



RESEARCH NOTES IN ECONOMICS

Forecasting Turkish GDP Growth with Financial Variables and Confidence Indicators

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Özet: Bu çalışmada Türkiye ekonomisi için finansal değişkenler ile güven endekslerinin dört çeyrek birikimli GSYİH büyümesi tahmin performansları değerlendirilmiştir. Sonuçlar, incelenen değişkenlerin bazılarının baz bir modele göre tahmin hatalarını düşürdüğünü ancak tahmin performansının zaman içinde değişebildiğini göstermektedir. Tahmin birleştirmesi için tahminlerin eşit ağırlıklandırılması ile son dönem performanslarına göre ağırlıklandırılması arasında önemli bir fark görülmemiştir.

Abstract: This note evaluates the forecast performance of the financial variables and confidence indicators for four quarter ahead cumulative growth of Turkish GDP. Our results point out that some indicators can help reduce forecast errors relative to a benchmark, but forecast performance of the variables may change over time. Combining forecasts with equal weight or based on the recent performance does not lead to a significant difference in forecast performance.

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1. Introduction

Forecasting key macroeconomic variables is an essential part of economic policy making process. However, it is not clear ex-ante whether a given indicator has forecasting power for key macroeconomics variables like output growth. In their review of the role of asset prices in forecasting output and inflation, Stock and Watson (2003) note that it is important to analyze the forecasting performance of the asset prices due to several reasons. First, for those who work on forecasting on a daily basis, it is important to know which, if any, asset prices can be useful at forecasting. Second, understanding the forecasting power of asset prices can serve as stylized facts and hence guide us about the workings of the economy. They find that asset prices have considerable forecasting power for output growth for some countries over some time periods. However, forecasting performance of the asset prices is not stable over time. For example, term spread is useful at forecasting output at certain cases while it performs poorly in other cases. One potential explanation for this observation is that forecasting performance of the asset prices may depend on the nature of shocks affecting the economy and state of the financial institutions. Since these may change over time and across countries, forecasting performance of asset prices may change as well. On the other hand, a promising finding of this study is that, while individual indicators can show unstable performance, using a combination scheme helps to deal with this instability.

Confidence indicators are also followed closely by policy makers, market players and the news media. However, there are different views about whether confidence indicators can have any predictive power. Dees and Brinca (2013) and Gürgür and Kılınç (2015) review the literature. In a nutshell, they note that one school of thought approaches the issue in terms of rational expectations. According to this view, confidence indicators should not have any value over other macroeconomic and financial variables. Other school of thought claims that due to psychological factors, sentiment can affect the consumption decision. Hence, it is an empirical issue to understand whether sentiment has predictive power. For example, Dees and Brinca (2013) analyze the role of consumer confidence for the US and Euro Area and find that in certain cases, such as large changes in the sentiment, confidence can help forecast consumption.

Various researchers tested the forecasting power of those indicators for output and inflation for Turkish economy.¹ For example, Altuğ and Uluceviz (2013) analyze the forecasting power of asset prices and sentiment indicators for industrial production and

¹ See Gürgür and Kılınç (2015) and Karasoy and Yüncüler (2015) for the list of papers that analyze the consumer confidence for Turkish economy.

inflation. They find that some asset prices and business sentiment indicators can have predictive power at certain horizons at certain evaluation periods. Karasoy and Yüncüler (2015) analyze the role of consumer confidence in forecasting consumption in Turkey. They find that even after controlling for other variables, some confidence indicators have forecasting power for one-step-ahead forecasts.

To sum up, financial variables and sentiment indices may have predictive power for the indicator that one wishes to forecast for a given country at a given time period. Yet, since empirical findings are mixed on the forecasting power of this sort of indicators, we need to analyze the forecasting performance of the candidate indicators. Against this background, this note has three aims. First one is to evaluate the forecasting performance of potentially forward looking indicators such as consumer confidence and asset prices for Turkish GDP growth for multi-period ahead. The second goal is to assess the stability of the forecast performance of the individual series. Finally, we analyze whether combining forecasts with different weighting schemes improves the forecasting performance over individual series. To this end, we combine forecasts using simple averages and also by weighting them according to their recent forecast performances.

