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ODNOS IZMEĐU ROČNE STRUKTURE NOMINALNIH KAMATNIH STOPA, REALNIH STOPA I INFLACIJE

Rezime

Mada se krive prinosa konstruišu svakodnevno, po svim valutama i različitim klasama investitora i koriste kao mera troška zaduživanja za različite ročnosti, malo se zna o tome šta pokreće kamatne stope. Pošto empirijsko istraživanje sugerira da stope koje čine krive prinosa ustvari predstavljaju "nominalne stope" na koje utiče uzajamno dejstvo između "realnih stopa" i očekivane inflacije za odgovarajuće vremenske horizonte, pitanje kako odrediti te komponente i njihovo učešće u nominalnim stopama izazvalo je mnogo rada u ovoj oblasti. Ovaj rad ima za cilj da prezentuje različite pristupe određivanju kompozicije nominalni kamatnih stopa i izvuče zaključke u pogledu implikacija tih nalaza na investicione strategije i ekonomski izgled.

Ključne reči: kamatne stope, inflacija, premija za inflatorni rizik, nominalne stope, realne stope, ekonomski rast

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THE RELATIONSHIP BETWEEN NOMINAL INTEREST RATES, REAL RATES AND INFLATION TERM STRUCTURE

Summary

Although yield curves are constructed daily, across all currencies and different investor classes, and are used as a measure of cost of borrowing for different maturities, very little is known about what drives the interest rates. As empirical research suggests that the rates comprising the yield curves are actually 'nominal rates' governed by the interplay between the 'real rates' and inflation expected for the corresponding time horizons, the question of how to determine these components and their participation in the nominal rates has prompted much work in this field. This paper aims to present various approaches to determining the composition of nominal interest rates and draw conclusions regarding the implication of these findings on the investment strategies and the economic outlook.

Key words: interest rate, inflation, inflation risk premium, nominal rates, real rates, economic growth

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Uvod

Očekivana inflacija i realne kamatne stope na različite vremenske horizonte predstavljaju važne ekonomske promenljive, a ipak ostaju neprimećene u praksi. Dok se inflacija tipično izvodi iz vrednosti CPI (Indeks potrošačkih cena), realne kamatne stope mogu samo da se procenjuju poređenjem istorijskih nominalnih kamatnih stopa i odgovarajuće inflacije. Mnogi autori tvrde da realne stope ostaju uglavnom nepromenjene, kako sugerišu istorijske analize koje podržavaju stalnost (Fama, 1975), srednju-reverziju (Hamilton, 1985) ili proces jedinstvenog korena (Rose, 1988) - stohastički proces koji se vremenom razvija, sa jednom kao korenom karakterističnih jednačina procesa. Dalje, promene (ako ih ima) u realnim stopama ograničavaju se na kratak deo krive prinosa implicirajući da su fluktuacije dugoročnog kraja krive prinosa uglavnom određene odgovarajućim promenama očekivane inflacije. Nasuprot tome, neki autori ukazuju na postojanje negativne korelacije između realnih stopa i očekivane inflacije (Marshall, 1992). Bilo kako, očigledan je značaj razumevanja uloge inflacije u ročnoj strukturi krive prinosa. Ako je inflacija primarna determinanta budućeg razvoja krive prinosa, investicije u instrumente duge ročnosti mogu da izgledaju manje profitabilne, jer će bilo kakve dobitke u većim kamatnim stopama kompenzovati gubitak vrednosti primljenih sredstava zbog inflacije. Zato naredne sekcije imaju za cilj da prikažu tekući rad na inflaciji i njenoj ulozi u ročnoj strukturi kamatne stope.

