Doctor of Philosophy Topic Proposal

Micro-Structure of Futures Prices: Convenience Yield and Open Positions Data as Basis for Conducting Inflation Targeting Based Monetary Policy in G20 Countries?

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INTRODUCTION

After early 1990s, migration of direct capital investments from industrialized nations to China accelerated significantly thanks to globalization paradigm (Prasad and Wei, 2005) The motive behind off-shoring production and service facilities was to cut costs, increase productivity and enjoy the benefits of low inflation at the cost of economy wide high unemployment. (Amiti and Wei, 2005) and (Mitra et al., 2007). From early 1990s till the middle of first decade of millennium, industrial nations did not suffer from rising unemployment as low inflation eliminated its negative influence on economy. (Smith 2006). However coupled with the rising world population, globalization has brought the commodity prices and inflation in to focus as productivity has began to lag behind the rising wealth in emerging markets (Mookherjee 1997). In addition, rising employment in emerging countries versus the rising unemployment in industrialized nations caused disorganized, unparallel and slow global economic growth in the second half of first decade of millennium. (Hajzler and Echevarria, 2005)

Keeping this in mind, assuming that industrialized and emerging economies that represent significant share of global GDP can be categorized as “open economies” one can conclude that commodity, foreign exchange and financial asset trading is strongly integrated amongst these nations. Therefore effects of demand or supply shocks in any country or in any region can easily be transfered to other economies. To be more specific, a nation with strong domestic industrial demand may cause global food and metal prices to rise while this could be stressful situation for another nation facing stagnant economy in which increased prices may force the central bank to raise the interest rates although the opposite is needed. As a result, a rise in inflation in one nation may infect stagnant economies with inflation and create stagnation.
Inflation may come from demand shocks as well as supply shocks and should be responded differently by businesses, households and especially by the government agencies, especially by the central banks whose main duty is to make monetary policies. One of the possible ways to make and manage monetary policy can be achieved by following inflation targeting method (Svensson 1997). Masson et al. (1997) describes inflation targeting as a monetary policy framework that contains a specific target of future inflation and adjust all available monetary tools to accomplish this objective regardless of what happens in other sectors of financial and economic structure. Since inflation targeting requires accurate and realistic forecast of inflation, it may be a critical for a central bank to forecast and define the possible sources of the inflation (Svensson 1999). In doing this, the highlight of the proposed thesis will be defining the future inflation signals by investigating the micro-structure of commodity futures prices. In particular futures prices will be studied by focusing on the “Convenience Yield” and the open positions data known as “Commitment of Traders Data” published by the Commodity Futures Trading Commission¹, to understand how and if they can be used to forecast the inflation primarily as well as some leading indicators and other macro-economic indicators² are used as important indicators for central banks. (Weller, 2002)

**OBJECTIVE**

New Zealand adopted inflation targeting in 1990 after which 26 other countries adopted inflation targeting as the key pillar of their macro-economic framework. Over the past two

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¹ Commodity Futures Trading Commission (CFTC) is the regulating body of commodity futures markets in the United States of America. CFTC’s mission is to regulate the futures industry and therefore it defines rules and regulations for orderly functioning of the futures industry. It enforces rules to assure that illegal acts such as manipulation, market squeezing and other abusing actions are avoided. In order to achieve this one of the actions that CFTC does is to compile data of open positions of large hedgers and speculators and publishes this information weekly every Friday at 15.30 hours eastern standard time. Therefore public may have access to which segment of the market participants did what action. For example, this report can show how many futures contracts are long or short by small and large speculators, hedgers and arbitragers.

² Some examples of conventional macro-economic indicators are unemployment, monetary aggregates, capacity utilization, gross domestic product, average hourly earnings, FED Fund rate, consumer and producer prices, interest rate differentials, yield curve real output growth and stock market returns.
decades inflation targeting has outperformed other monetary policy frameworks such as consumer price index targeting approach, fixed exchange approach and monetary aggregates approach. If the success of inflation targeting approach is evaluated based on the achievement to keep the inflation lower, it is clear that inflation targeting approach produces better results that non-inflation targeting approaches (Primus and Mahabir 2011). The success of inflation targeting framework does not only stem from the achievement to keep the inflation as low as possible but the transparency also contributes to the benefit of inflation targeting. It is thanks to inflation targeting that central banks and public established improved lines of communication and share the information about where the economy is headed (Bernanke et al. 1999). Friedman (1968) and Phelps (1968) concluded that the policy makers should focus more on maintaining inflation under control while paying relatively less attention on unemployment. Their reasoning depended on that, accommodative monetary stances to lower unemployment may produce economy wide desired results only temporarily. This is because if accommodative stance leads the inflation to rise, then unemployment shall return back to its high levels over time. Rogoff (1985) also concluded that society is better off if the central bank concentrates on inflation rather than concentrating on anything else in the absence of productivity shocks but he also reserves that inflation targeting may not be suitable in the presence of supply shocks.

