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International Capital Mobility  
and Financial Fragility - Part  
3. How Do Structural  
Policies Affect Financial  
Crisis Risk? Evidence from  
Past Crises Across OECD  
and Emerging Economies

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**INTERNATIONAL CAPITAL MOBILITY AND FINANCIAL FRAGILITY: PART 3. HOW DO  
STRUCTURAL POLICIES AFFECT FINANCIAL CRISIS RISK? EVIDENCE FROM PAST CRISES  
ACROSS OECD AND EMERGING ECONOMIES**

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by **Rudiger Ahrend and Antoine Goujard**

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## ABSTRACT/RÉSUMÉ

**International capital mobility and financial fragility: Part 3. How do structural policies affect financial crisis risk? Evidence from past crises across OECD and emerging economies**

This paper examines how structural policies can influence a country's risk of suffering financial turmoil. Using a panel of 184 developed and emerging economies from 1970 to 2009, the empirical analysis examines which structural policies can affect financial stability by either shaping the financial account structure, by reducing the risk of international financial contagion, or by directly reducing the risk of financial crises. Differentiated capital controls are found to affect financial stability *via* the structure of the financial account. Moreover, a number of structural policies including regulatory burdens on foreign direct investment, strict product market regulation, or tax systems which favour debt over equity finance are found to bias external financing towards debt, thereby increasing financial crisis risk. By contrast, more stringent domestic capital adequacy requirements for banks, greater reliance of a domestic banking system on deposits, controls on credit market inflows, and openness to foreign bank entry are found to reduce the vulnerability to financial contagion. Finally, vulnerability to international bank balance-sheet shocks is found to be lower in situations of abundant global liquidity, underlining the importance of adequate central bank reactions in situations of financial turmoil.

*JEL classification codes:* E44; F34; F36; G01; G18

*Keywords:* financial stability; balance sheet; financial account; external debt; capital controls; banking regulations; Foreign direct investment, FDI restrictions.

\*\*\*\*\*

**Flux de capitaux internationaux et fragilité financière : Partie 3. Comment les politiques structurelles affectent-elles la probabilité de crise financière? Analyse empirique des crises financières passées des pays OCDE et émergents**

Cet article examine comment les politiques structurelles peuvent influencer le risque de crise financière. L'analyse empirique porte sur un échantillon de 184 pays développés et émergents de 1970 à 2009 et teste quelles politiques structurelles peuvent favoriser la stabilité financière, soit en influant sur la structure du compte financier, soit en réduisant les risques de contagion financière internationale, soit en réduisant directement le risque de crise financière. Des mesures ciblées de contrôle des flux de capitaux ont influé sur la stabilité financière en modifiant la structure des engagements internationaux. De plus, de nombreuses politiques structurelles, comme les restrictions trop importantes aux investissements directs étrangers, une réglementation des marchés de produits défavorable à la compétition, ou des systèmes de taxation favorisant le financement par la dette au détriment des investissements de capitaux, ont contribué à réduire la stabilité financière en augmentant la part de la dette dans les engagements externes des pays au détriment des IDEs ou des investissements de capitaux. En revanche, une meilleure réglementation des fonds propres bancaires, un ratio crédits sur dépôts bancaires plus faible et une plus grande ouverture à l'entrée des banques étrangères ont réduit les risques de crises financières lors des épisodes de contagion bancaire. Enfin, la vulnérabilité des pays à la contagion par le système bancaire international a été moindre lorsque la liquidité globale était abondante, ce qui souligne l'importance d'une réaction appropriée des banques centrales lors des périodes d'instabilité financière.

*Codes JEL :* E44; F34; F36; G01; G18

*Mots-clés :* stabilité financière; bilan des banques; compte financier; dette externe; contrôle des flux de capitaux; réglementation bancaire; investissements directs étrangers; réglementation des IDEs.

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## TABLE OF CONTENTS

INTERNATIONAL CAPITAL MOBILITY AND FINANCIAL FRAGILITY: PART 3. HOW DO STRUCTURAL POLICIES AFFECT FINANCIAL CRISIS RISK? EVIDENCE FROM PAST CRISES ACROSS OECD AND EMERGING ECONOMIES .....	5
INTRODUCTION AND MAIN FINDINGS .....	5
1. THE ROLE OF STRUCTURAL POLICIES VIA THE FINANCIAL ACCOUNT .....	8
1.1 Methodology .....	9
1.2 Determinants of a debt bias in external liabilities .....	10
Capital controls .....	10
Regulatory restrictions on FDI and equity investments and more generally in product markets .....	12
Tax systems that favour debt over equity finance .....	14
Tax treaties .....	15
Housing and credit booms .....	18
1.3 Determinants of external bank debt .....	19
1.4 Determinants of the maturity of banking debt .....	21
1.5 Determinants of currency mismatches .....	22
2. THE ROLE OF STRUCTURAL POLICIES VIA BANK-BALANCE-SHEET CONTAGION .....	25
2.1 Methodology .....	25
2.2 Contagion shocks and banking regulation .....	27
2.3 Contagion shocks and other structural policies .....	32
2.4 Contagion shocks and the macroeconomic environment .....	33
BIBLIOGRAPHY .....	35
APPENDIX 1. DEFINITION OF THE MAIN VARIABLES .....	40
APPENDIX 2. ROBUSTNESS CHECK: BANK-BALANCE-SHEET SHOCKS <i>VERSUS</i> REGIONAL AND TRADE SHOCKS .....	43
.....	46

### Tables

1. Determinants of the share of debt in external liabilities 1970-2007 .....	12
2. Determinants of the share of debt in external liabilities: restrictiveness to foreign direct and equity investment 1997-2007 .....	13
3. Determinants of the share of debt in external liabilities of OECD countries: Product Market Regulation (PMR) and Employment Protection (EPL) .....	14
4. Determinants of the share of debt in external liabilities: corporate income tax .....	15
5. Determinants of the share of debt in external liabilities: tax treaties .....	16
6. Determinants of the share of debt in external liabilities: housing prices and credit growth .....	19
7. Determinants of external liabilities towards banks 1984-2006 .....	20
8. Determinants of external short-term bank debt 1984-2006 .....	22
9. Determinants of the currency mismatch 1990-2005 .....	24
10. Bank balance-sheet shocks, bank regulation and probability of banking crisis .....	28

11. Bank balance-sheet shocks, long run effects of bank regulations and probability of banking crisis .....	30
12. Bank balance-sheet shocks, capital controls, exchange rate regime and probability of banking crisis .....	33
13. Bank balance sheet shocks, macroeconomic conditions and probability of banking crisis .....	34
A1. Definition of the main variables.....	40
A2. Falsification tests: bank-balance-sheet shocks versus regional and trade shocks .....	44
A3. The impact of bank-balance-sheet shocks and other shocks on the probability of banking crisis .....	45

**Figure**

1. External liabilities in the form of debt have coincided with a higher risk of financial crisis .....	6
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**Boxes**

Box 1. The effect of bilateral tax treaties on foreign asset positions.....	16
Box 2. Domestic <i>versus</i> foreign bank presence in the case of bank-balance-sheet contagion shocks .....	30

## **INTERNATIONAL CAPITAL MOBILITY AND FINANCIAL FRAGILITY: PART 3. HOW DO STRUCTURAL POLICIES AFFECT FINANCIAL CRISIS RISK? EVIDENCE FROM PAST CRISES ACROSS OECD AND EMERGING ECONOMIES**

By Rudiger Ahrend and Antoine Goujard<sup>1</sup>

### **INTRODUCTION AND MAIN FINDINGS**

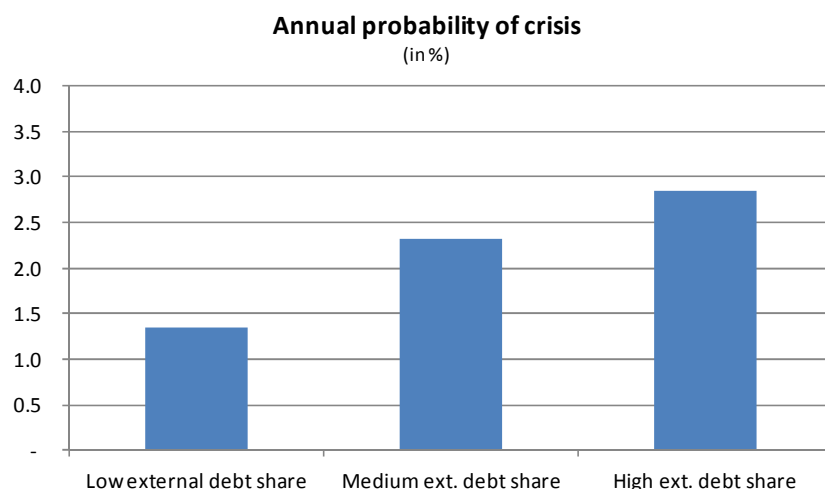
1. The recent financial crisis has underlined the need for reducing financial fragility, both by reducing the risk of financial crises occurring and by limiting their spreading and destructive impact when they occur. This report examines what role *structural* policies can play in reducing financial fragility *via* their influence on international capital flows. This impact comes over and above the effect of macroeconomic imbalances, such as misaligned exchange rates or fiscally unsustainable positions that have been extensively explored in the literature.

2. Simple stylised facts suggest that financial account structure could influence the risk of suffering a financial crisis. For example, systemic banking crises have been more frequent in countries where overall external liabilities (*i.e.* external debt, equity and FDI) included a higher share of debt (Figure 1). This suggests examining not only policies that may directly influence the risk of financial crisis, but also those that shape financial account structure. Indeed, a fairly large body of mainly theoretical or descriptive literature has argued that certain features of the structure of the financial account, such as a large share of debt in external liabilities, a bias of debt towards short maturities, or an aggregate currency mismatch between external asset and liabilities would increase financial fragility.

3. A companion paper (Ahrend and Goujard, 2011) shows empirically that greater (short-term) borrowing from external banks, a skew in external liabilities towards debt, as well as an aggregate currency mismatch indeed all increase the likelihood of systemic banking crisis. The present paper builds on these findings and explores the extent to which structural policies shape the financial account structure, and thereby indirectly affect financial crisis risk.

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**Figure 1. External liabilities in the form of debt have coincided with a higher risk of financial crisis**

Note: Simple descriptive statistics based on data covering 184 countries from 1970 to 2007 for gross external debt as a percentage of total external liabilities and episodes of systemic banking crisis taken from Laeven and Valencia (2010). Low, medium and high external debt is defined based on the 33rd and 66th percentiles of the external debt to external liabilities ratio for each year. Systemic banking crises are defined based on both significant signs of financial distress in the banking system and policy interventions in response to such distress.

Source: OECD calculations

4. Beyond their impact through the financial account, certain structural policies may also directly affect financial stability in situations of financial contagion. The recent crisis has highlighted that balance sheets of leveraged financial intermediaries such as banks are an important, and possibly the main transmission channel of financial contagion (Krugman, 2008). Bank-Balance-Sheet (BBS) contagion arises, for example, when banks from a creditor country with a deteriorating risk profile decide to withdraw international funding to comply with internal rules or prudential regulations such as capital adequacy requirements. BBS contagion can also arise indirectly through the international banking system when banks cut back on loans to a country in response to suffering losses on loans to another country – a channel sometimes referred to as common-creditor contagion. Ahrend and Goujard (2011) show that BBS-driven contagion has not only been a key transmission channel during the recent financial crisis, but has more generally been a major driver of financial crises. Structural policies may hence also reduce financial fragility by mitigating the impact of BBS-driven contagion shocks.

5. To what degree structural policies can influence financial stability remains, however, contested. For instance, Shimpalee and Breuer (2006) find only weak evidence that the removal of capital controls, a lack of central bank independence, and financial liberalisation increase the risk of banking crises. Similarly, Barth *et al.* (2004) find that even though regulatory policies such as accurate information disclosure have promoted stability,<sup>2</sup> capital adequacy requirements have only been weakly associated with financial stability. This paper therefore explores whether, and if so which, structural policies could increase financial stability, either through their impact on financial account structure or by mitigating the risk that bank-driven contagion pushes a country into financial crisis. The empirical analysis is based on a panel of 180 countries over the 1970-2009 period and two main empirical specifications. The first specification relates financial account structure to structural policies. It aims to measure how much structural policies can shape the risk of financial crisis through the structure of the financial account. The second specification explains the likelihood of systemic banking crises by the occurrence of shocks affecting a country's creditor banks. It explores if some structural policies, such as capital adequacy requirements or capital

2. Tadesse (2006) also finds that regulations that relate to information disclosure reduce banking instability.

controls, can mitigate the impact of those bank-balance-sheet contagion shocks on the likelihood of systemic banking crises.

6. The main findings are as follows:

- There is some empirical evidence that differentiated capital controls have an impact on contagion risk, and stronger evidence that they influence the structure of external liabilities, thereby affecting financial stability through both channels. In particular, inflow restrictions on credit operations have not only mitigated contagion risk, but also reduced external (short-term) bank debt and more generally the share of debt in total external liabilities. Similarly, capital account openness to FDI and equity investments has decreased the share of debt in external liabilities. Moreover, capital account openness to FDI and equity inflows appears to significantly reduce currency mismatch, presumably by removing a bias towards inflows that are denominated in foreign currency. However, some capital controls - such as restrictions on credit operations - that are found here to be beneficial for financial stability may come at a price to economic efficiency, *e.g.* by distorting competition among banks based on their country of origin.
- Regulatory burdens on foreign direct investment, as well as strict product market regulation in general, appear to have contributed to financial risk. More precisely, higher regulatory barriers to FDI and equity investment, as captured by the operational restrictions included in the OECD FDI Restrictiveness Index, have resulted in an increased bias of external liabilities towards debt, driven both by increases in external debt liabilities and decreases in equity and FDI liabilities. In particular, more stringent screening approvals for foreign investments, restrictions on employment of foreigners for key management and board positions, as well as operation restrictions on foreign investments (such as on branching or capital repatriation) are found to strongly increase the debt bias. Even though effects are less pronounced, stricter product market regulation, as measured by the OECD indicator of product market regulation in seven key non-manufacturing industries, also seems to bias external liabilities towards debt by diverting external financing away from equity and FDI.
- Underlining the importance of strict financial regulation, countries where the banking sector had been less leveraged and which had a lower credit-over-deposits ratio have faced a lower risk of bank-balance-sheet-driven contagion leading to a banking crisis. Domestic credit expansions have also been found to increase the share of debt in external liabilities, thereby increasing the likelihood of banking crisis. Overall, the analysis of the impact of banking regulation and supervision on the likelihood of systemic banking crises corroborates earlier OECD findings (Ahrend *et al.*, 2011a) that indicators of regulatory and supervisory strength are well correlated with the extent to which countries escaped damage to their banking sector during the 2007-09 financial crisis.
- Stricter domestic banking supervision – possibly reflecting regulatory arbitrage or alternatively an increased attractiveness of the country for financial investors – appears to increase (short-term) borrowing from foreign banks, thereby raising the exposure to bank balance-sheet shocks. However, stricter financial oversight has also been found to reduce financial fragility overall: countries with stronger banking supervision are less affected by investor-sentiment driven capital flow reversals (Ahrend and Schweltnus, 2012), and have a lower risk of suffering from financial crises (Ahrend and Goujard, 2011).
- Similarly, the institutional development of domestic securities markets is found to have increased external short-term bank debt. One possible interpretation for this finding would be that the development of a domestic securities market facilitates carry-trade activities, by making it easier



for domestic banks or other financial investors to borrow short-term abroad in order to invest in higher-yielding domestic debt securities. Lower state ownership of the banking sector and the absence of directed credit are also found to have increased (short-term) bank lending from abroad, thereby increasing the risk of financial crisis through bank balance-sheet contagion. However, institutional development of securities markets also appears to contribute directly to financial stability by reducing vulnerability to investor-sentiment-driven reversals in capital flows (Ahrend and Schweltnus, 2012).

