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General equilibrium pricing of CPI derivatives

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Abstract

We examine the issue of pricing forward futures and option contracts written on the Consumer Price Index (CPI), the change of which is a measure of inflation affecting the economy. Traditional approaches postulate an exogenous process for the price level and then derive CPI derivatives prices by standard arbitrage arguments. By contrast, we build the general equilibrium of a continuous time monetary economy that is affected by both real and nominal shocks. The price level and thus the inflation rate are found endogenously and solutions for the prices of CPI derivatives are obtained, which are in closed form in a specialized version of the economy.

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1. Introduction

On June 21, 1985, the Coffee, Sugar, and Cocoa Exchange in New York proposed for trade a new futures contract on the Consumer Price Index (CPI). This happened many years after several economists urged the regulatory authorities to create such a market because of persistent inflation. However, in spite of original enthusiasm, the CPI futures market experienced little activity and was finally closed in 1991. The reason for the failure was attributed to the non-existence of a primary market for inflation to trade against the futures.¹ The continuous issue by the US Treasury of TIPS (Treasury Inflation Protected Securities) since 1997 primed a new interest for CPI derivatives, whether forwards/futures or options. TIPS, although they do not provide a perfect protection against inflation for technical reasons, in particular the indexation lag issue and the taxation of revenues, could in effect be used as approximate devices for hedging such CPI derivatives.

At least four other arguments can be advanced for the potential interest of such markets. The first one is related to the current conduct of monetary policy. An important variable upon which the Federal Reserve grounds its policy interventions is inflation expectations on the part of economic agents. CPI derivatives will provide undoubtedly a close to perfect estimator of such expectations, in addition to revealing useful information as to the inflation risk premium and real interest rates. Standard techniques, such as the comparison of yields on nominal bonds with yields on indexed bonds, rely on too many assumptions to deliver estimates robust and reliable enough for policy purposes. The creation of futures/forward markets and options markets would enhance the informativeness of the bond and TIPS markets. A second argument in favor of the development of CPI derivatives markets is the high degree of expertise achieved by present traders, as evidenced by the development of derivative assets written on non-financial underlyings such as electricity, weather, CPU capacity or natural catastrophes.

Therefore, even though TIPS provide only imperfect hedges against inflation, this should not be a concern from a trading standpoint. The third argument is the recent revival in the strategic asset allocation literature of the study of how uncertain inflation impacts on long-lived investors' optimal portfolios. In particular, [Campbell and Viceira \(2001\)](#) in discrete time and for infinitely lived individuals, and [Brennan and Xia \(2002\)](#) in continuous time and for finite-horizon investors derive optimal dynamic portfolio strategies when only nominal assets are available for trade so that there exists no riskless security. It is found that the optimal portfolio composition depends crucially on the stochastic behavior of changes in the investment opportunity set, of which inflation is a critical element. Two complementary recent papers by [Kothari and Shanken \(2004\)](#) and [Roll \(2004\)](#) reinforce this point. They show that, as the correlation between stock returns and TIPS returns is negative, according to both calibrated simulation and empirical tests, including TIPS in an already diversified

¹ This was the very explanation of the President of the Exchange, James Bowe, quoted by [Wrase \(1997, footnote 4, p. 6\)](#).

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