2. Methodology

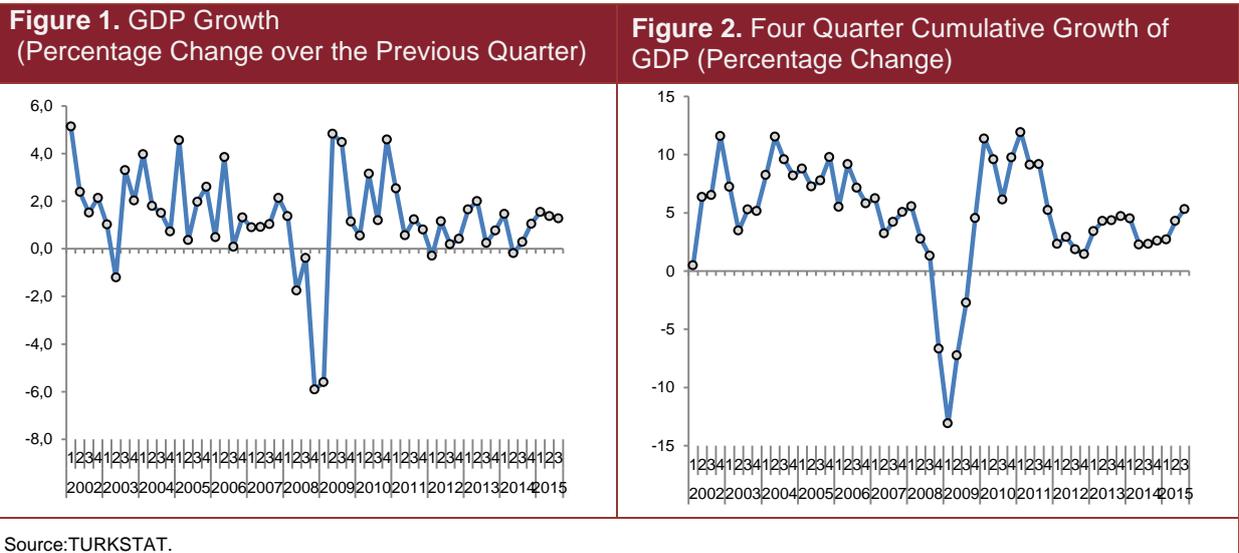
a. Multi-step Forecast Approach

We are interested in the four quarter ahead forecasts of Turkish GDP growth. When the aim is forecasting more than one period ahead, a researcher has two options for multi-step forecast approach: iterative or direct (See Marcellino et al. (2006) for a more detailed discussion). In the former approach, one estimates a one-step ahead model and iterates this model for h times to get the h period ahead forecast. In the case of direct forecasting, we directly model growth between $t+h$ and t using information at time t . Therefore, unlike the iterative case, where we use one model for all the forecast horizons, in the direct approach we estimate separate equations for each forecast horizon h .

Theoretically, which method would perform better is ambiguous. We follow Stock and Watson (2003) and use direct forecast approach. As noted by Ferrara et al. (2015), who use direct forecast approach, the rationale for using this approach is to reduce the potential impact of misspecification errors of the h -step ahead model. This is achieved by using the same loss function both for estimation and forecasting.

b. Definition of “h quarter ahead”

Another issue that we have to consider in the case of forecasting multi-period ahead is what we mean by, say, “four quarter ahead”. One option is to forecast the quarter on quarter growth rate of GDP four period ahead. For instance, when the last observation for GDP belongs to 2015Q3, we may want to forecast quarter on quarter change of GDP in 2016Q3. However, as can be seen from Figure 1, quarter on quarter GDP growth is a volatile time series. Hence, it may be difficult to get a reliable signal for the quarter on quarter growth of GDP for the next year using the changes in the variables today. Moreover, since the effect of changes in the confidence or interest rates may be observed in the economy over time, a policy maker may be more interested in the overall effect for a given time period. In this respect, rather than forecasting quarter on quarter growth four period ahead we may also be interested in forecasting the *cumulative* growth between time $t+h$ and t . For instance for four quarter ahead forecasts this would be year on year growth of GDP (Figure 2).² This is the approach taken by Stock and Watson (2003). We follow this approach as the variables that we are interested in this paper may show their impact over time.



c. Forecast Equation

We follow Stock and Watson (2003 and 2004) and formulate our forecasting equation as in Equation 1 using direct forecasting approach for h period ahead cumulative growth. On the left hand side, we have the cumulative change in GDP for h period ahead and on the right