**Inflation Targeting is not Perfect**

From its inception until 2009, academicians and practitioners discussed whether inflation targeting should focus on headline inflation or core inflation. Academicians have practitioners have tried to find ways to better plan and implement inflation targeting based monetary policies. Some academic studies compared targeting headline inflation and targeting core
inflation to understand which approach can produce better outcomes for achieving sustainable economic growth and maintaining low inflation. A study performed by Jose De Gregorio (2012) discusses that core inflation is better indicator than headline inflation in that the first one signals inflationary pressure better than the latter one. The study also discusses that commitment to inflation targeting reduces the required amount of response and the cost of maintaining the price stability. Finally this study reveals that commodity price shocks that happened in the middle of first decade of millennium has had different effects on different countries depending on their different economic structures and therefore caused a puzzle amongst the central bankers in determining how to respond to the commodity price shocks that were independent events. Another study on inflation targeting done by Tober and Zimmermann (2009) shows that focusing on either headline or core inflation depends on whether inflation is permanent or temporary. According to Tober and Zimmermann if inflation increases because of temporary effects then central bank should focus on expected core inflation. If on the other hand inflation surge is characterized as permanent, then the central banks should focus on either expected headline or core inflation. As suggested by Lars Svensson and Glenn Rudebusch (1999), in all cases, regardless of whether the central bank focuses on headline inflation or core inflation, the main success factor is to forecast the inflation accurately. In fact these three separate studies mentioned above actually talked about the major short coming of inflation targeting policy in that inflation targeting may not always be effective in cases of exogenous commodity price shocks (increases) and that inflation targeting could be effective only in cases where central banks do accurate inflation and economic forecasting with a wider perspective.

After revising the above information about the shortcomings of inflation targeting, another possible shortcoming of inflation targeting shall be that the central banks’ inflation projection
may not represent economy wide realities of price trends and market expectations. If this happens, like it happened during the economic and financial crisis of 2007 – 2009, the normal link between the short term and the longer term market rates can be disjoint (Wickman-Parak, 2009). Therefore, success of inflation targeting may depend on how accurately and realistically inflation can be forecasted (Svennsson 1999). Analysts and economists at central banks use different models and techniques to forecast inflation.

**Predicting Power of Convenience Yields of Futures Prices**

As the above literature indicates, researchers and practitioners spend significant amount of effort in trying to explore sound methods and models to predict the inflation. Studies suggest that future inflation can be forecasted by analyzing macro-economic data and yield differential of nominal and indexed bonds. (Rao, 2010)

While some researchers focus on macro-economic data in trying to develop models of inflation forecasting, another group of researchers and practitioners use the commodity prices develop models to forecast inflation. Boughton and Branson 1992, studied relationship between commodity prices and inflation and found that they are not co-integrated. However only custom commodity indices with customized weightings could minimize the residual variance in aggregate inflation regressions, mimic the behavior of the aggregate consumer price index reasonably well in the selected sample. However the study showed that although commodity prices themselves as a whole may not help predict the future inflation, commodity-price inflation however frequently precedes the turning points in consumer-price inflation.
The rationale of using futures data is that commodity futures are available and adjust to changes frequently at the exchanges on a daily basis, they are flexible and commodities are used as inputs at the earliest stages of production. In addition, commodity futures are forward looking in that they reflect the market expectations for the future demand and supply.

What gives futures prices forward looking capability actually comes from its theory of pricing.

\[ f^T(t) = S(t)e^{(r+c-cy)(T-t)} \]

where “f” is futures price at futures time “T” today (t), “S” is the spot price of the underlying commodity, “e” is the exponential function used for calculating compounding interests, “r” is risk free rate of return of the currency based on which the commodity is priced, “c” is cost of carry, and “cy” is the marginal convenience yield expressed as a percentage of the spot price “S”.  

