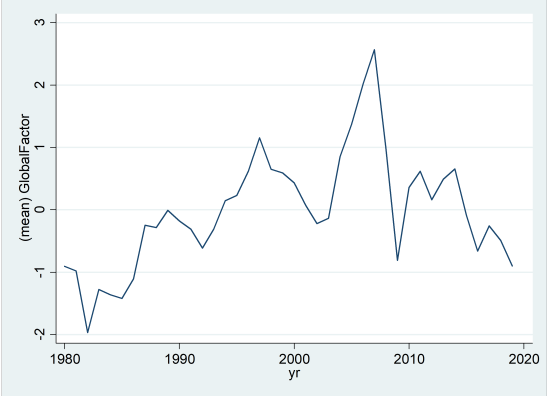


Figure 5: Global Factor - Standardized variable

Note: Annual averaging of original series; Data source: Miranda-Agrippino et al. (2020)

Finally, we include two bilateral time-varying institutional variables: first, the European Union common membership dummy which is the product of individual membership dummies between origin and destination countries; second, a calculated institutional quality variable based on the Regulatory Quality country indices from the World Bank Worldwide Governance Indicators Database. It reflects perceptions of the government's ability to formulate and implement sound policies and regulations that permit and promote private sector development. It ranges from -2.5 (weak) to 2.5 (strong) governance performance. We use the absolute value of the difference between Reporting Country i and Counterparty Country j indices as a measure of their institutional distance. We chose this index because regulatory proximity has been identified as a significant variable in empirical financial gravity literature and it may impact private investment.[15]

[14] Difference between USD 3-Month Libor and 3-Month Treasury Bill - Source: Fed

[15] Other methodologies are worth noting: simple averaging or successive testings of all indices of the six

Table 2: Individual and institutional variables
(o: reporting/origin country; d: counterparty/destination country)

| Variable | Definition | Expected sign | Data source |
|---|---|---|---|
| | **Country specific - Banking variables and exchange rate arrangements** | | |
| banking_crisis_dum_o<br>banking_crisis_dum_d | Dummy for banking crisis | Negative | Laeven and Valencia (2018) |
| NPL_o<br>NPL_d | Bank non-performing loans to gross loans (%) (measure of banking sector health) | Negative | World Financial Development (World Bank) |
| reg_capita o<br>reg_capita d | Bank regulatory capital to risk-weighted assets (%) – (capital adequacy ratio) | Negative | World Financial Development (WB) |
| bank_conce o<br>bank_conce d | Banking sector concentration (%)<br>Assets of the three largest banks as a share of total commercial banking assets | Negative | World Financial Development (WB) |
| creditmark o<br>creditmark d | Domestic credit provided by financial sector (% GDP) | Positive | World Financial Development (WB) |
| ER_stability_o<br>ER_stability_d | Exchange Rate Stability Index | Positive | Chinn Ito trilemma indices |
| | **Institutional variables** | | |
| Regulatory_quality | Bilateral variable: absolute value of the difference between Regulatory_quality_o and Regulatory_quality_d | Negative | Author's calculations |
| Regulatory_quality_o<br>Regulatory_quality_d | Regulatory Quality index for Reporting Country i and Counterparty Country j, respectively | Positive | WB Worldwide Governance Indicators |
| eu_both | Bilateral dummy variable for EU dual membership (product of eu_o and eu_d) | Positive | Author's calculations |
| eu_o<br>eu_d | Dummy for EU membership (1 after Accession) | Positive | CEPII |
| vienna_1_o | Dummy for Vienna Initiative participant country | Positive | Author's calculations |
| | **Global variables** | | |
| Global Factor | Global Financial Cycle estimate obtained from a dynamic factor model | Positive | Miranda-Agrippino et al. (2020) |
| US TED spread | USD 3-Month Libor rate - 3-Month Treasury bill rate | Negative | Federal Reserve (2020) |
| US Monetary Base growth rate | Annual log difference, in USD million | Positive | Federal Reserve (2020) |
| | **Individual Control variables** | | |
| l_fdi_d | Foreign Direct Investment volumes in USD millions (logs) | Positive | World Financial Development (WB) |
| ouv_comm_o<br>ouv_comm_d | Ratio of Merchandises exports and imports, over GDP in current USD | Positive | WB WDI |

### 4.4 Panel statistics and unit root testing

Table 3: List of BIS reporting countries included in dataset (with ISO-3 codes)

| | | | | | |
|---|---|---|---|---|---|
| Australia | AUS | Germany | DEU | | |
| Austria | AUT | Greece | GRC | South Africa | ZAF |
| Belgium | BEL | Hong Kong SAR | HKG | South Korea | KOR |
| Brazil | BRA | Ireland | IRL | Spain | ESP |
| Canada | CAN | Italy | ITA | Sweden | SWE |
| Chinese Taipei | TWN | Japan | JPN | Switzerland | CHE |
| Denmark | DNK | Luxembourg | LUX | United Kingdom | GBR |
| Finland | FIN | Macao SAR | MAC | United States | USA |
| France | FRA | Netherlands | NLD | Mexico | MEX |

Our database reflects a large range of international banking relations for the CESEE-6 countries and includes 26 origin countries[16]: only 13 reporting countries are European Union countries.[17] The CESEE countries are not BIS reporting countries. Jersey, Guernsey and Isle of Man are not included in our panel analysis since gravity variables are missing. Nevertheless, their outstanding banking claims in the CESEE region do not stand at high levels and offshore centers are usually excluded from gravity analysis. China and Portugal are not included as well because they report aggregrated banking claims at global level only. We selected the 6 CESEE countries as destination countries. The individual dimension of our panel (number of country pairs) is N=156 and the maximum time dimension (number of years) is T=30 (from 1990 to 2019). The time dimension differs upon countrypairs: start date is the latest between 1990, the beginning of BIS reporting and for Croatia and the Czech Republic, their State independence years (full description in Appendix 1.G). We therefore have an unbalanced panel database. Total number of bilateral cross-border observations is 2615. Maximum number of observations is 4530. Table 11 gives descriptive statistics of our dataset. Figure 6 shows that the relationship between outstanding banking claims and distance may be modelled with a gravity model.

Regarding panel unit root testing, most articles do not provide test results, even though they perform panel estimations and not cross-section ones (Bouvatier and Delatte, 2015; Yotov, 2012). Noticeably, Herrmann and Mihaljek (2011) use the log of quarterly change in external positions as the dependent variable, after performing several unit root tests. We perform Im et al. (2003) (IPS) unit panel root test that is robust to unit root heterogeneity under the alternative and accomodates unbalanced panel datasets. To perform this test, we have to exclude from our dataset reporting countries that have too few observations.[18] Individual error autocorrelation is corrected

indices - Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption-.

[16] out of 44 BIS reporting countries as of 2014

[17] Austria started reporting in 2007. For new reporting countries, data not reported before are indicated as "missing values", so that there exists both missing values and NaN.

[18] Brazil, Canada, Mexico, Macao, South Africa.

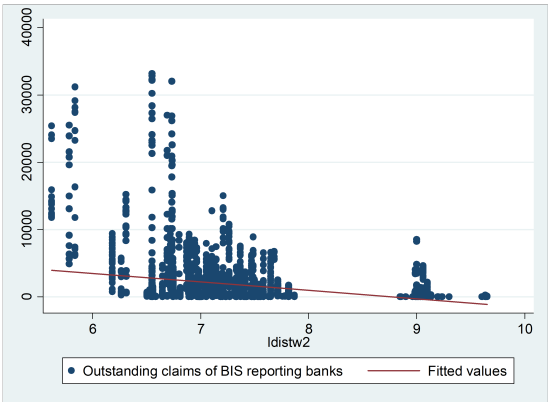


Figure 6: Scatter graph of outstanding cross-border banking claims against distance

through the addition of an autogressive term in the test regression, with lag length selection done with the AIC criteria (with robustness with the BIC and HQ criteria for our dependent variable). Graphical analysis of our dependent variable by countrypair points towards stationarity in the individual dimension. Table 10 in Appendix 1.B provides results for all bilateral and country-specific variables: almost all test statistic values are below the critical value of -1.96 at 5%, which means we reject the null of unit root for all panel units for all variables, except real GDPs, credit market size and US monetary base for which we use first-differenced series to insure stationarity at panel level.

# 5 Empirical findings

## 5.1 Estimation of the structural-consistent gravity model and the distance effect

We first estimate the gravity model over the 1990-2019 period: results are indicated in Table 4. We use Poisson Pseudo Maximum Likelihood estimator. As explained in Subsection 4.1, to insure unbiased estimation of gravity variables, we include time-invariant or time-varying fixed effects by origin and destination country, time fixed effects and real GDP growth controls for country sizes and demand. Several gravity variables (such as common language) were equal to zero in the full panel sample, so they are not included in the regression.