- Tax systems which favour debt over equity finance have biased external financing towards debt, thereby increasing crisis risk. Such tax systems are widespread as most countries provide a larger degree of tax deductibility of interest payments than of dividends or capital gains.
- Bilateral tax treaties are found to have been conducive to FDI while having no effect on other types of investment, thereby contributing to a reduction of the share of debt in external liabilities. Indeed, firms may invest more in countries with which their home countries have tax treaties as investors then no longer face the cost of double taxation. If this effect is particularly large for FDI investment, tax treaties should reduce any bias in a country's external liabilities towards volatile portfolio and bank liabilities.
- Housing price growth is found to have increased the bias towards external debt, tentatively suggesting that special tax treatments for owner-occupied housing can contribute to financial fragility. Indeed, owner-occupied housing is commonly subject to special tax treatment such as mortgage-interest relief without parallel taxation of imputed rents, and this has been found to increase both household leverage and house price volatility in previous studies (Andrews *et al.*, 2011).

7. The remainder of this paper is divided in two sections: Section 1 examines the impact of policies and institutions on financial stability *via* their impact on financial account structure. Section 2 then explores which structural policies mitigate the risk that BBS-driven contagion pushes a country into financial crisis.

## **1. THE ROLE OF STRUCTURAL POLICIES VIA THE FINANCIAL ACCOUNT**

8. The financial account matters for financial stability. Based on a large panel of developed and emerging economies over 40 years, a companion paper (Ahrend and Goujard, 2011) finds that the structure of the external financial account and the size of certain financial account positions affect financial stability *via* their impact on the likelihood of systemic banking crises. More specifically, Ahrend and Goujard (2011) assess the impact of different measures of financial account structure and positions, together with a set of other determinants of financial stability, on the likelihood of systemic banking crisis, as defined in Laeven and Valencia (2010). Their estimated baseline equation is based on the assumption that, conditional on the absence of crisis at time  $t-1$ , the likelihood of a banking crisis at time  $t$  is determined by a linear probability model that also controls for country and year fixed-effects. The following factors appear to increase the likelihood of systemic banking crises:

- A skew in external liabilities towards debt, affecting the risk of systemic banking crises in general.

- Greater international banking integration as measured by the indebtedness towards banks located in foreign countries (as a share of GDP), increasing the risk of financial turmoil through an increased sensitivity to bank balance-sheet contagion shocks, with particularly large effects for short-term borrowing from external banks.
- An aggregate currency mismatch (i.e. large foreign-currency denominated liabilities compared with foreign-currency denominated assets), affecting the risk of systemic banking crises in general.

9. To the degree that structural policies affect these measures of financial account structure, they should affect financial account risk. Therefore the analysis below explores the impact of policies on these dimensions of financial account structure.

### 1.1 Methodology

10. A large number of structural policies – such as FDI restrictiveness – would not be expected to directly affect financial crisis risk (which, indeed, is consistent with non-reported econometric analysis), but could conceivably do so by influencing the financial account. This section uses therefore a two-step procedure that is it looks at the impact of structural policies on those financial account measures that have been found to affect the risk of financial crisis. This approach implicitly assumes that a given financial account measure has the same effect on crisis probabilities independently of what drives it. More specifically, the baseline specification relates relevant financial account variables to structural policies through a linear panel data model controlling for country and year fixed effects:

$$b_{i,t} = P_{i,t-1}\alpha + X_{i,t-1}\beta + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (1)$$

where  $b_{i,t}$  is a variable measuring a dimension of the financial account position.  $P_{i,t-1}$  is a row vector containing the relevant set of public policies, and  $X_{i,t-1}$  is a row vector of additional control variables identified by the literature as key determinants of  $b_{i,t}$ .  $\gamma_i$  and  $\delta_t$  capture unobserved country and time specific shocks.  $\varepsilon_{i,t}$  are idiosyncratic disturbances. As a robustness check, some specifications also control for various measures of financial account size.<sup>3</sup> Fixed effects models require strict exogeneity of the explanatory variables and would therefore result in biased coefficients if structural policies depend on past financial account developments, which is likely to be the case. Therefore, the preferred estimation method relies on first-differences panel data models. First differencing only requires weak exogeneity and thus results in unbiased coefficients if financial account developments do not have a coincident impact on structural policy settings.

11. The four financial account variables affecting financial crisis risk,  $b_{i,t}$  are measured as follows (the definition of all the variables is detailed in Table A1 of Appendix 1):

- The share of debt in external liabilities is taken from the 2009 update of Lane and Milesi-Ferreti (2007).
- The bank debt-to-GDP ratio is computed using consolidated banking statistics from the Bank of International Settlements (BIS) and the GDP in current USD from Lane and Milesi-Ferreti (2007) updated using the IMF World Economic Outlook database.

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3. Both foreign currency reserves and other external assets (excluding reserves) are found to be higher in countries with a lower share of debt in external liabilities. This may reflect that countries which try to insure themselves by holding larger external assets also avoid large exposure to foreign lending. In contrast, the size of external liabilities is positively correlated with debt bias, reflecting that countries with large external liabilities also tend to have large external debt.

- The currency mismatch variable is calculated from Lane and Shambaugh (2010). The index measures the balance-sheet valuation losses (as a % of GDP) associated with exchange rate shocks, with positive values indicating an overexposure to exchange rate risk.
- The share of short-term bank debt is taken from the Bank of International Settlements (BIS) consolidated statistics. Short-term debt corresponds to debt towards BIS reporting banks with residual maturity below one year.

12. The baseline control variables  $X_{it-1}$  are those typically suggested in the literature (e.g. Faria *et al.*, 2007; Lane and Shambaugh, 2010) and are grouped into two main categories. Domestic vulnerabilities are proxied by measures of the credit-to-GDP ratio and credit growth, whereas macroeconomic control variables include GDP per capita, population, and trade openness (the sum of imports and exports as a share of nominal GDP). In addition, some specifications include the size of the financial account as measured by the assets-to-GDP and liabilities-to-GDP ratios to control for possible effects from such size on financial account structure.

13. The following sections examine first the determinants of a general debt bias in external liabilities, before turning more specifically to borrowing from external *banks*, the short-term bias in banking-debt maturity, and currency mismatch. In each section, policy determinants are introduced in a one-by-one fashion, sometimes controlling for similar variables in order to disentangle effects. Such parsimonious specifications are preferred to a simultaneous inclusion of all variables that would result in a massive decrease in sample size and hence degrees of freedom as coverage varies strongly across variables.

## 1.2 Determinants of a debt bias in external liabilities

14. A number of policies could contribute to a debt bias in external liabilities. In developing countries where shallow equity markets are a severe obstacle to equity finance, domestic financial reform may result in a higher share of equity in foreign liabilities (Faria *et al.*, 2007). The composition of capital flows and stocks could potentially also be influenced by selective capital controls. For instance, barriers to FDI and equity investment may increase the share of debt in external liabilities by decreasing FDI and equity inflows. Moreover, local corporate income tax (CIT) systems may create a bias towards debt, including international debt, if the tax system allows for deductions of interest but not of dividends or capital gains as, in some form, is the case in most countries. For example, De Mooij (2011a,b) documents that corporate financing is more biased towards debt in countries with higher corporate tax rates. Such bias could result in an aggregate bias in a country's external liability structure. Finally, a bias towards debt may also arise through housing taxation. Housing is commonly subject to special tax treatment such as mortgage-interest relief without parallel taxation of imputed rents, which may increase household leverage (Andrews *et al.*, 2011, Keen *et al.*, 2010, and Johnson, 2011). At least part of the resulting increase in credit may be directly or indirectly financed through international borrowing.

### *Capital controls*

15. Capital controls that target specific forms of capital flows may be able to skew the composition of external liabilities towards safer forms of finance and thereby make especially emerging economies more robust to external shocks (Henry, 2007; Jeanne and Korinek, 2010; Korinek, 2011). Capital inflow controls have taken a variety of forms including taxes, quantitative restrictions, and reserve requirements that discriminate against (short-term) foreign-currency-denominated deposits. However, in spite of a recent increase in the use of such restrictions, their effectiveness is still controversial, especially as regards their impact on the level (as opposed to the composition) of capital flows.

16. Equation (1) is estimated in first differences, with capital control variables featured in levels, to take into account the lagged response of capital stocks to changes in capital controls as in Binici *et al.* (2010). The capital control variables used here are dummy variables that summarise the *de-jure* openness of the financial account to inflows from credit operations, capital and money market securities, and FDI, respectively. They are taken from Brune (2006) and Brune and Guissinguer (2007) who analysed the IMF Annual Reports on Exchange Arrangements and Exchange Restrictions (AREAER) for 187 countries over the 1965-2007 period.<sup>4</sup> These variables are the only capital control indices that distinguish between different types of controls on inflows and outflows for a large number of countries and a long time period, and have been used by *e.g.* Eichengreen and Luengnaruemitchai (2008).

17. The first four columns of Table 1 report the point estimates of the effects of the capital control variables on the bias of external liabilities towards debt. Lower inflow restrictions on credit operations are found to increase debt as a share of total external liabilities, whereas capital account openness to FDI and equity investments is found to decrease the share of debt in external liabilities (Column 1). These estimates are robust to additional controls, as well as to instrumenting, and to adding country fixed effects to control for a possible correlation between capital controls and country specific unobserved heterogeneity (Columns 2, 3 and 4). Columns 5 to 7 present estimates of the impact of capital controls on the different components of external liabilities (debt, equity and FDI, respectively), in order to examine whether a bias in external liabilities towards debt arises directly through changes in debt, or indirectly through changes in other liabilities. These estimates suggest that differentiated capital controls affect the share of debt in external liabilities mainly through their direct impact on debt levels. For example, openness to inflows from credit operations increases debt inflows, while openness to FDI and equity investments decreases them (Column 5). Taken together, the empirical analysis carried out here finds strong empirical evidence that differentiated capital controls can influence the structure of external liabilities, thereby indirectly affecting financial stability.<sup>5</sup> However, some capital controls - such as restrictions on credit operations - that appear to be beneficial for financial stability may come at a price to economic efficiency, *e.g.* by distorting competition among banks based on their country of origin.

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4. Measuring financial account openness with dummy variables has several limitations. First, it measures a small fraction of the variance in actual capital controls. Second, gradual implementation of capital account reforms could dilute effects over time, especially for FDI flows that may respond only slowly to a reduction in inflow controls.

5. In principle, investors may respond to different capital controls by simply misreporting the type of their investments, leading to artificial empirical results. However, as similar results are obtained for different types of debt it appears unlikely that effects are purely driven by fictitious changes in reporting.

**Table 1. Determinants of the share of debt in external liabilities 1970-2007**

Dependent variable:	External debt / External liabilities				Log Debt	Log Equity	Log FDI
	First differences (FD) panel data model		FD-IV <sup>2</sup>	FD-IV <sup>2</sup>		FD-IV <sup>2</sup>	
Estimator:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Capital control variables:</b>							
Openness to inflows from credit operations <sup>1</sup>	0.610*** (0.204)	0.550*** (0.195)	0.591*** (0.216)	0.606* (0.324)	3.311* (1.700)	1.096** (0.529)	0.081 (0.305)
Openness to inflows of capital market instruments <sup>1</sup>	0.113 (0.227)	0.107 (0.216)	0.220 (0.243)	0.145 (0.424)	4.688 (2.918)	3.265 (2.559)	1.155 (0.832)
Openness to FDI and equity inflows <sup>1</sup>	-0.466** (0.191)	-0.455** (0.186)	-0.557** (0.221)	-0.764** (0.303)	-2.958** (1.495)	1.517 (2.143)	0.870 (0.691)
<b>Baseline control variables:</b>							
Domestic credit growth	0.014** (0.006)	0.009 (0.006)	0.009 (0.006)	0.010 (0.007)	0.035 (0.027)	0.005 (0.008)	-0.004 (0.011)
(log) Dom. credit over GDP <sub>t-1</sub>	0.019** (0.009)	0.013 (0.009)	0.010 (0.008)	0.001 (0.006)	0.005 (0.067)	-0.003 (0.007)	0.002 (0.021)
(log) GDP per capita	-0.004 (0.005)	0.002 (0.007)	0.003 (0.007)	0.015** (0.007)	-0.055** (0.023)	0.006 (0.009)	-0.026*** (0.008)
(log) Population	0.100 (0.071)	0.106 (0.071)	0.106 (0.070)	0.050 (0.132)	-0.312 (0.360)	0.062 (0.180)	-0.425*** (0.113)
Trade openness	-0.009 (0.011)	-0.009 (0.011)	-0.010 (0.011)	-0.012 (0.011)	-0.181 (0.189)	0.089 (0.078)	-0.071 (0.059)
Financial account size <sup>3</sup>	No	Yes	Yes	Yes	No	No	No
Country fixed effects	No	No	No	Yes	No	No	No
Observations	3,868	3,855	3,826	3,826	3,836	3,837	3,837
Countries	152	152	152	152	152	152	152

Note: Simple descriptive statistics based on data covering 184 countries from 1970 to 2007 for gross external debt as a percentage of total external liabilities and episodes of systemic banking crisis taken from Laeven and Valencia (2010). Low, medium and high external debt is defined based on the 33rd and 66th percentiles of the external debt to external liabilities ratio for each year. Systemic banking crises are defined based on both significant signs of financial distress in the banking system and policy interventions in response to such distress.

