



# Downside and upside risk spillovers between exchange rates and stock prices



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## ABSTRACT

We examined downside and upside risk spillovers from exchange rates to stock prices and vice versa for a set of emerging economies. We characterized the dependence structure between currency and stock returns using copulas and computed downside and upside value-at-risk and conditional value-at-risk. We documented a positive relationship between stock prices and currency values in emerging economies with respect to the US dollar and the euro, with downside and upside spillover risk effects transmitted both ways. Finally, we also documented asymmetries in upside and downside risk spillovers and asymmetric differences in the size of risk spillovers when the domestic currency values against the US dollar and the euro. Our results, consistent with flight-to-quality phenomena, have implications for downside and upside risk management of international investor portfolios in emerging markets.

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## 1. Introduction

Exchange rates and stock prices are two crucial macro finance variables that are intrinsically linked. Exchange rate movements have effects on stock prices given that an appreciation (depreciation) in a domestic currency reduces (increases) the international competitiveness of domestic firms and their cash flows, thereby reducing (increasing) domestic stock prices. Similarly, stock price changes impact exchange rates, since an increase in domestic stock prices triggers currency adjustments to accommodate variations in demand and supply for domestic and foreign assets included in internationally diversified portfolios. Therefore, understanding how exchange rates and stock markets co-move is an important issue for international investors and policy makers in equal measure. In particular, the spillover effect of extreme upward or downward exchange rate movements on stock market performance and

vice versa has important implications in terms of risk management and trading and hedging strategies for international portfolios. The aim of this paper is to quantify and test for spillover risk effects between stock and exchange markets in emerging economies.

The extant empirical literature offers extensive evidence regarding average stock and exchange rate relationships (see the literature review below). However, few studies have examined the dependence structure (in particular, tail dependence) between stock prices and exchange rates (see Ning, 2010; Michelis and Ning, 2010; Lin, 2011; Wang et al., 2013). Moreover, to our knowledge no study to date has analyzed co-movement between stock and exchange rate markets, paying specific attention to quantifying and testing for the impact of upward and downward movements in exchange rates on upside and downside risk in stock markets and vice versa. This issue is of particular interest to investors who want to protect a diversified portfolio against the adverse effects of extreme market movements. It is also of interest to policy makers, as specific shocks in foreign exchange markets could have ramifications for domestic stock markets and may affect capital inflows, which ultimately may affect economic growth. In studying co-movement and spillover risk effects between the stock and

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exchange rate markets, we attempt to add to the existing empirical literature regarding this relationship in two ways.

First, we studied co-movement between stock and exchange rate markets using static and dynamic copula functions, which enable us to assess both average movements across marginals and joint extreme upward and downward movements. On the basis of copula information, we then evaluated the impact of downside and upside risk spillover from one market to the other by computing the downside and upside conditional value-at-risk (CoVaR) (Adrian and Brunnermeier, 2011; Girardi and Ergün, 2013) in the stock and exchange rate markets. CoVaR captures spillover effects between markets by providing the value-at-risk (VaR) of one market conditional on the fact that the other market is under financial distress as measured by its VaR. We assessed spillover effects by testing for significant differences between CoVaR and VaR values using the Kolmogorov–Smirnov (KS) bootstrapping test as proposed by Abadie (2002) and applied by Bernal et al. (2014). Thus, our methodological approach has the advantage of flexibly and fully characterizing the dependence structure between stock and exchange rate markets and providing information on downside and upside spillover effects through the CoVaR, computed using the computationally tractable two-step copula procedure described in Reboredo and Ugolini (2015) for downside CoVaR.

Second, we studied downside and upside spillover effects between stock and exchange rate returns by examining dependence for a broad set of currency–equity pairs for emerging economies (Brazil, Chile, Colombia, India, Mexico, Russia, South Africa and Turkey)—given that these financial markets are sensitive to speculative attacks, to changes in policies with the aim of managing exchange rates and to capital inflows and outflows responding to currency and economic development uncertainties. As trading and capital flows in these economies are mainly denominated in dollars (USD) and euros (EUR), we considered rates for these two currencies against local currencies. Our evidence for the period April 2001 to November 2014 indicates average co-movement between stock and exchange rate markets: emerging economy currencies appreciated (depreciated) as stock market prices rose (fell), consistent with the fact that bullish (bearish) stock markets attract capital inflows as foreign investor demand for local assets increases (decreases)—thus ultimately increasing (reducing) the value of the home currency. We also found evidence of downside and upside risk spillover effects from exchange rates to stock markets and vice versa, given that the downside and upside CoVaR values were, in general, significantly different from the VaR values. In examining asymmetries, we found consistent evidence of asymmetric downside and upside spillovers, with the downside effects greater than the upside effects. We also found asymmetries in spillovers using different currency denominations: spillovers from and to the USD were greater than for the EUR, which may be explained by the fact that the USD plays a more crucial role in trade and finance in emerging economies. Our downside risk results are consistent with flight-to-quality and our analysis has practical implications for the management of downside and upside risk in international investor portfolios that include emerging market assets.