As can be seen on the above formula, the futures price is a function of spot price, carry cost (r+c) and convenience yield (cy). Simply to say, a futures price can be described as interest forgone in storing a commodity, warehouse costs and convenience yield on inventory. 

Brennan (1958). It is calculated by summing up all three components: spot price, carry cost or return and convenience yield. Amongst them, spot price is derived from the current supply and demand forces, carry cost is calculated by the net cost or return of holding the underlying asset, convenience yield is the expectation component that may change based on the expectations of future supply and demand.  


Theory behind forward pricing is called “no arbitrage theory” which assumes that all derivatives such as futures and forwards are priced in the absence of arbitrage. That means, in theory the price of a consumption commodity futures is determined by the spot price adjusted with the cost of carry, risk free interest rate and convenience yield. Based on this theory, buying the commodity today should cost the buyer the same amount if the commodity were purchased at a future date. This is because for example if an investor decides to postpone the purchase of a commodity, the seller/producer of the commodity may only be convinced if the buyer compensates the seller by paying the amount of interest (r) that would be earned if the commodity were sold at spot price and the carry cost (c) that the producer will pay to keep the commodity in saleable condition. One last issue that should be taken in to account in the process of convincing the seller to sell the commodity at a later date rather than today is the adjustment factor known as convenience yield (cy). Convenience yield is applied on the spot price of the commodity and reflects the measure of expectations of whether the commodity in focus will be scarce or abundant in the future.

From the equation above convenience yield may be derived from the the following formula:

\[ CY = S(t) - \int_{t}^{T} f(T) e^{(r+c)/(T-t)} \]

What convenience yield implies is when it is high; there is benefit of profiting from shorter term shortages of the commodity. Therefore investors tend to demand more delivery of the commodity in the near future or hold on to inventories rather than purchasing the commodity at distant future dates. In other words, investors or commercial users (hedgers) of the commodity become more committed to borrowing cash to own the commodity in the short term and prefer to borrow the commodity for the distant dates. In this situation since the
aggregate demand for near term dates rise, the price of near term futures prices of commodities may exceed the longer term prices. This is known as “backwardation” of futures prices.

On the contrary, when commodity inventories are high and therefore convenience yield is low, there is more benefit of holding on to the cash in the short term rather holding on to the commodity itself. This situation arises because short term traders and/or hedgers (commercial users) are inclined to postpone their commodity purchase commitments or even sell the commodities for near term maturities so that they invest the cash proceeds in risk free instruments. In this case, aggregate demand for near term futures declines while the demand for longer term futures may stay relatively higher. This results in the near term futures price to be lower than the longer term futures price. This is known as “contango” wherein the futures prices are above the spot prices.

Academic studies indicate that convenience yield can contain significant amount of information regarding the future demand and supply as well as the volatility and the future spot price expectations:

Dinçerler et al. (2005) identified the relationship between the spot price and the supply demand expectations by studying various commodities. They found that convenience yields are conversely related to inventories. In the case of crude oil for example, marginal convenience yields tend to remain elevated and flat with a low supply/inventory for crude oil, but in the case of copper and natural gas, the convenience yield declines over time, monotonically. Inventory withdrawals on the other hand tend to be related non-monotonically to the convenience yield and they forecast relatively significant futures returns. This finding
indicates that the inflation expectations may be a function of inventory level and that such information may be extracted from futures prices.

In other studies clues about how futures prices are in relation with the inventories and may contain information about expectations were found: Basembinder et al. (1992) found that convenience yield rises as the spot price of the commodity (except gold) increases.

Brennan (1958) tested “Theory of Storage” for agricultural commodities and found that convenience yields are negatively correlated to inventories. Schwartz (1997) spotted strong relation between commodity futures prices and inventories which has direct impact on convenience yield. In another academic paper Khan, Khokler and Simin (2005), it was suggested that although past supply and demand, impacts futures prices, implied option prices, and Values at Risk produced by current models help forecast future trend of commodity futures prices, consequence of ignoring inventory information in these models could lead to misforecasting of prices. Litzenberger and Rabinowitz (1995) related the tested the variation of spreads and found that they could be explained by price volatility. Gospodinov and Ng., (2011) concluded that individual and aggregate convenience yields of different portfolios of commodities may explain commodity prices and futures prices may contain expectations about future economic conditions. They also concluded that using multi variable convenience yields help predict the inflation accurately for all forecast horizons. Stepanek et al. (2011) found that convenience yield in general has predictive power on the inventory volume / turnover and future spot prices. Milonas and Henker (2011) concluded that convenience yield behaves like a call option because when the maturity of futures contracts nears, their convenience yields get smaller on a gradual basis. This is regarded as an

\[\text{spread} = \text{spot price} - \text{futures price}\]

