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## Sovereign debt defaults and currency crises in Latin America

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# Appendices

## A Two alternative definitions of the Exchange Market Pressure Index

Exchange Market Pressure Index (EMPI) according to Eichengreen et al. (1995) is defined as

$$EMPI_t^i \equiv \frac{1}{\sigma_{e_t^i}} \frac{\Delta e_t^i}{e_t^i} - \frac{1}{\sigma_{rm_t^i}} \left( \frac{\Delta rm_t^i}{rm_t^i} - \frac{\Delta rm_t^{GER}}{rm_t^{GER}} \right) + \frac{1}{\sigma_{r_t^i}} \Delta (r_t^i - r_t^{GER}), \quad (A.1)$$

where  $i$  refers to country  $i$ ,  $t$  refers to time,  $\Delta$  is the difference operator,  $e$  is the nominal period-average exchange rate,  $rm$  is the ratio of total non-gold international reserves to M1,  $r$  is the nominal short term interest rate (money market rate),  $\sigma_e$ ,  $\sigma_{rm}$  and  $\sigma_r$  are the standard deviations of  $\frac{\Delta e}{e}$ ,  $\left( \frac{\Delta rm}{rm} - \frac{\Delta rm^{GER}}{rm^{GER}} \right)$ , and  $\Delta (r - r^{GER})$  respectively. The index GER is the reference country Germany.

Exchange Market Pressure Index (EMPI) according to Kaminsky et al. (1998) becomes

$$EMPI_t^i \equiv \frac{1}{\sigma_{e_t^i}} \frac{\Delta e_t^i}{e_t^i} - \frac{1}{\sigma_{FR_t^i}} \frac{\Delta FR_t^i}{FR_t^i}, \quad (A.2)$$

where  $i$  refers to country  $i$ ,  $t$  refers to time,  $\Delta$  is the difference operator,  $e$  is the nominal period-average exchange rate,  $FR$  is the level of total non-gold international reserves in nominal US dollars,  $\sigma_e$  and  $\sigma_{FR}$  are the standard deviations of  $\frac{\Delta e}{e}$  and  $\frac{\Delta FR}{FR}$  respectively.

## B Sovereign debt default episodes in Argentina, Brazil, Chile and Mexico, 1870–2012

Table B.1. Sovereign debt default episodes: alternative sources.

	Reinhart & Rogoff (2010) External crises	Standard Poor's Sovereign crises	& debt	Purcell & Kaufman (1993) Sovereign crises	Kauf- debt	Manasse et al. (2003) IMF assis- tance
Argentina	1890–1893, 1951, 1956–1965, 1982–1993, 2001–2005	1890–1893, 1982–1993, 2001–2004		1890–1893, 1956–1965, 1982–1992		1995
Brazil	1898–1910, 1914–1919, 1931–1933, 1937–1943, 1961, 1964, 1983–1994, 2002	1898–1901, 1902–1910, 1914–1919, 1931–1933, 1937–1943, 1983–1994		1898–1910, 1914–1919, 1931–1943, 1961–1964, 1983–1992		1998–1999, 2001–2002
Chile	1880–1883, 1931–1947, 1961, 1963, 1965, 1972, 1974–1975, 1983–1990	1880–1883, 1931–1947, 1983–1990		1880–1883, 1931–1948, 1965, 1972–1975, 1983–1990		-
Mexico	1866–1885, 1914–1922, 1928–1942, 1982–1990	1866–1885, 1914–1922, 1928–1942, 1982–1990		1859–1885, 1914–1922, 1928–1942, 1982–1990		1995

## Notes:

Sovereign defaults as reported by Standard and Poor's are taken from Borensztein and Panizza (2009). Purcell and Kaufman (1993), also used by Beim and Calomiris (2001), include all types of private lending to the sovereign government, in the form of bonds, bank loans and suppliers' credits. Manasse et al. (2003) include years in which substantial IMF assistance (defined as access in excess of 100 percent of quota) is provided by the IMF to avoid a sovereign debt default. These so-called stand-by credits have been available since the early 1990s.

## C Explanatory variables for Argentina, Brazil and Mexico, 1990–2009: definitions and sources

### External economic indicators (trade and finance)

	Indicator	Definition and source	Transformation	Countries
1	Deviation from real exchange rate trend	$RER = e(P_f/P)$ , with: $e$ = nominal exchange rate Local Currency Unit (LCU) per US dollar, source: IFS; $P$ = domestic price level: Consumer Price Index, source: IFS; $P_f$ = foreign price level: Consumer Price Inflation in USA, source: IFS.	Deviation from 5 year moving average	Argentina, Brazil, Mexico (A, B, M resp.)
2	Exchange rate volatility	Monthly volatility of the nominal exchange rate in the current month and the 47 months preceding, source: IFS.	Standard deviation	A, B, M
3	Export growth	Exports F.O.B. in nominal USD, source: IFS.	12 months percentage change	A, B, M
4	Import growth	Imports F.O.B. in nominal USD, source: IFS.	12 months percentage change	A, B, M
5	Terms of Trade	For Mexico: Ratio of export price index to import price index, sources: IFS; For Argentina and Brazil: Ratio of unit value of exports to unit value of imports, sources: IFS	Ratio	A, B, M
6	Current Account as a % of GDP	Current account in nominal USD: balance on goods, services and income plus current transfers, source: IFS; GDP in nominal LCU, source: IFS; converted in USD with the average nominal exchange rate.	Ratio	A, B, M
7	Net Portfolio Investment as a % of GDP	Difference between portfolio assets and portfolio liabilities, both in nominal USD, sources: IFS.	None (ratio)	A, B, M
8	Net Foreign Direct Investment as a % of GDP	For Argentina and Brazil: difference between Foreign Direct Investments (FDI) outflow and inflow, both in nominal USD, source: IFS; For Mexico: FDI inflow, in nominal USD, source: IFS.	Ratio	A, B, M
9	Ratio of Financial Account to GDP	Financial account: balance of all accounts, including trade, FDI and portfolio investments, source: IFS	Ratio	B, M
10	Trade openness	Trade openness: sum of absolute value of exports and imports of goods and services as a percentage of nominal GDP. All in nominal USD, sources: IFS.	12 months percentage change	A, B, M
11	Change in international reserves	Foreign exchange reserves excluding gold, in nominal USD, source: IFS.	12 months percentage change	A, B, M

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*External economic indicators (trade and finance)—continued*

	<b>Indicator</b>	<b>Definition and source</b>	<b>Trans-formation</b>	<b>Countries</b>
12	M2 as a % of international reserves	Sources: M2 for Argentina after 2000, Brazil and Mexico: IFS; Argentina before 2000: Central Bank Rep. Argentina. Converted into USD with end-of-period nominal exchange rate, source: IFS.	None (ratio)	A, B, M
13	Change in import cover	Ratio of foreign exchange reserves excluding gold to imports. Sources: IFS	12 months percentage change	A, B, M

*Domestic economic indicators (real, fiscal and monetary)*

	<b>Indicator</b>	<b>Definition and source</b>	<b>Trans-formation</b>	<b>Countries</b>
1	Real GDP growth	GDP in nominal Local Currency Units (LCU) deflated with the Consumer Price Index; base year 2006 = 100. Sources: GDP for Brazil and Mexico: IFS; for Argentina—before 1995: INDEC; after 1995: IFS; CPI: IFS	12 months percentage change	A, B, M
2	Real GDP per capita	Real GDP divided by total population, source: IFS	12 months percentage change	A, B, M
3	Unemployment	Unemployment as % of total of unemployed and employed, source: IFS	12 months percentage change	B
4	Government consumption expenditure as a % of GDP	Government consumption in LCU, source: IFS	Ratio	B, M
5	Household consumption expenditure as a % of GDP	Household consumption in LCU, source: IFS	Ratio	A, B, M
6	Ratio of government revenues to GDP	Government revenues in LCU is constructed from two series: cash receipts from operating activities (up to 2000) and revenues (from 2000 on), sources: IFS.	12 months percentage change	B, M
7	Ratio of government expenses to GDP	Government expenses in LCU is constructed from two series: cash payments for operating activities (up to 2000) and expenses (from 2000 on), sources: IFS.	12 months percentage change	B, M
8	Fiscal balance as a % of GDP	Difference between ratio of government revenues to GDP and ratio of government expenses to GDP	Ratio	B, M
9	Change in ratio of inventories to GDP	Change in inventories in nominal LCU, source: IFS	Ratio	M
10	Consumer Price Inflation	Consumer Price Inflation index (CPI), source: IFS	12 months percentage change	A, B, M
11	Growth of industrial production	Industrial production index, source for Brazil and Mexico: IFS, source for Argentina: Datastream (code AGIPTOT.G)	12 months percentage change	A, B, M

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*Domestic economic indicators (real, fiscal and monetary)—continued*

Indicator	Definition and source	Trans-formation	Countries
12 Domestic Savings as a % of GDP	Ratio of savings to GDP, source: WDI (code: NY.GDS.TOTL.ZS)	None (ratio)	A, B, M
13 Gross capital formation	Source for Argentina and Mexico: IFS; source for Brazil: WDI (code: NE.GDI.TOTL.KD.ZG)	12 months percentage change	A, B, M
14 Domestic real interest rate	6 month time deposit rate deflated by Consumer Price Index, source for 6 months time deposit rate: IFS	(1 + deposit rate) / (1 + inflation) - 1	A, B, M
15 Domestic nominal short term interest rate	28 days treasury bill interest rate, source: IFS	None	M
16 M2 growth (real LCU)	Source for Argentina after 2000, Brazil and Mexico: IFS; source for Argentina before 2000: Central Bank Rep. Argentina	12 months percentage change	A, B, M
17 M2 money multiplier	Ratio of M2 to monetary base (base money), source for base money: IFS	ratio	A, B, M
18 Sovereign Bond Interest Rate Spreads	Difference between local government interest rate on bonds in USD and US government on bonds in USD, source: GEM	None	B
19 J.P. Morgan Emerging Markets Bond Index (EMBI+): monthly return	Source EMBI+: GEM.	Monthly return	B
20 Return on the major stock index	Major stock index from each country (IPC for Mexico, Merval for Argentina and BOVESPA for Brazil), source: Economática.	Monthly return	A, B, M

