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

Abstract

Over the last two centuries, the international financial system has experienced important financial shocks and important historical events have shaped financial markets and economies worldwide. We revisit financial integration across international markets during the period from 1870 to 2016 by using a versatile dynamic panel approach that allows for measuring cross-country dependence. Our results reveal some interesting findings. For real interest rates, we show evidence of a clear U-shaped pattern while for equities, the trend of global financial market integration is rather swoosh-shaped. On the other hand, long-term interest rates and bond markets have become considerably more integrated after Bretton Woods tracing out a J-shaped pattern over the period under study.

Keywords: Financial Integration; Dynamic Panels; Cross-country Dependence; First Era of Globalization; Floating Exchange Rates; U-shaped pattern.

JEL classification: F2; F3; N1; N2; C3

1. Introduction

Measuring the comovements across international financial markets and consequently quantifying the degree of financial integration is a major concern for academics and policy-makers. If international financial markets are highly interconnected, financial crises and economic downturns can easily spread across economies. It is widely accepted in the literature that financial markets became highly integrated following the demise of the Bretton Woods System (see Berden and Jansen (2005) for equity markets, among others). This period is also referred as the modern era of financial globalization. Still, from a long-run perspective some researchers cast doubt on the degree of financial integration post-Bretton Woods compared to the period of the classic Gold Standard (also known as the first era of financial globalization). For instance, Quinn (2003), Bordo and Flandreau (2003), and Bordo and Murshid (2006) argue that international financial markets were even more integrated prior to World War I (WWI) than today. Quinn (2003) is based on an index of financial openness over the period 1890-1999, while Bordo and Murshid (2006) use factor analysis to investigate shock transmissions and currency crises. Both studies conclude that financial markets were more globalized before 1914 than now. Focusing on the Scandinavian case, Øksendal (2007) claims the importance of the Scandinavian Monetary Union in fostering financial integration and emphasizes the significance of the monetary union for a more integrated short-term credit market at the end of the first era of globalization.

On the other end of the spectrum, Bordo et al. (1999b, 2001), Mauro et al. (2002), and Quinn and Voth (2008) claim that financial markets became more integrated in the modern era of financial globalization. In a similar spirit, Volosovych (2011) finds that financial market integration was higher by the end of the twentieth century than in earlier periods and exhibited a J-shaped trend with a trough in the 1920s. According to Bordo et al. (1999b), improvements in transportation, contract enforcement, government trade barriers, and information asymmetry have contributed to the globalization and deepening of capital markets after the 1970s. In this line of research, Bordo et al. (2001) conclude that financial crises (banking, currency, and twin crises) are more frequent today because of high capital mobility (especially short-term capital) and financial safety nets that enable more risk-taking. Moreover, Quinn and Voth (2008) directly take a stock market correlation approach for developed markets while Mauro et al. (2002) use a similar method for bond markets spread correlations but for emerging markets. Both studies argue for increased financial integration in the post-Bretton Woods period with the latter study pointing out the reduced diversification benefits of investing in emerging markets. More recently, researchers became interested in the financial integration of Asia with the rest of the world. Yao et al. (2018) provide time series evidence on stock markets and examine the cross-border integration of China's stock market at the global level. The authors show that Chinese stock markets have become more integrated with the world markets irrespective of any macroeconomic fluctuations over the period 2000-2015. Furthermore, Holmes et al. (2011), taking a country panel data approach on deposit rates and long-term government bond yields, advocate for a high degree of financial integration among Asian countries based on the co-movement of interest rates and the ability of central banks' monetary policy to affect long rates within and beyond borders. Additionally, Fry-McKibbin et al. (2018) studying East Asia and the Association of Southeast Asian Nations equity markets argue for a significant level of increased global and regional financial integration from 1997 to 2016, showing, however, reversals in this trend during crises periods such as the Great recession and the European debt crisis. Also, they emphasize the significant impact of the Chinese economy on regional financial integration with trade being the most important determinant in rising financial integration over time.