5 The difference between the spot and the futures price. It is calculated by subtracting the futures price from spot price.
indication that the maturity effect exists in futures prices and convenience yields affect crude oil price spreads, which act as substitute for demand/supply conditions and market price behavior. **Alquist and Kilian (2008)** studied the relationship between the spot and futures price of crude oil and the findings indicate that the spread fluctuates according to the level of uncertainty regarding the oil supply. The findings indicate that whenever there is a change in the level of uncertainty, the spot price of the crude oil tends to rise while having any positive or negative impact on the futures price.

The extent to which convenience yield may effectively be employed is, it helps predict the future spot commodity prices. **Thomas A. Knetsch (2006)** suggested forecasting technique approach to the issue of future spot price forecasting of commodities by employing convenience yield. The findings did not improve the level of forecast accuracy however provided valuable statements regarding the change of the direction of commodity price.

**B.M. Daniele (2010)** analyzed the accuracy of relation between convenience yield and commodity prices in different volatility environments and concluded that volatility can influence the forecasting accuracy of convenience yield. The study concluded that energy prices which have relatively higher effect on inflation are reactive to the convenience yield movements especially in highly volatile conditions.

**Mirantes et al. (2012)** studied how short and long term factors as well as seasonal factors can affect the empirically observed characteristics of commodity convenience yields such as mean reversion and stochastic seasonality. The study showed that the commodity price seasonality is better estimated through convenience yields than the futures prices themselves.
Stepanek et al. (2012) tested the convenience yield of commodity futures as criticality factor. The study suggested that convenience yield has predictive power on the static stock lifetime such as inventory volume and turnover and the spot future prices. This lead to conclude that convenience yield could be regarded as applicable indicator for commodities criticality.

French (2005) conducted an empirical study to link the returns of oil to convenience yield, inventory news, and revisions of expected production cost and concluded that convenience yield can have marginally good predictive power and that the convenience yield does predict the future spot prices generally when backwardation is severe.

Although the above studies mention that convenience yield itself may have predictive power to some degree, there are other studies which suggest that futures prices which embody the convenience yield also are good predictors of future spot prices. For example Chinn and Coibion (2013) examined the biasedness and predictive content of energy, agricultural, precious metals and base metals futures prices and concluded that futures prices of energy and agricultural commodities are good indicators of future spot prices while precious and base metals futures prices are not effective indicators of subsequent price levels. Forecasting performance of commodity futures prices examined by Reeve and Vigfusson (2011) suggested that futures prices are reasonable guide for forecasting commodity prices. In particular this study proposes that when spot and futures prices are significantly different, futures prices on average outperforms random walk while if commodity futures prices and the random walk forecasting models are employed together as the forecasters of future spot prices, they perform significantly better than simple extrapolations like regressions.
As discussed in the academic papers presented above, convenience yield component of futures prices may contain valuable information about the expectations of future supply and demand, volatility, price behavior characteristics and the price direction of different futures classes\(^6\). Therefore, if the convenience yield is used in a sound model, it may provide researchers and monetary policymakers valuable information about future spot prices of commodities. Therefore central banks may benefit from convenience yield in predicting future inflation so that they can adjust their monetary policies according to the future inputs rather than using ex-ante inputs in to their prediction models. Not only convenience yield may help forecasters predict the future inflation, convenience yield may also act as principal predicting factor for other economic indicators such as unemployment, gross domestic product, real interest rates, industrial production, retail sales and so forth. If this could be achieved then policy makers may have the advantage of considering forward looking indicators to achieve more reliable proactive monetary policy management.