Komponente kamatne stope

Mada je veliki rad uložen u procenjivanje realnih kamatnih stopa primenom različitih modela, najvećem broju teoretskih pristupa nedostaju transparentnost, operabilnost i često se oslanjaju na neopažajne promenljive (na pr. trenutne stope) ili na nerealne uslove (na pr. ravnoteža, nepostojanje arbitraže, neutralnost u pogledu rizika ili racionalna očekivanja). Ipak, nezavisno od pristupa modeliranja, većina autora se sreće sa teškoćom pristupa pouzdanim podacima. Na primer, informacije o očekivanom nivou inflacije tokom roka obveznice tipično se izvode iz razlike između nominalnog prinosa i prinosa vezanog za inflaciju i naziva se "rentabilna inflaciona stopa". Ipak, paradoksalno, investicioni proizvodi vezani za inflaciju nisu samo relativno retki na tržištu, već takođe implicitno polaze od određenih nivoa inflacije, uvodeći na taj način još jedan nivo neizvesnosti u procene. Dalje, oslanjanje na instrumente vezane za CPI uvodi vremensko kašnjenje između informacije uzete za modeliranje i sadašnjeg nivoa inflacije, zbog oslanjanja na objavljene istorijske podatke. Otuda, u najboljem slučaju, inflacija se može proceniti sa nekim nivoom poverenja. Problem se dalje osložava činjenicom da je čak procenjena rentabilna stopa inflacije samo mera sa *šumom* očekivane inflacije, zbog komponente premije za inflatorni rizik impliciran u njenom nivou. Prema Hördahlu i Tristaniju (2007), premija likvidnosti može isto tako da ima značajnu ulogu u očekivanom nivou inflacije, gde tržišne sile ponude i tražnje iskrivljavaju sliku realnih ekonomskih očekivanja. Pri datom gledištu da će sve privremene kratkoročne promene inflacije imati samo lokalizovane efekte na ekonomiju, dugoročna inflatorna očekivanja su od interesa za investitore - polazeći od kredibilnosti inflacionih ciljeva centralne banke - i ostaju usidrena na nivou konzistentnom sa objavljenim projektovanim nivoima. Otuda, analitički fokus je na dugoročnim nominalnim prinosima, za koje se jednoobrazno prihvata da se sastoje od realnog prinosa, prosečnih inflatornih očekivanja i premije za inflatorni rizik. Ovde, premija za inflatorni rizik predstavlja komponentu koja odražava nivo samog inflatornog rizika ili nivo averzije investitora da nose taj rizik - koji se naziva "tržišna cena rizika" - a najverovatnije oba. Međutim, u prvom slučaju, viši inflatorni rizik može da se tumači kao indikator veće neizvesnosti u ukupnom makroekonomskom okruženju, dok u drugom, varijacije nivoa inflatornog rizika mogu jednostavno da postoje zbog konkretnih preferencija investitora i njihove potrebe za izloženošću cikličnim pozicijama ekonomije ili nivou inflacije. Otuda, odvajanje premije za inflatorni rizik od premije vezane za nominalne kamatne stope (što implicitno uključuje realnu premiju koju zahtevaju investitori da bi se kompenzovali za

Introduction

The expected inflation and real interest rates over different time horizons are important economic variables, yet they remain unobservable in practice. While inflation is typically derived from the CPI (Consumer Price Index) values, real interest rates can only be estimated by comparison of the historical nominal interest rates and corresponding inflation. Many authors claim that real rates should remain largely unchanged, as suggested by historical analyses that support either constancy (Fama, 1975), mean-reversion (Hamilton, 1985), or unit root process (Rose, 1988)-a stochastic process that evolves with time, with one as the root of the process's characteristic equation. Moreover, the changes (if any) in the real rates should be confined to the short end of the yield curve, implying that the fluctuations in the long-term end of the yield curve are largely determined by the corresponding changes in expected inflation. In contrast, some authors propose existence of negative correlation between real rates and expected inflation (Marshall, 1992). Whatever the case might be, the importance of understanding the role of inflation in the yield term structure is evident. If inflation is the primary determinant of the future evolution of the yield curve, investments into instruments of long maturity may appear less favourable, for any gains in greater interest rates will be compensated by the devaluation of the funds received due to inflation. Thus, the following sections aim to describe current work on inflation and its role in the interest rate term structure.