Another strand of the literature emphasizes that financial integration in the first era of globalization is actually as high as in the modern era of financial globalization arguing for a U-shaped pattern (Obstfeld and Taylor 2003, 2004 and Goetzmann et al., 2001). Obstfeld and Taylor (2003, 2004) employ a rich dataset comprised of prices and quantities to reach this conclusion, while Goetzmann et al. (2001) confirm the U-shape relationship in a historic stock market correlation framework. In another survey, Bekaert and Mehl (2019) examine financial globalization in seventeen countries employing a factor model of equity returns to propose a "swoosh" shape pattern with a high pre-1913, higher post-1990, and low interwar period degree of financial integration. Focusing on international trade, Rajan and Zingales (2003) show that financial development is positively related to trade openness both at the beginning of the twentieth century and in the late 1990s.

The current paper reconsiders whether there was an increase in financial integration in global markets during the post-Bretton Woods era in relation to the earlier periods of 1870-1913 and 1950-1973, by pointing out the importance of cross-country dependence in equity markets, bond markets as well as interest rates in a large panel country dataset. Specifically, we contribute to the existing literature in two ways. First, we adopt a novel methodology, which allows us to pin down the level of cross-country dependence in the three periods under investigation. We do so by making use of the dynamic common correlated effects (DCCE) framework of Chudik and Pesaran (2015), which is a versatile econometric framework consistent under both cross-country dependence and cross-country heterogeneity. Measuring cross-country dependence and heterogeneity has drawn a great deal of attention in the empirical literature (Sarafidis and Wansbeek, 2021). At the same time, our approach examines the effect of fiscal and monetary policy on financial market integration.

Our results bring out some interesting findings. Based on long-term interest rates and bonds, we conclude that financial integration increased considerably after Bretton Woods tracing out a J-shaped pattern over time. However, based on real interest rates, we confirm the other hypothesis of a U-shaped pattern in financial markets, first documented and popularized by Obstfeld and Taylor (2003, 2004). As for equities, our findings corroborate with the results of Bekaert and Mehl (2019) supporting a swoosh-shaped pattern in financial integration.

The remainder of the paper is structured as follows. Section 2 presents the econometric methodology we use to measure international financial market integration over the long run. Section 3 identifies the data sources, describes the sample selection, and presents the findings. Finally, Section 4 provides our concluding remarks.

2. Econometric Methodology

2.1. Dynamic panel approach

Assume that the dependent variable, the regressors, x_{it}, and the covariates, g_{it}, are generated according to the following linear covariance stationary dynamic heterogeneous panel data model,

$$y_{it} = c_{yi} + \phi_i y_{i,t-1} + \beta_{0i}' x_{i,t} + \beta_{1i}' x_{i,t-1} + u_{it} \tag{1}$$

$$u_{it} = \gamma_i' f_t + \varepsilon_{it} \tag{2}$$

and

$$\omega_{it} = \begin{pmatrix} x_{i,t} \\ g_{it} \end{pmatrix} = c_{\omega i} + a_i y_{i,t-1} + \Gamma_i' f_t + v_{it} \tag{3}$$

for $i = 1,2, \ldots, N$ and $t = 1,2, \ldots, T$, where c_{yi} and $c_{\omega i}$ are individual fixed effects for country i, x_{it} is $k_x \times 1$ vector of regressors specific to cross-sectional country i at time t, g_{it} is $k_g \times 1$ vector of covariates specific to country $i, k_g \geq 0, k_x + k_g = k,$ f_t is an $m \times 1$ vector of unobserved common factors, ε_{it} represents the idiosyncratic errors, Γ_i is an $m \times k$ matrix of factor loadings, a_i is a $k \times 1$ vector of unknown coefficients, and v_{it} is assumed to follow a general linear covariance stationary process distributed independently of the idiosyncratic errors, ε_{it}.