Equation (1) estimated with PPML and country TI FE and time fixed effects shows that banking claims' elasticity to distance is estimated at -1.33 and is significant at 5%. This means a 1 per cent increase in distance tends to reduce cross-border banking claims by about 1.33 per cent. This estimate is above the mean estimate of -1.1 from the meta-analysis on estimated coefficients for trade gravity equations in Head and Mayer (2013). Gravity models for financial flows are more recent; nevertheless, Brei and von Peter (2018) assume cross-border banking's elasticity to distance is lower than for trade. Common legal origins are not significant at 5% and following our procedure for gravity variables' selection, we exclude the variable from subsequent equations.

Second interesting result in Equation (1) is the significativity of shared imperial subordination or sibling history in explaining cross-border banking claims. History estimated coefficient is 1.31, which translates into 2.25 times more claims between these countries compared to countries without common history. This estimate reflects the importance of historical links in the region: it is probably not fully captured because Austria started to report Locational Banking Statistics in 2007.

Adjacency variable becomes significant in Equation (2) where we exclude both common legal origins and Mixed variables from our regressions since they are not significant at 5% in Equation (1). Adjacency estimate has a unexpected negative sign, which contrasts with a mean of + 0.66 in Head and Mayer (2013) meta-analysis. This variable is actually relative to Austria and Hungary on the one hand (both hegemonic states) and to the Czech Republic and Germany in the other hand. We therefore think this estimate may capture a lower-than-average cross-border banking activity from Austria towards Hungary after 2007 (-41%), more than a gravity-type contiguity effect.

Equation (3) shows that -1.33 estimate of cross-border banking elasticity to distance in Equation (2) is robust to another specification accounting for time-varying unobserved individual heterogeneity (when using time-varying country fixed effects, we find a -1.48 estimate that is significant at highest standards). Finally, real GDP growth variables are significant at highest standard in most equations, with an unexpected negative sign though. We think these first-differenced variables do not play their usual role of size

factors in the gravity specification and may suffer from endogeneity with the dependent variable: we investigated this by using GDP variables lagged by one period and found both origin and real GDP growth were not significant at 5% in this case. Several distance robustness analyses are also performed in Section 6.

Table 4: Gravity equation and the distance effect

| Equation | (2) | (3) | (4) |
|---|---|---|---|
| Dependent | q | q | q |
| Specification | ( 6) | ( 6) | ( 8) |
| Estimator | PPML | PPML | PPML |
| Distance (logs) | -1.33** | -1.26*** | -1.48*** |
| | (-2.57) | (-2.95) | (-3.91) |
| History | 1.31*** | 1.22*** | 1.15*** |
| | (4.33) | (4.99) | (4.75) |
| Adjacency | -0.52 | -0.54*** | -0.57*** |
| | (-1.42) | (-3.57) | (-4.03) |
| Mixed | 0.01 | | |
| | (0.02) | | |
| Common legal origins | -0.20 | | |
| | (-0.64) | | |
| real_gdp_o_growth | -0.03*** | -0.03*** | |
| | (-3.08) | (-3.21) | |
| real_gdp_d_growth | -0.02** | -0.03*** | |
| | (-2.56) | (-2.77) | |
| Constant | 8.52* | 15.22*** | 12.43*** |
| | (1.80) | (6.27) | (4.50) |
| Observations | 2405 | 2420 | 2612 |
| Countrypairs | 148 | 148 | 154 |
| $R^2$ | 0.764 | 0.752 | 0.857 |
| Origin/Destination Country Fixed Effects | TI | TI | TV |
| Time Fixed Effects | Yes | Yes | Yes |
| Error clustering (over distance) | Yes | Yes | Yes |
| Countrypair Fixed Effects | No | No | No |
| RESET specification F-test (p-value) | 0.05 | 0.075 | 0.01 |

$z$ statistics in parentheses; TI: Time invariant; TV: Time varying

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

## 5.2 Country-specific determinants of cross-banking banking claims

Estimations based on Specification 12 are reported in Table 5. Depending on data availability, we have two sets of equations. Equations (1) and (2) refer to the most recent period between 1996 and 2019, because they embed country-specific financial and banking system variables as described above. Equations (3) and (4) focus on identification of country-specific financial stability variables (exchange rate stability, banking crises) with individual controls relative to trade and FDI integration, over the 1990-2019 period.

For all equations, the number of observations is lower than in the standard gravity

model because of incomplete series on the countrypair dimension. We use the Poisson Pseudo Maximum Likelihood panel estimator, with countrypair and time fixed effects. Most gravity effects and unobserved heterogeneity (typically, unobserved bilateral banking transaction costs) are accounted for with countrypair time-invariant fixed effects. Hence, equations do not have gravity variables but the set of fixed effects and the inclusion of GDPs account for a gravity-compliant setting for estimation.

First interesting result is that our selection of banking sector variables are relevant either as push or pull factors. Most variables are significant at standard levels and have expected signs, but only for reporting or counterparty countries. They may also be significant on the short term -Equations (1) and (2)-, and not on the longer period -Equations (3) and (4)-. More precisely, banking crisis events in origin countries are significant at 5% over the longer sample period and have the expected significant and large negative impact on cross-border banking flows (-18.5% in average). The banking crisis estimate for destination countries is significant with a positive impact on cross-border claims: this effect is not robust to other specifications. We believe it is due to the fact that most systemic banking crises identified by Laeven and Valencia (2018) happened at the beginning of the transition period, so before 1996 which is the estimation start date for Equations (1) and (2). The strong positive effect is likely to reflect some positive outlier positions from several countrypairs. Cross-border banking claims are significantly increased by 16.5% if origin countries have been participating to the Vienna Initiative, at 5% significance (which almost offsets the banking crisis estimate in Equation (4)). This last result is in line with the Vienna Initiative impact described in Section 3. Several other push factors are identified: Non Performing Loans and banking concentration that both have the expected negative impact on cross-border banking claims at highest standard, lower by 1.5% in average. Variables related to the size and leverage of the economy are either not significant (domestic credit not significant except at 10% in Equation (3)) or have an unexpected negative contribution to cross-border banking claims as push factors (real GDP growth).

Two pull factors are identified as well: first, banking sector concentration and second, regulatory capital, that are significant over the 1996-2019 period at highest significant level, with the expected negative sign potentially indicating a stabilizing or countercyclical role. Individual control variables for merchandise trade and FDI integration are not significant at 5% in Equation (4). Overall, these results point towards the importance of reporting countries' banking and economic factors over domestic factors. Finally, the exchange rate arrangement, more precisely its stability, is identified both as a pull and push factor, but its role depends on the period considered. On the most recent period -Equations (1) and (2)-, exchange rate stability is significant for destination countries, at highest significance level, with a positive sign. On the longest period, exchange rate stability is significant at 5% and a positive push factor, only.

Table 5: Country-specific determinants of cross-border banking claims (Specification 12)

| Equation | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent | q | q | q | q |
| real_gdp_o_growth | -0.02** | -0.02** | -0.04*** | -0.03*** |
| | (-2.10) | (-2.37) | (-2.67) | (-2.71) |
| real_gdp_d_growth | -0.02*** | -0.02*** | 0.00 | -0.00 |
| | (-3.37) | (-3.04) | (0.08) | (-0.54) |
| banking_crisis_dum_o | -0.08 | -0.08 | -0.24*** | -0.17*** |
| | (-1.54) | (-1.64) | (-3.25) | (-2.75) |
| banking_crisis_dum_d | 0.28*** | 0.28*** | -0.06 | -0.04 |
| | (4.28) | (4.02) | (-0.37) | (-0.30) |
| vienna_1_o | 0.11 | 0.14** | 0.06 | 0.18** |
| | (1.59) | (2.07) | (0.53) | (2.12) |
| NPL_o | -0.02*** | -0.02*** | | |
| | (-2.69) | (-2.63) | | |
| NPL_d | -0.01 | -0.01 | | |
| | (-1.11) | (-1.19) | | |
| reg_capital_o | 0.01 | 0.01 | | |
| | (0.31) | (0.23) | | |
| reg_capital_d | -0.06*** | -0.06*** | | |
| | (-2.84) | (-3.02) | | |
| bank_concentration_o | -0.01** | -0.01** | | |
| | (-2.16) | (-2.27) | | |
| bank_concentration_d | -0.02*** | -0.02*** | | |
| | (-5.14) | (-5.35) | | |
| ExchangeRateStabilityIndex_o | 0.02 | -0.04 | 0.60* | 0.59** |
| | (0.07) | (-0.15) | (1.84) | (2.01) |
| ExchangeRateStabilityIndex_d | 0.80*** | 0.77*** | -0.27 | 0.04 |
| | (3.10) | (2.67) | (-0.72) | (0.08) |
| credit_size_growth_o | 0.00 | | 0.01* | |
| | (1.20) | | (1.95) | |
| credit_size_growth_d | -0.01 | | 0.01 | |
| | (-1.17) | | (1.01) | |
| ouv_commerce_o | | | 0.00 | 0.00 |
| | | | (0.20) | (0.81) |
| ouv_commerce_d | | | -0.00 | 0.00 |
| | | | (-0.15) | (0.32) |
| lfdi_d | | | -0.03 | -0.00 |
| | | | (-1.01) | (-0.03) |
| _cons | -3.00*** | -3.00*** | 3.61** | 2.41* |
| | (-4.75) | (-4.94) | (2.43) | (1.85) |
| $N$ | 1371 | 1420 | 1706 | 1874 |
| $R^2$ | 0.949 | 0.947 | 0.901 | 0.915 |
| Error clustering (over distance) | Yes | Yes | Yes | Yes |
| Countrypair Fixed Effects | Yes | Yes | Yes | Yes |
| Time Fixed Effects | Yes | Yes | Yes | Yes |

