Regulatory arbitrage and global push factors

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Abstract

This paper identifies two theoretical mechanisms that relate the regulatory arbitrage behavior of internationally active banks (IABs) to global financial conditions. According to the first mechanism, regulation becomes more binding during adverse financial conditions. Under these conditions, IABs face higher compliance costs in more regulated markets. According to the second mechanism, higher regulation suppresses the degree of risk-taking and asset returns so that highly-regulated nations are more insulated from global financial risk. These results are reversed in less-regulated nations. We use a panel of bilateral BIS banking statistics and a unique empirical strategy to find that the first of the two theoretical mechanisms above is more prevalent. Specifically, IABs expand their claims more rapidly in less-regulated nations when global perception of financial risk is higher. The direction of arbitrage is reversed under loose conditions. This evidence is corroborated by the inferences from a structural vector autoregressive model fitted to data from individual countries.

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1 Introduction

Despite efforts to harmonize bank regulation in the past 30 years, regulation of internationally active banks (IABs) remains fragmented.[1] The regulatory differences that IABs face across the host nations where they hold claims would be irrelevant if these claims were stable. Evidence shows otherwise. IABs, use their internal capital markets effectively and frequently to shift large amounts of funds across countries (Avdjiev et al., 2019; Cetorelli and Goldberg, 2012; Fratzscher, 2012). This mobility, given the size of funds, has dramatic implications for local and global financial markets and economies.

Amongst other factors, such as changing local and global economic conditions, changes in the regulatory stringency in host-nations is often identified as the reason why IABs reshuffle their global portfolios. Studies such as Houston et al. (2012), Bremus and Fratzscher (2015), and Ongena et al. (2013) find that IABs direct funds to countries (especially advanced economies) with less regulation. In this paper, we predict and find that this negative relationship between a host-nation's regulatory stringency and its IAB claims is observed only under adverse global financial conditions. By contrast, if global financial conditions are loose, we find evidence showing that countries with more stringent banking regulation experience a higher growth in IAB claims.

To explain this seemingly conflicting effects of regulation on bank claims, we build a two bank, two country model in which one country regulates banking while the other does not. The model is characterized by two counteracting mechanisms. According to the first mechanism, more stringent regulation decreases returns due to high compliance costs in the regulated country. By contrast, higher regulation benefits banks by decreasing the riskiness of their asset holdings in the regulated market. While these two mechanisms have not been investigated jointly, to the best of

[1] In the World Bank surveys that we use in this paper, the coefficient of variation (CV) for the overall restrictiveness of financial conglomerates, our basline regulatory variable, is 0.27. While this amount of variation is small compared to most macroeconomic variables (real GDP growth, for example, has a CV of 1.08 in our sample), it is not too different, if not larger, than the CV for the other institutional variables in the World Bank surveys. For example, CVs for financial statement transparency and external governance indices are 0.18 and 0.12.

our knowledge, there is empirical evidence, some of which we discuss below, showing that they are both alive.

We model banks' portfolio allocation decision as a simultaneous game in which the banks have mean-variance preferences over asset returns. The optimality conditions from banks' maximization problem produces a Sharpe ratio which includes indicators of regulatory stringency and global financial conditions. It should be pointed out here that the Sharpe ratio is an equilibrium quantity. Using this ratio we weigh the two counteracting effects of regulation on portfolio returns, variance and risk diversification across the two countries, and ultimately on the amount of IAB funds that the regulated country receives. The comparison shows that a country with a higher degree of bank regulation could experience a larger retrenchment of IAB claims (despite a setback in diversification benefits) if global financial markets conditions are sufficiently adverse. This result is reversed under loose global financial conditions and the more regulated country receives a higher share of banking assets.

In the second half of the paper, we empirically test our theoretical predictions by using country level banking statistics from the Bank for International Settlements (BIS). The key feature of the BIS statistics is that they are bilaterally available for country pairs and thus they provide a unique opportunity to investigate how regulatory differences interact with global financial conditions to determine the country-by-country allocation of IAB claims. More specifically, using the BIS database we are able to track the changes in the country-specific claims of IABs (local claims booked through the affiliates of IABs in host-nations) operating and/or headquartered in reporting countries. Our dataset is populated by annual observations of banking claims from 2000 to 2018. Matching these data with country-specific regulatory indices and indicators of global financial conditions (i.e, global push factors) for the same time period allows us to observe how IABs' reaction to regulatory differences, i.e., regulatory arbitrage, depends on global financial conditions.

The bilateral dimension of the data also proves advantageous for our identification strategy. By comparing the IAB claim growth rate of a reporting country across the host-nations where it holds these claims, we are able to control for any fixed and time-varying reporting-country-specific effects that may influence lending. Shutting down these so-called push effects allows us to uniquely identify the host-nation-specific effects on IAB claim growth. Doing so with a dynamic panel model estimator is more suitable for our dataset and identification as estimators with fixed effects cannot simultaneously control for both fixed and time varying reporting-country-specific effects. Besides push factors, we also control for the strength of local economies when determining the relationship between regulation and IAB claims.

To gauge regulatory stringency we use the indices in Barth et al. (2013) that are derived from World Bank Surveys of Bank Regulation. These surveys were conducted in years 1999, 2003, 2007 and 2011 and cover various dimensions of bank regulation such as restrictions on underwriting, owning non-financial firms, entry, and stringency in regulating asset risk and index that captures the transparency of bank financial statements. We add 5 push variables to our baseline dataset. These are amongst the widely-agreed indicators of global financial conditions (e.g., Miranda-Agrippino and Rey, 2015). Two of the push variables, VIX and VSTOXX, are volatility indices that measure the degree of risk aversion in the US and European financial markets respectively. We use the FED funds rate given evidence that links global push effects to US monetary policy. The remaining two, Baa-Aaa corporate bond spread and the Gilchrist and Zakrajsek (2012) credit spread are commonly-used measures of credit risk.

The main inference from our estimations is that there is a retrenchment of IAB claims in countries with high regulation only at higher values of the push variables (adverse global financial conditions). Otherwise, higher degree of regulation attracts IAB claims. These results imply that strict regulation could be more (less) costly during adverse (loose) global financial conditions and that the first mechanism in our theoretical framework may be the principal driver of IAB claims. This inference is drawn from an empirical model that includes global factors and allows these factors to interact with regulatory indices. When we exclude global push factors, we find, especially for advanced economies, that higher regulation drives away IAB assets. This finding corroborates the evidence for regulatory arbitrage in the literature (e.g., Houston et al., 2012). More critically, the disparity between this result and our main results imply that omitting global financial conditions when assessing the impact of regulation on IAB asset holdings could be misleading. In other words, the nature of the financial trilemma that countries face can depend on global financial conditions. A country that safeguards its financial markets with higher regulation, for example, may not have to sustain banking outflows during loose financial conditions.

In our empirical analysis, we also conduct various other tests. We use different regulatory indices, different periods, and we account for the 2008 financial crisis, exchange rate fluctuations and economic significance. All of these tests provide support for our main inference that the well-documented regulatory arbitrage behavior of banks is observed only under adverse global financial conditions. By using a different identification strategy, we also infer that it is the regulatory stringency of host-nations, and not that of IABs home countries, that affect IAB claims and significantly interact with global factors.

In addition to this evidence from panel data, we investigate whether the same inference can be drawn on a country-by-country basis. We fit a structural vector autoregressive (SVAR) model individually to the reporting countries in BIS statistics. We allow for the interaction between regulation and global push factors by using a unique strategy and we find that reporting countries' claims grow by a smaller amount in more regulated host nations compared to those with less regulation. This stronger and more dynamic result reinforces our main inference.

We should note the two general perspectives in our paper. First, the paper reasonably treats regulatory stringency as an institutional variable that is much more stable across time compared to most macroeconomic and financial variables. It is further assumed that regulatory differences across countries are more stable compared to the global push factors across time. This is a reasonable assumption as we observe that while regulatory indices change from one survey to the other, the differences across countries remain relatively constant.[2] It is not the change in regula-

[2]For example, the indices for overall financial conglomerates restrictiveness in the US were 9, 7, 8 and 10 accord-

tory stringency but rather the change in how regulation becomes more or less binding over time is the key factor in our analysis. Second the analysis primarily focuses on a non-crisis setting as the linear dynamic panel estimators that we use are a better fit for periods with smaller disturbances. Nevertheless, we investigate how our main inferences change when we allow for a more dynamic regulatory variable and incorporate the financial crisis periods, 2008 and 2009.

Our empirical results are driven by two theoretical mechanisms related to bank regulation, the higher costs of regulation during adverse financial conditions and the mitigating effects of regulation on asset market risk. There is evidence, albeit documented by separate strands of the literature, showing that both mechanisms exist and that they have shaped banks' decision-making during the time period that we analyze. On the first of these mechanisms, there is a vast literature on the relationship between economic/financial conditions and regulatory costs. While most studies focus on severe market downturns/upswings and financial crisis (Almasi, et al. 2017; Blinder, 2015; Dagher, 2018; Goldstein, 2009), others such as Angelini et al. (2009), Beatty et al. (2019) investigate more general business cycles. The inference, however, is the same: regulation is more costly for banks during downswings. According to this research, both the perception and quantity of risk rises during adverse economic/financial conditions, risk-based capital requirements become more binding for banks and regulatory agencies receive more funding and resources. By contrast these effects are reversed during upswings. The same principal applies to other institutional aspects such as accounting standards, managerial incentives (Trichet, 2009). There is additional evidence for higher regulatory costs during downturns. Kowalska et al. (2017) and Liu and Ryan (2006), for example, find that banks' in more regulated countries hold more loan loss provisions during downturns compared to banks in less regulated countries to avoid regulatory scrutiny. Studies such as Nodari (2014) and Mahoney (2019) similarly find that higher financial regulation uncertainty observed during downswings increases bank borrowing and regulatory compliance costs. Overall,

ing to the 2001, 2004, 2007 and 2011 surveys, respectively. The corresponding values for the UK were 3, 3, 5 and 5. A similar disparity is observed for most of the country pairs.

as regulation becomes more binding in response to higher market risk, banks restrict lending by more than what capital crunch theory would predict. This incremental restriction is the difference between the two countries in our theoretical framework. We should also note that while the weaker interaction between global push factors and regulation after 2009 in our empirical results suggests that prudential regulatory policies in Basel III may have been effective, the interaction remains statistically and economically significant after 2009.

On the second mechanism, the risk mitigating effects of bank regulation, there is a large body of literature. Studies such as Barth et al. (2004), Buch and DeLong (2008), Kim and Santomero (1994), Laeven and Levine (2009) and Ongena et al. (2013) indicate that banks should and do take less risk in response to higher regulation. In addition, studies such as Delis and Staikouras (2011) and Klomp and de Haan (2012) find that the distance to default is shorter with more regulation such as stricter leverage restrictions, and that regulation generally reduces the riskiness of banks' assets. A branch of the literature (Ongena et al., 2013; Goldberg, 2009) further finds that banks facing higher regulation at home shift funds and lower lending standards abroad. Unlike this literature, we find that IABs' fund allocation is driven by asymmetric regulations in host-nations, not by those where they are headquartered. This is in spirit with the international regulatory arbitrage behavior (amongst host-nations) identified by Houston et al. (2012) and Bremus and Fratzscher (2015). As mentioned above the unique finding in our analysis is that this arbitrage behavior depends on global financial conditions – higher regulation causes a retrenchment (growth) in IAB claims during downswings (upswings).