The study conducted by Attaoui and Six (2008) claims that unlike recent papers which conclude that commodity derivatives pricing, interest rates and risk premia of assets are assumed to develop randomly in the long run, the risk premium of convenience yield may actually be derived endogenously and this makes it possible to analyze agent preference structure and investment horizon impact the risk premium of convenience yield. Therefore this study brings forward another aspect that may help forecast future spot prices from another futures data called “Open Positions”. Open positions data is reported under the report name called “Commitment of Traders” by the futures regulator “Commodity Futures Trading Commission (CFTC). The report simply displays the information of the structure of

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\(^6\) Futures are classified as metals, softs, energies, grains, indices, foreign exchange, financial, stocks and weather.
ownerships of commodities. This report may provide critical information for predicting future spot prices especially when used in conjunction with convenience yield information.

**Convenience Yield and Commodity Prices as Forecasting Tools for Inflation and For Macro-Economic Indicators**

_Gospodinov and Ng (2011)_ provided evidence that the convenience yield of 23 different commodity prices explain inflation and can be seen as informational variables about future economic conditions as guided by the futures markets. After studying the price actions of cocoa, orange juice, copper, soybeans, oats and silver, the study concluded that the above commodities’ individual convenience yields and the combinations may contain information useful for the prediction of inflation.

_Chen et al. (2012)_ also studied forecasting aggregates using commodity price aggregates and concluded that for five small commodity dependent countries, Australia, Canada, Chile, New Zealand and South Africa that have adopted inflation targeting monetary policies, world commodity price aggregates have predictive power for their CPI and PPI inflation. The study also suggested that establishing the sub-indexes of commodity prices may predict inflation even better therefore using such sub-indexes may be employed as an appropriate component of monetary policy.

_Sek et al. (2012)_ conducted empirical experiments on the relationship between exchange rate and inflation targeting regime to understand if exchange rates affect the performance of inflation targeting (IT) regime in the three developed and three emerging Asian economies that have adopted inflation targeting. The results indicate significant correlation between
exchange rate movements and inflation and output movements in both sub-periods. If the findings of this research is combined with the study that Toni Beutler (2012) conducted regarding the predictive power of commodity convenience yields for the exchange rate of commodity currencies, one can conclude that commodity convenience yields may be in relationship with inflation and output to some degree of significance.

Predicting Power of Open Position Data

Commodity Futures Trading Commission (CFTC), the futures regulatory agency in the United States, requires clearing houses reporting long and short positions larger than pre-specified amounts by the number of contracts. At the end of each trading week, CFTC publishes a report so called Commitment of Traders (COT) Report intended to inform about the size of the long and short positions held by different groups of traders such as large speculators, small speculators and commercial users (also known as hedgers, processors, farmers, factories). Although this report does not seem to go beyond showing who are buying and who are selling a futures contract, a number of academic researchers have claimed that the COT report shall be used for accurate timing of position opening and predicting futures prices which may be very helpful for a monetary policy maker to determine policy changes and/or revisions.

The studies show that CFTC “Commitment of Traders” report could signal valuable information regarding an upcoming commodity boom for a long only portfolio manager and could lead the portfolio manager to successfully buy commodity futures contracts at the right time (Basu et al. 2010). The results also suggest that, following a specific group of traders may not be sufficient to predict the futures prices but rather studying interaction between
different group of traders may convey the information necessary for successful market timing and for determining when to allocate funds in between commodities and equities. The significance of this study may be better explained if one examines the literature edited by Bjornland and Laitemo in 2004. The findings of this study show that there is great interdependence between interest rate setting and stock market returns as one percent stock price shock leads to immediate increase in the interest rates by 10 basis points. As a result, given the findings of these two independent studies, COT data may signal when funds may flow from commodities to equities and vice versa and also that stock price shocks may influence the interest rates.

Although some literatures claim the opposite in general, speculative positions are found to have predicting power of forecasting the price of oil one year forward. The study conducted by Suomen Pankki in 2011 explained a model that predicted the crude oil prices accurately for the one year ahead based on speculative positions published in the COT data.