$z$ statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

### 5.3 Global and institutional determinants of cross-banking banking claims

We first turn to the global factors that can be potential determinants of cross-border banking claims. Our estimations are based on the same specification as in previous Subsection which adds countrypair time-invariant and time fixed effects (Specification 12) and are reported in Table 6. We have also kept individual controls and the Exchange Rate Stability variable, except in Equation (4) where we exclude the latter to reintegrate the USA as counterparty country.

Over the three global factors tested, we can see that the Global Financial Cycle factor is not significant at 5% in Equation (2). We did a robustness check of Equation (2) using VIX as a global measure of uncertainty, which was significant at highest level with a positive impact of 0.07. From the global liquidity candidates, the US monetary base growth rate is significant at highest level on the longest period, and is positively associated with the extension of cross-border banking claims. One interesting result is that the TED spread is not significant at 5% in Equation (1) where the USA are excluded, but becomes significant (at 10%) when the USA are reintegrated into the panel in Equation (4). As for the Global Financial Cycle, we believe both results emphasize the fact that financial variables that are observed on a very high frequency may not suited for gravity models. Additionally, these results may point out that both global risk aversion and liquidity cycles play a role for CESEE countries as regard the extension of their banking liabilities. If we now turn to the institutional determinants of cross border banking flows, we first test the significance of the bilateral Regulatory Quality Distance index calculated from the WGI country indices. Some endogeneity bias may still be present, but at a lesser extend compared to the inclusion of individual indices. We find in Equation (5) that regulatory distance is identified as a determinant at highest significance, with a rather strong -0.58 estimate.

Table 6: Determinants of cross-border banking flows- Global factors and Institutional distance

| Equation | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent | q | q | q | q | q |
| real_gdp_o_growth | -0.02* | -0.02* | -0.02* | -0.03** | -0.03** |
| | (-1.92) | (-1.92) | (-1.92) | (-2.09) | (-2.11) |
| real_gdp_d_growth | -0.01 | -0.01 | -0.01 | -0.00 | -0.00 |
| | (-0.81) | (-0.81) | (-0.81) | (-0.50) | (-0.01) |
| banking_crisis_dum_o | -0.16*** | -0.16*** | -0.16*** | -0.15** | -0.19*** |
| | (-2.86) | (-2.86) | (-2.86) | (-2.54) | (-3.26) |
| banking_crisis_dum_d | -0.03 | -0.03 | -0.03 | -0.03 | 0.11 |
| | (-0.22) | (-0.22) | (-0.22) | (-0.21) | (0.89) |
| vienna_1_o | 0.12 | 0.12 | 0.12 | 0.19* | 0.15 |
| | (1.19) | (1.19) | (1.19) | (1.79) | (1.49) |
| ExchangeRateStabilityIndex_o | 0.60* | 0.60* | 0.60* | | 0.56** |
| | (1.91) | (1.91) | (1.91) | | (1.97) |
| ExchangeRateStabilityIndex_d | 0.19 | 0.19 | 0.19 | | 0.67** |
| | (0.43) | (0.43) | (0.43) | | (1.99) |
| ouv_commerce_o | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| | (0.29) | (0.29) | (0.29) | (0.47) | (0.46) |
| ouv_commerce_d | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | (0.24) | (0.24) | (0.24) | (0.34) | (0.29) |
| lfdi_d | -0.01 | -0.01 | -0.01 | -0.01 | 0.01 |
| | (-0.29) | (-0.29) | (-0.29) | (-0.20) | (0.57) |
| credit_size_growth_o | 0.01* | 0.01* | 0.01* | 0.01* | 0.01* |
| | (1.83) | (1.83) | (1.83) | (1.93) | (1.74) |
| credit_size_growth_d | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | (0.83) | (0.83) | (0.83) | (0.81) | (1.26) |
| TedspreadUSD | 0.17 | | | 0.19* | |
| | (1.60) | | | (1.67) | |
| GlobalFactor | | -0.02 | | | |
| | | (-0.37) | | | |
| monet_base_growth | | | 0.03*** | | |
| | | | (5.19) | | |
| Regulatory_Quality_Distance | | | | | -0.58*** |
| | | | | | (-3.06) |
| _cons | 4.80*** | 4.82*** | 2.82** | 1.76* | 4.80*** |
| | (3.16) | (3.17) | (2.06) | (1.84) | (3.63) |
| $N$ | 1766 | 1766 | 1766 | 1874 | 1647 |
| Countrypairs | 131 | 131 | 131 | 137 | 131 |
| $R^2$ | 0.917 | 0.917 | 0.917 | 0.910 | 0.927 |
| Error clustering (over distance) | Yes | Yes | Yes | Yes | Yes |
| Countrypair Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Time Fixed Effects | Yes | Yes | Yes | Yes | Yes |

$z$ statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 provides results on standardized variables, which allow us to rank the variables by their relative effect (measured as standard deviations -std-). We have estimated again the equations in which most factors are identified.

On the 1996-2019 period -Equation (1)-, we interestingly find that banking pull factors have the largest relative weights (bank concentration -0.28 std and regulatory capital −0.30 std). For the push factors, Non Performing Loans and banking concentration have a respective -0.11 and -0.15 std impact on cross-border banking claims. Banking concentration impact is almost twice as important as a pull factor than as a push factor. Banking crises and Vienna Initiatives do not strongly determine cross-border banking claims when we use that unit. The exchange rate arrangement as a pull factor has also a strong contribution (+0.19 std), significant at highest standard.

On the 1990-2009 sample -Equations (2) to (4)-, global and push factors have a much larger weight on cross-border banking claims compared to pull factors. Credit market size, banking crises and exchange rate stability are significant at either 5% or 10% with estimated +0.06, −0.05 and +0.19 standard deviations. If we consider size effects related to real GDP growth and credit market growth (significant for origin countries only), they offset each other, pointing towards an insignificant size effect in our financial gravity model compared to trade gravity equations. The weight of the US monetary base growth rate (significant at highest standard) is +0.46 std, largest above all, pointing towards a policy dilemma effect.

Table 7: Determinants of cross-border banking claims - Standardized results

| Equation | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent | q | q | q | q |
| real_gdp_o_growth_SD | -0.07** | -0.08* | -0.08* | -0.08** |
| | (-2.10) | (-1.92) | (-1.92) | (-2.11) |
| real_gdp_d_growth_SD | -0.10*** | -0.03 | -0.03 | -0.00 |
| | (-3.37) | (-0.81) | (-0.81) | (-0.01) |
| banking_crisis_dum_o_sd | -0.02 | -0.05*** | -0.05*** | -0.05*** |
| | (-1.54) | (-2.86) | (-2.86) | (-3.26) |
| banking_crisis_dum_d_sd | 0.08*** | -0.01 | -0.01 | 0.03 |
| | (4.28) | (-0.22) | (-0.22) | (0.89) |
| vienna_1_o_sd | 0.02 | 0.02 | 0.02 | 0.02 |
| | (1.59) | (1.19) | (1.19) | (1.49) |
| NPL_o_sd | -0.11*** | | | |
| | (-2.69) | | | |
| NPL_d_sd | -0.05 | | | |
| | (-1.11) | | | |
| reg_capital_o_sd | 0.02 | | | |
| | (0.31) | | | |
| reg_capital_d_sd | -0.30*** | | | |
| | (-2.84) | | | |
| bank_concentration_o_sd | -0.15** | | | |
| | (-2.16) | | | |
| bank_concentration_d_sd | -0.28*** | | | |
| | (-5.14) | | | |
| credit_size_growth_o_sd | 0.03 | 0.06* | 0.06* | 0.05* |
| | (1.20) | (1.83) | (1.83) | (1.74) |
| credit_size_growth_d_sd | -0.04 | 0.04 | 0.04 | 0.04 |
| | (-1.17) | (0.83) | (0.83) | (1.26) |
| ExchangeRateStabilityIndex_o_sd | 0.01 | 0.19* | 0.19* | 0.18** |
| | (0.07) | (1.91) | (1.91) | (1.97) |
| ExchangeRateStabilityIndex_d_sd | 0.19*** | 0.04 | 0.04 | 0.16** |
| | (3.10) | (0.43) | (0.43) | (1.99) |
| ouv_commerce_o_sd | | 0.05 | 0.05 | 0.07 |
| | | (0.29) | (0.29) | (0.46) |
| ouv_commerce_d_sd | | 0.04 | 0.04 | 0.05 |
| | | (0.24) | (0.24) | (0.29) |
| lfdi_d_sd | | -0.02 | -0.02 | 0.03 |
| | | (-0.29) | (-0.29) | (0.57) |
| monet_base_growth_SD | | | 0.46*** | |
| | | | (5.19) | |
| Regulatory_Quality_Distance_SD | | | | -0.26*** |
| | | | | (-3.06) |
| _cons | -5.56*** | 3.19*** | 3.47*** | 5.08*** |
| | (-15.17) | (3.43) | (3.99) | (14.95) |
| $N$ | 1371 | 1766 | 1766 | 1647 |
| $R^2$ | 0.949 | 0.917 | 0.917 | 0.927 |
| Error clustering (over distance) | Yes | Yes | Yes | Yes |
| Countrypair Fixed Effects | Yes | Yes | Yes | Yes |
| Time Fixed Effects | Yes | Yes | Yes | Yes |