2 Theoretical analysis

In this section, we consider a model where banks allocate assets between countries with different degrees of regulatory stringency. In the model, regulatory measures can be interpreted as the capital requirements and leverage restrictions imposed on banks. The mechanical effect of forcing banks to set aside capital, for example, is that it increases the cost of holding assets, thereby reducing the expected return of bank's assets. Similarly, leverage restrictions reduces variability of asset returns. In other words, regulatory measures affect the first and second moments of banks' asset returns. Therefore, banks' optimal asset allocation problem translates naturally into a standard mean-variance framework for a portfolio problem as the one first introduced in Markowitz (1952).[3] In partial equilibrium of this framework, where the covariance structure of asset return are exogenously given, it is clear that banks should diversify.

In our setting, the covariance structure of asset returns is an equilibrium quantity. For example, the optimal market portfolio—therefore the market risk, or beta, of banks' portfolios—in our setting would be endogenous. (see for example, Merton (1972) for a characterization of the market portfolio). With regard to asset risk in a given country (say, country A), banks' asset allocations are strategically complementary. If a rival bank already has a large holding in country A, allocating assets to country A leads to further concentration of assets, therefore higher risk. In equilibrium, the diversification effect emerges via banks' risk sharing. The beta of banks' equilibrium portfolio is the smallest beta, given its rival bank's portfolio.[4]

We proceed by describing the basic setup and the banks' problem. We then derive and discuss the impact of regulation on banks' asset allocation.

2.1 Framework

In our model there are two countries, indexed by A and B, and two banks, indexed by 1 and 2. We assume that country A regulates banking and that country B does not. Each bank strategically chooses asset allocation between the two countries by taking into account that of the other bank.

[3] See also, Grossman and Stiglitz (1976) and Dvbvig and Ingersoll (1982) for other examples.

[4] The risk-sharing aspect of our result can be seen more directly in an equivalent formulation via the stochastic discount factor (SDF). The mean-variance setting is equivalent to one where the banks have CARA utility u and asset returns have normal density p. In equilibrium, banks' SDF's, or pricing kernels, differ by a multiplicative factor $u'_A(x)\,p(x) \propto u'_B(x)\,p(x)$, where x is realization of asset return, and the proportional constant is the ratio of the bank's Lagrange multipliers. In our case, p is a normal density with first and second moments determined in equilibrium.

Bank i's portfolio claims in the two countries are denoted by $\begin{bmatrix} \phi_A^i \\ \phi_B^i \end{bmatrix}$ for $i = 1, 2$. We assume that the two banks are similar in size and that $\phi_A^i + \phi_B^i = 1$ for $i = 1, 2$.

For both banks, asset returns in country A, R_A, are given by,

$$R_A = \mu_A + \varepsilon_{A,D} + \varepsilon_{A,F} - (1 + \lambda) P \tag{1}$$

where μ_A is the expected level of asset returns that are related to country-specific factors. $\varepsilon_{A,D}$ and $\varepsilon_{A,F}$, respectively, represent a macroeconomic and a financial shock that both originate in country A and affect asset prices in this country. Unlike these two shocks, P is a push factor that is determined in world financial markets and it symmetrically affects asset returns in country A and B. According to the formulation above, an increase in P corresponds to an adverse push effect that depresses asset prices. In addition, we assume that the costs of regulation are related to the push factor. Specifically, we assume that regulation becomes more binding in response to an adverse push effect and banks incur higher operating costs as a result. This sensitivity of regulatory costs is captured by the parameter λ. As mentioned above, the literature interprets this positive sensitivity as the higher perception of risk, more binding risk-based capital requirements, higher funding for regulatory agencies during adverse financial conditions.

μ_A is a deterministic quantity and the shocks $\varepsilon_{A,D}$ and $\varepsilon_{A,F}$ have a mean of zero and are pairwise uncorrelated. The mean of P is not necessarily equal to zero and it is uncorrelated with the two shocks. However, the second moment of $\varepsilon_{A,F}$ depends on the variance of P via the following ARCH specification:

$$\varepsilon_{A,F} = \nu \sqrt{\eta_A \left(\phi_A^1 + \phi_A^2\right) \sigma_P^2} \tag{2}$$

$$\sigma_{A,F}^2 = \eta_A \Phi_A \sigma_P^2 \tag{3}$$

where $\sigma_{A,F}^2$ and σ_P^2 are the variances of $\varepsilon_{A,F}$ and P, respectively, ν is a mean-zero, variance-one random variable independent from P, and $\Phi_A = .\phi_A^1 + \phi_A^2$, represents the total amount of banking claims in country A. Here we assume that the parameter η_A captures the effects of regulation on the riskiness of assets in country A. This relationship can be interpreted as the mitigating effects of bank regulation such as leverage restrictions on the volatility of asset returns (for example, asset returns are less volatile when leverage is low). We assume that η_A is between 0 and 1, and that smaller values of η_A imply more stringent regulation which in turn mitigates banks' asset risk in country A. In addition, we assume that asset market risk in country A is positively related to total banking assets in this country (representing scale effects) and the volatility of the push factor.

To summarize, the relationship between regulation and the push factor P, enters asset returns of country A via two parameters, λ and η_A. λ is a multiplier on the push factor that increases banks' operating costs under adverse push conditions (while also having second order effects on asset risk as explained below). η_A is a multiplier that captures the risk-reduction effects of regulation. These two counteracting effects of the two parameters introduce regulatory arbitrage considerations into the banks' return-risk trade-off.

Let $\sigma_{A,D}^2$ denote the variance of $\varepsilon_{A,D}$, then the first and second moment of asset returns in country A are given by,

$$E[R_A] = \mu_A - (1+\lambda) E[P] \tag{4}$$

$$Var(R_A) = \sigma_{A,F}^2 + \sigma_{A,D}^2 + (1+\lambda)^2 \sigma_P^2 = \sigma_{A,D}^2 + \left[\eta_A \Phi_A + (1+\lambda)^2\right] \sigma_P^2 \tag{5}$$

The return on assets in the unregulated country, country B, are then denoted as follows:

$$R_B = \mu_B + \varepsilon_{B,D} + \varepsilon_{B,F} - P \tag{6}$$

Unlike in country A, there are no additional regulatory costs stemming from adverse push shocks in country B. The first and second moment of asset returns in country B are given by,

$$E[R_B] = \mu_B - E[P] \tag{7}$$

$$Var(R_B) = \sigma_{B,F}^2 + \sigma_{B,D}^2 + \sigma_P^2 = \sigma_{B,D}^2 + \left[\left(\phi_B^1 + \phi_B^2\right) + 1\right] \sigma_P^2 \tag{8}$$

where $\phi_B^1 + \phi_B^2 = \Phi_B$ similarly represents the total amount of banking claims in country B.

2.2 Covariance of returns and banks' maximization problem

We will assume that financial and macroeconomic shocks are not only uncorrelated within a country but also across the two countries. Given this restriction the covariance of the two asset returns are given by,

$$\begin{aligned} Cov(R_A, R_B) &= \rho_F \sigma_{A,F} \sigma_{B,F} + \rho_D \sigma_{A,D} \sigma_{B,D} + (1+\lambda)\, \sigma_P^2 \\ &= \rho_F \eta_A^{1/2} \Phi_A^{1/2} \Phi_B^{1/2} \sigma_P^2 + \rho_D \sigma_{A,D} \sigma_{B,D} + (1+\lambda)\, \sigma_P^2 \end{aligned} \tag{9}$$

where the parameter ρ_F and ρ_D determine the comovement of the two asset markets and macroeconomies, respectively, and their values are between -1 and 1. We do not impose any sign restrictions on these parameters.

Given banks' allocations $\phi^i = \begin{bmatrix} \phi_A^i \\ \phi_B^i \end{bmatrix}$ for $i = 1, 2$, the variance-covariance matrix $\Sigma\left(\phi^1, \phi^2\right)$ of asset returns can be represented as,

$$\Sigma\left(\phi^1, \phi^2\right) = \begin{bmatrix} Var(R_A)\left(\phi^1, \phi^2\right) & Cov(R_A, R_B)\left(\phi^1, \phi^2\right) \\ Cov(R_A, R_B)\left(\phi^1, \phi^2\right) & Var(R_B)\left(\phi^1, \phi^2\right) \end{bmatrix} \tag{10}$$

We model banks' allocation decision as a simultaneous game in which the banks have mean-variance preferences over asset returns, or equivalently, constant absolute risk aversion (CARA) preferences with normal asset returns. In this game, Bank 1's problem is maximizing

$$\begin{bmatrix} \mu_A-(1+\lambda)E[P] & \mu_B-E[P] \end{bmatrix} \begin{bmatrix} \phi_A^1 \\ \phi_B^1 \end{bmatrix} - \frac{\gamma}{2} \begin{bmatrix} \phi_A^1 & \phi_B^1 \end{bmatrix} \Sigma\left(\phi^1,\phi^2\right) \begin{bmatrix} \phi_A^1 \\ \phi_B^1 \end{bmatrix} \tag{11}$$

over ϕ_A^1 and ϕ_B^1 while taking ϕ^2 as given. In the expression above, γ is an exogenous risk aversion parameter that we assume is the same for each bank. More explicitly, bank 1's objective function is

$$(\mu_A-(1+\lambda)E[P])\,\phi_A^1+(\mu_B-E[P])\,\phi_B^1-\frac{\gamma}{2}\left[Var(R_A)\left(\phi_A^1\right)^2+Var(R_B)\left(\phi_B^1\right)^2+2\phi_A^1\phi_B^1Cov(R_A,R_B)\right]. \tag{12}$$

It should be noted that there is an analogous expression for bank 2's optimization problem. We omit this expression for brevity.

