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Market-Based Measurement of Expectations on Short-Term Rates in Turkey

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Abstract

This paper aims to serve two purposes. First, it evaluates the ability of various financial market instruments to capture market expectations on short-term rate. Second, it proposes an alternative approach to obtain estimates of term premium inherent in alternative returns. Empirical results reveal that Turkish lira (TRY) returns implied by USD/TRY forward rates dominate all other return types for predicting the overnight interbank repo rate, followed by TRY interbank bid rate. Moreover, these return types are found to contain the lowest and least volatile term premium. However, forecasting ability of returns declines significantly with the introduction of the new policy framework by the Central Bank of Turkey, which utilizes "controlled degree of uncertainty" in o/n rates as an additional tool. In the recent period TRY interbank bid and ask rates stand out as returns with the highest ability to represent market expectations.

JEL Codes: E43, E52, G12.

Keywords: Monetary policy, expectations on short-term rate, market-based measures of expectations, term premium

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1. Introduction

Expectation management is an essential component of monetary policy, especially in economies where financial markets play a significant role as expectations of forward-looking market participants constitute a direct channel for monetary policy. Svensson (2004) defines monetary policy as "to a large extent the management of expectations." In this context, proper measurement and monitoring of market expectations on short-term money market rate, which is very closely linked to monetary policy, is critically important for the efficacy of monetary policy as these expectations directly determine long-term rates, which central bank intends to have effect on.

One way of obtaining market expectations on short-term rate is to refer to reports and surveys. However, declaration based expectations carry the risk of being improperly reported or biased depending on investment positions of market participants. Additionally, being observed in low frequencies constrains their usefulness significantly for timely monitoring of market expectations. The other approach is to utilize the market prices of financial instruments for measuring market expectations. Expectations derived from market prices are expected to be free of declaration or reporting biases. Moreover, high frequency market prices enable the timely monitoring of and hence capturing changes in market expectations. This approach necessitates for central banks to better understand and analyze the relationship between market prices and expectations on short-term rates.

Measuring expectations on short-term rate from asset prices has been the focus of many empirical papers in literature. However, bulk of these papers adopts advanced economies with deep financial markets and financial instrument diversity as their laboratory. Krueger and Kuttner (1996), Rudebusch (1998) and Brunner (2000) could be named among the pioneers in using market rates to analyze market expectations and have been followed by many others. While many papers focus on the same issue of extracting market expectations on short term or policy rates, they differentiate in terms of the assets chosen. In this context,

Kuttner (2001) uses the current-month federal funds futures contract to measure expectations on short-term rate in US, Bomfim (2003) and Poole and Rasche (2000) the month-ahead federal funds futures contract, Cochrane and Piazzesi (2002) the one-month Eurodollar deposit rate, Rigobon and Sack (2002) the three-month Eurodollar futures rate, and Ellingsten and Soderstom (2004) the three-month treasury bill rate. Wide variety of financial instruments used in various papers in related literature has brought up the question of which of those instruments is superior to others in terms of the ability to capture market expectations. To answer this question, Gürkaynak et. al. (2007) evaluate the empirical success of a variety of financial market instruments in predicting the future path of monetary policy. They present evidence that federal funds futures dominates all other securities in forecasting monetary policy at horizons out to six months.

Despite the vast quantity of papers focusing on advanced economies, literature shrinks down significantly when it is the emerging economies at the focal point. In one of these papers, Reppa (2008) constructs a yield curve, which is proposed to represent market expectations on the future path of short-term rates, by using money market and swap rates. On the other hand, Alp et. al. (2010) compare the ability of various financial instruments in measuring market expectations on central bank's current-month policy rate decision in Turkey using various methods. Konstantinou (2005) tests whether expectations hypothesis holds for the short end of the Polish interbank term structure and provides some empirical evidence that the actual yield spread is an unbiased predictor of the perfect foresight spread.

This paper aims to serve two purposes. First, it evaluates the ability of various financial market returns which are considered to be closely related to short-term rates, to capture market expectations on the future course of short-term rate and hence monetary policy. To this end, alternative returns' success in predicting the weighted average of Turkish lira (TRY) overnight (o/n) repo rate in the period between January 1, 2007 and July 27, 2011 is estimated for various horizons up to six months. Those returns having the highest predictive

power are taken to be the best measures of market expectations. Returns included in the analysis are TRY interbank bid (Trylibid) and ask rates (Trylibor), TRY depo ask (Depoask), bid (Depobid) and last rates (Depolast) quoted by financial institutions in Bloomberg and TRY rates implied by USD/TRY forward contracts (Tryforw).[3] These returns are expected to be closely linked to the o/n rate as they are either close substitutes or functions of the o/n repo rate. Unlike Alp et. al. (2010), we left bond returns out of the return set since these returns may include various premiums such as inflation and default premium as stated by Başçı and Ekinci (2005). Additionally, the analysis is conducted separately for the period between December 2010 and July 2012. In this period, the Central Bank of Turkey (CBT) has adopted a new policy framework in which it has used the degree of policy predictability and uncertainty in o/n rate as an additional tool.

The paper also proposes an alternative method to obtain estimates for term premium inherent in alternative returns. These estimates serve as an additional measure for the convenience of returns for measuring market expectations. Arguably more importantly, premiums are measured in such a way that they can be used for practical purposes as these estimates could be incorporated in the construction of the curve for market expectations on the course of the o/n rate. For this, distributions of differences between forward rates are obtained for periods in which policy rate is unanimously expected to remain unchanged.

