Cross-country dependence and financial integration in the last 150 years

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July 11, 2023

Outline

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Objective

- The interconnectedness of the global financial system has changed over time.
- We study financial integration taking a **cross-country perspective** over the period from 1870 to 2016.
- We adopt a novel methodology of Chudik and Pesaran (2015), consistent under **cross-country dependence** and **heterogeneity** across countries.
- In addition, we examine the effect of fiscal and monetary policy on financial market integration.

Outline

Literature review

– Financial integration is defined and measured in different ways in the literature.

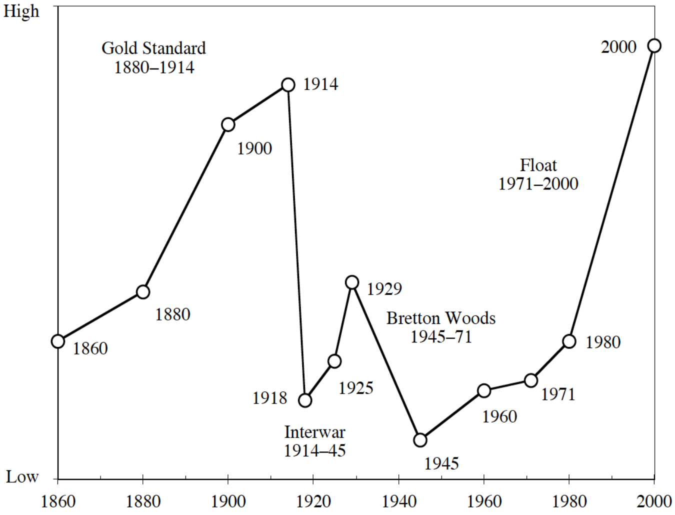
U-shaped pattern (Obstfeld and Taylor, 2003)

In their empirical work:

i. nominal interest arbitrage
ii. real interest rate convergence
iii. equity returns

they argue for **U-shaped** pattern over time.

U-shaped pattern

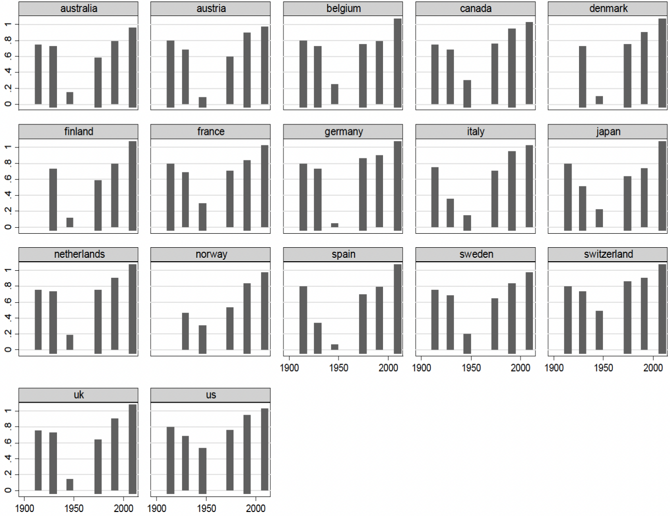


Source: Obstfeld and Taylor, 2003

Swoosh-shaped pattern (Bekaert and Mehl, 2019)

1. Propose a measure of **equity market** integration for seventeen countries.
2. They formulate an international factor model with two factors (**global market factor** - regional market factor).
3. The temporal pattern of global financial market integration is nicely **swoosh-shaped** in all countries.

Swoosh-shaped pattern

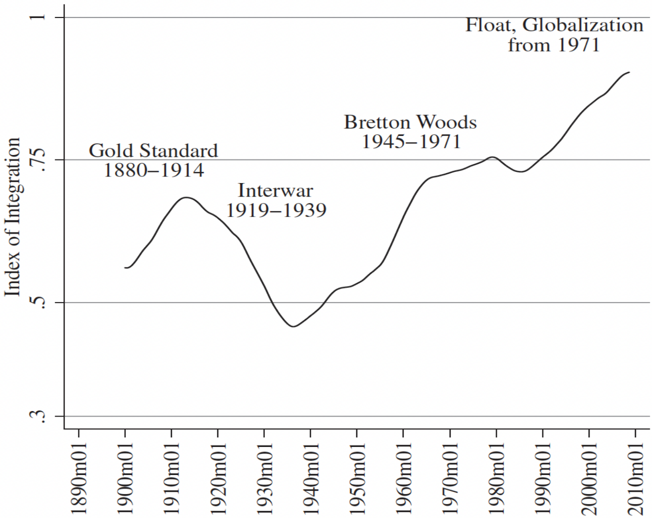


Source: Bekaert and Mehl, 2019

J-shaped pattern (Volosovych, 2011)