*Debt indicators*

Indicator	Definition and source	Trans-formation	Countries
1 Total external debt as a % of GDP	Source for Total external debt in USD: WDI (code: DT.DOD.DECT.CD)	None (ratio)	A, B, M
2 Short term external debt as a % of total external debt	Source for Short term debt: WDI (code: DT.DOD.DSTC.CD); source for Total debt: WDI (code: DT.DOD.DECT.CD)	None (ratio)	A, B, M
3 Use of IMF credit as % of GDP	source for IMF credit: WDI (code: DT.DOD.DIMF.CD)	None (ratio)	A, B, M
4 Arrears as a % of total external debt	source for Interest arrears on public and publicly guaranteed debt in USD: WDI (code: DT.IXA.DPPG.CD); source for Principal arrears on public and publicly guaranteed debt in USD: WDI (code: DT.AXA.DPPG.CD); source for Total external debt in USD: WDI (code: DT.DOD.DECT.CD)	None (ratio)	A, B, M
5 Debt reduction of total external debt	Source for Debt reduction: WDI (code: DT.DFR.DPPG.CD); source for Total debt: WDI (code: DT.DOD.DECT.CD)	None (ratio)	A, B, M

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*Debt indicators—continued*

	<b>Indicator</b>	<b>Definition and source</b>	<b>Trans-formation</b>	<b>Countries</b>
6	Long term private non-guaranteed debt as a % of total external debt	Source for LT PNG debt: WDI (code: DT.DOD.PRVS.CD); source for Total debt: WDI (code: DT.DOD.DECT.CD)	12 months percentage change.	A, B, M
7	Long term public and publicly guaranteed debt as a % of total external debt	Source for LT PPG debt: WDI (code: DT.DOD.PUBS.CD); source for Total debt: WDI (code: DT.DOD.DECT.CD)	12 months percentage change.	A, B, M
8	Ratio of international reserves to total external debt	Source for Total debt: WDI (code: DT.DOD.DECT.CD); source for international reserves excluding gold, in USD: IFS	12 months percentage change	A, B, M
9	Debt service as a % of exports	Source for debt service in nominal USD: WDI (code: DT.TDS.DECT.CD); source for Exports in nominal USD: IFS	None (ratio)	A, B, M
10	Debt service as a % of international reserves	Source for Debt service: WDI (code: DT.TDS.DECT.CD); source for international reserves excluding gold: IFS	None (ratio)	A, B, M

*Banking indicators*

	<b>Indicator</b>	<b>Definition and source</b>	<b>Trans-formation</b>	<b>Countries</b>
1	Domestic credit to the public sector as a % of GDP	Domestic credit provided by banking sector as a % of GDP minus Domestic credit to private sector as a % of GDP, sources: WDI (codes: FS.AST.DOMS.GD.ZS and FS.AST.PRVT.GD.ZS)	None (ratio)	A, M
2	Commercial bank lending as a % of GDP	Domestic credit provided by banking sector as % of GDP, source: WDI (code: FS.AST.DOMS.GD.ZS).	None	A, B, M
3	bank sector's liquid liabilities as a % of GDP	Source: Financial Structure, from World Bank (FS/WB) and Beck et al. 2000, 2009 (code: ll.usd).	12 months percentage change	A, B, M
4	Central bank assets as a % of GDP	Claims on domestic real non-financial sector by the Central Bank as a share of GDP, source: FS/WB (code: cbagdp).	12 months percentage change	B
5	Deposit money bank assets as a % of GDP	Claims on domestic real non-financial sector by deposit money banks as a share of GDP, source: FS/WB (code: dbagdp).	12 months percentage change	A, B, M
6	Private credit by all financial institutions as a % of GDP	Private credit by deposit money banks and other financial institutions to GDP, source: FS/WB (code: pcrdbogdp).	12 months percentage change	A
7	Private credit by deposit money banks as a % of GDP	Private credit by deposit money banks to GDP, source: FS/WB (code: pcrdbgdp).	12 months percentage change	A, B, M

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*Banking indicators—continued*

Indicator	Definition and source	Trans-formation	Countries
8 Private credit by other financial institutions as a % of GDP	Private credit by other financial institutions to GDP, calculated as the difference between private credit by all financial institutions and private credit by deposit money banks, source: FS/WB (code: pcrdbofgdp & pcrdbgdp).	12 months percentage change	B, M
9 Financial system deposits as a % of GDP	Demand, time and saving deposits in deposit money banks and other financial institutions as a share of GDP, source: FS/WB (code: fdgdp).	12 months percentage change	A, B, M
10 Ratio Bank credit to bank deposits	Private credit by deposit money banks as a share of demand, time and saving deposits in deposit money banks, source: FS/WB (code: bcbd).	12 months percentage change	A, B, M
11 Net interest margin	Accounting value of bank's net interest revenue as a share of its interest-bearing (total earning) assets, source: FS/WB (code: netintmargin).	None	A, B, M
12 Bank concentration	Assets of three largest banks as a share of assets of all commercial banks, source: FS/WB (code: concentration).	None	A, B, M
13 Bank Return on Equity	Average Return on Equity (Net Income/Total Equity), source: FS/WB (code: roe).	None	A, B, M
14 Bank Z-Score	$Z = 1.2A + 1.4B + 3.3C + 0.6D + 1.0E$ with: A = Working Capital / Total Assets; B = Retained Earnings / Total Assets; C = EBIT / Total Assets; D = Market Value of Equity / Total Liabilities; E = Sales/Total Assets; source: FS/WB	None	B
15 Deposit money banks and other banking institutions: assets	Sum of Deposit money banks assets and Other banking institutions assets; both in USD, source: IFS	12 months percentage change	A
16 Deposit money banks and other banking institutions: liabilities	Sum of Deposit money banks liabilities and Other banking institutions liabilities; both in USD, source: IFS	12 months percentage change	A
17 Central Bank's foreign assets minus foreign liabilities	Difference between Central banks' foreign assets and foreign liabilities; both in USD, source: IFS	12 months percentage change	A
18 Central Bank's net claims on central government	Difference between claims on central government and central government deposits; both in LCU, source: IFS	12 months percentage change	A
19 Central Bank's claims on deposit money banks and other banking institutions	Sum of claims on deposit money banks and claims on other banking institutions; both in USD, source: IFS	12 months percentage change	A
20 Bank sector: reserves	Sum of reserves from deposit money banks and reserves from other banking institutions; both in LCU, source: IFS	12 months percentage change	A

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*Banking indicators—continued*

	<b>Indicator</b>	<b>Definition and source</b>	<b>Trans-formation</b>	<b>Countries</b>
21	Bank sector: Foreign assets minus foreign liabilities	Difference between foreign assets from banks and foreign liabilities from banks; both in LCU, source: IFS	12 months percentage change	A
22	Bank sector: claims on public and publicly guaranteed institutions	Claims on Public and Publicly Guaranteed institutions (PPGs): sum of claims on central government, claims on state and local government, and claims on official entities; all in LCU, source: IFS	12 months percentage change	A
23	Banks: claims on private sector	Sum of claims from deposit money banks on private sector and claims from other banking institutions on private sector; both in LCU, source: IFS	12 months percentage change	A
24	Banks: demand deposits	Demand deposits in deposit money banks, in LCU, source: IFS	12 months percentage change	A
25	Banks: time, savings and foreign currency deposits	Time, savings and foreign currency deposits; source: IFS	12 months percentage change	A

*Institutional and political indicators*

	<b>Indicator</b>	<b>Definition and source</b>	<b>Trans-formation</b>	<b>Countries</b>
1	Herfindahl Index Government	DPI (World Bank / Beck et al. 2001): Herfindahl Index represents a measure of government coalition concentration, by squaring the percentage of parties in the government coalition. The presence of a majority party in the government coalition increases the index. Having many (small) parties in the government reduces it. Source: DPI (code: herfgov)	None	A, B, M
2	Herfindahl Index Opposition	Same as the Herfindahl Index Government, but for government opposition. Source: DPI (code: herfopp)	None	B, M
3	Government Stability	The governments ability to carry out its declared program(s), and its ability to stay in office. Subcategories: government unity, legislative strength and popular support. On a scale from 0 to 12, with 12 the highest level of stability and 0 the highest level of instability. Source: ICRG	12 months percentage change	A, B, M
4	Socioeconomic Conditions	Socioeconomic pressures at work in society that could constrain government action or fuel social dissatisfaction. Subcategories: unemployment, consumer confidence and poverty. On a scale from 0 to 12, with 12 the highest level of socioeconomic conditions and 0 the lowest level. Source: ICRG	12 months percentage change	A, B, M
5	Investment Profile	All factors affecting the risk to investment that are not covered by other political, economic and financial risk components, such as contract viability, expropriation, profits repatriation and payment delays. On a scale from 0 to 12, with 12 the best investment profile (low risk) and 0 the worst profile (high risk). Source: ICRG	12 months percentage change	A, B, M

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*Institutional and political indicators—continued*

Indicator	Definition and source	Transformation	Countries
6 Internal Conflict	Political violence in the country and its actual or potential impact on governance. Subcategories: civil war, coup threat, terrorism, political violence and civil disorder. On a scale from 0 to 12, with 12 the lowest level of internal conflict (low risk) and 0 the highest level (high risk). Source: ICRG	12 months percentage change	A, B, M
7 Democratic accountability	Ac- how responsive government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one. On a scale from 0 to 6, with 6 the highest level of democratic accountability and 0 the lowest level. Source: ICRG	12 months percentage change	A, B, M
8 Corruption	Not only financial corruption (demands for special payments and bribes), but also concerned with excessive patronage, nepotism, job reservations, favor-for-favors, secret party funding, and suspiciously close ties between politics and business. On a scale from 6 (low corruption) to 0 (high corruption). Source: ICRG	12 months percentage change	A, B, M
9 Law and Order	To assess the Law element, the strength and impartiality of the legal system are considered, while the Order element is an assessment of popular observance of the law. On a scale from 6 (high law and order) to 0 (low law and order). Source: ICRG	12 months percentage change	A, B, M
10 Bureaucracy Quality	High quality when the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government service. Low quality when a change in government tends to be traumatic in terms of policy formulation and day-to-day administrative functions. On a scale from 4 (high bureaucratic quality) to 0 (low bureaucratic quality). Source: ICRG	12 months percentage change	A, B, M
11 Party orientation with respect to economic policy	Dummy indicates orientation of the executive power. Right (1); Left (3); Center (2); No information (0). Source: DPI (code: execrlc)	None	A, B, M
12 Absolute majority in the houses	Dummy indicates if executive has absolute majority in the houses. 1 = yes, 0 = no. Source: DPI (code: allhouse)	None	A, B, M
13 Degree of polarization	Polarization is the maximum difference between the chief executives party's value and values of the three largest government parties and the largest opposition party. 0 = no polarization. Source: DPI (code: polariz)	None	A, B, M
14 Election year for executive power	Dummy variable with value 1 in the year of elections for executive power and 0 otherwise. Source: DPI (code: exelec)	All months in election year: value 1	A, B, M
15 Election year for legislative power	Dummy variable with value 1 in the year of elections for legislative power and 0 otherwise. Source: DPI (code: legelec)	All months in election year assigned value 1	A, B, M