Results reveal that Tryforw dominates all other returns for predicting the o/n repo rate at horizons out to six months, closely followed by Trylibid. Prediction performance declines for longer horizons for all return types except Tryforw whose predictive power remains substantial even at six months horizon. Moreover, Tryforw is found to contain the lowest and least volatile term premiums together with Trylibid. All these findings bring Tryforw to the fore as being the most convenient return for the derivation of market expectations for the period examined. Trylibid also performs well.

[3] TRY rates implied by USD/TRY forward contracts are found to be very close to TRY rates quoted for USD/TRY cross currency swaps. Hence, results obtained for Tryforw could also apply for rates quoted for USD/TRY cross currency swaps.

However, estimations for the period in which the CBT has adopted a new policy framework depict a contrasting picture with the previous ones. In this period, forecasting power of all types of returns diminishes to a significant extent, even vanishing at some sub periods. This is in line with our expectations as the CBT has intended to incorporate uncertainty by creating high level of volatility in the ISE repo market via gauging the amount of liquidity in the interbank market. Trylibid and Trylibor stand out as having "relatively" high forecasting power through the recent period.

The remainder of the paper proceeds as follows. Section two provides our estimation framework and discusses the methodology. Section three displays the estimation results. Section four focuses on the recent period of new monetary policy framework and reports estimation results for that period. Section five presents an alternative method to obtain measures for term premium in alternative returns. Section six concludes.

2. Empirical Specification

Rational market participants are expected to use all available information to make the best forecasts. For this reason, in this paper we take the ability of alternative financial returns to predict the TRY o/n repo rate for various horizons as an indicator of how convenient they are for measuring market expectations. In this context, we refer to the "weak form of expectation hypothesis" (WFEH), which is a common assumption in literature. According to this hypothesis, due to the ability of investors to substitute between different financial market instruments, a long-term return must be equal to the expected rate of return from an investment strategy of rolling over o/n rates through the term of the long-term return, plus a risk premium which covers premiums required for risks associated with investing for longer terms. In this framework, we test the forecasting power of various financial returns by estimating equation (1), which is a standard interest rate forecasting regression widely used in the literature:

$$i_t^p = \alpha + \beta\left(\left(\left(\prod_{k=t}^{t+p-1}\left(1+\frac{on_k}{36000}\right)\right)-1\right)\left(\frac{36000}{p}\right)\right) + \varepsilon_t \qquad (1)$$

In the equation above, i_t^p is the rate of return on a p-term market instrument at day t and on_k denotes the o/n rate at day k. The expression in the outmost parenthesis presents the compounded return to the strategy of rolling over o/n rate and α incorporates the average level of risk premium. To avoid the problem of autocorrelation, horizons of long-term returns in the sample should not overlap. By other words, the sample should be comprised of observations at time t, t+p, t+2p...

According to WFEH, under the no-arbitrage condition, β should be equal to 1, α to be equal to a constant including a term premium together with all other premiums imposed by the structure of the financial instrument and ε_t to cover deviations of term premium from its long-term average, plus all other factors contributing to the deviation of the return from compounded o/n rate. Although WFEH assumes term premium to be constant over time, we do not require this assumption for this paper, since we are interested in the forecasting performance of regression (1) rather than structural estimates of β. To the extent that the risk premium varies over time, it will deteriorate the forecasting performance of the financial return and lead us to favor against it. Thus we will automatically be led to favor instruments for which time varying risk premium is less of an issue. We are interested in particular in the $R^2$of the regression as it is a measure of the usefullness of returns for forecasting the o/n rate.

The estimation of equation (1) brings together the problem of cointegration among variables and in that case the estimated coefficients represent the long-run relationship between variables. Since we are primarily interested in the ability of market rates to predict the o/n at the horizon up to six months, we follow the common practice in literature and "stochastically detrend" equation (1) by subtracting off the current level of o/n rate from both sides of the equation:

$$i_t^p - on_t = \alpha + \beta\left(\left(\left(\prod_{k=t}^{t+p-1}\left(1+\frac{on_k}{36000}\right)\right)\left(\frac{36000}{p}\right)\right) - on_t\right) + \varepsilon_t \qquad (2)$$

3. Results

Estimation results of equation (2) for alternative returns and horizons of 1, 2, 3 and 6 months are reported in Table 1 and R^2 values are plotted in Figure 1 as a function of the horizon[4]. As seen in Figure 1, there exists no pronounced pattern for the R^2 values with the forecast horizon up to three months. However, forecasting power of all types of returns diminishes sharply except for Tryforw at the six-month horizon. Results indicate that Tryforw dominates all other return types in predicting o/n rates at all horizons. At the horizon of one month, Trylibid also has a high forecasting power, a result consistent with Alp et al (2010), which concludes that Trylibid has the highest forecasting power at the horizon of one week.

The estimated average risk premium, which is denoted by α in equation (2) is quite large and increasing with the horizon for returns except Tryforw. It may in part reflect the compensation for higher counterparty risk for longer horizons. However consecutive reduction in policy rates by amounts larger than market anticipated in the period between November 2008 and November 2009 may well have boosted the estimated risk premiums. On the other hand, estimated risk premium is fairly low or even statistically insignificant at some horizons for Tryforw as it does not incorporate any significant counterparty risk since forward agreements comprise an exchange instead of a loan.

