A Comprehensive Analysis of the Evolution of Global Financial Integration: Japan as a Case Study

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Abstract

We conduct a comprehensive examination of the evolution of global financial integration from the classical Gold Standard era to the 21st century, with a special focus on Japan as a case study. This allows us to compare Japan's role with that of other advanced countries in the ongoing process of global financial integration initiated during the first era of financial globalization. Unlike previous literature that has mainly focused on a single asset class, we examine financial integration using data on equity, bonds, and housing. To achieve our objective, we compute a set of financial integration indices that allow us to describe the dynamics of financial integration over time and identify vulnerable and systemic countries in the integration process. Hence, our approach enables us to elucidate Japan's role in comparison to key players in the integration process. First, regarding the global financial integration, our results show a higher and more volatile level of integration for stocks and bonds, respectively, compared to housing returns. However, there are notable differences in the dynamics of stocks and bonds integration level. Stock integration exhibits a swoosh-shaped pattern, while bond integration follows a J shaped pattern or L-inverted shaped pattern. In contrast, housing returns exhibits a consistently low and stable level of integration. Second, results at the country level show a high heterogeneity across countries, asset classes, and time periods. Japan provides a particularly interesting case study, exhibiting the most isolated stock and bond markets. However, during the second era of financial globalization, Japan's integration with European economies increased significantly.

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Keywords: Global financial integration; stock returns; bond returns; housing returns; Japan

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1. Introduction

Global capital market integration has importantly increased over the last three decades. Even after considering the reversal periods accompanying the Russian, Asian and Latin American crises at the end of the 20th century, and the Global Financial Crisis, European Debt and Covid19 crises, in the first two decades of the 21st century, this increased trend in globalization is notorious (e.g., Aizenman et al., 2010, 2022; Chinn and Ito, 2006, 2022). Financial integration has the potential to yield various benefits for countries and market participants. For example, the latter obtain larger investment opportunities and better chances for risk sharing, while the former benefit in terms of deeper financial markets and economic resilience. Financial openness has proven effective in increasing consumption opportunities and risk sharing, and in reducing the volatility of consumption growth (Bekaert et al. 2006). Moreover, risk sharing is a key channel through which financial integration improves the resilience of the global financial system. But, the benefits of financial integration are not cost-free. In a more financially integrated world, national policies and relevant financial events may have important cross-border effects. Over the past three decades, crises have become frequent, spreading at a faster rate. These crises now impact a larger number of countries and exhibit greater persistence and disruption.

These new patterns do not necessarily imply that global capital market integration is unprecedented. An increasing number of publications have ventured to adopt a more systematic historical approach to global financial integration. However, the evidence provided by this literature is still contested regarding whether financial integration was higher during the first era of financial globalization compared to the modern era of financial globalization (see Bordo et al., 1999; Mauro et al., 2000; Goetzmann et al., 2005; Bordo and Murshid, 2006; Volosovych, 2011; Bekaert and Mehl, 2019; among others). Thus, inspired by these previous studies, we conduct a comprehensive examination of the evolution of global financial integration from the classical Gold Standard era to the 21st century, with a special focus on Japan. This allows us to compare Japan's role with that of other advanced countries in the ongoing process of global financial integration initiated during the first era of financial globalization. This analysis remains extremely relevant for understanding both the opportunities and the challenges of financial globalization for the rest of the Asian economies, as they increasingly integrate into the global capital market.

To carry out our analysis we focus on 16 advanced economies and 3 asset classes (equity, bonds, and housing) and compute a set of indices of financial integration. The key strengths of our indices of financial integration are (1) that they describe the level and dynamics of financial integration over time; (2) even most importantly, they allow us to identify vulnerable, systemic and isolated countries in the integration process; and (3) we can use them to uncover the role of Japan as a receiver or transmitter of shocks from/to the rest of the examined markets.

Our paper is related to a well-established branch of the economic history literature that empirically studies financial integration during the classical Gold Standard. Obstfeld and Taylor (2005) pointed to the Gold Standard as the driving factor in the convergence of interest rates across countries and provide evidence of a U-shaped trend line in global capital mobility. Using bond yield spreads, Mauro, et al. (2002) show that yield spreads are higher and more volatile in the 1990s than they were in the pre-World War I period. Bordo and Murshid (2006) suggest that financial market shocks were more globalized before 1914 compared to the present. Contrary, Volosovych (2011) studied the integration of sovereign bond markets using principal component analysis and concludes that there is a clear evidence of greater integration at the end of the 20th century than prior to World War I. Their results also show that that global financial integration is rather characterized by a J-shape pattern, with a trough in the 1920s.

The above-mentioned studies focus mainly on debt markets. But there is also a large body of literature that analyze stock market integration from the classical Gold Standard era. For example, Goetzmann et al. (2005) examine the correlation structure of the major world equity markets over 150 years and find that correlations vary considerably through time and are highest during periods of economic and financial integration such as the late 19th and 20th centuries. Campbell and Rogers (2017) conclude that domestic securities on the London and New York Stock Exchanges showed little sustained integration during the pre-First World War period, even when controlling for the different characteristics of stocks. Using stock market data, Bekaert and Mehl (2019) propose a measure of financial market integration based on a factor model of equity returns computed back to the first era of financial globalization for 17 countries. They conclude that global financial integration follows a "swoosh" shape – high pre-1913, higher post-1990, low in the interwar period – rather than other shapes hypothesized in earlier literature. Finally, using data on 8 Stock Exchanges, Stuart (2024) investigates stock market integration during the classical Gold Standard by estimating 'global components' of stock market returns. Results show that integration increased during the first decades of the Gold Standard before levelling off thereafter, however, the level of integration was low compared to today. Overall, the evidence provided by the previous literature is not conclusive as to whether financial integration was higher during the first era of financial globalization compared to the modern era of financial globalization.

Our proposal is novel in two respects. First, contrary to the previous literature that has mainly focused on one asset class, we examine financial integration using the Jordà-Schularick-Taylor Macrohistory Database provided by Jordà et al. (2019), which includes data on total returns for equity, bonds, and housing of 16 advanced economies from 1870 to 2020. Former studies on global financial integration focused on long-term government bonds or interest rates and, subsequently on stock markets, separately. However, the degree of integration may differ across different asset classes. Thus, our analysis using data on equity, bonds and housing will shed new

light on the process of global financial integration allowing us to assess and compare the level of integration of each asset class.

Our second contribution is related to the methodological approach. We use the spillover index approach proposed by Diebold and Yilmaz (2009 and 2012) to explore global financial integration. This entails incorporating market prices into Vector Autoregression (VAR) systems and computing rolling window statistics based on forecast error variance decompositions. Overall, this approach provides measures of the intensity of linkages across markets and allows the decomposition of spillover effects (total spillover, directional spillovers and net spillovers). Thus, it allows us to explore the evolving nature of financial integration, a characteristic mainly overlooked in the previous literature. Most importantly, it is possible to identify vulnerable, systemic and isolated countries in the integration process. Hence, it enables us to elucidate Japan's role in comparison to key players in the integration process. The resulting indicators allow us to examine various facets of financial integration in the long term, in a fashion not achievable using *de jure* or *de facto* indicators of integration found in the literature, such as Chinn and Ito's (2006) indexes, statistics on asset holdings by foreigners, or flows of direct and indirect foreign investment. This limitation arises either due to insufficient historical data to construct these statistics or because they fail to adequately capture all facets of financial integration, or both. In short, our methodology enables the exploration of previously uncharted territory regarding the nature of global financial integration

Our results provide clear evidence on the dynamic nature of global financial integration. We find a large variability in the integration index for stocks and bonds, respectively, fluctuating mostly between 55% and 90%. The level of integration starts at high levels during the Gold standard era (pre-1913) and it is still higher during the second era of financial globalization (1991-2020). Nevertheless, the dynamics of stock and bond integration levels reveal noteworthy differences between 1930-1990. Bond integration is higher during the Great Depression until the late 70s. But, interestingly, the common upward trajectory in integration after this period starts earlier in stocks, around 1980, in contrast to bonds, which begins around 1990. In fact, we find that stock integration follows a swoosh-shaped pattern, while bond integration follows a J or L-inverted shaped pattern.

Unlike equities and bonds, housing returns have exhibited a consistently low and stable level of connectedness, ranging from 55% to 63%. This may be attributed to the fact that housing assets are less globally tradable than equities and are more susceptible to idiosyncratic country-level shocks. From the perspective of international diversification, the ideal investor would like to hold an internationally diversified portfolio of real estate holdings, even more so than equities. Indeed, the disparity in the integration levels of housing returns and those of stocks and bonds becomes more evident, particularly during the second era of globalization (1990-2020).

Interestingly, results at the country level show a high heterogeneity across countries, asset classes, and time periods. Japan provides a particularly interesting case study, exhibiting the most isolated

stock and bond markets. However, during the second era of financial globalization, Japan's integration with European economies increased significantly.

The remainder of the paper is organized as follows. In Section 2 we present the empirical framework we use to analyse global financial market integration. In Section 3 we present the data. Results are in Section 4. Finally, in Section 5, we provide some concluding remarks.

2. Methodology

We employ the methodological framework of Diebold and Yilmaz (2009, 2012) to construct spiilover and connectedness statistics within stocks, government bonds and housing returns. Their approach builds on the seminal work on Vector Autorregressive models (VAR) by Sims (1980) and the notion of variance decomposition. The starting point for the analysis is the following VAR(p):

$$y_t = \sum_{i=1}^{p} \Phi_i y_{i-1} + \varepsilon_t \quad (1)$$

where $y_t = (y_{1,t}, y_{2,t}, ..., y_{N,t},)$ is a vector of endogenous variables (asset returns), $\mathbf{\Phi}_i$ is an *NxN* matrix of parameters to be estimated, and ε_t is a vector of independently and identically distributed disturbances with zero mean, and Σ covariance matrix. If the VAR model is covariance stationary, we can derive the moving average representation of model (1), which is given by:

$$y_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \quad (2)$$

where $A_i = \Phi_1 A_{i-1} + \Phi 2 A_{i-2} + ... + \Phi_p A_{i-p}$, A_0 is the *NxN* identity matrix and $A_i = 0$ for *i<0*. A transformation of coefficients in the moving average representations can be used to identify variance decompositions. Variance decomposition allows us to decompose the h-step ahead forecast error variance into *own variance shares*, the fraction of the forecast error variance in forecasting y_i due to shocks to y_i, for i=1, 2, …, N, and cross variance shares, or spillovers, the fraction of the forecast error variance in forecasting y_i due to shocks to y_j for j=1, 2, …, N and $j \neq i$.

Diebold and Yilmaz (2009) proposed using Cholesky decomposition to decompose the variance. However, Cholesky decomposition is sensitive to ordering. Diebold and Yilmaz (2012) resolve this ordering problem by exploiting the generalized VAR framework of Koop et al. (1996) and Pesaran and Shin (1998), KPSS, in which variance decomposition is invariant to the ordering of the variables. Variable j's contribution to i's H-step ahead generalized forecast error variance decomposition is given by:

$$\theta_{ij}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i' A_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (e_i' A_h \Sigma A_h' e_i)} \quad (3)$$

where Σ is the estimated variance matrix of the error vector ε, σ_{jj} is the (estimated) Standard deviation of the error term for the variable *j*, and e_i is a selection vector with one as the *i*-th element and zeros otherwise. When applying the KPSS decomposition, the summation of the own and cross-variable variance contributions shares does not sum to one, thus we normalize each entry of the variance decomposition matrix as:

$$\tilde{\theta}_{ij}(H) = \frac{\theta_{ij}(H)}{\sum_{j=1}^{N} \theta_{ij}(H)} \quad (4)$$

where $\sum_{j=1}^{N} \tilde{\theta}_{ij}(H) = 1$ and $\sum_{i,j=1}^{N} \tilde{\theta}_{ij}(H) = N$.

