



# **A Decomposition of Global Linkages in Financial Markets Over Time**

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# Introduction

- ◆ 1<sup>st</sup> half of 2002, US economy buffeted by a series of negative shocks
  - US stock market fell by 17%
- ◆ Some markets from around the world fell in harmony
  - Finland ↓30%; Ireland ↓14%; Mexico ↓11%; Hong Kong ↓6%
- ◆ But other markets performed relatively well
  - Iceland ↑26%; S. Africa ↑21%; Korea ↑12%; Colombia ↑11%
- ◆ Why do shocks to the world's largest economies spread to some markets, while others remain relatively immune?
  - Can low frequency real linkage variables explain high frequency comovements in financial markets?



# Talk Outline

- ◆ Related literature
- ◆ Model and estimation framework
- ◆ New data set
- ◆ Key results: stock markets
- ◆ Key results: bond markets
- ◆ Summary of sensitivity tests
- ◆ Conclusions



# Related Literature

- ◆ Asset market comovement and financial integration
  - Importance of sectoral effects: Heston & Rouwenhorst ('94), Griffin & Karolyi ('98), Brooks & Del Negro ('02, '03)
- ◆ Business cycle synchronization and real integration
  - Comovement in real variables: Kose et al ('03)
  - Explain comovement: Frankel & Rose ('98), Imbs ('03)
- ◆ Firm-level exposure to real and financial shocks
  - Weak effect of real linkages on ER exposure: Dominguez & Tesar ('01)
  - Exception: Brooks and Del Negro ('03)
- ◆ International transmission of crises and contagion
  - Importance of trade: Glick & Rose ('99), Forbes ('02)
  - Add bank lending: Van Rijckeghem & Weder ('01, '02)
  - Omitted variable bias from a subset of potential bilateral linkages?



# Factor Model: Stage 1

- ◆ Returns in 2 countries could comove for 3 reasons:
  - Global factors
  - Sectoral factors
  - Cross-country factors
- ◆ 1<sup>st</sup> stage: a factor model of market returns:

$$R_{it} = \alpha_i + \sum_{g=1}^G \phi_i^g f_t^g + \sum_{s=1}^S \gamma_i^s f_t^s + \sum_{c=1}^C \beta_i^c f_t^c + \varepsilon_{it}$$

- ◆ Potential concern: multicollinearity between cross-country factors and sectoral/global factors



## Linkage Model: Stage 2

- ◆ Decompose cross-country factor loadings ( $\beta$ 's) into 4 bilateral linkages:
  - Import demand (direct trade)
  - Trade competition in 3<sup>rd</sup> markets
  - Bank lending
  - Foreign direct investment

$$\beta_i^c = \alpha_0 + \alpha_1 \text{Import Demand}_i^c + \alpha_2 \text{Trade Competition}_i^c + \alpha_3 \text{Bank Lending}_i^c + \alpha_4 \text{Foreign Investment}_i^c + \alpha_5 \mathbf{X}_i^c + \eta_{ic}$$

- ◆ Other bilateral linkages? Data limitations
- ◆ Expected coefficient signs? Difficult to predict *a priori*



# Model Estimation

- ◆ 16 specifications for each of the base estimates:
  - With and without sectoral factors
  - With and without controls for capital account restrictions
  - Variables averaged over the relevant period and panel estimates based on annual data
  - Local currency market values and U.S. dollar market values



# Data: Factor Model

- ◆ Weekly market returns: DataStream
- ◆ Global factors:
  - Global interest rates, oil prices, gold prices, commodity index
- ◆ Sectoral factors:
  - 14 indices based on MSCI Industrial Sectoral Indices
  - Autos, chemicals, consumer goods, electronics, energy, forest products & paper, industrial components, financial, leisure & tourism, merchandising, metals, telecom., textiles & apparel, transportation
- ◆ Cross-country factors: France, Germany, Japan, UK & US
  - Comparable returns in 5 largest economies



# Data: Bilateral Linkages

- ◆ Trade variables: Statistics Canada/Worldview Trade Analyzer

$$\text{Import Demand}_i^c = \frac{\text{Imp}_i^c}{\text{GDP}_i}$$

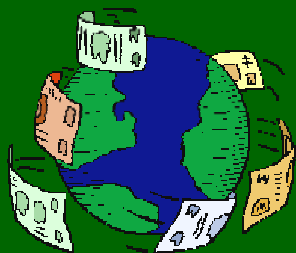
$$\text{Trade Competition}_i^c = \frac{100}{\text{MaxTradeCompetition}} \sum_k \left( \frac{\text{Exp}_{W,k}^c}{\text{Exp}_{W,k}^W} * \frac{\text{Exp}_{W,k}^i}{\text{GDP}_i} \right)$$

