



The ADR shadow exchange rate as an early warning indicator for currency crises

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ABSTRACT

We develop an indicator for currency crisis risk using price spreads between American Depositary Receipts (ADRs) and their underlyings. This risk measure represents the mean exchange rate ADR investors expect after a potential currency crisis or realignment. It makes crisis prediction possible on a daily basis as depreciation expectations are reflected in ADR market prices. Using daily data, we analyze the impact of several risk drivers related to standard currency crisis theories and find that ADR investors perceive higher currency crisis risk when export commodity prices fall, trading partners' currencies depreciate, sovereign yield spreads increase, or interest rate spreads widen.

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1. Introduction

This paper uses American Depositary Receipt (ADR) market data to measure and explain currency crisis expectations on a daily basis. After the introduction of capital controls, price spreads between US dollar-denominated ADRs and their underlying stocks in the emerging market can develop. These price spreads are considered as a high-frequency indicator of currency crisis risk. We use these market price data to calculate the ADR shadow exchange rate, i.e. the mean exchange rate ADR investors expect after a potential currency crisis or realignment. We show that for the capital control episodes in Argentina 2001–2002, Malaysia 1998–1999, Venezuela 1994–1996, and Venezuela 2003–2007, the ADR shadow exchange rate exceeds the pegged rate well before a currency crisis or realignment actually occurs, indicating that ADR investors correctly anticipate these events.

To explain the magnitude of depreciation expectations, we use the ADR spread, which measures the percentage premium of the ADR shadow exchange rate over the official exchange rate. Within panel regressions, we analyze which currency crisis risk drivers ADR investors use to make their pricing decisions, which then determine the level of the ADR spread. In the literature, low-fre-

quency data are often used to verify theoretical hypotheses concerning the occurrence of currency crises. As we focus on a currency crisis measure based on stock market quotes, we are able to identify the observable variables that drive currency crisis risk on a daily basis as measured by the ADR spread. This enables us to analyze the impact of five risk drivers that are closely related to theories about the occurrence of currency crises using daily data: the link between commodity prices and currency crisis risk, the temptation of competitive devaluations, the risk of twin debt and currency crises, the risk of twin banking and currency crises, and the accuracy of interest parity to signal a devaluation.

We find that falling export commodity prices, depreciating export partners' currencies, rising sovereign yield spreads, and rising interest rate spreads increase the risk of a currency crisis – as indicated by rising ADR spreads. This provides evidence that ADR investors take information about the sustainability of a peg as signaled by other segments of the financial market into account when modifying their depreciation expectations.¹

Having identified the risk drivers that determine the magnitude of devaluation ADR investors expect, we study whether there are

¹ These results are obtained even after controlling for market sentiment variables as proposed by Kim et al. (2000) and Arquette et al. (2008) who find that changes in market sentiments, such as US stock market returns or relative price-earnings ratios, are significant drivers violating the law of one price between ADRs and their local underlyings. In our study these sentiment variables also show significant influence on ADR spreads.

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regime switches in the process of determination of currency crisis expectations. We apply the regime switching methodology of Bai et al. (1998), which Kallberg et al. (2005) and Pasquariello (2008) recently used to determine regime breaks in stock pricing induced by financial crises. For the capital control episodes in Malaysia and Venezuela (2003–2007), we find a switch from a relatively tranquil peg regime to a vulnerable peg regime as the correlation between the ADR spread and the risk drivers increased significantly. For Argentina, we find that shortly after the breakdown of the peg, devaluation expectations became much less responsive to the risk drivers of other markets.

The most important branches of literature dealing with the prediction of currency crises are based either on logit/probit models as introduced by Eichengreen et al. (1995) and Frankel and Rose (1996), or on the signals approach put forward by Kaminsky et al. (1998) and Kaminsky and Reinhart (1999). Recently, some authors have applied Markov switching methodology to develop early warning systems for currency crises (Kittlmann et al., 2006; Alvarez-Plata and Schrooten, 2006). These prediction models use macroeconomic variables that presumably lead to currency crises. This literature not only provides useful insight into the nature and causes of currency crises but also shows that crisis prediction is possible at all.

As market data obviously exhibit some advantages over macroeconomic data, such as high frequency and a forward-looking nature, a literature emerged that uses market-based approaches to forecast banking and debt crises. While some pioneering papers forecast the occurrence of banking crises using macroeconomic data (see e.g., Demircuc-Kunt and Detragiache, 1998), recent papers use market information to predict banking distress (see e.g., Gropp et al., 2006; Moshirian and Wu, 2009). To forecast debt crises, some papers use economic fundamentals (see e.g., Detragiache and Spilimbergo, 2004) while others apply market data to estimate country default risk (see e.g., Claessens and Pennacchi, 1996; Huschens et al. 2007).