The KPSS variance decomposition allows us to compute the following spillover measures:

(1) The *total spillover index,* which measures the contribution of spillovers of shocks across all markets to the total forecast error variance:

$$S(H) = \frac{\sum_{i,j=1, i \neq j}^{N} \tilde{\theta}_{ij}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{ij}(H)} \text{x } 100 \quad (5)$$

(2) The *directional spillovers* received by market *i* from all other markets *j* :

$$S_{i\bullet}(H) = \frac{\sum_{j=1, i \neq j}^{N} \tilde{\theta}_{ij}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{ij}(H)} \text{x } 100 \quad (6)$$

(3) The *directional spillovers* transmitted by market *i* to all other markets *j* :

$$S_{\bullet i}(H) = \frac{\sum_{j=1, i \neq j}^{N} \tilde{\theta}_{ji}(H)}{\sum_{i,j=1}^{N} \tilde{\theta}_{ji}(H)} \text{x } 100 \quad (7)$$

(4) The *net spillover*, namely the difference between the gross shocks transmitted to and those received from all other markets, which identifies whether a market is a receiver/transmitter of shocks from/to the rest of the examined markets. The net spillover index from market *i* to all other markets *j* is obtained by subtracting equation (6) from equation (7):

$$NS_i(H) = S_{\bullet i}(H) - S_{i\bullet}(H) \quad (8)$$

(5) The *net pairwise spillover* between markets *i* and *j,* which shows which market is a receiver/transmitter of shocks between two markets:

$$NS_{ij}(H) = \frac{\tilde{\theta}_{ji}(H) - \tilde{\theta}_{ij}(H)}{N} \text{ x } 100 \tag{9}$$

Finally, we estimate the following model to examine the effect (if any) of financial crises episodes on our indexes of financial integration:

$$S(H)_t = \alpha_t + \beta_1 D_{Ct} + \varepsilon_t \tag{10}$$

The dependent variable, $S(H)_t$, is the total spillover index and D_{Ct} is a dichotomous variable that equals 1 during financial crises episodes. This will allow us to explore whether episodes of financial crises coincide with reversals in the process of financial integration or have no discernible effect. We estimate the model using the Ordinary Least Squares (OLS) method with Newey and West (1986) heteroskedasticity and autocorrelation consistent standard errors.

3. Data

We use the Jordà-Schularick-Taylor Macrohistory Database provided by Jordà et al. (2019). This database includes annual data on total returns for equity, government bonds and housing of 16 advanced economies from 1870 to 2020.[4] Thus, our dataset spans 151 years of economic history.[5] The database captures the near-universe of advanced-country macroeconomic and asset price dynamics, covering on average over 90 percent of advanced-economy output and over 50 percent of world output. The countries covered are Australia, Belgium, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States[6].

We impute missing values in the original database using an iterative procedure based on the Expectation Maximization (EM) algorithm combined with Principal Components Analysis (PCA), due to Josse and Husson (2012) and implemented by Josse and Husson (2016) in the statistical software R. Figure 1A in the Appendix provides a visual representation of the number

[4] We refer to https://www.macrohistory.net/database/ for details on the construction of total returns for equity, government bonds and housing.

[5] For housing total returns, the sample period starts in 1900 due to a significant number of missing values at the beginning of the dataset.

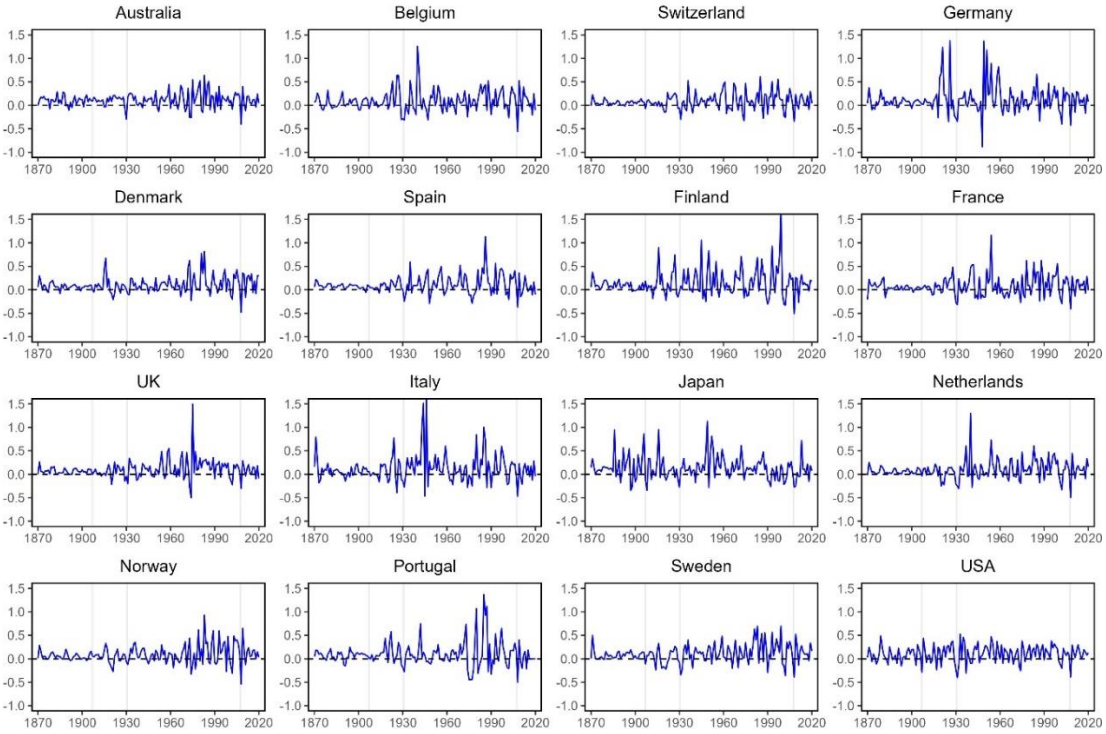
[6] We impute missing values in the original database using an iterative procedure based on the EM algorithm combined with PCA. Figure 1A in the Appendix provides a visual representation of the number of missing values over the sample period. As expected, there is a higher occurrence of missing values at the start of the sample period.

of missing values over the sample period. As expected, there is a higher occurrence of missing values at the start of the sample period.

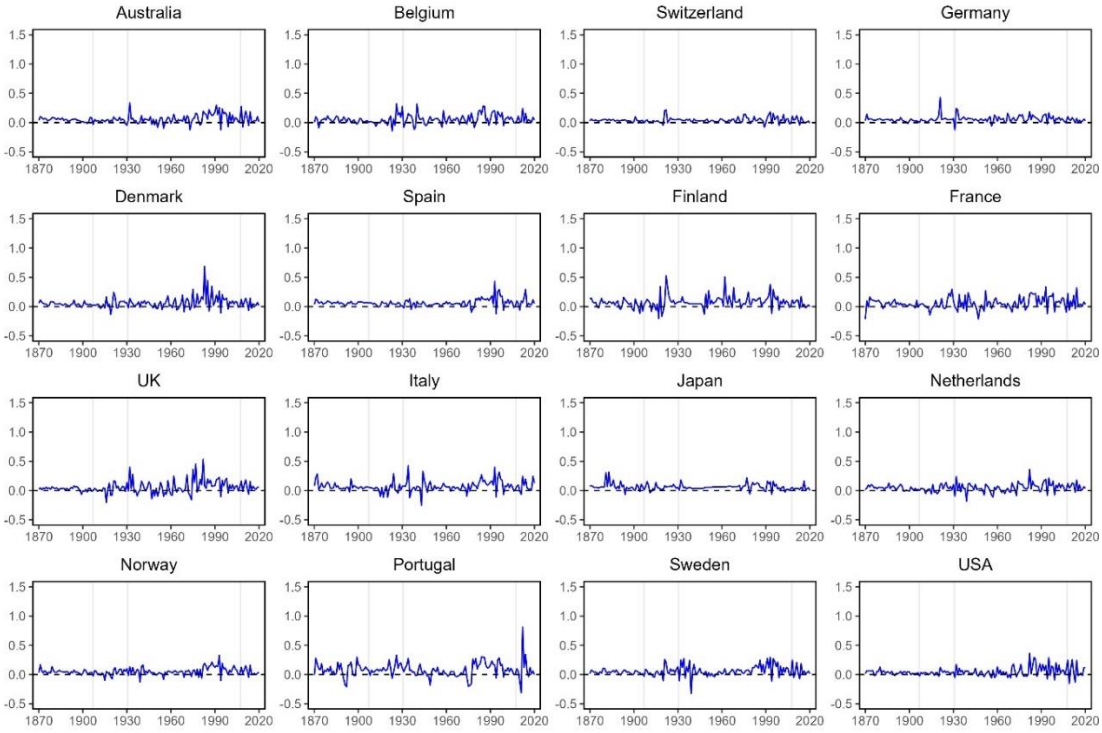
Figure 1 show the evolution of annual equity, bond and housing returns during the sample period. An initial noteworthy observation is the comparability of housing and equity returns, with housing exhibiting significantly lower volatility. Moreover, in the late 19th century until World War I, both equity and bond returns generally remained low and stable. However, post-World War I, there was a sharp increase in the volatility of equity and bond returns. In contrast, housing returns demonstrated remarkable stability, particularly during the period from 1990 to 2020, commonly denoted as the second era of financial globalization.

Figure 1. Annual return series

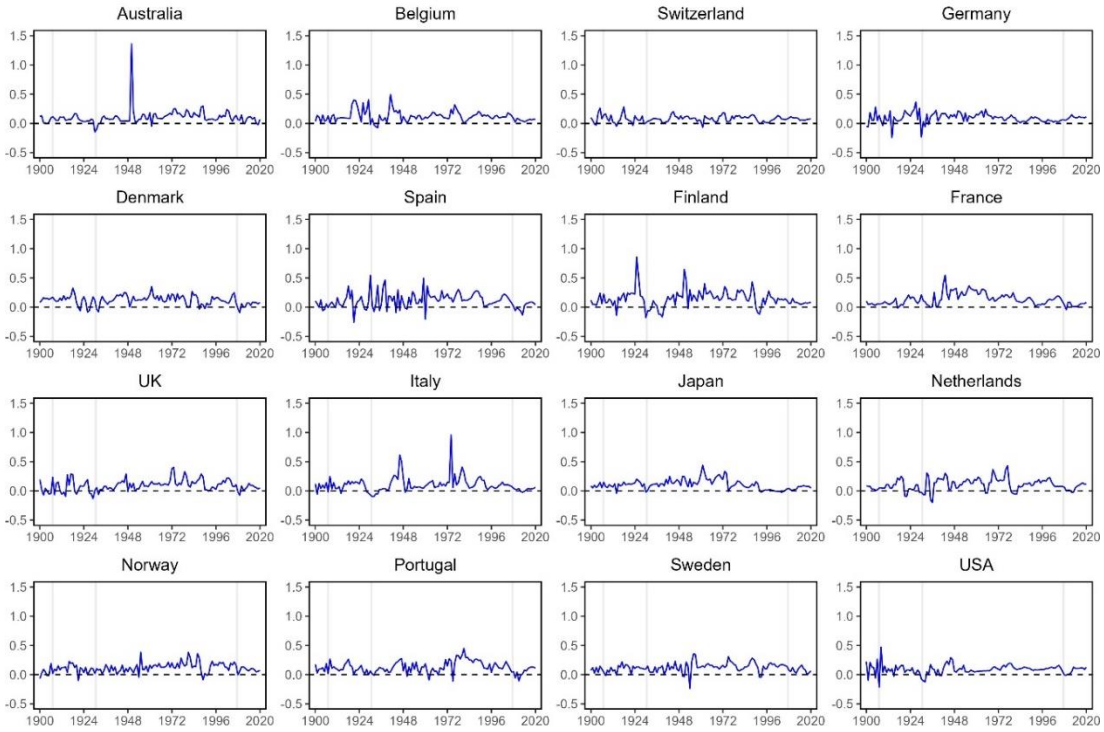
Panel A. Equity returns



Panel B. Bond returns



Panel C. Housing returns



Note: The sample period spans from 1870 to 2020 for bond and equity returns and from 1900 to 2020 for housing returns. Shaded areas highlight periods of financial crises, as defined by Jordà et al. (2011): the panic of 1907, the Great Depression of 1930-31, and the Global financial crisis of 2007-08.

Table 1 displays the average annual percentage return and the corresponding standard deviation for equities, bonds, and housing across countries for the full sample and five distinct subperiods. Period I, spanning from 1870 to 1913, marks the first era of financial globalization (Classical gold standard). Period II, encompasses the years 1914 to 1939, covering the retreat period. Period III spans from 1940 to 1971, the Bretton Woods era. Period IV covers the Bretton Woods' immediate aftermath from 1972 to 1990. Finally, Period V, from 1991 to 2020, is commonly known as the second era of financial globalization. The findings align with the visual insights from Figure 1.

Average annual returns for equity and housing appear similar, yet housing exhibits notably lower volatility. This pattern holds true for the entire sample period as well as each of the five subperiods. Bonds consistently demonstrate lower returns and volatility compared to risky assets. Moreover, there is evident heterogeneity among individual countries. In the case of equities (Panel A), both returns and volatilities are higher during Periods III, IV and V (1940-2020). Period IV, in particular, witnesses considerably high volatility. There is a group of Southern European countries (Italy, Spain and Portugal), some of the Nordic countries (Finland

and Norway) as well as the UK with volatilities above average. But, very notably, there are some countries that stand out for higher returns in the first period, and Japan is among them.

