International tax arbitrage, currency options and put-call parity conditions☆

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ABSTRACT

Using a finite-horizon general equilibrium model with uncertainty and money, we characterize situations where tax arbitrage opportunities may arise for international portfolio investors in an economy with heterogeneous capital income taxation where foreign currency exposure can be hedged using forward contracts and a set of currency options. We obtain tax-modified option prices similar to the no-tax ones, but augmented by tax-induced "risk-premium" terms; tax-modified put-call parity conditions are derived that revert to their standard (no-tax) format if the respective marginal agents in the bond and option markets are in identical tax brackets.

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1. Introduction

The use of derivative securities has become pervasive in international financial markets, prompting a substantial literature dealing with the pricing of such instruments.[1] A well-known no-arbitrage result in this context, alongside the standard covered interest parity condition, is the put-call parity condition relating the forward price of a currency to the prices/strike prices of put and call options on that currency.[2] Common to most of this literature is abstraction from the effects of international capital income taxation on the asset prices in question. This is not necessarily an innocuous assumption as sufficient heterogeneity in the taxation of international capital income may provide opportunities for

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[1] See e.g. Hull (2008) for an overview.
[2] See e.g. the early exposition by Grabbe (1983).

international tax arbitrage, which has non-trivial implications for the characterization of the pricing relationships involved. From a theoretical viewpoint, tax arbitrage opportunities, i.e. arbitrage opportunities resulting from different tax treatments across agents and/or assets, are well-known to give rise to existence problems in sufficiently diverse asset economies with taxation unless the equilibrium is suitably bounded.[3] Given that international capital income taxation is pervasive and not typically of a strictly homogeneous nature, the question of how these put-call parity conditions would measure up under explicit consideration of heterogeneous capital income taxation clearly deserves some further examination.

In the present paper, we use a finite-horizon general equilibrium model with uncertainty and money to characterize more explicitly situations where tax arbitrage opportunities may arise for risk-neutral portfolio investors. The model applies to an economy with heterogeneous capital income taxation in which foreign currency exposure can be hedged using forward contracts and a set of currency options and gives insights into the implications for portfolio choices and pricing relationships (i.e. interest parity and put-call parity conditions, forward rates and option prices) in international capital markets. By extending the Martingale methodology introduced to the tax area by Dybvig and Ross (1986) and Ross (1987), we obtain tax-modified uncovered interest parity conditions and forward rates similar to the ones derived for the no-tax case, but augmented by "risk-premium" terms featuring the conditional Martingale covariance of one-period-ahead exchange rates and tax factors, normalized by the conditional Martingale expectation of the latter. Tax-modified option prices can be similarly decomposed; the "risk-premium" terms in this case feature the conditional Martingale covariance of one-period-ahead exercise values and tax factors, normalized by the conditional Martingale expectation of the latter. The discount factor component in option prices features the ratio of conditional Martingale expectations of one-period-ahead tax factors as determined by the respective marginal agents in the bond and option markets, resulting in tax-modified versions of the put-call parity conditions that revert to their standard (no-tax) format if those marginal agents are in identical tax brackets. This is probably not an unrealistic assumption considering the prevalence of large, similarly taxed participants, i.e. major investment banks, in these markets and matches the important stylized fact that put-call parity conditions approximately hold for the major traded foreign currencies.

Covered interest parity conditions remain unaffected by the introduction of capital income taxes, a consequence of our assumption that all capital income components are being taxed equally throughout; this matches the well-known stylized fact that covered interest parity conditions approximately hold for the major traded foreign currencies. Unlike marginal agents, non-marginal ones are generally indifferent only between domestic and foreign bonds that are covered by forward contracts and/or option reversals where the strike price equals the forward rate. Their net option holdings and net borrowing/lending are at boundaries of their respective choice sets, constraints we motivate by recourse to tax and resource arguments, generally allowing them to exploit finite tax arbitrage opportunities in equilibrium. The methodology used can be adapted to further scenarios where tax arbitrage opportunities due to tax wedges prevailing in an international environment may seem exploitable for international portfolio investors.

The remainder of the paper is then organized as follows: Section 2 introduces our basic framework and derives personalized Martingale representations of interest parity and put-call parity conditions, forward rates and option prices for the case of homogeneous taxation; Section 3, allowing for the existence issues associated with the arising tax arbitrage opportunities, modifies those results for the case of heterogeneous taxation; and Section 4 concludes the paper.

2. Model with homogeneous taxes

As our basic framework we consider a finite-horizon general equilibrium model[4] with uncertainty and money, featuring dates $t \in \mathbf{T} = \{0 \ldots T\}$. The evolution of uncertainty can be characterized

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[3] For a general treatment see e.g. Dammon and Green (1987).
[4] The modeling approach extends the framework in Strobel (2001, 2005).