Keynes and Hicks (1930) argued that futures markets participants, speculators and hedgers, built an economy between each other in that hedgers transfer their risks to speculators in return for a fee when a trade is executed. For example when a short hedger sells inventory to a speculator against a possible decline in value of inventory, speculators usually accept to buy if the futures price is lower than expected spot price. On the other hand, when a long hedger buys inventory from a speculator against a possible rise in value of production input, speculators usually accept to sell if the futures price is higher than expected spot price at the moment the trade is executed. Since COT report include the information regarding whether the hedgers are long or short and speculators vice versa, COT data may cover valuable information to forecast future spot price.
**Mensah and Yuan (1997)** analyzed the impact of term structure of forward rates to extract expected inflation and suggested that forward rates consist of four unobservable components which are expected future inflation, expected real interest rates, the inflation-risk premium, and the forward-term risk premium. Although convenience yield of commodities is not in the focus of this study, the study’s findings support the conclusions of Svensson’s in that forward rate curve is an indication of the expected time path of the variables in question. Therefore in practice, forward rate curves may effectively indicate price level expectations for the short, medium, and long term. **Svensson (1993)** From this it may be concluded that interpreting the term structure of forward rates in a similar way of interpreting the convenience yield may lead to better understanding of the the way expectations reflect on interest rates and this may lead practitioners and academia to forecast inflation more accurately since fixed income markets contain significant amount of information of expectation due to its large size and volume.

**Celasun et al. (2012)** analyzed the effects of oil shocks on the long term inflation expectations and concluded that oil shocks have significant impact on inflation expectations. Since oil shocks are associated with the backwardation of commodity prices and convenience yield, analyzing the changes in the convenience yield may lead to extract information regarding expectations of inflation.

**Conventional Macro-Economic Indicators as Forecasting Tools of Headline Inflation**

Analysts often try to predict inflation by watching and studying some macro economic indicators such as unemployment, capacity utilization, gross domestic product. In addition financial indicators such as exchange rates, monetary aggregates and interest rate spreads also
become the focus analysts who try to predict upcoming inflationary or deflationary forces. Simple statistical tests indicate that single indicator alone may have very limited forecasting power but a combination of indicators may perform better. *(Cecchetti et al. 2000)*

Similar studies also show that some macro-economic indicators may be used to predict the inflation. *Stock and Watson, 1999*, found evidence that macro-economic indicators may act as predictors of inflation. Amongst them, Philips Curve can produce more accurate forecasts of inflation than other macro-economic variables.

A study conducted by *Estrella and Mishkin in 1998*, found that term structure of interest rates, mainly known as slope of the yield curve performs very well in predicting recessions in the United States. This particular paper does not specifically study whether yield curve can predict the inflation but the fact that yield curve can predict recession may influence inflation factors to a certain degree.

In some cases country specific researches indicate that macro-economic data can be used as predictor of inflation. A study done by *Bruneau et al., 2007* assessed the performance of large economic indicators individually and jointly by implementing methodology offered by *Stock and Watson (1999)*. The conclusion was that survey results provided better evidence of accurately expected inflation while pure mathematical approaches such as VAR showed more stable forecasting in the long run.
RESEARCH QUESTIONS

The financial and economic crisis that struck the world in 2008 clearly has raised questions and concerns about the reliability of inflation targeting monetary paradigm as well as the central banks since they willingly accepted high risks by increasing monetary mass and purchasing highly risky mortgage backed securities and other assets.

Households, businesses and government agencies are now more dependent of the success of central banks and their policies. The world needs well defined, well communicated, rule based sound monetary policies to avoid too high and too low inflation to avoid excessive income discount and to avoid disinflation trap respectively. The world also needs accountable central banks so that in the future, encountered problems can be solved effectively.

The intention of this thesis is to offer a procedure, as a defined rule\(^7\) of inflation targeting, to forecast the future core inflation by extracting hidden expectations information from “convenience yield” and “open positions” data of futures and options, in the absence of supply shocks, explain the relationship between economic growth expectations and macro-economic indicators to understand how well “expectations adjusted conventional macro-economic indicators including inflation” shall be used as forward looking indicators and finally, establish Taylor Rule\(^8\) based model to design a proactive monetary policy setting methodology and then test by simulating the policy outcomes in G20 countries.

\(^7\) The society welfare is improved if the central bank conducts monetary policy based on a rule rather than discretion (Kydland and Prescott 1977)

\(^8\) Taylor Rule: If inflation raises by one percent, FED should increase the interest rates by at least 1%. If the Gross Domestic Product falls by 1%, the interest rates should fall by 0.5%.
Under the light of this information, the two main research questions of this thesis are as follows:

**CAN CONVENIENCE YIELD AND OPEN POSITIONS DATA BE EFFECTIVELY EMPLOYED TO ANTICIPATE THE FUTURE SPOT PRICES, CONVENTIONAL MACRO-ECONOMIC INDICATORS AND POSSIBLE DEMAND FLUCTUATIONS?**

**HOW EFFECTIVELY CAN INFLATION TARGETING CENTRAL BANKS IMPROVE THEIR POLICY MAKING PROCEDURES IF THEY WERE TO ADOPT THE METHODOLOGY THAT WILL BE PROPOSED TO ANTICIPATE THE UNDERLYING INFLATION IN G20 COUNTRIES?**

**RATIONALE**

Targeting macro economic indicators are risky since macro economic indicators by their nature are counter cycle in that they reflect what has happened in the past and therefore do not contain future expectations (Bernanke and Woodford, 1997).