Japan experiences the highest average annual return in Periods I (14.66), and III (21.71) but the lowest in Period V (2.77). This trend in annual returns during Period I correlates with Japan's industrialization process initiated during the Meiji era (1868-1912) and its subsequent intensification at the beginning of the Taisho era (1912-1926) due to the dynamism of its export industry (Ito and Hoshi, 2023).

In relations to the Period III, first Japan confronted economic challenges stemming from the devastation of its industrial sector in World War II. But it swiftly entered a phase of rapid economic expansion, with an approximately 10% average real growth of the economy from the mid 1950s to the early 1970s. By 1970, Japan had emerged as the world's second-largest economy after the United States (Ohno, 2017). This pattern resembles that of Germany and Italy, the other two high-growth economies, which also experienced exceptionally high returns in Period III (17.61 Germany and 20.79 Italy). Thus, in Period III, high-growth economies exhibit high average annual returns in the stock market.

However, in Period V (1991-2020), Japan faced the consequences of the so-called "Lost Two Decades" (1992-2012), characterized by low economic growth following the burst of its housing and stock market bubble in the 1980s. During the 1980s the financial markets were deregulated and the yen appreciates in relation to the dollar, so the asset prices skyrocketed. But at the early 1990s, the asset prices collapsed and the Japanese economy entered in a long period of financial problems (Ito and Hoshi, 2023). Even if the context and causes can be different, it was not the only economy that developed a similar performance. For instance, we can compare it with the Finish case study. In Finland during the second era of financial globalization, the average return and volatility for equity are remarkably high at 18.13 and 40.77, respectively, attributed to the economic performance of Finland. Since the early 1980s, financial liberalization in Finland facilitated significant international capital flows into the economy. But coinciding with the beginning of the second era of globalization, between 1989 and 1991, the Finnish financial system and economy faced challenges such as rising interest rates and the collapse of the Soviet Union, which was one of its main trading partners. In subsequent years, Finland saw a rise in non-performing loans, leading to the government interventions to rescue several banks (Jonung et al. 2009).

Turning our attention to bonds (Panel B), bond returns across all countries remained consistently low and stable during Period I. Periods IV and V are marked by increased returns and variability. Notably, Japan distinguishes itself by having the lowest bond volatility during Periods II and III, in comparison to period IV and in contrast with most of the studied countries, specially Portugal which stands out as the country with the highest bond volatility in the second era of globalization.

In Japan, the bond market played a minor role in the financial market until recently. During the first era of globalization, some government bonds were issued to support war efforts. In the post-WWII period, particularly during the 1950s and 1960s, the government budget was generally in surplus, and no government bonds were issued until 1965. Additionally, until the mid-1970s, the Japanese bond market was limited to large Japanese banks, with no secondary bond market. Deregulation of the government bond market began in the 1970s, followed by the deregulation of the corporate bond market (Ito and Hoshi, 2023). Since the 1990s, Japan's budget deficit to GDP ratio has been the worst among the G7 countries, leading to the continued issuance of government bonds, although returns have remained relatively constant and low.

Both housing returns and volatility (Panel C) show an increase in Periods III and IV. Housing returns and volatilities demonstrate a closer resemblance in Periods I and V (first and second era of financial globalization, respectively), in contrast to equities and bonds, where lower levels were observed in Period I. In the case of Japan, before the high growth period, the lifestyle of the Japanese people in terms of housing changed very slowly and people lived mainly in wooden houses. By the 1960s and 1970s, Japan's housing system began to change dramatically, leading to increased returns in Periods III and IV.

During the second era of globalization, housing returns consistently exhibit the lowest volatility across all countries, as compared to equities and bonds. Again, Japan stands out as noteworthy, with the lowest housing returns in Period V. This likely reflects the significant Japanese housing bubble burst of the preceding boom in the 1980s. and the consequences of the "Lost Two Decades" (Ohno, 2017).

Table 1. Descriptive statistics.

Panel A. Equity returns. Descriptive statistics

	Total Period 1870-2020		Period I 1870-1913		Period II 1914-1939		Period III 1940-1971		Period IV 1972-1990		Period V 1991-2020	
	Mean	Std.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std.	Mean	Std.	Mean	Std.
Australia	11.36	15.69	10.17	8.61	10.80	12.11	10.55	14.51	16.67	29.15	11.09	16.20
Belgium	9.36	22.48	5.45	10.20	8.19	27.51	11.93	29.14	14.42	22.36	10.16	23.26
Switzerland	8.06	16.65	5.62	5.40	4.61	17.21	11.28	17.82	7.92	23.97	11.25	19.94
Germany	12.26	29.39	7.29	9.12	16.77	41.72	17.61	42.93	11.56	22.17	10.37	21.82
Denmark	10.80	17.62	7.09	6.86	8.38	18.34	8.40	10.40	21.93	29.44	13.88	21.65
Spain	10.72	18.82	7.20	4.94	8.91	15.59	13.48	18.25	16.35	32.74	10.93	22.67
Finland	14.80	27.74	8.51	9.34	15.34	26.70	17.48	29.05	18.87	30.60	18.13	40.77
France	8.24	21.15	5.27	8.26	6.47	17.55	8.26	29.66	13.98	29.23	10.49	20.80
UK	9.93	19.24	6.27	5.77	6.06	14.52	12.71	19.19	20.50	38.93	9.02	15.28
Italy	12.18	29.54	6.78	14.86	11.16	25.65	20.79	44.44	16.09	37.09	9.30	22.56
Japan	13.37	24.92	14.66	26.73	10.41	22.75	21.71	28.23	17.14	18.15	2.77	20.94
Netherlands	9.57	20.39	6.45	6.20	3.52	19.53	13.18	28.97	14.84	22.24	12.20	21.76
Norway	8.90	19.42	5.70	6.58	6.44	15.75	6.28	13.38	16.37	32.72	13.78	26.96
Portugal	9.56	26.35	6.79	8.14	10.44	19.28	9.15	16.65	18.90	60.00	7.38	23.80
Sweden	10.97	19.70	7.93	9.24	2.41	20.47	12.04	15.97	20.68	27.57	15.55	24.72
USA	10.53	17.69	7.70	15.36	10.46	24.85	12.62	16.11	12.37	17.29	11.34	15.93
Unweighted average	*10.66*	*21.67*	*7.43*	*9.73*	*8.77*	*21.22*	*12.97*	*23.42*	*16.16*	*29.60*	*11.10*	*22.44*

Panel B. Government bond returns. Descriptive statistics

	Total Period 1870-2020		Period I 1870-1913		Period II 1914-1939		Period III 1940-1971		Period IV 1972-1990		Period V 1991-2020	
	Mean	Std.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std.	Mean	Std.	Mean	Std.
Australia	5.79	7.27	4.49	2.88	4.54	6.71	3.91	5.59	9.11	9.02	8.69	10.68
Belgium	5.55	8.04	3.23	4.23	5.02	10.99	5.50	7.32	8.32	10.46	7.70	7.75
Switzerland	4.10	4.25	3.41	1.81	4.71	5.47	3.45	2.08	4.30	5.39	5.17	6.12
Germany	5.71	5.46	4.02	2.52	7.89	9.54	5.39	4.17	7.19	5.01	5.73	4.72
Denmark	6.09	9.40	3.93	2.97	5.14	7.68	4.56	6.91	13.78	19.04	6.82	8.18
Spain	6.43	6.43	6.17	2.25	4.48	4.36	4.50	2.24	8.19	7.27	9.43	11.51
Finland	7.56	10.22	4.94	6.54	8.21	14.77	9.61	11.55	8.66	6.42	7.93	10.20
France	5.64	9.66	4.15	6.01	4.47	11.08	3.40	9.28	9.75	10.40	8.60	11.57
UK	5.30	10.39	2.50	2.77	4.49	11.98	3.11	9.89	12.44	17.42	7.92	8.52
Italy	7.19	9.18	6.88	5.61	4.27	11.77	5.83	8.57	9.89	7.87	9.89	11.44
Japan	6.09	5.35	6.91	7.05	5.98	3.96	5.60	1.27	7.01	6.35	4.91	5.54
Netherlands	4.81	6.97	3.95	3.60	3.62	8.75	2.91	6.03	7.50	9.26	7.41	7.47
Norway	5.22	6.26	4.27	3.43	3.67	6.63	3.87	4.38	8.59	7.99	7.26	8.35
Portugal	8.09	12.52	7.65	9.99	10.94	8.77	2.41	6.25	11.70	15.95	10.05	18.47
Sweden	5.84	8.43	3.81	3.19	6.14	13.17	3.61	4.55	9.15	6.28	8.81	11.33
USA	4.76	7.77	3.28	2.83	4.17	4.66	2.61	5.87	8.30	12.06	7.48	11.41
Unweighted average	*5.88*	*7.97*	*4.60*	*4.23*	*5.48*	*8.77*	*4.39*	*6.00*	*8.99*	*9.76*	*7.74*	*9.58*

Panel C. Housing returns. Descriptive statistics

	Total Period 1900-2020		Period I 1900-1913		Period II 1914-1939		Period III 1940-1971		Period IV 1972-1990		Period V 1991-2020	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std.	Mean	Std.	Mean	Std.
Australia	10.28	13.44	6.69	4.58	5.50	6.62	13.26	23.15	17.05	6.55	8.62	5.62
Belgium	12.09	9.27	8.14	5.24	13.56	14.19	13.90	9.03	14.08	8.43	9.48	3.96
Switzerland	7.91	5.59	8.74	8.31	6.49	6.58	8.18	5.18	10.87	4.23	6.58	3.41
Germany	9.71	9.32	7.81	10.07	9.70	13.13	14.19	10.21	7.28	3.72	7.36	3.44
Denmark	11.83	8.20	13.57	3.13	9.39	10.13	15.94	6.25	12.26	9.76	8.48	6.86
Spain	11.16	12.98	4.28	6.19	11.48	18.70	13.84	13.50	18.64	6.63	6.50	8.12
Finland	14.43	14.29	9.65	5.78	12.27	22.25	19.59	12.88	20.67	10.56	9.10	7.58
France	13.26	10.00	6.01	1.91	9.09	7.37	24.25	9.99	15.23	4.70	7.30	5.63
UK	9.36	9.78	3.34	10.21	5.79	10.94	10.82	6.07	18.58	10.69	7.85	6.78
Italy	10.70	13.11	7.64	7.43	5.81	9.34	13.83	13.37	21.34	20.60	6.27	5.03
Japan	10.62	8.55	7.80	2.64	10.09	5.15	18.46	8.85	12.33	8.37	2.96	3.79
Netherlands	10.63	10.32	5.62	3.15	6.89	13.47	15.35	9.06	12.03	12.54	10.29	6.64
Norway	11.47	8.39	6.54	7.09	9.48	7.18	11.55	7.48	16.95	11.62	11.94	6.74
Portugal	12.84	9.79	11.51	6.81	9.58	6.13	11.62	9.50	25.09	10.78	9.85	7.43
Sweden	11.87	7.91	7.34	4.46	10.84	5.39	12.83	10.63	16.99	6.97	10.63	6.59
USA	9.04	8.15	10.22	16.81	5.69	7.85	9.45	6.99	12.27	3.49	8.90	4.18
Unweighted average	*11.08*	*9.94*	*7.81*	*6.49*	*8.85*	*10.28*	*14.19*	*10.13*	*15.73*	*8.73*	*8.26*	*5.74*

This table reports the mean and standard deviation of returns for equities (Panel A), government bond (Panel B) and housing (Panel C). Period I, spanning from 1870 to 1913, marks the first era of financial globalization (Classical gold standard). Period II, encompasses the years 1914 to 1939, covering the retreat period. Period III spans from 1940 to 1971, the Bretton Woods era. Period IV covers the Bretton Woods' immediate aftermath from 1972 to 1990. Finally, Period V, from 1991 to 2020, is commonly known as the second era of financial globalization. Unweighted average refers to the arithmetic mean of individual country returns and standard deviations, respectively.

4. Results

The spillover measures for returns presented in section 3.2. are calculated from the estimation of a VAR(1) model, based on the Akaike Information Criterion (AIC), for a 1-step ahead forecast horizon. First, we show the static or full-sample analysis and then we show the rolling window analysis.

5.1. Full sample analysis

Table 2 reports the full sample cross country return spillovers for equities (Panel A), bonds (Panel B) and housing (Panel C). The diagonal elements represent the own-country spillovers while the off-diagonal elements measure the pairwise return directional spillovers. The off-diagonal column sums (labelled TO) and row sums (labelled FROM) gives the total directional spillovers to all others from country *i* and from all others to country *i*, respectively. Finally, the bottom-right element (in boldface) is the total spillover, which is calculated as the sum of the non-diagonal elements of the spillovers matrix, divided by number of markets.

