International swap market contagion and volatility

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ABSTRACT

Using interest rate swap yield and spread data the linkages and volatility transmission between three major international swap markets: Japan, UK and the US are investigated. The volatilities of the swap yield and spreads are decomposed into long and short term components enabling an assessment to be made of the strength and direction of the volatility transmission process between the three markets. Strength is measured through the dynamic correlation between the long- and short-term components, while direction is measured through the causality of these components. The contagion effects of key economic events are also considered. The paper presents three key findings. First, cross-market correlations of both short- and long-term components between Japan and the US, and Japan and the UK are very low, which is consistent with weak integration. This would motivate international investors to take advantage of the differential between the lower long-term yields of Japanese Government bonds and the higher long-term yields of US bonds. On the other hand the cross-market correlations between the UK and the US are high, which is consistent with strong integration. Second, contagion exists in both the long- and short-term volatility components of the swap spread, but not on the swap rates. Third, in terms of the direction of transmission, the volatility spillovers (both components) are mostly multidirectional between the markets.

1. Introduction

The recent global financial crisis (GFC) has highlighted the connectedness and interdependence of international financial markets. One implication of this new world order is that it is critical to determine the extent that interest rates in different countries are correlated and to identify the volatility components that may dominate the transmission process. In this paper we use interest rate swap yield[4] and spread data to investigate the link and volatility transmission process between three major international swap markets where there is also a high degree of economic integration: Japan, the UK and the US. A key novelty is that we decompose the volatilities of the swap yield and spreads into long- and short-term components and investigate almost the entire history of the swap market from 1990.[5]

This study builds upon an existing literature that links market integration, contagion and volatility transmission between financial assets that trade both within and across countries. Initially, we show that

an appropriate volatility specification is needed to describe the patterns of market links and volatility transmission. In fact, the use of aggregate volatility shocks makes it difficult to measure the degree of integration and to identify which volatility component is dominant in the transmission process. Consequently, many earlier studies find inconclusive evidence of information transmission between the markets investigated. Second, the previous literature typically examines the correlation, contagion and causality among the markets in isolation. However, in this paper we are able to provide a comprehensive study of the market linkages and volatility transmission between swap markets, although we stop short of drawing conclusions on regulatory policy. This we leave to others such as Georgoutsos and Migiakis (2013).

This approach enables us to make the following contribution: First, this is the first study that examines the linkages and volatility transmission across the three major swap markets by decomposing the aggregate volatility into short- and long-term components.[6] Second, we identify the strength (correlations) and direction (causality) of volatility transmission from both contemporaneous and Granger causality perspectives. Third, we examine the contagion effect of crises on the linkages between swap markets. Finally, this study considers different

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  [4] For brevity, henceforth, simply "swaps".
  [5] The Euro is not considered since it was introduced mid sample.

[6] The prior literature links the short-term component to market skewness risk or noise trading, while the long-term component to business cycle risk. See for instance, Adrian and Rosenberg (2008), Engle and Rangel (2008), Engle et al. (2008), Azad et al. (2011), and Rangel and Engle (2012).

approaches to modelling the volatility links among the three major swap markets (Japan, the UK and the US).

While market integration theory suggests that the swap yield curve should be parallel across different markets, short-term deviations from the no-arbitrage condition may cause non-parallel shifts of the term structure of yield, or spread. Lekkos et al. (2007) argue that these links exist among derivative markets due to common variations in the business cycles across economies and the effect of coordinated arbitrage and hedging activities (see also Lekkos and Milas (2001); Eom et al. (2002)), while the recent work of Jotikasthira et al. (2015) find that world inflation and US yield level explain over two-thirds of the covariance of yields of the US, the UK and Germany at all maturities. However, the existing swap literature does not explicitly disentangle the common variation that may be due to business cycle risks. Dornbusch et al. (2000) classify transmission into three categories: (i) the transmission or spillover that takes place during both 'good' times and 'bad' times, (ii) the excess co-movement of shocks that have less relevance to fundamental links (financial links, economic/real links and political links) and (iii) an increased correlation, defined as 'pure contagion' by Forbes and Rigobon (2002), during the 'turmoil period' relative to 'tranquil period'. Hence, this study addresses three key research questions (RQs):

RQ1: Does long-term volatility co-vary across the three major international swap markets investigated?
RQ2: Does short-term volatility co-vary across the three major international swap markets?
RQ3: Is there any contagion effect in the above three major international swap markets?