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<i>Global indicators</i>				
Indicator	Definition and source	Trans-formation	Countries	
1	US long term interest rate	Yield on the 10 year US government bond, source: IFS	12 months percentage change	USA
2	US short term interest rate	3 months short term interest rate, source: IFS	None	USA
3	US real GDP growth	U.S. GDP in USD, source: IFS; deflated with the U.S. consumer price inflation index, source: IFS	12 months percentage change	USA
4	World GDP volume growth	World GDP volume, source: IFS	12 months percentage change	world
5	Contagion of crises in the region	Based on EMPI calculations: dummy = 1 if there is a currency crisis in one of the other countries (Argentina, Brazil or Mexico)	None	A, B, M
<i>Commodities indicators</i>				
Indicator	Definition and source	Trans-formation	Countries	
1	Added value from agriculture sector a % of GDP	Source: WDI (code: NV.AGR.TOTL.ZS)	12 months percentage change	A, B, M
2	Oil prices	World oil price, source: IFS	12 months percentage change	world
3	Agricultural commodities price index	Global agricultural raw materials price index, source: IFS	12 months percentage change	world
4	Metals commodities price index	Global metals price index, source: IFS	12 months percentage change	world
5	Agricultural raw materials exports as a % of GDP	Agricultural raw material exports, expressed as % of GDP. Elaborated from the following series: Agricultural raw material exports, as % of merchandise exports, source: WDI (code: TX.VAL.AGRI.ZS.UN); Goods exports (BoP) in current USD, source: WDI (code: BX.GSR.MRCH.CD); GDP in current USD, source: WDI (code: NY.GDP.MKTP.CD)	Agricultural exports as % of GDP x (exports / GDP); 12 months % change	A, B, M
6	Food exports as a % of GDP	As agricultural raw materials exports, but with food exports, source: WDI (code: TX.VAL.FOOD.ZS.UN)	Food exports as % of GDP x (exports / GDP); 12 months % change	A, B, M
7	Fuel exports as a % of GDP	As agricultural raw materials exports, but fuel exports; source: WDI (code: TX.VAL.FUEL.ZS.UN)	Fuel exports as % of GDP x (exports / GDP); 12 months % change	A, B, M

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*Commodities indicators—continued*

Indicator	Definition and source	Trans-formation	Countries
8 Ores and metals exports as a % of GDP	As agricultural raw materials exports, but ores and metals exports. Source: WDI (code: TX.VAL.MMTL.ZS.UN)	Ores and metals exports as % of GDP $\times$ (exports / GDP); 12 months % change	A, B, M
9 Agricultural raw materials imports as a % of GDP	Agricultural raw material imports, expressed as % of GDP. Elaborated from the following series: Agricultural raw material imports, as % of merchandise imports, source: WDI (code: TM.VAL.AGRI.ZS.UN); Goods imports (BoP) in current USD, source: WDI (code: BM.GSR.MRCH.CD); GDP in current USD, source: WDI (code: NY.GDP.MKTP.CD)	Agricultural imports as % of GDP $\times$ (imports / GDP); 12 months % change	A, B, M
10 Food imports as a % of GDP	As agricultural raw materials imports, but food materials imports, source: WDI (code: TM.VAL.FOOD.ZS.UN)	Food imports as % of GDP $\times$ (imports / GDP); 12 months % change	A, B, M
11 Fuel imports as a % of GDP	As agricultural raw materials imports, but fuel imports, source: WDI (code: TM.VAL.FUEL.ZS.UN)	Fuel imports as % of GDP $\times$ (imports / GDP); 12 months % change	A, B, M
12 Ores and metals imports as a % of GDP	As agricultural raw materials imports, but ores and metals imports, source: WDI (code: TM.VAL.MMTL.ZS.UN)	Ores and metals imports as % of GDP $\times$ (imports / GDP); 12 months % change	A, B, M

## Notes:

LCU: Local Currency Unit (domestic currency)

USD: US dollar

## Sources:

IFS: International Financial Statistics

WB: World Bank

WDI: World Development Indicators (World Bank)

GEM: Global Economic Monitor (World Bank)

FS/WB: Financial Sector indicators (World Bank)

ICRG: International Country Risk Guide (PRS Group)

DPI: Database for Political Institutions (World Bank)

## D Interpretations of the static factors of the Early Warning System for currency crises in Argentina, Brazil and Mexico 1990–2009

### D.1 Argentina: variables with the highest correlations with the static factor

#### Factor 1

indicator	correlation	contribution
Banks claims on private sector	0.905	4.2%
Food exports as % of GDP	−0.875	3.9%
Added value from agricultural sector as % of GDP	−0.857	3.8%

#### Factor 2

indicator	correlation	contribution
Arrears as a % of total debt	0.873	6.3%
Exchange rate volatility	0.799	5.3%
M2 money multiplier	−0.766	4.8%

#### Factor 3

indicator	correlation	contribution
US short term interest rate	0.729	6.6%
Ore and metal commodities price index	0.710	6.3%
World GDP volume growth	0.700	6.1%

#### Factor 4

indicator	correlation	contribution
Debt service as a % of international reserves	0.812	12.5%
Long term private non-guaranteed debt as % of total external debt	−0.583	6.4%
Financial system deposits as % of GDP	−0.577	6.3%

#### Factor 5

indicator	correlation	contribution
Bank sector claims on public and publicly guaranteed debt	0.520	7.7%
Bank Return on Equity	−0.501	7.1%
Deposit money banks assets as a % of GDP	0.477	6.5%

## Argentina: variables with the highest correlations with the static factor (continued)

### Factor 6

indicator	correlation	contribution
Change in import cover	-0.610	11.2%
M2 as a % of international reserves	0.565	9.6%
Long term public and publicly guaranteed debt as % of total external debt	-0.510	7.8%

### Factor 7

indicator	correlation	contribution
Short term external debt as % of total external debt	-0.520	9.3%
Change in US long term interest rate	0.515	9.1%
Long term private non-guaranteed debt as % of total external debt	0.412	5.8%

### Factor 8

indicator	correlation	contribution
Change in oil price	-0.543	11.6%
Net FDI as % of GDP	-0.483	9.2%
Change in net claims from CB on central government	0.465	8.5%

### Factor 9

indicator	correlation	contribution
Reduction of total external debt	-0.507	11.1%
International reserves as a % of total external debt	0.454	8.9%
Exports growth	-0.369	5.9%

### Factor 10

indicator	correlation	contribution
Long term public and publicly guaranteed debt as % of total external debt	-0.716	25.0%
Agriculture commodities price index	-0.432	9.1%
Consumer price inflation	-0.320	5.0%

## **D.2 Argentina: dominant category per static factor**

The indicators are grouped into seven categories (domestic economic, external economic, debt, banking, commodities, global and institutional indicators). For each factor we sum the contribution of the indicators that belong to the same category. The contribution is the square of the element of the eigenvector that corresponds to the indicator. The sum of all contributions is 100%. For labeling each factor, we label the categories for which the average contribution per variable is larger than 1.4%. This percentage is based on the average contribution per variable is 1.4% ( $100\% / 73$  variables).



**Factor 1**

Category	total	average
Commodities	24.5%	2.0%
Bank	36.7%	1.7%

**Factor 6**

Category		total	average
External nomy	eco-	34.2%	2.8%
Global		8.8%	2.2%

**Factor 2**

Category		total	average
Domestic nomy	eco-	28.4%	2.2%
Debt		19.0%	1.9%
External nomy	eco-	21.4%	1.8%

**Factor 7**

Category		total	average
Global		12.1%	3.0%
Debt		18.4%	1.8%
Commodity		19.5%	1.6%

**Factor 3**

Category		total	average
Global		18.3%	4.6%
Commodities		17.9%	1.5%

**Factor 8**

Category		total	average
Global		11.5%	2.9%
External nomy	eco-	21.1%	1.8%
Commodities		18.8%	1.6%

**Factor 4**

Category		total	average
Debt		26.9%	2.7%
Commodities		20.3%	1.7%
Bank		32.9%	1.5%

**Factor 9**

Category		total	average
Debt		31.2%	3.7%

**Factor 5**

Category		total	average
Bank		47.4%	2.2%

**Factor 10**

Category		total	average
Debt		36.5%	3.7%
Global		8.2%	2.0%
Commodities		22.3%	1.9%

### D.3 Brazil: variables with the highest correlations with the static factor

#### Factor 1

indicator	correlation	contribution
Debt service as % of exports	0.846	4.7%
Debt service as % of international reserves	0.819	4.4%
Deviation from real exchange rate trend	0.786	4.1%

#### Factor 2

indicator	correlation	contribution
Long term private non-guaranteed debt as % of total external debt	-0.737	4.7%
Domestic credit to the public sector as % of GDP	0.720	4.5%
Current Account as % of GDP	0.716	4.4%

#### Factor 3

indicator	correlation	contribution
Reduction of total external debt	-0.758	7.8%
Sovereign bond interest rate spread	0.689	6.5%
Consumer price inflation	0.629	5.4%

#### Factor 4

indicator	correlation	contribution
Deposit money bank assets as a % of GDP	-0.721	7.9%
Bank sector liquid liabilities as % of GDP	-0.646	6.3%
Financial system deposits as % of GDP	-0.609	5.6%

#### Factor 5

indicator	correlation	contribution
Added value from agriculture sector as % of GDP	-0.725	12.3%
Change in oil price	0.532	6.6%
Change in real GDP per capita	0.451	4.8%

#### Factor 6

indicator	correlation	contribution
M2 as a % of international reserves	0.612	10.6%
Long term public and publicly guaranteed debt as % of total external debt	0.590	9.8%
Food imports as a % of GDP	-0.575	9.3%

**Brazil: variables with the highest correlations with the static factor (continued).**

<b>Factor 7</b>		
indicator	correlation	contribution
US real GDP growth	-0.508	8.2%
Financial account as % of GDP	0.444	6.2%
Terms of Trade	-0.424	5.7%

<b>Factor 8</b>		
indicator	correlation	contribution
Central bank assets as % of GDP	0.603	13.1%
Net interest margin of bank sector	0.448	7.3%
US real GDP growth	0.443	7.1%

**D.4 Brazil: dominant category per static factor**

The indicators are grouped into seven categories (domestic economic, external economic, debt, banking, commodities, global and institutional indicators). For each factor we sum the contribution of the indicators that belong to the same category. The contribution is the square of the element of the eigenvector that corresponds to the indicator. The sum of all contributions is 100%. For labeling each factor, we label the categories for which the average contribution per variable is larger than 1.45%. This percentage is based on the average contribution per variable:  $100\% / 69$  variables.