As can be observed in Panel A, the total spillover indicates that on average, across our entire sample, 67.64% of equity return forecast error in all countries comes from spillovers, which gives an idea of the global integration level. In the case of bonds (Panel B) and housing (Panel C), the total spillovers equal 71.07% and 25.67%, respectively. These figures highlight the first empirical evidence, equity and bond markets, respectively, have been highly integrated during our sample period (respectively) and housing markets have been far much more less integrated (74.33% of the variation is due to idiosyncratic shocks). This may be attributed to the fact that housing assets are less globally tradable than equities and bonds and are more susceptible to idiosyncratic country-level shocks.

Looking at Panel A, we observe that own-country equity return spillovers (the diagonal elements) fluctuate between 68.55 for Japan (followed by far by Germany with 39.84 and Italy with 38.43) and 21.57 for Sweden. Japan is the most disconnected from the others, as shown by the high percentage of self-generated forecast error variance and the low contribution *from* (31.45)/*to* (10.98) others. Interestingly, Japan is the only country where the own spillover is higher than any total directional connectedness *from* and *to* others, suggesting that returns in the other countries are somewhat dependent of each other. Namely, shocks that affect to the equity returns of a particular country extensively spread on the equity returns of the other countries. This general pattern of isolation showed by Japan for the entire period can be attributed to its distinct participation in the global financial market.

Despite the fact that Japan joined the gold standard in the 1890s, it abandoned the system in 1917. The Japanese government suspended gold exports in September 1917, following the footsteps of the United States. After World War I, many countries returned to the gold standard, but Japan did not, making it the only industrialized country that had not returned to the gold standard in the 1930s (Tamaki, 1995).

During the post-war period, Japan's economic performance was very successful, with the high growth rate period of the 1960s followed by a mid-growth rate of the 1970s. However, the Japanese economy during the Bretton Woods period was also characterized by extensive and strict capital controls and exchange controls. During this period Japan domestic policies aimed to maintain the fixed exchange rate with US dollar. Borrowing and lending to foreign markets were limited and all dollars earned from exports had to be exchanged into yen (Bastidon, 2019).

Additionally, the Japanese financial markets were closed to the rest of the world until 1971. The Japanese were not allowed to acquire foreign securities or real state, and foreigners were not allowed to purchase most Japanese securities or equities. It was then when Japan began to liberalize the financial markets. But since then, the size of inward investment has been much smaller than the outward direct investment and low compared with other advanced economies (Ito and Hoshi, 2023).

For the bond markets, Panel B provides similar intuition. As can be seen, the diagonal elements (own connectedness) are the largest individual elements in the table, but total directional connectedness (*from* or *to* others) tends to be much larger, except for Japan and Portugal. This result suggests that shocks affecting the bond returns of a specific country have a widespread impact on the bond returns of other countries. Furthermore, it highlights that Japan and Portugal are notably disconnected from other countries. Specifically, Portugal and Japan exhibit the highest own-country bond return spillovers, recording 54.79 and 52.25, respectively. Following at a considerable distance are Finland (35.84), Italy (33.61), and Germany (31.66), while, again, Sweden exhibits the lowest own spillover at 19.78.

In the case of Japan, during the Gold Standard period, there were some limited attempts to obtain foreign capital by issuing government bonds for foreign investors. During the Meiji period, Japan issued government bonds in London and New York to cover the cost of the war against China (1894-95) and against Russia (1904-05). Between this last war and the World War I, the bond issue was repeated seven more times to pay off government bonds and to issued more funds for the Japanese industries (Ohno, 2017).

During the high growth period, Japan financed the enormous investment demand mainly from domestic sources, eliminating the need for foreign investment in Japanese bonds and stocks. Until the mid-1970s, the Japanese bond market was limited to large Japanese banks, with no secondary bond market. Deregulation of the government bond market began in the 1970s, followed by the deregulation of the corporate bond market. This ongoing financial deregulation led to increased financial internationalization (Ito and Hoshi, 2023). However, despite the growing issuance of government bonds since the 1990s, the majority of the public debt has been domestically held. It is only recently that there has been a growing foreign interest in Japan's government bonds.

Panel C provides a distinctly landscape for housing returns. Across all countries, the own spillover surpasses any total directional connectedness *from* or *to* others, implying a certain degree

of disconnection in housing returns across countries. Notably, Japan, Portugal, and Germany, which previously demonstrated a higher degree of disconnection in equity and bond returns from other countries, now exhibit the lowest own-country returns spillovers. Conversely, the Nordic countries, Australia, and France now stand out as the most disconnected in terms of housing returns.

Table 2. Full sample return spillovers

Panel A. Equity returns.

	Australia	Belgium	Switzerl.	Germany	Denmark	Spain	Finland	France	UK	Italy	Japan	Netherl.	Norway	Portugal	Sweden	USA	FROM
Australia	28.27	3.94	7.37	2.80	3.25	3.46	2.73	5.92	9.63	3.40	0.07	7.28	6.10	4.71	7.17	3.91	*71.73*
Belgium	3.81	28.49	7.56	5.70	1.92	5.89	3.25	9.52	3.21	1.51	0.30	12.42	4.67	2.08	5.68	3.98	*71.51*
Switzerl.	6.39	7.08	23.62	5.31	2.25	2.88	2.33	6.83	9.01	3.38	0.30	8.26	4.68	2.68	8.15	6.87	*76.38*
Germany	4.08	7.70	8.69	39.84	0.22	3.62	1.85	7.69	3.64	1.06	1.86	6.04	1.72	2.80	5.13	4.04	*60.16*
Denmark	1.53	3.41	3.38	0.35	33.05	2.71	5.68	3.06	4.39	2.72	1.50	6.41	13.20	1.18	12.97	4.47	*66.95*
Spain	3.79	8.23	6.77	3.02	2.36	30.11	3.36	6.05	2.17	4.35	0.35	4.26	6.18	10.88	5.36	2.76	*69.89*
Finland	2.68	7.07	5.01	3.32	5.12	3.61	32.43	3.35	3.65	2.46	1.32	6.01	6.63	3.45	10.07	3.82	*67.57*
France	4.96	10.23	7.24	4.85	2.27	4.10	2.73	24.47	5.81	4.09	0.20	9.91	5.85	2.30	7.93	3.06	*75.53*
UK	10.29	3.40	11.26	2.67	2.30	1.63	2.05	6.91	29.31	3.59	0.75	7.05	1.97	1.65	8.03	7.15	*70.69*
Italy	4.79	2.64	6.24	1.91	3.22	2.89	1.72	5.88	4.97	38.43	0.89	4.70	4.75	6.02	6.40	4.55	*61.57*
Japan	0.72	0.85	2.00	3.11	3.23	0.90	2.95	0.56	3.03	2.52	68.55	0.46	1.56	2.74	1.28	5.56	*31.45*
Netherl.	5.72	10.19	8.00	3.58	3.14	2.13	3.14	9.32	6.13	2.65	0.11	23.55	6.09	1.34	10.43	4.51	*76.45*
Norway	4.21	5.17	5.22	0.69	10.50	5.43	5.85	6.67	2.01	3.11	0.56	7.38	26.09	3.39	11.04	2.69	*73.91*
Portugal	6.75	6.09	4.50	3.69	1.37	11.20	3.80	4.70	1.62	5.31	1.30	2.34	5.15	37.30	2.55	2.32	*62.70*
Sweden	4.91	5.07	7.45	2.66	6.51	3.14	6.23	6.95	6.23	3.56	0.16	9.64	8.43	1.63	21.57	5.87	*78.43*
USA	4.51	5.04	9.43	4.00	3.03	2.21	2.52	4.25	8.32	3.09	1.31	5.85	3.49	2.07	8.18	32.72	*67.28*
TO	*69.12*	*86.09*	*100.10*	*47.65*	*50.68*	*55.79*	*50.17*	*87.66*	*73.81*	*46.82*	*10.98*	*98.00*	*80.46*	*48.91*	*110.38*	*65.55*	**67.64**

Panel B. Bond returns.

	Australia	Belgium	Switzerl.	Germany	Denmark	Spain	Finland	France	UK	Italy	Japan	Netherl.	Norway	Portugal	Sweden	USA	FROM
Australia	20.70	2.70	6.60	3.87	4.43	6.42	3.57	5.03	9.35	3.07	2.24	6.98	7.63	0.83	7.82	8.76	*79.30*
Belgium	3.60	27.65	5.25	2.96	5.07	4.59	3.02	9.43	5.57	3.79	2.01	7.64	6.62	3.51	4.93	4.36	*72.35*
Switzerl.	7.22	4.30	22.66	7.77	3.60	5.17	3.20	4.25	5.90	1.50	2.32	8.81	6.86	0.43	8.73	7.27	*77.34*
Germany	5.92	3.39	10.86	31.66	4.20	2.93	1.34	2.45	6.41	0.46	3.41	9.21	3.46	0.26	8.16	5.88	*68.34*
Denmark	6.05	5.18	4.49	3.75	28.29	4.77	3.65	7.56	5.01	2.49	1.48	4.93	8.98	1.20	7.07	5.09	*71.71*
Spain	7.32	3.91	5.38	2.18	3.98	23.58	4.22	6.85	2.90	8.03	1.83	5.41	8.98	2.21	7.42	5.79	*76.42*
Finland	6.18	3.92	5.06	1.51	4.63	6.41	35.84	5.12	5.10	3.75	1.68	2.71	5.88	0.98	5.78	5.45	*64.16*
France	5.84	8.20	4.51	1.86	6.43	6.99	3.44	24.06	4.59	4.97	0.83	6.23	7.69	3.17	6.03	5.16	*75.94*
UK	10.91	4.87	6.29	4.89	4.28	2.97	3.43	4.61	24.15	2.94	1.95	8.37	5.59	0.10	6.85	7.82	*75.85*
Italy	4.98	4.61	2.22	0.49	2.96	11.45	3.52	6.94	4.09	33.61	0.73	4.64	6.76	3.77	5.63	3.61	*66.39*
Japan	5.66	3.80	5.34	5.63	2.74	4.06	2.46	1.80	4.21	1.14	52.25	3.61	1.19	0.22	3.81	2.09	*47.75*
Netherl.	6.97	5.71	8.03	6.02	3.60	4.75	1.56	5.35	7.17	2.86	1.43	20.67	7.58	1.30	9.23	7.77	*79.33*
Norway	7.58	4.92	6.23	2.24	6.52	7.83	3.37	6.57	4.75	4.13	0.47	7.54	20.56	1.29	9.72	6.26	*79.44*
Portugal	2.20	6.95	1.03	0.45	2.33	5.13	1.50	7.22	0.23	6.15	0.23	3.45	3.44	54.79	3.53	1.37	*45.21*
Sweden	7.47	3.52	7.62	5.10	4.94	6.22	3.19	4.96	5.61	3.31	1.44	8.83	9.35	1.27	19.78	7.38	*80.22*
USA	9.55	3.56	7.24	4.19	4.06	5.55	3.43	4.84	7.31	2.43	0.90	8.49	6.87	0.57	8.42	22.58	*77.42*
TO	*97.45*	*69.55*	*86.15*	*52.92*	*63.76*	*85.23*	*44.91*	*82.98*	*78.20*	*51.00*	*22.96*	*96.86*	*96.88*	*21.11*	*103.14*	*84.05*	**71.07**

Panel C. Housing returns.