1. Reported dummy variables' coefficients are multiplied by 100, to increase the readability of the table.

2. Capital controls in t-1 are instrumented with capital controls in t-4.

3. Controls for the size of the financial account consist of linear and quadratic terms for total assets (excluding reserves) over GDP, external reserves (excluding gold) over GDP, and total liabilities over GDP.

Source: OECD calculations

### **Regulatory restrictions on FDI and equity investments and more generally in product markets**

18. Regulatory burdens on foreign direct investment have contributed to financial risk. Based on the OECD FDI restrictiveness index, which captures not only capital controls but also operational barriers to both FDI and equity investment, various measures of barriers to FDI and equity investment are indeed found to influence the bias in external liabilities towards debt.<sup>6</sup> More precisely, higher regulatory barriers

6. The OECD FDI Regulatory Restrictiveness Index measures statutory restrictions on foreign direct investment in 49 countries in 1997, 2003, 2006 and 2010. Values for intermediate years have been obtained by linear interpolation. The empirical results were robust to restricting the sample to the years of availability of the index. The overall FDI restrictiveness index is the sum of four sub-components: foreign equity limitations (full exclusion of foreign participation, restrictions on majority holdings and limits on full foreign ownership), screening or approval mechanisms, restrictions on the employment of foreigners as

to FDI and equity investment have resulted in an increased bias of external liabilities towards debt (Table 2, Column 1), driven both by increases in external debt liabilities and decreases in equity and FDI liabilities (Columns 2-4).<sup>7</sup> In particular, more stringent screening approvals for foreign investments, restrictions on employment of foreigners for key management and board positions, as well as operation restrictions on foreign investments (such as on branching or capital repatriation) are found to increase the debt bias (Columns 5-6).<sup>8</sup> To give an order of magnitude, an increase of the overall restrictiveness index from the median to the 3<sup>rd</sup> quartile of OECD countries in 2010 would imply an increase of the share of debt in external liabilities by nearly 3 percentage points.<sup>9</sup> Based on the estimates from Ahrend and Goujard (2011), this would translate into an increase in financial crisis risk for a country of roughly 0.3 percentage points, from an average annual crisis risk of about 2½-3%.

**Table 2. Determinants of the share of debt in external liabilities: restrictiveness to foreign direct and equity investment 1997-2007**

Dependent variable:	Debt /	Log	Log	Log	Debt /	Log	Log	Log
	Ext.				Ext.			
Estimator:	liabilities	Debt	Equity	FDI	liabilities	Debt	Equity	FDI
	First differences	linear panel data	model	model	First differences	linear panel data	model	model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Overall FDI restrictiveness <sup>1</sup>	0.576*** (0.170)	1.184*** (0.418)	-3.531*** (0.758)	-1.046 (0.978)				
<b>Sub-components of FDI restrictiveness</b>								
Screening approvals <sup>1</sup>					0.923*** (0.202)	0.105 (0.551)	-3.982*** (1.071)	-4.509*** (0.681)
Restricted Employment of foreigners <sup>1</sup>					0.585*** (0.201)	2.120*** (0.695)	-0.799 (1.078)	1.023 (1.527)
Operational restrictions <sup>1</sup>					1.133* (0.566)	2.626 (2.077)	-3.818 (2.787)	-3.056 (3.717)
Foreign equity restrictions <sup>1</sup>					-0.218 (0.407)	1.386 (1.191)	-2.489 (1.642)	4.167** (1.821)
Financial account size	Yes	No	No	No	Yes	No	No	No
Observations	353	353	352	353	353	353	352	353
Countries	41	41	41	41	41	41	41	41

Note: All the specifications control for year fixed effects, as well as for the baseline variables introduced in Table 1. Some specifications also control for financial account characteristics (see Table 1). Country fixed effects are eliminated by first-differencing. All regressors are lagged one period and introduced in first differences. Standard errors are clustered at the country level. \* denotes a significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. The overall FDI restrictiveness index takes values between 0 and 1, 1 indicating being closed to equity and FDI investments. The components of the index - foreign equity limitations, screening or approval mechanisms, restrictions on the employment of foreigners as key personnel, and operational restrictions - takes also values between 0 and 1, 1 indicating the most severe restrictions to equity and FDI investments.

Source: OECD calculations.

key personnel (managers, directors), and operational restrictions (e.g. restrictions on branching and on capital repatriation or on land ownership). The overall index is between 0 and 1, 1 indicating being closed to equity and FDI investments.

7. In addition, restrictions on foreign equity are found to shift investment from equity to debt and FDI.
8. Similar results are obtained when the sub-components of the FDI restrictiveness index are introduced one-by-one in different regressions, confirming that the reported results are not driven by correlations between the different sub-components of the index.
9. This overall impact is driven by an increase in external debt liabilities by 6%, and a decrease in equity liabilities by 16% (Columns 2 and 3).

19. Anti-competitive domestic product market regulation may also affect foreign direct investment by imposing unnecessary costs on businesses or creating barriers to entry. Even though effects are econometrically less robust than for direct measures of FDI restrictiveness, stricter product market regulation appears indeed to orient external financing away from equity and FDI, thereby increasing the bias of external liabilities towards debt. More precisely, Table 3 provides some evidence that more stringent anti-competitive product market regulation, as measured by the OECD ETCR indicator, may have some impact on the share of debt (Column 5). As expected, this effect seems driven by significantly lower equity and FDI inflows (Columns 7 and 8). Based on Column 5, an easing of the product market regulation from the 3<sup>rd</sup> quartile to the median OECD country in 2007 would result in a decrease in the share of debt in external liabilities by 1.8 percentage points, *ceteris paribus*. No evidence is found that employment protection legislation (EPL) has any effect on financial account structure.

**Table 3. Determinants of the share of debt in external liabilities of OECD countries: Product Market Regulation (PMR) and Employment Protection (EPL)**

Dependent variable: Estimator:	Debt / External liabilities					Ln(debt)	Ln(equity) FD	Ln(FDI)
	First-differences linear panel data model (FD)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Product market regulation <sup>1</sup>	0.014 (0.009)		0.012 (0.011)	0.034* (0.018)	0.038* (0.019)	-0.076 (0.048)	-0.230** (0.089)	-0.195*** (0.067)
Employment protection (EPL) <sup>2</sup>		0.005 (0.015)	-0.002 (0.018)		-0.014 (0.025)	0.044 (0.034)	0.149 (0.158)	0.034 (0.096)
Overall FDI restrictiveness				0.744*** (0.204)	0.738*** (0.215)	1.544*** (0.537)	-2.805*** (0.928)	-0.956 (1.848)
Financial account size	Yes	Yes	Yes	Yes	Yes	No	No	No
Observations	672	522	440	229	216	216	216	216
Countries	30	28	28	30	28	28	28	28

Note: All the specifications control for year fixed effects, as well as for the baseline variables introduced in Table 1. Some specifications also control for financial account characteristics (see Table 1). Country fixed effects are eliminated by first-differencing.

1. The Product Market Regulation (PMR) indicator used here, based on the regulation in energy, transport and communication sector, is available since 1975. Higher values indicate more regulated countries.

2. The Employment Protection Legislation (EPL) indicator corresponds to the unweighted average of the sub-indicators for regular and temporary contracts. Higher values indicate more regulated countries.

Source: OECD calculations.

### *Tax systems that favour debt over equity finance*

20. Unfortunately, a measure of the degree to which the tax treatment of interest differs from that of dividends and capital gains is unavailable across countries. However, differences in tax treatment should have a larger impact on corporate financing when corporate tax rates are higher. Making this assumption, a second-best approach uses the statutory tax rate as an explanatory variable. The analysis finds indeed that the more tax systems favour debt over equity finance the more they bias external financing towards debt, thereby indirectly increasing crisis risk. Using a simple first-difference estimator, an increase in the CIT rate is found to have increased the share of debt in external liabilities, and reduced reliance on external equity finance (Table 4, Column 1). This finding is robust to the introduction of the previously discussed measures of *de-jure* financial account openness (Column 2).<sup>10</sup> Consistent with these results, an increase in the CIT rate seems to increase international debt liabilities (Column 4).

10. The results are also robust to the inclusion of indicators of government quality (estimates for the latter indicators are not reported as not significant at conventional levels). Tentatively used variables include the ICRG (International Country Risk Guide) corruption index, the ICRG bureaucratic quality index, the ICRG

21. The simple first-difference estimators of the debt-bias elasticity to the CIT are likely to be biased downward by measurement error, however. This would explain why it is smaller than elasticities from micro-data (De Mooij, 2011a,b). Ideally, the CIT rate should be interacted with a variable measuring the degree to which the tax treatment of interest differs from the treatment of dividends and capital gains. As this variable is unavailable, using the CIT rate makes the implicit assumption that the difference in tax treatment is always maximal, resulting in serious measurement error. While this potential problem of measurement error cannot be overcome, an attempt at mitigating it consists in instrumenting the change in the CIT by its level in year t-2. When doing this, the point estimate for the elasticity of the external debt bias (0.6) is roughly in line with firm-level evidence, though only borderline significant at the 10% level (Column 3).

**Table 4. Determinants of the share of debt in external liabilities: corporate income tax**

Dependent variable: Estimator:	External debt / External liabilities (log)			Log Debt	Log Equity	Log FDI
	FD	FD	FD-IV <sup>(3)</sup>	FD-IV <sup>(3)</sup>	FD-IV <sup>(3)</sup>	FD-IV <sup>(3)</sup>
	(1)	(2)	(3)	(4)	(5)	(6)
(log) Statutory corporate income tax (CIT) rate	0.073** (0.033)	0.089** (0.040)	0.644 (0.416)	1.569* (0.856)	-1.665 (1.590)	0.319 (0.922)
Openness to inflows from credit operations <sup>(1)</sup>		1.980*** (0.683)	2.114** (0.827)	0.931 (2.308)	-10.533** (4.704)	-3.230 (2.412)
Openness to inflows of capital market instruments <sup>(1)</sup>		0.816 (0.581)	0.629 (0.984)	-0.383 (2.264)	-0.134 (3.732)	0.056 (1.974)
Openness to FDI and equity inflows <sup>(1)</sup>		-0.841 (0.608)	-1.547* (0.891)	-4.126* (2.389)	1.322 (4.028)	1.389 (2.237)
Financial account size	No	Yes	Yes	No	No	No
Government quality <sup>(2)</sup>	No	Yes	Yes	Yes	Yes	Yes
Observations	780	682	595	595	590	595
Countries	47	47	47	47	47	47

Note: All the specifications control for year fixed effects, as well as for the baseline variables introduced in Table 1. Some specifications also control for financial account characteristics (see Table 1). Country fixed effects are eliminated by first-differencing. The log CIT is introduced in first differences. Capital controls are lagged one period and introduced in levels. All other regressors are lagged one period and introduced in first differences. Standard errors are clustered at the country level. \* denotes a significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

(1) The estimated coefficients of the dummy variables are multiplied by 100. Some specifications also control for the characteristics of the financial account

(2) Proxies for government quality include the ICRG law and order, corruption, investment profile, and bureaucracy indices (see Appendix 1 for details).

(3) The evolution of the (log) CIT rate between t and t-1 is instrumented with the (log) level of the CIT rate in t-2 and t-3. Capital controls in t-1 are instrumented by capital controls in t-4. The Hansen J-statistics fails to reject the joint validity of the instruments.

### ***Tax treaties***

22. Firms may invest more in countries with which their home countries have tax treaties, as investors then face no longer the cost of double taxation. If this effect is particularly large for FDI investment, tax treaties should reduce any bias of a country's external liabilities towards more volatile portfolio and bank liabilities. Previous studies, mainly based on US FDI data, have found little evidence for FDI-enhancing effects of tax treaties (Blonigen and Davies, 2004; Louie and Rouslang, 2008).<sup>11</sup> In

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investment profile index that measures contract viability, and the ICRG law and order index that captures the impartiality and efficiency of the legal system.

11. Tax treaties frequently include rules for information exchange between tax authorities. Insofar as FDI prior to the tax treaty was motivated by tax evasion, reduced tax evasion possibilities may counteract the investment-enhancing effects of double-taxation relief.



contrast, this paper, based on external positions of a large sample of countries and a comprehensive database of bilateral tax treaties, suggests that countries that rely more on tax treaties (in the sense of covering a larger share of the world economy through them) have a larger share of their external liabilities in the form of FDI. The (GDP-weighted) number of signed tax treaties statistically significantly decreases the share of debt in external liabilities, even though economic effects are rather small (Table 5, Column 1).<sup>12</sup> This result is robust to controlling for *de jure* measures of financial account openness (Column 2). As would be expected, the effect arises predominantly through an increase in FDI liabilities while debt liabilities remain unaffected (Columns 3 and 5). These findings are supported by analysis based on bilateral data that points to countries having more FDI in countries with which they have tax treaties, with no effects found for other types of investment (Box 1).<sup>13</sup>

**Table 5. Determinants of the share of debt in external liabilities: tax treaties**

Dependent variable:	Debt / External liabilities		Ln(debt)	Ln(equity)	Ln(FDI)
	First-differences				
Estimator:	(1)	(2)	(3)	(4)	(5)
Tax treaties weighted by the share of partner countries in world GDP <sup>(1)</sup>	-0.076** (0.038)	-0.084** (0.038)	0.045 (0.106)	0.225 (0.334)	0.551*** (0.163)
Financial account openness <sup>(2)</sup>	No	Yes	Yes	Yes	Yes
Financial account size	Yes	Yes	No	No	No
Observations	2,942	2,927	2,927	1,506	2,909
Countries	131	130	130	105	130

Note: All the specifications control for year fixed effects, as well as for the baseline variables introduced in Table 1. Some specifications also control for financial account characteristics (see Table 1). Country fixed effects are eliminated by first-differencing. All regressors are lagged one period and introduced in first differences. Standard errors are clustered at the country level. \* denotes a significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. This variable represents the share of the tax partner countries in the world GDP. It takes value 1 if a country signed a tax treaty with all its potential partners.
2. Financial account openness is controlled for by three dummy variables for inflows restrictions on credit market operations, capital market operations and foreign direct investment. Capital controls are lagged one period and introduced in levels.