2.3 Optimality condition

Bank 1's first order condition is given by,

$$\begin{aligned} &\mu_A-\mu_B-\lambda E[P]-\gamma\underbrace{\left(Var(R_A)\phi_A^1-Var(R_B)(1-\phi_A^1)+(1-2\phi_A^1)Cov(R_A,R_B)\right)}_{\text{non-strategic term}} \\ &-\gamma\underbrace{\left((\phi_A^1)^2\frac{\partial}{\partial\phi_A^1}Var(R_A)+(1-\phi_A^1)^2\frac{\partial}{\partial\phi_A^1}Var(R_B)+2\phi_A^1(1-\phi_A^1)\frac{\partial}{\partial\phi_A^1}Cov(R_A,R_B)\right)}_{\text{strategic term}}=0 \end{aligned} \tag{13}$$

The economic mechanism underlying our model can be inferred from the optimality condition above. If asset variance-covariance structure is exogenous, then the strategic term in equation (13) vanishes and we recover the standard relationship

$$\frac{\mu_A - \mu_B}{Var(A)\phi_A^1 - Var(B)(1-\phi_A^1) + (1-2\phi_A^1)Cov(A,B)} = \gamma. \quad (14)$$

The left hand side can be viewed as risk-discounted relative asset returns, a quantity similar to the Sharpe ratio. The right hand side reflects banks' risk appetite. In other words, banks would choose the portfolio share in country A so that excess return of country A relative to country B, discounted by relative riskiness, is equal to risk appetite, and vice versa. In our setting, asset riskiness is endogenous and the expected excess return is discounted by the additional strategic term. The explicit expression for the first term in the strategic component is given by, $\frac{\partial}{\partial \phi_A^1} Var(A) = (1+\eta_A)\sigma_p^2$. This term is always positive implying that if banks shift assets towards country A, the riskiness of returns in country A increases. Conversely, the negative second term, $\frac{\partial}{\partial \phi_A^1} Var(B) = -\sigma_p^2$, implies that shifting assets towards country A decreases riskiness of country B. The partial derivative $\frac{\partial}{\partial \phi_A^1} Cov(A,B) = \rho_F \eta_A^{\frac{1}{2}} \frac{\Phi_B - \Phi_A}{2\Phi_A^{\frac{1}{2}}\Phi_B^{\frac{1}{2}}} \sigma_p^2$ captures the strategic diversification effect. Suppose $\rho_F < 0$, i.e. it is beneficial for banks to diversify if asset riskiness is exogenous. The benefit of diversification is overturned when banks already collectively over-weight country A relative to country B, i.e. $\Phi_B - \Phi_A < 0$. Banks' asset allocations in the same country can therefore be strategic substitutes or complements, depending on total asset allocation Φ_B and Φ_A. The optimal portfolio is characterized by banks' indifference between two countries in the sense that risk-discounted asset returns are the same in each country.

2.4 Equilibrium

The equilibrium in our model is characterized by banks' first order conditions, equation (13) for bank 1 and the analogous expression for bank 2, which is a system of two equations and two unknowns, ϕ_A^1 and ϕ_A^2. Equilibrium asset allocations ϕ_A^{1*} and ϕ_A^{2*} in turn produce the equilibrium asset returns covariance structure $\sum^*$ and the market portfolio ϕ^*. The covariance of ϕ^* with, say, bank 1's optimal allocation $\left(\phi_A^{1*},\ 1-\phi_A^{1*}\right)'$ would be bank 1's endogenous beta.

2.4.1 Symmetric equilibrium

To solve the model, we impose symmetry across the two banks so that $\phi_A^{1*}=\phi_A^{2*}$, which is then characterized by equation (13). Below we demonstrate the effects of regulation on ϕ_A^{1*} and denote this variable by ϕ for simplicity but it should be noted that given symmetry, the inferences that we draw for ϕ_A^{1*} (or ϕ) also hold for $\phi_A^{*}=\phi_A^{1*}+\phi_A^{2*}$. These inferences are reversed for $\phi_B^{*}=(1-\phi_A^{*})$.

The optimality condition above (equation 13) takes the following form under a symmetric equilibrium:

$$\begin{aligned}
&\mu_A-\lambda E\left[P\right]-\mu_B-\gamma\phi\left[\sigma_{A,D}^2+\left(2\phi\eta_A+(1+\lambda)^2\right)\sigma_P^2\right] \\
&-\frac{\gamma}{2}\phi^2\eta_A\sigma_P^2+\gamma(1-\phi)\left[\sigma_{B,D}^2+2\left(1-\phi\right)\sigma_P^2+\sigma_P^2\right] \\
&+\frac{\gamma}{2}\left(1-\phi\right)^2\sigma_P^2-\frac{5}{2}\gamma\rho_F\eta_A^{1/2}\left(1-2\phi\right)\left[\phi\left(1-\phi\right)\right]^{1/2}\sigma_P^2 \\
&-\gamma(1-2\phi)\rho_D\sigma_{A,D}\sigma_{B,D}-\gamma(1-2\phi)\left(1+\lambda\right)\sigma_P^2=0
\end{aligned} \tag{15}$$

Our goal here is to determine how regulation affects the portfolio allocation of banks. To this end, we derive the marginal effects of the two regulatory parameters, λ and η_A on the optimal allocation of claims to country A, ϕ, by differentiating the equation above. The following two expressions show how the optimal allocation to country A is related to λ and η_A, respectively:

$$\frac{d\phi}{d\lambda}=-\frac{\frac{E[P]}{\gamma\sigma_P^2}+2\phi\lambda+1}{\frac{Var\left(\varepsilon_{A,D}-\varepsilon_{B,D}\right)}{\sigma_P^2}\lambda^2+5\left[1-\left(\eta_A-1\right)\phi\right]-\frac{5}{4}\rho_F\eta_A^{1/2}g\left(\phi\right)} \tag{16}$$

$$\frac{d\phi}{d\left(1-\eta_A\right)}=\frac{\frac{5}{2}\phi^2+\frac{5}{4}\rho_F\eta_A^{-1/2}f\left(\phi\right)}{\frac{Var\left(\varepsilon_{A,D}-\varepsilon_{B,D}\right)}{\sigma_P^2}\lambda^2+5\left[1-\left(\eta_A-1\right)\phi\right]-\frac{5}{4}\rho_F\eta_A^{1/2}g\left(\phi\right)} \tag{17}$$

where $f(\phi)$ and $g(\phi)$ are small for reasonable values of ϕ and do not substantially alter the partial derivatives above.[5] Notice that the expressions reveal two counteracting effects of regulation. According to the first expression, higher regulation causes a shift away from the regulated country. In other words, as the regulatory cost of an adverse push effect increases (as λ increases), the share of claims in country A, for both bank 1 and 2, decreases. This result is reversed when λ decreases. The mechanism that generates this result is simple. The regulatory multiplier λ has three effects on banks' portfolio decisions. Higher λ depresses expected asset returns while elevating (regulatory) risk in country A, and it increases the correlation of asset returns between the two countries. All three effects, prompt banks to divert assets out of country A, provided the expected push shock is sufficiently large.

Conversely, the second expression shows that higher regulation can prompt an increase in banking claims in the more regulated country. Here, we express the partial derivative with respect to $(1-\eta_A)$ instead of η_A to align the stringency of regulation in the two expressions; an increase in λ and $(1-\eta_A)$ both indicate higher regulation. The second expression has a positive sign, suggesting that banks allocate a higher share of their assets to country A when this country is more regulated. The regulatory multiplier η_A only affects banks' portfolio decision through asset risk in country A. For example, when regulation in country A becomes tighter, i.e. η_A decreases, assets in country A become less risky. There is also a second effect, captured by the second term in the numerator, on diversification benefits—reducing the asset variability in A also means lower correlation between A and B. The relative order of the two effects depends on total asset allocation. In an equilibrium where banks underweight country A, the asset correlation effect is second order compared to that of risk reduction in country A. This attracts bank capital to country A. In an equilibrium where banks overweight country A, asset correlation effect becomes first order and this leads to banks shifting assets away from this country. As explained above, however, the benefits and disbenefits

[5] $f(\phi)=(1-2\phi)\left[\phi(1-\phi)\right]^{1/2}$ and $g(\phi)=\left(4\phi(1-\phi)-(1-2\phi)^2\right)\left[\phi(1-\phi)\right]^{-1/2}$. $f(\phi)$ is trivial for the 0-1 range of ϕ. $g(\phi)$ also does not play a major role unless ϕ is above 0.9 or below 0.1. If ϕ is outside of this range $g(\phi)$ becomes large but negative. Therefore the sign of the denominator in both of the expressions remain positive. The mechanisms that we describe above, however, become weaker as ϕ approaches 0 and 1.

of risk diversification are small for reasonable parameter values.[6]

To determine which of these two effects is stronger, we compare the numerators of the two expressions as the denominators are the same. In this comparison, the more critical variable for our paper is $E[P]$, or the push variable. Specifically, the main goal of our paper is to determine how the interaction of regulation and cross-country banking claims is related to global financial conditions (i.e., global push effects). The theory that we describe above, predicts that push effects can play a pivotal role. If $E[P]$ is positive and large (compared to its variance), for example, this would increase the strength of the first mechanism (higher regulation causes a retrenchment of claims in country A). In other words, IAB claims decrease by more in country A when global financial markets are operating under adverse push conditions (higher $E[P]$) even when shifting assets to country A would offer diversification benefits.

In our empirical analysis below we will account for and investigate the role of expected push conditions when assessing the impact of regulation on the allocation of banking claims. The first mechanism described above is also stronger if the initial (optimal) portfolio share in country A, ϕ, and the regulatory costs of the push factor, λ, is large. The effects of ρ_F and η_A depend on the

[6] To obtain a more general intuition, consider the first order condition Equation 13. η_A enters into asset risk through the following terms:

$$2\phi_A^{1*} Var(R_A) = \eta_A \Phi_A^* \sigma_P^2 + \underbrace{\cdots}_{\text{terms independent of } \eta_A} \tag{F.1}$$

$$(\Phi_B^* - \Phi_A^*) Cov(R_A, R_B) = (\Phi_B^* - \Phi_A^*) \left(\rho_F \eta_A^{\frac{1}{2}} \Phi_A^{\frac{1}{2}} \Phi_B^{\frac{1}{2}} \sigma_P^2 + \underbrace{\cdots}_{\text{terms independent of } \eta_A} \right) \tag{F.2}$$

$$(\phi_A^{1*})^2 \frac{\partial}{\partial \phi_A^1)} Var(R_A) = (\phi_A^{1*})^2 \eta_A \tag{F.3}$$

$$\phi_A^{1*}(1-\phi_A^{1*}) \frac{\partial}{\partial \phi_A^1} Cov(R_A, R_B) = \phi_A^{1*}(1-\phi_A^{1*}) \rho_F \eta_A^{\frac{1}{2}} \frac{\Phi_B - \Phi_A}{2\Phi_A^{\frac{1}{2}} \Phi_B^{\frac{1}{2}}} \sigma_p^2 \tag{F.4}$$

which are the effects of portfolio choice on $Var(R_A)$ and $Cov(R_A, R_B)$. Expressions F.1 and F.2 show the standard partial equilibrium effects, while F.3 and F.3 are derived from the strategic term. Expressions F.1 and F.3 show that decreasing η_A by a small increment $\Delta\eta_A$ leads to a decrease in bank asset risk in country A of order $\Delta\eta_A$. On the other hand, expressions F.2 and F.4 show that the absolute value of the covariance of asset returns decreases by $\Delta\eta_A^{\frac{1}{2}}$, if $\Phi_B^* - \Phi_A^* < 0$. For reasonable parameter values, the first marginal effect dominates the second effect.

initial value of ϕ (whether it is greater than 0.5 or not). The latter effects are of second order since f is small for reasonable parameter values.

It is important to note here that these effects of regulation depend on the symmetry of the two economies. Specifically, we observe that regulation has a smaller impact on bank portfolio allocations when the macroeconomic shocks affecting the two economies are dissimilar (when $Var\left(\varepsilon_{A,D} - \varepsilon_{B,D}\right)$ is large). This is especially valid when the differences in domestic shocks are large compared to global push effects. It is, therefore, important to control for local macroeconomic conditions when identifying the independent effects of regulation.

3 Empirics

In this section, we empirically investigate how regulatory arbitrage is related to global push factors. We proceed by describing the global banking data that we use. We then outline our empirical methodology. Finally, we discuss our baseline estimation results and those obtained from various other tests. The data definitions are provided in Appendix A.