The process for the exogenous variables, (3), can also be written equivalently as an autoregressive distributed lagged (ARDL) panel model in ω_{it} . But we have chosen to work with this particular specification as it allows us to distinguish between cases of strictly and weakly exogenous regressors in terms of the feed-back coefficients, a_i. The case of strictly exogenous regressors, covered in Pesaran (2006), refers to the special case when $a_i = 0_{k\times 1}$. As in the earlier literature, the above specification also allows the regressors to be correlated with the unobserved common factors. Lags of x_{it} and g_{it} are not included in (3), but they could be readily included. In order to keep the notations and exposition simple, we also abstract from observed common effects, additional lags of the dependent variable, and other deterministic terms in (1) and (3). Such additional regressors can be readily accommodated at the cost of further notational complexity.

2.2. Cross-country dependence

We base the CCE mean group estimator on the following cross-sectionally augmented country-specific regressions,

$$y_{it} = c_{yi} + \phi_i y_{i,t-1} + \beta_{0i} x_{i,t} + \beta_{1i} x_{i,t-1} + \sum_{l=0}^{p_T} \delta'_{il} \bar{z}_{t-l} + e_{yit} \tag{4}$$

for $i = 1,2,\dots,N$ where $\bar{z}_t = N^{-1} \sum_{i=1}^{N} \bar{z}_{it} = (\bar{y}_t, \bar{x}_t, \bar{g}_t)'$. We set p_T equal to the integer part of $T^{1/3}$, denoted as $p_T = \left[T^{1/3}\right]$.

3. Empirical analysis

3.1. Data description

We utilize data on nominal long-term interest rates, real long-term interest rates, bond returns, and equity returns. All these variables are used as dependent variables in our model, while for control variables we use important macroeconomic output variables such as inflation as an indicator of monetary policy, the debt-to-GDP ratio as an indicator of fiscal policy and equity dividend yield (only for equities), all in the form of the first lag. In fact, we use the *ex-post* real long-term interest rate, which is calculated as the difference between the long-term nominal interest rates and inflation. To examine the dynamic panel model, we employ panels of annual data of a total of 9180 observations. These data are available at an annual frequency and are obtained from the *Macrohistory Database*.

Furthermore, to avoid noisy data from nonmarket periods, the wartime years (1914–18, 1939–45) have been omitted, as has the German hyperinflation period (1919–23). Specifically, we focus on three different periods that correspond to three different monetary regimes: the First Era of Globalisation (1870–1913), the Bretton Woods Monetary System (1950–73) and the Floating Exchange Rates period (1974–2016).

In our analysis, 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.

3.2. Main results

Our results, in Tables 1-4, show that in the First Era of Globalization cross-country dependence is estimated at around 30 percent for real rates, 24 percent for equities, 16 percent for nominal rates and 10 percent for bonds. These figures are highly significant based on the Pesaran (2015) cross-sectional dependence test. However, during Bretton Woods arrangements, cross-country dependence drops substantially for real rates and equities. For nominal rates, the decrease in the dependence is rather small, while for bonds the figures across the two periods are essentially similar. This result can be primarily attributed to the fact that after World War I international financial markets remained largely disintegrated with the recovery of confidence in the benefits of financial and more generally economic integration taking time to come back. Besides, the new international monetary system after World War II was predicated upon limited cross-border capital mobility and active economic policies. Following the collapse of the Bretton Woods System during the floating rate era international financial markets would again experience explosive growth coupled with less financial regulation and later on with the elimination of restrictions on international capital mobility. These policy choices are reflected in our cross-country dependence measure, which rises substantially during the last period reaching levels even higher than in the First Era of Globalization. Specifically, for nominal interest rates the average cross-country dependence increases to around 54 percent, for bonds to 35 percent, for equities to 32 percent and for real rates to 22 percent.