1. Uses sovereign **bond markets** of fifteen industrialized economies from 1875 to 2009.
2. Methodology is based on **principal components analysis**.
3. Financial market integration by the end of the 20th century was higher than in earlier periods exhibiting a **J-shaped** trend with a trough in the 1920s.

J-shaped pattern



Source: Volosovych, 2011

Outline

Dynamic panel approach

- We use a **dynamic panel approach** to estimate a heterogeneous coefficient model in panels with dependence across countries.
- The estimation method is the **Dynamic Common Correlated Effects Estimator** (DCCE, Chudik and Pesaran, 2015).
- We test for **cross-country dependence** which is a measure of financial integration.

- The **CCE estimator** works by augmenting the model by **cross-sectional averages** of the **dependent variable** and **regressors** in order to account for the common factors.

Assume the following equation with heterogeneous coefficients (Pesaran, 2006)

$$y_{it} = a_i + \beta_i' x_{it} + u_{it}$$
$$u_{it} = \gamma_i' f_t + e_{it}$$

where f_t is a vector of unobserved common factors, a_i is individual fixed effect for country i. e_{it} is a idiosyncratic error term, different across i and over t. The heterogeneous coefficients are randomly distributed around a common mean such that $\beta_i = \beta + v_i \sim N(0, \Omega_u)$.

- Extending **CCE** estimator to the **Dynamic** form:

$$y_{it} = a_i + \phi_i y_{i,t-1} + \beta_i' x_{it} + u_{it}$$
$$u_{it} = \gamma_i' f_t + e_{it}$$

where the idiosyncratic errors u_{it} are *cross-sectionally weakly dependent*, $E(\phi_i) = \phi$ and y_{it} is not strictly exogenous.

Measuring cross-country dependence

- We use **Pesaran's CD test** (Pesaran, 2015):

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right)$$

which shows that under the null hypothesis of weak cross-sectional dependence $CD \xrightarrow{d} N(0,1)$ for $N \rightarrow \infty$ and T sufficiently large.

Where $\hat{\rho}_{ij}$ is the sample estimate of the pairwise correlation of the residuals.

Outline

Data

- To investigate the financial integration in global markets we use financial and macroeconomic variables.
- We build panel data sets on **long-term nominal interest rates, real long-term interest rates, equities** and **bonds** in 17 countries.
- We use as explanatory variables the **long-term nominal interest rates, real long-term interest rates, equities, bonds, inflation, debt to GDP ratio** and **equity dividend yield** in the form of lag(1).

- The sample period starts in **1870** and ends in **2016.**
- The entire period is split into three sub-periods:
  - **First Era of Globalisation** (1870-1913)
  - **Bretton Woods** (1950-1973)
  - **Floating Exchange Rates** (1974-2016)
- To avoid noisy data from nonmarket periods, the wartime years **(1914-18, 1939-45)** have been omitted, as well as the German hyperinflation period **(1919-23).**
- We use annual data for the following countries:
  Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the UK and the USA.

Empirical results

Table 1. Real long-term interest rate

	Estimation period 1871-1913	Estimation period 1950-1973	Estimation period 1974-2016
	Dynamic CCE	Dynamic CCE	Dynamic CCE
Dependent variable			
Real long-term interest rate			
Control variables			
Real long-term interest rate lag(1)	1.514***	0.926	0.465***
	(2.81)	(0.79)	(5.25)
Inflation lag(1)	1.663***	0.821	0.245**
	(3.26)	(0.73)	(2.52)
Debt/GDP lag(1)	-0.013	0.051	0.016
	(-0.38)	(1.00)	(0.84)
Cross-country dependence (average) applies to the u_{it} (CD)	0.291***	0.084***	0.225***

Notes: The table displays results examining heterogeneous-coefficient panel models. Estimation methods are the Dynamic Common Correlated Effects Model (DCCE, Chudik and Pesaran 2015). Dependent variable is the Real long-term interest rate: Long-term interest rate minus inflation. Control variables are the lagged values of Real long-term interest rate, inflation and Debt to GDP ratio. CD test for the average cross-country dependence (Chudik and Pesaran 2015). (***), (**), and (*) indicate 1%, 5% and 10% significance levels, respectively.