The first research question asks whether the long-term volatilities across the swap markets are correlated and, if they are, are the correlation times varying? This is linked to the Dornbusch et al. (2000)'s classification of the fundamental link and correlations of business cycle risk. Note that Litzenberger (1992) and Lang et al. (1998) show that default risk of swap counterparties co-varies with the business cycle risk. The second research question is related to Dornbusch et al. (2000)'s classification of excess co-movement, also known as the correlation of the noise component, or skewness risk, across financial markets. Adrian and Rosenberg (2008) define market skewness risk as a measure of tightness of financial constraints. The credit spread differentials across the domestic and international markets can be regarded as skewness risk in swaps (Nishioka and Baba, 2004). With respect to the third research question, Eom et al. (2002) argue that the trading behaviour associated with crisis events is likely to accentuate the integration of swap markets. Hence, it is important to evaluate the influence of key events – such as crisis – on swap market integration. The specific events investigated in this study are explained in the methodology section, but include key periods of financial crisis arising during the recent Lehman default and the Asian financial crisis of 1998.

To investigate these questions, the empirical analysis is based on swaps with a 5-year maturity trading in Japan, the UK and the USA, which are three of the most liquid markets. For brevity we limit the analysis to these maturities and markets. However, this approach can be duplicated by others for other markets and maturities. The analysis is conducted as follows: First, the study decomposes the aggregate volatility shocks into short- and long-term components using the Factor-Spline-GARCH (hereafter FSG-Spline GARCH) of Rangel and Engle (2012). Second, the strength of integration is measured through the short- and long-term volatility correlations using Engle's (2002) Dynamic Conditional Correlation (DCC). These correlations are then utilized to examine the contagion effect. Finally, we model contemporaneous and Granger causality of the volatility components to determine the direction of transmission.

Our findings are as follows. Relating to the first and second research questions, the time-varying correlations between Japan and the UK and between Japan and the US are very low for both swap rates and spreads. These results imply that the level of swap market integration between these countries is statistically weak, and suggests that when swap rates and spreads change, the underlying yield curve shifts in a non-parallel manner. If these circumstances persist international investors could take advantage of this opportunity by going long (or buying) Japanese yen interest rate swaps and going short (or selling) US dollar, or UK pound, swaps to take advantage of the differential between the lower long-term yields of Japanese government bonds and the higher long-term yields of US, or UK, bonds. The low correlations between Japan and the US, or the UK, may also cause an increase in the yen swap rate. Our findings of weak integration between Japan and the UK, and between Japan and the US, suggest that the market linkages detected by prior studies are mainly due to volatility misspecification. Finally, our analysis demonstrates that most of the crisis events influenced the correlations of long- and short-term volatilities across the markets investigated. However, the contagion effect was more evident on the swap spreads than on the underlying yield curve. That is, credit risk components appear to be more affected than swap market risk.

The remainder of this paper is organized as follows. The importance of studying swap market linkages and volatility transmission is discussed briefly in Section 2. To motivate our hypotheses, in Section 3, we review the prior literature on volatility spillovers in swap markets and in two-factor (short- and long-term) volatility models. Section 4 describes the data while Section 5 explains the estimation techniques. Section 6 reports the empirical findings and analysis thereof, while Section 7 concludes.

2. Importance of studying swap market linkages

An interest rate swap is a highly liquid over-the-counter (OTC) derivative instrument comprising two legs, one paying fixed rate and the other paying a floating rate, typically the London interbank offered rate (LIBOR). This study focuses on the plain vanilla swap, i.e., fixed-for-floating swap rate. The swap spread causes the swap yield (fixed-for-floating rate) curve to be above the Treasury (government bond) yield curve. In theory, this spread, at any given maturity, reflects the additional risk premium associated with bank sector credit risk compared to government credit risk. Ito (2010) notes that with the efficient pricing of swap and government bonds, swap spreads provide insights into the level of systemic risk in the banking sector. Unlike the prior swap literature our study examines the linkages, not only of the swap yield, but also its credit risk component, and does so across three major developed countries: Japan, the UK and the USA.

There are several reasons why we examine the linkages present in swap markets. The swap markets around the world have experienced rapid growth in recent years. The most recent BIS (2014) survey indicates that the amount outstanding has grown from very low volumes in the early 1990s to US$421 trillion at end-June 2014. An important observation from the BIS survey is that after the GFC crisis, the use of interest rate swaps has continued to increase. This is because many non-financial corporations use swaps to hedge interest rate risk and to manage their macroeconomic and business risks [ISDA (International Swaps and Derivatives Association, Inc., 2009)]. In terms of notional principal, interest rate swaps represent about 72% of the total OTC interest rate derivatives (BIS, 2014).

Another notable feature of the swap market (in comparison to stocks and bond markets) is that the swap rate is used as a benchmark interest rate in some countries for pricing corporate bonds and various other securities. The academic literature also suggests that the swap rate is a better proxy of the risk-free rate for credit risk pricing [see for instance, Blanco et al. (2005); Xiang et al. (2011)]. This means that the linkages between cross-border swap markets reflect the linkages between different interest rate markets, including government bond markets.