² Four quarter log-difference of the seasonally and calendar day adjusted GDP series would be approximately equal to the calendar day adjusted year on year growth. Of course, for unadjusted data, due to calendar day affects this approximation will not be very accurate.

hand side we have quarter on quarter changes of GDP and the indicators that we are testing for the forecasting power.

$$Y_{t+h}^h = \beta_0 + \beta_1(L)X_t + \beta_2(L)Y_t + u_{t+h}^h, \quad (1)$$

where Y is the $\left(\frac{400}{h}\right) \ln\left(\frac{GDP(t+h)}{GDP(t)}\right)$ and X is the indicator that we use for forecasting

such as change in the interest rate. In this note we use $h = 4$.

In Equation 1, lag lengths of the indicators and GDP growth are chosen by minimizing Bayesian Information Criterion (BIC). We use up to three lags of these indicators.

d. Forecast Evaluation

We evaluate forecasting power of indicators using a recursive pseudo out of sample forecasting exercise for 2011Q1-2015Q3. More specifically, we first estimate the model for the 2002Q1-2010Q1 period and get a forecast for the cumulative growth between 2010Q1 and 2011Q1. Then, we extend the sample by one period and get the forecast for the cumulative growth between 2010Q2 and 2011Q2. Continuing in this fashion, the last forecast is obtained for 2015Q3 using information that would be available when we have GDP data until 2014Q3. We also estimate a benchmark AR model to understand whether the indicators add value over the time series behavior of GDP growth alone.

e. Forecast Combination

Stock and Watson (2004) evaluate the forecast performance of several indicators for seven countries. They find that forecasts based on individual predictors are unstable over time, but combining forecasts help improve over the benchmark. In this respect, in addition to individual indicators we combine forecasts using two ways. First method is to use the average of the individual forecasts. Taking simple (arithmetic) average means weighting the forecasts equally. However, using the recent forecast performance of the models may bring improvement over equal weighting scheme by giving more weight to the better performing models. Hence, as the second method, we weight series using the inverse of the Root Mean Squared Error (RMSE) for the last eight quarters. For example, while forecasting the cumulative growth between 2015Q3 and 2016Q3, we weight indicators based on their forecast performance for the eight quarters in 2013Q4-2015Q3.

3. Data

We test the forecasting power of 22 indicators that are potentially informative about developments in the economic activity (Table 1). Data are transformed to ensure the stationarity of the series.

Table 1: Data Set			
Name of the Series	Transformation	Source	Abbreviation used in Tables 2 and 3
Interest Rate for Other Credit	First Difference	CBRT-EDDS	<i>Int_Other</i>
Interest Rate for Vehicle Credit	First Difference	CBRT-EDDS	<i>Int_Housing</i>
Interest Rate for Housing Credit	First Difference	CBRT-EDDS	<i>Int_Vehicle</i>
Interest Rate for Commercial TL Credit	First Difference	CBRT-EDDS	<i>Int_Com_euro</i>
Interest Rate for Commercial Euro Credit	First Difference	CBRT-EDDS	<i>Int_Com_TL</i>
Interest Rate for Commercial US dollar Credit	First Difference	CBRT-EDDS	<i>Int_Com_dollar</i>
Business Tendency Survey-General Outlook	First Difference	CBRT-EDDS	<i>BTS-General Outlook</i>
Bloomberg HT Consumer Confidence	Quarterly Percentage Change	Bloomberg HT	<i>BHT CCI</i>
Bloomberg HT Consumer Confidence - Question 1 (Personal Situation over the last 12 month)	Quarterly Percentage Change	Bloomberg HT	<i>BHT CCI-Q1</i>
Bloomberg HT Consumer Confidence - Question 2 (Personal Situation over the next 12 month)	Quarterly Percentage Change	Bloomberg HT	<i>BHT CCI-Q2</i>
Bloomberg HT Consumer Confidence - Question 3 (Turkish economy over the last month)	Quarterly Percentage Change	Bloomberg HT	<i>BHT CCI-Q3</i>
Bloomberg HT Consumer Confidence - Question 4 (Turkish economy over the next 12 month)	Quarterly Percentage Change	Bloomberg HT	<i>BHT CCI-Q4</i>
Bloomberg HT Consumer Confidence-Question 5 (Durable goods purchase timing)	Quarterly Percentage Change	Bloomberg HT	<i>BHT CCI-Q5</i>
Oil Price	Quarterly Percentage Change	Index Mundi	<i>Oil Price</i>
Industrial Input Prices	Quarterly Percentage Change	Index Mundi	<i>Ind. Input Price</i>
US dollar/TL	Quarterly Percentage Change	CBRT-EDDS	<i>Dollar/TL</i>
Euro/US dollar	First Difference	CBRT-EDDS	<i>Euro/Dollar</i>
Borsa Istanbul-30	Quarterly Percentage Change	Bloomberg	<i>Borsa Istanbul-30</i>
CDS	First Difference	Bloomberg	<i>CDS</i>
VIX	First Difference	Bloomberg	<i>VIX</i>
US 2Y Interest Rate	First Difference	St. Louis FED	<i>US2Y</i>
US 10Y-2Y Interest Rate Differential	First Difference	St. Louis FED	<i>US10Y2Y</i>