<b>Factor 1</b>			<b>Factor 2</b>		
Category	total	average	Category	total	average
Debt	24.2%	2.4%	Bank	24.9%	2.1%
Bank	18.7%	1.6%	Debt	21.0%	2.1%

<b>Factor 3</b>			<b>Factor 4</b>		
Category	total	average	Category	total	average
debt	18.5%	1.9%	Global	15.8%	3.9%
dom.econ	29.7%	1.6%	Bank	23.2%	1.9%
ext.econ	19.7%	1.5%	Commodities	21.3%	1.8%
bank	18.2%	1.5%			

<b>Factor 5</b>			<b>Factor 6</b>		
Category	total	average	Category	total	average
Commodities	38.3%	3.2%	External economy	35.4%	2.7%
Bank	23.5%	2.0%	Commodities	23.9%	2.0%
Global	5.9%	1.5%	Debt	14.7%	1.5%

<b>Factor 7</b>			<b>Factor 8</b>		
Category	total	average	Category	total	average
Global	12.8%	3.2%	Bank	30.7%	2.6%
External economy	31.3%	2.4%	Global	7.9%	2.0%
Commodities	17.7%	1.5%	Commodities	18.3%	1.5%

## D.5 Mexico: variables with the highest correlations with the static factor

### Factor 1

indicator	correlation	contribution
current account as % of GDP	0.819	4.8%
bank concentration	-0.795	4.6%
deviation from real effective exchange rate trend	0.777	4.4%

### Factor 2

indicator	correlation	contribution
Consumer price inflation	0.952	8.2%
Use of IMF credit as % of GDP	0.922	7.7%
Total external debt as % of GDP	0.913	7.5%

### Factor 3

indicator	correlation	contribution
Domestic real interest rate	0.798	8.1%
Domestic nominal short term interest rate	0.673	5.8%
Change in international reserves	-0.665	5.6%

### Factor 4

indicator	correlation	contribution
US short term interest rate	-0.581	5.9%
US long term interest rate	-0.541	5.1%
Terms of Trade	-0.539	5.1%

### Factor 5

indicator	correlation	contribution
US real GDP growth	0.599	7.4%
Growth of industrial production	0.586	7.1%
Exchange Rate volatility	0.526	5.7%

### Factor 6

indicator	correlation	contribution
Arrears as % of total external debt	0.543	7.8%
Ratio of M2 to international reserves	0.509	6.9%
Long term private non-guaranteed debt as % of total external debt	0.481	6.1%

## D.6 Mexico: dominant category per static factor

The indicators are grouped into seven categories (domestic economic, external economic, debt, banking, commodities, global and institutional indicators). For each factor we sum the contribution of the indicators that belong to the same category. The contribution is the square of the element of the eigenvector that corresponds to the indicator. The sum of all contributions is 100%. For labeling each factor, we label the categories for which the average contribution per variable is larger than 1.5%. This percentage is based on the average contribution per variable: 100% / 67 variables.

<b>Factor 1</b>			<b>Factor 2</b>		
Category	total	average	Category	total	average
Commodities	29.8%	2.5%	Debt	27.6%	2.5%
Bank	24.2%	2.4%	Commodities	21.1%	1.8%

<b>Factor 3</b>			<b>Factor 4</b>		
Category	total	average	Category	total	average
External econ.	26.8%	2.1%	Global	16.0%	4.0%
Bank	19.2%	1.9%	External econ.	25.7%	2.0%

<b>Factor 5</b>			<b>Factor 6</b>		
Category	total	average	Category	total	average
Global	10.8%	2.7%	Debt	28.6%	2.6%
Debt	24.9%	2.3%	Global	7.2%	1.8%
Bank	19.2%	1.9%			
External econ.	22.0%	1.7%			

## **E Robustness checks of 6 and 24 months run-up periods for Argentina, Brazil and Mexico, 1990–2009**

### **E.1 Ordered logit estimation results**

In this appendix we present the results of robustness checks of the model presented in Section 3.5. We use two alternative run-up periods, of 6 and 24 months respectively, instead of 12 months. With a 6 (24) months run-up period, the six (twenty four) months preceding the crisis are considered as the period that ends in a currency crisis. Therefore the months in the run-up period are assigned the same dummy variable value as the crisis itself.

#### **Argentina**

The fit (in terms of adjusted pseudo  $R^2$ ) is better for the shorter run-up period. With 6 months run-up the adjusted pseudo  $R^2$  is 0.51, compared to 0.34 for the 12 months run-up model and 0.26 for the 24 months run-up model.

Including institutional indicators improves the adjusted pseudo  $R^2$  for all run-up periods. The Wald test for the 24 months run-up ( $F$ -value is 7.557, and the  $p$ -value is 0.000) shows that the included institutional variables contribute to explaining the currency crises in Argentina, which is similar to the 12 months run-up period model. However, in the model constructed with the 6 months run-up period institutional indicators do not play a significant role ( $F$ -value is 1.720, and the  $p$ -value is 0.191).

#### **Brazil**

The fit (in terms of adjusted pseudo  $R^2$ ) is better for the longer run-up period. With 6 months run-up the adjusted pseudo  $R^2$  is 0.15, compared to 0.22 for the 12 months run-up model and 0.40 for the 24 months run-up model.

Including institutional indicators improves the adjusted pseudo  $R^2$  for all run-up periods. The Wald test for the 24 months run-up ( $F$ -value is 6.338,

and the  $p$ -value is 0.001) shows that the included institutional variables contribute to explaining the currency crises in Brazil, which is similar to the 12 months run-up period model. In the model constructed with the 6 months run-up period institutional indicators play a less significant role ( $F$ -value is 2.776, and the  $p$ -value is 0.044).

### **Mexico**

The fit (in terms of adjusted pseudo  $R^2$ ) is better for the shorter run-up period. With 6 months run-up the adjusted pseudo  $R^2$  is 0.50, compared to 0.36 for the 12 months run-up model and 0.31 for the 24 months run-up model.

Including institutional indicators improves the adjusted pseudo  $R^2$  for all run-up periods. The Wald test for the 24 months run-up ( $F$ -value is 4.720, and the  $p$ -value is 0.000) shows that the included institutional variables contribute to explaining the currency crises in Mexico, which is similar to the 12 months run-up period model. Also in the model constructed with the 6 months run-up period institutional indicators play a significant role ( $F$ -value is 5.613, and the  $p$ -value is 0.001).



Table E.1. Ordered logit estimation results for Argentina, with a 6 months run-up period.

Dependent variable: currency crisis dummy				
Variable	(1) Without institutional indicators		(2) Including institutional indicators	
	coef-ficient	standard error	coef-ficient	standard error
SF1	-0.802**	0.372	-0.660*	0.389
SF2	-1.140***	0.415	-0.990**	0.431
SF3	1.692**	0.778	1.651**	0.785
SF4	0.720***	0.244	0.822***	0.256
SF5	-0.646	0.485	-0.510	0.475
SF6	-0.190	0.360	-0.208	0.355
SF7	1.197***	0.451	1.219***	0.447
SF8	0.828	0.523	0.492	0.566
SF9	-0.696**	0.280	-0.943***	0.341
SF10	1.593***	0.513	2.008***	0.598
$\Delta$ LAWORD			-1.067	0.813
Pseudo $R^2$ =	0.572		0.578	
Adj Pseudo $R^2$ =	0.512		0.511	

Notes:

\*: significant at 10%, \*\*: significant at 5%, and \*\*\*: significant at 1%;

Explanations of the symbols used:

- SF1: Static Factor 1, SF2: Static Factor 2, et cetera;
- $\Delta$  LAWORD: Change in the law and order dummy variable;

Pseudo  $R^2$ : Coefficient of correlation for the ordered logit regression model;

Adjusted Pseudo  $R^2$ : Coefficient of correlation, adjusted for the degrees of freedom as a consequence of including more explanatory variables.

Table E.2. Ordered logit estimation results for Argentina, with a 24 months run-up period.

Dependent variable: currency crisis dummy				
Variable	(1) Without institutional indicators		(2) Including institutional indicators	
	coef-ficient	standard error	coef-ficient	standard error
SF1	-0.036	0.047	-0.164**	0.078
SF2	-0.218***	0.051	-0.393***	0.106
SF3	0.236***	0.066	0.249***	0.077
SF4	0.247***	0.074	0.374***	0.104
SF5	-0.672***	0.112	-0.729***	0.117
SF6	-0.217**	0.091	-0.197**	0.099
SF7	0.800***	0.101	0.837***	0.142
SF8	0.079	0.114	-0.411**	0.186
SF9	-0.229**	0.105	-0.240*	0.123
SF10	0.015	0.114	-0.524**	0.228
$\Delta$ CORRUPT			-1.201***	0.365
$\Delta$ SOCIOECO			1.226**	0.589
ELECLEGYR			1.076***	0.395
Pseudo $R^2 =$	0.298		0.329	
Adj Pseudo $R^2 =$	0.263		0.283	

## Notes:

\*: significant at 10%, \*\*: significant at 5%, and \*\*\*: significant at 1%;

Explanations of the symbols used:

- SF1: Static Factor 1, SF2: Static Factor 2, et cetera;
- $\Delta$  CORRUPT: Change in corruption dummy variable;
- $\Delta$  SOCIOECO: Change in socioeconomic dummy variable;
- ELECLEGYR: Dummy variable that is 1 if there is an election year for the legislative power and 0 otherwise.

Pseudo  $R^2$ : Coefficient of correlation for the ordered logit regression model;

Adjusted Pseudo  $R^2$ : Coefficient of correlation, adjusted for the degrees of freedom as a consequence of including more explanatory variables.

Table E.3. Ordered logit estimation results for Brazil, with a 6 months run-up period.