	Australia	Belgium	Switzerl.	Germany	Denmark	Spain	Finland	France	UK	Italy	Japan	Netherl.	Norway	Portugal	Sweden	USA	FROM
Australia	89.67	0.01	0.07	0.95	0.03	2.71	0.64	0.15	0.16	0.05	2.01	0.01	0.09	2.62	0.79	0.03	*10.33*
Belgium	0.01	77.86	3.08	5.76	0.42	0.88	0.47	0.71	0.90	6.87	1.38	0.19	0.35	1.09	0.04	0.00	*22.14*
Switzerl.	0.07	3.12	78.99	0.06	0.12	0.00	4.89	1.82	6.09	0.89	0.14	0.58	0.00	3.13	0.10	0.00	*21.01*
Germany	0.65	4.49	0.04	60.75	0.00	2.78	7.38	0.00	0.04	1.54	16.26	0.22	1.19	2.96	1.58	0.12	*39.25*
Denmark	0.03	0.46	0.12	0.01	84.48	0.53	0.02	0.07	1.74	0.19	1.23	6.62	0.04	0.13	1.08	3.25	*15.52*
Spain	2.39	0.90	0.00	3.63	0.49	79.20	0.05	0.80	1.34	1.10	0.81	5.60	0.57	1.75	0.82	0.55	*20.80*
Finland	0.48	0.40	4.10	8.04	0.01	0.04	66.20	0.50	6.30	1.63	10.46	0.54	0.52	0.02	0.52	0.25	*33.80*
France	0.14	0.78	1.97	0.00	0.07	0.86	0.64	85.50	1.24	2.46	0.42	2.61	0.30	0.66	2.34	0.01	*14.50*
UK	0.12	0.79	5.24	0.04	1.40	1.16	6.47	0.99	68.02	0.43	1.93	0.10	1.90	6.85	4.25	0.32	*31.98*
Italy	0.03	5.95	0.76	1.71	0.15	0.93	1.66	1.94	0.42	67.45	2.71	0.15	0.77	6.68	0.30	8.38	*32.55*
Japan	1.35	1.07	0.10	16.16	0.88	0.62	9.54	0.30	1.71	2.43	60.36	0.46	1.49	0.02	2.48	1.02	*39.64*
Netherl.	0.01	0.20	0.59	0.29	6.28	5.67	0.65	2.44	0.11	0.18	0.61	80.11	0.33	1.22	1.07	0.26	*19.89*
Norway	0.08	0.35	0.00	1.56	0.04	0.57	0.63	0.28	2.21	0.91	1.96	0.32	79.41	6.75	3.08	1.84	*20.59*
Portugal	1.78	0.85	2.40	2.96	0.09	1.34	0.02	0.47	6.11	6.00	0.02	0.92	5.16	60.67	0.10	11.11	*39.33*
Sweden	0.70	0.04	0.10	2.07	1.02	0.82	0.63	2.18	4.97	0.35	3.27	1.06	3.09	0.14	79.55	0.01	*20.45*
USA	0.03	0.00	0.00	0.14	2.73	0.49	0.27	0.00	0.34	8.83	1.20	0.23	1.65	13.01	0.01	71.06	*28.94*
TO	*7.85*	*19.40*	*18.60*	*43.36*	*13.75*	*19.41*	*33.95*	*12.64*	*33.69*	*33.85*	*44.43*	*19.61*	*17.45*	*47.03*	*18.57*	*27.16*	**25.67**

Note: Columns show the market that produces the shock and rows the market that receives the shock. The diagonal elements represent the own-market spillovers while the off-diagonal elements measure the pairwise return directional spillovers. The model was estimated using the generalized variance decomposition on an annual frequency and 1-year step ahead forecast. The lag length was set at 1, following the AIC criterion. The total spillover is calculated as the sum of the non-diagonal elements of the spillovers matrix, divided by number of assets.

5.2. Rolling sample analysis

The static analysis provides a good characterization of the connectedness over the full sample period. However, it is not helpful for understanding how connectedness change over time. In order to assess the time-varying nature of both total and directional spillovers, we estimate the VAR using a 30-years rolling window[7] and 1 year as the predictive horizon for the underlying variance decomposition.[8]

Figure 3 displays the time-varying total spillover indexes for equities (Panel A), bonds (Panel B) and housing (Panel C), respectively. Panel D displays the three total spillover indexes together. Panel A reveals a large variability in the connectedness index for equities, fluctuating mostly between 55 and 90. While formal testing is conducted later, consistent with Bekaert and Mehl (2019), we find a swoosh shaped pattern in the global stocks market integration. The level of integration starts at high levels during the Gold standard era (pre-1913), still higher during the second era of financial globalization (1991-2020) and low in between. Notably, there are substantial leaps in global connectedness. Initially, there is a considerable decrease during WWI, followed by a temporary recovery until the Great Depression. Then sharply declines during WWII, reaching its lowest point, potentially due to the protectionist measures of that period. The Bretton Woods era (1940-1970) is marked by disintegration, characterized by tight financial regulation and prevalent capital controls. From 1980 onward, the integration level steadily increases, surpassing pre-1913 levels only after 1990.

Similar to the equity markets integration, Panel B reveals a large variability in the connectedness index for bonds, primarily oscillating between 55 and 90. The level of integration remains relatively stable, remaining around 70 during the first era of globalization but experiences a decline during WWI. Subsequently, the index exhibits an ascent between 1929 and 1932, coinciding with the Great Depression, reaching a level close to an all-time high before the onset of the second era of globalization. From 1932 to 1944, connectedness index dropped from 77 to 66 (coinciding with the end of the WWII). Following a rebound until 1948, there ensues a period marked by a sharp decrease in the connectivity index until early 60s. Nonetheless, during this period the level of integration is much higher than that of equities and housing. The level of connectedness exhibits considerable volatility until the 1990s. Notably, in the early 90s, the

[7] We test the robustness of the results to the size of the rolling window and the main results are not affected by this choice. Results are available in the Appendix (Figure A2).

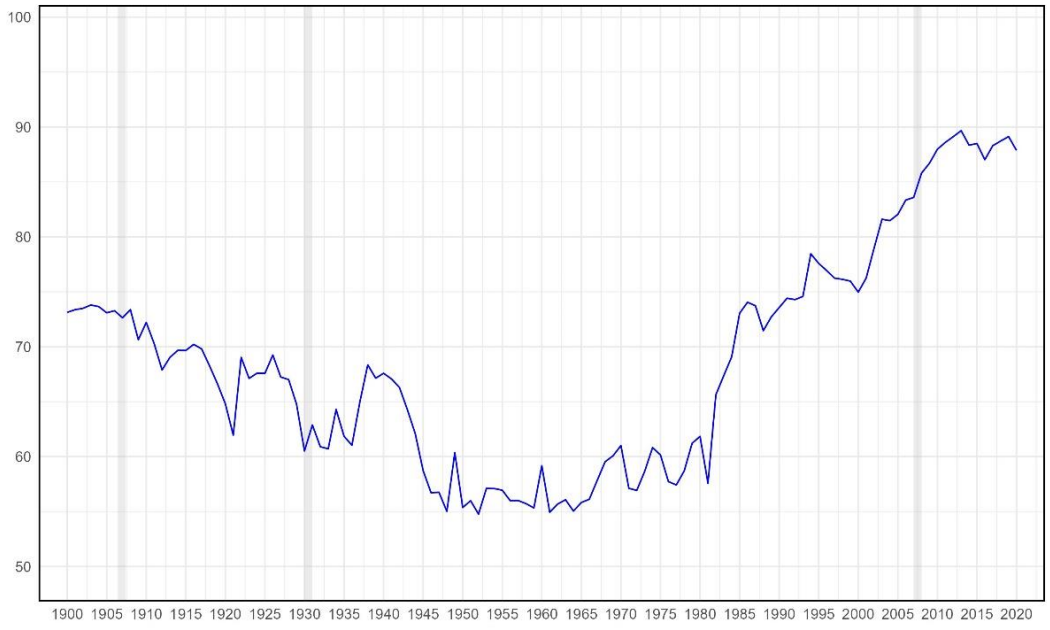
[8] Notice that nothing prevents that the cross-spillover index remains below the total spillover statistic during the full period analysed. The total spillover statistic comes from a VAR model fitted on the full sample, while the total spillover index consists of variance decomposition statistics extracted from VAR models fitted on subsamples. Naturally, the set of VAR models fitted on the subsamples fit the data better than the total sample VAR. For this reason the variance share of every series explained by others is larger in the dynamic exercise than in the static one. In the static case most of the explanation comes from the own variance share, and this means that the VAR model fits to a lesser extent compared to the subsample VARs. There is not contradiction in this finding.

connectivity index undergoes a significant surge from 60 to 82, until the end of the European debt crisis when it stabilized at around 87. Interestingly, the upward trend in equities connectedness starts at an early date, 1980. In the case of the bond markets integration, looking at the dynamic of the index, it is not possible to stablish if integration follows a U-shaped, a J (or L-inverted) shaped or a swoosh-shaped pattern. We test for it later.

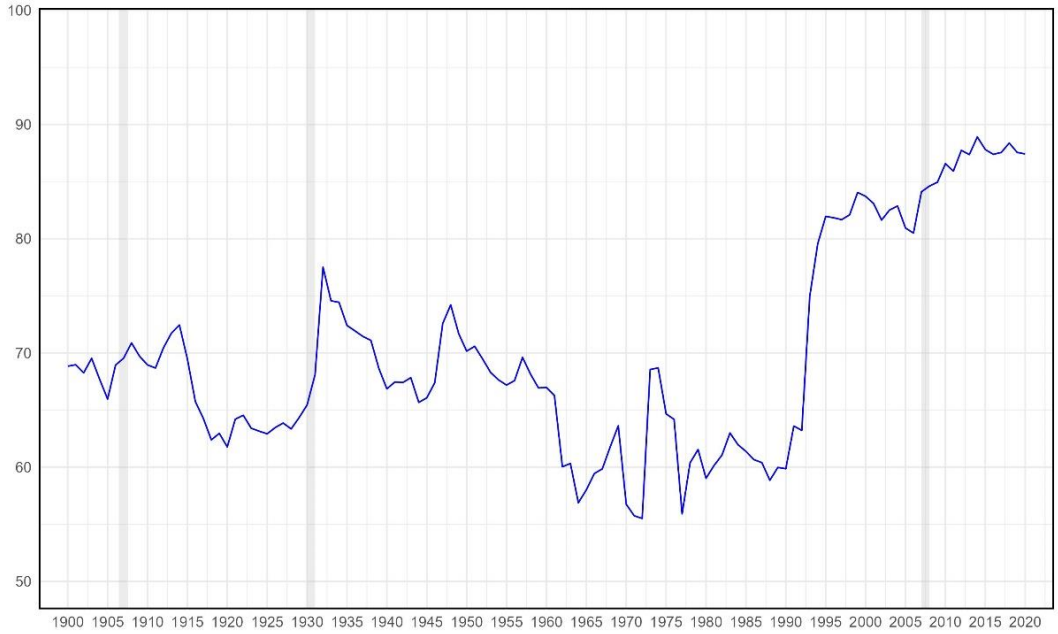
Unlike equities and bonds, housing returns have exhibited a consistently low and stable level of connectedness, ranging from 55 to 66 (Panel C). This may be attributed to the fact that housing assets are less globally tradable than equities and are more susceptible to idiosyncratic country-level shocks. According to Jordà et al. (2019), from the perspective of international diversification, the ideal investor would like to hold an internationally diversified portfolio of real estate holdings, even more so than equities. The connectedness index experienced a significant decline during WWII and its aftermath. Interestingly, the integration levels of equities and housing during 1950-1980 align, coinciding with the period of significant disintegration in equities. Additionally, between 1980 and 1985, the index decreased while the connectedness of bonds increased. This decline in the index is likely associated with the expansion of investment opportunities due to liberalization. Subsequently, a robust upward trend in the index emerged from 1991 to 1998, reaching a global maximum of 66 and indicating heightened total connectedness. However, the gap between the level of integration and that of equities and bonds is very pronounced during the second era of globalization.