### Box 1. The effect of bilateral tax treaties on foreign asset positions

Countries conclude bilateral tax treaties to reduce distortions from double taxation, *i.e.* taxing the same tax base in two or more jurisdictions. This can be achieved by exempting foreign investors (with tax residence abroad) from domestic taxes, or by one of the governments granting domestic residents tax credits for taxes paid abroad. Both procedures require the exchange of information between tax authorities, either to control foreign investors' declarations of tax residence or to verify domestic residents' declaration of taxes paid abroad. While removing double taxation should in principle increase bilateral investment by reducing the overall tax burden, it has been argued that enhanced information exchange between tax authorities may limit the scope for tax evasion. Insofar as FDI prior to the tax treaty was motivated by tax evasion, reduced tax evasion possibilities may counteract the investment-enhancing effects of double-taxation relief.

Previous analyses, mainly based on US FDI data, have found little evidence for FDI-enhancing effects of bilateral tax treaties (*e.g.* Blonigen and Davies, 2004; Louie and Rousslang, 2008).<sup>1</sup> To some extent, this may reflect negative effects of enhanced information exchange offsetting positive effects from double taxation relief (Blonigen *et al.*, 2011).

12. Each tax treaty is weighted by the lagged GDP of the partner country, in order to take into account the economic importance of the partner countries. Hence the tax treaty variable takes value between 0 and 1 when a country signed tax treaties with all the other countries in the world.
13. This result is robust to controlling for initial financial integration, indicating that the causality runs indeed from concluding tax treaties to increased FDI investment.

However, it may also reflect the limited country coverage of these studies. This paper relies on a large panel of countries, drawing on comprehensive datasets of bilateral external positions and bilateral tax treaties. This allows the estimation of a fixed-effects gravity model, which has become the workhorse model for the analysis of bilateral external positions (e.g. Lane and Milesi-Ferretti, 2008).

The effect of bilateral tax treaties on foreign asset positions is estimated as follows. A standard gravity equation with investing-country-year and recipient-country-year fixed effects is augmented by a dummy variable indicating the existence of a tax treaty. In addition to fixed effects that control for multilateral financial frictions (Okawa and van Wincoop, 2010), the estimated gravity model includes numerous proxies for bilateral financial frictions: geographical distance, common language, common border, colonial relationship in the past and membership in the euro area. The model is estimated for the repeated cross sections of 2005-06, which improves estimation efficiency compared with using a single year.<sup>2</sup> The estimated equation takes the following form:

$$y_{ijt} = \beta_T \cdot TaxTreaty_{ij} + \beta X_{ij} + \gamma_{it} + \gamma_{jt} + \varepsilon_{ijt} \quad (1)$$

$y_{ijt}$  is the bilateral asset position of country  $i$  in country  $j$  in year  $t$ ;  $TaxTreaty_{ij}$  is a dummy variable that takes value one if a bilateral tax treaty is in place between countries  $i$  and  $j$  and zero otherwise; and  $\gamma_{it}$  and  $\gamma_{jt}$  are sending-country-year and recipient-country-year fixed effects, respectively.

**Table A: Tax treaties increase bilateral FDI assets**

2005-06

Dependent variable	(1) Total portfolio assets	(2) Equity portfolio assets	(3) Debt portfolio assets	(4) FDI assets
Distance	-0.163** (0.072)	-0.172** (0.075)	-0.254*** (0.094)	-0.811*** (0.101)
Common language	0.677*** (0.155)	0.382*** (0.143)	0.840*** (0.178)	0.403** (0.181)
Common border	0.123 (0.203)	0.218 (0.177)	0.021 (0.236)	-0.208 (0.224)
Colony	0.006 (0.194)	-0.007 (0.173)	-0.035 (0.255)	0.743*** (0.246)
Euro area	1.326*** (0.165)	0.704*** (0.150)	1.717*** (0.227)	0.379* (0.207)
Initial financial integration	0.129*** (0.037)	0.154*** (0.038)	0.155*** (0.046)	0.152*** (0.053)
Tax treaty	-0.145 (0.125)	0.111 (0.145)	-0.125 (0.155)	0.352** (0.177)
Observations	1596	1158	1395	1524
Adjusted R-squared	0.90	0.92	0.85	0.81

Notes:

1. Includes investor-year and recipient-year fixed effects
2. Robust standard errors clustered at the country pair level in parentheses
3. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

The initial level of bilateral financial integration (computed as the sum of country  $i$ 's assets in country  $j$  and  $j$ 's assets in  $i$ ) is included as an additional control variable as the probability of signing a tax treaty may not be independent of the level of bilateral financial integration. As neither the IMF CPIS nor the OECD Foreign Direct Investment database contains sufficiently long time series for bilateral external positions, initial bilateral financial integration is calculated from BIS Locational Banking Statistics which are available since the end of the 1970s.<sup>3</sup> As total external assets (liabilities) and external bank assets (liabilities) are highly correlated, the BIS data should provide a fairly good measure of initial financial integration.<sup>4</sup> As the inclusion of initial financial integration in 1980 risks confounding cause and effect for those country pairs that already had a tax treaty in place in 1980, only country pairs without a tax treaty in 1980 are retained in the analysis, resulting in a sample that contains around 200 new tax treaties.

Estimation results are reported in Table A. The estimated coefficients on distance, common language and the euro area dummy are statistically significant and have the expected signs, whereas common border and colonial relationship generally turn out to be insignificant. The reason for the non-significance of these proxies for bilateral frictions and for the relatively weak distance effect is the inclusion of the initial financial integration term, which partly

captures the effect of bilateral frictions and is highly significant with the expected sign. The estimated coefficient on the tax treaty dummy is insignificant for portfolio investments (Columns 1-3) but positive and statistically significant at the 5% level for FDI (Column 4). The lack of results for portfolio investments could reflect that the positive effect of double taxation relief may be fully offset by the negative effect of reduced possibilities of tax avoidance for these types of investment.

1. Egger *et al.* (2006) use a global database but rely on implementation dates to identify the effects of tax treaties on FDI. Given that there are usually long lags between the dates of signing and implementing tax treaties and some of the effects on FDI may materialise before the actual implementation date, this may result in a downward bias in the estimated coefficients.
2. The years 2005-2006 are chosen to avoid the data to be contaminated by (sharp) capital flow reversals during the global financial crisis of 2007-2009.
3. IMF CPIS data on bilateral external portfolio positions are unavailable before the late 1990s while the country coverage of bilateral FDI positions in the OECD International Direct Investment database is insufficient for the purposes of gravity model estimation before the early 1990s.  
Over the period 2001-09, the sample correlation between total and bank assets is around 0.9.

### *Housing and credit booms*

23. Housing price growth is found here to have increased the bias towards external debt (Table 6, Panel A, Columns 1 and 2). In so far as special tax treatments for owner-occupied housing may contribute to house price volatility, they may thus increase debt biases and thereby financial fragility at times of housing booms. This result is robust to instrumenting which indicates that it is not driven by reverse causation (Column 5).<sup>14</sup>

24. Domestic credit and, in particular, strong domestic credit expansions could also be partly financed from abroad and thereby increase the share of debt in external liabilities. Domestic credit is indeed positively correlated with a bias in external liabilities towards debt (Panel B, Column 1). This is found to arise through an increase in the level of external debt, as the levels of external equity and FDI liabilities do not decline (Panel B, Columns 2 to 4). This result is robust to instrumenting (Column 5)<sup>15</sup>, indicating that the results are not biased by contemporaneous domestic economic developments that could be correlated with phases of credit expansion. Taken at face value, the IV-estimates suggest that an increase of domestic credit by 25 points of GDP (corresponding to an increase from the position of the median to the third quartile of OECD countries in 2004), would increase the share of debt in external liabilities by 7 percentage points.

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14. Domestic housing prices are instrumented by the average of the other countries housing prices multiplied by the standard-deviation of domestic housing prices over time.

15. Instruments are lags of the credit over GDP ratios in year t-3 and t-4.

**Table 6. Determinants of the share of debt in external liabilities: housing prices and credit growth**

Dependent variable:	Ext. Debt / Ext. liabilities	Log Debt	Log Equity	Log FDI	Ext. Debt / Ext. liabilities
Estimator:	First differences linear panel data model (FD)				FD-IV <sup>(1)</sup>
Panel A. Housing prices	(1)	(2)	(3)	(4)	(5)
(log) Real housing prices	0.060*** (0.021)	0.301*** (0.057)	-0.263 (0.181)	0.060 (0.093)	0.100** (0.050)
Observations	800	800	800	800	800
Countries	34	34	34	34	34
Panel B. Domestic credit	(1)	(2)	(3)	(4)	(5)
Domestic credit over GDP	0.040** (0.017)	0.382*** (0.083)	-0.084 (0.162)	0.152* (0.092)	0.343** (0.166)
Financial account size	Yes	No	No	No	Yes
Observations	3,734	3,796	1,994	3,756	3,556
Countries	151	151	121	151	150

Note: All the specifications control for year fixed effects, as well as for the baseline variables introduced in Table 1 with the exception of the credit-related baseline variables. Country fixed effects are eliminated by first-differencing. Some specifications also control for financial account characteristics (see Table 1). Capital controls are lagged one period and introduced in levels. All other regressors are lagged one period and introduced in first differences. Standard errors are clustered at the country level. \* denotes a significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

(1) Lagged real housing prices are instrumented by global (log) real housing prices in t-2 and t-3 multiplied by the country's standard deviation of housing prices over the sample period as a measure of the sensitivity of domestic housing prices to global housing price development. Lagged domestic credit to GDP ratio is instrumented by the credit to GDP ratio in t-3 and t-4.

Source: OECD calculations.

### 1.3 Determinants of external bank debt

25. This sub-section turns to the drivers of a country's *level* of external *bank* debt, which has previously been found to contribute to financial fragility by increasing BBS-contagion risk (Ahrend and Goujard, 2011). As typically domestic banks account for a large part of the demand for borrowing from external banks, the banking sector regulation and supervision of the borrowing country may be expected to play some role. In addition, targeted capital controls – especially those restricting possibilities to borrow from foreign banks – could be expected to influence a country's level of external bank debt.

26. As in the previous section, equation (1) is estimated in first differences. However, the dependent variable is now the bank debt over GDP ratio (in logarithm), implying that estimated coefficients are semi-elasticities. Independent variables are the previously discussed measures of *de-jure* financial account openness, as well as indicators of banking regulation and financial reforms taken from Abiad *et al.* (2010). These indicators measure the strength of banking supervision, the degree of banking sector privatisation and contestability, as well as the absence of various forms of financial repression. Variables take larger values when banking supervision is stronger, or when the banking sector is more liberalised. In addition, the same control variables are added as in the previous section, with the exception of credit-related base controls which are dropped as they are likely to partly depend on banking regulation.

27. The empirical analysis indeed find capital controls to influence external bank debt: the coefficient on the dummy variable that measures the capital account openness to inflows from credit operations is strongly significant and positive, implying that capital account openness to inflows from credit operations increases external bank debt as a share of GDP. By contrast, openness to FDI and equity inflows would

reduce external bank debt, the estimated coefficient also being highly statistically significant (Table 7, Column 1). In addition, several characteristics of a well-developed banking sector are found to increase bank lending from abroad, including stricter banking supervision (Column 1), lower state ownership of the banking sector (Column 2) and the absence of directed credit (Column 4).<sup>16</sup> For the first two of these indicators, results remain robust to the simultaneous inclusion of all variables of banking sector regulation and supervision (Column 6).

**Table 7. Determinants of external liabilities towards banks 1984-2006**

Dependent variable:	External bank debt/GDP (log)					
Estimator:	First differences linear panel data model (FD)					
	(1)	(2)	(3)	(4)	(5)	(6)
Openness to inflows from credit operations <sup>(1)</sup>	8.009** (4.017)	10.834** (4.157)	12.674*** (4.006)	12.304*** (3.996)	11.643* (6.170)	6.251 (5.696)
Openness to inflows of capital market instruments <sup>(1)</sup>	2.011 (4.299)	1.967 (4.223)	3.693 (4.350)	3.170 (4.436)	12.128* (7.123)	5.136 (6.156)
Openness to FDI and equity inflows <sup>(1)</sup>	-9.177** (3.949)	-11.078*** (4.183)	-10.581** (4.271)	-10.654** (4.169)	-12.121** (5.480)	-11.527** (5.369)
Banking supervision <sup>(2)</sup>	11.104*** (3.372)					14.012*** (4.585)
Banking sector privatisation <sup>(2)</sup>		5.077*** (1.804)				4.438* (2.373)
Absence of entry barriers <sup>(2)</sup>			0.969 (1.312)			-0.783 (2.285)
Absence of directed credit <sup>(2)</sup>				2.789* (1.605)		3.035 (2.466)
Absence of aggregate credit ceilings <sup>(1)</sup>					2.115 (2.036)	2.909 (2.077)
(log) GDP per capita	0.222** (0.096)	0.214** (0.095)	0.221** (0.097)	0.216** (0.097)	0.183* (0.106)	0.185* (0.107)
(log) Population	-4.330*** (1.346)	-6.177*** (1.376)	-5.466*** (1.322)	-5.721*** (1.335)	-4.891*** (1.647)	-4.520** (1.765)
Trade openness	0.251 (0.249)	0.215 (0.247)	0.225 (0.246)	0.222 (0.247)	0.268 (0.304)	0.302 (0.308)
Observations	1,602	1,602	1,602	1,602	969	969
Countries	88	88	88	88	57	57

Note: All the specifications control for year fixed effects. Country fixed effects are eliminated by first differencing. Regressors are lagged one period and introduced in first differences. Measures of capital controls and banking regulation are lagged one period and introduced in levels. Standard errors are clustered at the country level. \* denotes a significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

(1) The estimated coefficients of the capital controls and removal of credit ceilings dummy variables are multiplied by 100.