As the last point, we cannot reject the hypothesis that β=1 at 95% confidence level for horizons up to three months for all return types. However, note that the estimated values of β differ from unity considerably, albeit not significantly as forecast horizon increases except for Fxforw. At the horizon of six months β statistically differs from 1 while it is still not different than 1 for Tryforw at 90% confidence level. Here, we should emphasize that the sample size used in estimations is limited especially for the six-month horizon due to the unavailability of

[4] Limited size of the sample restrains us from estimating the forecasting power of returns at longer horizons.

data prior to the period analyzed and necessity for non-overlapping horizons. This requires a cautious approach in the assessment of results for longer horizons.

4. The New Framework For Monetary Policy: Controlled Uncertainty

In the post-crisis period, Turkish economy has experienced a strong domestic demand driven recovery. Strengthening short term capital inflows fueled by extremely easy monetary policies across advanced economies have further supported rapid credit growth and led to an appreciation in TRY, exacerbating the divergence between the pace of recovery in domestic demand and external demand. Rapidly widening current account deficit coupled with short term capital inflows raised financial stability concerns, bringing new challenges for the implementation of monetary policy.

In order to cope with these challenges, the CBT modified its existing framework to bring the economy to a soft landing and to rebalance the composition of growth, without hampering the price stability objective. Accordingly, the CBT has adopted a new policy mix by using alternative policy tools, namely the required reserve ratios, short-term interest rates and the interest rate corridor.[5]

One of the motivations for adopting interest rate corridor as an additional instrument was to introduce "controlled uncertainty" in short-term rates, thus discourage short-term speculative inflows by reducing the expected return-to-risk ratios from carry trades and reinforce the effectiveness of required reserve ratios. The induced volatility in short-term rates has been accompanied by less policy guidance regarding the path of future policy rates to further bolster the impact of the interest rate risk channel. By other words, The CBT started using the degree of policy predictability and uncertainty in o/n rate as an additional tool.

The new policy framework has taken its toll on the ability of various returns to forecast the future course of o/n rate, as intended. Table 2 designates results for the re-estimation of equation (2) for the period extended to cover the "controlled uncertainty" period. Results reveal that forecasting powers of all alternative returns decline significantly,

[5] See Başçı and Kara (2011) for a detailed exposition of the new policy framework.

the decline being relatively limited for Trylibor and Trylibid. Additionally, the hypothesis that β is equal to unity is rejected for some horizons, which in part reflects time-varying term premium.

Results are not surprising since the uncertainty induced by the monetary policy directly reflects on o/n repo market; but also lead us to isolate and have a closer look at the recent period. To this end, we estimated equation (2) for the period between December 2010 and July 2012, however this time taking the forecast horizon as one week and by rolling regressions of 30 observations. Though not compatible with the previous section, one-week forecast horizon enabled us to have enough observations to conduct regressions, and rolling regressions to trace changes in forecasting ability of returns through time. Figure 2 depicts rolling R^2 values of regressions for the whole-sample best forecasters. Unsurprisingly, forecasting powers of returns decline in the recent period, albeit to surprisingly low levels. The R^2 values follow a volatile course through the period, sometimes even touching the "almost zero" bound. In this period, Trylibor and Trylibid step ahead as returns with higher forecasting ability and hence better in capturing market expectations. On the other hand, term premiums estimated for tryforw are significantly higher than the premiums obtained previously, while difference is not noteworthy for other return types.

5. An Alternative Approach for the Term Premium:

Estimated values of average term premiums, which are denoted by α in equation (2), are not of our primary interest in the previous section as we focus on measuring the ability of various returns to forecast the o/n rate. However, in practical use it is of critical importance as one needs to assume a reasonable rate of term premium in order to obtain market expectations curve. Otherwise uncertainty as to whether the difference between forward rates reflects the term premium or expectations of o/n rate change could lead to wrong inferences. Equation (3) below presents the relationship between spot and forward rates:

$$(1 + i_{t,t+N})^N = (1 + i_{t,t+p})^p \times (1 + f_{t+p,t+N})^{N-p} \quad (3)$$

In the equation above, $i_{t,t+N}$ and $i_{t,t+p}$ denote spot rates at time t with terms of N and p months, respectively. $f_{t+p,t+N}$ represents the (t+p)x(t+N) forward rate at time t, that is the forward return at time t for the period of length (N-p) months between time (t+p) and (t+N). Forward curve can be constructed by applying equation (3) recursively using spot rates. More precisely, forward rates for the first three months of the curve, tx(t+1), (t+1)x(t+2) and (t+2)x(t+3) forward rates, are calculated as follows:

$$f_{t,t+1} = i_{t,t+1} \quad (4)$$

$$f_{t+1,t+2} = ((i_{t,t+2} + 1)^2/(i_{t,t+1} + 1)) - 1 \quad (5)$$

$$f_{t+2,t+3} = ((i_{t,t+3} + 1)^3/(i_{t,t+2} + 1)^2) - 1 \quad (6)$$

Forward rates calculated as above are comprised of two components according to WFEH: Compounded rate of expected o/n rates through the period forward rate covers and a term premium. In this respect there must be a term premium between forward rates with consequent value dates such as $f_{t+1,t+2}$ and $f_{t+2,t+3}$. For this reason, it is crucial to assess whether the difference between $f_{t+1,t+2}$ and $f_{t+2,t+3}$ is a reflection of expectations of a change in the o/n rate from the period of (t+1,t+2) to (t+2,t+3) or just the term premium.

