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Executive Summary: The term structure of CIP violations

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One of the pillars of how we think about the international currency system is that of covered interest parity (e.g., Keynes 1923), henceforth CIP. According to CIP, the cross-currency basis, that is, the difference between the forward premium relative to the spot exchange rate and the cross-country interest rate differential, should be equal to zero. At trading horizons longer than one year, CIP is also associated with rates on cross-currency basis swaps (xccy) that should be equal to zero. Xccy are foreign exchange derivative instruments that allow for the exchange of two variable rate loans denominated in different currencies.

A growing and important literature provides evidence of persistent CIP violations since the 2008 global financial crisis (GFC) (e.g., Ivashina, Scharftstein, and Stein 2015; Du, Tepper, and Verdelhan 2018). Figure 1 offers an example of the evidence of non-zero basis and xccy rates in the case of the euro, using LIBOR as a proxy for marginal funding costs, following standard practice in the literature. Departures from zero are taken as prima facie evidence that CIP is violated. These violations are mostly considered to be violations of fundamental no-arbitrage principles in financial economics, explained by constraints faced by financial intermediaries (Andersen, Duffie, and Song 2019; Du, Tepper, and Verdelhan 2018; Fleckenstein and Longstaff 2020).

Extant economic theories propose different channels through which intermediary constraints could affect CIP. On one hand, financial constraints could increase the shadow cost of financial intermediation, which bears a risk premium, thereby operating through the stochastic discount factor that is used to value cash flows of financial contracts (e.g., Brunnermeier and Sannikov 2014; He and Krishnamurthy 2013). That channel does not imply any arbitrage opportunities. On the other hand, financial constraints may impact prices of similar assets with identical cash flows differently without requiring a risk premium. In that case, CIP departures from the zero benchmark would be aligned with theories of limits to arbitrage (e.g., Garleanu and Pedersen 2011; Gromb and Vayanos 2010; Shleifer and Vishny 1997).

In our research, "The Term Structure of CIP Violations," we make a dual contribution. First, we exploit CIP violations across different trading horizons to quantify that about two-thirds of the deviations from the zero cross-currency basis and zero xccy rate benchmarks are consistent with the no-arbitrage (NA) principles, while about one-third of them are consistent with the limits-to-arbitrage (LTA) paradigm. Second, we find that the most popular measures of intermediary constraints are related to both the NA and LTA components.

We reach this conclusion by revisiting the valuation of foreign exchange contracts through the lens of fundamental no-arbitrage frameworks. We argue that the key to understanding the CIP violations is understanding the nature of effective funding rates (EFRs) available to marginal international investors. Especially since the GFC, there is no readily available benchmark, even though the cross-currency basis computation relies on an explicit choice of interest rate for discounting cash flows. Relatedly, the conclusion that CIP is violated at longer horizons because xccy rates are non-zero relies on the implicit assumption that LIBOR is the EFR.

Our conceptual framework only assumes the existence of a stochastic discount factor that can be used to value cash flows. Under this premise, we reach the important conclusion that both the cross-currency basis and xccy rates cannot be simultaneously zero under no-arbitrage unless the EFR is equal to LIBOR and it is riskless. There are two reasons for that. First, the EFR has to be riskless due to full collateralization of both forward and xccy contracts. Second, both the cross-currency basis and xccy rates are equal to zero only if the EFR is equal to LIBOR.

Because of the challenges in finding an observable proxy for the EFRs after the GFC, we extract them from related interested derivatives using no-arbitrage principles for a sample of G11 currencies from 2000 to 2019. We show that xccy contracts can be valued relative to plain vanilla interest rate swaps in two different currencies. That insight allows us to use our no-arbitrage framework to model the term structure of interest rates, a standard exercise, and back out the EFRs. The implied EFRs for our panel of 11 currencies are significantly different from LIBOR and are well explained by a linear combination of Treasury rates that are adjusted for convenience yield, sovereign default premiums, and interbank rates. We then use these implied EFRs to value xccy contracts out of sample.

The implied EFRs deliver indeed a zero basis (as opposed to a non-zero LIBOR basis) and non-zero cross-currency rates. That is consistent with our conceptual framework, which highlights a tension between short- and long-horizon CIP benchmarks of a zero basis and xccy rates due to the differences in the EFR and LIBOR. We fit xccy rates reasonably well on average: 21 basis points in the model versus 24 basis points in the data.

Because the extant theory suggests that intermediary constraints could operate through the stochastic discount factor, or outside of it, we examine whether classical variables of intermediary constraints, such as the intermediary capital ratio of He, Kelly, and Manela (2017), and a factor capturing the expensiveness of the USD, are related to our implied pricing kernels or to the pricing errors. We find supportive evidence of both channels, which prevents us from concluding in favor of the most relevant theory for explaining the recent evidence surrounding CIP deviations.

Nevertheless, we can exploit the fact that the pricing errors are orthogonal to the no-arbitrage model, by construction, to attribute xccy rate departures from zero to either the no-arbitrage or limits-to-arbitrage paradigms. A variance decomposition of xccy rates suggests that about two-thirds of their variations are explained by our no-arbitrage framework, while about one-third of their variations are explained by the pricing errors, and thus, are consistent with the limits-to-arbitrage paradigms.

Violations of CIP are in stark contradiction with fundamental theories in finance and international economics. The recent evidence ascribes these violations to a breakdown of the no-arbitrage principles. We show that a third of the violations do represent potential arbitrage opportunities.

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Figure 1: **CIP deviations for the Euro.** We display the log three-month LIBOR basis, defined as the difference between the forward-spot exchange rate premium and the LIBOR interest rate differential in the corresponding currencies, $f - s - (i^{\$} - i^{€})$, and the 5-

year cross-currency basis swap rate for the Euro vs. the U.S. dollar. The swap exchanges interest payments reflecting LIBOR rates in the two countries. The swap rate is quoted as the spread over the EURIBOR-based interest payments. The sample period is January 2000 to December 2019. Source: Bloomberg.