Dependent variable: currency crisis dummy				
Variable	(1) Without institutional indicators		(2) Including institutional indicators	
	coef-ficient	standard error	coef-ficient	standard error
SF1	0.172***	0.053	0.174***	0.057
SF2	-0.166***	0.064	-0.107	0.104
SF3	0.186***	0.070	0.236***	0.080
SF4	-0.147	0.099	-0.182*	0.105
SF5	-0.507***	0.121	-0.608***	0.217
SF6	0.258**	0.116	0.329**	0.133
SF7	0.102	0.120	0.217	0.174
SF8	0.297**	0.115	-0.096	0.230
$\Delta$ BURQUAL			-0.468	0.349
$\Delta$ INVPROF			-0.798	0.561
ELECEXEYR			1.023**	0.520
Pseudo $R^2$ =	0.194		0.223	
Adj Pseudo $R^2$ =	0.148		0.156	

Notes:

\*: significant at 10%, \*\*: significant at 5%, and \*\*\*: significant at 1%;

Explanations of the symbols used:

- SF1: Static Factor 1, SF2: Static Factor 2, et cetera;
- $\Delta$  BURQUAL: Change in the bureaucratic quality dummy variable;
- $\Delta$  INVPROF: Change in the investment profile dummy variable;
- ELECEXEYR: Dummy variable that is 1 if there is an election year for the executive power and 0 otherwise.

Pseudo  $R^2$ : Coefficient of correlation for the ordered logit regression model;

Adjusted Pseudo  $R^2$ : Coefficient of correlation, adjusted for the degrees of freedom as a consequence of including more explanatory variables.

Table E.4. Ordered logit estimation results for Brazil, with a 24 months run-up period.

Dependent variable: currency crisis dummy				
Variable	(1) Without institutional indicators		(2) Including institutional indicators	
	coef-ficient	standard error	coef-ficient	standard error
SF1	0.282***	0.052	0.150	0.134
SF2	-0.709***	0.096	-0.914***	0.136
SF3	-0.235***	0.062	-0.214***	0.071
SF4	-0.544***	0.087	-0.484***	0.087
SF5	-0.511***	0.098	-0.833***	0.157
SF6	0.255**	0.100	0.007	0.115
SF7	-0.307***	0.102	-0.283*	0.162
SF8	-0.182	0.121	0.009	0.167
$\Delta$ CORRUPT			-0.638	0.401
$\Delta$ LAWORD			1.145***	0.439
HERFOPP			1.098*	0.646
Pseudo $R^2$ =	0.435		0.501	
Adj Pseudo $R^2$ =	0.401		0.453	

Notes:

\*: significant at 10%, \*\*: significant at 5%, and \*\*\*: significant at 1%;

Explanations of the symbols used:

- SF1: Static Factor 1, SF2: Static Factor 2, et cetera;
- $\Delta$  CORRUPT: Change in corruption dummy variable;
- $\Delta$  SOCIOECO: Change in socioeconomic dummy variable;
- HERFOPP: measure of government opposition concentration.

Pseudo  $R^2$ : Coefficient of correlation for the ordered logit regression model;

Adjusted Pseudo  $R^2$ : Coefficient of correlation, adjusted for the degrees of freedom as a consequence of including more explanatory variables.

Table E.5. Ordered logit estimation results for Mexico, with a 6 months run-up period.

Dependent variable: currency crisis dummy				
Variable	(1) Without institutional indicators		(2) Including institutional indicators	
	coef-ficient	standard error	coef-ficient	standard error
SF1	-0.150	0.103	-0.061	0.127
SF2	0.473***	0.152	0.430**	0.179
SF3	0.834***	0.122	0.846***	0.188
SF4	-0.095	0.153	-0.292	0.263
SF5	0.615***	0.168	0.374	0.238
SF6	0.201	0.188	0.478*	0.256
$\Delta$ BURQUAL			1.146***	0.289
$\Delta$ DEMACC			0.990**	0.477
ELECLEGYR			-1.110	0.925
Pseudo $R^2$	0.518		0.591	
Adj. Pseudo $R^2$	0.496		0.540	

Notes:

\*: significant at 10%, \*\*: significant at 5%, and \*\*\*: significant at 1%;

Explanations of the symbols used:

- SF1: Static Factor 1, SF2: Static Factor 2, et cetera;
- $\Delta$  BURQUAL: Change in the bureaucratic quality dummy variable;
- $\Delta$  DEMACC: Change in the democratic accountability dummy variable;
- ELECLEGYR: Dummy variable that is 1 if there is an election year for the legislative power and 0 otherwise.

Pseudo  $R^2$ : Coefficient of correlation for the ordered logit regression model;

Adjusted Pseudo  $R^2$ : Coefficient of correlation, adjusted for the degrees of freedom as a consequence of including more explanatory variables.

Table E.6. Ordered logit estimation results for Mexico, with a 24 months run-up period.

Dependent variable: currency crisis dummy				
Variable	(1) Without institutional indicators		(2) Including institutional indicators	
	coef-ficient	standard error	coef-ficient	standard error
SF1	-0.156***	0.045	-0.180***	0.054
SF2	0.102*	0.055	0.112*	0.067
SF3	0.767***	0.112	0.769***	0.144
SF4	-0.212**	0.093	-0.205	0.144
SF5	0.513***	0.093	0.324***	0.120
SF6	-0.325***	0.106	-0.137	0.135
$\Delta$ GOVSTAB			0.741***	0.198
$\Delta$ DEMACC			0.539	0.330
$\Delta$ LAWORD			0.413*	0.228
ELECLEGYR			-0.931	0.583
HERFOPP			-0.830***	0.307
Pseudo $R^2$	0.327		0.386	
Adj. Pseudo $R^2$	0.305		0.342	

Notes:

\*: significant at 10%, \*\*: significant at 5%, and \*\*\*: significant at 1%;

Explanations of the symbols used:

- SF1: Static Factor 1, SF2: Static Factor 2, et cetera;
- $\Delta$  GOVSTAB: Change in government stability dummy variable;
- $\Delta$  DEMACC: Change in the democratic accountability dummy variable;
- $\Delta$  LAWORD: Change in law and order dummy variable;
- ELECLEGYR: Dummy variable that is 1 if there is an election year for the legislative power and 0 otherwise;
- HERFOPP: measure of government opposition concentration.

Pseudo  $R^2$ : Coefficient of correlation for the ordered logit regression model;

Adjusted Pseudo  $R^2$ : Coefficient of correlation, adjusted for the degrees of freedom as a consequence of including more explanatory variables.

## **E.2 Forecasted probabilities of currency crises**

In this appendix we investigate the out-of-sample performance in the period 2008M1–2009M12 of the estimated EWS models with the 6 months and 24 months run-up.

### **Argentina**

For Argentina the model with a 6 months run-up has a very poor performance, because the model does not predict an increased probability of a crisis, contrary to the actual mild crisis that occurred in October 2008. The model with static factors only shows a slightly increased probability of a mild currency crisis in 2009. The model with a 24 months run-up has a very mixed performance. The model with only factors has a good performance, as the probability of a crisis increases sharply in the third quarter of 2008. The model does not differentiate well between the different severity classes. The model with factors and institutional indicators does not have a good performance. The sharp increase in the possibility of a currency crisis by the end of 2009 is remarkable. By the end of December 2009 the probability reaches 90%.

### **Brazil**

Forecasts based on the 6 months run-up period (Figure E.3) show a similar picture as the model with a 12 months run-up period. The model with factors only predicts a slowly increasing probability of a crisis since 2008, which peaks in January 2009, four months after the Lehman Brothers event that triggered the currency crisis. The model with factors and institutional indicators peaks earlier, in October 2008. In 2009 the probability of a crisis decreases slowly. The 24 months run-up model (Figure E.4) shows a very different picture. The probability of a crisis is high throughout the forecast period. Whereas a mild crisis has highest probability in 2008, a deep crisis has highest probability in 2009. The elevated level lasts for the entire 2009;

Figure E.1. Probability of a currency crisis for Argentina for the out-of-sample period, 2008–2009, with a 6 months run-up period. The upper panel contains the graph with the forecasts of the model with factors only. The lower panel contains the graph with the forecasts of the model with factors and a combination of institutional indicators.

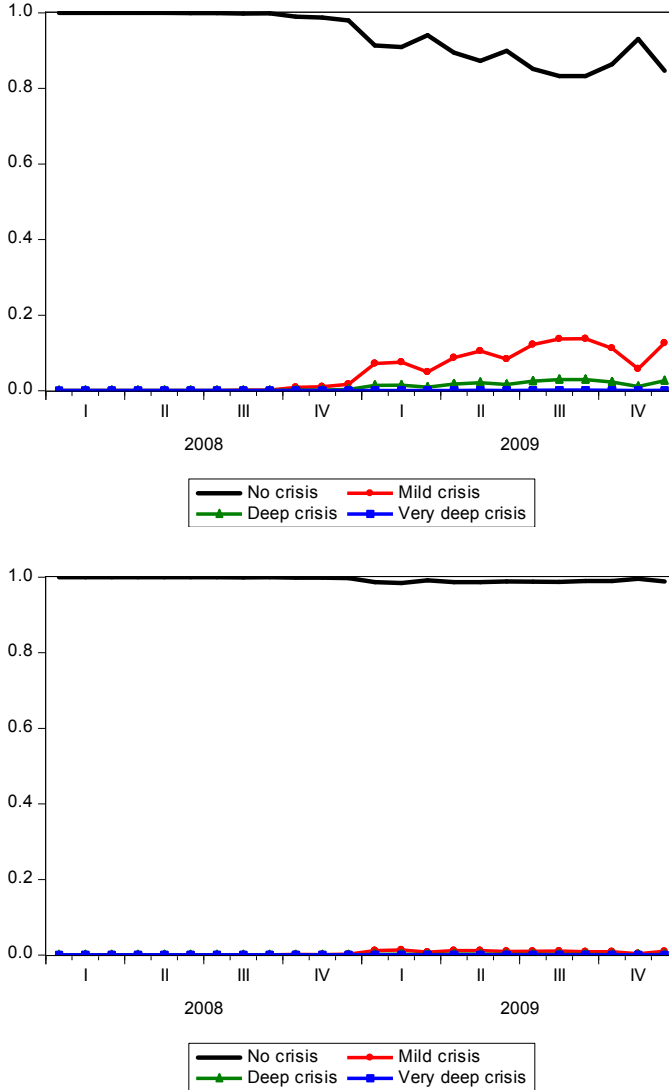
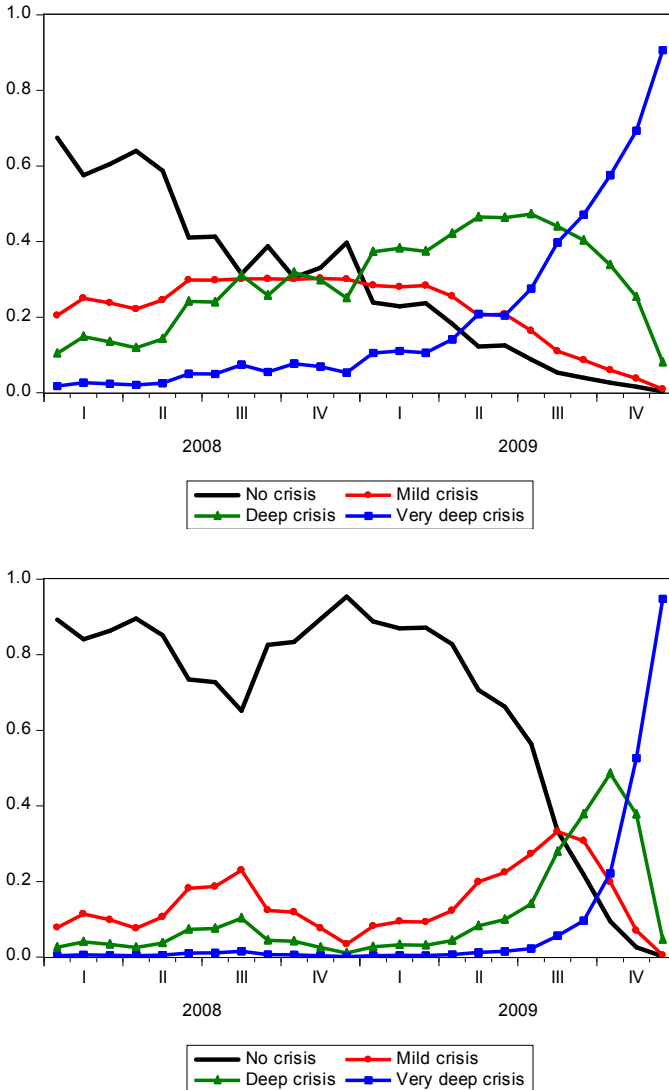