Estimates of α in equation (2) in section two contain information regarding the term premium in alternative returns for different terms. However, the limited sample size used in estimations and the dominance of downside shocks to policy rate in the sample period requires caution in using these estimated values of term premiums in practice. Additionally, α also includes premium for the structural differences between investing in alternative financial instruments and o/n repo market in ISE such as taxation, transaction costs etc.

In this context, an alternative approach to have an indicator of the term premium incorporated in alternative returns is to analyze the differences between forward rates with different value dates for the periods in which there exists a complete consensus on constant

o/n rate through the horizon of three months[6]. Expectations of no change in o/n rate imply that differences between forward rates shown below will mostly reflect term premium.

$$d_{t,t+1} = f_{t,t+1} - on_t \tag{7}$$

$$d_{t+1,t+2} = f_{t+1,t+2} - f_{t,t+1} \tag{8}$$

$$d_{t+2,t+3} = f_{t+2,t+3} - f_{t+1,t+2} \tag{9}$$

$d_{t,t+1}$, $d_{t+1,t+2}$ and $d_{t+2,t+3}$ can be taken as proxies for term premiums between forward rates[7]. Descriptive statistics for these differences for the periods of 15.12.2009 - 15.03.2010 and 01.07.2010 - 30.11.2010 in which market participant are in complete agreement in favor of o/n rate to be constant through the three month horizon are reported in Table 2 and their distribution in Panel 1[8].

Results reveal that premiums for Tryforw are distributed symmetrically around zero, $d_{t,t+1}$, $d_{t+1,t+2}$ and $d_{t+2,t+3}$ having median values of 12, 1 and 8 basis points. These figures are consistent with the findings in section two and what we expected as these instruments include an exchange rather than lending. Trylibid, which is another good predictor of o/n rates especially for shorter horizons, is found to contain term stable term premium. Overall, term premiums for alternative returns are tended to increase with horizon, which is a natural consequence of the proportionality of risk premium, uncertainty and the horizon.

Findings in this section underpin the results of the previous section in the sense that Fxforw is the return type with lowest and stable term premium, Trylibid accompanying them in terms of the stability of premium. On the hand, term premiums obtained by two different

[6]The CBT's Survey of Expectations reports expectations for o/n rate only up to three-months horizon, rendering calculations impossible for horizons longer than three months.

[7] There are two reasons for calculating differences between forward rates and using them as proxies of term premiums in the construction of the expectations curve: First, an mentioned previously, forward rates, which are calculated recursively from spot rates, are used to measure expectations on the course of the o/n rate. In this respect, inferences regarding expectations are made by evaluating these differences between consequetive forward returns. Second, this methodology prevents the volatility in o/n term returns of various financial instruments passing through to term premium calculations.

[8] Market participants are assumed to be in complete agreement in favor of o/n rate to be constant through the three month horizon if appropriate mean of expected o/n rate after three months is equal to the current o/n rate in the CBT's Survey of Expectations.

methods in the two sections of this paper are found to be closely correlated as shown in Figure 2, 3 and 4.

6. Conclusions

This paper aims to serve two purposes. First, it evaluates the ability of various financial market instruments to capture market expectations on the future course of short-term rate and hence monetary policy. Second, it proposes an alternative method to obtain estimates for term premiums inherent in alternative returns which serves as an additional measure in the comparison of the convenience of financial returns for deriving market expectations and also can be used in the construction of the curve for market expectations.

Results for the period until July 2011 reveal that TRY returns on USD/TRY forward rate agreements dominates all other returns for predicting the o/n repo rate at horizons up to six months, followed closely by TRY interbank bid rate. Predicting performance declines for longer horizons for all return types except returns on forward rate contracts whose predictive power remains substantial even at the six month horizon. Moreover, these return types are found to contain the lowest and least volatile term premium.

However, forecasting ability of returns declines significantly with the introduction of the new policy framework by the CBT, which utilizes “controlled degree of uncertainty” in o/n rates as an additional tool in the recent period. The new framework takes its toll on forward rate returns, the two instruments which that are traded actively. In the recent period TRY interbank bid and ask rates stand out in terms of the ability to capture market expectations.

References

Alp, H., Kara, H., Keleş, G., Gürkaynak R. and Orak M. (2010), "Türkiye'de Piyasa Göstergelerinden Para Politikası Beklentilerinin Ölçülmesi," Working Papers 2011, Central Bank of Turkey.

Başçı, E., Ekinci, M. F. (2005), "Bond Premium in Turkey: Inflation Risk or Default Risk?," Emerging Markets Finance & Trade, Vol. 41, No. 2, pp. 25-40

Başçı, E., Kara, H. (2011), "Finansal İstikrar ve Para Politikası", İktisat İşletme ve Finans, Bilgesel Yayıncılık, vol. 26(302), pages 9-25.

Bomfim, A. (2003), "Pre-Announcement Effects, News Effects, and Volatility: Monetary Policy and the Stock Market," Journal of Banking and Finance, 27, 133-151.

Brunner, A. D. (2000), "On the Derivation of Monetary Policy Shocks: Should We Throw the VAR Out with the Bath Water?" Journal of Money, Credit, and Banking, 32, 254-79.