Interest Rate Components

Although ample work has been carried out on estimating real interest rates by applying different models, most theoretical approaches lack transparency, tractability and often rely on unobservable variables (e.g. instantaneous rates) or unrealistic conditions (e.g. equilibrium, no arbitrage, risk-neutrality, or rational expectations). Yet, irrespective of the modelling approach, most authors face the difficulty in accessing reliable data. For example, information on expected level of inflation over the life of a bond is typically derived from the difference between the nominal and inflation-linked yield and is termed 'break-even inflation rate'. Yet, paradoxically, the inflation-linked investment products are not only relatively rare in the market, they also implicitly assume certain inflation levels, thus introducing yet another level of uncertainty in the estimate. Moreover, relaying on CPI-linked instruments introduces a time lag between the information used in modelling and the actual level of inflation, due to their reliance on published historical data. Hence, at best, the inflation can be estimated with some level of confidence. The problem is further compounded by the fact that even the estimated break-even inflation rate is just a noisy measure of expected inflation, due to the inflation risk premium component implicit in its level. According to Hördahl and Tristani (2007), liquidity premia may also play an important role in the expected level of inflation, whereby the market forces of supply and demand distort the picture of real economic expectations. Given the view that any temporary, short-term changes in inflation will only have localized effects on economy, it is the long-term inflation expectations that are of interest to the investors and-assuming credibility of the central bank's inflation objective-should remain anchored at the level consistent with the announced projected levels. Hence, the analytical focus is on long-term nominal yields, which are uniformly accepted as comprised of a real yield, average inflation expectations and an inflation risk premium. Here, the inflation risk premium is the component that reflects either the level of inflation risk itself, or the level of investors' aversion to bear that risk-referred to as the 'market price of risk', and most likely both. However, in the first case, the higher inflation risk could be interpreted as an indicator of greater uncertainty in the overall macroeconomic environment, whereas, in the second, variations in the inflation risk level may simply be due to the particular investors' preferences and their need for exposure to the cyclical position of the economy or the inflation level. Hence, separating the inflation risk premium form that associated with nominal interest rates (which implicitly includes the real premium the investors require in order to compensate for the uncertainly in the expected real interest rates), requires rich set of variables, most of which are not directly

neizvesnost u očekivanim realnim kamatnim stopama), zahteva bogat skup promenljivih, od kojih većina nije neposredno vidljiva na tržištu.

Da bi se ovaj problem prevazišao, eksperti u oboj oblasti imaju raznovrsne pristupe, koji se grubo mogu klasifikovati kao: (i) izvlačenje očekivane inflacije i realnih stopa iz nominalnih prinosa izvedenih iz proizvoda kojima se trguje u kombinaciji sa realizovanim ili prognoziranim nivoima inflacije; (ii) primena ravnotežnih afinih modela na ročne strukture; i (iii) inkorporisanje zamene inflacionog režima u modele ročne strukture.

Pregled literature

Najraniji objavljeni rad u ovoj oblasti bio je prilično jednostavan, jer, umesto korišćenja postojeće ročne strukture za razvijanje modela određivanja cene sposobnog da procenjuje realne stope i očekivanu inflaciju, prognoziranje je bilo ograničeno na projekciju ex-post realnih stopa na instrumentalne promenljive (Mishkin, 1981; Huiziga & Mishkin, 1986). Ovaj pristup nije samo osetljiv na predubeđenja koja proizilaze iz izostavljanja važnih promenljivih koje utiču na ročnu strukturu, već je sklon grešci u merenju, koja sa svoje strane nastaje zato što je očekivana inflacija jednostavno izjednačena sa razlikom između nominalnih i realnih stopa. Sofisticiraniji pristup zasniva se na korišćenju modela nižeg reda Auto-regresivnog integrisanog pokretnog proseka (ARIMA) za identifikovanje očekivane inflacije i realnih stopa pod pretpostavkom racionalnih očekivanja (Fama & Gibbons, 1982; Hamilton, 1985; Burmeister, Wall & Hamilton, 1986). Ti modeli su, u suštini, doterane verzije modela nasumičnog hoda i nasumičnog trenda, gde se kašnjenja diferenciranih serija i/ili kašnjenja grešaka u prognozi dodaju u jednačini prognoze da bi se eliminisala autokorelacija iz greške u prognozi. Međutim, ovaj pristup još uvek zahteva implicitne pretpostavke u pogledu procesa vremenskih serija i racionalnih očekivanja investitora.