(2) The reported point estimates correspond to the percentage-points increase due to a one-standard-deviation increase of the regulation index.

Source: OECD calculations.

16. Bilateral bank flows have been analysed using BIS bank flows by Papaïonnou (2009) and McGuire and Tarashev (2008). The analysis takes a different approach and studies the multilateral stocks of bank liabilities towards the reporting creditor countries.

#### 1.4 Determinants of the maturity of banking debt

28. Ahrend and Goujard (2011) also show that – in close analogy to total external bank debt – *short-term* bank debt influences financial stability by mainly increasing a country's vulnerability to financial contagion.<sup>17</sup> As short-term bank debt is highly correlated with overall debt towards banks, Table 8 examines the drivers of the share of short-term in overall bank debt.<sup>18</sup> The specification is identical to the previous section, the only difference being that the dependent variable is now short-term bank debt as a share of bank debt (instead of overall bank debt as a share of GDP). The results for short-term external bank debt differ from those for overall bank debt in one dimension: The institutional development of domestic securities markets is found to increase the level of external short-term bank debt, but not of bank debt of longer maturities.<sup>19</sup> A one-standard-deviation in the institutional development of securities markets for OECD countries in 2005 would increase the share of short-term bank debt by 9 percentage points. Since most developed countries have had fully-developed securities markets for some time, the room for further changes in this area lies in emerging economies. One possible interpretation for this finding would be that the development of a domestic securities market facilitates carry-trade activities, *i.e.* by facilitating domestic banks or other financial investors to borrow short-term abroad in order to invest *e.g.* in higher-yielding domestic debt securities (Galati *et al.*, 2007).

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17. Short-term bank debt also increases the risk of financial crisis directly, but the effect is much larger when a country is exposed to financial contagion.

18. A similar analysis was conducted using the short-term bank debt-to-GDP ratio. The (non reported) results were qualitatively similar to those in Table 7.

19. The domestic securities development variable from Abiad *et al.* (2010) takes discrete value between 0 and 3, 3 indicating a fully developed domestic securities market. The variable captures both the development of securities markets and openness of the equity market to foreign investors. The specifications control for most of the variation from the second dimension through the capital controls variables. The estimation of the impact of domestic securities development on debt with maturity above one year has shown that it is only significant for debt with maturity below one year (results not reported).

**Table 8. Determinants of external short-term bank debt 1984-2006**

Dependent variable:	Short-term bank debt / bank debt					
Estimator:	First differences linear panel data model (FD)					
	(1)	(2)	(3)	(4)	(5)	(6)
Openness to inflows	-0.204	-0.107	0.067	-0.014	0.039	0.277
from credit operations <sup>(1)</sup>	(0.466)	(0.468)	(0.446)	(0.425)	(0.444)	(0.671)
Openness to inflows of	0.141	0.173	0.262	0.187	0.232	0.039
capital market instruments <sup>(1)</sup>	(0.457)	(0.482)	(0.464)	(0.457)	(0.471)	(0.740)
Openness to FDI and equity	-0.392	-0.487	-0.511	-0.581	-0.524	-0.566
inflows <sup>(1)</sup>	(0.436)	(0.441)	(0.433)	(0.435)	(0.433)	(0.589)
Securities market development <sup>(2)</sup>	0.583**					
	(0.253)					
Banking supervision <sup>(2)</sup>		0.377				
		(0.299)				
Banking sector privatisation <sup>(2)</sup>			-0.060			
			(0.216)			
Absence of entry barriers <sup>(2)</sup>				0.267		
				(0.220)		
Absence of directed credit <sup>(2)</sup>					0.028	
					(0.233)	
Absence of aggregate credit						0.055
ceilings <sup>(1)</sup>						(0.502)
(log) GDP per capita	0.035*	0.035*	0.035*	0.035*	0.035*	0.044**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
(log) Population	0.234	0.193	0.163	0.174	0.153	0.199
	(0.191)	(0.195)	(0.193)	(0.188)	(0.192)	(0.226)
Trade openness	0.019	0.022	0.021	0.021	0.021	0.056
	(0.055)	(0.054)	(0.055)	(0.055)	(0.055)	(0.060)
Observations	1,569	1,569	1,569	1,569	1,569	946
Countries	88	88	88	88	88	57

Note: All the specifications control for year fixed effects. Country fixed effects are eliminated by first-differencing. All regressors are lagged one period and introduced in first differences. The measure of capital controls and banking regulation are lagged one period and introduced in level. Standard errors are clustered at the country level. \* denotes a significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

(1) The estimated coefficients of the capital controls and removal of credit ceilings dummy variables are multiplied by 100.

(2) The reported point estimates correspond to the percentage-points increase due to a one-standard-deviation increase of the regulation index.

Source: OECD calculations.

## 1.5 Determinants of currency mismatches

29. Currency mismatch between external assets and liabilities has been empirically found to increase the risk of systemic banking crises (Ahrend and Goujard, 2011), and therefore a better understanding of the structural policies that contribute to such mismatch is of interest. For example, countries' capacity to issue domestic-currency liabilities may be limited by a poor institutional environment, thus increasing mismatch (Eichengreen *et al.*, 2007). Capital controls may also play a role: inflow controls may partly prevent foreign-currency denominated liabilities, thereby reducing currency mismatch. In contrast, outflow controls may impinge on the ability to acquire foreign-currency denominated assets, thereby increasing currency mismatch (Lane and Shambaugh, 2010). Trade openness may be another determinant of foreign-currency exposure, since the propensity to consume imported goods may increase the value of holding foreign-currency-denominated assets as a form of insurance against exchange-rate-driven shocks to import prices (Obstfeld and Rogoff, 2001). Finally, lax banking regulation and supervision may allow banks to

accumulate excessive levels of foreign-currency liabilities by borrowing cheaply in foreign currency and lending in domestic currency at higher rates, especially under fixed exchange rate regimes (for recent evidence see Ranci re *et al.*, 2010).

30. Table 9 focuses on the drivers of the aggregate currency mismatch. The currency mismatch index measures the balance sheet valuation losses (as a % of GDP) associated with exchange rate shocks, with foreign currency reserves included in the calculation of the index.<sup>20</sup> Positive values indicate an overexposure to exchange rate risk. As previously, equation (1) is estimated in first differences with the aggregate (or alternatively the debt) currency mismatch as dependent variable. Independent variables are the previously discussed measures of *de-jure* financial account openness, both for inflows and outflows. In addition to previously used control variables, the specifications also control for proxies of export market growth. Any variable that positively affects the external debt bias may almost by construction also have a positive impact on the aggregate currency mismatch, as – except for reserve currency issuers – debt is much more likely to be foreign-currency denominated than other liabilities. Therefore an analysis of the drivers of the currency mismatch is hard to distinguish from an analysis of the external debt bias. Given this concern, the table presents the same specifications both for the aggregate currency mismatch (Columns 1-3) and for a *debt* currency mismatch (Columns 4-6) which is less likely to be affected by any mechanical effect.<sup>21</sup> Capital account openness to FDI and equity inflows appears to significantly reduce currency mismatch (Columns 3 to 6), presumably by biasing capital inflows towards those flows that are less likely to be denominated in foreign currency.

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20. The index is the negative of the “net financial index” from Lane and Shambaugh (2010).

21. The two measures are strongly correlated, however. In 2004, among OECD countries, the correlations between the overall and debt currency mismatches were: 0.75 (Pearson) and 0.55 (Spearman).



**Table 9. Determinants of the currency mismatch 1990-2005**

Dependent variable:	Aggregate currency mismatch			Debt currency mismatch		
	FD	FD	FD-IV <sup>(2)</sup>	FD	FD	FD-IV <sup>(2)</sup>
	(1)	(2)	(3)	(4)	(5)	(6)
Openness to inflows	-1.204	-1.372	-2.427**	0.408	0.322	-0.430
from credit operations <sup>(1)</sup>	(0.813)	(0.842)	(1.194)	(0.669)	(0.791)	(0.904)
Openness to inflows of	-1.094	-0.693	-2.474	-0.086	0.307	-0.750
capital market instruments <sup>(1)</sup>	(1.076)	(1.208)	(1.974)	(0.667)	(0.803)	(0.980)
Openness to FDI and equity	-1.461	-1.508	-3.086*	-1.850**	-1.900**	-2.842***
inflows <sup>(1)</sup>	(1.381)	(1.390)	(1.768)	(0.800)	(0.800)	(1.021)
Openness to outflows		1.380	4.758*		0.542	1.827
from credit operations <sup>(1)</sup>		(0.997)	(2.613)		(0.977)	(1.332)
Openness to outflows of		-1.418	-2.333		-1.237	-2.132*
capital market instruments <sup>(1)</sup>		(1.421)	(2.144)		(0.907)	(1.247)
Openness to FDI and equity		-0.532	-0.784		0.205	1.584
outflows <sup>(1)</sup>		(1.081)	(1.841)		(1.032)	(1.445)
Domestic credit growth	0.040	0.040	0.042	0.054	0.054	0.053
	(0.038)	(0.038)	(0.037)	(0.033)	(0.033)	(0.032)
(log) Dom. credit over GDP <sub>t-1</sub>	0.071	0.071	0.075	0.078	0.077	0.075
	(0.046)	(0.047)	(0.047)	(0.051)	(0.052)	(0.051)
(log) GDP per capita	0.089	0.091	0.089	0.017	0.018	0.017
	(0.066)	(0.067)	(0.067)	(0.056)	(0.056)	(0.056)
(log) Population	-0.506	-0.504	-0.473	-0.621**	-0.611**	-0.561*
	(0.353)	(0.351)	(0.360)	(0.281)	(0.283)	(0.292)
Trade openness	-0.209**	-0.209**	-0.209**	-0.128	-0.128	-0.128
	(0.088)	(0.088)	(0.087)	(0.083)	(0.084)	(0.083)
Growth of trading partners	0.335	0.335	0.403	-0.259	-0.259	-0.204
	(0.440)	(0.438)	(0.430)	(0.336)	(0.334)	(0.324)
Growth of trading partners	-0.873	-0.892	-1.112	-0.289	-0.294	-0.428
× (Export/GDP) <sub>t-3</sub>	(0.969)	(0.978)	(1.005)	(0.725)	(0.728)	(0.732)
Observations	1,069	1,069	1,068	1,124	1,124	1,123
Countries	97	97	97	106	106	106

Note: All specifications control for financial account size (see Table 1) and year fixed effects. Country fixed effects are eliminated by first-differencing. All regressors except the log CIT rate and measures of capital controls are lagged one period and introduced in first differences. Standard errors are clustered at the country level. \* denotes a significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

(1) The estimated coefficients of the dummy variables are multiplied by 100.

(2) Capital controls in t-1 are instrumented by capital controls in t-4.

Source: OECD calculations.

## 2. THE ROLE OF STRUCTURAL POLICIES VIA BANK-BALANCE-SHEET CONTAGION

31. This section examines the extent to which sound structural policies mitigate the impact of bank-balance-sheet (BBS) contagion shocks on the likelihood of systemic banking crisis. BBS shocks arise, for example, when banks from a creditor country with a deteriorating risk profile decide to withdraw international funding to comply with internal rules or prudential regulations such as capital adequacy requirements. BBS contagion can also arise indirectly through the international banking system when banks cut back on loans to a country in response to suffering losses on loans to another country. This indirect financial contagion mechanism – often referred to as common-creditor contagion – was first suggested by Calvo (1998) to introduce a causal link between the 1998 Russian crisis and the following crisis in Brazil. Krugman (2008) argues that contagion *via* the balance sheets of leveraged financial institutions played an important role in the spreading of the recent global financial crisis, and Ahrend and Goujard (2011) – based on a panel of 184 developed and emerging economies from 1970 to 2009 - provide empirical evidence that BBS shocks have more generally increased the likelihood of systemic banking crises.

32. Structural policies can mitigate the effect of BBS shocks on the likelihood or the strength of banking crises. Theoretical models of bank failures emphasise that large and highly leveraged financial institutions, which result in part from the features and (lack of) enforcement of financial regulation, play a key role in propagating financial turmoil (*e.g.* Greenwood *et al.*, 2011 or Tirole, 2011, for a review). Simulations show that macroprudential regulations could mitigate the systemic impact of bank balance-sheet losses (Basel Committee on Banking Supervision, 2010). However, there is no direct empirical evidence on whether, and if so what structural policies can preserve financial stability when countries are hit by bank-driven contagion. Beyond structural policies, a number of papers find that the macroeconomic environment can influence the impact of BBS shocks. For example, simulations of stylised models of BBS contagion show that liquidity injections in the interbank market can partly offset the effect of BBS shocks (Tressel, 2010). This is in line with cross-country time-series evidence that, over the 1993-2000 period, a weakening in bank balance sheets led to a stronger reduction in credit growth when monetary policy was tight (Nier and Zicchino, 2008). More generally, Cetorelli and Goldberg (2008) provide empirical evidence that US domestic liquidity shocks can be partly smoothed when banks have access to alternative funding, while Van den Heuvel (2012) shows that US states with more leveraged banks (*i.e.* that have a lower capital-to-assets ratio) are more affected by federal monetary policy. Therefore, the empirical analysis tests for the impact of banking regulations, capital controls and other structural policies, as well as the macroeconomic environment on the likelihood of systemic banking crisis when countries are hit by BBS shocks.