Regarding the control variables, we document that during flexible exchange rates, monetary policy as proxied by inflation plays an important role in the determination of financial variables. For example, there is a strong positive inflation effect for interest rates (real and nominal) whereas for equities and bonds the effect is admittedly less pronounced, though still statistically significant (Viceira, 2012). Another result drawn from the tables is that for equities the dividend yield ratio plays an important role with the expected positive sign, which supports results in the extant financial literature (Campbell et al. 1998, Hodrick 1992 and Nelson and Kim 1993, among others). In addition, in line with Fama and Schwert (1977), we find that inflation is negatively related to equity returns for the Bretton Woods period, though the result is not statistically significant. As for persistence, the first lag turns out to be significant but mainly for interest rates, a result that corroborates with important contributions in the broader literature (for example, Campbell and Yogo 2006).

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.

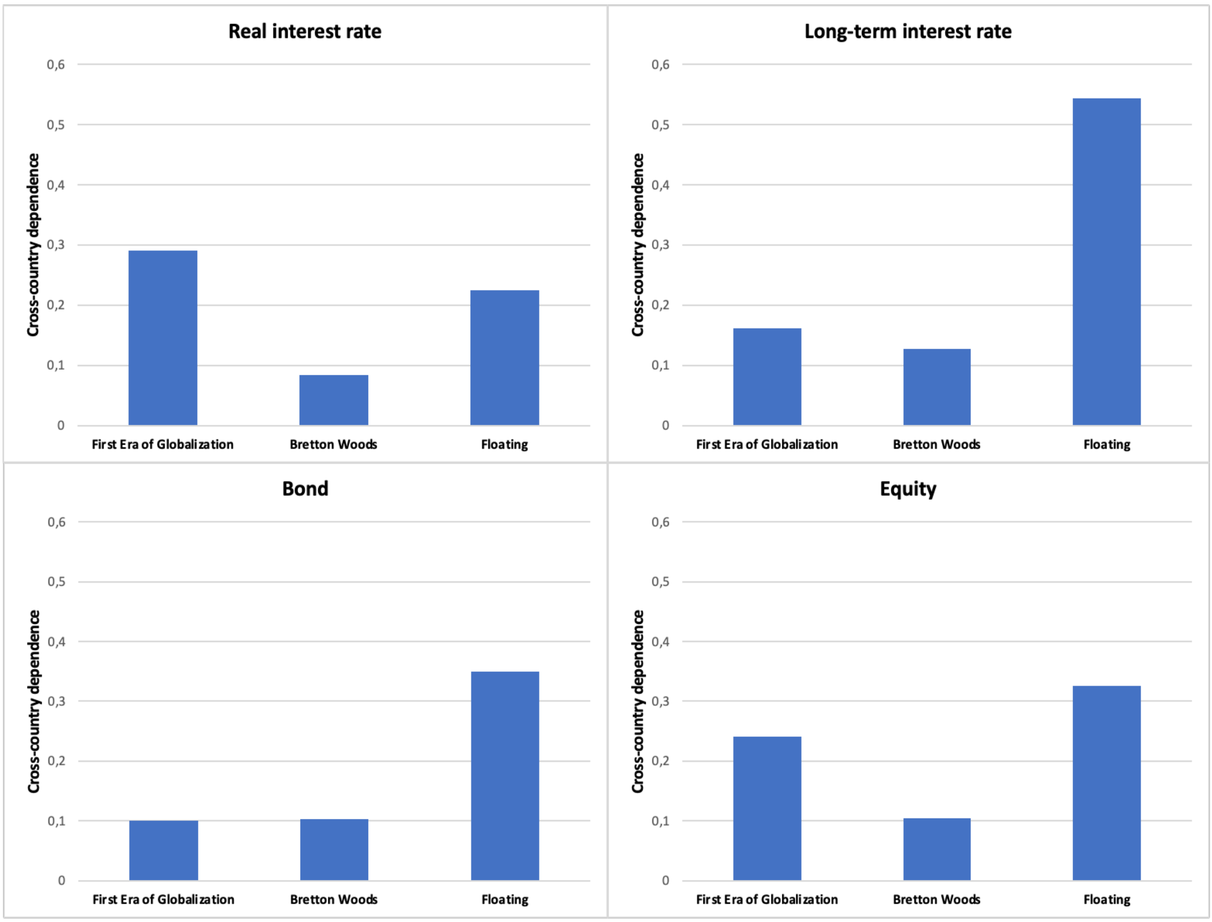

Figure 1. The figure displays the results of cross-country dependence in three different sub-periods: the First Era of Globalisation (1870-1913), the Bretton Woods Monetary System (1950-1973), and Floating Exchange Rates (1974-2016).

Focusing on the cross-country measure of dependence, we aim to identify whether the long-run temporal pattern of financial market integration follows a U-shaped (proposed by Obstfeld and Taylor 2003, 2004) or a J-shaped (put forward by Volosovych 2011) or a "swoosh" pattern (as termed by Bekaert and Mehl, 2019) the last 150 years. In consequence, this framework can allow us to explicitly distinguish the different patterns of the global financial market integration.

An illustrative perspective of our analysis is provided by Figure 1 which shows the cross-country dependence estimates for the selected periods under study. The findings for the real interest rates show clear evidence of the U-shaped pattern supporting Obstfeld and Taylor (2003) hypothesis. However, for equity markets, the temporal pattern of global financial market integration is rather swoosh-shaped in line with Bekaert and Mehl (2019). Moreover, our analysis of long-term interest rates and bond markets claims that after the collapse of the Bretton Woods financial markets became considerably more integrated with average cross-country dependence surpassing the levels of the pre-1914 period. Thus, for bonds and long-term interest rates, we trace out a J-shaped pattern of financial integration over time. This latter result firmly supports Volosovych (2011), who also looks at sovereign bond markets.