First group of variables is related to interest rates for credits. We use quarterly difference of interest rates on consumer and commercial credits. Second group of variables is related to consumer confidence. We use consumer confidence data published by the Bloomberg HT.³ In addition to the headline series for consumer confidence, we also test the forecasting power of the each question that construct the consumer confidence index. Yüncüler (2016) shows that these questions that constitute the headline consumer confidence can move differently. Hence, we test whether specific questions do have better predictive power over other questions or the headline index. We use a question from the Business Tendency Survey, applied to manufacturing firms, to analyze the forecasting performance of the real sector confidence. It is about the perception of the firms regarding the general outlook of the economy. In addition to interest rates and confidence indicators, testing the forecasting power of the commodity prices may be helpful. In this regard, we use oil price and industrial input prices. Recently, developments in the US economy and changes in its monetary policy have certain effects on the financial markets. We use the interest rates for two-year US treasuries and the difference of the yield between ten and two-year US treasuries in our forecasting exercise.

Our data starts in 2002Q1 and ends in 2015Q3. The start of the sample is set by the availability of the consumer confidence and credit interest rate indicators. For GDP we use official seasonally and calendar adjusted figures, published by TurkStat.

4. Results

a. Analyzing 2011Q1-2015Q3.

In Table 2, we present RMSE of the indicators and the combination of forecasts relative to the benchmark for 2011Q1-2015Q3 period. Note that this type of presentation, namely comparing individual series with AR, is also used by Stock and Watson (2003), who analyze the role of asset prices on forecasting output and inflation. A value less than 1 indicates that using the respective indicators improve the forecast performance over the benchmark AR model. Stock market is the indicator that helps most for forecasting four quarter ahead in this sample. First question from the consumer confidence survey, which is how consumers evaluate their economic situation compared to previous twelve months, is also among the top performers. Interest rate on the euro based commercial credit does worse than the best model only slightly. Interest rate on consumer loans also helps to forecast GDP.

³Consumer confidence index that is currently published by Bloomberg HT used to be published by CNBC-e until July 2015.

Forecast combination also improves the performance over many of the individual forecasts. We note however that using equal weight or weighting based on the recent performance has a negligible effect on the forecast performance. As defined by Stock and Watson (2004), this is known as the “forecast combination puzzle”, which is the repeated finding that the simple combination schemes perform better than sophisticated adaptive methods. Clemen and Winkler (1986) and Smith and Wallis (2009) also show that simple methods can perform relatively well.

Table 2: Root Mean Squared Errors of the Indicators relative to the Autoregressive Benchmark for 2011Q1-2015Q3	
Borsa Istanbul-30	0.85
BHT CCI-Q1	0.86
Int_Com_euro	0.87
RMSE Weighted Mean	0.87
Mean of Forecasts	0.88
Int_Other	0.90
Int_Vehicle	0.90
Int_Housing	0.91
BTS-General Outlook	0.92
CDS	0.94
Oil Price	0.95
Int_Com_TL	0.95
BHT CCI-Q4	0.95
Euro/Dollar	0.96
Ind. Input Price	0.98
Dollar/TL	0.98
AR	1.00
VIX	1.01
US2Y	1.08
BHT CCI-Q3	1.10
BHT CCI-Q5	1.10
BHT CCI-Q2	1.14
Int_Com_dollar	1.16
BHT CCI	1.31
US10Y-2Y	1.35