Pošto sadašnji pregled literature potvrđuje odsustvo bilo koje saglasnosti kao i odsustvo robustnih rezultata u pogledu predznaka, veličine, ročne strukture i volatilnosti premije za inflatorni rizik, zamena režima (gde predznak inflacionog rizika može da prelazi iz pozitivnog u negativni kao i da omogući povećanu volatilnost na kratkom kraju inflacione krive) pokazao se kao najprihvatljiviji pristup odvajanju realnih i nominalnih stopa.

Mada empirijski dokazi o prisustvu zamene režima kod kamatnih stopa podržavaju ovo gledište (na pr. Gray, 1996; Sola & Driffil, 1994; Bekaert, Hodrick, & Marshal, 2001; Ang & Bekaert, 2002), mnogi od autora koji su inkorporisali informacije o ročnoj strukturi u model određivanja cena da bi dobili realne stope i procene očekivane inflacije isključili su izmenu režima i strukturne promene iz svog okvira (na pr. Pennachi, 1991, Sun, 1992, Evans, 1998; Remolona, Wickens, & Gong, 1998). Dalje, čak i autori koji su razvili modele ročne strukture koji uključuju izmene režima (Naik & Lee, 1994; Bansal, Tauchen, & Yhou, 2003, Dai, Singleton, & Young, 2003) usredsredili su se samo na podatke o nominalnim kamatnim stopama. Istaknuti izuzetak je rad Veronezija i Yareda (1999), čiji model obuhvata realne i nominalne prinose, mada dopušta izmene režima samo kod dugoročnog proseka. Najzad, model koji predlažu Ang i Bekaert (2003) ne samo da je unapredio praćenje već je uprostio proces procenjivanja. Sličan pristup je primenio Evans (2003), koji je pretpostavio da su realni prinosi vidljivi i formulisao je dinamički model utvrđivanja cene sa izmenama režima. Drugi radovi koji mogu da bace svetlo na raznovrsnost pristupa i tehnika koje se koriste za određivanje realnih prinosa uključuju, na primer, model sa pragovima zasnovan na hipotezi očekivanja, koju je razvio Modena (2008), koja se nastavlja na postojeću teoriju očekivanja uključenjem prirode ročne premije koja se menja kroz vreme. Sa druge strane, Adrian i Wu (2010) pružaju procene ročne strukture inflatornih očekivanja izvedenih iz afinih modela realnih i nominalnih krivih prinosa. Autori su inkorporisali stohastičku kovarijansu inflacije u svoj model, koji prikazuje jezgro realnog utvrđivanja cene, uklapajući se na taj način ne samo u prinose, već i u odgovarajuću matricu varijanse-kovarijanse. Da bi se unapredila operabilnost njihovog pristupa, Chernov i Mueller (2008) oslonili su se na praćenje prognoza da bi dopunili podatke koje nudi ročna struktura inflatornih očekivanja implicirana u nominalnim prinosima. Ključno

observable in the market.

In order to overcome this problem, experts in the field have taken variety of approaches, which could be broadly classified as: (i) extracting the expected inflation and real rates from nominal yields derived from traded products in combination with the realized or forecast inflation levels; (ii) applying equilibrium affine models to the term structure; and (iii) incorporating the inflation regime switching into the term structure models.

Literature Review

The earliest published work in this field was fairly simplistic, as, rather than using extant term structure to develop a pricing model capable of estimating real rates and expected inflation, forecasting was confined to projecting ex-post real rates on instrumental variables (Mishkin, 1981; Huizinga & Mishkin, 1986). This approach is not only sensitive to bias arising from omitting important variables affecting the term structure, it is also prone to measurement error, which, in turn, arises because expected inflation is simply equated to the difference between nominal and real rates. A more sophisticated approach is based on using low-order Auto-Regressive Integrated Moving Average (ARIMA) models to identify expected inflation and real rates under the assumption of rational expectations (Fama & Gibbons, 1982; Hamilton, 1985; Burmeister, Wall, & Hamilton, 1986). These models are, in essence, fine-tuned versions of random-walk and random-trend models, whereby lags of the differenced series and/or lags of the forecast errors are added to the prediction equation, in order to eliminate autocorrelation from the forecast error. However, this approach still requires implicit assumptions regarding the time-series process and rational investor expectations.