$z$ statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

### 5.4 Impact of policy variables on cross-border banking claims (European Union, RTA)

We finally want to test the significance of two types of institutional impacts: first, international country agreements reflected in dual membership (European Union and Regional Trade Agreement) and second, the impact of private sector regulation distance on cross-border banking claims in CESEE countries. In order to deal with potential endogeneity issues of policy variables, we use the Poisson Pseudo Maximum Likelihood estimator for Specification 10, that includes countrypair fixed effects and origin/destination time-varying individual fixed effects. Our results are in Table 8.

This empirical model can identify impact of time-varying bilateral variables only. This means country-specific time dummy variables (such as the Vienna Initiative participation) are not identified. Moreover, even if we create an interaction term between dummy variables of origin and destination countries, they may not be identified as well due to their lack of variability. This lack of variability impacts the Vienna Initiative case, but also the European Banking Union one, because they have no within group variability. As stated by Baldwin and Taglioni (2006), countrypair fixed effects wipe out information in the cross-section variation so that all identification comes from time variation in the variables.

Table 8: Institutional determinants of cross-border banking claims

| Equation | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent | q | q | q | q | q |
| eu_both | 0.34* | | 0.32* | | 0.39** |
| | (1.88) | | (1.73) | | (2.33) |
| 1=RTA (Source: WTO, 2015°) | | -0.20 | -0.06 | | |
| | | (-0.76) | (-0.24) | | |
| Regulatory Quality Distance | | | | 0.41 | 0.41 |
| | | | | (0.87) | (0.88) |
| Observations | 2615 | 2614 | 2614 | 2300 | 2300 |
| $R^2$ | 0.979 | 0.979 | 0.979 | 0.980 | 0.980 |

$z$ statistics in parentheses; °: extended into 2019 by author
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regarding European Union impact, Equation (1) shows that common European Union membership increases significantly -at 10%, then 5% in Equation (5)- and very positively cross-border banking claims in CESEE countries, by 41% compared to average. On the contrary, Equation (2) shows that common trade agreement has no significant impact on cross-border banking claims in CESEE countries, which may be an indication of the disconnection between banking and trade. If we control for trade on a different time period in Equation (3)[19], EU membership is still significant at 10%. As a robustness check of the EU dual membership impact, we estimate a standard gravity equation with country-fixed effects: EU dual membership is not significant at 5% (Table 9, Equation (2)). In this robustness estimation, we don't control for correlation between EU common

[19] Variance inflation factor between RTA and EU membership is relatively low at 1.43, allowing to include both variables in Equation (3).

membership and other unobservable factors relative to cross-border banking, which have possibly a drag-down effect on outstanding claims or are negatively correlated with the other variable since EU membership estimate is lower than in Equation (1).

If we now turn to regulatory quality distance which is a time-varying bilateral variable, it is not significant at 5% over the full 1990-2019 sample. This result is different from Table 6 for the following reasons: first, this estimate is based on a larger individual dimension (131 versus 148 countrypairs) and second, the specification better controls for policy endogeneity.

## 6 Robustness of distance and EU membership estimates

In Table 9, we check the distance estimates from Table 4, using PPML estimator with time and country TV FE (time varying fixed effects), by focusing on the years following the transition period's main crises (start date in 1996) and by adding the European Union membership dummies, both bilateral in Equation (2) and individual in Equation (3). Indeed, EU partners have supposedly less information and friction costs due to unified legal framework, EU trade integration and European Banking Union. Dual EU membership is not significant at 5%, meaning that this effect is not identified in this set up of fixed effects, whereas we know that it plays a crucial role in the development of cross-border banking in CESEE countries from previous Subsection. On the contrary, EU individual membership for destination countries is significant at highest standard and its estimate shows an average 3.5 additional level of cross-border banking claims compared to pre-EU accession period. Distance estimates in the three first equations are robust to both the inclusion of EU variables and to the different estimation period.

Equations (4) and (5) use additional or different variables accounting for geographical distance, on initial 1990-2019 time frame. In Equation (4), we added a distance adjustment by country, that accounts for internal distance, that is found significant in Brei and von Peter (2018). An approximation for this internal distance is provided by the square root of the country's area multiplied by 0.4 (Head and Mayer, 2013). It is significant for both origin and destination countries at highest standard and distance estimate is lower (but on a different number of observations), pointing towards a decrease in the "distance puzzle". Equation (5) uses the number of hours difference between origin and destination countries (time zone) as the variable accounting for distance: it is not significant at 5%.

Table 9: Gravity equation - Distance robustness and EU dual or individual membership

| Equation | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Dependent | q | q | q | q | q |
| Distance | -1.46*** | -1.53*** | -1.53*** | -1.26*** | |
| | (-3.14) | (-3.92) | (-3.92) | (-2.96) | |
| real_gdp_o_growth0 | -0.07*** | -0.07*** | -0.09*** | -0.03*** | -0.03*** |
| | (-4.16) | (-4.54) | (-8.05) | (-3.22) | (-3.17) |
| real_gdp_d_growth | -0.02 | -0.02 | -0.02 | -0.03*** | -0.03*** |
| | (-0.70) | (-0.73) | (-0.73) | (-2.77) | (-2.81) |
| History | 1.30*** | 1.14*** | 1.15*** | 1.22*** | 1.53*** |
| | (4.75) | (4.74) | (4.74) | (4.99) | (4.45) |
| Adjacency | -0.47 | -0.57*** | -0.57*** | -0.54*** | -0.18 |
| | (-1.43) | (-4.02) | (-4.02) | (-3.58) | (-1.05) |
| Mixed | 0.11 | | | | |
| | (0.38) | | | | |
| Common legal origins | -0.23 | | | | |
| | (-0.81) | | | | |
| eu_both | | -0.12 | | | |
| | | (-0.29) | | | |
| 1=Origin is a EU member | | | 0.96 | | |
| | | | (1.22) | | |
| 1=Destination is a EU member | | | 1.50*** | | |
| | | | (6.99) | | |
| Internal distance origin | | | | -0.00*** | |
| | | | | (-3.71) | |
| Internal distance destination | | | | 0.02*** | |
| | | | | (11.84) | |
| Number of hours difference between o and d | | | | | -0.39 |
| | | | | | (-1.39) |
| Constant | 18.05*** | 17.33*** | 16.27*** | 12.54*** | 0.09 |
| | (3.95) | (6.60) | (4.90) | (3.21) | (0.12) |
| Observations | 2176 | 2191 | 2191 | 2421 | 2408 |
| $R^2$ | 0.867 | 0.856 | 0.856 | 0.752 | 0.722 |
| Origin/Destination Country Fixed Effects | TV | TV | TV | TI | TI |
| Time Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| Error clustering (over distance) | Yes | Yes | Yes | Yes | Yes |
| Countrypair Fixed Effects | No | No | No | No | No |

$z$ statistics in parentheses
$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

# 7 Conclusion

The choice of the gravity model has been relevant in analyzing the determinants of cross-border banking claims of CESEE countries: many gravity variables together with pull, push and global factors are found significant at standard levels. Results are robust to various specifications and controls for fixed or time-varying heterogeneity across countries and countrypairs. Historical, geographical and cultural links have played an important role in financial integration of CESEE countries, together as the European Union bilateral membership and the multilateral Vienna Initiative. Nevertheless, the gravity model does not always identify correctly distance from historical effects.