There are academic papers concluding that economic indictors have significant effect of commodity prices. For example Barnhart (1989) concluded that money supply, FED’s discount rate, durable good orders, housing starts, net free reserves have significant impact on commodity prices in general. The study also concludes that producer price index and unemployment data has even more significant impact on lumber prices and T-Bills.
Inflation and monetary shocks may sometimes happen in response to commodity price shocks. Then central banks’ main concern becomes the core inflation because second round effects of food and oil prices becomes the center of problems caused by inflation. When central banks raise interest rates too quickly and create an interest rate shock, then market participants expect that inflation is on the rise and that it could stay elevated for a considerable amount of time although it may actually be that the commodity shocks could be only temporary phenomenon (Armesto and Gavin, 2005). Also, As concluded by Casassus et al. (2010), when commodity shocks happen, monetary policymakers react too much too quickly so that inflation and futures returns are positively correlated. However if the monetary policymakers were to stay neutral, then the correlation would be negative. As one shall understand commodity prices increases cause monetary shocks and monetary shocks cause interest rate shocks which may sometimes lead the market participants to over react and affect the expectations. This is because people can not always distinguish inflation trends from relative prices pressures such as temporary commodity supply shocks and reading commodity price trends can be misleading and confusing (Humpage, 2011). What is more, energy prices for example affect the core inflation with a time gap due to asymmetrical pass-through of effects and this causes even more uncertainty as suggested by (Hooker, 1990) and (Humpage and Pelz, 2002)

Policymakers use macro-economic indicators in their models to estimate inflation (Rao 2010). However the nature of macro-economic indicators is that they are ex-ante aggregates and reflects what has happened in the past. As suggested by (Frankel et al., 2008) monetary policy is counter-cyclical, meaning that the monetary response comes as a reaction to changes that have already happened in the economy.
So far monetary policy makers and academia spent considerable amount of effort in trying to define the effects of economic indicators and inflation on both monetary policy and commodity prices. It was concluded by Armesto and Gavin, (2005) that commodity futures data contain substantial amount of information about how markets respond to the implementation of monetary policy. However there seems to be not much research done about how the commodity prices may affect the macro-economic indicators and inflation and as a result how may the commodity prices affect the monetary policy in the end can not be assessed well.

After consideration of the relevant literature especially about the micro structure of futures prices, the convenience yield and open positions data may contain information about the expectations. If ex-ante conventional macro-economic data is adjusted with the expectations information that is extracted from convenience yield and open positions data and transform the lagging macro-economic indicators in to forward-looking measures to predict inflation, perhaps monetary policy makers may conduct much more effective proactive inflation targeting monetary policies. It is believed that this kind of a research will be the first of its kind although similar studies have been done by Ocran and Biekpe (2007) and it may be interesting to see the results.

**RESEARCH METHODOLOGY AND METHODS**

Two methodologies all of which are positivistic approaches supported by objectivist epistemology are as follows:

9 This study is limited to exploring how the futures prices can inform about macro-economic policies.

10 Softwares: Matlab, SPSS, R and eViews softwares will be run to display the results of quantitative analysis. In addition more methodologies shall be used when necessary.
The following methodologies will be recruited to answer the research problems. However depending on the necessity and appropriateness some methodologies may be added to or deducted from the list shown in the above table.