3.1 Data

The data used in our paper are from four different sources. The bilateral banking data are from the BIS, Consolidated Banking Statistics. These data are available for country pairs consisting of reporting and counterparty countries (host nations). The data represent the host-country-by-host-country consolidated positions of internationally active banks (including the positions of their foreign affiliates) headquartered in reporting countries. More specifically, the data that we use are the total claims, including both cross-border and local claims, of banks chartered by reporting countries. These total claims are on all sectors, they are of all maturities, all currencies and they include all reported instruments such as debt securities, loans and deposits.

Our baseline dataset is populated by annual observations from 2000 to 2018 and it includes

31 reporting and 113 counterparty countries. These countries are listed in Table 1 but we should mention here that most of the reporters are advanced economies, and the counterparties include both advanced and developing economies. The table also shows that IAB claims, especially in advanced economies, are quite substantial when compared to the GDP of the nations where they hold claims. We choose year 2000 as our cutoff point as there are many missing observations for the country pairs that we use prior to this date. In our baseline estimations we omit the observations for years 2008 and 2009 that are subject to substantial global financial market instability. While the 31 reporting countries cover the entire set reported in BIS statistics, there are more than 113 host nations. The choice of the host nations is determined by the availability of other data that we describe next.

To approximate the strength of local economic conditions we obtain real GDP data from the International Financial Statistics (IFS) database. These data are available for 113 of the counterparty countries in the BIS database. Incorporating real GDP growth (obtained by log-differencing the GDP series) into our analysis allows us to account for any pull effects that could be related to IAB lending in host-nations besides regulatory stringency.

We obtain regulatory indices from Barth et al. (2013). The authors use responses to World Bank Surveys of Bank Regulation in years 1999, 2003, 2007, 2011 to construct 52 indices that capture bank regulatory stringency and institutional characteristics related to banking in 180 countries. The higher values of regulatory indices indicate higher stringency. We allocate the variables from the 4 surveys to our annual dataset as follows: For the periods 2000-2003, 2004-2007, 2008-2011, 2012-2018, we use the indices from the 1999, 2003, 2007 and 2011 surveys, respectively. In a sensitivity analysis we use various indices from Barth et al. (2013) indices (these indices are listed and described in Appendix A) but in our baseline estimations we use Overall Financial Conglomerates Restrictiveness as the regulatory variable, an index ranging between 3 and 12. The mean and standard deviation of this variable, along with those for the main variables in our estimations, are reported in Table 1. In alternative estimations we also use the more dynamic regulatory index of

Cerutti et al. (2017).

Finally, we obtain time series data for five global push factors, mostly from the Federal Reserve Bank of St. Louis, FRED database. The two volatility indices that we obtain, VIX and VSTOXX, are commonly-used measures to capture the degree of risk aversion in US and European markets, respectively. To capture risk perception, we also use the Moody's Seasoned Baa-Aaa corporate bond spread and the Gilchrist and Zakrajsek (2012) credit spreads. Finally, we use the effective federal funds rate as an alternative push factor given the well-documented close link between US monetary policy and global capital flows (Miranda-Agrippino and Rey, 2019). All of the variables except the G-Z spread are from the FRED database. G-Z spread is obtained from the authors' website.

3.2 Dynamic panel model and estimation methodology

Our main goal is to determine how host-nations' regulatory stringency affects IABs' cross-country positions and how this relationship is affected by global push factors. The emphasis, therefore, is on the host-nation specific drivers of IAB asset holdings. The challenge we face here is that the changes in IAB asset holdings could also be simultaneously determined by the changes in reporting country conditions or more directly, those of the reporting banks. To shut-down this potential channel of transmission, we measure the annual growth rate of a reporter's claims in a given host nation relative to the mean growth rate of that reporter's claims across all other host nations. Specifically, let c_{ijt} denote the growth rate of claims of country i in host country j at year t, and let $\overline{c_{it}}$ denote the average growth rate of country i's claims across all host nations that she holds claims then the relative claim growth rate of country i in country j is given by,

$$\tilde{c}_{ijt} = c_{ijt} - \overline{c_{it}} \tag{18}$$

We follow the same strategy to construct the relative growth rate of host-nations' real GDP, $\tilde{g}_{jt-1}$, and relative regulatory stringency, $\tilde{r}_{jt-1}$,. We then estimate the following model:

$$\tilde{c}_{ijt} = \sum_{k=1}^{3} \beta_k \tilde{c}_{ijt-k} + \gamma \tilde{r}_{jt-1} + \alpha p_{t-1} + \rho \tilde{r}_{jt-1} * p_{t-1} + \mu \tilde{g}_{jt-1} + \varepsilon_{ijt} \tag{19}$$

where p_{t-1} represents the global push factors described above. In this equation, our focus is on both the coefficients of the regulatory variable and the interactive term, γ and ρ. By design, a positive and significant coefficient value for the regulatory variable would imply that banks in host nations with more strict regulations would experience a higher growth in local claims compared to their sister banks (banks affiliated with the same parent IAB) in other nations. A positive value of the interactive term coefficient would then imply that this positive relationship between regulatory stringency and growth in claims would be stronger under adverse global financial conditions (e.g. higher perception of risk in global financial markets). We should note that since global push factors affect each country symmetrically, we do not anticipate them to be significantly related to our dependent variable (measured as deviations from mean values).

To estimate equation (19), we use the two-step general method of moments (GMM) dynamic panel estimator of Blundell and Bond (1998). This methodology offers several advantages. First, it is designed for panels with a much longer cross-sectional dimension. While there are only 17 years in our baseline dataset, there are 1,050 country pairs. Second, it controls for fixed and random effects at the panel level and accounts for heteroscedasticity and serial correlation in errors. Third, it does not require strict exogeneity as it instruments endogenous variables with the lags of their first differences. In all our estimations, we use the first lags of the variables as instruments.[7]

It is important to note here that we prefer this methodology over a fixed effects estimator since it offers a distinct advantage not mentioned above. Specifically, by measuring our variables as

[7] In all of our estimations we also use the Windmeijer's finite-sample correction since the standard two-step estimation produces downward biased standard errors. We also use three lags of the dependent variable since this lag structure allowed us to avoid second order serial correlation throughout our different estimations

deviations from mean values and incorporating them into the dynamic model estimation, we are able to control for any fixed effects (panel and country level) that may be varying across time. These fixed factors may symmetrically affect the regulatory stringency of countries and IAB claim growth, and that the strength of this effect may change over time. Our approach is a better fit for capturing these time-variant effects, that otherwise may not be accounted for with a standard fixed effects estimator. We do, however, check the robustness of our results by using a standard fixed effects estimator.

3.2.1 Baseline results

The results from our baseline estimations are displayed in Table 2. The columns display the results obtained when different push factors are used. There are several inferences. Most importantly, tighter banking restrictions repel IAB funds only during adverse global financial conditions. This inference holds for all the different push factors that we use. The coefficient values of the regulatory variable and VIX, 0.0208 and -0.0013, have the following interpretation: Assume that a host nation's, say country *x*'s, banking regulatory stringency is a unit higher than all other nations. The coefficient value of 2.08 then implies that IAB claims grow 2.08 percent higher in country *x* than all the other countries that IABs operate in. This unit difference in regulation corresponds to 15% of the mean value of the regulatory variable (6.9). Now assume that there is a 1 percent increase in the VIX index, (i.e., the market expects S&P to move +/- 1% more than it did before over the next year) then -0.0013 implies that IAB claims in country *x* would be 0.13% lower than if VIX had stayed the same. A similar thought process applies to all the other coefficient values for the regulatory and interactive variables. The regulatory variable coefficients for the estimations with VSTOXX and FFR are insignificant.

The more general message here is that it is misleading to conclude that regulatory stringency drives away or attracts IAB funds without considering global financial conditions. We quantify the economic importance of the interactive and regulatory variable coefficients later in the paper to compare the two coefficient values of interest and to determine whether the interaction of push factors with regulation is economically significant.

Notice also that the coefficient value for the pull factor, relative GDP growth rate, is strongly significant for all the estimations. The coefficient values imply that if the real GDP growth rate of a host nation is 1 percent higher than other host nations, IAB claims grow roughly one percent more in this country than others. We make this observation also in all the other estimations below.

Consistent with our prior expectations, we find that the push factor is mostly insignificant. The significant values for the Baa-Aaa and the G-Z spread may be due to flight to quality and search for yield effects as the more numerous host nations are also the smaller economies in our sample and changes in the push factor could affect relative growth of claims.

The Hansen test for over-identifying restrictions indicate that the instruments are valid and exogenous, and we do not find any evidence for second order serial correlation in the error term.[8]

3.2.2 Other World Bank regulatory indices

Next, we use 7 other regulatory indices to check the robustness of our results. These indices are chosen mostly based on data availability but they also provide a good representation of the different aspects of regulation in the surveys. For example, we use the overall restrictiveness of bank regulation which captures the strength of restrictions banks face when underwriting securities, insurance, and real estate investment. We also use the restrictions on security underwriting individually as there appears to be considerable variation in this variable across countries. As an additional variable in the financial conglomerate module, we use the index that measures the extent to which financial conglomerates can own non-financial firms. To gauge the level of regulatory obstacles that restrict competition, we use the index that measures the degree to which applications to enter banking are denied. We use a similar index that does the same for foreign banks. The capital

[8] Instrument validity is also suggested by the Sargan test statistic. We report the Hansen statistic since it is more robust to heteroskedasticity and autocorrelation.

regulatory index tracks the stringency in regulating asset risk and initial capital injections. Finally, we include an index that quantifies the transparency of bank financial statements to gauge the level of external scrutiny of corporate governance.

In this section, we use the VIX index to quantify global financial conditions.[9] The results obtained by using the alternative World Bank indices are displayed in Table 3 and they point to similar inferences. The interactive variable coefficients are once again negative and the regulatory variable coefficients are positive, albeit insignificant for half the estimations. Out of the eight interactive variable coefficients, only the ones including capital regulatory index and entry restrictions are insignificant. The later aspect of regulation is nevertheless significant for foreign entries.

Similar to earlier results, the push and pull factor coefficients are mostly insignificant and strongly significant, respectively.

3.2.3 Earlier periods and the 2008-09 crisis

So far, we‘ve only considered the period after year 2000 and omitted years 2008 and 2009 that are characterized by global financial market turmoil. In this section, we first investigate the period before 2000 to determine whether regulation and global push factors have similar effects on IAB claims. The bilateral banking data dates back to 1983. We are able to obtain federal funds rates, Baa-Aaa spreads and the GZ-spread including and after 1983. The VIX and VSTOXX indices, however, are available after 1989 and 1998, respectively. We, therefore, exclude VSTOXX from our analysis and consider the 1990-1999 period for the estimations with VIX. In addition, we include the Global Factor of Miranda-Agrippino and Rey (2019), a global factor that explains 20% of the variance in global financial variables in a dynamic factor model, as an additional variable. Next, we investigate the impact of the 2008/09 crisis by following two methodologies. First, we compare how our results change when we include years 2008 and 2009. Second, we generate a new variable by multiplying our interactive variable with a dummy variable that takes the value 1

[9] We obtain very similar inferences when we use the other push factors.

after 2009. We then include this variable in our estimations to detect whether the interaction of push factors with regulation has been different in the aftermath of the crisis, especially given the considerable changes in the regulatory stance ensuing 2009.