Characteristics of foreign banking systems are important drivers of cross-border banking claims over the longest estimation sample, with push factors being more significant than pull factors. As in Emter et al. (2019), we find that Non-Performing Loans drive down cross-border banking claims, but only as push factors. Banking concentration as a negative push factor is also significant: this result echoes the European Banking Union's objective to foster banking sector consolidation in order to avoid excessive credit growth and ultimately promote private risk sharing. The US liquidity influence on cross-border banking claims in CESEE-6 countries has also been identified and points towards a policy dilemma. Finally, exchange rate regimes have played and continue to be an important determinant of cross-border banking claims: this obviously has an impact on the timing of the Euro area accession. Exchange rate stability comes at a cost in terms of capital flows' regulation.

The results are slightly different on the shorter 1996-2019 sample: pull factors have more weight than push factors. Banking concentration and capital adequacy ratio have negative signs in our estimations: this may indicate first, a financial stability spillover effect from foreign banks' presence in the CESEE countries (proxied by the banking concentration index) and second, an interesting counter cyclical effect from the capital adequacy ratio in these countries.

Since push, global and exchange rate factors are significant determinants in the long run, we formulate the following policy recommendation: if CESEE countries want to exercise better control over the level of their external banking liabilities, fostering international cooperation is necessary, maybe through European Banking Union or Euro area early membership.

Further research could extend the analysis from various perspectives, particularly on the role of institutions and regulation. Our results are mixed since regulatory quality distance variable has been found statistically insignificant, but at the same time regulatory capital, European Union membership and Vienna Initiative variables are significant variables. The role of macroprudential measures in this respect should be further investigated.

Second, gravity model estimates point towards a large influence of time-invariant characteristics, particularly the (low) distance and the historical relationships. In our opinion, this means we could estimate a panel model with a spatial interdependence structure. To illustrate our point, we have included in Appendix 1.F an isochrone railway map of the Austro-Hungarian empire in 1914, that shows a very high level railway density from Austria towards Hungary, Poland and even Croatia at that time. It will be interesting to understand the role of real distance in the informational frictions of the financial gravity model for these countries.

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## Appendix 1.A Historical evolution by country of foreign banks' ownership of banking assets (Figure 7); External assets and liabilities (Figure 8)

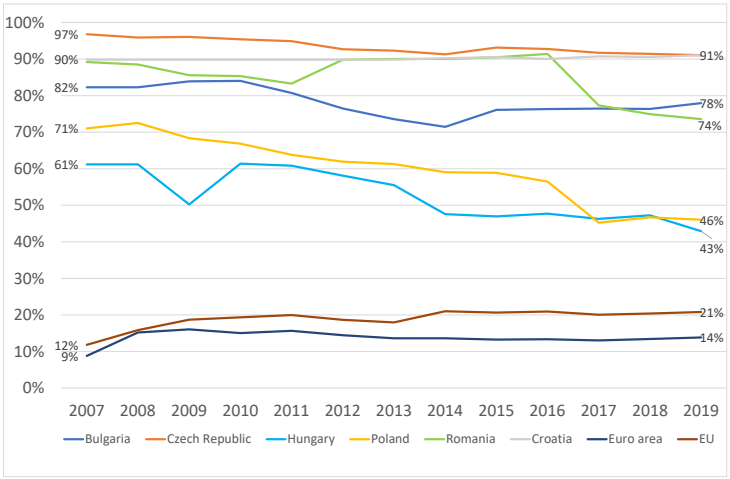


Figure 7: Foreign banks' ownership of domestic banking assets (2007-2019)
Source: ECB Consolidated Banking Statistics

We decompose the assets and liabilities positions by functional category and by country in Figure 8, over the 1989-2020 period.
Five Investment functional categories are included into international accounts, with some definition variations: (a) Direct Investment; (b) Portfolio Investment; (c) Financial Derivatives; (d) Other Investments and (e) Reserve assets. These investment categories are derived from IMF Balance of Payments Manuals (BPM5 or BPM6).
Notes: Positions are expressed in USD hundreds of billion for the Czech Republic, Hungary, Poland and Romania; in USD tens of billion for Croatia and Bulgaria. Gold holdings are excluded from foreign exchange reserves, whereas they are included in official IIP statistics, as these are not financial claims on another economy.

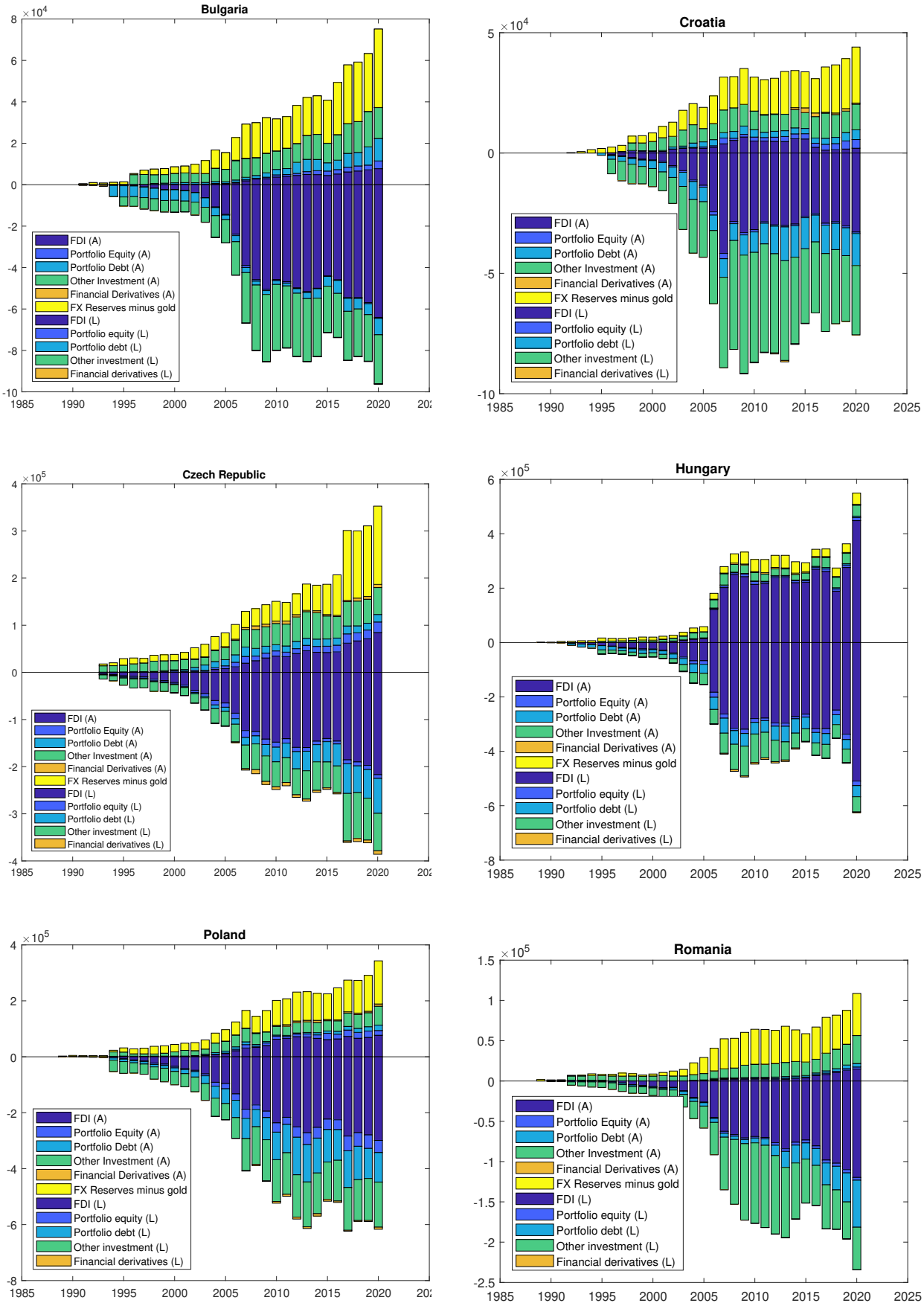


Figure 8: Historical evolution of external assets and liabilities by country (1989-2020)

Source: External Wealth of Nations Mark II database (Lane and Milesi-Ferretti, 2017) and author's calculations from IMF IIP