As extant literature review confirms the absence of any agreement as well as lack of robust results on the sign, size, maturity structure and volatility of inflation risk premia, regime switching (whereby the sign of inflation risk can alternate between positive and negative as well as allow for increased volatility at the short end of the inflation curve) seems to be the most appropriate approach to segregating real and nominal rates.

Although empirical evidence on the presence of regime switching in interest rates supports this view (e.g. Gray, 1996; Sola & Driffill, 1994; Bekaert, Hodrick, & Marshall, 2001; Ang & Bekaert, 2002), a number of authors that have incorporated the term structure information into a pricing model in order to obtain real rate and expected inflation estimates have excluded both the regime switching and the structural changes from their framework (e.g. Pennacchi, 1991; Sun, 1992; Evans, 1998; Remolona, Wickens, & Gong, 1998). Moreover, even the authors that have developed term structure models incorporating regime switches (e.g. Naik & Lee, 1994; Bansal, Tauchen, & Zhou, 2003; Dai, Singleton, & Yang, 2003) focused solely on nominal interest rate data. Notable exception is the work of Veronesi and Yared (1999), whose model addressed both real and nominal yields, albeit allowing regime switching only in the long-term mean. Finally, the model proposed by Ang and Bekaert (2003) not only improved on the tractability but also simplified the estimation process. Similar approach was taken by Evans (2003), who assumed that real yields are observable and formulated a dynamic pricing model with regime switches. Other works that may shed light on the variety of approaches and techniques used to determine real yields include, for example, the threshold model based on expectations hypothesis, developed by Modena (2008), which expands on the extant expectations theory by incorporating the time-varying nature of the term premium. On the other hand, Adrian and Wu (2010) provided estimates of the term structure of inflation expectations derived from an affine model of real and nominal yield curves. The authors incorporated stochastic covariation of inflation into their model, which features a real pricing kernel, thus fitting not only to yields, but also to the corresponding variance-covariance matrix. In order to improve tractability of their approach, Chernov and Mueller (2008) relied on survey forecasts in order to supplement the data offered by the term structure of inflation expectations implicit in the nominal yields. The key question the authors aimed to answer was whether US monetary policy was effective. Moreover, their model not only accommodated

pitanje autora imalo je za cilj otkrivanje da li je monetarna politika SAD bila efektivna. Dalje, njihov model nije samo obuhvatio prognoze po višestrukim horizontima iz višestrukih izvora već je takođe omogućio razlike između rizično neutralnih, subjektivnih i objektivnih mera verovatnoće. Slično, Berardi (2007) je razvio interno konzistentan strukturni model, koji nameće među-sekcijska ograničenja dinamici ročne strukture kamatnih stopa, kao i inflatorne nivoe i rast autputa. Konkretnije, ovaj model je uveo centralne tendencije koje variraju sa vremenom i stohastički uslovni prosek rasta autputa. Najzad, Gürkaynak, Sack, i Wright (2008) koristili su hartije od vrednosti Trezora zaštićene od inflacije (TIPS) - dužničke hartije od vrednosti čije su otplate kupona i glavnice indeksirane prema Indeksu potrošačkih cena (CPI) - da bi pružili procenu inflatorne kompenzacije. Prema autorima, inflatorna kompenzacija (ili rentabilne inflatorne stope) mogu da se izvedu poređenjem TIPS-a sa odgovarajućom nominalnom krivom prinosa. Uspostavljanje odnosa između procenjene inflatorne kompenzacije i inflatornih očekivanja i neizvesnosti takođe je pružilo neke empirijske podatke u prilog gledišta da na te mere utiče premija za inflatorni rizik, koja može znatno da varira. Njena definicija i ključne karakteristike daju se sa više detalja u daljem tekstu.