### 2.1 Methodology

33. The empirical analysis relies on a panel of 184 developed and emerging economies from 1970 to 2009. The econometric specification identifies the impact of structural policies on the likelihood of banking crisis in case of BBS contagion shocks,  $BBS\ Shock_{i,t}$ , by interacting the magnitude of the BBS shocks with structural policy indicators. BBS shocks are measured using BIS locational banking statistics and "Institutional Investor" sovereign ratings. More precisely, country  $i$ 's exposure to BBS shocks in period  $t$  is captured by:

$$BBS\ Shock_{i,t} = \frac{Bankdebt_{i,t}}{GDP_{i,t}} \times \left( \sum_{r \in R, r \neq i} sbl_{i,r,t} \cdot \frac{-\Delta rating_{r,t}}{rating_{r,t-1}} \right) \quad (2)$$

where the ratio of external bank debt to GDP captures overall exposure to foreign creditor banks, whereas the term in brackets represents the deterioration in foreign creditor banks' balance-sheets.  $R$  is the set of lending (reporting) countries.  $sbl_{i,r,t}$  is the share of the bank liabilities of country  $i$  held by the banks of country  $r$  at time  $t$ .  $rating_{r,t}$  is the rating of country  $r$  according to "Institutional Investor".<sup>22</sup> This rating is based on bi-annual data from a survey in which institutional investors grade each of the countries on a scale from 0 to 100, with 100 representing the highest possible level of creditworthiness. The ratings are available for a much larger sample than ratings from rating agencies. As the ratings are based on the perception of the main investors in each market, they are also likely to be reflected more accurately in price developments.<sup>23</sup>

34. The baseline equation assumes that, conditional on the absence of crisis at time  $t-1$ , the likelihood of a banking crisis at time  $t$  is determined by a linear probability model:<sup>24</sup>

$$c_{i,t} = P_{i,t-1}\alpha + BBS\ Shock_{i,t-1}\theta + P_{i,t-1} \times BBS\ Shock_{i,t-1}\pi + X_{i,t-1}\beta + \gamma_i + \delta_t + \varepsilon_{i,t} \quad (3)$$

where  $c_{i,t}$  is a dummy variable taking value one at the beginning of a systemic banking crisis.  $P_{i,t-1}$  is a row vector containing measures of structural policies and the macroeconomic environment, which in the equation are interacted with the BBS shock variable.  $X_{i,t-1}$  is a row vector containing the relevant financial account characteristics and additional control variables identified by the literature as key determinants of financial stability.  $\gamma_i$  and  $\delta_t$  capture unobserved country and time specific shocks.  $\varepsilon_{i,t}$  are idiosyncratic disturbances. As the occurrence of systemic banking crises may lead to changes in structural policies, the preferred estimation method relies on first-difference estimators.<sup>25</sup>

35. The control variables included in  $X_{i,t-1}$  are those typically suggested in the literature and are grouped into four main categories (see Table A1 of Appendix 1, for details):

- Macroeconomic and related country-specific characteristics, including (the logarithm of) per capita GDP and (the logarithm of) population.
- The characteristics of the country's financial sector and international financial exposure, as measured by *e.g.* the development of the domestic banking sector, the size of credit to the non-financial sector, and country-specific balance-sheet characteristics of the financial account. The latter include the share of debt in external liabilities, the total size of external assets, reserves, and of external liabilities (as a share of GDP).

22. These ratings have been used, *e.g.*, by Reinhart and Rogoff (2009), Eichengreen and Mody (2000) and Hallak (2011), the latter also providing a detailed discussion of them.

23. Ahrend and Goujard (2011) provide a descriptive analysis of the intensity of BBS contagion during the 1998 Asian crisis and the recent global financial crisis.

24. Systemic banking crisis episodes are defined according to Laeven and Valencia (2010). They define the end of a systemic banking crisis as the year preceding two consecutive years of real GDP and real credit growth. When the first two years of the crisis record real GDP and real credit growth, the first year of the crisis is also the end year. Therefore, observations corresponding to an ongoing banking crisis and the two subsequent years are not included in the regressions.

25. The political economy literature argues that financial crises not only usually result in a deterioration of the financial account but may also imply more structural reforms (see *e.g.* Duval, 2008).

- International trade variables, including openness to international trade measured as (the logarithm of) the sum of imports and exports as a share of nominal GDP, and export prospects, proxied by real GDP growth in the country's trading partners. Making sure that BBS shocks do not simply proxy for trade shocks requires systematically controlling for the latter. Appendix 2 provides further empirical evidence that the measure of BBS shocks does not proxy for trade or regional shocks and that BBS shocks are only transmitted through international banking integration.
- State and duration dependence: The probability that a crisis occurs in a country that already suffered financial turmoil in the past is typically higher than for a country where no crisis occurred recently (Demirgüç-Kunt and Detragiache, 1998). The empirical specifications control for state and duration dependence effects by interacting a quadratic function of the time elapsed since the last systemic banking crisis with dummy variables for the number of previous crises.

36. A potential source of concern regarding the robustness of the results is that countries with sound structural policies may also be more developed or more resilient to shocks. It is therefore difficult to disentangle the relative importance of structural policies on the likelihood of banking crisis in the case of BBS shocks from the effect of other policies. For example, prudential banking regulations could be correlated with higher levels of (financial) development. Interaction terms between, on the one hand, BBS shocks and, on the other hand, GDP per capita, indicators of governance quality and overall banking regulation are included in the empirical specifications. These falsification tests further strengthen the view that the effect of structural policies on the likelihood of systemic banking crises in case of BBS shocks,  $\pi$ , can be interpreted as causal.

## 2.2 Contagion shocks and banking regulation

37. Table 10 reports how bank capital adequacy requirements have affected the likelihood of systemic banking crises when countries have been hit by BBS contagion shocks. The stringency of capital adequacy requirements is measured based on the cross-sectional data collected by the World Bank and aggregated according to Ahrend *et al.* (2011a).<sup>26</sup> More stringent *de jure* capital requirements are associated (at the 10% significance level) with a lower likelihood of systemic banking crises when countries are hit by BBS contagion shocks (Column 1). The interaction term between BBS shocks and the indicator of capital requirements is statistically significant and economically sizable. Taken at face value, the point estimate of 0.3 implies that the likelihood of experiencing a systemic banking crisis for the median OECD country in terms of capital requirements regulation (1998-2006 average) is roughly one third higher than for the third-quartile country, when a similar BBS shock hits both countries.

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26. The *de jure* measures of banking regulations are standardised to facilitate the comparison between the estimated coefficients for the different indicators. As the World Bank surveys cover the 1998-2006 period, the measures of banking regulations may be endogenous to past banking crises. However, under the assumption that past banking crises have led to stricter banking regulations, this should bias the estimates towards zero rather than towards statistically significant coefficients.

**Table 10. Bank balance-sheet shocks, bank regulation and probability of banking crisis**

Dependent variable: Estimator:	Start of a banking crisis						
	First differences linear probability model						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
BBS Shock	1.019*** (0.131)	2.055*** (0.368)	0.532** (0.247)	0.892*** (0.109)	0.876*** (0.131)	0.963*** (0.302)	1.072*** (0.276)
BBS Shock <sup>1</sup>							
* <i>de jure</i> capital requirements	-0.308* (0.178)						
* bank capital / assets		-0.22*** (0.062)					
* bank credit / deposits			0.731* (0.374)				
* overall banking regulations				-0.169 (0.128)			
* banking regulations (excl. capital requirements) <sup>2</sup>					-0.130 (0.172)		
* overall institutional quality						-0.001 (0.152)	
* GDP per capita							-0.039 (0.070)
Observations	1,565	430	2,195	1,777	1,777	2,204	2,183
Countries	105	88	146	119	119	146	145

Note: All specifications control for year fixed effects, with country fixed effects being eliminated by first-differencing. All regressors are lagged one period. Baseline controls include (log) GDP per capita, (log) population, domestic credit growth, the lagged level of domestic credit over GDP, as well as controls for duration and state dependence (a quadratic function in the number of years since the last crisis interacted, respectively, with a dummy variable for having, or not having experienced a crisis since 1970). In addition, all specifications control for the characteristics of the financial account by including linear and quadratic terms for total assets (excluding reserves) over GDP, external reserves (excluding gold) over GDP, and total liabilities over GDP. Standard errors are clustered at the country level. \* denotes significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. Structural policies in Columns 1 to 4 are measured as average values of the corresponding indicators over the period 1970-2009 or the largest sub-period available. They are normalised.

2. These banking regulations include requirements related to liquidity and diversification, accounting and provisioning, external auditing and information disclosure, entry rules and ownership structure, exit rules and disciplining devices, depositor protection and the authority of the banking supervisor.

Source: OECD calculations.

38. This result is confirmed using *de facto* indicators of bank capitalisation.<sup>27</sup> The interaction term between BBS shocks and domestic banks' capital-to-assets ratio is significant at the 1% level (Table 10, Column 2): when hit by a BBS shock, a higher capital-to-assets ratio appears to reduce the likelihood of suffering a systemic banking crisis. The point estimates suggest that, for a similar BBS shock, a country with an OECD median capital to asset ratio would be nearly three times more prone to a systemic banking crisis than the third-quartile OECD country in 2004. Similarly, countries where the domestic credit-to-deposits ratio is higher appear more prone to banking crisis in case of BBS shocks (Column 3).<sup>28</sup> Countries that rely more on deposit-funded credit would hence appear less vulnerable to BBS shocks, likely because the latter affect deposits less than alternative sources of funding, such as cross-border lending. This is in line with bank-level evidence that domestic banks which relied more on deposits were less affected than the affiliates of multinational banks during the global financial crisis (de Haas and van Lelyveld, 2011).

27. *De facto* bank-leverage ratios are taken from the World Bank Development Indicators. *De facto* bank-leverage ratios are only available after 2000. Therefore, the magnitude of these estimates cannot be directly compared to that of other specifications.

28. The credit-to-deposits ratio is taken from Beck *et al.* (2009).

39. In contrast, the general quality of banking regulation does not appear to significantly reduce the risk of systemic banking crisis when countries are hit by external BBS shocks.<sup>29</sup> Even though the interaction term between BBS shocks and the overall banking regulation displays the expected negative sign, the estimated coefficient is relatively small and not statistically significant (Column 4).<sup>30</sup> Similarly, general indicators of economic development that could be correlated with banking regulations or financial development do not affect the impact of BBS shocks on the likelihood of systemic banking crises (Columns 6 and 7).<sup>31</sup> This suggests that the point estimate of the interaction term between BBS shocks and capital adequacy requirements indeed captures the true effect of capital requirements on the likelihood of systemic banking crises when countries are hit by BBS shocks, rather than countries' overall institutional environment.

40. Some forms of banking regulations may affect a country's vulnerability to BBS shocks only in the long run by shaping the structure of the domestic banking sector. As many banking regulations are subject to political economy feedbacks from past banking crises, the indicators of banking regulations of Abiad *et al.* (2010) are therefore taken at the beginning of the sample (between 1973 and 1982) and interacted with BBS shocks.<sup>32</sup> Using these initial values indicates that countries with lower barriers to foreign banks entry at the beginning of the sample period have been less likely to suffer banking crises in case of BBS shocks (Table 11, Column 1). Similar results are obtained using indicators of *de facto* past privatisation of domestic banks, or of the initial level of liberalisation of the financial account (Columns 2 and 3).<sup>33</sup> As these regulatory measures also affect foreign bank ownership, the results provide suggestive evidence that regulations conducive to foreign bank entry may – *via* their impact on the structure of the banking sector – have contributed to financial stability during BBS-driven contagion shocks. This is also consistent with empirical evidence that foreign bank ownership had a cushioning effect in case of external shocks (Jiménez *et al.*, 2010). However, due to the small sample size, the high correlation of the regulation of bank entry and other financial policy settings (as measured by Abiad *et al.*, 2010), and the unavailability of *de facto* measures of bank ownership (Claessens and van Horen, 2012), these results are only suggestive.

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29. The overall banking regulation index, which is based on World Bank data, is defined in Appendix 1.

30. The different dimensions of banking regulation were also included one-by-one in the regressions, results being insignificant at conventional levels.

31. Overall institutional quality is measured by World Bank Governance indicators (Table A1 in Appendix 1).

32. A similar analysis was conducted lagging the indicator of Abiad *et al.* (2010) by only one year. None of the interaction terms between these lagged indicators and BBS shock was significant at conventional levels.

33. These results are robust to controlling for an interaction term between the initial level of GDP per capita and BBS shocks.

**Table 1. Table 11. Bank balance-sheet shocks, long run effects of bank regulations and probability of banking crisis**

Dependent variable: Estimator:	Start of a banking crisis					
	First differences linear probability model					
	(1)	(2)	(3)	(4)	(5)	(6)
BBS Shock	4.682*** (0.969)	4.824*** (0.795)	4.352*** (0.996)	3.511*** (0.994)	3.732*** (1.063)	3.398*** (0.930)
BBS Shock						
* <i>de jure</i> openness to foreign bank Entry <sup>1</sup>	-0.891** (0.418)					
* <i>de facto</i> privatisation of banks <sup>1</sup>		-1.175*** (0.411)				
* <i>de jure</i> liberalisation of financial Account <sup>1</sup>			-1.267** (0.565)			
* <i>de jure</i> banking supervision <sup>1</sup>				-0.123 (0.283)		
* <i>de jure</i> controls on credit <sup>1</sup>					-0.270 (0.324)	
* <i>de jure</i> controls on interest rates <sup>1</sup>						0.013 (0.315)
Observations	1,035	1,035	1,035	1,035	1,035	1,035
Countries	67	67	67	67	67	67

Note: All specifications control for year fixed effects, with country fixed effects being eliminated by first-differencing. All regressors are lagged one period. Baseline controls and financial account characteristics are controlled for as described in Table 10. Standard errors are clustered at the country level. \* denotes significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. All banking regulations are measured as the average between 1973 and 1982 using the indicators from Abiad *et al.* (2010). They are standardised to facilitate the comparison between the different point estimates. Higher values indicate a more liberalised banking sector.

Source: OECD calculations.

41. The analysis turns therefore to bilateral international bank lending to assess the importance of banking sector structure in mitigating contagion shocks (Box 2). External bank flows towards foreign-controlled banks appear indeed more stable than flows towards domestically-owned banks in case of BBS contagion shocks. In other words, external lending by banks without a local presence increases financial fragility more than lending of international banking groups to their local operations in case of international bank-driven contagion.

### Box 2. Domestic versus foreign bank presence in the case of bank balance-sheet contagion shocks

While financial integration through bank debt generally increases financial fragility, effects could differ with the structure of the banking sector in the borrowing country. In particular, borrowing directly from international banks may have a different risk profile than international lending channeled through branches or subsidiaries of international banks. Domestic banks may be more vulnerable to host country shocks than subsidiaries of foreign banks as the latter can rely on internal capital markets of their multinational parent banks (Ashcraft, 2004; de Haas and van Lelyveld, 2006). Similarly, when international banks rebalance their international portfolios in the wake of negative shocks, they may predominantly withdraw their funds from non-affiliated banks while maintaining their external positions towards foreign affiliates (Broner *et al.*, 2006; Krugman, 2008; Cetorelli and Goldberg, 2011). On the other hand, in so far as domestic banks rely more on stable domestic sources of funding such as deposits, rather than on external international capital markets, they may partly insulate countries against international shocks (de Haas and van Lelyveld, 2010; Jiménez *et al.*, 2010).