There are also indicators that do worse than the benchmark model. Our results show that headline index is not helpful for forecasting GDP growth. This seems to be mainly due to three out of five questions that are used to construct the index. Recently, developments in the US economy and financial markets are on the headlines. We find that using US variables

in the forecasting equation do not bring improvement over the benchmark. However, there may be other channels through which the US interest rates affect Turkish economy. Therefore, this result should not be interpreted as developments in the US interest rates do not have any effect on Turkish economy.⁴

b. Analyzing Sub-periods

In Table 2, we have evaluated the indicators for a relatively long time period. But as Stock and Watson (2003, 2004) note that forecast performance of the individual indicators may not be stable over time. For Turkish economy, using the direct forecast approach for cumulative growth rates, Altuğ and Uluceviz (2013) evaluate various indicators for forecasting industrial production and inflation from 1993 to 2010 for three subsamples. They find that forecast performances of the indicators are not stable over time. In this respect, we evaluate our models for moving eight quarter periods from 2011Q1. To give an example, we first forecast the GDP growth between 2010Q1 and 2011Q1 when we have data up to 2010Q1. Then we extend our sample by one period and forecast the growth between 2010Q2 and 2011Q2. We do this analysis up to the last quarter of 2012Q4 so that we can evaluate forecast performance of the indicators for eight quarters. We find the top five indicators in this period. Then, we find the best five indicators for forecasting GDP four quarter ahead for 2011Q2 and 2013Q1.

⁴ We also use modified DM test (a la Harvey et al., 1997) to check the test of equal forecasting accuracy. Test results show that mean, RMSE weighted mean and interest rate on vehicle credits are statistically better than the benchmark at 5 percent. However, since our models and the benchmark are nested and we are using recursive out of sample exercise, caution is needed in interpreting modified DM test results.

Table 3: Best Performing Models for Moving Eight Quarter Forecast Evaluation Periods for Four Quarter Ahead GDP Growth

Forecast Evaluation Period	1 st Best	2 nd Best	3 rd Best	4 th Best	5 th Best
2011Q1-2012Q4	BHT CCI-Q1	Int_Com_EU	BTS-General Outlook	Borsa Istanbul-30	RMSE Weighted Mean
2011Q2-2013Q1	BHT CCI-Q5	Borsa Istanbul-30	Oil Price	RMSE Weighted Mean	Mean
2011Q3-2013Q2	Borsa Istanbul-30	Int_Com_TL	Int_Other	Int_Housing	RMSE Weighted Mean
2011Q4-2013Q3	Int_Com_TL	Borsa Istanbul-30	Int_Housing	Int_Other	BHT CCI-Q5
2012Q1-2013Q4	Int_Com_TL	Borsa Istanbul-30	Int_Housing	Int_Other	CDS
2012Q2-2014Q1	Int_Com_TL	Int_Housing	Int_Other	Borsa Istanbul-30	CDS
2012Q3-2014Q2	Borsa Istanbul-30	Int_Com_TL	Int_Housing	BHT CCI-Q1	Int_Other
2012Q4-2014Q3	BHT CCI-Q2	CDS	Int_Housing	Borsa Istanbul-30	Int_Com_TL
2013Q1-2014Q4	Int_Housing	CDS	Int_Vehicle	Int_Other	Borsa Istanbul-30
2013Q2-2015Q1	Int_Housing	CDS	Int_Vehicle	Borsa Istanbul-30	RMSE Weighted Mean
2013Q3-2015Q2	Int_Housing	Int_Vehicle	CDS	Int_Other	RMSE Weighted Mean
2013Q4-2015Q3	Int_Housing	CDS	Int_Vehicle	Int_Other	RMSE Weighted Mean

Table 3 and Figure A.1 show that indicators with the best forecasting power may change as we move through time. Each indicator are colored differently to better show the frequency of appearance of an indicator. Yet, we see that the change in the credit on housing, shown as blue cells, has been among the best models since 2011Q2. Borsa Istanbul performed relatively well until the last two evaluation samples. CDS, which ranked as the eighth indicator in Table 2, stays among top models since 2012Q1. We should note that all the best indicators in the sub-periods perform better than benchmark AR model.