Table 2. Long-term nominal interest rate

	Estimation period 1871-1913	Estimation period 1950-1973	Estimation period 1974-2016
	Dynamic CCE	Dynamic CCE	Dynamic CCE
Dependent variable			
Long-term nominal interest rate			
Control variables			
Long-term nominal interest rate lag(1)	0.661***	0.488***	0.361***
	(7.83)	(4.29)	(4.48)
Inflation lag(1)	0.005*	0.012	0.151**
	(1.66)	(0.19)	(2.25)
Debt/GDP lag(1)	0.362	3.201	-1.199
	(0.33)	(1.16)	(-0.84)
Cross-country dependence			
(average) applies to the u_{it} (CD)	0.161***	0.127***	0.544***

Notes: The table displays results examining heterogeneous-coefficient panel models. Estimation method is the Dynamic Common Correlated Effects Modes (DCCE, Chudik and Pesaran 2015). Dependent variable is the Long-term nominal interest rate. Control variables are the lagged values of Long-term nominal interest rate, inflation and Debt to GDP ratio. CD test for the average cross-country dependence (Chudik and Pesaran 2015). (∗∗∗), (∗∗), and (∗) indicate 1%, 5% and 10% significance levels, respectively.

Table 3. Bond total return

	Estimation period 1881-1913	Estimation period 1950-1973	Estimation period 1974-2015
	Dynamic CCE	Dynamic CCE	Dynamic CCE
Dependent variable			
Bond			
Control variables			
Bond lag(1)	0.168	-0.347	-0.244**
	(1.63)	(-1.48)	(-2.46)
Inflation lag(1)	0.001	-0.002	0.012**
	(0.40)	(-0.30)	(2.28)
Debt/GDP lag(1)	0.001	-0.003	0.001
	(0.99)	(-1.35)	(0.52)
Cross-country dependence (average) applies to the u_{it} (CD)	0.100***	0.103***	0.350***

Notes: The table displays results examining heterogeneous-coefficient panel models. Estimation method is the Dynamic Common Correlated Effects Model (DCCE, Chudik and Pesaran 2015). Dependent variable is the government Bond total return. Control variables are the lagged values of Bond return, inflation and Debt to GDP ratio. CD test for the average cross-country dependence (Chudik and Pesaran 2015). (∗∗∗), (∗∗), and (∗) indicate 1%, 5% and 10% significance levels, respectively.

Table 4. Equity total return

	Estimation period 1881-1913	Estimation period 1950-1973	Estimation period 1974-2015
	Dynamic CCE	Dynamic CCE	Dynamic CCE
Dependent variable			
Equity			
Control variables			
Equity lag(1)	0.048	0.205	0.056
	(0.42)	(1.26)	(0.43)
Inflation lag(1)	0.002	-0.003	0.040**
	(0.65)	(-0.32)	(2.23)
Equity dividend lag(1)	0.004	0.540***	0.179*
	(0.94)	(2.82)	(1.65)
Cross-country dependence (average) applies to the u_{it} (CD)	0.241***	0.104***	0.326***

Notes: The table displays results examining heterogeneous-coefficient panel models. Estimation method is the Dynamic Common Correlated Effects Model (DCCE, Chudik and Pesaran 2015). Dependent variable is the Equity total return. Control variables are the lagged values of Equity total return, inflation, and the log of the equity dividend yield. CD test for the average cross-country dependence (Chudik and Pesaran 2015). (***), (**), and (*) indicate 1%, 5% and 10% significance levels, respectively.