Figure E.2. Probability of a currency crisis for Argentina for the out-of-sample period, 2008–2009, with a 24 months run-up period. The upper panel contains the graph with the forecasts of the model with factors only. The lower panel contains the graph with the forecasts of the model with factors and a combination of institutional indicators.



only in the last months of the year the probability of a deep crisis drops and the probability of a mild crisis increases.

### **Mexico**

For Mexico, forecasts based on the 6 months run-up period (Figure E.5) predicts a virtually non-existing probability of a crisis, similar to the model with the 12 months run-up period. The 24 months run-up model with static factors and a combination of institutional indicators shows a very different picture. Throughout 2008 the probability of a crisis is high, but decreasing. After October 2008 the probability of no crisis rapidly increases. Regarding the severity, the forecast is less clear. The probability of a mild crisis and a very deep crisis move between 20% and 40%.

Figure E.3. Probability of a currency crisis for Brazil for the out-of-sample period, 2008–2009, with a 6 months run-up period. The upper panel contains the graph with the forecasts of the model with factors only. The lower panel contains the graph with the forecasts of the model with factors and a combination of institutional indicators.

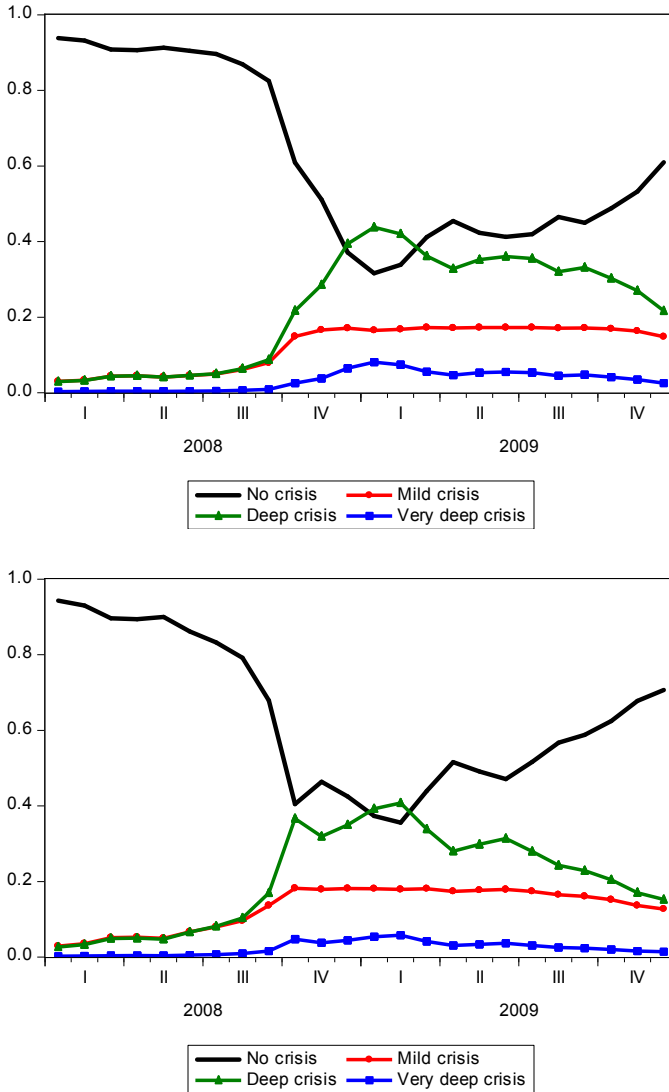


Figure E.4. Probability of a currency crisis for Brazil for the out-of-sample period, 2008–2009, with a 24 months run-up period. The upper panel contains the graph with the forecasts of the model with factors only. The lower panel contains the graph with the forecasts of the model with factors and a combination of institutional indicators.

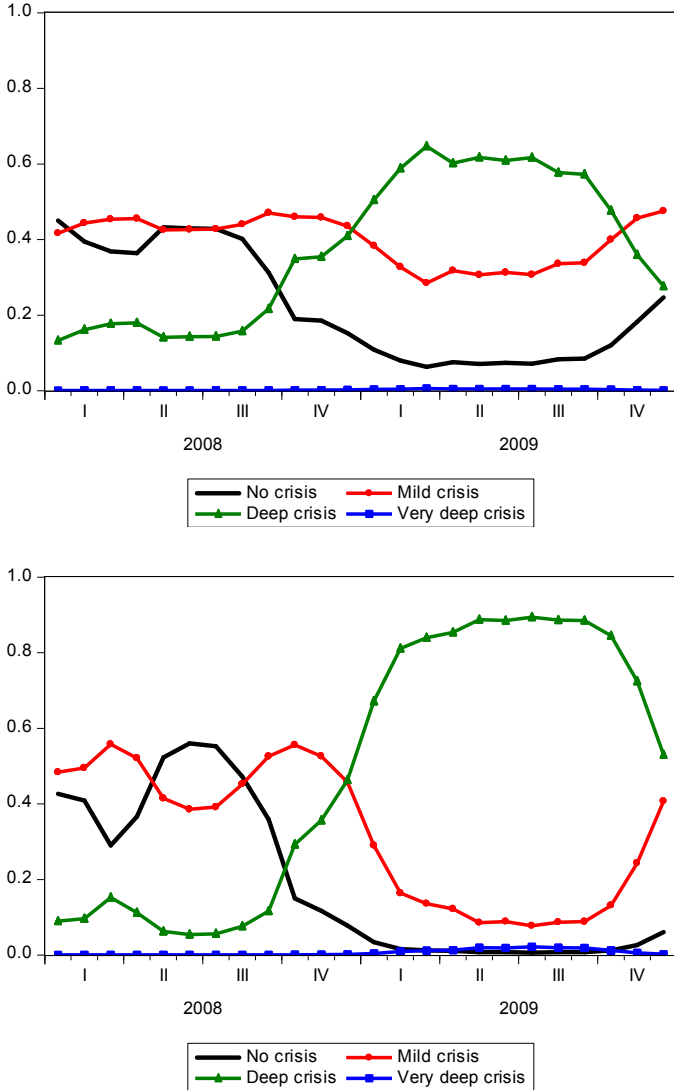


Figure E.5. Probability of a currency crisis for Mexico for the out-of-sample period, 2008–2009, with a 6 months run-up period. The upper panel contains the graph with the forecasts of the model with factors only. The lower panel contains the graph with the forecasts of the model with factors and a combination of institutional indicators.

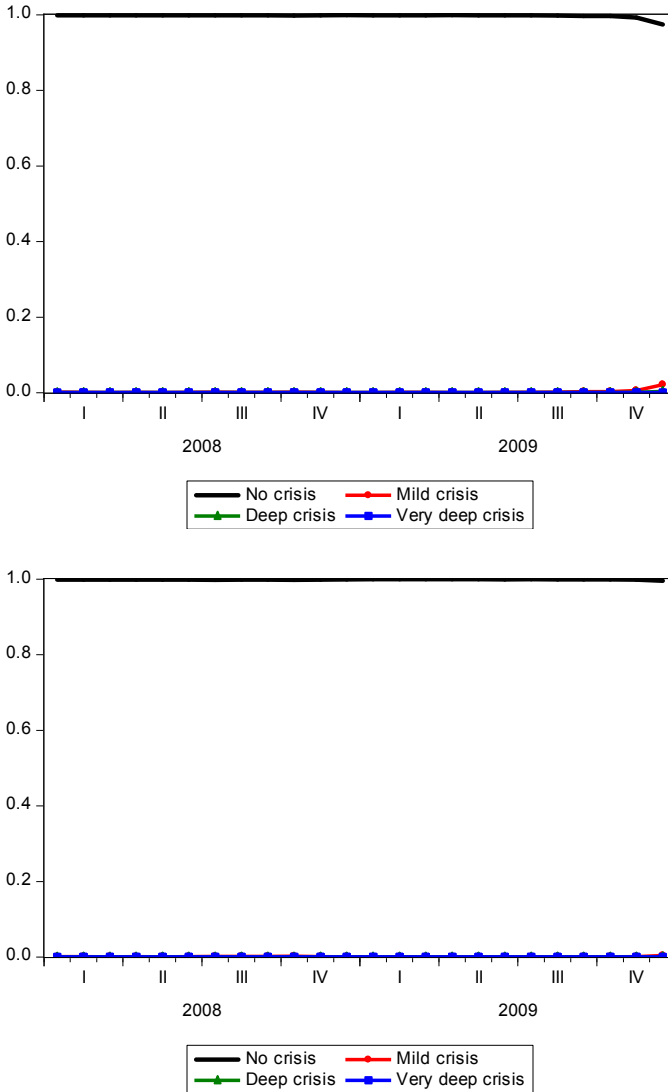
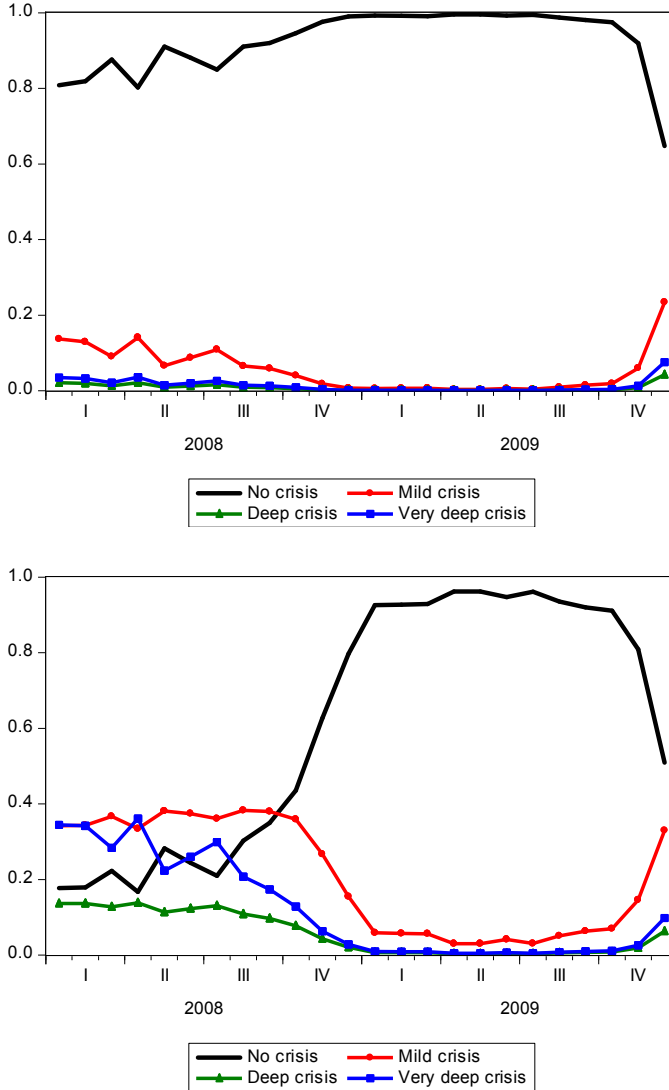


