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Currency crisis prediction using ADR market data: An options-based approach

Dominik Maltritz*, Stefan Eichler

Faculty of Business and Economics, TU Dresden, Muenchner Platz 1-3, 01062 Dresden, Germany

Abstract

During capital control episodes, large price deviations between American Depositary Receipts (ADR) and their underlying stocks signal that a currency crisis is about to occur. We interpret this price spread as the price of a call option. Using option pricing theory we derive detailed information about both the probability of a currency crisis and the expected magnitude of devaluation. Analyzing daily ADR market data preceding the Venezuelan crisis (1996), our approach predicts crisis probabilities of almost 100% and forecasts the exchange rate after floating quite accurately. During the Argentine crisis (2002), the estimated exchange rates are similar to the actual ones.
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1. Introduction

Over the past few decades, many developing countries have fallen victim to financial crises. Due to their harmful effects, the literature has thus put an increasing amount of effort into developing models to predict the occurrence of such crises. This paper presents an approach for forecasting currency crises that relies on option pricing theory and uses high-frequency stock market data. In particular, we consider the price spreads between American Depositary Receipts (ADRs) and their underlying stocks in the emerging market.

The most important branches of the literature on forecasting currency crises are based on either logit/probit models – which Eichengreen, Rose, and Wyplosz (1995, 1996) and Frankel and Rose (1996) promote – or the signal or early warning indicator system put forward by Kaminsky, Lizondo, and Reinhart (1998) and Kaminsky and Reinhart (1999). Both types of model use observable economic and sociopolitical variables that presumably lead to currency crises. This body of literature not only provides useful insights into the nature and causes of currency crises, but also shows that currency crisis prediction in general is possible. Indeed, it appears that it would be possible to predict the occurrence of a currency crisis up to two years in advance with some accuracy.

* Corresponding author. Tel.: +49 351 46335905.
E-mail address: Dominik.Maltritz@mailbox.tu-dresden.de (D. Maltritz).

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We focus on short term crisis prediction. The use of stock market data may yield noticeably more accurate forecasts than the models mentioned above, which are based on past observations of economic data describing the causes of a crisis. On the eve of a currency crisis, economic conditions change quickly and dramatically. The data used in existing models are generally observed infrequently and are often outdated. In contrast to these backward-looking approaches, the use of market data is forward-looking, since these data reflect market participants' expectations. Moreover, the high frequency of stock market data more accurately represents changing conditions and makes daily crisis forecasts possible.

The use of market data is based on the assumption that financial markets are able to efficiently process information about the value of the securities being traded, which implies that market prices should reflect all information available in this context, and that market participants are able to correctly anticipate exchange rate movements, at least on average. The market prices of securities whose value depends on the exchange rate can thus be used as input data to derive an assessment of currency crisis risk and the unobservable value of the exchange rate. Even if the markets themselves are not perfect in a theoretical sense, market data may still be superior to other sources of information.

The ADR market in particular reveals information about exchange rate expectations, since the price difference between an ADR stock and its "original" stock is driven by the exchange rate. An ADR stock represents the ownership of a specific number of "underlying" or "original" shares in the home market on which the ADR stock is written.[1] While the ADR stock is traded at a US stock exchange and is denominated in US dollars, the "original" stock is denominated in the currency and traded at the stock exchange of the home market. Every ADR stock can be converted into its respective "original" stock (and vice versa) through ADR conversion using custodian banks. Since the ADR stock and its corresponding "original" stock are substitutes through ADR conversion, and incorporate equivalent rights and dividend claims, both types of a company's stock should exhibit the same price in exchange rate-adjusted terms. Previous to several currency crises, large and persistent price spreads developed between "original" stocks and their cross-listed ADR stocks. This happens when capital controls impede arbitrage forces and induce price segmentation. In this case, the law that an ADR stock and its "original" stock must have the same price no longer holds.

Contemporaneously with the establishment of liquid ADR markets and the growing importance of ADR securities over the past decades, a comprehensive body of literature on ADR pricing has emerged. With respect to our topic, papers that are concerned with the relation between ADR prices and currency (crisis) risk are especially important. In analyzing daily data for a broad set of crisis episodes – including the United Kingdom (1992), Mexico (1994), Southeast Asia (1997), Russia (1998), and Brazil (1999) – Bin, Blenman, and Chen (2004), for example, find that the outbreak of a currency crisis in a given country leads to significantly negative abnormal returns on ADRs in that country. Bailey, Chan, and Chung (2000) analyze intraday ADR prices during the Mexican crisis of 1994/1995, and also report that ADR returns were (negatively) affected by news about the Mexican exchange rate regime and actual depreciations of the peso. Liang and Mougoue (2001) examine monthly data for 110 firms located in the UK, Japan, and South Africa from 1976 to 1990, and confirm that exchange rate fluctuations affect ADR prices.

Several interesting studies, such as Arquette, Brown, and Burdekin (2008), Auguste, Dominguez, Kamil, and Tesar (2006), Levy Yeyati, Schmukler, and van Horen (2004) and Melvin (2003), consider the *spreads* between ADR and corresponding domestic stock prices, rather than the ADR *prices* themselves. They argue that these ADR spreads reflect the risk of a devaluation, since market participants can use the ADR market to hedge their funds (denominated in the domestic currency) against devaluation losses during periods in which capital control exists. Thus, they interpret the ADR spread as an indicator of devaluation risk, and discuss the development of this risk indicator during crisis periods. Some authors, such as Arquette et al. (2008) and Auguste et al. (2006), also analyze the determinants of ADR spreads.

Our paper is inspired by these interesting contributions, but has a different focus. Instead of discussing

[1] See Karolyi (1998) for an excellent survey on the ADR market.

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