# Appendix 1.B Unit root tests and descriptive statistics of variables

Table 10: Im et al. (2003) IPS unit root test results

| Variables | Avg ADF lag | i | Avg nb of periods | W_t_bar |
|---|---|---|---|---|
| *Cross-border banking claims* | | | | |
| AIC criteria | 0.39 | 119 | 20.85 | -4.75 |
| BIC criteria | 0.34 | 119 | 20.85 | -4.76 |
| HQ criteria | 0.39 | 119 | 20.85 | -4.99 |
| Predefined | 1 | 119 | | -3.89 |
| *Individual and institutional variables* | | | | |
| bank_conce o | 0.25 | 119 | 21.55 | -4.54 |
| bank_conce d | 0.31 | 119 | 21.92 | -7.17 |
| NPL_o | 0.52 | 113 | 18.88 | -6.96 |
| NPL_d | 0.66 | 119 | 17.41 | -6.25 |
| reg_cap_o | 0.2 | 113 | 19.42 | 12.67 |
| reg_cap_d | 0.5 | 119 | 17.75 | -4.02 |
| ERstability_o | 0.18 | 114 | 29.68 | -22.20 |
| ERstability_d | 0.17 | 119 | 29.15 | -13.16 |
| Regulatory_quality_o | 0.20 | 119 | 24 | -4.65 |
| Regulatory_quality_d | 0.50 | 119 | 23.97 | -2.29 |
| cred_market_size_o | 0.69 | 113 | 27.58 | 2.17 |
| cred_market_size_d | 0.83 | 119 | 25.77 | -3.93 |
| *Global and individual controls* | | | | |
| Global_factor | 1 | 119 | 30 | -15.89 |
| Log_USMonetaryBase (trend) | 0 | 119 | 30 | 6.56 |
| TedSpreadUS | 1 | 119 | 30 | -35.26 |
| l_fdi_d | 0.5 | 119 | 28.05 | -12.77 |
| ouv_comm_o (trend) | 0.11 | 113 | 28.57 | -2.79 |
| ouv_comm_d (trend) | 0.34 | 119 | 28.50 | -8.16 |
| *GDP variables* | | | | |
| l_gdp_real_o (trend) | 0.58 | 113 | 30 | 2.09 |
| l_gdp_real_d (trend) | 0.83 | 119 | 29 | 10.39 |

H0: All panel units have unit root; H1: Some panel units are stationary;
W_t_bar: standardized test statistic; Test critical value is the value of standardized N(0,1) @ 5%-1.96
i: Individual dimension (number of countrypairs); Avg: average; Nb: Number

Table 11: Descriptive statistics (with variable labels)

| | Nb obs | Mean | Standard Deviation | Min | Max |
|---|---|---|---|---|---|
| Outstanding claims of BIS reporting banks | 2615.00 | 1697.50 | 3904.99 | 0.00 | 33181.00 |
| Distance (logs) | 4525.00 | 7.91 | 1.08 | 5.62 | 9.65 |
| 1=Contiguity | 4512.00 | 0.03 | 0.18 | 0.00 | 1.00 |
| 1=Pair ever in sibling relationship | 4527.00 | 0.01 | 0.11 | 0.00 | 1.00 |
| 1=Pair ever in colonial relationship | 4514.00 | 0.02 | 0.14 | 0.00 | 1.00 |
| 1=Common legal origins after transition | 4514.00 | 0.26 | 0.44 | 0.00 | 1.00 |
| 1=RTA (Source: WTO, 2015) | 4514.00 | 0.34 | 0.47 | 0.00 | 1.00 |
| Real USD GDP_o (l_gdp_real_o, in logs) | 4188.00 | 27.17 | 1.43 | 22.73 | 30.54 |
| Real USD GDP_d (l_gdp_real_d, in logs) | 4389.00 | 25.54 | 0.76 | 24.16 | 27.22 |
| Regulatory quality index o | 3528.00 | 1.36 | 0.49 | -0.32 | 2.23 |
| Regulatory quality index d | 3619.00 | 0.69 | 0.37 | -0.18 | 1.31 |
| Regulatory quality distance index | 3525.00 | 0.77 | 0.46 | 0.00 | 2.21 |
| EU common membership | 4516,00 | 0.17 | 0.38 | 0.00 | 1.00 |
| Vienna Initiative 1 participant | 4530.00 | 0.03 | 0.18 | 0.00 | 1.00 |
| Banking crisis dummy - o | 4222.00 | 0.11 | 0.31 | 0.00 | 1.00 |
| Banking crisis dummy - d | 4218.00 | 0.13 | 0.34 | 0.00 | 1.00 |
| Bank non-performing loans to gross loans (%) - o | 2700.00 | 3.51 | 5.08 | 0.09 | 45.57 |
| Bank non-performing loans to gross loans (%) - d | 2634.00 | 9.06 | 6.16 | 1.80 | 29.30 |
| Bank regulatory capital to risk-weighted assets (%) - o | 2765.00 | 14.18 | 3.16 | 7.00 | 26.94 |
| Bank regulatory capital to risk-weighted assets (%) - d | 2686.00 | 16.66 | 5.09 | 10.40 | 41.80 |
| Domestic credit to private sector (% of GDP) - o | 3953.00 | 103.09 | 45.70 | 12.88 | 233.21 |
| Domestic credit to private sector (% of GDP) - d | 3899.00 | 39.73 | 17.85 | 7.13 | 82.80 |
| Bank concentration (%) - o | 3240.00 | 66.68 | 19.51 | 20.19 | 100.00 |
| Bank concentration (%) - d | 3312.00 | 57.73 | 12.38 | 34.32 | 100.00 |
| Exchange Rate Stability Index$_o$ | 3750.00 | 0.66 | 0.33 | 0.05 | 1.00 |
| Exchange Rate Stability Index$_d$ | 3623.00 | 0.43 | 0.26 | 0.02 | 1.00 |
| GlobalFactor | 4530.00 | 0.30 | 0.78 | -0.90 | 2.57 |
| US Monetary base (l_monetarybase, in logs) | 4530.00 | 13.88 | 0.88 | 12.66 | 15.19 |
| Ted spread USD | 4530.00 | 0.46 | 0.30 | 0.14 | 1.34 |
| FDI in destination country (l_fdi_d, in logs) | 4085.00 | 21.53 | 1.91 | 9.21 | 25.04 |
| ouv_commerce_o | 4068.00 | 67.57 | 59.62 | 9.03 | 419.96 |
| ouv_commerce_d | 4311.00 | 84.94 | 33.61 | 32.21 | 159.14 |

# Appendix 1.C Cross-correlation matrix of gravity and policy variables

| Variables | q | Distance | 1=Contiguity | 1=Sibling | 1=Imperial | History | Adjacenccy | Mixed | 1= Language | 1=EU$_o$ | 1=EU$_D$ | eu_both | vienna_1_o | gdp_o | gdp_d |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIS Outstanding claims | 1.000 | | | | | | | | | | | | | | |
| Distance | -0.324 | 1.000 | | | | | | | | | | | | | |
| | (0.000) | | | | | | | | | | | | | | |
| 1=Contiguity | 0.429 | -0.315 | 1.000 | | | | | | | | | | | | |
| | (0.000) | (0.000) | | | | | | | | | | | | | |
| 1=Sibling relationship | 0.073 | -0.152 | 0.302 | 1.000 | | | | | | | | | | | |
| | (0.000) | (0.000) | (0.000) | | | | | | | | | | | | |
| 1=Imperial relationship | 0.499 | -0.252 | 0.504 | -0.017 | 1.000 | | | | | | | | | | |
| | (0.000) | (0.000) | (0.000) | (0.184) | | | | | | | | | | | |
| History | 0.276 | -0.175 | -0.022 | 0.493 | 0.399 | 1.000 | | | | | | | | | |
| | (0.000) | (0.000) | (0.084) | (0.000) | (0.000) | | | | | | | | | | |
| Adjacency | 0.211 | -0.207 | 0.626 | -0.013 | -0.017 | -0.013 | 1.000 | | | | | | | | |
| | (0.000) | (0.000) | (0.000) | (0.279) | (0.184) | (0.280) | | | | | | | | | |
| Mixed | 0.373 | -0.233 | 0.769 | 0.399 | 0.660 | -0.016 | -0.016 | 1.000 | | | | | | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.184) | (0.184) | | | | | | | | |
| Common official language | . | . | . | . | . | . | . | . | . | | | | | | |
| | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | | | | | | | |
| Origin EU member | 0.246 | -0.740 | 0.119 | 0.096 | 0.065 | 0.058 | 0.069 | 0.095 | . | 1.000 | | | | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (1.000) | | | | | | |
| Destination EU member | 0.253 | 0.006 | 0.017 | -0.004 | -0.005 | -0.021 | 0.013 | 0.009 | . | 0.075 | 1.000 | | | | |
| | (0.000) | (0.605) | (0.178) | (0.758) | (0.705) | (0.087) | (0.279) | (0.448) | (1.000) | (0.000) | | | | | |
| Both EU members | 0.388 | -0.352 | 0.091 | 0.039 | 0.048 | 0.018 | 0.060 | 0.065 | . | 0.465 | 0.674 | 1.000 | | | |
| | (0.000) | (0.000) | (0.000) | (0.002) | (0.000) | (0.155) | (0.000) | (0.000) | (1.000) | (0.000) | (0.000) | | | | |
| vienna_1_o | 0.249 | -0.140 | 0.042 | 0.056 | 0.039 | 0.056 | 0.019 | 0.039 | . | 0.152 | 0.167 | 0.261 | 1.000 | | |
| | (0.000) | (0.000) | (0.001) | (0.000) | (0.002) | (0.000) | (0.123) | (0.002) | (1.000) | (0.000) | (0.000) | (0.000) | | | |
| real_gdp_o_growth | -0.127 | 0.169 | -0.052 | -0.057 | -0.030 | -0.038 | -0.027 | -0.045 | . | -0.103 | -0.127 | -0.177 | -0.203 | 1.000 | |
| | (0.000) | (0.000) | (0.001) | (0.000) | (0.060) | (0.016) | (0.090) | (0.004) | (1.000) | (0.000) | (0.000) | (0.000) | (0.000) | | |
| real_gdp_d_growth | -0.004 | -0.007 | -0.000 | -0.014 | 0.012 | -0.003 | -0.005 | 0.003 | . | 0.029 | 0.131 | 0.081 | -0.129 | 0.175 | 1.000 |
| | (0.830) | (0.667) | (0.974) | (0.376) | (0.422) | (0.824) | (0.728) | (0.825) | (1.000) | (0.057) | (0.000) | (0.000) | (0.000) | (0.000) | |