Estimation results obtained for the earlier period, displayed in Table 4, show that both regulation and its interaction with push factors is less significant. While the interactive terms are still mostly negative, they are significant only for the VIX index and the Global Factor. Also, we observe that the pull factor, while significant, has a smaller impact on IAB claims in the earlier period. We should note, however, that there are many missing observations for the country pairs in this period.

Comparing the results obtained by including the crisis years, 2008 and 2009, to the baseline results we observe that the coefficients for both regulation and the interactive variable are less significant and smaller in magnitude. These results reveal the relatively minor role that regulatory differences played during the tumultuous period between 2008 and 2009. We infer that this diminishing effect of regulatory stringency is not only observed during the 2008-09 crisis but also after 2009 when we incorporate the crisis dummy variable in to our analysis. The positive and significant coefficient value displayed in the bottom panel of the table indicates that the negative effects of regulatory stringency on IAB claims during adverse global financial conditions, as suggested by the negative coefficient of the interactive term, were weaker after 2009.

3.2.4 Regulatory arbitrage

It is generally accepted that IABs shift funds to countries with fewer regulations (e.g., Houston et al., 2012). Our results, so far, indicate that this may only be the case under adverse global financial conditions. If these conditions are loose, by contrast, we find that banks shift funds to countries with stronger regulations. In this section, we use the dataset that we constructed to investigate whether regulatory arbitrage exists and how it is related to the time period and the set of countries that we consider.

To align our analysis with earlier methodologies, we omit the interactive variable and we focus solely on the effects of regulatory arbitrage on the growth of IAB claims. Throughout this experiment, we use the VIX as the global push factor.

The results are displayed in Panel A of Table 6. Using our baseline dataset, dataset that excludes years 2008 and 2009, we find first that regulatory differences are not significant determinants of IAB claims. Conversely, pull factors, measured by GDP growth rates, remain strongly significant. These observations are also made when we include the crisis periods. Next, we only include host nations that are also reporting countries to the BIS surveys. This group of countries are populated by most of the advanced economies in the world. We conduct this experiment since Houston et al. (2012) find a stronger link between regulatory arbitrage and bank flows amongst advanced economies. The results, consistent with Houston et al. (2012), reveal a retrenchment in bank claims in highly regulated countries. The pull factor in this estimation, and throughout all other estimations, is significantly and positive related to IAB claim growth.

Next, we check whether there has been a shift in how regulatory arbitrage operates following the crisis by considering the pre-crisis period (before 2008). This also makes our sample period more consistent with that of Houston et al. (2012). Our dataset, however, does include our baseline set of host-nations (including both advanced and developing countries). The results indicate a more significant and stronger relationship between regulatory differences and IAB claims before the crisis. This is consistent with the inferences drawn from our analysis above.

So far, we have only examined the relative regulatory stringency of host-nations. Here, we take a different angle and test whether differences in reporting country regulations affect the claims of IABs that they charter. Doing so, however, also requires a modification of our methodology to neutralize host-nations specific factors while honing in on reporting country regulations. We do this by measuring our variables as deviations from host-nations specific averages. For example, to measure our relative claim growth variable (our dependent variable), we first calculate the mean claim growth of all reporters in a host-nation, $\bar{c}_{jt}$. We then measure the relative claim growth variable as,

$$\tilde{c}_{ijt} = c_{ijt} - \bar{c}_{jt} \tag{20}$$

where t, i and j similarly denote, the time period, and reporting and host countries, respectively. We follow the same strategy when measuring our right hand side variables. The regulatory variable, for example, measures how strict reporter i's regulations are relative to all other countries whose IABs also have claims in host-nation j. Similarly, the pull factor here is replaced by the GDP growth rate of country i relative to the GDP growth rate of all other countries that have claims in country j. Notice here that by following this strategy we are able to shut-down any time-invariant and time-variant host nation specific factors (such as GDP growth and regulatory stringency) that may affect IAB claims. The results obtained by using our baseline dataset show that a reporter's regulatory stringency is not a significant determinant of IAB claims. When we only include advanced countries, however, we find that reporters who face tighter regulations at home report a faster claim growth abroad.

As an alternative test, we include reporters' (lenders') regulatory variable, measured according to equation (20), and its interaction with VIX in our baseline model so that the model incorporates the regulatory variables of reporters and host-nations at the same time. In this model we also include the relative GDP growth of both reporter and host nations. We should also note that including the regulatory variables of both lenders and host-nations allows us to account for any potential effects of international claims (claims that are booked directly from the reporters' home countries). If a host-nation tightens regulation, for example, it is possible that while locally booked claims of IABs in this nation decline, international claims increase. The international claims of reporting countries would, therefore, depend on not only their home regulations but also those of host nations. By including both sets of regulatory variables we are able to account for the potential substitution effects of regulation more thoroughly. The results obtained by using VIX as the push factor are displayed in Panel B of Table 6. Consistent with our earlier inferences, we find that it is only the host-nations' regulatory stringency and its interaction with push factors that is significantly related to the growth of IAB claims in host nations. Also consistent with our earlier results, we find that only the GDP growth of host-nations is significant. This finding is omitted from the table for brevity.

3.2.5 A more dynamic regulatory indicator

While there is considerable cross-sectional variation in the World Bank regulatory indices that we use so far, the indices are relatively stable across time. In this section, we check the robustness of our results by using regulatory data from Cerutti et al. (2017). These data include variables that capture the change in the intensity of macroprudential regulatory policies over time. These variables offer a more dynamic alternative to our baseline regulatory indices. From the set of regulatory variables, we choose two. First, we use the changes in the level of required capital buffers as it is an aggregate of sector-specific buffers in the database (sum of buffers across the residential, consumer, and other sectors). Second, we use the changes in capital requirements as a result of the implementation of Basel capital agreements as it is the most relevant regulatory variable in the dataset.

The results from our estimations with these alternative regulatory variables are displayed in Table 7. All except one of the interactive variable coefficients displayed in the table are negative and significant. These results similarly imply that stricter regulations prompt a retrenchment in IAB claims only under adverse global financial conditions. While this observation can be made for both of the regulatory indices that we consider, only the coefficients of the capital buffer regulations are significant. These coefficients, consistent with our baseline findings, are positive.

3.2.6 Economic Significance

So far, the two coefficients of interest, those of the interactive variable and the regulatory index, have had opposite signs, implying that they have the opposite effects on IAB claims. A natural way to proceed is to determine which of these relationships is stronger. In other words, if global financial conditions tighten, does a host-nation with tighter bank regulation experience a net growth or decline of IAB funds? Our earlier inferences that are based off of statistical significance fall short of answering this question.

In this section, we divide our right hand side variables by their standard deviations so that the coefficient values measure the impact of a one standard deviation change in the right hand side variable on IAB claim growth. The results from this exercise are reported in Table 8. Here, we only report the size of the significant coefficients. The results, displayed for different push factors and regulatory indices show generally that the size of the interactive variable coefficient is larger than that of regulation and thus push factors, or more specifically how they interact with regulation, is the more important driver of IAB claims.

To illustrate this point, let's take the results corresponding to the VIX index on the top panel for example. The coefficient value of 0.0371 implies that if a host-nation's regulatory stringency is one standard deviation higher than those of all other host-nations, IABs' claims in this country grow 3.7 percent more than their claims in all other host-nations. The interactive variable coefficient value of -0.0442 then implies that if at the same time there is a one standard deviation increase in the VIX index, the same host-nation (with stricter regulation) experiences 4.4 retrenchment in IAB claims compared to other host-nations. The net effect under this scenario is a 0.7 percent decline in IAB claims. The results indicate that this net effect of global push factors is largest for the Baa-Aaa spread. Notice also that if by contrast the VIX index decreases (lower risk perception), the tighter regulation country experiences 8.1 percent higher IAB claim growth. We find similar results for the two other regulatory indices in the bottom panel. The results also show that the push-regulation interaction is less important than regulation when we use transparency of bank statements.

Overall, these findings indicate that the inferences drawn from statistical significance are parallel to those from economic significance.

3.2.7 Other tests

We constructed our dataset by using BIS consolidated banking statistics (CBS). These data are measured for banks that are headquartered in BIS reporting countries. Alternatively, BIS also collects data to compile locational banking statistics (LBS), or the outstanding claims of all banks located in BIS reporting countries (banks that are not necessarily headquartered in these countries). In this section, we construct an alternative dataset by using data from LBS and investigate whether our results are similar. Using this alternative dataset also allows us to account for currency composition of the loans and any change in claims that could be due to exchange rate fluctuations. For example, if an IAB's claims in host-nation x are in Euros, while they are in US dollars everywhere else, its claims in host-nation x would grow faster *ceteris paribus* if there is a US dollar depreciation.

To measure changes in claims due to exchange rate fluctuations, total claims are first broken down by the currency in which they are denominated. These claims, reported in US dollars, are expressed in terms of the currency in which they are booked by using end of period exchange rates as follows:

$$c_{ijt}^{k} = c_{ijt}^{k,usd}/e_{t}^{k,eop} \tag{21}$$

where $c_{ijt}^{k,usd}$ denotes the US dollar value of the claims booked in terms of currency k, $e_{t}^{k,eop}$ denotes the end of period exchange rate expressed as US dollar per currency k and c_{ijt}^{k} is the currency k equivalent of $c_{ijt}^{k,usd}$. We should note here that we are using the end of period exchange rates to convert US dollar claims to claims in other currencies since total US dollar claims represent end of period amounts. The change in claims in currency k are then measured as,

$$\tilde{c}_{ijt}^{k} = c_{ijt}^{k} - c_{ijt-1}^{k} \tag{22}$$

After doing this for every currency that reporting country i holds their claims in host-nation j, the exchange rate adjusted change in claims are measured as follows:

$$\tilde{c}_{ijt} = \sum_{k=1}^{M} e_t^{k,a} \tilde{c}_{ijt}^{k} \tag{23}$$

where $\tilde{c}_{ijt}$, $e_t^{k,a}$ and M are the total exchange rate adjusted change in claims, the average US dollar exchange rate in year t for currency k, and the number of currencies that reporting country i's claims in host-nation j are held in. We use this exchange rate adjusted change to re-construct our dependent variable, c_{ijt}^{a}, as follows:

$$c_{ijt}^{a} = \log(c_{ijt} + \tilde{c}_{ijt}) - \log(c_{ijt}) \tag{24}$$

The results obtained by using this alternative dependent variable and dataset are reported in the top panel of Table 9. These results point to similar inferences. Comparing with our baseline results we find that the coefficient values are larger and generally more significant (except for the federal funds rate).