Šta je premija za inflatorni rizik

Premija za inflatorni rizik nastaje zbog izloženosti nepredvidivim promenama u inflaciji kojoj su podvrgnuti investitori koji drže nominalnu aktivu. Pošto se većina investicija kotira po nominalnom prinosu, stvarne isplate realizovane do dospeća uveliko zavise od toga kako se inflacija razvija tokom tog perioda. Pri datoj implicitnoj neizvesnosti u pogledu budućih nivoa inflacije, investitori zahtevaju premiju koja može da pruži kompenzaciju za rizik povezan sa fluktuacijama inflacije koje ne mogu da se prognoziraju. Otuda, izgleda logično da premija za inflatorni rizik treba ne samo da bude pozitivna, već i da se povećava sa ročnošću aktive. Međutim, mnogi ekonomski teoretičari sugerišu nešto drugo. Na primer, neki prostiji modeli zasnovani su na pretpostavci da je cena aktive direktno vezana za kovarijansu

forecasts over multiple horizons from multiple sources but also allowed for differences between risk-neutral, subjective, and objective probability measures. Similarly, Berardi (2007) developed and internally consistent structural model, imposing cross-sectional restrictions on the dynamics of the interest rates term structure, as well as inflation levels and output growth. More specifically, this model introduced both time-varying central tendencies and a stochastic conditional mean of output growth. Finally, Gürkaynak, Sack, and Wright (2008) used Treasury inflation-protected securities (TIPS)—debt securities for which the coupon and principal payments are indexed to the Consumer Price Index (CPI)-to provide an estimate of inflation compensation. According to the authors, inflation compensation (or breakeven inflation rates) can be derived by comparing TIPS with the corresponding nominal yield curve. The established relationship between the estimated inflation compensation and its expectations and uncertainty also provided some empirical evidence in support of the view that these measures are affected by the inflation risk premium, which can vary considerably.

Its definition and the key characteristics are covered in more detail below.

What is Inflation Risk Premium?

Inflation risk premia arise due to the exposure to unanticipated changes in inflation that investors holding nominal assets are subjected to. As most investments are quoted in terms of nominal yield, the actual payoff realised until maturity is greatly dependent on how inflation evolves over that period. Given the implicit uncertainty in the future levels of inflation, the investors require a premium that can compensate for the risk associated with inflation fluctuations that cannot be forecast. Hence, it seems logical that inflation risk premium should not only be positive, but also increase in magnitude in line with the asset maturity. However, many economic theorists suggest otherwise. For example, some simpler models are based on an assumption that the price of an asset is directly related to the covariance between its payoff and the real consumption growth. Under this framework,

između isplate i realnog rasta potrošnje. Prema ovom okviru, cene nominalne aktive, na pr. obveznice sa kuponima, implicitno će zavisiti od kovarijanse između potrošnje i inflacije. Zato će predznak ove implicitne kovarijanse odrediti predznak premije inflatornog rizika, pri čemu, ako je negativan, investicije u nominalnu aktivu postaju rizičnije i zahtevaće pozitivnu premiju da bi ostale atraktivne. S druge strane, pozitivna kovarijansa bi omogućila nominalnoj aktivi da delimično hedžuje iznenadne padove nivoa potrošnje. Otuda, u takvom scenariju, investitori bi bili voljni da prihvate niži očekivani povraćaj, tj. inflatorna premija bila bi negativna. Međutim, pri datom značaju uzajamnog dejstva između inflacije i kamatnih stopa kod određivanja ne samo profitabilnosti investicija, već i kod ocenjivanja ekonomskih izgleda, važno je ispitati ulogu premije za inflatorni rizik u ročnoj strukturi kamatne stope. Nezavisno od svog predznaka, premija za inflatorni rizik čini da pokušaji na dekomponovanju nominalne kamatne stope na njene sastavne delove budu komplikovaniji. Na primer, za datu nominalnu obveznicu, može se posmatrati nekoliko mera: (1) realni prinos do dospeća obveznice, (2) realna premija zbog rizika vezanog za evoluciju realne stope, (3) prosečna očekivana stopa inflacije tokom perioda u kome ugovor o obveznici izjednačava očekivani realni povraćaj na nominalnu obveznicu sa povraćajem na odgovarajuću realnu obveznicu, i (4) premija na inflatorni rizik. Jasno, ukupna ročna premija vezana za ugovor o obveznici (obično poznata kao premija za nominalni rizik) predstavlja zbir premije za realni rizik i premije za inflatorni rizik i jednaka je razlici između nominalnog prinosa na obveznicu i očekivane prosečne nominalne kamatne stope za jedan period tokom trajanja obveznice. Odatle, rentabilna inflaciona stopa (tj. stopa koja bi dovela nominalni prinos u sklad sa realnim prinosom) može lako da se dobije i ona određuje odnose između rentabilne stope i inflatornih očekivanja investitora.