Figure 3. Rolling Total Spillover Index

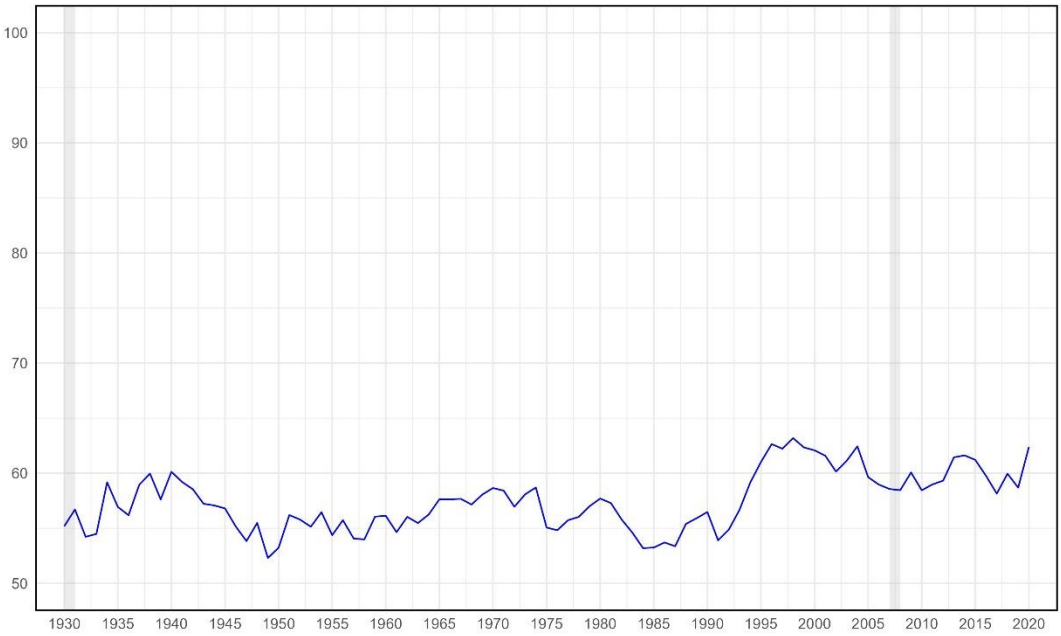
Panel A. Equity returns spillover index



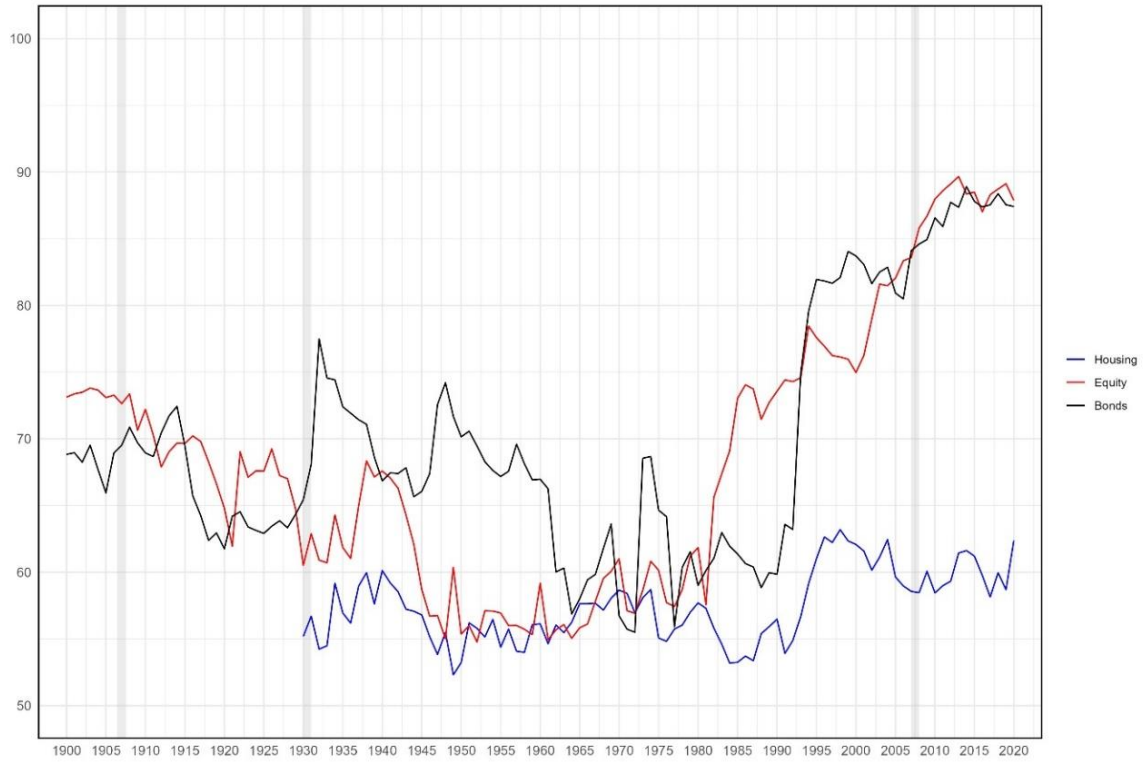
Panel B. Bond returns spillover index



Panel C. Housing returns spillover index



Panel D. Equity, bond and housing returns spillover index



Note: Annual total connectedness index. Window length equals 30 years. Shaded areas highlight periods of financial crises, as defined by Jordà et al. (2011): the panic of 1907, the Great Depression of 1930-31, and the Global financial crisis of 2007-08.

Following Bekaert and Mehl (2019), who formally test the shape of the level of integration (straight line, U-shaped, J-shaped or swoosh-shaped pattern) in equity markets, we run the following regression for the level of integration of equities, bonds and housing, respectively:

$$S(H)_t = \lambda_t + \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \varepsilon_t \quad (11)$$

The dependent variable, $S(H)_t$, is the total spillover index, λ_t is a linear trend, and D_{1t} , D_{2t} and D_{3t} are dichotomous variables that equals 1 during periods 1, 2 and 3, respectively, and zero otherwise. Period 1 is pre-1913, the years of the first era of globalization, period 2 spans from 1914 to 1990, including the Bretton Woods period and its immediate aftermath and, period 3 is 1990-2020, the second era of financial globalization.[9] We estimate the model using the Ordinary Least Squares (OLS) method with Newey and West (1986) heteroskedasticity and autocorrelation consistent standard errors. The inequality restrictions for the U-shaped pattern

[9] For housing markets, data is no available for period 1, and period 2 starts in 1930.

are H_0: $\beta_1 = \beta_3$, $\beta_1 > \beta_2, \beta_3 > \beta_2$; for the J-shaped pattern are H_0: $\beta_1 = \beta_2$, $\beta_3 > \beta_1, \beta_3 > \beta_2$, and for the swoosh-shaped pattern are H_0: $\beta_1 > \beta_2, \beta_3 > \beta_1, \beta_3 > \beta_2$.

Panel A in Table 3 presents estimations derived from Eq. (11) for equity markets. The estimation of β is 72.13 during the initial period (pre-1913), decreases to 62.45 for the subsequent period (1914-1990), and then rises to 82.42 during the second era of globalization (1990-2020). In the third column, the Wald tests cannot reject the null of a swoosh-shaped pattern while they do reject the null hypotheses of a linear, U-shaped, or J-shaped pattern. This aligns with the finding of Bekaert and Mehl (2019) that integration of equity markets followed a swoosh-shaped pattern, with higher integration during the second era of globalization compared to the late-nineteenth century period, with a decline in integration in between.

For bond markets (Panel B), the estimation of β remains quite similar during both the first and second periods (63.14 and 65.09, respectively), but it rises to 82.81 during the second era of globalization. The Wald tests in this case do not reject the J (or inverted L)-shaped pattern, indicating that financial integration levels were not significantly different during the initial two periods. However, bond market integration experienced a significant increase from the last decade of the twentieth century onwards. Finally, the results in Panel C shows that for housing markets the overall pattern tends to follow an upward trend, with a higher level of integration during the second era of globalization than before. Overall, the findings from Table 3 are consistent with the integration patterns illustrated in Figure 3, indicating distinct integration trajectories across equity, bond, and housing markets from the classical Gold Standard era to 2020.

Table 3. Testing the shape of the level of integration

Panel A. Equity markets

		Wald test.	**Shape**
D_{1t}	72.135*** (0.216)	$\beta_1 = \beta_3$ (Rejection) $\beta_1 > \beta_2$ (No Rejection) $\beta_3 > \beta_2$ (No Rejection)	U-shaped pattern
D_{2t}	62.451*** (1.467)	$\beta_1 = \beta_2$ (Rejection) $\beta_3 > \beta_1$ (No Rejection) $\beta_3 > \beta_2$ (No Rejection)	J (or inverted L)-shaped pattern
D_{3t}	82.421*** (1.455)	$\beta_1 > \beta_2$ (No Rejection) $\beta_3 > \beta_1$ (No Rejection) $\beta_3 > \beta_2$ (No Rejection)	Swoosh-shaped pattern
		$\beta_1 = \beta_2 = \beta_3$ (Rejection)	Straight line

Panel B. Bond markets

		Wald test	Shape
D_{1t}	63.144*** (0.281)	$\beta_1 = \beta_3$ (Rejection) $\beta_1 > \beta_2$ (Rejection) $\beta_3 > \beta_2$ (No Rejection)	U-shaped pattern
D_{2t}	65.082*** (1.689)	$\beta_1 = \beta_2$ (No Rejection) $\beta_3 > \beta_1$ (No Rejection) $\beta_3 > \beta_2$ (No Rejection)	J (or inverted L)-shaped pattern
D_{3t}	82.809*** (2.527)	$\beta_1 > \beta_2$ (Rejection) $\beta_3 > \beta_1$ (No Rejection) $\beta_3 > \beta_2$ (No Rejection)	Swoosh-shaped pattern
		$\beta_1 = \beta_2 = \beta_3$ (Rejection)	Straight line

Panel C. Housing markets

		Wald test	
D_{2t}	56.218*** (0.251)	$\beta_1 = \beta_2$ (Rejection)	Straight line
D_{3t}	59.972*** (0.357)	$\beta_2 > \beta_1$(No Rejection) $\beta_2 < \beta_1$ (Rejection)	

This table presents estimates based on Eq. (11). D_{1t} , D_{2t} and D_{3t} are dichotomous variables that equals 1 during periods 1, 2 and 3, respectively, and zero otherwise. Period 1 represents the pre-1913 era, period 2 spans from 1914 to 1990, and period 3 covers 1990-2020. For housing markets, data is not available for period 1, and period 2 starts in 1930. We report the coefficients of the three dummy variables in each case, along with the standard errors. We estimate the model using the Ordinary Least Squares (OLS) method with Newey and West (1987) heteroskedasticity and autocorrelation consistent standard errors. *, **, *** indicate statistical significance at the 10%, 5%, 1% levels, respectively. The third column displays the Wald tests and the decision of the test.

5.3. Pairwise spillover indexes

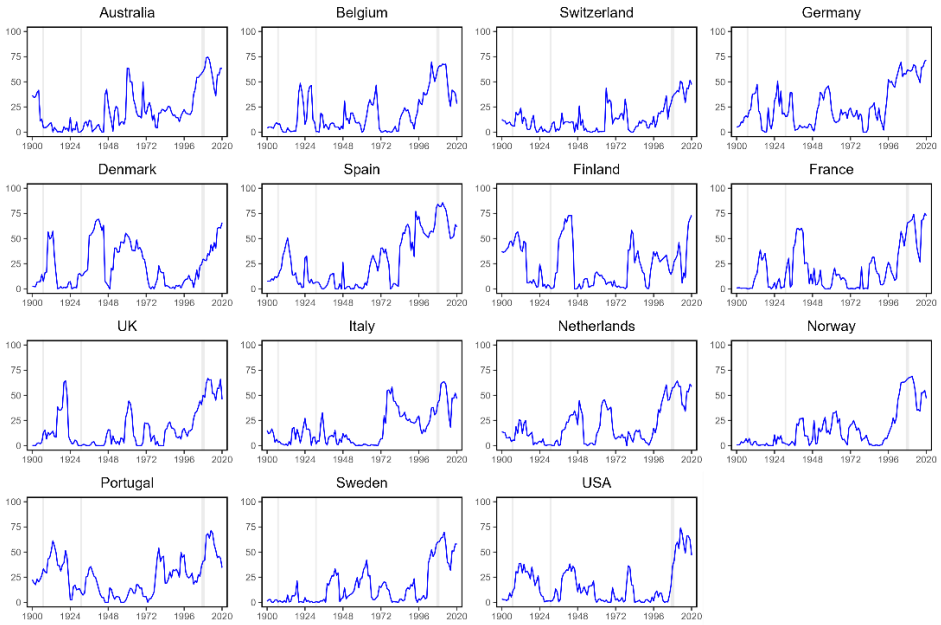
Figure 4 shows the pairwise spillover index of Japan with each of the other economies. Regarding stocks, Japan's connectivity with other countries remained relatively low until the 1970s, when there was a notable increase in connectivity with most European countries. This increasing connectivity aligns with Japan's investment endeavors in Europe, which began in the 1970s, gained momentum during the 1980s, and continued in subsequent decades. Notably, Italy, Spain, Belgium, and later Germany emerge prominently in this regard. In Spain, following Japan's initial investments in the 1970s, there was a marked surge during the 1980s, particularly within sectors such as electronics and automotive. In recent years, there has been a discernible surge in connectivity, particularly with Germany, the United States, and the United Kingdom in terms of stocks. Finally, the second era of globalization shows the highest level of integration over the sample period.