**GRANGER CAUSALITY**

Granger causality is a methodology that helps to explain expected time gapped change in one variable according to a change in another variable. In more particular, it there is a surprise change in a “cause” that leads to a later change in “effect” then the effect is said to be “Granger causal”. *Granger, C. W. J. (1969)*

The way Granger causality works is first the number of occurrences of lags are determined according to standard called Akaike information criterion so that the model can be rated based on the number of lags and the level of goodness of fitting (how low is residual sum of squares). Then the lag occurrences are selected for use in the regression analysis based on the level of significance of “t” tests and how well the all selected occurrences contribute to the explanatory power of the model based on “F” tests. At the final stage a null hypothesis is performed to see whether or not Granger causality is accepted. The null hypothesis of no Granger causality is accepted in the case where no lagged values of an explanatory variable have been retained in the regression.
It can be mathematically expressed with the equation below:

\[ y_t = a_0 + a_1 y_{t-1} + a_2 y_{t-2} + \ldots + a_m y_{t-m} + b_1 x_{t-1} + \ldots + b_q x_{t-q} + \text{residual}_t. \]

Ocran and Biekpe (2007) studied whether commodity prices can be used as signal for informing macroeconomic policy for possible actions in South Africa using the approach for testing Granger causality developed by Toda and Yamamoto, (1995). Evidence of causality from average gold price to interest rate, money, exchange rate and the consumer price index was observed. Also Kıymaz and Perdue (2009) used Granger Causality to find observable long run relationships between energy prices and currency exchange rates. One of the main questions of this research is to define the relationship between the convenience yield and macro economic indicators as well as open positions data and macro-economic indicators, including inflation. With a similar approach that Kıymaz and Perdue used, this thesis will analyze whether or not convenience yield changes and/or open position data have Granger causality with respect to macro-economic data changes. Finally Verheyen (2010) used Granger Causality method and found strong evidence that there is strong link between commodity prices and consumer price index. Given the ability of what Granger Causality can achieve, it may be appropriate to use this methodology in this thesis and it is expected to be helpful in finding answers to the first research question.

**BAYESIAN VECTOR AUTO REGRESSIVE MODELING**

Bayesian vector auto regressive model (VAR) is a combination of vector auto regressive analysis with a Bayesian approach. Since Bayesian analysis quantifies the parameters with association of probability such VAR is called as Bayesian VAR. Koop and Korobilis (2010)
Thanks to Bayesian approach, the number of parameters and independent variables could be increased since Bayesian estimators, conditional probabilities, can help shrink unlimited least squares. This helps dynamic models with large data bases to be analyzed from the VAR point of view. Since this thesis is about many independent variables, convenience yields and open positions data with different term structures being in relation with the macro-economic dynamics, Bayesian VAR may be helpful to analyze the extent to which he independent variables are connected to dependent variables such as inflation and other macro-economic data. Banbura et al. (2010)

Pankki (2008) employed the Bayesian Vector Auto Regressive Model an estimation framework of oil prices that tend to have different character of risk premiums depending on different periods. Applying this model to other futures contracts is expected to produce data regarding the reliability of past risk premiums’ ability forecast the future. If the data shows that past futures prices’ risk premiums can foresee the future, then a better selection of futures contracts are made so that inflation forecasting be made with a greater accuracy. Therefore the aim of this methodology is to answer the first and the second research question.

POTENTIAL FINDINGS

Reviewed studies indicate that futures prices and convenience yields are good reflectors of expectations and are good predictors of future spot prices. Studies also show that open position data contains information about the trend and expectations of the underlying assets of the futures contracts. Other studies revealed that commodities are in close relationship with macro-economic indicators as well as headline and core inflation. Individual futures contracts may be analyzed by their convenience yield and open position data to find the best list of
contracts that may be forecasted. Using multivariate analysis and portfolio composition models, a portfolio of futures contracts may be constructed and analyzed to see if their convenience yield and open positions contain hidden forward-looking information about how macro-economic indicators and inflation may evolve. This is expected to help inflation targeting central banks in their efforts to fine tune their monetary policies so that they do not overshoot their targets and optimize their results.

**SCHEDULE**

The following schedule indicates the expected progress of the research study. Necessary tasks are expected to be completed in the next 48 months from research proposal to final draft of the complete thesis.

**CONCLUSION**

The literature that has been studied indicated strong ties between inflation and macro-economic data and the inflation. Although this is the case central banks did not focus on the effects of commodity prices on the economy in general. However if commodities are further investigated, academic and practitioners may find that there is more information hidden in the commodity futures prices. This thesis will focus on to finding a procedure to extract forward-
looking information from convenience yield and open positions data and use the findings to adjust economic indicators and inflation data that central banks use in their decision-making models. The results will be tested to see if the policy makers were to use the techniques proposed in this thesis would be better off or not. It is expected that this thesis will contribute to the scientific knowledge of monetary policymaking and therefore it will be a valuable piece of study.
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