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Testing for Uncovered Interest Rate Parity Using Distributions Implied by FX Options

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A popular test of market rationality and risk neutrality has been that of the uncovered interest rate parity (the UIP) hypothesis using the famous Fama regression. Unfortunately, the estimation strategy relies on a wide array of assumptions other than rationality and risk neutrality, such as large samples and normality of expectational errors, that are unlikely to be met in the available samples. The results of the tests based on this regression are therefore difficult to interpret and hence the researchers appear reluctant to accept the failure of this test for UIP as a strong case for irrationality or risk aversion. We circumvent the binding restictions of econometric reggressions by suggesting that the UIP be tested directly using the revealed infomation on distribution of future exchange rates implied by option prices.

We begin with traditional tests of the UIP on our data, which position our main results based on estimation of implied risk neutral distributions (RNDs). These involve direct tests of the UIP based on the implied distributions as well as Monte-Carlo simulations based on estimated distributions, which show that some regression based rejections might stem from small sample biases.

We utilize two methods of estimating RNDs, each applied in a different market segment. First, by a means of example, to estimate RNDs from the Chicago Mercantile Exchange (CME) data we employ a non-parametric Jackwerth and Rubinstein approach. We demonstrate the potential power of such non-parametric tests of the UIP verification using data on yen options from two days in January 1999 when the UIP seemed to have failed in its predictions. On the basis of the implied distributions we could not reject the UIP hypothesis on either of the dates, the reason being an apparent thickness of the distributions of expectations. These examples in our view justify the usage of non-parametric or at least less restrictive methods allowing for different shapes of distributions investors' expectations of future exchange rates in tests for the UIP. However, because CME data offer only a handful of maturity days per year, they seem to us less efficient for the tests of forward rate unbiasedness than the more abundant OTC options. Therefore, we perform formal tests of predictive capability of risk neutral distributions using data from the OTC market. The price of using data from this more representative market is that we had to resort to a more restrictive parametric method. Specifically, for estimation of RNDs from European OTC options we base our approach on the technique of Malz, who suggests quadratic extrapolation of the options' smile in the delta space, extended by Cincibuch to account for very heavy tails of the distributions.

Having the risk neutral distributions estimated, we design a series of tests to see to what extent the observed data on expectation errors contradict the behavior implied by RNDs. We test directly for the zero mean of the observed expectation errors using the implied RNDs as a transformation of the errors to independent standard normal observations. We cannot reject the hypothesis in neither of subsamples containg uncorrelated observation of non-overlapping contracts. The same result was obtained in an attempt to pool all the observations into one sample by estimating its covariance structure. This result is also quite robust with respect to the parametric

form of the distribution. In turn it means that the UIP hypothesis is not rejected on conventional levels for maturity of one month. By a way of comparison, we ran the same tests using the distributional assumptions of the expectation errors assumed by the conventional Fama regression. Although we cannot reject the hypotheses either, the results appear weaker.

Further, we test a more general hypothesis that RNDs are good enough approximation of the true distribution of expectations. To do so we apply variants of the Pearson's and likelihood ratio tests for the whole class of distribution parametrizations. We find that there exists a distribution in this class for which this hypothesis also performs quite well. Thus, the main result of our tests is that we tend not to reject the hypothesis that actual realizations of the exchange rate were drawn from the implied risk-neutral distribution.

SUMMARY

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A popular test of market rationality and risk neutrality has been that of the uncovered interest rate parity hypothesis (UIP) using Fama regression. The test's estimation strategy relies on a wide array of assumptions other than rationality and risk neutrality, such as large samples and the normality of expectational errors, which are unlikely to be met in the available samples. The regression results are therefore difficult to interpret and researchers appear reluctant to accept the failure of this test for UIP as a strong case for irrationality or risk aversion. We circumvent the binding restrictions of econometric regressions by suggesting that UIP be tested directly using the revealed information on distribution of future exchange rates implied by option prices. We design a series of tests based on implied risk-neutral distribution and tend not to reject the hypothesis.