Zaključak

Razumevanje odnosa između ročne strukture kamatne stope i odgovarajućih nivoa inflacije od ključnog je značaja za donošenje investicionih odluka kao i za formulisanje ekonomske politike. Empirijski podaci sugerišu da inflatorna očekivanja i očekivanja ekonomskog rasta isto tako imaju ključnu ulogu u utvrđivanju cena finansijskih instrumenata i mogu uticati na raspoloživu količinu nekih klasa proizvoda koje najviše pogađaju njihove fluktuacije. Dalje, pošto sve drastične fluktuacije u poslovnom ciklusu imaju negativan uticaj na ekonomiju, države i centralne banke sve više su usmerene na upravljanje inflacijom u pokušaju da se izbegnu znatne fluktuacije u poslovnom ciklusu i da se podstakne ekonomski rast. Međutim, isto tako je tačno da će sve promene cena aktive i ekonomske politike imati uticaj na nivoe inflacije i realnog rasta i na taj način implicitno uticati na očekivanja tržišta u pogledu njihovih budućih trendova.

Međutim, pošto preovlađujuće strukture kamatne stope i krive prinosa ostaju u fokusu pažnje ekonomista i stratega tržišta, nije inflacija *per se* interesantna, već njen efekat na profitabilnost štednje i investicija, jer stvara "klin" između nominalne i realne kamate ostvarene tokom trajanja proizvoda.

Ekstenzivna literatura je otkrila raznovrsne pristupe diferenciranju realnih od nominalnih kamatnih stopa kao i isto tako ukazala na vrlo malo slaganja o veličini i čak o predznaku premije za inflatorni rizik. Međutim, podaci izvedeni iz raspoloživih obveznica vezanih za indeks sugerišu da nominalne stope tipično nadmašuju realne prinose. Dalje, pošto je kriva nominalnog prinosa tipično strmija od krive realnog prinosa, to sugeriše da je gep između njih ne samo pozitivan u korist nominalnih stopa, već da se isto tako širi sa ročnošću instrumenta. Pri datom međusobnom uticaju između kamatnih stopa i inflacije, ovi podaci jasno ukazuju na pozitivnu premiju za inflatorni rizik. Međutim, takvo gledište je previše uprošćeno, jer da bi se u potpunosti obuhvatio njegov efekat, potrebno je imati stav o dugoročnim inflatornim očekivanjima. Pošto to nije vidljiv kvantitet, potreban je teoretski okvir. Mada je teško i neoprezno davati bilo kakve definitivne zaključke u pogledu inflacije i njenog efekta na kamatne stope, neke opservacije mogu biti interesantne:

1. Kod kratkih ročnosti, realne stope su tipično promenljive. To sugeriše da sentiment učesnika na tržištu kao i tržišni uslovi utiču

prices of nominal assets, e.g. coupon-bearing bonds, will implicitly depend on the covariance between the consumption and inflation. Therefore, the sign of this implicit covariance will determine the sign of the inflation risk premium, whereby, if negative, investments into nominal assets would become more risky and would require a positive premium to remain attractive. On the other hand, positive covariance would allow the nominal assets to partially hedge sudden drops in consumption levels. Hence, in such a scenario, investors would be willing to accept a lower expected return, i.e. the inflation premium would be negative. However, given the importance of the interplay between the inflation and interest rates in determining not only profitability of investments, but also assessing the economic outlook, it is important to examine the role of inflation risk premium in the interest rate term structure. Irrespective of its sign, the inflation risk premium makes the attempts at the decomposition of nominal interest rates into its component parts more complicated. For example, for a given nominal bond, several measures can be observed: (1) the real yield until the bond matures, (2) the real premium due to risk associated with the evolution of the real rate, (3) the average expected inflation rate during the bond contract equating the expected real return of the nominal bond to that of the corresponding real bond, and (4) the inflation risk premium. Clearly, the total term premium associated with the bond contract (commonly known as the nominal risk premium) is the sum of the real risk premium and the inflation risk premium, and is the difference between the nominal bond yield and the expected average one-period nominal interest rate during the life of the bond. From here, the break-even inflation rate (i.e. the rate that would bring the nominal yield in line with the real yield) can be easily obtained and it determines the relationship between the break-even rate and investors' inflation expectations.

