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## Measuring financial market integration over the long run: Is there a U-shape?

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Using long time series for sovereign bond markets of fifteen industrialized economies from 1875 to 2009, I find that financial market integration by the end of the 20th century was higher than in earlier periods and exhibited a J-shaped trend with a trough in the 1920s. The main reason for the higher financial integration seen today is the recent extensive globalization. Around the turn of the 20th century, countries frequently drifted apart. Conversely, in recent years, the bond markets of most countries have moved together. Both policy variables and the global market environment play a role in explaining the time variation in integration, while “unexplained” changes in the overall level of country risk are also empirically important. My methodology, based on principal components analysis, is immune to outliers and accounts for global and country-specific shocks and, hence, can capture trends in financial integration more accurately than standard techniques such as simple correlations.

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### 1. Introduction

The extent of international financial integration has important implications for economic theory and policy debates. The relative degree of financial integration during the two capital market booms, before World War I and after the collapse of the Bretton Woods system, remains subject to

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disagreement. Typical measures of integration include proxies for intensity of legal restrictions on cross-border capital flows, price-based criteria, and quantity-based criteria.<sup>1</sup> Quinn (2003) argues that financial markets were more integrated during the pre-WWI era, whereas Mauro et al. (2002) find that they are more integrated post-Bretton Woods. Others, including Obstfeld and Taylor (2003, 2004) and Goetzmann et al. (2005), argue that financial markets demonstrate a U-shape and hence an equal amount of integration before 1914 and after 1971. It is important to know which period has been associated with a higher degree of capital market integration because these periods differ drastically in terms of the economic environment and policies.

I argue that mixed results in the literature are a result of studies using different methodologies and the failure to differentiate between global or country shocks. To address these concerns, I propose a systematic methodology based on the method of principal components that has several advantages. First, it accounts for several dimensions of integration including market co-movement and segmentation, within a straightforward statistical methodology that is widely used in microeconomic research. Second, it is robust to the presence of outliers or heavy-tailed distributions. Third, the current method is robust to the choice of a reference country (such as the United States or Great Britain). Fourth, the methodology has a clear theory-based interpretation. Finally, using this method I was able to account for global shocks while several other methodologies spuriously interpret large global shocks as integration because common global shocks make financial variables move together.

The focus of this paper is on financial markets integration from the perspective of investors in financial assets or financial arbitrageurs, as opposed to integration of commodity markets or markets for real assets. Standard no-arbitrage theory predicts that, when investors in financial markets are neutral to exchange (or currency) risk and market frictions are negligible, free international capital flows (*financial arbitrage*) result in the Uncovered Interest Parity (UIP) condition. This result implies that similar assets in different locations have the same expected nominal rate of return regardless of exposure to the exchange risk. However, literature has accumulated abundant evidence of non-negligible exchange, default, and political risk across countries and over time. Further, these risks may result in persistent and volatile risk premia and hinder the ability of countries to tap into international capital markets. If these risks depend on, or are correlated with, legal restrictions to capital flows or the underdevelopment of financial markets, international arbitrage opportunities may also be limited. These combined factors reduce financial integration.

I do not expect to find perfect capital mobility anywhere in history given all the evidence from the literature. Rather, I intend to concentrate on a weaker notion of integration characterized by smaller and more stable risk premia that would result in a higher *comovement* (but not necessarily equalization) of a country's financial returns.<sup>2</sup> Even if a greater comovement is driven by common global shocks, the fact that such shocks propagate across countries and these shocks are frequent might also be a sign of greater interconnection between individual economies (Bordo et al., 2001). I also verify how comovement of returns has changed over time conditional on time-varying determinants of the risk premia.

My empirical methodology is based on principal component analysis (PCA). The PCA is a non-parametric empirical methodology used to reduce the dimensionality of data and describe common features of a set of economic variables. This method transforms the observed data vectors into new variables referred to as *components*, which are linear combinations of the original data that maximize variance.<sup>3</sup> The goal of the method is to capture most of the observed variability in the data in a lower-dimensional object and, thereby, filter out noise. Often, a single component summarizes most of the variation of the original data.

I argue that the “first” principal component (with the components ordered according to how much of the data-variation they capture) has a natural interpretation when the PCA is applied to

<sup>1</sup> Price-based criteria include various interest parity conditions or the purchasing power parity condition, while quantity-based criteria are based on the volume of capital flows and the stocks of external assets and liabilities. See Kose et al. (2009) for a discussion of advantages and disadvantages of various measures.

<sup>2</sup> Clarida and Taylor (1997) demonstrate that the nominal interest rate differential is stationary even if we allow for deviations from the simple efficient markets hypothesis due to risk premia and deviations from rational expectations if the resulting deviations from UIP are themselves stationary.

<sup>3</sup> See Jolliffe (2002) for a more detailed treatment of the PCA.

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