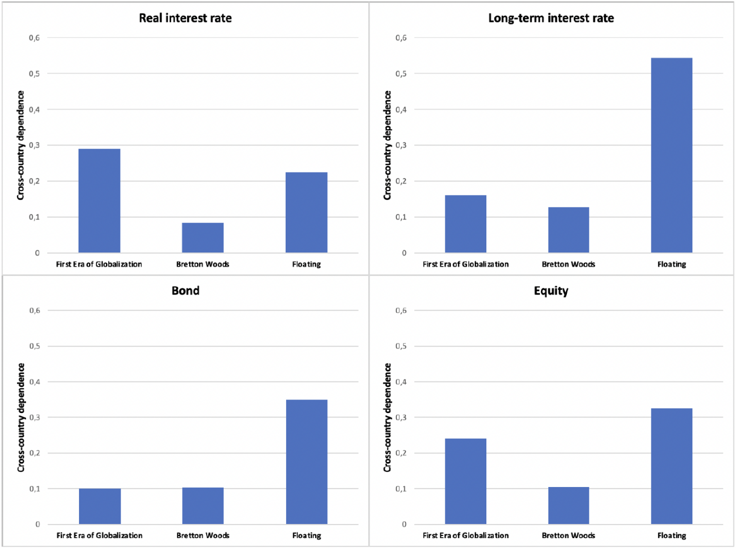


Figure 1. The figure displays the results of cross-country dependence in three different sub-periods: the First Era of Globalisation (1870-1913), the Bretton Woods Monetary System (1950-1973), and Floating Exchange Rates (1974-2016).

Outline

Monte Carlo simulation

- We study the finite-sample properties of the Dynamic Common Correlated Effects Model (DCCE, Chudik and Pesaran 2015) by Monte Carlo simulations.
- The parameter values for the data generating processes (DGPs) are as in Ditzen (2018) but using small samples of size $N = \{10, 15, 20\}$ and $T = \{20, 25, 30, 35, 40\}$.
- Our aim is to adopt rather sampler sizes, which are close to those of our empirical analysis. The number of simulations is set to $M = 500$, but the results are stable to $M > 500$.

Table 5. Monte Carlo simulations

Small-sample properties Dynamic Common Correlated Effects Model

(N , T)	Bias (×100)					RMSE (×100)				
	20	25	30	35	40	20	25	30	35	40
$\phi = 1/N \sum_{i=1}^{N} \phi_i$										
10	-66.27	-44.11	-43.28	-33.32	-26.26	26.67	11.84	11.21	6.91	4.24
15	-69.01	-49.22	-45.86	-36.84	-28.71	27.31	13.74	12.10	7.76	4.93
20	-68.09	-48.48	-47.13	-36.79	-28.07	26.41	13.05	12.37	7.56	4.51
$\beta_0 = 1/N \sum_{i=1}^{N} \beta_{0i}$										
10	0.00	2.63	0.22	0.40	1.96	16.27	6.48	5.03	3.70	2.24
15	-2.00	2.12	1.13	2.62	0.39	15.01	5.97	5.09	3.55	2.44
20	-0.84	-0.15	2.25	1.39	-0.12	14.61	5.26	4.59	2.66	1.84
$\beta_1 = 1/N \sum_{i=1}^{N} \beta_{1i}$										
10	-72.26	-45.84	-44.09	-35.81	-24.25	33.77	12.06	10.87	7.42	4.20
15	-66.79	-44.96	-42.12	-33.51	-28.26	27.81	11.65	10.15	6.62	4.98
20	-61.02	-46.74	-41.73	-32.46	-26.16	25.27	11.62	9.68	6.04	4.36

Notes: Bias and Root Mean Squared Error (RMSE). The sample sizes are $N = \{10, 15, 20\}$ and $T = \{20, 25, 30, 35, 40\}$. The number of Monte Carlo simulations is 500. For more details on the data-generating process, see Ditzen (2018).

Outline

Conclusions

- Using long-term interest rates and bonds, our analysis reveals a significantly J-shaped increase in financial integration after Bretton Woods such as the one documented in Volosovych (2011).
- Examining real interest rates, our study corroborates with the earlier literature's proposition of a U-shaped trend in international financial markets.
- For equities, we confirm a swoosh-shaped pattern in financial integration, which aligns with the research of Bekaert and Mehl (2019).
- In general, we argue for increased financial integration in the post-Bretton Woods period with stock and bond markets showing large cross-country dependence.
- As for future research, we aim to investigate financial crises (e.g., banking, exchange rate or debt crises) and their international transmission mechanism across countries.

Outline

References

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Thank you for your attention!