As we mentioned above, it is also possible that regulatory changes in the countries of reporting banks can affect these banks' relative claim growth in host-nations. To check whether this effect is observed, we transform our analysis as described in Section 3.2.3 above so that we put the focus on the variation amongst parent reporting banks (in terms of both claim growth and regulation). For example, our dependent variable now measures the claim growth of reporting country i's IABs in country j relative to the IABs of other reporting countries. Similarly, the regulatory variable represents the relative stringency of reporting country i's regulations compared to all other reporting countries whose IABs have claims in host nation j. The results from this exercise are reported in the Panel B of Table 9. These results show that reporting country regulations and their interaction with global push factors are not significant drivers of IAB claims in host-nations as none of the interactive variable coefficients, except the G-Z index, are significant.

One disadvantage of the difference GMM estimator is that the large number of instruments that it uses decreases the degrees of freedom and the sample substantially. As an alternative test we use a more standard method and estimate our model with country and time fixed effects. In so doing, we still include the first lags of the independent variable and the two lags of the dependent variable on the right hand side to decrease the chances of reverse casuality and to account for the serial correlation in the error term, respectively. We should note, however, that lagged dependent variables on the right hand side could cause a dynamic panel bias and the results reported here are only a part of our robustness tests. To obtain our results we use areg with robust standard errors in STATA since this estimator is designed for large panels with many groups such as ours. The estimation results are reported in Panel C of Table 9. Overall, these results reveal similar inferences as all of the interactive and regulatory variable coefficients, except those from the estimation with VSTOXX, have the same signs and they are significant.

3.3 Evidence from individual reporting countries

In this section, we use a Structural Vector Autoregression (SVAR) model to determine whether our main mechanism is observed on a country-by-country basis. We conduct this experiment at the reporting country level and we investigate whether these countries' claims in highly regulated host-nations grow faster in response to adverse push shocks. To do so, we first construct a measure that captures the relative growth of claims in highly-regulated host-nations as follows:

$$rc_{it} = \frac{\sum_{j=1}^{R^i} \left(r_{jt} c_{ijt} - c_{it} \right)}{\sum_{j=1}^{R^i} r_{jt}} \tag{25}$$

This relative growth variable, denoted by, rc_{it} for reporting country i, gives higher weight to the claim growth of highly-regulated host nations that country i holds claims in. Subtracting the total claim growth of reporting country *i* from the regulation weighted claim growth variable ensures that the sign of the relative growth variable depends mainly on the direction of claim growth in more regulated nations. If, for example, country *i* shifts its funds/claims out of less regulated to more regulated host-nations, the relative claim growth variable would be positive. This would also be true if claims grow faster in highly regulated countries.

Our main goal is to observe how the variable constructed above responds to push shocks (measured by shocks to the VIX index in this section). In doing so, however, it is important to also account for changes in pull factors as changes in relative claim growth could also be related to changes in domestic pull conditions prompted by push shocks. To match the relative claim growth variable, we construct a regulation weighted GDP growth rate for host nations by using the formulation above. As with claim growth, if GDP growth is faster in more regulated nations, the relative GDP growth variable becomes positive, and negative otherwise.

To derive the responses to orthogonal shocks in the SVAR model, we use a Cholesky decomposition with the following ordering of the variables: push factor, relative GDP growth, relative claim growth. The corresponding restrictions on the contemporaneous correlation matrix imply that push factor growth is not contemporaneously affected by host nations' GDP or claim growth, that relative GDP growth is not affected by the relative claim growth within the same period. These are reasonable restrictions since forward looking expectations based, global measures such as VIX would not be too sensitive to current economic conditions in an individual host nation. By contrast ordering, claim growth last implies that this variable depends on not only past shocks but also current shocks to push and pull factors.

We use the 1990-2018 sample period, similarly excluding 2008 and 2009, and estimate our SVAR model individually for each reporting country. The reason we extend the time period back to 1990 is to obtain sufficient number of observations to conduct our time series analysis. After doing so, there were 14 reporting countries with sufficient observations in our dataset. Figure 1 displays the responses of relative claim growth of these 14 countries to a one percent increase in the VIX index.

Consistent with our earlier inferences, reporting banks shift funds out of highly-regulated countries in response to an adverse push shock. More specifically the negative impulse responses imply either that claim growth in more regulated countries, following an exogenous increase in VIX, is smaller or that the retrenchment in claims is more substantial in these countries. The responses of claim growth to an orthogonal one percent shock to the pull factor (relative growth of GDP) are by contrast positive. This indicates that if more regulated nations' economies grow faster, they receive a larger amount of IAB funds compared to less regulated host nations.

In Table 10, we compare the shares of claim growth forecast error variance explained by push and pull shocks. If the reported statistic is greater than one, this implies that push factor's share in the forecast error variance decomposition is higher than that of the pull factor. The results generally indicate that the shares are about the same at the earlier horizons and that the shares explained by push shocks increase as the horizon gets longer.

4 Concluding remarks

This paper identified two theoretical reasons why regulatory arbitrage behavior of IABs may depend on global financial conditions (i.e., global push factors).Under adverse global financial conditions, for example, IABs can face higher compliance costs in more regulated markets if regulation becomes more binding under these conditions. Conversely, if higher regulation suppresses the degree of risk-taking, the asset returns in highly-regulated nations may be more insulated from the rise in global financial risk under the same conditions.

In the second half of the paper, we let banking data inform us on which of these two reasonable effects of regulation dominates. Using a unique identification strategy, we found that the standard regulatory arbitrage behavior is only observed under adverse push conditions, proving that the first of the two theoretical mechanisms above is more prevalent. More specifically, IABs expand their claims more rapidly in less regulated countries only when global perception of financial risk is higher. This direction of arbitrage is reversed under loose conditions as countries with more strict banking regulation experience a higher growth in IAB claims. We found that our results are not driven by a few country pairs in our panel by extracting corroborating evidence from a SVAR model fitted to data from individual countries.

A natural way to proceed would be to investigate the systematic risk implications of the push-factor-regulation interaction. For example, does the finding that IAB funds grow faster in less-regulated nations during high asset market risk also imply that global financial volatility is higher during these periods? It would be reasonable to postulate that the answer is yes if most countries with weaker banking regulations also have volatile/high-risk financial markets. If this were to be true, it would also reveal that the second mechanism in our theoretical framework (the risk-mitigation effects of regulation) is alive and strong.

Also, our results are based on country-level data. While for most of the country pairs in the BIS database, the number of reporting banks is small (the number of banks per country pair is 5.24 on average in Avdjiev et al, 2019, for example), it could be interesting to determine whether the significant interaction between push factor and regulation that we find is observed also at the bank-level. This type of research would also allow one to determine the banking characteristics (such as size and breadth of global activities) that are more closely related to regulatory arbitrage and the sensitvitiy to global conditions.

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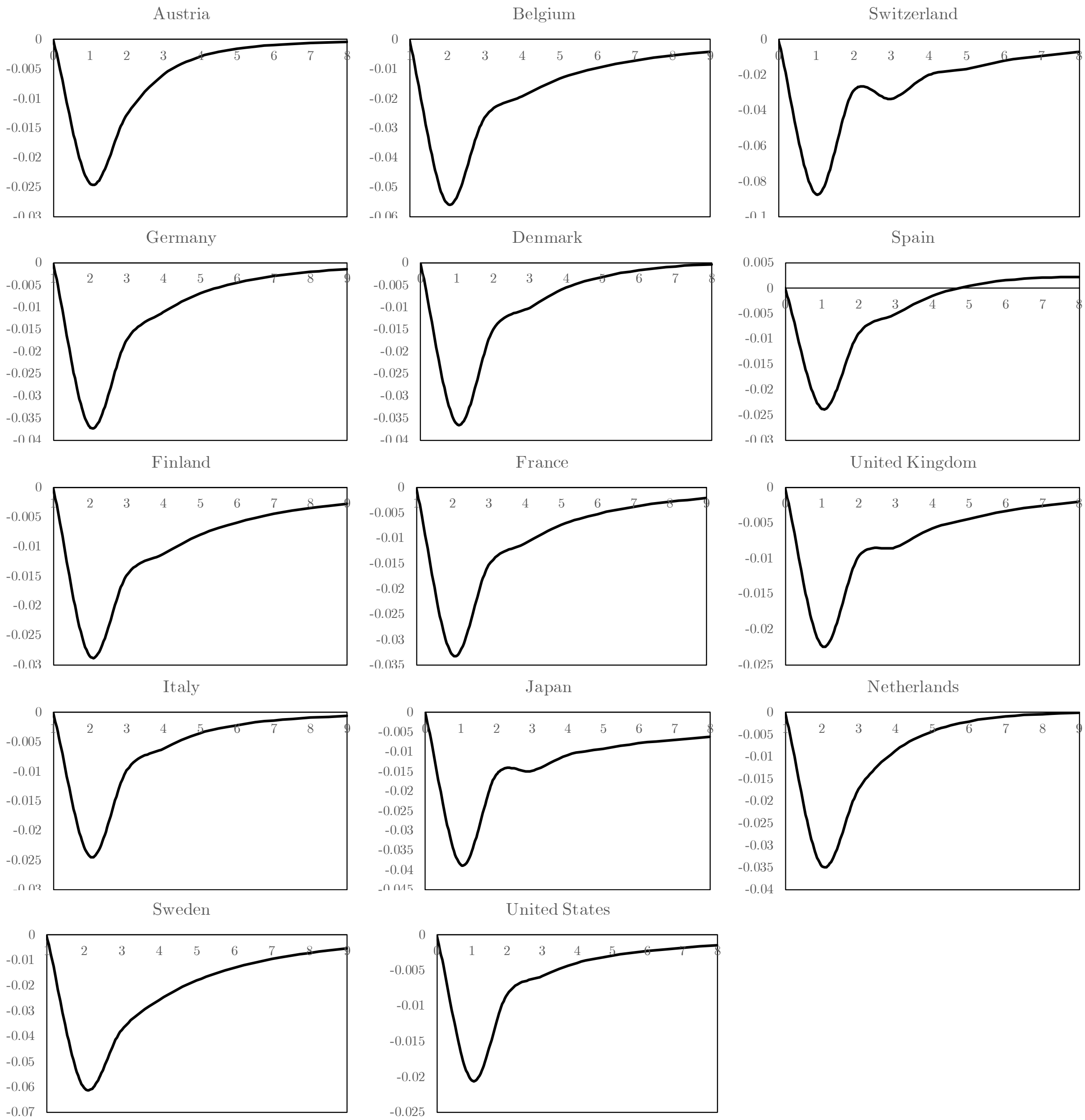
Appendix A. Data definitions