Conclusion

Understanding the relationship between the interest rate term structure and the corresponding inflation levels is critical in making investment decisions as well as formulating economic policy. Empirical evidence suggests that inflation and economic growth expectations also play a key role in pricing financial instruments and can affect trading volumes of certain product classes most affected by their fluctuations. Moreover, as any drastic fluctuations in the business cycle have negative impact on the economy, governments and central banks are increasingly focused on managing inflation, in an attempt to avoid significant business cycle fluctuations and spur economic growth. However, it is equally true that any changes in asset prices and economic policies will have an effect on inflation and real growth levels, and thus implicitly influence market expectations of their future trends.

However, as prevalent interest rate and the yield curve structure remain the focus of economists and market strategists, it is not inflation per se that is of interest, but rather its effect on the profitability of savings and investments, as it creates a 'wedge' between the nominal and real interest achieved over the lifetime of the product.

Extensive literature review has revealed variety of approaches to differentiating real from nominal interest rates as well as pointed to the very little agreement on the size and even the sign of the inflation risk premium. However, the data derived from available index-linked bonds suggests that nominal rates typically exceed the real yields. Moreover, as the nominal yield curve tends to be steeper than the real yield curve, it would suggest that the gap between the two is not only positive in favour of the nominal rates, but it also widens with instrument maturity. Given the interplay between the interest rates and inflation, this evidence clearly points to positive inflation risk premium. However, such view is overly simplistic, as in order to fully capture its effect, it is necessary to take a stance on long-term inflation expectations. As this is not an observable quantity, a theoretical framework is necessary. Although making any definitive conclusions with respect of inflation and its effect on rates is hard, and rather imprudent, some observations may be of interest.

1. At short maturities, real rates are typically variable. This suggests that trading

na stope samo privremeno.

2. Kod dugih ročnosti, realne stope se ne menjaju bitno i uglavnom ih ne pogađaju promene tržišnih uslova. Otuda se može istaći da inflatorna očekivanja teže da budu konvergentna sa prognoziranim nivoom.
3. Realna kratkoročna kamatna stopa tipično je negativno korelisana sa inflacijom, što implicira da su viši nominalni povraćaji ostvareni u kratkim periodima zavaravajući zbog visoke inflacije.

Sve u svemu, mada ne postoji definitivan odgovor u pogledu efekta premije za inflatorni rizik na realne povraćaje, poređenje između instumenata vezanih za CPI i njihovi pandani sa odgovarajućom nominalnom stopom mogu da služe kao gruba mera očekivanja ekonomskog rasta. Treba, međutim, napomenuti da su tržišta još uvek vođena spekulativnom trgovinom i njihove reakcije na objave javne politike treba uzimati oprezno, naročito kada se radi o dugoročnim investicijama.

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sentiments and market conditions affect the rates only temporarily.

2. At long maturities, real rates are smooth and mostly unaffected by changes in market conditions. Hence, it may be noted that inflation expectation tends to converge to the forecast level.
3. The real short-term interest rate is typically negatively correlated with inflation, implying that the higher nominal returns achieved in short periods would be misleading, due to high inflation.

In sum, although there is no definitive answer as to the effect of inflation risk premium on real returns, comparisons between CPI-linked instruments and their corresponding nominal rate counterparts can serve as a crude measure of economic growth expectations. It should, however, be noted, that markets are still largely driven by speculative trading and their reactions to public policy announcements should be treated with caution, especially when long-term investments are made.

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