# Appendix 1.D Cross-correlation matrix of banking variables

| Variables | q | vienna_1_o | Crisis- o | Crisis- d | Conc-o | Conc-d | NPLs - o | NPLs - d | Reg cap-o | Reg cap-d | Credit- o | Credit - d | ERS- o | ERS- d | FDI_d |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BIS Outstanding claims | 1.000 | | | | | | | | | | | | | | |
| vienna_1_o | 0.249 | 1.000 | | | | | | | | | | | | | |
| | (0.000) | | | | | | | | | | | | | | |
| Banking crisis dummy - o | 0.233 | 0.299 | 1.000 | | | | | | | | | | | | |
| | (0.000) | (0.000) | | | | | | | | | | | | | |
| Banking crisis dummy - d | 0.007 | 0.040 | 0.083 | 1.000 | | | | | | | | | | | |
| | (0.690) | (0.001) | (0.000) | | | | | | | | | | | | |
| Bank concentration (%) - o | 0.003 | 0.043 | -0.114 | -0.027 | 1.000 | | | | | | | | | | |
| | (0.898) | (0.015) | (0.000) | (0.124) | | | | | | | | | | | |
| Bank concentration (%) - d | -0.208 | -0.117 | -0.135 | 0.148 | -0.004 | 1.000 | | | | | | | | | |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.809) | | | | | | | | | | |
| Bank NPLs to gross loans (%) - o | 0.009 | 0.112 | 0.102 | 0.017 | 0.001 | 0.015 | 1.000 | | | | | | | | |
| | (0.710) | (0.000) | (0.000) | (0.376) | (0.964) | (0.434) | | | | | | | | | |
| Bank NPLs to gross loans (%) - d | -0.108 | 0.030 | -0.081 | 0.280 | -0.037 | 0.355 | 0.107 | 1.000 | | | | | | | |
| | (0.000) | (0.118) | (0.000) | (0.000) | (0.061) | (0.000) | (0.000) | | | | | | | | |
| Bank regulatory capital to RWA (%) - o | 0.086 | -0.032 | -0.030 | -0.075 | -0.054 | -0.111 | 0.093 | 0.090 | 1.000 | | | | | | |
| | (0.000) | (0.095) | (0.117) | (0.000) | (0.005) | (0.000) | (0.000) | (0.000) | | | | | | | |
| Bank regulatory capital to RWA (%) - d | -0.150 | -0.041 | -0.109 | -0.134 | -0.035 | 0.209 | 0.088 | 0.358 | 0.131 | 1.000 | | | | | |
| | (0.000) | (0.035) | (0.000) | (0.000) | (0.073) | (0.000) | (0.000) | (0.000) | (0.000) | | | | | | |
| Domestic credit to private sector (% GDP) - o | -0.027 | 0.020 | 0.118 | 0.021 | -0.164 | -0.127 | -0.120 | -0.025 | 0.008 | -0.036 | 1.000 | | | | |
| | (0.157) | (0.133) | (0.000) | (0.111) | (0.000) | (0.000) | (0.000) | (0.209) | (0.675) | (0.068) | | | | | |
| Domestic credit to private sector (% GDP) - d | 0.132 | 0.156 | 0.158 | 0.013 | -0.047 | -0.463 | 0.058 | -0.014 | 0.295 | -0.200 | 0.090 | 1.000 | | | |
| | (0.000) | (0.000) | (0.000) | (0.398) | (0.007) | (0.000) | (0.003) | (0.480) | (0.000) | (0.000) | (0.000) | | | | |
| Exchange Rate Stability Index - o | 0.094 | 0.148 | 0.033 | -0.075 | 0.105 | -0.033 | 0.208 | 0.005 | 0.151 | 0.003 | -0.058 | 0.019 | 1.000 | | |
| | (0.000) | (0.000) | (0.039) | (0.000) | (0.000) | (0.068) | (0.000) | (0.807) | (0.000) | (0.869) | (0.001) | (0.251) | | | |
| Exchange Rate Stability Index - d | -0.090 | -0.012 | -0.055 | -0.215 | -0.014 | -0.267 | 0.028 | 0.034 | 0.095 | 0.461 | 0.096 | 0.217 | 0.080 | 1.000 | |
| | (0.000) | (0.418) | (0.000) | (0.000) | (0.442) | (0.000) | (0.151) | (0.079) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | | |
| FDI_d | 0.153 | 0.009 | 0.084 | 0.018 | -0.001 | -0.228 | -0.059 | -0.259 | -0.008 | -0.276 | 0.173 | 0.067 | 0.034 | -0.032 | 1.000 |
| | (0.000) | (0.522) | (0.000) | (0.205) | (0.975) | (0.000) | (0.002) | (0.000) | (0.663) | (0.000) | (0.000) | (0.000) | (0.036) | (0.040) | |

## Appendix 1.E Variance Inflation Factor analysis

Table 14: VIF analysis for Tables 4, 5 and 6

| **Variable** | **VIF** | **Tolerance** |
|---|---|---|
| Distance | 1.18 | 0.85 |
| real_gdp_o_growth | 1.06 | 0.94 |
| real_gdp_d_growth | 1.03 | 0.97 |
| History | 1.08 | 0.92 |
| Adjaceny | 1.11 | 0.90 |
| Mixed | 1.10 | 0.91 |
| Common legal origins | 1.13 | 0.88 |
| **Mean VIF** | **1.10** | |

| **Variable** | **VIF** | **Tolerance** |
|---|---|---|
| real_gdp_o_growth | 1.49 | 0.67 |
| real_gdp_d_growth | 1.60 | 0.62 |
| banking_crisis_dum_o | 1.52 | 0.66 |
| banking_crisis_dum_d | 1.30 | 0.77 |
| vienna_1_o | 1.26 | 0.80 |
| NPL_o | 1.18 | 0.85 |
| NPL_d | 1.86 | 0.54 |
| reg_capital_o | 1.27 | 0.79 |
| reg_capital_d | 1.79 | 0.56 |
| bank_concentration_o | 1.05 | 0.95 |
| bank_concentration_d | 1.36 | 0.74 |
| Exchange Rate Stability Index - o | 1.14 | 0.88 |
| Exchange Rate Stability Index - d | 1.50 | 0.67 |
| credit_size_growth_o | 1.15 | 0.87 |
| credit_size_growth_d | 1.88 | 0.53 |
| **Mean VIF** | **1.42** | |

| **Variable** | **VIF** | **Tolerance** |
|---|---|---|
| real_gdp_o_growth | 1.41 | 0.71 |
| real_gdp_d_growth | 1.53 | 0.66 |
| banking_crisis_dum_o | 1.47 | 0.68 |
| banking_crisis_dum_d | 1.17 | 0.85 |
| vienna_1_o | 1.22 | 0.82 |
| Exchange Rate Stability Index - o | 1.24 | 0.80 |
| Exchange Rate Stability Index - d | 1.28 | 0.78 |
| ouv_commerce_o | 1.22 | 0.82 |
| ouv_commerce_d | 1.37 | 0.73 |
| lfdi_d | 1.56 | 0.64 |
| credit_size_growth_o | 1.02 | 0.98 |
| credit_size_growth_d | 1.43 | 0.70 |
| TedspreadUSD | 1.48 | 0.67 |
| monet_base_growth | 1.48 | 0.67 |
| **Mean VIF** | **1.35** | |