Cochrane, J. H. ve Piazzesi, M. (2002), "The Fed and Interest Rates: A High Frequency Identification," American Economic Review Papers and Proceedings, 92, 90-101.

Ellingsen, T., Söderström, U. ve Massenz, L. (2004), "Monetary Policy and the Bond Market," Manuscript, Stockholm School of Economics ve IGIER, Universit`a Bocconi.

Gürkaynak, R., Sack, B. ve Swanson, E. P. (2007), "Market-Based Measures of Monetary Policy Expectations," Journal of Business and Economic Statistics, 25(2), 201-212.

Konstantinou, P. T. (2005), "The Expectations Hypothesis of the Term Structure : A Look at the Polish Interbank Market," Emerging Markets Finance & Trade, Vol. 41, No. 3, pp. 70-91

Krueger, J. T. ve Kuttner, K. N. (1996), "The Fed Funds Futures Rate as a Predictor of Federal Reserve Policy," Journal of Futures Markets, 16, 865-879.

Kuttner, K. (2001), “Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market,” Journal of Monetary Economics, 47(3), 523-44.

Poole, W. ve Rasche, R. H. (2000), “Perfecting the Market’s Knowledge of Monetary Policy,” Journal of Financial Services Research, 255-298.

Reppa, Z. (2008), "Estimating yield curves from swap, BUBOR and FRA data," MNB Occasional Papers 2008/73, Magyar Nemzeti Bank (the central bank of Hungary).

Rigobon, R. ve Sack, B. (2002), “The Impact of Monetary Policy on Asset Prices,” National Bureau of Economic Research, Working Paper 8794.

Rudebusch, G. (1998), “Do Measures of Monetary Policy in a VAR Make Sense?” International Economic Review, 39, 907-931.

Svensson, L. E. O. (2004), “Challenges for Monetary Policy,” paper presented at the Bellagio Group Meeting, National Bank of Belgium, Brussels, 26-27 January 2004.

Appendix

Table 1: Monthly Regression Results of Equation (2) for the period between January 2007 and July 2011

$$i_t^p - on_t = \alpha + \beta\left(\left(\left(\prod_{k=t}^{t+p-1}\left(1+\frac{on_k}{36000}\right)\right)\left(\frac{36000}{p}\right)\right) - on_t\right) + \varepsilon_t$$

	α	Standard errors	β	Standard errors	R^2	*p-value* H_0:β=1
Tryforw						
one-month	0.04	(0.07)	1.06***	(0.10)	0.70	0.55
two-month	0.00	(0.08)	0.97***	(0.10)	0.81	0.77
three-month	0.16	(0.11)	0.83***	(0.10)	0.81	0.11
six-month	0.73**	(0.25)	0.41*	(0.18)	0.47	0.01
Trylibor						
one-month	1.10***	(0.09)	1.00***	(0.12)	0.58	1.00
two-month	1.20***	(0.16)	0.70***	(0.19)	0.35	0.13
three-month	1.45***	(0.26)	0.63**	(0.22)	0.33	0.11
six-month	2.03***	(0.25)	-0.13	(0.18)	0.08	0.00
Trylibid						
one-month	0.39***	(0.08)	1.06***	(0.11)	0.65	0.59
two-month	0.49***	(0.15)	0.74***	(0.19)	0.39	0.18
three-month	0.72**	(0.25)	0.67***	(0.21)	0.37	0.13
six-month	1.18***	(0.23)	-0.14	(0.16)	0.11	0.00
Depoask						
one-month	1.53***	(0.15)	1.01***	(0.20)	0.34	0.96
two-month	1.71***	(0.22)	0.79***	(0.27)	0.25	0.44
three-month	1.82***	(0.25)	0.66***	(0.21)	0.37	0.12
six-month	2.57***	(0.44)	-0.10	(0.31)	0.02	0.01
Depobid						
one-month	0.07	(0.09)	0.99***	(0.12)	0.56	0.93
two-month	0.09	(0.17)	0.81***	(0.20)	0.39	0.35
three-month	0.20	(0.19)	0.70***	(0.16)	0.54	0.08
six-month	1.05***	(0.27)	-0.07	(0.19)	0.02	0.00
Depolast						
one-month	0.60***	(0.18)	0.95***	(0.24)	0.22	0.84
two-month	0.79***	(0.17)	0.73***	(0.21)	0.33	0.21
three-month	1.06***	(0.16)	0.68***	(0.14)	0.61	0.04
six-month	1.81***	(0.31)	-0.09	(0.22)	0.02	0.00