Comparing international bank flows towards foreign affiliates with those towards domestic banks or firms when countries are hit by BBS shocks allows shedding some light on the effect of foreign bank entry regulation on financial stability. The Bank of International Settlements (BIS) statistics differentiate locational bank flows based on the

residency principle (including banks' internal flows towards foreign affiliates), and consolidated bank flows that aggregate locational flows using an ownership principle (and hence exclude banks' internal flows towards foreign affiliates). Therefore, if locational bank flows are less prone to reversals in the case of a BBS shock than consolidated bank flows, this can be interpreted as evidence that banks' internal flows towards foreign affiliates are more stable than international bank funding channeled directly to domestic banks.<sup>1</sup>

In order to assess the effect of foreign banks presence in a debtor country in case of international shocks, it is necessary to isolate creditor-specific shocks from debtor or demand shocks, as the financial-stability effects of foreign banks presence may differ across these shocks. Bilateral bank flows allow controlling for all debtor-specific shocks in a specification close to Khwaja and Mian (2008). More precisely, the flows  $\Delta \ln(L_{c,d,t})$  are computed as the change in (end-of-year logarithm of) locational or consolidated liabilities of country d (debtor) towards the banks of country c (creditor).<sup>2</sup> The relationship between yearly flows and shocks is given by:

$$\Delta \ln(L_{c,d,t}) = \alpha + CCC Shock_{c,d,t-1} \beta + \gamma_{d,t} + \delta_{c,d} + \varepsilon_{c,d,t} \quad (1)$$

where  $CCC Shock_{c,d,t-1}$  represents a creditor-specific shock, more precisely a common-creditor-contagion (CCC) shock.  $\gamma_{d,t}$  captures any time-varying shocks that are specific to debtor countries (e.g. demand-side shocks or valuation effects) as well as the influence of the overall macroeconomic environment (e.g. changes in world interest rate).  $\delta_{c,d}$  takes into account the time-invariant factors that could affect the level of bank flows of the country pair. Alternatively, the specifications only control for creditor fixed effects.  $\varepsilon_{c,d,t}$  are idiosyncratic disturbances. The two empirical specifications for locational and consolidated flows allow testing if, for the same debtor country, consolidated lending flows are more volatile than overall bank flows (including flows to foreign affiliated banks and domestic banks) when the balance-sheets of the creditor banks deteriorate due to rating changes of other debtor countries.

As described in Ahrend and Goujard (2011), CCC shocks are computed using country credit ratings from "Institutional Investor" and BIS bilateral locational banking statistics. In particular shocks to international bank portfolios are approximated by:

$$CCC Shock_{c,d,t} = \sum_{v,v \neq d} wbl_{c,d,v,t} \frac{-\Delta rating_{v,t}}{rating_{v,t-1}} \quad (2)$$

where  $wbl_{c,d,v,t}$  represents the share of external loans extended by the banks of creditor country c to country v (excluding the debtor country d), and  $rating_{v,t}$  is the credit rating of debtor country, v. As creditor banks could be affected by third-party shocks from domestic banks and their subsidiaries, the structure of their external lending is measured using locational statistics.<sup>3</sup>

**Table A. Bank balance-sheet shocks: difference in impacts on locational and consolidated bank flows**

Dependent variable: Estimator: Type of bank flows:	Yearly change in (log) creditor's assets in country d					
	Debtor*year fixed-effects model					
	Locational flows			Consolidated flows		
	(1)	(2)	(3)	(4)	(5)	(6)
Common Creditor Contagion shock	-1.084* (0.595)	-0.733 (0.636)	-0.615 (0.618)	-2.714*** (0.969)	-3.709*** (0.949)	-3.418*** (0.936)
Debtor*year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Creditor fixed effects	No	Yes	No	No	Yes	No
Creditor*debtor fixed effects	No	No	Yes	No	No	Yes
Observations	54,312	54,312	54,312	41,303	41,303	41,303
Creditor*year	514	514	514	431	431	431
Debtor countries	217	217	217	211	211	211

Note: Observations are yearly debtor-creditor flows. The explanatory variable is lagged one period. \* denotes significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%. Standard errors are two-way clustered at the debtor and creditor\*year levels. They allow for cross-sectional dependence among countries sharing the same creditor and similar common-creditor-shocks, and dependence and autocorrelation across bank flows towards the same debtor country.

In all the specifications of Table A the shocks on creditor banks appear with the expected negative sign: a deterioration in creditors' balance sheets leads to a decrease in bank flows towards the debtor country. However, the effects of CCC shocks on locational flows are essentially not statistically significant (Columns 1-3), while their effects



on consolidated bank flows are three times larger and highly significant. Hence, countries that rely more on international funding not channeled through affiliates of foreign banks appear more vulnerable when creditor banks are hit by negative shocks to their international asset holdings.<sup>4</sup> Taken at face value, the estimates imply that when the rating of a creditor's portfolio is downgraded by 1%, the growth of its bank lending to a particular debtor country shrinks by 2.7 to 3.7 percentage points for consolidated flows. This implies that during the global financial crisis cross-border bank lending should have contracted by somewhat below 20 percentage points (compared with a no-crisis scenario), given that the average credit rating downgrade was 5%.

The empirical results complement related analysis which shows that a larger share of foreign-owned banks has ambivalent effects on financial stability (e.g. de Haas and van Lelyveld, 2010 and 2011). Increasing financial stability during local or regional financial crisis in emerging economies, but increasing fragility during the recent global financial crisis. These effects appear to be driven by the larger share of deposit finance of domestically owned banks. From a financial-stability point of view, a mix of domestically-owned and foreign-owned banks might help diversify risks, with the latter mainly taking care of indispensable international borrowing in the event of local or regional shocks by drawing funds from their owners.

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1. The consolidated flows do not represent a subset of the locational flows (Takáts, 2010). Hence, it is not possible to compare directly cross-border lending towards non-affiliated banks and the international internal banking flows of multinational banks.
  2. End-of-year liabilities towards foreign banks are expressed in current US dollars.
  3. As a robustness checks, consolidated statistics were used. They revealed a similar pattern though the magnitude of the coefficients was lower.
  4. Though the point estimates in Columns 3 and 6 are not statistically different, statistically significant effects for CCC shocks are only found for consolidated bank flows. Furthermore, locational bank flows include cross-border lending towards domestically-owned banks and foreign banks lending towards affiliates, suggesting that the impact of CCC shocks on the latter flows is close to 0.

### 2.3 Contagion shocks and other structural policies

42. The effect of BBS shocks on the likelihood of systemic banking crises depends crucially on international financial integration, and therefore potentially on capital controls. Using the aggregate indicator of overall capital account openness from Brune (2006), no evidence is found that economies which are in general more financially open are affected differently by contagion shocks (Table 12, Column 1).<sup>34</sup> However, inflow controls on credit operations are found to mitigate BBS contagion shocks (Column 2), possibly by restraining (short-term) external bank debt. No empirical evidence is found that other forms of capital controls play any significant role in mitigating the impact of BBS shocks.<sup>35</sup>

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34. This result is robust to different de jure aggregate measures of capital account openness such as that of Quinn and Toyoda (2008).

35. The results of these specifications are not reported.

**Table 12. Bank balance-sheet shocks, capital controls, exchange rate regime and probability of banking crisis**

Dependent variable: Estimator:	Start of a banking crisis				
	First differences linear probability model				
	(1)	(2)	(3)	(4)	(5)
BBS Shock	1.149 (0.726)	1.035*** (0.143)	1.188* (0.663)	0.989*** (0.130)	1.000*** (0.129)
* Financial account openness	-0.018 (0.066)				
* Financial account closedness to inflows of credit operations		-1.023*** (0.251)			
* <i>de-facto</i> fixed exchange rate regime <sup>1</sup>			-0.208 (0.624)		
* <i>de-facto</i> floating exchange rate regime <sup>1</sup>				-3.532 (6.836)	
* <i>de-facto</i> intermediate exchange rate regime <sup>1</sup>					-0.040 (0.602)
Observations	2,204	2,204	2,004	2,004	2,004
Countries	146	146	140	140	140

Note: All specifications control for year fixed effects, with country fixed effects being eliminated by first-differencing. All regressors are lagged one period. Baseline controls and financial account characteristics are controlled for as described in Table 10. Standard errors are clustered at the country level. \* denotes significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. Fixed exchange rate regimes are defined including countries with no separate legal tender, a pre-announced peg or currency board arrangement, a pre-announced horizontal band that is narrower than or equal to +/-2% or a *de facto* peg. Floating exchange rate regimes are "freely floating" and intermediate regimes regroup countries with a pre-announced crawling band that is wider than or equal to +/-2%, a *de facto* crawling band that is narrower than or equal to +/-5%, a moving band that is narrower than or equal to +/-2% and managed floating exchange rates (Ilzetzki *et al.*, 2008).

Source: OECD calculations.

43. The exchange rate regime has also been advocated as a potential factor of financial stability. Theory suggests that exchange rate flexibility, by easing adjustment, should be associated with smaller output losses in the face of external shocks. However, some authors have argued that intermediate exchange rate regimes – as opposed to fixed or freely floating – may be more prone to financial crises in case of external shocks as the adoption of a transparent and credible policy stance could limit foreign investor panics and capital outflows in emerging markets (*e.g.* Edwards, 2000). Using the *de facto* classification of exchange rate regimes of Ilzetzki *et al.* (2008) no evidence is found here that fixed, floating or intermediate exchange rate regimes are more prone to systemic banking crises when countries are hit by BBS shocks.<sup>36</sup> This result is in line with Tsangarides (2010) who finds that output losses during the global financial crisis were of similar size for emerging market economies with pegged or floating exchange rate regimes.

## 2.4 Contagion shocks and the macroeconomic environment

44. Macroeconomic conditions may also influence whether BBS shocks result in financial crises. In particular, the effect of contagion shocks may be magnified in situations of tight global liquidity, as creditor banks may not be able to raise money on the interbank market and alternative sources of funding may be unavailable for debtor countries. Furthermore, when domestic monetary policy is tight, global banks may reduce the lending activity of their foreign affiliates, and the parent banks may increase their

36. This result is robust to the alternative *de facto* exchange rate classification of Levy-Yeyati and Sturzenegger (2005) that is available for a smaller sample period (1974-2004).

borrowing through internal capital markets. Cetorelli and Goldberg (2008) provide empirical evidence that funds flow into US parent banks at a faster pace when US domestic monetary policy is tighter.

**Table 13. Bank balance sheet shocks, macroeconomic conditions and probability of banking crisis**

Dependent variable: Estimator:	Start of a banking crisis					
	First differences linear probability model					
	(1)	(2)	(3)	(4)	(5)	(6)
BBS shock <sup>1</sup>	2.240*** (0.372)	1.920*** (0.456)	0.859** (0.413)	2.029*** (0.458)	1.832*** (0.503)	0.817** (0.396)
BBS shock <sup>1</sup>						
* US real interest rate	1.176*** (0.235)			1.085*** (0.322)		
* world real interest rate		0.959** (0.368)			1.031** (0.403)	
* Overall liquidity			-0.419** (0.191)			-0.390** (0.181)
Controlling for Risk aversion (VXO)	No	No	No	Yes	Yes	Yes
Observations	2,204	2,204	2,079	2,025	2,025	1,900
Countries	146	146	146	146	146	146

Note: All the specifications control for year fixed effects, with country fixed effects being eliminated by first-differencing. All regressors are lagged one period. Baseline controls and financial account characteristics are controlled for as described in Table 10. Standard errors are clustered at the country level. \* denotes significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. BBS shocks are bank-balance-sheet shocks.

Source: OECD calculations.

45. The empirical specification measures the effect of global liquidity conditions on the likelihood of systemic banking crises when countries are hit by BBS shocks, while controlling for the direct impact of global macroeconomic conditions by including time fixed effects. Global liquidity conditions are measured using real US interest rates, a proxy of global real interest rate, or a proxy for real global money supply based on M2, alternatively.<sup>37</sup> Table 13 reports the estimates of the interaction terms between BBS shocks and these measures of global liquidity conditions. All point estimates have the expected signs and are statistically significant, implying that global liquidity reduces the impact of external BBS shocks on the likelihood of banking crises. For example, a decrease of the US real interest rate by 1 percentage point reduces the effect of BBS shocks on the likelihood of systemic banking crises by 25%. A possible concern regarding this result is that periods of global liquidity may be correlated with periods of lower risk aversion. Therefore, an interaction term between BBS shocks and an indicator of market risk aversion, the VXO index, is introduced in the regressions. The estimated effects of global liquidity are robust to the inclusion of this additional control variable (Columns 4-6).<sup>38</sup>

37. All the macroeconomic time-series have been standardised to ease the comparison between the different estimates. The world real interest rate and the world aggregate liquidity based on the macroeconomic aggregate M2 are constructed as GDP weighted average of the US, the Euro-zone and Japan. The construction of each variable is detailed in Table A1 of Appendix 1.

38. The VXO represents the option-implied volatility of the S&P 100 stock price futures. The VXO indicator is available starting in January 1986, compared with January 1990, for the VIX. The correlation between these two indicators, however, is almost 0.99. As discussed by Bekaert *et al.* (2010), the VXO volatility index can be interpreted as reflecting both an uncertainty component, that captures the actual expected stock market volatility, and a component reflecting risk aversion.