The remainder of the paper is laid out as follows: in Section 2 we review the literature on the relationship between stock prices and exchange rates; in Section 3 we outline the methodological approach to characterizing dependence and the CoVaR; in Section 4 we present our data and in Section 5 we discuss the results. Finally, Section 6 concludes the paper.

## 2. Literature review

The relationship between stock prices and exchange rates is well established at the theoretical level. The model of exchange

rates proposed by Dornbusch and Fischer (1980) focuses on the effects of exchange rate movements on international competitiveness and trade balances. Thus, depreciation (appreciation) of local currency improves (deteriorates) the international competitiveness of local firms and their cash flows, thereby increasing (reducing) stock prices. Other exchange rate models (Branson, 1993; Frankel, 1983) focus on the impact of stock markets on exchange rates: a reduction in stock prices discourages capital inflows as foreign investor demand for local assets decreases, thereby reducing the value of the local currency. Similarly, since changes in the value of local assets can rebalance international investor portfolios, capital flows generate dependence between stock and currency markets (Hau and Rey, 2006; Pavlova and Rigobon, 2007). Furthermore, monetarist models of exchange rate determination (Gavin, 1989) state that changes in the value of stocks may affect exchange rates through the demand for money.

The relationship between stock prices and exchange rates has empirically been extensively examined. Some studies of causality provide evidence, differing across countries, of no causality, unidirectional causality or bivariate causality.<sup>1</sup> Yet other studies have examined the structure of dependence between stock and exchange rate markets. Ning (2010) used different static copulas to characterize dependence between the equity and foreign exchange rate markets for six industrialized countries in the periods before and after the launch of the EUR, finding evidence of symmetric tail dependence. Contrarily, Michelis and Ning (2010) found evidence of asymmetries between Canadian stock returns and the exchange rate against the USD. Also, Lin (2011) examined copula dependence in five East Asian economies, finding evidence of tail independence and asymmetric tail dependence. Finally, Wang et al. (2013) studied dependence between stock and foreign exchange markets in six major industrial countries using a Markov switching copula, finding that dependence and tail dependence were asymmetric in regimes where local currency values against the USD and stock returns were negatively correlated, but symmetric in regimes where local currency values against the USD and stock returns were positively correlated.

Another strand of the literature has examined the relationship between currency and stock returns through the impact on currency markets of capital flows generated by changes in international equity portfolio investments. Thus, Froot et al. (2001), Griffin et al. (2004) and Richards (2005) reported a positive relationship between equity returns and capital inflows—in particular in emerging markets—that generated positive links between equity and local currency values in emerging economies. More recently, Cho et al. (2016) reported that capital inflows and outflows in emerging economies were sensitive to equity market conditions, especially in downturns, when capital movements induced by flight-to-quality generated positive correlations between equity and local currencies.

All the above-mentioned empirical studies consider mean or variance effects in their identification of causal effects between stock prices and exchange rates or consider symmetric effects in the tail dependence structure between equity and exchange rates. However, no study—as far as we are aware—has considered the relationship between stock and exchange rate markets in terms of downside/upside spillover effects of one market on another market—very crucial in terms of international portfolio risk management. To fill this gap, we characterize dependence between stock and exchange rate returns for a broad set of emerging countries. We use static and dynamic copulas, as these offer information on

<sup>1</sup> See, e.g., Abdalla and Murinde (1997), Chow et al. (1997), Ajayi et al. (1998), Granger et al. (2000), Nieh and Lee (2001), Yang and Doong (2004), Phylaktis and Ravazolo (2005), Aloui (2007), Pan et al. (2007), Diamandis and Drakos (2011), Lin (2012)

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