Figure E.6. Probability of a currency crisis for Mexico for the out-of-sample period, 2008–2009, with a 24 months run-up period. The upper panel contains the graph with the forecasts of the model with factors only. The lower panel contains the graph with the forecasts of the model with factors and a combination of institutional indicators.



### E.3 Performance of the logit model using the Quadratic Probability Score

We evaluate whether our model is able to predict the probability of a crisis out-of-sample (2008M1–2009M12) for mild, deep and very deep crises with the Quadratic Probability Score (QPS). The QPS is a score statistic that lies between 0 (perfect prediction) and 2 (perfect false signal). In other words, the closer the score statistics are to zero, the more accurate the model predictions are. And the closer the score statistic to value of 2, the worse the model predictions. In the out-of-sample period (2008M1–2009M12) Argentina and Brazil faced a mild crisis, while Mexico experienced a very deep crisis. We show the QPS for models with different run-up periods and with or without institutional indicators in Table E.1.

The QPS for Argentina shows that the model with factors only and a 24 months run-up period has the lowest score (0.502) for the actual crisis that occurred (mild). The forecasts of this model also produce an increased probability of deep and very deep crises, which did not occur in reality. The model with a 6 months run-up period shows also a low score for mild crises (0.583 for the model with factors and institutional indicators, and 0.591 for the model with factors only). The probability of a deep and very deep crisis is well predicted. For Brazil the forecasts of the model with factors and institutional indicators and a 24 months run-up period produce the best performance for the mild crisis forecasts, since it has the lowest QPS score (0.301). However, the forecasts of the model produce a very high score (0.709) for a deep crisis in the out-of-sample period, which is not in line with actual facts. The increased probability of a deep currency crisis can be explained by the increase of the EMPI in the months following the Lehman Brothers event. The depreciation of the Brazilian real was large, but extended over a period of various months and therefore (just) not defined as a deep crisis. The forecasts of the model with a 6 months run-up has a higher QPS for the (correct) mild crisis, but a lower QPS for the (incorrect) deep crisis. For Mexico the 24 months run-up period model with institutional indicators predicts the very deep currency crisis in 2008 the best. The score is 0.460. The scores for

Table E.1. Quadratic Probability Score for forecasting currency crises in Argentina, Brazil and Mexico 1990–2009, with run-up periods of 6, 12 and 24 months.

Country	Run-up		Out-of-sample		
			Severity of crises		
			Mild	Deep	Very deep
Argentina	6 months	Factors only	0.591	< 0.001	< 0.001
		+ Institut. var.	0.583	< 0.001	< 0.001
	12 months	Factors only	0.651	0.260	0.019
		+ Institut. var.	0.778	0.200	0.022
	24 months	Factors only	0.502	0.198	0.186
		+ Institut. var.	0.669	0.056	0.103
Brazil	6 months	Factors only	0.673	0.143	0.003
		+ Institut. var.	0.641	0.117	0.002
	12 months	Factors only	0.627	0.553	0.035
		+ Institut. var.	0.627	0.606	0.100
	24 months	Factors only	0.429	0.355	< 0.001
		+ Institut. var.	0.301	0.709	< 0.001
Mexico	6 months	Factors only	< 0.001	< 0.001	0.583
		+ Institut. var.	< 0.001	< 0.001	0.583
	12 months	Factors only	< 0.001	< 0.001	0.831
		+ Institut. var.	0.010	< 0.001	0.833
	24 months	Factors only	0.013	< 0.001	0.798
		+ Institut. var.	0.131	0.013	0.460

less severe crises are relatively low (0.131 for mild crises and 0.013 for deep crises), which is a good prediction.

We conclude that the forecasts of the model with the 24 months run-up period perform better than the models with a shorter run-up period. For Brazil and Mexico the preferred model includes institutional indicators and for Argentina the model only includes the factors.



## F Explanatory variables for Argentina, Brazil, Chile and Mexico, 1870–2012: definitions and sources

Variable	Definition	Source
Real GDP	Total real GDP, in constant local currency 2006 prices	1870–2003: Real GDP per capita: BU2008, population: ACT2011; 2004–2012: IFS (Brazil 2012: WDI)
Population	Population at mid-year	1870–2003: ACT2011, 2004–2011: IFS, 2012: WDI (Mexico 2012: growth derived from WDI)
Exports	Exports, in millions of USD	1870–2003: ACT2011, 2004–2012: IFS
Imports	Imports, in millions of USD	1870–2003: ACT2011, 2004–2012: IFS (Brazil and Mexico: 1948–2012: IFS)
Export volume	Exports volume index, 2000 = 100	1870–2003: ACT2011, 2004–2012: IFS (Argentina and Brazil), growth from WDI (Chile and Mexico)
Import volume	Imports volume index, 2000 = 100	1870–2003: ACT2011, 2004–2012: IFS (Argentina and Brazil), growth from WDI (Chile and Mexico)
Terms of trade	Terms of trade, index: 2000 = 100	1870–2003: ACT2011, 2004–2012: calculation: ToT = [exports / export volume] / [imports / import volume]
Inflation	Consumer Price Inflation (CPI), annual, geometric change	1870–2003: ACT2011, 2004–2012: IFS
Domestic interest	Domestic, nominal interest rate	1870–2003: ACT2011, 2004–2012: IFS (money market rate)
Domestic real interest	Domestic, real interest rate	Nominal domestic interest rate deflated by CPI
External spread	Interest difference between USA and domestic government; difference in yield on 10 year government bonds denominated in USD	Argentina, Brazil and Chile 1870–2004: ACT2011 (see additional notes at end of table), 2004–2012: Bloomberg; Mexico 1996–2012: Bloomberg
Government expenditure	Government expenses, in constant 1995 local currency; index: 1995 = 100	1870–2004: ACT2011, 2005–2012: WEO (adjusted for structural break)
Government revenues	Government revenues, in constant 1995 local currency; index: 1995 = 100	1870–2004: ACT2011, 2005–2012: WEO (adjusted for structural break)
Gross debt to GDP	Central government (external and domestic) debt to GDP	1870–2009: RR2011, 2010–2012: Ministerio de Economía (Argentina), Tesouro Nacional (Brazil), Banco de Chile (Chile), Secretaria de Hacienda y Finanzas Publicas (Mexico)
Polity2	Polity2 index: -10 (autocracy) to +10 (democracy)	1870–2012: Polity IV project, Center for Systemic Peace

Continued on next page

Variable	Definition	Source
War	Intrastate war and interstate war (binary dummy)	1870–2012: Correlates of War
Years no change	# years since the last substantial regime change	1870–2012: Polity IV project, Center for Systemic Peace
BC index	Business Cycle Indicator	1870–2004: ACT2011
BC expansion dummy	Dummy for the short business cycle: 1 if in expansion phase (incl. peak), 0 otherwise	1870–2004: ACT2011
Real GDP USA	US real GDP, in billions of USD	1870–2012: Maddison
Real GDP core	Real GDP, in billions of USD of four core countries: USA, UK, Germany and France	1870–2012: Maddison
Real interest rate on 3 months bills	Annual average yield on 3 months bills, deflated with CPI; up to 1920: UK, after 1920: USA	1870–2003: ACT2011, 2004–2012: IFS
US 10 years interest rate	10 years US bond nominal interest rate, deflated with U.S. CPI	1870–2003: ACT2011, 2004–2012: IFS
Capital mobility	Global capital mobility dummy, with: 1 = low, 2 = low-moderate, 3 = moderate, 4 = moderate-high, and 5 = high	1870–2008: RR2008
Commodity price: cacao, coffee, copper, iron, maize, petrol, silver, sugar, tin and zinc	Price, index: 1900 = 100	1870–1899: BHW2004, 1900–1999: OxLAD, 2000–2012: WB
Sovereign debt crisis	Sovereign debt crisis dummy	1870–2004: BP2009, 2005–2012: Standard and Poor's
Currency crisis	Currency crisis dummy	1870–2010: RR2011, 2011–2012: own calculations
Banking crisis	Banking crisis dummy	1870–2010: RR2011, 1970–2011: LV2012

## Sources:

ACT2011: Aiolfi et al. (2011)

BHW2004: Blattman et al. (2004)

BP2009: Borensztein and Panizza (2009)

BU2008: Barro and Ursua (2008)

IFS: International Financial Statistics, from IMF

LV2012: Laeven and Valencia (2012)

OxLAD: Oxford Latin America Economic History Database

RR2011: Reinhart and Rogoff (2011)

RR2008: Reinhart and Rogoff (2008)

WB: World Bank

WDI: World Development Indicators, from WB

WEO: World Economic Outlook, from IMF.