## Appendix 1.F Sibling relationship: the Austro-Hungarian Empire

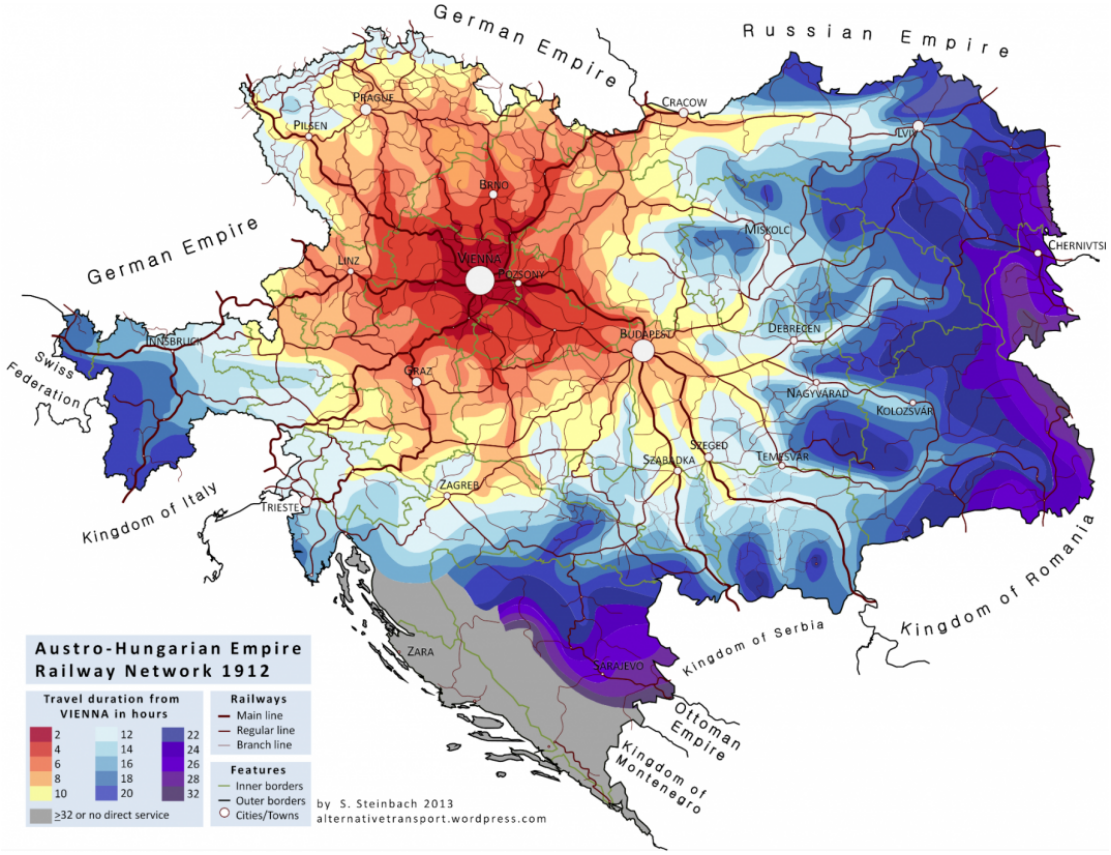


Figure 9: Isochrone railway map - Austro-Hungarian Empire in 1914; Source: Europe Centrale et Balkanique: Atlas d'histoire politique (Editions Complexe, 1995)

## Appendix 1.G BIS outstanding claims - Reporting start dates by countrypair

| | | Destination countries | | | | | |
|---|---|---|---|---|---|---|---|
| | | BGR | CZE | HRV | HUN | POL | ROU |
| **Origin countries** | | **Bulgaria** | **Czech Rep** | **Croatia** | **Hungary** | **Poland** | **Romania** |
| AUT | **Austria** | 2007 | 2007 | 2007 | 2007 | 2007 | 2007 |
| BEL | **Belgium** | 1978 | 1993 | 1994 | 1978 | 1978 | 1978 |
| DEU | **Germany** | 1978 | 1993 | 1999 | 1978 | 1978 | 1978 |
| ESP | **Spain** | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 |
| FIN | **Finland** | 1983 | 1993 | 1999 | 1983 | 1983 | 1997 |
| FRA | **France** | 1978 | 1993 | 1993 | 1978 | 1978 | 1978 |
| GRC | **Greece** | 2007 | 2005 | 2010 | 2005 | 2005 | 2007 |
| IRL | **Ireland** | 1996 | 1997 | 1997 | 1991 | 1996 | 1997 |
| ITA | **Italy** | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 |
| LUX | **Luxembourg** | 1978 | 1993 | 1993 | 1978 | 1978 | 1978 |
| NLD | **Netherlands** | 2014 | 1993 | 2014 | 1978 | 1978 | 1978 |
| AUS | **Australia** | 2006 | 2004 | 2007 | 2003 | 2004 | 2012 |
| CAN | **Canada** | 2007 | 2014 | - | 2016 | 2014 | 2014 |
| CHE | **Switzerland** | 1977 | 1993 | 1993 | 1977 | 1977 | 1977 |
| DNK | **Denmark** | 1977 | 1993 | 1993 | 1977 | 1977 | 1978 |
| GBR | **UK** | 1977 | 1993 | 1994 | 1977 | 1977 | 1977 |
| HKG | **Hong-Kong** | 2014 | 2014 | 2014 | 2014 | 2014 | 2014 |
| JPN | **Japon** | 1981 | 1993 | 1996 | 1981 | 1977 | 1977 |
| KOR | **South Korea** | 2005 | 2005 | 2005 | 2005 | 2005 | 2005 |
| MAC | **Macao** | 2003 | - | - | 2014 | - | 2003 |
| MEX | **Mexico** | 2017 | - | 2017 | 2016 | - | - |
| SWE | **Sweden** | 1977 | 1995 | 1997 | 1977 | 1977 | 1977 |
| TWN | **Taipei** | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 |
| USA | **USA** | 1978 | 1997 | - | 1978 | 1977 | 1978 |
| ZAF | **South Africa** | 2010 | - | - | 2016 | 2013 | 2013 |

# Appendix 1.H Literature review

Table 15: Push and pull factors identified in selected literature related to CESEE capital flows

| | **Pull factors (Country-specific, Destination countries)** | **Push factors (Global or from Origin countries)** |
|---|---|---|
| **Brana and Lahet (2012)** | | |
| Macro-level | *Country growth rate - destination countries* | *Country growth rate - origin countries* |
| | *Foreign banks assets among total banks assets* | *Non Performing Loans (% total loans) - origin countries* |
| | Country rating (Standard & Poors) | *Bank profitability - origin countries* |
| | ERDB transition indicators | Euro area M3 growth rate |
| | Bank capitalization ratio | M3/PIB excess liquidity ratio |
| | Bank liquidity ratio | US and Euro Ted spread |
| **International Monetary Fund (2014)** | | |
| Macro-level | *Lagged real GDP growth* | *Global investor risk aversion (VIX)* |
| Dep: Cross-border bank flows | *Loan-to-deposit ratio* | *G4 Financial Leverage (non core bank funding/total funding)* |
| 18 CESEE countries | *Lagged ROE* | *USD-DEU 10-year yield spread* |
| 2009-Q2/2013Q3 | *Non Performing Loans (% total loans) - origin countries* | Price index of global liquidity (Chen et al (2013)) |
| Dep: Changes in BIS locational data | *Level of parent bank funding as a share of GDP (Cerutti 2013)* | US 10-year government bond yield |
| (exchange rate adjusted) | *Changes in sovereign CDS spreads* | Weighted average of CDS spreads of parent banks in host country |
| | Government debt (% of GDP) | Key policy rates in advanced economies |
| | Current account balance (% of GDP) | |
| | Bank credit growth | |
| **Herrmann and Mihaljek (2011)** | | |
| Dep: log of quarterly, change in | *General government balance (borrower country risk)* | *VIX Index* |
| BIS external positions, exchange-rate adjusted | *Bilateral financial openness ratio* | Common lender effect indicator |
| (not strictly a pull/push analysis) | *Reinhart- Rogoff (2004) exchange rate regime index* | Deviation of the banking subindex from the main equity index |
| | *Deviation of the banking subindex from the main equity index* | |
| **Emter et al. (2019)** | | |
| Dep: Cross-border loans to banks | *Non Performing Loans (% total loans) - origin countries* | *Non Performing Loans (% total loans) - origin countries* |
| 2008-2015 | *Return On Equity (ROE)* | Return On Equity (ROE) |
| EU-27 or EU-18 | Leverage ratio | Leverage ratio |
| Gravity model | Short-term interest rate | Short-term interest rate |
| | Long-term interest rate | Long-term interest rate |
| | Central Bank liquidity | Central Bank liquidity |
| | *Index of prudential policy stringency (PPI) - lender* | *Index of prudential policy stringency (PPI) - lender* |
| | Index of prudential policy stringency (PPI) - borrower | Index of prudential policy stringency (PPI) - borrower |
| | Measure of the tax burden arising from levies on banks (TAX) | Measure of the tax burden arising from levies on banks (TAX) |

Note: Significant variables are highlighted in red.