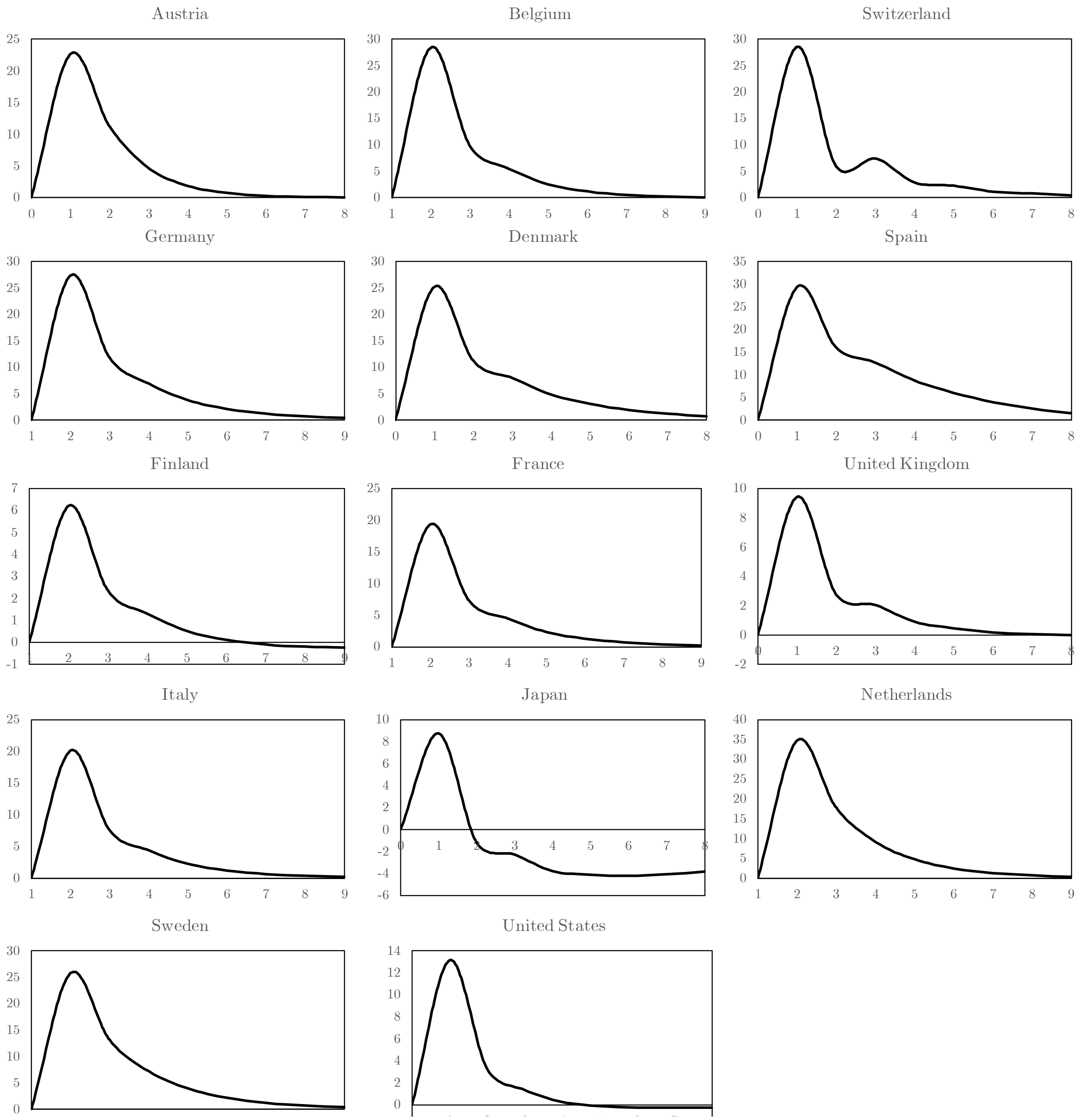
Variables	Description
BIS, Claims (Consolidated Banking Statistics)	Consolidated positions of banks' worldwide offices, including the positions of banks' foreign subsidiaries and branches but excluding inter-office activity. The positions are reported on an immediate counterparty basis so that the funds are allocated to the country and sector of the entity to which they were lent.
BIS, Claims (Locational Banking Statistics)	Outstanding claims and liabilities of banking offices located in BIS reporting countries, including intragroup positions.
GDP	Gross Domestic Product by Expenditure in Constant Prices. Seasonally adjusted index, 2010=1.
Exchange rate	Annual average and end of period nominal exchange rates expressed as US Dollars per currency.
Overall Financial Conglomerates Restrictiveness	The sum of the regulatory indices for "Securities Activities", "Real Estate Activities", "Insurance Activities".
Overall Banking Restrictiveness	The sum of the regulatory indices for "Bank Owning Nonfinancial Firms", "Nonfinancial Firms Owning Banks", "Nonbank Financial Firms Owning Banks".
Underwriting Restrictiveness	The extent to which banks may engage in underwriting, brokering and dealing in securities, and all aspects of the mutual fund industry.
Bank ownership restrictiveness	The extent to which banks may own and control nonfinancial firms.
Capital Regulation index	Sum of the indices for overall and initial capital stringency. Overall stringency depends on whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy is determined. Initial capital stringency depends on whether certain funds may be used to initially capitalize a bank and whether they are official.
Transparency	The transparency of bank financial statements practices.
Entry restrictiveness	The degree to which applications to enter banking are denied.
Entry restrictiveness, foreign	The degree to which foreign applications to enter banking are denied.
Cerutti et al. (2017), capital buffers	Sum of changes in sector-specific capital buffers across the residental, consumer, and other sectors.
Cerutti et al. (2017), capital requirements	Change in capital requirements. Implementation of Basel capital agreements.
VIX	Market expectation of near term volatility conveyed by the option prices for S&P 500 stocks.
VSTOXX	Quantifies investor sentiment and overall economic uncertainty by measuring the 30-day implied volatility of the EURO STOXX 50.
Federal funds rate	Effective federal funds rate: interest rate depository institutions charge each other for overnight loans of funds in the US.
Baa-Aaa spread	Difference between Moody s seasoned Baa and Aaa corporate bond yields.
Gilchrist-Zakrajsek risk spread	Credit spread index that predicts future economic activity.

Figure 1. Claim growth response to a push shock



Notes: The figure displays the responses of the relative claim growth variable, $rc_{i,t}$, to a positive one percent orthogonal shock to the VIX index.

Figure 2. Claim growth response to a pull shock



Notes: The figure displays the responses of the relative claim growth variable, $rc_{i,t}$, to a positive one percent orthogonal shock to pull factor (the relative GDP growth variable.

Table 1. Data

Number of reporting nations, CBS, LBS	31	
Number of reporting nations, Houston et al. (2013)	25	
Number of host nations, CBS	113	
Number of host nations, LBS	103	
IAB Claims / Host nations GDP, Reporters	0.512	
IAB Claims / Host nations GDP, Host nations	0.395	

	Mean	Std. Dev.
Claim growth	0.043	0.742
GDP growth	0.040	0.037
Financial Conglomerates Restrictiveness, regulatory index	6.894	1.820
VIX	18.245	4.814
Federal funds Rate	1.849	1.978
VSTOXX	22.787	6.103
Baa-Aaa spread	0.947	0.181
Gilchrist-Zakrajsek spread	2.356	0.516

Host nations

Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Bahamas, Bangladesh, Barbados, Belgium, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica, Cote d Ivoire, Croatia, Czech Republic, Denmark, Developed countries, Developing countries, Egypt, El Salvador, Estonia, Euro area, Falkland Islands, Finland, France, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea, Honduras, Hong Kong SAR, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Kenya, Latvia, Lebanon, Lithuania, Luxembourg, Macao SAR, Macedonia, FYR, Madagascar, Malaysia, Malta, Mauritius, Mexico, Moldova, Montenegro, Morocco, Mozambique, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, South Korea, Spain, Sri Lanka, Sweden, Switzerland, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Kingdom, United States, Uruguay, Venezuela, Zambia, Zimbabwe.

Reporting nations

Austria, Australia, Brazil, Canada, Switzerland, Chile, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hong Kong SAR, Ireland, India, Italy, Japan, Republic of Korea, Luxembourg, Mexico, Netherlands, Norway, Panama, Portugal, Sweden, Singapore, Turkey, Chinese Taipei, United States

Notes: This table describes the contents of the dataset that we use in our baseline estimations.

Table 2. Interaction of regulation and push factors

	Push factors				
	VIX	VSTOXX	FFR	Baa-Aaa	G-Z spread
Push*regulation	-0.0013	-0.0008	-0.0049	-0.0298	-0.0119
	(0.0005)**	(0.0005)*	(0.0017)***	(0.0144)**	(0.005)**
Regulation	0.0208	0.0168	0.0052	0.0268	0.0240
	(0.0098)**	(0.0114)	(0.0032)	(0.0141)*	(0.0122)**
Push factor	0.0009	0.0001	-0.0016	-0.0519	0.0188
	(0.0009)	(0.0009)	(0.0031)	(0.0264)**	(0.0097)*
Pull factor	1.1253	1.1250	1.1147	1.1277	1.0671
	(0.174)***	(0.174)***	(0.1738)***	(0.1743)***	(0.1785)***
Dependent variable	-0.0909	-0.0910	-0.0941	-0.0917	-0.0779
lags	(28.99)***	(29.10)***	(29.72)***	(29.29)***	(20.22)***
# of observations	10,962	10,962	10,962	10,962	10,962
Hansen test	0.215	0.212	0.236	0.201	0.113
AR2 test	0.532	0.527	0.563	0.534	0.301

Notes: This table reports the results obtained from the estimation of equation (19). The dependent variable in each estimation is the relative claim growth variable, $\tilde{c}_{ijt}$. The results are obtained separately for each of the push factors (displayed in the column headers) as independent variables. *, **, *** significant at 10%, 5%, 1%, respectively. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 3. Other regulatory indicators

	Regulatory Restrictions							
	Overall Financial Conglomerates Restrictiveness	Overall Restrictions on Banking Activities	Underwriting, brokering and dealing in securities	The extent to which banks may own and control nonfinancial firms	Capital Regulation Index	The transparency of bank financial statements practices	Entry Restrictions	Entry Restrictions , Foreign
Push*regulation	-0.0013	-0.0011	-0.0028	-0.0021	0.0009	-0.0033	-0.0032	-0.0076
	(0.0005)**	(0.0005)**	(0.0014)**	(0.0011)**	(0.0006)	(0.0011)***	(0.0045)	(0.0046)*
Regulation	0.0208	0.0194	0.0442	0.0310	-0.0148	0.0684	0.0009	0.0398
	(0.0098)**	(0.0087)**	(0.0245)*	(0.0192)	(0.0116)	(0.0209)***	(0.0907)	(0.0888)
Push factor	0.0009	0.0008	0.0010	0.0012	0.0017	0.0011	0.0000	0.0005
	(0.0009)	(0.001)	(0.001)	(0.001)	(0.001)*	(0.0009)	(0.0012)	(0.0011)
Pull factor	1.1253	1.2188	1.2025	1.2367	1.1661	1.0855	1.4426	1.3206
	(0.174)***	(0.1742)***	(0.1756)***	(0.1757)***	(0.1738)***	(0.1646)***	(0.2133)***	(0.2044)***
Dependent var.	-0.0909	-0.1020	-0.1045	-0.1034	-0.1002	-0.0894	-0.1244	-0.1477
lags	(28.99)***	(36.60)***	(36.70)***	(31.96)***	(32.00)***	(29.34)***	(41.56)***	(58.10)***
# of obs.	10,962	11,196	11,139	11,087	11,179	11,683	7,318	10,962
Hansen test	0.215	0.350	0.362	0.388	0.440	0.460	0.297	0.292
AR2 test	0.532	0.985	0.972	0.855	0.677	0.985	0.377	0.231

Notes: This table reports the results obtained from the estimation of equation (19). The dependent variable in each estimation is the relative claim growth variable, $\tilde{c}_{ijt}$. The results are obtained separately for each of the push factors (displayed in the column headers) as independent variables. *, **, *** significant at 10%, 5%, 1%, respectively. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 4. Evidence from earlier periods