Our contribution is inspired by a new literature that studies the impact of financial crises on ADR pricing. A common finding is that the returns on U.S. dollar-denominated ADRs are negatively affected by currency crises as the devaluation of the local currency depresses the dollar value of the underlying stock (see e.g., Bailey et al., 2000; Kim et al., 2000; Bin et al., 2004). Pasquariello (2008) finds that the outbreak of a financial crisis typically leads to a disintegration of the local capital market measured by a persistent violation of the law of one price between an ADR and its underlying stock. Chandar et al. (2009) find that cross-listed stocks exhibit higher average returns than non-cross-listed stocks, in particular after the outbreak of financial crises. Another branch of the literature studies how the introduction of capital controls in the home market affects ADR pricing (Melvin, 2003; Levy Yeyati et al., 2004; Auguste et al., 2006). These authors argue that controls on capital outflows lead to a premium of the underlying stock price over the ADR price as the possibility of converting the local currency-denominated underlying stocks into US dollar-denominated ADRs (ADR conversion) represents a legal opportunity of capital flight. Levy Yeyati et al. (2009) confirm this view finding that controls on capital outflows (inflows) lead to persistent price premiums (discounts) of the underlying over the ADR stock. Arquette et al. (2008) analyze the price spreads between Chinese underlying stocks and their corresponding ADRs (or Hong Kong H-shares). They find that exchange rate expectations – extracted from forward exchange rates – explain 40% of the variation in the ADR price spread but that investor sentiments also influence the spread. The literature thus far has concluded that capital controls can lead to a violation of the law of one price, that financial crises influence the relative pricing of ADRs and their underlyings, and that the price spread is correlated with market-traded forward exchange rates.

We contribute to this literature in several ways. First, we quantify ADR shadow exchange rates, which can directly be used as early warning indicators for currency crises. Second, we explain ADR investors' devaluation expectations, as reflected in the ADR spreads, within a regression framework using market-based risk drivers that are related to theories that explain the occurrence of currency crises. Third, we date regime switches in the process of determination of currency crisis expectations, thereby deriving evidence for an endogenous change in ADR investors' assessment of the sustainability of the currency peg.

The remainder is organized as follows. Section 2 describes how depreciation expectations are derived from ADR market data. Section 3 applies this approach to four capital control episodes. Section 4 explains the risk drivers used to explain ADR investors' currency crisis expectations. Section 5 tests the hypotheses of Section 4 and searches for breaks in the process of determination of currency crisis expectations. Section 6 concludes.

2. Measuring currency crisis expectations using ADR market data

The following presents a formal representation of the price relation between ADRs and their underlying stocks in the emerging market and how this information can signal a currency crisis. An ADR stock represents the ownership of a specific number of underlying shares in the home market on which the ADR is written.² While the ADR is traded at a U.S. stock exchange and is denominated in US dollars, the underlying stock is denominated in the currency and traded at the stock exchange of the home (emerging) market.

The starting point of our discussion is ADR conversion. ADR conversion means that one ADR, traded in the US and quoted in US dollars at price p_{it}^{ADR} , can be converted into γ_i shares of the underlying stock, traded in the emerging market and quoted in the emerging market's currency at price p_{it}^{EM} . The variable γ_i is called the conversion ratio and is specific to the ADR stock of each company, i .³

Since ADR conversion can be conducted at any point in time, the ADR and its corresponding underlying stock are perfect substitutes. Thus, assuming perfect capital markets with zero transaction costs, both types of stock should exhibit the same price after applying the market exchange rate, S_t .⁴ In the absence of capital controls, arbitrage forces ensure the validity of the following arbitrage consistent price parity:

$$p_{it}^{EM} = \frac{p_{it}^{ADR} S_t}{\gamma_i} \quad (1)$$

As long as the emerging country fixes its exchange rate to the US dollar at the peg rate S^* , the arbitrage consistent ADR pricing Eq. (1) can be rewritten as:

$$p_{it}^{EM} = \frac{p_{it}^{ADR} S^*}{\gamma_i} \quad (2)$$

Since arbitrage forces guarantee that both types of stock are worth the same, an investor is indifferent as to where to allocate his capital. Eqs. (1) and (2) are, however, only binding as long as ADR arbitrage is possible and cross-border capital flows are not being restricted.

The imposition of capital controls can result in a permanent violation of the arbitrage consistent pricing Eqs. (1) and (2). Because financial proceeds cannot be transferred across borders and, thus,

² See Karolyi (1998) for an excellent survey on the ADR market.

³ Conversely, one emerging market stock can be converted into $1/\gamma_i$ ADRs.

⁴ The exchange rate is defined as the amount of domestic currency units per US dollar.

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