- ◆ Bank data: Bank of International Settlements (BIS)

$$\text{Bank Lending}_i^c = \frac{\text{Lending}_i^c}{\text{GDP}_i}$$

- ◆ Foreign investment: OECD's *International Direct Investment Statistics Yearbook*

$$\text{Foreign Investment}_i^c = \frac{\text{Investment}_i^c}{\text{GDP}_i}$$



# Data Set

- ◆ 38 countries  $i$  (plus France, Germany, Japan, UK & US)
- ◆ 1985-2000 for stocks; 1994-2000 for bonds
- ◆ Dataset – key contribution of paper
  - Some variables are fairly new to literature
  - 1<sup>st</sup> time can simultaneously control for all 4 bilateral linkages
  - Interesting patterns across countries and time
- ◆ Examine time-series characteristics of data
  - Series-by-series tests (Elliott et al., 1996)
  - Panel unit root tests (Breitung and Meyer, 1994)
  - Only FDI is nonstationary, estimate FDI in first differences



# Factor Model Estimates

$$R_{it} = \alpha_i + \sum_{g=1}^G \phi_i^g f_t^g + \sum_{s=1}^S \gamma_i^s f_t^s + \sum_{c=1}^C \beta_i^c f_t^c + \varepsilon_{it}$$



# Factor Model Results: 86-00

## F-test of joint significance of factors:

Country <i>i</i>	Global	Sector	X-country	R <sup>2</sup>
Brazil	1.57	3.05**	6.80**	0.38
Canada	8.38**	7.04**	22.53**	0.66
Mexico	2.84**	1.10	3.73**	0.20
Venezuela	4.21**	0.89	0.07	0.07

## Beta for cross-country factor loadings:

Country <i>i</i>	France	Germany	Japan	U.K.	U.S.
Brazil	0.35**	0.15	0.29**	0.11	1.02**
Canada	0.06**	0.01	-0.01	0.10**	0.43**
Mexico	0.04	0.24	0.08	0.13	0.48**
Venezuela	0.05	-0.05	0.08	0.03	0.00



# Factor Model Results

- ◆ X-country & sectoral factors more important than global factors
  - Largest economy in region most important to neighbors
  - Colonial heritage & cultural similarities important
- ◆ Multicollinearity between sectoral factors & Japan/US
  - Exclude sectoral factors, Japan & US factors more important
- ◆ Examine changes over time (5-year periods from '85-'00)
  - Sectoral factors gain importance in '96-'00, especially in Asia
  - Cross-country factors gain importance in '96-'00
    - ◆ U.S. factor substantially more important over time
    - ◆ Japanese and UK factors less important in '96-'00



# Bilateral Linkage Estimates

$$\begin{aligned}\beta_i^c = & \alpha_0 + \alpha_1 \text{Import Demand}_i^c + \alpha_2 \text{Trade Competition}_i^c \\ & + \alpha_3 \text{Bank Lending}_i^c + \alpha_4 \text{Foreign Investment}_i^c \\ & + \alpha_5 \mathbf{X}_i^c + \eta_{ic}\end{aligned}$$

- ◆  $\mathbf{X}_i^c$ : Capital controls
  - Chinn and Ito (2002): Measure of financial openness



# Bilateral Linkage Results

Stock market returns in local currency, averages, 1986-2000

N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lend.	Foreign Invest.	Capital Controls
<i>With Sectoral Factors</i>						
181	0.03	0.390 (0.561)	-0.221 (0.160)	0.137 (0.105)	8.905* (4.986)	
161	0.04	0.729 (0.561)	-0.251 (0.188)	0.174 (0.128)	6.548 (5.122)	-0.003 (0.013)
<i>Without Sectoral Factors</i>						
181	0.10	1.282** (0.395)	-0.189 (0.123)	0.090 (0.071)	0.030 (4.332)	
161	0.14	1.555** (0.367)	-0.271** (0.133)	0.121 (0.082)	-2.467 (4.527)	0.007 (0.009)