	Push factors				
	VIX	FFR	Baa-Aaa	G-Z spread	Global Factor
Push*regulation	-0.0017	-0.0018	-0.0038	0.0011	-0.0002
	(0.0008)**	(0.0014)	(0.0098)	(0.0118)	(0.0001)*
Regulation	0.0381	0.0165	0.0089	0.0042	0.0178
	(0.0145)***	(0.009)*	(0.0094)	(0.0179)	(0.0063)***
Push factor	0.0005	0.0037	0.0484	0.0299	0.0000
	(0.0015)	(0.0027)	(0.0218)**	(0.0239)	(0.0002)
Pull factor	0.7661	0.8083	0.8098	0.7909	0.7593
	(0.1822)***	(0.1195)***	(0.1184)***	(0.1188)***	(0.1164)***
Dependent variable lags	0.0149	-0.0578	-0.0589	-0.0583	-0.0597
	(20.84)***	(48.39)***	(50.07)***	(47.96)***	(49.32)***
# of observations	3,165	4,471	4,471	4,471	4,471
Hansen test	0.199	0.196	0.197	0.185	0.180
AR2 test	0.987	0.990	0.993	0.977	0.973

Notes: This table reports the results obtained from the estimation of equation (19). The dependent variable in each estimation is the relative claim growth variable, $\tilde{c}_{ijt}$. The results are obtained separately for each of the push factors (displayed in the column headers) as independent variables. The sample period is 1990 to 1999. *, **, *** significant at 10%, 5%, 1%, respectively. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 5. Accounting for the 2008-09 crisis

	Push factors				
	VIX	VSTOXX	FFR	Baa-Aaa	G-Z spread
Excluding 2008-2009					
Push*regulation	-0.0013	-0.0008	-0.0049	-0.0298	-0.0119
	(0.0005)**	(0.0005)*	(0.0017)***	(0.0144)**	(0.005)**
Regulation	0.0208	0.0168	0.0052	0.0268	0.0240
	(0.0098)**	(0.0114)	(0.0032)	(0.0141)*	(0.0122)**
Including 2008-2009					
Push*regulation	-0.0007	-0.0006	-0.0029	-0.0100	-0.0048
	(0.0003)**	(0.0003)*	(0.0012)**	(0.0058)*	(0.0026)*
Regulation	0.0113	0.0115	0.0021	0.0085	0.0095
	(0.0067)*	(0.0087)	(0.0027)	(0.0068)	(0.0071)
Post-crisis regulatory stance					
Push*regulation	-0.0014	-0.0011	-0.0040	-0.0497	-0.0114
	(0.0005)***	(0.0005)**	(0.0018)**	(0.0152)***	(0.0051)**
Regulation	0.0140	0.0133	0.0001	0.0339	0.0157
	(0.0106)	(0.0116)	(0.0042)	(0.0142)**	(0.0135)
post 08/09 indicator	0.0009	0.0007	0.0224	0.0199	0.0056
	(0.0003)***	(0.0002)***	(0.0119)*	(0.0056)***	(0.0024)**

Notes: This table reports the results obtained from the estimation of equation (19). The dependent variable in each estimation is the relative claim growth variable, $\tilde{c}_{ijt}$. The results are obtained separately for each of the push factors (displayed in the column headers) as independent variables. The top panel shows our baseline results The two other panels show the results we obtained when we included the crisis periods and a crisis dummy, respectively. *, **, *** significant at 10%, 5%, 1%, respectively.

Table 6. Regulatory arbitrage

PANEL A	Regulation	Pull factor	Number of obs.	AR(2)	Hansen
Baseline	-0.0014	1.1224	10,962	0.539	0.214
	(0.0027)	(0.1738)***			
Including crisis	-0.0021	1.1802	14,919	0.460	0.112
	(0.0023)	(0.129)***			
Advanced economies	-0.0059	1.4997	4,110	0.539	0.214
	(0.0025)**	(0.2642)***			
Houston et al. (2012) sample period	-0.0085	0.9572	7,008	0.186	0.160
	(0.003)***	(0.1561)***			
Reporting country regulations	-0.0007	1.0752	11,041	0.954	0.191
	(0.0027)	(0.1728)***			
Reporting country regulations - Advanced economies	0.0077	1.4879	4,050	0.501	0.457
	(0.0028)***	(0.3003)***			

PANEL B	Host nation (baseline) variables			Lending nation variables	
	Regulation	Regulation*push		Regulation	Regulation*push
Specification with both host and lender regulations (Push factor=VIX)	0.0216 (0.0098)**	-0.0013 (0.0005)***		0.003 (0.0099)	0.000 (0.0005)

Notes: Panel A reports the results obtained when we exclude the interactive term from equation (19). The dependent variable in each estimation is the relative claim growth variable, $\tilde{c}_{ijt}$. Panel B reports the results from the model that includes the regulatory variable, the interactive term and the GDP growth of the reporting countries. *, **, *** significant at 10%, 5%, 1%, respectively.

Table 7. A more dynamic indicator of regulatory stringency

	Push factors				
	VIX	VSTOXX	FFR	Baa-Aaa	G-Z spread
Push*regulation, capital requirements	-0.0114	-0.0098	-2.6305	-0.2562	-0.1091
	(0.0065)*	(0.0049)**	(1.0436)**	(0.1143)**	(0.0507)**
Regulation, capital requirements	0.1047	0.1323	0.2149	0.1758	0.1532
	(0.1472)	(0.1464)	(0.1554)	(0.1490)	(0.1458)
Number of observations	5,453	5,453	5,453	5,453	5,453
Hansen test	0.2160	0.2162	0.2089	0.2125	0.2140
AR2 test	0.2401	0.2389	0.2340	0.2376	0.2385
Push*regulation, capital buffers	-0.0363	-0.0301	0.1158	-1.1389	-0.4592
	(0.0124)***	(0.0088)***	(0.0472)**	(0.2886)	(0.1181)
Regulation, capital buffers	0.7336	0.7845	-0.0491	1.2705	1.1373
	(0.2477)***	(0.2316)***	(0.0895)	(0.3130)***	(0.2941)***
Number of observations	5,671	5,671	5,671	5,671	5,671
Hansen test	0.2751	0.2729	0.3082	0.2911	0.2884
AR2 test	0.6483	0.6360	0.7116	0.6374	0.6506

Notes: This table reports the results obtained from the estimation of equation (19). The dependent variable in each estimation is the relative claim growth variable, $\tilde{c}_{ijt}$. The results are obtained separately for each of the push factors (displayed in the column headers) as independent variables. The regulatory indices are from Cerutti et al. (2017). *, **, *** significant at 10%, 5%, 1%, respectively. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 8. Economic impact of regulation and push factors

Panel A: Baseline regulation, different push factors	VIX	VSTOXX	FFR	Baa-Aaa	G-Z spread
Push*regulation	-0.0442	-0.0335	-0.0246	-0.2113	-0.0520
Regulation	0.0371			0.0478	0.0428
Panel B: VIX, different regulations	Overall Restrictions on Banking Activities	Underwriting, brokering and dealing in securities	The extent to which banks may own/control nonfin. firms	Transparency: bank financial statements practices	Entry restrictions, foreign
Push*regulation	-0.0432	-0.0388	-0.0354	-0.0570	-0.0300
Regulation	0.0395	0.0335		0.0624	

Notes: This table reports the results obtained from the estimation of equation (19). The reported coefficient values represent the impact of a one standard deviation change in the dependent variable on claim growth. The results are obtained separately for each of the push factors displayed in the column headers of panel A and for the different regulatory measures in panel B. *, **, *** significant at 10%, 5%, 1%, respectively. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 9. Other considerations

Panel A: Exchange rate adjusted lending, locational statistics	VIX	VSTOXX	FFR	Baa-Aaa	G-Z spread
Push*regulation	-0.0023	-0.0019	0.0044	-0.0358	-0.0240
	(0.0008)***	(0.0007)***	(0.0042)	(0.01778)**	(0.0092)***
Regulation	0.0416	0.0453	-0.0018	0.0368	0.0556
	(0.0151)***	(0.0169)***	(0.0052)	(0.01775)**	(0.0219)**
Panel B: Reporting country regulations	VIX	VSTOXX	FFR	Baa-Aaa	G-Z spread
Push*regulation	0.0003	0.0004	-0.0016	0.0237	-0.0126
	(0.0005)	(0.0004)	(0.0017)	(0.0155)	(0.0049)***
Regulation	-0.0028	-0.0056	0.0059	-0.0196	0.0383
	(0.0094)	(0.0111)	(0.0034)*	(0.0152)	(0.0126)***
Panel C: Fixed effects estimator	VIX	VSTOXX	FFR	Baa-Aaa	G-Z spread
Push*regulation	-0.00168	-0.0024	-0.0013	-0.0324	-0.0125
	(0.0006)***	(0.002)	(0.0005)**	(0.0166)*	(0.0055)**
Regulation	0.0278	0.0016	0.0266	0.0295	0.0241
	(0.0116)**	(0.0046)	(0.0123)**	(0.0165)*	(0.0138)*

Notes: This table reports the results obtained from the estimation of equation (19). The dependent variable in each estimation is the relative claim growth variable, $\tilde{c}_{ijt}$. The results are obtained separately for each of the push factors (displayed in the column headers) as independent variables. The results in Panel A are obtained after adjusting the dependent variable for exchange rate fluctuations. The results in Panel B correspond to the model where the regulation variable captures the variation amongst reporting country regulations. Panel C reports the results obtained by using a fixed effects estimator. *, **, *** significant at 10%, 5%, 1%, respectively. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 10. Forecast error variance decomposition share of push shocks

	Forecast horizon						
	2	3	4	5	6	7	8
Austria	0.65	0.73	0.75	0.75	0.76	0.76	0.76
Belgium	1.54	1.77	1.89	1.95	1.98	1.99	2.00
Switzerland	0.61	0.69	0.77	0.80	0.82	0.83	0.84
Germany	0.73	0.84	0.89	0.90	0.91	0.91	0.91
Denmark	0.33	0.38	0.39	0.40	0.40	0.40	0.40
Spain	0.49	0.53	0.53	0.52	0.51	0.51	0.51
Finland	1.47	1.69	1.80	1.85	1.88	1.90	1.91
France	0.93	1.08	1.16	1.19	1.21	1.22	1.22
United Kingdom	1.88	2.15	2.34	2.43	2.49	2.52	2.53
Italy	0.49	0.55	0.58	0.58	0.59	0.59	0.59
Japan	1.51	1.73	1.93	2.01	2.05	2.08	2.09
Netherlands	1.33	1.33	1.32	1.32	1.32	1.32	1.32
Sweden	1.69	2.14	2.35	2.45	2.50	2.53	2.55
United States	0.86	0.98	1.03	1.06	1.07	1.08	1.09
Average	1.04	1.18	1.27	1.30	1.32	1.33	1.34

Notes: This table reports the share of push shocks, relative to pull shocks, in the forecast error variance decomposition of the relative claim growth variable in Section 3.3. The shares are separately reported for each forecast horizon displayed in the column headers.