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Does Export Composition Determine the Forecasting Power of Exchange Rates on Commodity Prices?

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Abstract

It is important for both inflation control and production planning to have reliable predictions on primary commodity prices. Previous studies show that "commodity currencies", currencies of countries with large primary commodity export shares, carry information about future primary commodity prices. In this paper we study if this relationship also applies to "non-commodity currencies", currencies of countries with a small share of primary commodity export. We perform both in-sample and out-of-sample analysis of exchange rates' forecasting power on country-specific commodity price indices and world commodity price indices. The results show that exchange rates possess information about future primary commodity prices, but the primary commodity prices do not possess information about future exchange rates, which is consistent with previous findings in the literature. They also show that non-commodity currencies possess forecasting power, hence this relationship is not unique for commodity currencies.

Key words: Commodity currencies, Non-commodity currencies, Exchange rates, Commodity prices, In-sample analysis, Out-of-Sample analysis

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1. INTRODUCTION

Previous studies have found that the exchange rate of large primary commodity exporters can be used to predict future fluctuations in commodity prices (Chen et al. 2010). This paper investigates if export composition determines the forecasting power of exchange rates when predicting world commodity prices. We examine whether a large export share of primary commodities is a determinant factor for the exchange rate ability to predict future commodity prices.

We analyze two types of currencies. Both types are similar in the sense that they are currencies of countries highly integrated in the international financial markets and both are floating, which means that the exchange rates are determined in the market. The currencies are divided into two different types depending on the countries' export composition. The first type is the so-called "*commodity currency"*, which is a currency of a country for which primary commodities make up a large share of their export earnings. The other type is the so-called "*non-commodity currency*", which is the currency of a country with exports consisting first and foremost of manufactured goods, hence the non-commodity currency has just a small proportion of export earnings due to primary commodity export.

In the paper we study six currencies, three of each type. The commodity currencies are the Australian, Canadian and New Zealand dollar, while the non-commodity currencies are the South Korean won, the Philippine peso and the Turkish lira. All the countries of these currencies are small open economies, highly integrated in financial markets. The fact that they are small open economies means that they cannot by them self affect the price structure of the goods they trade – this as each countries' trade are too small in relation to the total world trade. They are therefore considered as price takers on the world market **(**Cashin et al., 2004; Chen et al., 2010). Besides selecting the currencies based on the countries' primary commodity exports share and floating exchange rate we also consider their size relative to each other in terms of total exports/imports, not only exports/imports of primary commodities. This to avoid a situation where the two groups of currencies analyzed represents countries that are too different. The results could then be due to their "trade size" rather then being large commodity exporters or not. Therefore, each commodity currency has a non-commodity currency as its counterpart in terms of exports/imports size. E.g. the Canadian dollar and the South Korean won represents two countries that are similarly ranked in terms of their export/import size. Canada is the world's 12^{th} largest exporter and importer, while South Korea is the world's 8^{th} largest exporter and 9^{th} largest importer. In the same way Australia is matched by size with Turkey and New Zealand and Philippines are each other's counterparts. [1]

Through the classification of commodity and non-commodity currencies we are able to use the commodity currencies as a control group to which we compare the results of the non-commodities currencies. The main hypothesis is that non-commodity currencies carry information of future commodity prices like commodity currencies has shown to do. This as the determining factor would rather be total trade in primary commodities then just the large share of export of primary commodities.

We use the same approach as Chen et al. (2010) but extend their analysis by studying both commodity currencies and non-commodity currencies. We are then able to verify if export composition of countries determines if their exchange rate has forecasting power in predicting future commodity prices or not. We use a present-value asset-pricing approach connecting the exchange rate to its fundamentals, the commodity prices, to study the relationship between exchange rates and commodity prices.

We test our model using both an in-sample and an out-of-sample analysis. The in-sample analysis is done with Granger causality tests. For the out-of-sample analysis we apply a one-step ahead rolling forecast scheme and compare the forecast error of our extended model, including the exchange rate, to a univariate benchmark model to test our hypothesis. In the literature it can be found that empirical exchange rate models have performed well in in-sample tests, but underperformed in out-of-sample tests compared to non-economic models like the random walk (Meese & Rogoff, 1983; Cheung et al. 2002). The findings of inconsistent results in-sample and out-of-sample is not uncommon, thus we argue that using both is a necessary condition for validity of the results.

[1] See Table (2) in appendix for specific ranking

We find that for the reference group, the commodity currencies, the exchange rates can be used to forecast commodity prices and these results are robust both in-sample and out-of-sample. These results are in line with earlier findings in the literature. However, our findings show that these properties are not unique for the commodity currencies as we also find that the non-commodity currencies possess this information. Even though these findings are less robust than for the commodity currencies they open up for more research in search of reliable predictors of future commodity prices.

In the next part we give a description of the background of the problem and why it is interesting to investigate. In section 3, we derive the model and in section 4 we describe the empirical approach used to test our hypothesis. Section 5 provides a description of the data, which is then followed by the empirical results. Finally in section 7 we provide our concluding remarks.