Maddison: The Maddison-Project,

<http://www.ggdcc.net/maddison/maddison-project/home.htm>, 2013 version.

## G Dummy variable approach: regressions for Argentina, Brazil, Chile and Mexico, 1870–2012

Table G.1. Impact of sovereign debt defaults on economic growth for pooled data (Argentina, Brazil, Chile and Mexico; 1870–2012): dummy variable approach.

Dependent variable: 100 $\Delta$ log (real GDP)		
Constant	-0.668	1.665
Sovereign debt default (+1)	-4.676 ***	1.566
Sovereign debt default (+2)	1.722	1.654
Sovereign debt default (+3)	0.825	1.606
Sovereign debt default (+4)	-2.553	1.591
Sovereign debt default (+5)	-0.328	1.590
Sovereign debt default (+6)	0.989	1.564
Sovereign debt default (+7)	-1.472	1.558
Sovereign debt default (+8)	-0.411	1.541
Change in gov't expenses (-1)	1.120	1.737
Ratio of gov't expenses to gov't revenues (-1)	-0.796	0.924
Percentage population growth (-1)	1.425 ***	0.311
Gross gov't debt to GDP (-1)	0.017	0.012
Inflation (-1)	-0.011 **	0.005
Polity2 dummy	0.033	0.049
Terms of Trade (-1)	-0.002	0.004
Exports as a ratio of imports (-1)	0.730	0.690
US 3 months T-bill interest rate	0.083	0.067
US real GDP growth	0.086 *	0.051
US business cycle dummy	1.554 **	0.626
Log change in cacao price	-0.306	1.101
$\Delta$ log (coffee price)	0.980	1.079
$\Delta$ log (copper price)	1.269	1.768
$\Delta$ log (iron price)	0.305	1.448
$\Delta$ log (maize price)	0.046	1.311
$\Delta$ log (oil price)	-0.229	1.150
$\Delta$ log (silver price)	3.999 **	1.625
$\Delta$ log (sugar price)	0.951	0.861
$\Delta$ log (zinc price)	-0.193	1.594
$R^2$		0.173
Adjusted $R^2$		0.124

Table G.2. Impact of sovereign debt defaults on economic growth, in periods 1870–1930, 1931–1971 and 1972–2012 (pooled data): dummy variable approach.

Dependent variable: 100 $\Delta$ log (real GDP)						
Variable	Period I 1870–1930		Period II 1931–1971		Period III 1972–2012	
	coef- ficient	standard error	coef- ficient	standard error	coef- ficient	standard error
Constant	-4.894	4.395	-1.295	3.538	-1.759	3.159
Sovereign debt default (+1)	-4.254**	1.762	-3.804	3.258	-4.324	3.647
Sovereign debt default (+2)	1.699	1.765	2.546	3.434	-2.082	2.097
Sovereign debt default (+3)	2.124	2.277	0.489	4.289	-3.998**	2.018
Sovereign debt default (+4)	1.077	3.650	-7.045*	3.585	-2.130	1.817
Sovereign debt default (+5)	0.430	2.867	0.650	3.422	-1.270	1.979
Sovereign debt default (+6)	2.855	2.271	0.632	1.416	-2.082	1.624
Sovereign debt default (+7)	-5.722	4.997	3.315*	1.865	-3.293	2.243
Sovereign debt default (+8)	-1.131	2.260	-1.401	2.305	1.872*	0.987
Change in gov't expenses (-1)	3.769	3.694	-0.271	2.524	-3.621	3.405
Ratio of gov't expenses to gov't revenues (-1)	3.470	2.363	-0.691	1.430	-6.776***	1.988
Percentage population growth (-1)	0.192	0.420	2.055***	0.517	3.213***	0.872
Gross gov't debt to GDP (-1)	0.062***	0.023	0.032	0.027	0.025**	0.012
Inflation (-1)	-0.013	0.029	0.003	0.029	-0.017**	0.007
Polity2 dummy	0.222	0.156	0.032	0.069	0.062	0.060
Terms of Trade (-1)	0.006	0.007	0.001	0.006	0.009	0.013
Exports as a ratio of imports (-1)	-1.351	1.631	0.672	1.142	4.579***	1.391
US 3 months T-bill interest rate	0.324**	0.156	0.098	0.169	-0.236	0.170
US real GDP growth	0.168	0.131	0.066	0.075	0.645***	0.227
US business cycle dummy	2.726**	1.245	-0.446	1.242	-0.022	1.426
$\Delta$ log (cacao price)	-5.026*	2.933	0.387	1.511	-0.623	1.212
$\Delta$ log (coffee price)	0.098	2.448	-3.842	2.784	2.267**	0.948
$\Delta$ log (copper price)	-0.561	2.624	4.729	3.850	-4.452**	1.841
$\Delta$ log (iron price)	-3.470	2.350	0.332	2.552	2.651**	1.272
$\Delta$ log (maize price)	2.935	2.343	2.372	2.003	-0.038	1.652
$\Delta$ log (oil price)	0.261	2.793	6.939	4.884	-1.362	1.173
$\Delta$ log (silver price)	9.244	6.556	4.436	3.478	2.134	1.619
$\Delta$ log (sugar price)	0.713	1.632	0.618	1.301	2.097**	0.898
$\Delta$ log (tin price)	-1.973	1.825	3.429	3.870	3.133**	1.269
$\Delta$ log (zinc price)	2.376	3.377	1.223	4.196	0.856	1.282
$R^2$		0.245		0.319		0.444
Adjusted $R^2$		0.105		0.171		0.324

Notes:

\*: significant at the 10% level, \*\*: significant at the 5% level, \*\*\*: significant at the 1% level.

The value between parenthesis refers to the number of years prior or posterior to the debt default entry year. For example, 'Sovereign debt default (+3)' is a dummy variable with value 1 three years after the debt default entry year, and 0 in all other years; 'Inflation (-1)' refers to the inflation one year before the debt default entry year.

Table G.3. Impact of sovereign debt defaults on economic growth per country (Argentina, Brazil, Chile and Mexico), 1870–2012: dummy variable approach.

Dependent variable: 100  $\Delta$  log (real GDP)

Variable	Argentina		Brazil		Chile		Mexico	
	coef- ficient	std error	coef- ficient	std error	coef- ficient	std error	coef- ficient	std error
Constant	1.082	3.743	-0.139	5.027	-4.019	5.027	2.033	3.159
Sovereign debt default (+1)	-8.879**	4.258	2.032	2.104	-9.396**	4.134	-6.030***	1.241
Sovereign debt default (+2)	3.286	4.998	0.690	2.204	1.912	2.187	0.708	3.011
Sovereign debt default (+3)	-4.664	4.502	3.655	2.300	-0.111	1.798	4.490***	1.454
Sovereign debt default (+4)	6.501	4.341	-2.783	1.817	-3.643	3.300	-6.265***	2.330
Sovereign debt default (+5)	0.978	2.887	0.379	2.941	-3.364	2.048	6.172***	2.198
Sovereign debt default (+6)	0.243	3.460	1.716	2.438	0.221	1.970	3.249**	1.533
Sovereign debt default (+7)	-11.989*	6.664	-0.818	2.297	1.970	2.178	3.254**	1.328
Sovereign debt default (+8)	-0.820	3.638	1.176	1.508	-7.320***	1.682	2.483*	1.359
Change in gov't expenses (-1)	-0.141	4.544	9.727***	2.742	-3.085	2.924	-5.594	3.475
Ratio of gov't expenses to gov't revenues (-1)	0.759	2.519	-1.530	2.664	0.944	2.127	0.897***	2.283
Percentage population growth (-1)	0.753	0.512	1.932***	0.703	0.895	0.968	1.218*	0.420
Gross gov't debt to GDP (-1)	0.015	0.049	-0.007	0.025	0.056***	0.017	-0.048	0.024
Inflation (-1)	-0.009	0.010	-0.010*	0.005	-0.000	0.024	-0.007	0.019
Polity2 dummy	0.084	0.070	0.078	0.071	0.238*	0.126	0.028	0.088
Terms of Trade (-1)	-0.014	0.015	-0.008	0.025	-0.021	0.015	0.005	0.006
Exports as a ratio of imports (-1)	0.948	1.258	1.056	1.305	1.514	2.461	-1.915	1.234
US 3 months T-bill interest rate	0.147	0.184	0.221**	0.096	0.193	0.133	-0.206**	0.091
US real GDP growth	0.079	0.110	0.196	0.122	0.025	0.085	0.214***	0.072
US business cycle dummy	0.159	1.337	0.290	1.129	4.290***	1.078	0.293	0.868
$\Delta$ log (cacao price)	1.822	2.141	0.521	1.630	-1.349	2.469	-1.171	1.095
$\Delta$ log (coffee price)	2.783	2.102	1.174	1.868	-0.869	2.024	-0.133	1.063
$\Delta$ log (copper price)	3.700	4.230	0.106	2.732	2.041	3.190	0.659	3.330
$\Delta$ log (iron price)	-2.267	2.529	0.102	1.798	-0.352	2.548	-0.115	2.503
$\Delta$ log (maize price)	-3.029	2.519	1.535	2.452	3.608	3.508	0.736	1.558
$\Delta$ log (oil price)	-0.377	1.889	3.218	1.941	1.198	2.020	-1.557	1.660
$\Delta$ log (silver price)	3.095	3.013	7.290	3.023	1.822	3.265	3.638	2.233
$\Delta$ log (sugar price)	1.522	1.791	-1.231	1.465	2.001	1.370	0.177	0.907
$\Delta$ log (tin price)	6.603*	3.479	-1.333	2.117	2.785	2.951	-3.973**	1.910
$\Delta$ log (zinc price)	-2.984	4.061	-0.164	2.344	-3.443	2.217	4.288**	2.080
$R^2$	0.285		0.284		0.371		0.542	
Adjusted $R^2$	0.088		0.086		0.198		0.389	

Notes:

\*: significant at the 10% level, \*\*: significant at the 5% level, \*\*\*: significant at the 1% level.

The value between parenthesis refers to the number of years prior or posterior to the debt default entry year. For example, 'Sovereign debt default (+3)' is a dummy variable with value 1 three years after the debt default entry year, and 0 in all other years; 'Inflation (-1)' refers to the inflation one year before the debt default entry year.