*10% significance level; ** 5% significance level; *** 1% significance level

Figure 1: $R^2$of Regressions for Alternative Returns

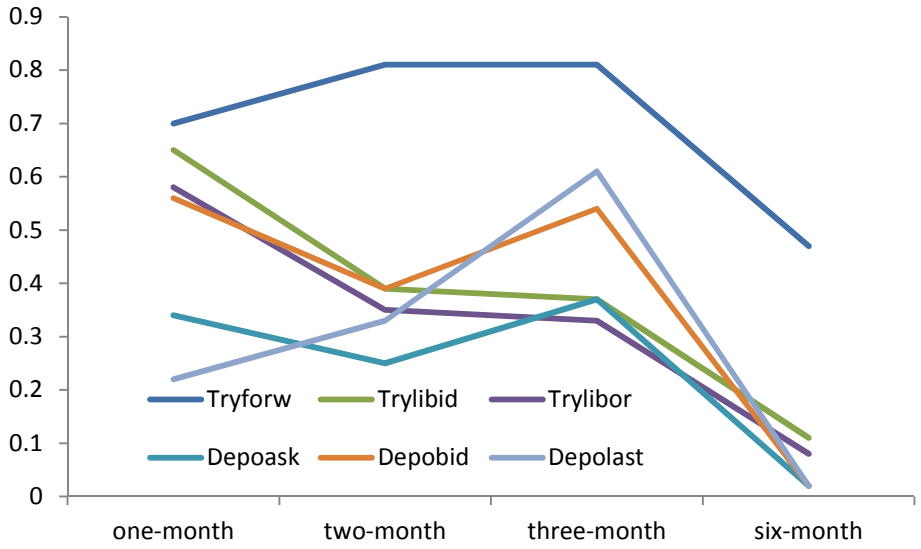


Table 2: Monthly Regression Results of Equation (2) for the period between January 2007 and July 2012

$$i_t^p - on_t = \alpha + \beta\left(\left(\left(\prod_{k=t}^{t+p-1}\left(1+\frac{on_k}{36000}\right)\right)\left(\frac{36000}{p}\right)\right) - on_t\right) + \varepsilon_t$$

	α	Standard errors	β	Standard errors	R^2	*p-value* H_0:β=1
Tryforw						
one-month	-0.15	0.10	0.84***	0.12	0.42	0.19
two-month	-0.24	0.15	0.73***	0.16	0.40	0.10
three-month	-0.03	0.15	0.82***	0.13	0.66	0.19
six-month	0.19	0.37	0.43	0.24	0.19	0.04
Trylibor						
one-month	1.09***	0.08	0.81***	0.10	0.50	0.07
two-month	1.17***	0.14	0.52***	0.15	0.27	0.00
three-month	1.42***	0.22	0.59***	0.20	0.30	0.06
six-month	1.82***	0.24	-0.09	0.19	0.02	0.00
Trylibid						
one-month	0.43***	0.08	0.85***	0.10	0.54	0.12
two-month	0.50***	0.14	0.55***	0.15	0.30	0.01
three-month	0.74***	0.22	0.62***	0.20	0.33	0.07
six-month	1.54***	0.33	0.14	0.21	0.06	0.00
Depoask						
one-month	1.65***	0.13	0.78***	0.17	0.26	0.19
two-month	1.75***	0.20	0.60***	0.21	0.21	0.06
three-month	1.92***	0.22	0.63***	0.20	0.33	0.08
six-month	2.56***	0.39	-0.08	0.25	0.01	0.00
Depobid						

one-month	-0.05	0.10	0.81***	0.13	0.39	0.13
two-month	-0.07	0.18	0.57***	0.19	0.23	0.03
three-month	0.07	0.18	0.67***	0.17	0.45	0.06
six-month	0.37	0.46	-0.02	0.37	0.00	0.02
Depolast						
one-month	0.65***	0.16	0.74***	0.19	0.19	0.18
two-month	0.74***	0.16	0.56***	0.16	0.27	0.01
three-month	1.01***	0.14	0.67***	0.13	0.57	0.02
six-month	1.75***	0.30	-0.04	0.19	0.01	0.00

*10% significance level; ** 5% significance level; *** 1% significance level

Figure 2: $R^2$of Roling Regressions with Weekly Data between December 2010 and July 2012

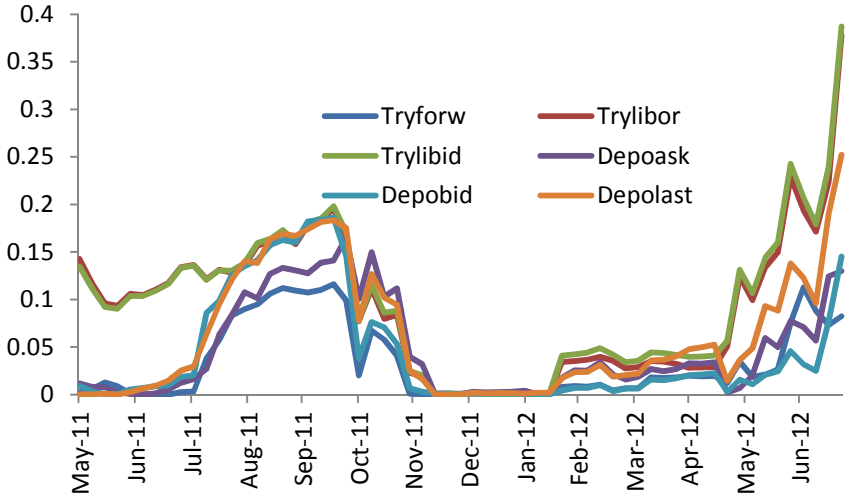


Table 2: Descriptive statistics of $d_{t,t+1}$, $d_{t+1,t+2}$ and $d_{t+2,t+3}$ for the periods of 15.12.2009 - 15.03.2010 and 01.07.2010 - 30.11.2010