# Bilateral Linkage Results

Stock market returns in local currency, averages, 1986-1990

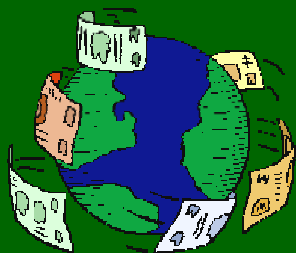
N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lend.	Foreign Invest.	Capital Controls
<i>With Sectoral Factors</i>						
65	0.01	-0.449 (0.542)	-0.099 (0.325)	0.191 (0.157)	-11.296 (12.078)	
60	0.01	0.117 (0.829)	-0.316 (0.432)	0.283 (0.249)	-11.640 (19.224)	-0.001 (0.031)
<i>Without Sectoral Factors</i>						
65	0.03	-0.664 (0.408)	0.203 (0.177)	0.135 (0.102)	-11.471 (10.026)	
60	0.05	-0.294 (0.603)	-0.043 (0.286)	0.169 (0.144)	-9.193 (13.880)	0.034 (0.022)



# Bilateral Linkage Results

Stock market returns in local currency, averages, 1996-2000

N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lend.	Foreign Invest.	Capital Controls
<i>With Sectoral Factors</i>						
167	0.12	1.180* (0.640)	-0.872** (0.212)	0.807** (0.299)	7.988** (2.951)	
149	0.14	1.498** (0.677)	-0.968** (0.234)	0.799** (0.335)	7.294** (3.045)	0.007 (0.015)
<i>Without Sectoral Factors</i>						
167	0.16	1.633** (0.239)	-0.387** (0.116)	0.429** (0.199)	0.421 (1.446)	
149	0.18	1.699** (0.226)	-0.383** (0.121)	0.358** (0.203)	-0.597 (1.331)	0.002 (0.010)



# Bilateral Linkage Results

Bond market returns in US dollars, averages, 1994-2000

N	R <sup>2</sup>	Import Demand	Trade Comp.	Bank Lend.	Foreign Invest.	Capital Controls
<i>With Sectoral Factors</i>						
157	0.09	2.398** (0.476)	-0.540* (0.300)	1.440* (0.826)	6.104 (4.590)	
142	0.11	2.646** (0.516)	-0.959** (0.392)	1.468* (0.809)	6.800 (5.214)	0.054* (0.031)
<i>Without Sectoral Factors</i>						
157	0.13	2.839** (0.436)	-0.522* (0.274)	1.291 (0.833)	5.376 (4.556)	
142	0.16	3.082** (0.471)	-0.905** (0.331)	1.364 (0.828)	6.428 (5.255)	0.046* (0.027)



# Sensitivity Tests

- ◆ Different variable definitions
  - Capital controls: Edison & Warnock ('02), Kaminsky & Schmukler ('02)
  - Different sectoral/global factors, moving average returns
- ◆ Different model specifications
  - Smaller set of cross-country factors, exclude global factors
  - Add regional dummy variables, variables for simple non-linearities
- ◆ Sample selection & outliers
  - Exclude oil exporters, countries with banking and/or currency crisis
  - Only high or low income countries
- ◆ Late 80's & early 90's, lack of consistency & explanatory power
- ◆ Late 90's, stronger results in both stock and bond markets
  - Import demand – consistently positive and significant
  - Bank lending & trade competition – fluctuating significance
  - Foreign investment – rarely significant



# Key Findings

- ◆ Movements in large financial markets are important determinants of stock & bond returns around the world
  - Increased importance of US market in late-1990's
  - Decreased importance of Japanese & UK markets
- ◆ 1985-95: difficult to explain these cross-market linkages using real and financial variables
- ◆ 1996-00: real & financial bilateral linkages become more important determinants of how shocks are transmitted from large economies to markets around the world
  - **Direct trade**: most important variable in stock & bond markets
  - **Bilateral bank lending & trade competition in third markets**: importance mixed, depends on model specification
  - **Bilateral foreign investment**: generally insignificant



# Key Findings

- ◆ Despite the recent growth in capital flows across countries, direct trade linkages still appear to be more important than financial linkages in determining how shocks to the world's largest economies affect financial markets around the globe
  - Caveat: poorer measures of financial market linkages?
  
- ◆ Results document that real linkages between countries, even when measured at an annual frequency, can be large and important determinants of higher frequency movements in financial markets



# Future Research

- ◆ Analysis in this paper is only a start...
  - Does the importance of different global linkages vary across crisis and non-crisis periods?
  - Does the importance of different linkages vary based on the type of shock affecting the large economies?
  - Do these results apply to linkages between pairs of smaller countries?
  - What is the importance of other types of linkages (through multinationals, portfolio investment)?