Regarding bonds, as in the case of stocks, the level of connectedness with other countries is generally higher during the second era of globalization. This can be attributed to Japan's budget

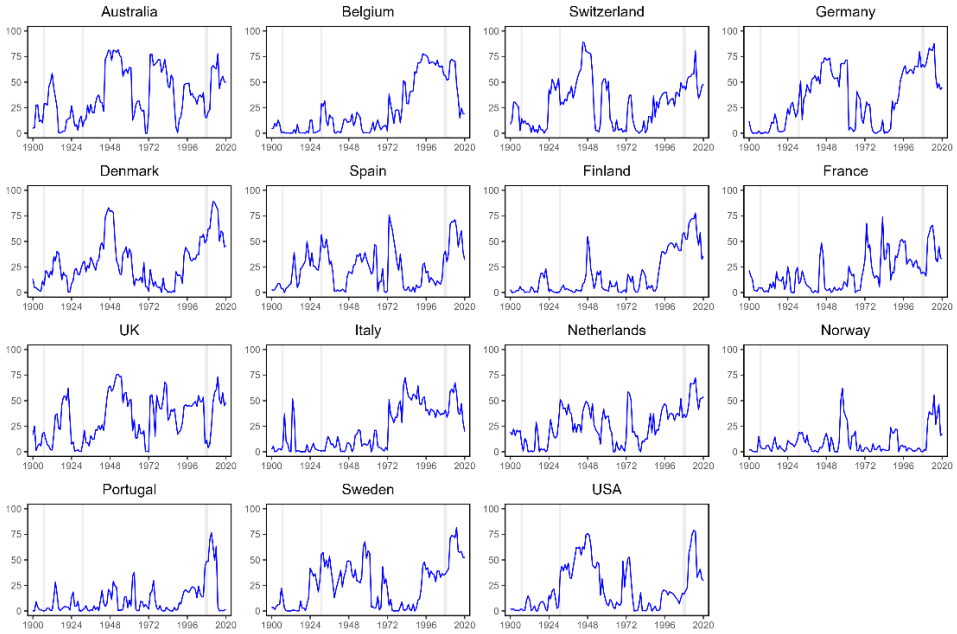
deficit to GDP ratio, which has been the worst among the G7 countries since the 1990s, leading to the continued issuance of government bonds.

Figure 4. Pairwise dynamic spillovers

Panel A. Equity returns



Panel B. Bond returns



Note: Pairwise dynamic spillovers from Japan with each market. Shaded areas highlight periods of financial crises, as defined by Jordà et al. (2011): the panic of 1907, the Great Depression of 1930-31, and the Global financial crisis of 2007-08.

5.4. Net pairwise spillover indexes

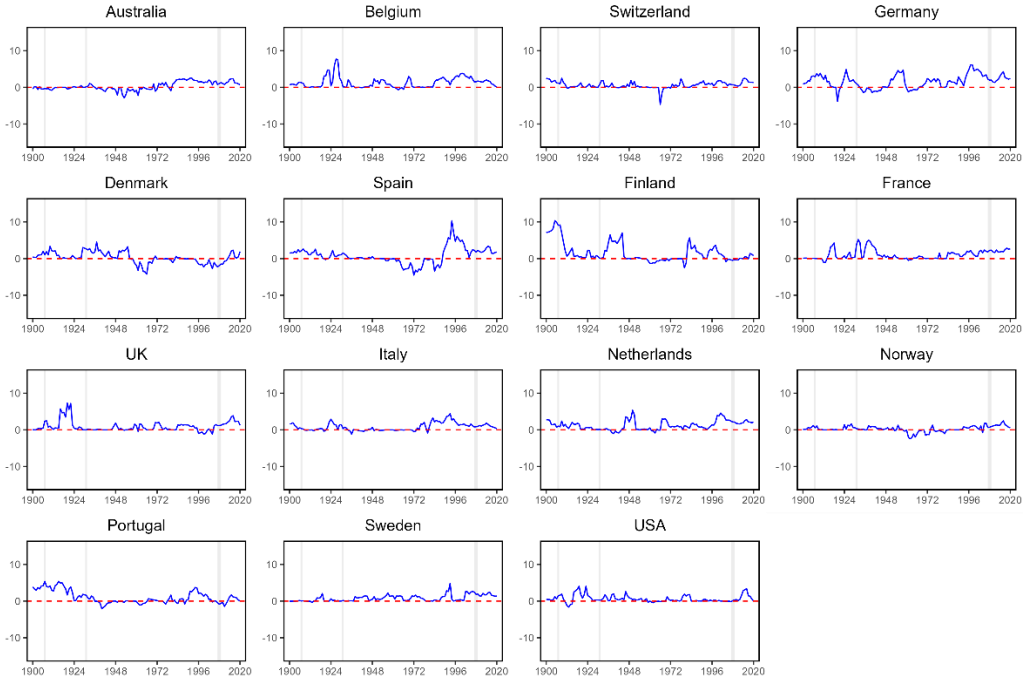
Figure 5 displays the net pairwise spillover indexes for Japan with each of the other economies. A positive number means that Japan acts as a net transmitter of shocks, while a negative number indicates it is a net receiver. It is more evident to identify a clear role as a transmitter or receiver of shocks in the bond markets compared to stock markets.

Regarding stocks, with some exceptions at the beginning of the sample period, it is not until the 1970s that Japan is observed to clearly act as a net transmitter of shocks. This correlates with the onset of financial market deregulation in Japan and the gradual initiation of Japanese corporate investments in Europe. Foreign investment has consistently surpassed inward investment into Japan, albeit at a reduced scale. This trend underscores the incremental growth observed over the past two decades.

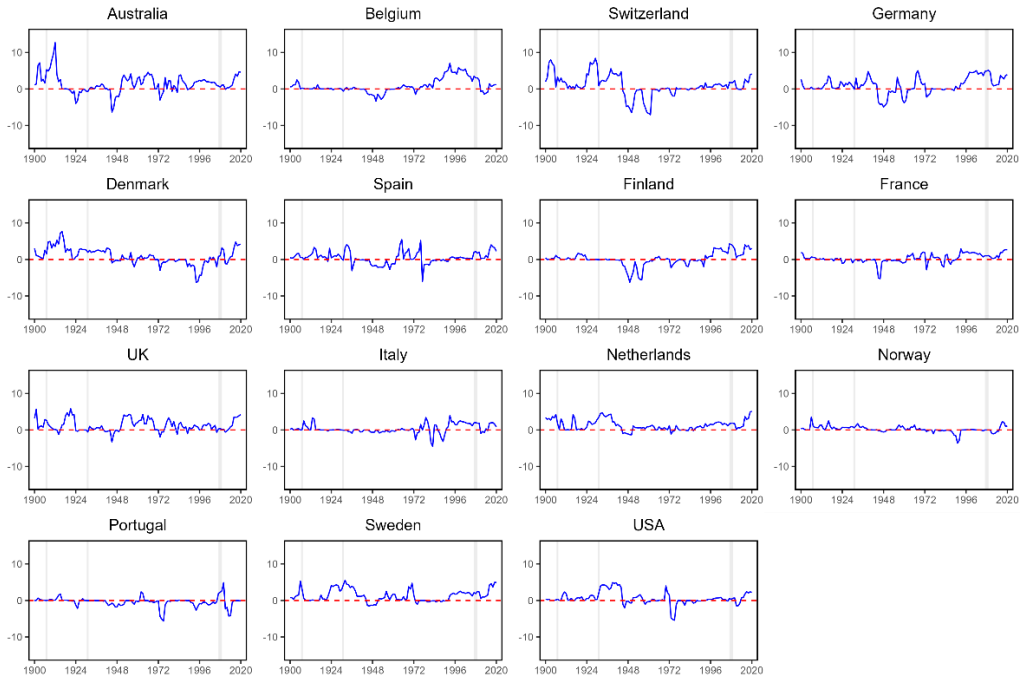
Concerning the bond market, pre-World War II Japan predominantly acted as a net transmitter rather than a receiver of shocks. This can be attributed to Japan's efforts to issue foreign bonds to attract external investments for war efforts despite the delayed development of its bond market. Interestingly, in the early 1970s, coinciding with the oil crisis, Japan was a net receiver of shocks from most countries, especially the US. In the subsequent years, Japan emerged as a net transmitter of shocks to most countries. During this period, the Japanese market was not only deregulated, but the government also initiated a relatively high and sustained issuance of debt in the form of government bonds, especially from the 1990s onward. Although historically foreign participation in Japan's government bond market has been modest, recent years have witnessed a growing trend, potentially reflected in the ascending trend observed in the latter years.

Figure 5. Net pairwise dynamic spillovers

Panel A. Equity returns



Panel B. Bond returns



Note: Net pairwise dynamic spillovers from Japan to each market. A positive number means that Japan is a net transmitter of shocks in this period, while a negative number means it is a net receiver. Shaded areas highlight periods of financial crises, as defined by Jordà et al. (2011): the panic of 1907, the Great Depression of 1930-31, and the Global financial crisis of 2007-08.

5. Conclusions

We conduct a comprehensive examination of the evolution of global financial integration from the classical Gold Standard era to the 21st century. Contrary to the previous literature that has mainly focused on one asset class, we examine financial integration using data on equity, housing, and bonds. To achieve our objective, we compute a set of indices of financial integration that allow us to describe dynamics of financial integration over time and to identify vulnerable and systemic countries in the integration process.

Our results document a heightened and more volatile degree of integration in stocks and government bonds, than in real estate markets. Nonetheless, the dynamics of stock and bond integration exhibit notable disparities. Notably, stock integration demonstrates a swoosh-shaped pattern, characterized by increased integration during the second era of globalization compared to the late-nineteenth century, with a subsequent decline in integration, whereas bond integration follows a J-shaped trajectory, with integration levels remaining relatively stable during the initial two periods. In contrast to equities and bonds, housing returns consistently display lower and relatively stable levels of integration. This contrast in integration levels between housing returns and stocks/bonds becomes especially pronounced during the second era of globalization (1990-2020). Overall, all three markets exhibited lesser integration during the Classical Gold Standard era compared to the contemporary era of globalization, with stock and bond markets experiencing more substantial integration.

Interestingly, results at the country level show a high heterogeneity across countries, asset classes, and time periods. Japan provides a particularly interesting case study, exhibiting the most isolated stock and bond markets. However, during the second era of financial globalization, Japan's integration with European economies increased significantly.

The indicators of financial integration proposed in this paper allows us to explore an interesting question, which is left for further research: Can the level of integration in a given period of time anticipate the occurrence of a financial crisis several periods ahead? That is, in the same way that previous research has shown that external debt surges are an antecedent to banking crises (Reinhart and Rogoff, 2011), we will test whether financial integration anticipates financial crises, including both idiosyncratic crises of countries and other crises that are more global in nature. To achieve this objective, we will focus on the probability of crises and employ risk models based on duration analysis, in which covariates help to understand the necessary time elapsed before an event (crisis) is observed, conditional on certain levels of market integration.

References

Aizenman, J., Chinn, M. and H. Ito, (2010). The emerging global financial architecture: tracing and evaluating the new patterns of the Trilemma's configurations, *Journal of International Money and Finance*, 29 (4): 615–641.

Aizenman, J., Chinn, M, and H. Ito, (2022). The impacts of crises on the Trilemma configurations, *NBER Working Paper Series*, 30406.

Bastidon, C., Bordo, M., Parent, A. and M. Weidenmier, (2019). Towards an Unstable Hook: The Evolution of Stock Market Integration Since 1913, National Bureau of Economic Research, Working Paper Series, 26166.

Bekaert, G., Harvey, C.R. and C. Lundblad, (2006). Growth volatility and financial liberalization, *Journal of International Money and Finance*, 25(3), 370-403.

Bekaert, G. and A. Mehl, (2019). On the global financial market integration 'swoosh' and the trilemma, *Journal of International Money and Finance*, 94, 227-245.

Bernanke, B., (2000). Essays on the Great Depression, Princeton, Princeton University Press.

Bordo, M., Eichengreen, B., Klingebiel, D., Martinez-Peria, M.S. and A. K. Rose, (2001). Is the Crisis Problem Growing More Severe?, *Economic Policy*, 16(32), 53-82.

Bordo, M.D., Eichengreen, B., and D. Irwin, (1999). Is Globalization Today Really Different from Globalization a Hundred Years Ago? in: Collins, S.M., Lawrence, R.Z., (Eds.), Brookings Trade Forum 1999. Brookings Institution Press, Washington, 1–72

Bordo, M. and A. P. Murshid, (2006). Globalization and changing patterns in the international transmission of shocks in financial markets, *Journal of International Money and Finance*, 25(4), 655-674.

Campbell, G. and M. Rogers, (2017). Integration between the London and New York Stock Exchanges, 1825-1925, *Economic History Review*, 70(4), 1185–1218.

Chinn, M. and H. Ito, (2006). What Matters for Financial Development? Capital Controls, Institutions, and Interactions, *Journal of Development Economics*, 81(1): 163-192.

Chinn, M. and H. Ito, (2022). Notes on the Chinn-Ito financial openness index 2020 update. Unpublished manuscript available at https://web.pdx.edu/~ito/Readme_kaopen2020.pdf

Diebold, F.X., and K. Yilmaz (2009). Measuring financial asset return and volatility spillovers, with application to global equity markets, *Economic Journal*, 119(534), 158-71.

Diebold, F. and K. Yilmaz, (2012). Better to give than to receive: Forecast-based measurement of volatility spillovers, *International Journal of Forecasting*, 28(1), 57-66.