	$d_{t,t+1}$			$d_{t+1,t+2}$			$d_{t+2,t+3}$		
	Mean	**Median**	**St. Dev.**	**Mean**	**Median**	**St. Dev.**	**Mean**	**Median**	**St. Dev.**
Tryforw	0.16	0.12	0.25	0.00	0.01	0.13	0.09	0.08	0.10
Trylibid	0.08	0.08	0.12	0.23	0.20	0.10	0.35	0.35	0.10
Trylibor	0.21	0.21	0.01	0.23	0.20	0.10	0.38	0.38	0.11
Depobid	0.11	0.09	0.33	-0.09	0.04	0.37	-0.13	0.08	1.02
Depoask	1.26	1.37	0.60	0.50	0.16	0.96	1.45	1.05	1.81
Depolast	0.63	0.63	0.43	0.26	0.12	0.41	0.63	0.57	0.59

Panel 1: Histograms of $d_{t,t+1}$, $d_{t+1,t+2}$ and $d_{t+2,t+3}$ (the highest and lowest 5% excluded)

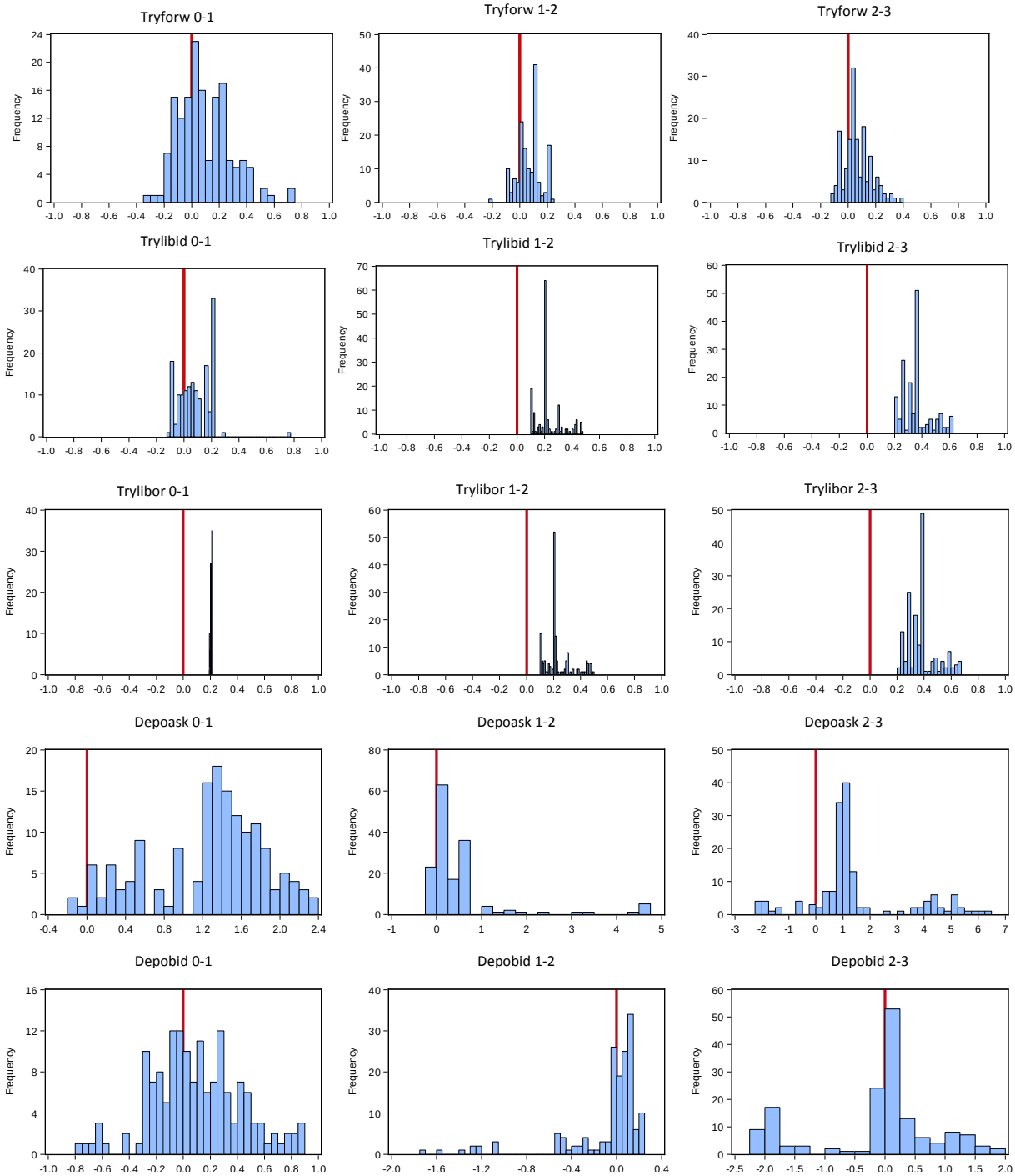


Figure 2a: Comparison of one-month term premiums obtained by two methods

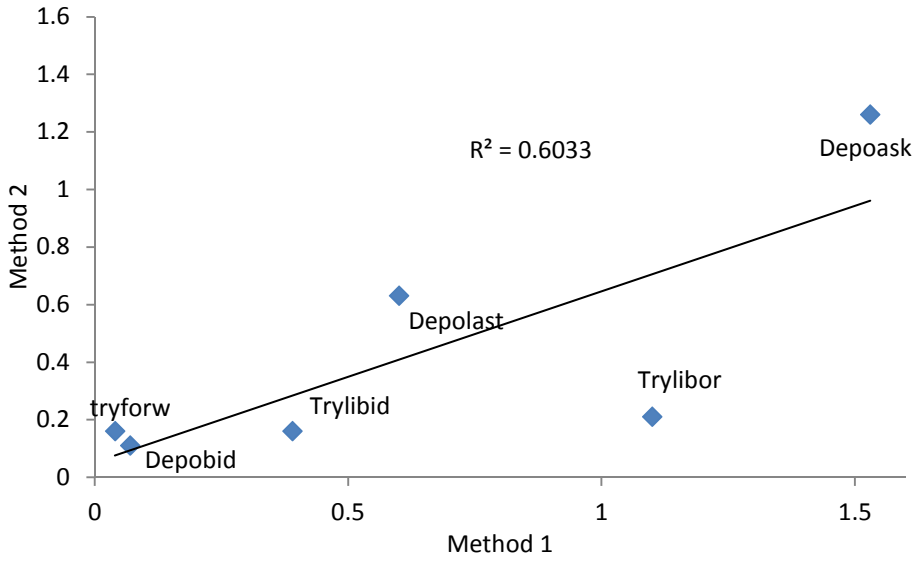


Figure 2b: Comparison of two-month term premiums obtained by two methods

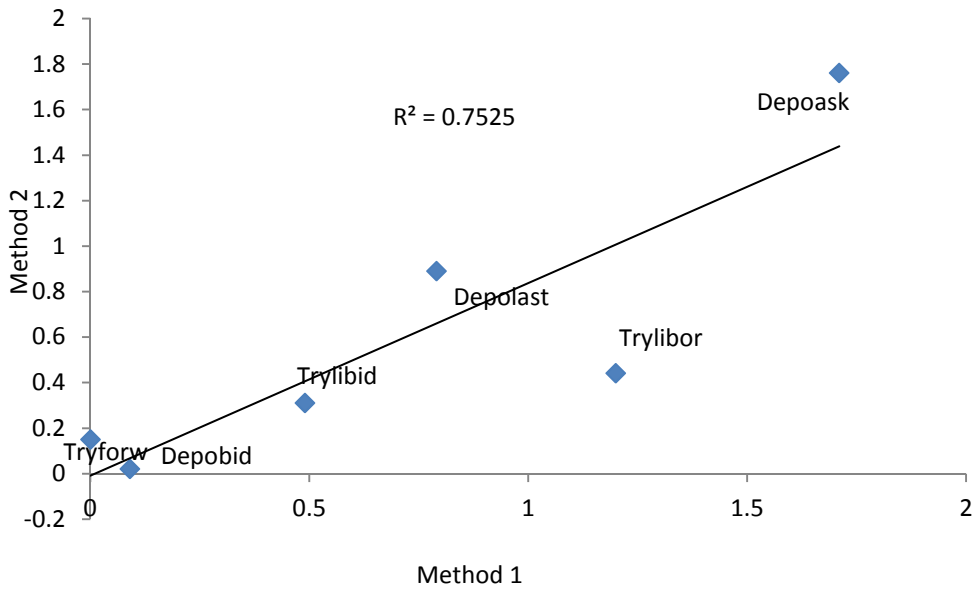
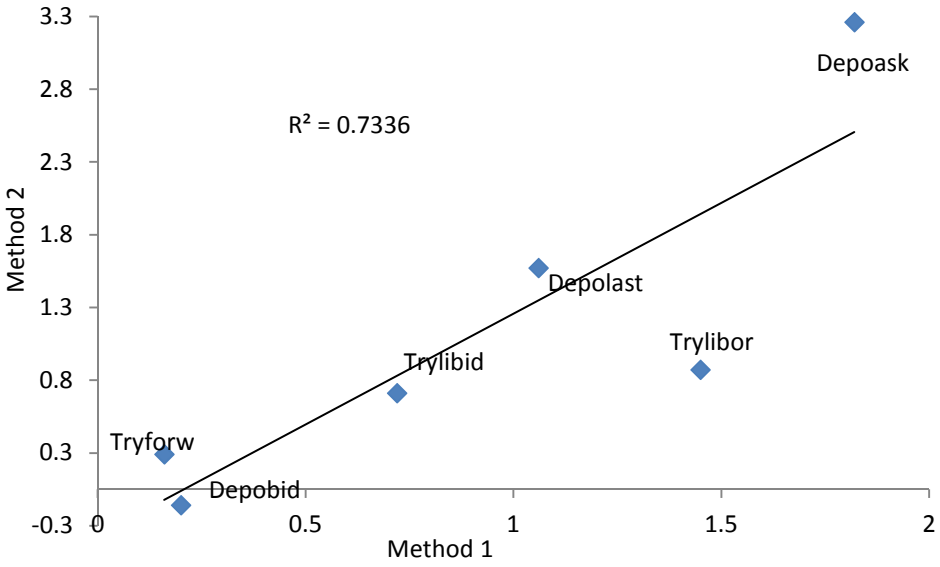


Figure 2c: Comparison of three-month term premiums obtained by two methods


3.3
2.8
2.3
1.8
1.3
0.8
0.3
-0.3
Method 2
0
0.5
1
1.5
2
Method 1
R² = 0.7336
Depoask
Depolast
Trylibor
Trylibid
Tryforw
Depobid

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