5. Conclusion

We evaluate the performance of financial variables and the consumer confidence indicators for forecasting Turkish GDP growth. Our results show that several financial variables perform relatively well for four quarter ahead GDP forecasts. We find that while headline consumer confidence does not reduce the forecast error in our sample, using certain questions from the consumer confidence survey helps reduce the forecast error. We observe that performance of the indicators can change over time. For instance, consumer confidence indicators do not appear anymore in the best 5 equations in the recent periods. Besides, combining forecasts with different weighting schemes brings some improvement

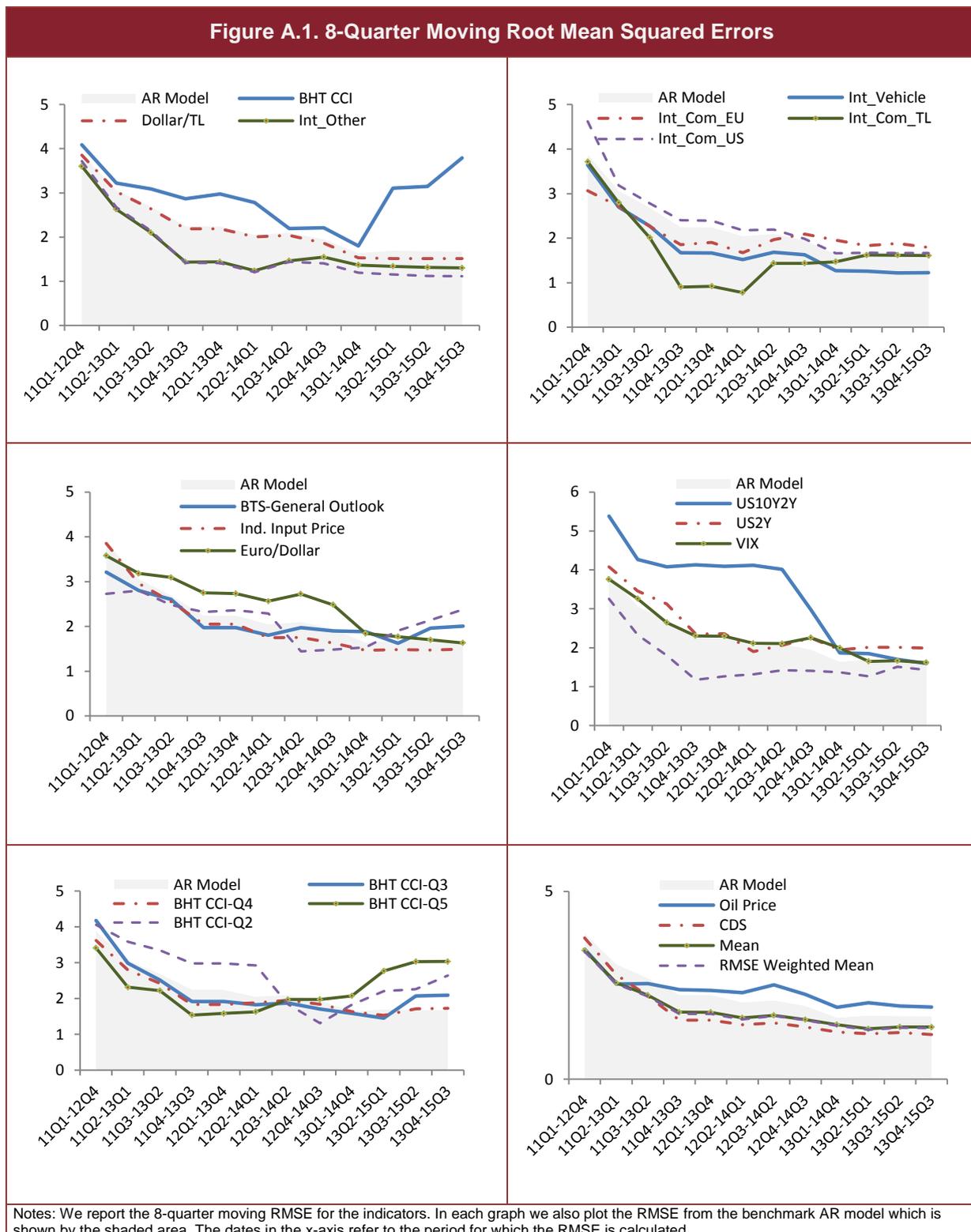
over the individual forecasts. However, using a weighting scheme that takes into account the recent performance of the models do not bring substantial improvement over using arithmetic average of all the models.

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Appendix

Figure A.1. 8-Quarter Moving Root Mean Squared Errors



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