It is worth pointing out that Bekaert and Mehl (2019) study of equity markets altogether rejects the existence of other shapes hypothesized in the earlier literature (Obstfeld and Taylor 2003 and Volosovych 2011) such as the U-shaped and J-shaped patterns and proposes the "swoosh" pattern. Instead, we emphasize the presence of all three different shapes indicating that during the First Era of Globalization, equities were more integrated into global financial markets than bonds.

3.3 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. Specifically, 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).

As expected, and in line with the results reported in Ditzen (2018), both the Bias and the RMSE values decrease as the number of time-series observations increases from 20 to 40. Moreover, the number of cross-sectional units does not greatly affect the results. Overall, we conclude that the DCCE model performs well even in relatively small samples.

4. Summing up

In this paper, we reconsider the U-shaped, J-shaped and swoosh-shaped patterns in international financial market integration from the late nineteenth century to the present era. To this end, we adopt a flexible econometric framework to explicitly measure cross-country dependence in several financial variables with the aim to answer the question of whether there was an increase in financial integration in global markets after the Bretton Woods era compared to the earlier periods of the heyday of financial integration (1870-1913) and of the Bretton Woods.

Our overall assessment of financial market integration over time is at best mixed. In some cases, the financial integration of the pre-1913 era remains unsurpassed, but in others, today’s financial markets are more closely integrated than those of the past. Specifically, 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). At the same time, by examining real interest rates, our study corroborates with the earlier literature's proposition of a U-shaped trend in international financial markets (Obstfeld and Taylor 2003, 2004 and Goetzmann et al., 2001). As for equities, we confirm a swoosh-shaped pattern in financial integration, which aligns with the research of Bekaert and Mehl (2019).

As for future research, we aim to obtain higher frequency data and investigate financial crises (e.g., banking, exchange rate or debt crises) and their international transmission mechanism across countries. In particular, it would be interesting to model the probability of a country (or a group of countries) being jointly in a financial crisis and to pin down the major determinants of such a crisis.

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