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## APPENDIX 1. DEFINITION OF THE MAIN VARIABLES

Table A1. Definition of the main variables

Measure	Definition and source
Financial crisis start	Systemic banking crises are defined according to Laeven and Valencia (2008, 2010) with data taken from the 2010 update.
Share of debt in external liabilities and financial account structure	The share of debt liabilities in total external liabilities and financial account variables are taken from Lane and Milesi-Ferretti (2007), "External Wealth of Nations" dataset, 1970-2007 (updated in 2009).
Currency mismatch	The index measures the balance sheet valuation losses (as a % of GDP) associated with exchange rate shocks. Positive values indicate an overexposure to exchange rate risk. Foreign currency reserves are included in the calculation of the index. The index is the negative of the "net financial index" from Lane and Shambaugh (2010).
Debt currency mismatch	The index represents balance sheet valuation losses associated to currency shocks as percentage of GDP for the debt part of the balance sheet only. Data are from Lane and Shambaugh (2010) and Lane and the updated data of lane and Milesi-Ferretti (2007).
Assets, reserves and liabilities as a share of GDP	The ratio of assets, liabilities and reserves over GDP are taken from Lane and Milesi-Ferretti (2007), "External Wealth of Nations" dataset, 1970-2007.
GDP per capita	GDP in current US dollars, taken from Lane and Milesi-Ferretti (2007), "External Wealth of Nations" dataset, 1970-2007. Population as defined below.
Population	The primary source is the WB WDI. Missing values are filled with data from the IMF IFS and, subsequently, from the IMF WEO when available.
Credit and credit growth, credit-to-GDP ratio and credit-to-deposit ratio	Private credit by deposit money banks and other financial institutions over GDP. All data are taken from Beck <i>et al.</i> (2009). Data updated in November 2010.
Bank debt	Bank debt is measured by the debt liabilities towards BIS reporting banks (BIS Table 9, Variable A). The BIS consolidated banking statistics (on the immediate borrower basis) report banks' on-balance-sheet financial claims on the rest of the world and provides a measure of the risk exposures of lenders' national banking systems.
Short-term bank debt	Short-term bank debt is measured by the debt liabilities towards BIS reporting banks with residual maturity below one year (BIS Table 9, Variable B). The BIS data report the residual maturity (not the original maturity) of bank debt.
Bilateral bank positions	Locational and consolidated bank positions come from the banking statistics of the Bank of International Settlements (BIS).
Openness to trade	The sum of imports and exports divided by GDP from the WB WDI. Missing values are completed with data from the IMF-IFS.
Corporate tax rate	The primary source is the OECD tax data base, completed by data collected by Iizetzki (2011) from Price Waterhouse Cooper and KPMG reports for EMEs.
Capital adequacy requirements and overall banking regulation	Banking regulations such as capital adequacy requirements and overall banking regulation are computed as the average of the World bank surveys (1998-2006) and aggregated according to Ahrend <i>et al.</i> (2011). More precisely, the indicator of <i>de jure</i> capital requirements includes the regulation of minimum capital to asset ratios, variations of capital to asset ratios according to individual banks' credit market or operational risks, the application of simple leverage ratios, and the acceptability of subordinated debt and of revaluation gains as capital. Overall banking regulation takes into account requirements related to liquidity and diversification, capital, accounting and provisioning, external auditing and information disclosure, entry rules and ownership structure, exit rules and disciplining devices, depositor protection and the authority of the banking supervisor.

Banking regulation, and financial reforms	The indicators are taken from Abiad <i>et al.</i> (2010). The banking supervision is an index between 0 and 3. 3 indicates the highest level of banking supervision. The other qualitative variables of <i>de-jure</i> regulations take higher values when the banking sector is liberalized. The banking sector privatization is a <i>de-facto</i> qualitative index.
Capital account openness	The dummy variables are defined by Brune (2006). The analysis uses openness to inflows and outflows of three main categories: flows pertaining to capital and money market securities, flows pertaining to credit operations, and inward direct investment (equity, joint ventures and FDI). The sample covers 187 countries for the period 1965-2007. The analysis also uses the <i>de-jure</i> aggregate indicator of capital account openness of Quinn (2007).
Credit rating	Based on ratings from "Institutional Investor". Published each March and September, these ratings are based on a survey of international bankers, who assign a numerical value ranging from 0 to 100 (with 100 indicating zero probability of default).
Bank-balance-sheet shocks (BBS shocks)	This index is calculated based on changes in credit ratings (see above) and bilateral assets position of the BIS reporting banks on a locational basis. The locational banking statistics gather quarterly data on international financial claims and liabilities of banks in the BIS reporting countries.
Growth of real GDP in country trading partners	Export-weighted average of GDP growth of a country's trading partners. Export weights are computed as average exports over the period 1990-2009 from UNCTAD data. Real GDP growth is based on (by order of importance): OECD, IMF WEO, IMF IFS, or proxied by real industrial production growth from the IMF IFS to extend the sample coverage.
FDI restrictiveness	The OECD indicators of FDI restrictiveness cover four main types of restrictions on FDI: foreign equity limitations, screening or approval mechanisms, restrictions on the employment of foreigners as key personnel, and operational restrictions (e.g. restrictions on branching and on capital repatriation or on land ownership). The indicators are available for 49 countries over the period 1997-2010 and are taken from the OECD FDI Regulatory Restrictiveness Index webpage (2011).
Product Market Regulation (PMR)	The OECD indicator of PMR is the aggregate indicator of regulation in energy, transport and communications (ETCR) for the period 1975-2007. It is taken from the OECD Product Market Regulation Homepage (2011).
Employment Protection Legislation (EPL)	The OECD indicator of EPL is the unweighted average of sub-indicators for regular contracts and temporary contracts. It is taken from the OECD Indicators on Employment Protection - annual time series data for the period 1985-2008.
Overall institutional quality	The overall institutional quality is measured as the first standardised principal component of the following World Bank Governance indicators: Government effectiveness, political stability, voice, rule of law, control of corruption and regulatory quality.
Bilateral tax treaties	Tax treaties are taken from the OECD tax treaty database and cover the period 1945-2002. They are taken into account at the date of the signing of the agreement and are weighted by lagged GDP in current USD from Lane and Milesi-Ferretti (2007).
Exchange rate regimes	The main variables are based on the <i>de-facto</i> classification of Ilzetzki <i>et al.</i> (2008) that covers 153 countries and the period 1946-2010. Robustness checks have used the <i>de-facto</i> classification of Levy-Yeyati and Sturzenegger (2005) that covers 183 countries for the period 1974-2004.
US real interest rates	The real U.S. federal funds rate is computed using the Effective Federal Funds Rate taken from the FED website. The one-year-ahead expected inflation rate used to construct the <i>ex ante</i> real rate for the United States corresponds to the forecasts of the change in the GDP deflator from the Survey of Professional Forecasters, published by the Federal Reserve Bank of Philadelphia.
World real interest rates	Global real interest rates are proxied by a GDP weighted average of the real European Central Bank financing rate (the Bundesbank base rate prior to 1999) and the real U.S. federal funds rate computed as above. The one-year-ahead expected inflation rate used to construct the <i>ex ante</i> real rate for Europe is calculated using the one-year-ahead forecast of consumer price inflation from the European Central Bank or the realised lagged core inflation rate from OECD statistics when the forecasted rate was not available.

Overall liquidity	Global liquidity is proxied by a GDP weighted average of the monetary aggregate M2 for the U.S., Europe and Japan, all taken from Datastream.
VXO index	Global risk aversion is taken from the Chicago Board of Options Exchange Volatility Index, VXO. The VXO index is a measure of implied volatility calculated using 30-day S&P 100 index at-the-money options.
Government Quality	Indicators are taken from the International Country Risk Guide (ICRG), 2010 update. "Law and Order" is an assessment of the strength and impartiality of the legal system and of popular observance of the law. "Corruption" is an assessment of the strength of corruption within the political system. "Investment profile" is an assessment of factors affecting the risk to investment that are not covered by other political, economic and financial risk components. "Bureaucracy Quality" measures the capacity of a country's bureaucracy to govern without drastic changes in policy or interruptions in government services.

**APPENDIX 2. ROBUSTNESS CHECK: BANK-BALANCE-SHEET SHOCKS *VERSUS*  
REGIONAL AND TRADE SHOCKS**

46. This appendix presents further empirical evidence that bank-balance-sheet (BBS) shocks do not proxy for trade or regional shocks and assesses whether BBS shocks can be transmitted by other forms of financial integration than debt towards international banks. To assess if the bank-balance-sheet channel is not mistaken for regional shocks and regional integration, three placebo tests are constructed.

47. The first two placebo tests assume that creditor country  $c$ 's assets in country  $d$  are proportional to  $\text{dist}_{cd}^{-1}$  or  $\text{dist}_{cd}^{-2}$ , respectively, where  $\text{dist}_{cd}$  is the distance between country  $c$  and country  $d$ .<sup>39</sup> The third placebo test assumes that creditor country  $c$ 's assets in country  $d$  are proportional to its exports,  $\text{exp}_{cd}$ , as measured by UNCTAD. For each of the three tests, regional shocks to the debtor countries are constructed as an average of their neighbouring countries' credit rating changes weighted by bilateral geographical closeness (respectively  $\text{dist}_{cd}^{-1}$  or  $\text{dist}_{cd}^{-2}$  and  $\text{exp}_{cd}$ ). More precisely, the placebo shocks are as follows:

$$\text{Placebo Shock}_{i,t} = \frac{\text{Bankdebt}_{i,t}}{\text{GDP}_{i,t}} \times \left( \sum_{r \in R, r \neq i} \text{sbl}_{ir,t} \cdot \frac{-\Delta \text{rating}_{r,t}}{\text{rating}_{r,t-1}} \right), \quad (\text{A.1})$$

where  $\text{sbl}_{ir,t}$  is the share of liabilities of country  $i$  towards country  $r$  according to the above assumptions. These regional shocks are then interacted with banking integration (as measured by the ratio of BIS bank debt over GDP) and introduced jointly with the previously measured bank-balance-sheet shocks. Column 1 of Table A2 presents the benchmark estimates of the impact of contagion shocks and banking integration on the risk of suffering a systemic banking crisis. Columns 2 to 4 reproduce the specification of Column 1 adding one by one the placebo shocks and their interaction with international banking integration. Column 5 introduces jointly all the placebo shocks and their interactions with international banking integration.

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39. Geodesic distances in kilometers are from the CEPII database.

**Table A2. Falsification tests: bank-balance-sheet shocks versus regional and trade shocks**

Dependent variable: Estimator:	Start of a banking crisis					
	First differences linear probability model					
	(1)	(2)	(3)	(4)	(5)	(6)
BBS shock	-0.943*** (0.110)	-1.455*** (0.225)	-1.047*** (0.142)	-0.957*** (0.314)	-0.750** (0.294)	-0.638*** (0.148)
Placebo (distance)	No	Yes	No	No	Yes	No
Placebo (distance <sup>2</sup> )	No	No	Yes	No	Yes	No
Placebo (trade)	No	No	No	Yes	Yes	No
Continent * year dummies	No	No	No	No	No	Yes
Baseline controls <sup>2</sup>	Yes	Yes	Yes	Yes	Yes	Yes
Country and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,204	2,148	2,148	2,139	2,139	2,204
Countries	146	146	146	145	145	146

Note: All regressors are lagged one period. Standard errors are clustered at the country level. \* denotes significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. BBS shocks are bank-balance-sheet shocks.

2. Baseline controls include (log) GDP per capita, (log) population, domestic credit growth and the lagged level of domestic credit over GDP. In addition, all the specifications control for the characteristics of the financial account by including linear and quadratic terms for total assets (excluding reserves) over GDP, external reserves (excluding gold) over GDP, and total liabilities over GDP. Controls for duration and state dependence are also included through a quadratic function in the number of years since the last crisis interacted, respectively, with a dummy variable for having, or not having experienced a crisis since 1970.

48. The estimate of the effect of BBS shocks on the likelihood of systemic banking crises remains stable and highly significant across the specifications in Columns 2 to 5. This confirms that countries which are more exposed to international bank lending suffer more from bank-balance-sheet shocks and not from some forms of regional shocks. Finally, Column 6 of Table A2 uses a less parametric strategy to control for regional shocks. It controls instead for a whole range of regional-and-year specific shocks by adding a full set of continental dummy variables interacted with yearly dummies.<sup>40</sup> The coefficient of the impact of BBS shocks declines slightly but remains significant at the 1% level.

49. Finally, to confirm that the constructed BBS contagion shocks capture a risk to financial stability that is transmitted through the banking system, alternative contagion indicators are constructed. In these alternative contagion “shocks”, banking integration is replaced by debt, equity or FDI integration. International integrations through external debt, equity and FDI liabilities are then considered as additional channels of transmission for the deterioration in creditor banks’ balance sheets. Concretely, the analysis assumes that the degradation of the creditor’s bank balance sheets could be transmitted by other forms of financial integration than liabilities towards banks and substitutes the ratios of debt, equity and FDI to GDP, respectively for the ratio of bank debt to GDP in equation (2):

$$Liabilities\ Shock_{i,t} = \frac{Liabilities_{i,t}}{GDP_{i,t}} \times \left( \sum_{r \in R, r \neq i} wbl_{ir,t} \cdot \frac{-\Delta rating_{r,t}}{rating_{r,t-1}} \right) \quad (A.2)$$

where *liabilities* are alternatively external debt, equity and FDI liabilities taken from Lane and Milesi-Ferreti (2007), with the term in brackets representing the deterioration in creditor banks’ balance sheets.

40. Five continent dummy variables are defined as: Africa, America, Asia, Europe, Pacific.

**Table A3. The impact of bank-balance-sheet shocks and other shocks on the probability of banking crisis**

Dependent variable: Estimator:	Start of a banking crisis			
	First differences linear probability model			
	(1)	(2)	(3)	(4)
BBS Shock <sup>1</sup>	0.961*** (0.285)	1.101*** (0.284)	1.251*** (0.267)	1.121*** (0.301)
Debt Shock	-0.000 (0.079)			-0.044 (0.109)
Equity Shock		-0.004 (0.055)		-0.094 (0.205)
FDI Shock			-0.089 (0.079)	0.383 (0.243)
Observations	2,204	2,201	2,204	2,201
Countries	146	146	146	146

Note: All specifications control for year fixed effects, with country fixed effects being eliminated by first-differencing. All regressors are lagged one period. Baseline controls and financial account characteristics are controlled for as described in Table 10, as well as direct measures of debt, equity and FDI liabilities as a share of GDP. Standard errors are clustered at the country level. \* denotes significant estimate at the 10% level, \*\* at 5%, \*\*\* at 1%.

1. BBS shocks are bank-balance-sheet shocks.

Source: OECD calculations.

50. These three shocks are introduced together with BBS shocks in the crisis-probability model (Table A3). The three specifications confirm that deteriorations in creditor banks' balance sheets are indeed transmitted through the bank debt channel, and only through that channel. The point estimate for the BBS shock is stable, while the estimated effects of the three shocks constructed with other forms of international financial integration are close to zero and economically and statistically insignificant.

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