Eichengreen, B., and P. Temin, (2000). The Gold Standard and the Great Depression, *Contemporary European History,* 9(2), 183-207.

Goetzmann, W. N., Li, L. and K. G. Rouwenhorst, (2005). Long-Term Global Market Correlations, *The Journal of Business*, 78(1), 1-38.

Ito, T., and T. Hoshi (2023). The Japanese Economy, 2nd Edition, MIT Press.

Jonung, L., Kiander, J., & Vartia, P. (2009). The great financial crisis in Finland and Sweden: the dynamics of boom, bust and recovery, 1985–2000. In L. Jonung, J. Kiander, & P. Vartia (Eds.), The Great Financial Crisis in Finland and Sweden. The Nordic Experience of Financial Liberalization. Edward Elgar Publishing Limited.

Jordà, O., Schularick, M., and Taylor, A.M., (2011). Financial Crises, Credit Booms, and External Imbalances: 140 Years of Lessons. IMF Economic Review, 59(2), 340–378.

Jordà, O., Schularick, M., and Taylor, A.M., (2015). Betting the House, *Journal of International Economics*, 96, Supplement 1, S2-S18.

Jordà, O., Knoll, K., Kuvshinov, D., Schularick, M. and A.M. Taylor, (2019). The Rate of Return on Everything, 1870–2015, *Quarterly Journal of Economics*, 134(3), 1225-1298.

Josse, J., and F. Husson, (2016). missMDA A package for handling missing values in multivariate data analysis, *Journal of Statistical Software,* 70(1), 1-31.

Josse, J., and F. Husson, (2012). Handling missing values in exploratory multivariate data analysis methods, *Journal de la Société Française de Statistique,* 153, 79-99.

Kindleberger, C.P. (2000). Manias, Panics, and Crashes, New York, John Wiley & Sons.

Koop, G., Pesaran, M. and S. Potter, (1996). Impulse response analysis in non-linear multivariate models, *Journal of Econometrics*, 74(1), 119–147.

Mauro, P., Sussman, N. and Y. Yafeh, (2002). Emerging market spreads: then versus now', *Quarterly Journal of Economics*, 117, 695–733.

Neal, L.D. and M.D. Weidenmier, (2003). Crises in the Global Economy from Tulips to Today: Contagion and Consequences", in Bordo, M.D, Taylor, A.M. and Williamson JG. (ed.), Globalization in Historical Perspective, University of Chicago Press, Chicago.

Newey, W., and K. West, (1987). A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix, *Econometrica*, 55(3), 703-08.

Obstfeld, M., and A.M. Taylor, (2005). Global Capital Markets: Integration, Crisis, and Growth, Cambridge University Press, Cambridge.

Ohno, K. (2017). The History of Japanese Economic Development: Origins of Private Dynamism and Policy Competence (1st ed.). Routledge.

Pesaran, M., and Y. Shin, (1998). Generalized impulse response analysis in linear multivariate models, *Economics Letters*, 58(1), 17–29.

Quinn, D.P., and H.J. Voth, (2008). A Century of Global Equity Market Correlations, *American Economic Review*, 98(2), 535-40.

Piketty, T., and G. Zucman, (2014). Capital Is Back: Wealth-to-Income Ratios in Rich Countries, 1700–2010, *Quarterly Journal of Economics*, 129, 1255-1310.

Reinhart, C. M., and K.S. Rogoff, (2011). From financial crash to debt crisis. *American Economic Review*, 101(5), 1676-1706.

Sims, C.A, (1980). Macroeconomis and reality, *Econometrica*, 48(1), 1-48.

Straumann, T., (2019). 1931: Debt, Crisis, and the Rise of Hitler. Oxford, Oxford University Press.

Stuart, R. (2024). Measuring stock market integration during the Gold Standard, Cliometrica, 18, 191-2020.

Sylla, R., Wilson, J.W. and R.E. Wright, (2006). Integration of Trans-Atlantic capital markets, 1790–1845, *Review of Finance*, 10(4), 613-644.

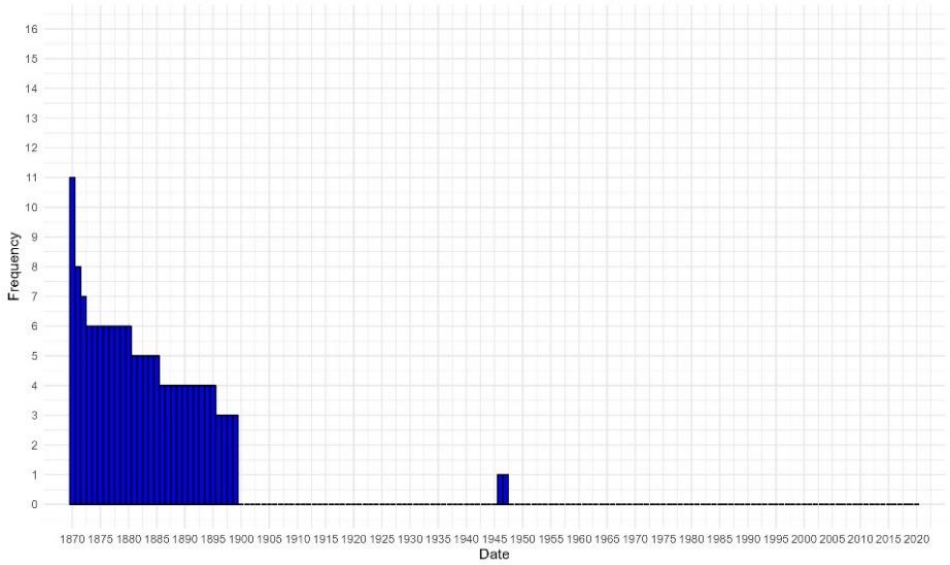
Tamaki, N. (1995). Japanese banking: A history, 1859–1959. Cambridge University Press.

Volosovych, V. (2011). Measuring financial market integration over the long run: Is there a U-shape?, *Journal of International Money and Finance*, 30(7), 1535-1561.

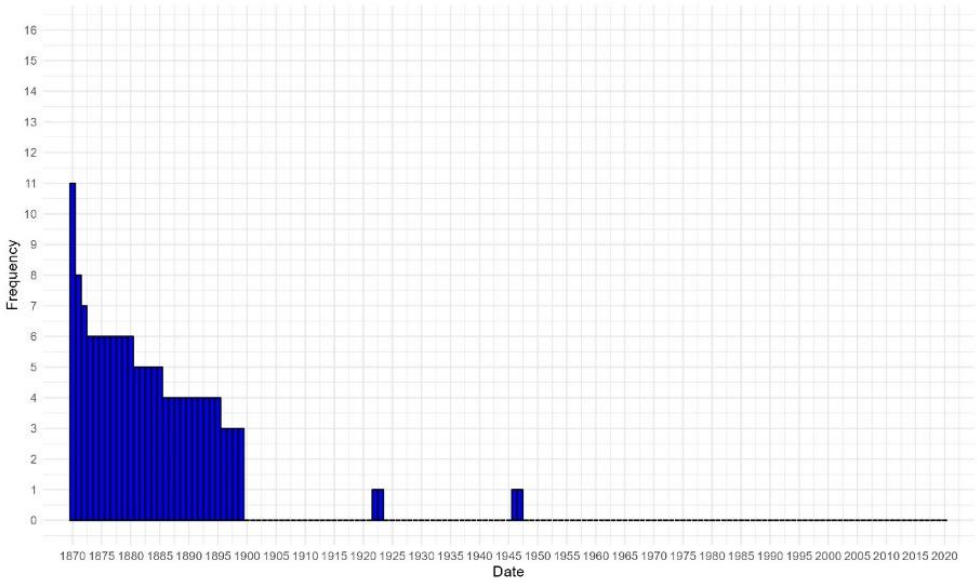
Appendix

Figure 1A. Number of missing values

Panel A. Equity returns



Panel B. Bond returns



Panel C. Housing returns

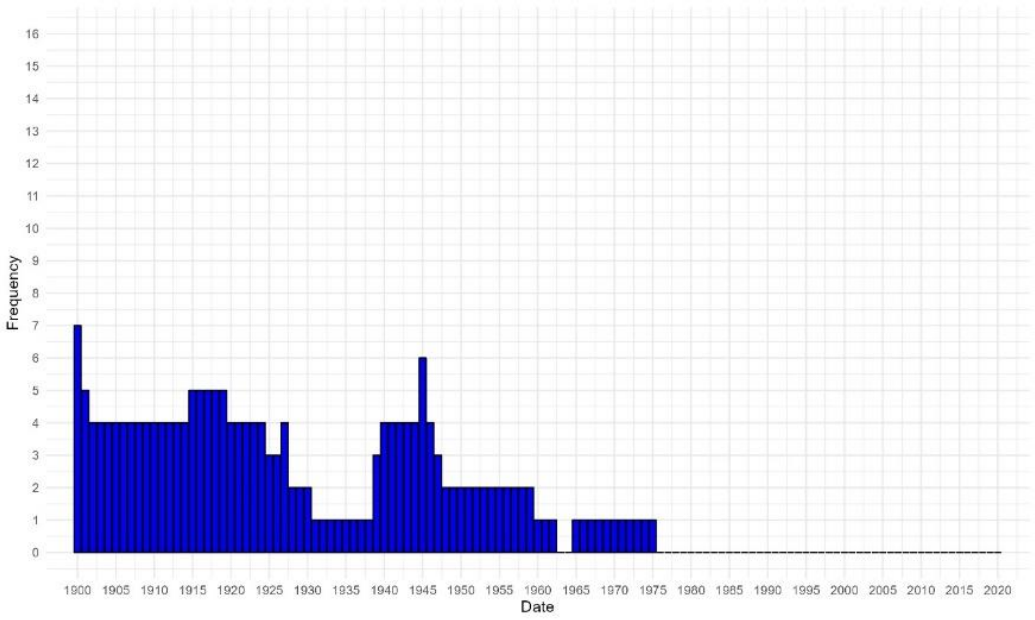
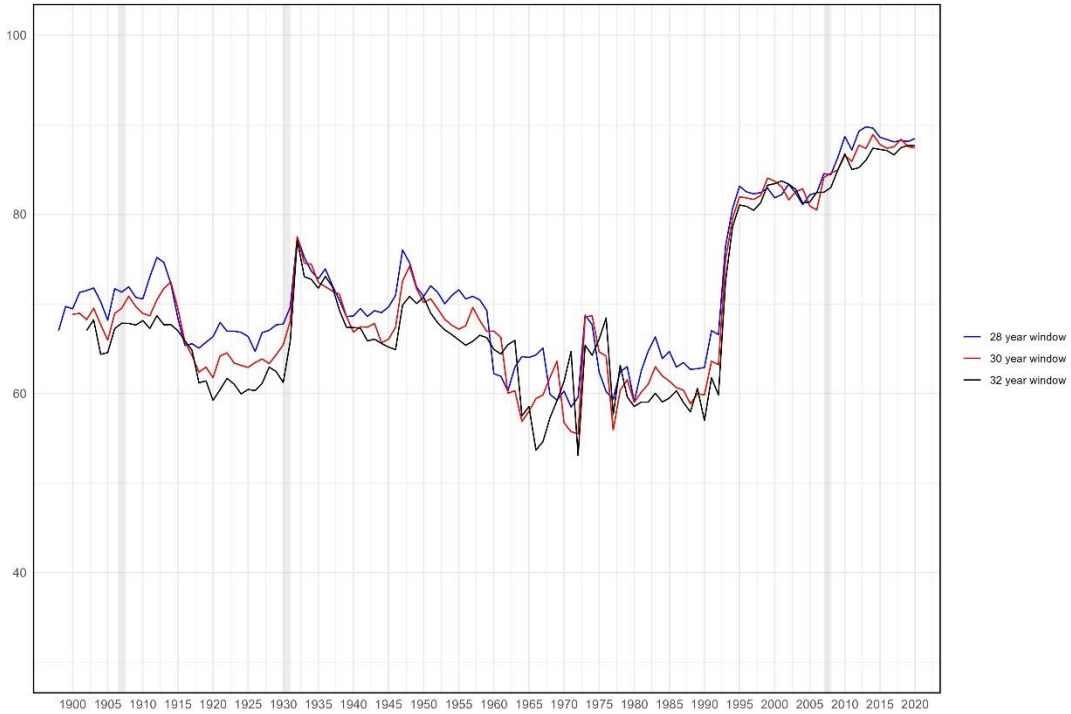


Figure A2. Sensitivity of Rolling Total Spillover Index to Rolling Window Size

Panel A. Equity returns spillover index

Panel B. Bond returns spillover index



Panel C. Housing returns spillover index