2. BACKGROUND

In June 2008, the issue of reliable predictions of future commodity prices was brought to the surface by the chairman of the Federal Reserve, Ben Bernanke, who stated that there is a lack of literature focusing on reliable estimates of future commodity prices. If the forecasts of future commodity prices are not credible, expectations of future inflation made upon these estimates will be unreliable. Therefore he asked for additional studies in the area, that could be complements to the models commonly used, e.g. expectations made upon future contracts (Bernanke, 2008). Accurate predictions of future commodity prices are a significant factor in a wide scope of decision making, not only in the case of inflation control. They are also crucial in production planning and demand analysis made by the industry, for developing countries when planning for production levels and export activity or for governments in planning public interventions programs related to mitigation of poverty. These are just a few economic agents for whom reliable predictions of commodity prices are highly valuable.

However, the difficulty in predicting future commodity prices lies in the nature of the primary commodities. If we look at the markets of commodities, arbitrage opportunities create trade of commodities between low priced and high priced areas, which drives up the prices in the low price area while it forces the prices downward in the area with the higher price. This will go on until equilibrium between the two markets is reached, which makes cost of factors such as transportation, storage and inventory levels to have direct impact on the price structure of commodities as well (Farma & French, 1989; Deaton & Laroque, 1996; Vercammen, 2011). Structural shifts in both demand and supply also affect the price of the underlying commodities, e.g. sharp increase in demand of commodities in China and India, or increased global demand of biofuels, that transforms earlier crop cultivation into fields of biofuel. Therefore, as the commodity prices are determined by many different factors they also become highly volatile and hard to predict (Gilbert & Morgan, 2010).

The possibility to forecast commodity prices with exchange rates has been studied by Chen et al. (2010). They follow a similar approach as Engel & West (2005), who examine the relation between floating exchange rates and their underlying fundamentals by using a present value model. Engel & West (2005) show that the present value model of exchange rates can be derived out of existing exchange rate models, in which the exchange rate is related to both current and future expected values of its fundamentals. The fundamentals investigated in their study are money supply, interest rate, inflation and output. Even though their results only suggests a weak support for the causal relationship between exchange rates and fundamentals their study highlights the fact that exchange rates, considered as an asset price, should possess information of future changes in its underlying fundamentals. However, the fundamentals that Engel & West (2005) use in their study all suffers from endogeneity. This means that the exchange rate both can be affected by them and be a cause of changes in them.

Chen et al. (2010) use the present value approach to study the relationship between the exchange rate and one of its fundamentals, commodity prices. Thereby they have a fundamental that is exogenous to the exchange rates of countries with a large share of commodity export. Fluctuations in commodity prices will appear as terms-of-trade shocks to these economies and they can all be seen as price takers. Even though these countries have between a quarter and almost three quarters of their total exports earnings due to primary commodity export, they are too small exporters – compared to total world trade – to affect world prices of these commodities. Chen et al (2010) found that exchange rates of small commodity exporting countries yields better estimates of future commodity prices than both random walk models and estimates based on commodity futures.

3. THEORETICAL FRAMEWORK

In this part we derive the present-value relation of the exchange rate and its fundamentals, and discuss the assumptions behind it.

3.1 THE PRESENT VALUE MODEL

When the exchange rate is related to its fundamentals, it is sometimes refereed to as the "asset approach" of the exchange rate since the exchange rate is argued to behave like the price of other financial assets such as stocks on the stock market (Mark, 2001):

> "One very important and quite robust insight is that *the nominal exchange rate must be viewed as an asset price.* Like other assets the exchange rate depends on expectations on future variables"
>
> Obstfeld & Rogoff (1996; p 529)

There are several structural models from which the link between the exchange rate and its fundamentals can be derived.[2] Here we use the monetary model under flexible exchange rates to make this explicit. The determination of the exchange rate relies on two stable money demand functions, uncovered interest rate parity and purchasing-power parity. In a small open economy where the exchange rate is floating, the stock of money is exogenously given. The equilibrium in the domestic (1) and foreign (2), where * denotes foreign, money markets is then given by:

$$m_t - p_t = \phi y_t - \lambda i_t \qquad (1)$$

$$m_t^* - p_t^* = \phi y_t^* - \lambda i_t^* \qquad (2)$$

[2] For other models, see i.e. Mark (2001); Obsfeld & Rogoff (1996) or Malinvaud (1953).

where m_t is the log-money stock, p_t is the log-price level, y_t is the log-national income level and i_t is the opportunity cost, or interest rate of holding money.[3] We assume that the income elasticity of money demand is equal to one ($\phi = 1$), the interest elasticity of money demand is $\lambda > 0$ and both parameters are equal across countries.

The capital market relies on the assumption of no-arbitrage opportunities between investments in the countries, thereby the uncovered interest rate parity is assumed to hold (Mark, 2001). This means that the investors are indifferent in the sense of risk of the exchange rate between the two countries. They therefore assume that the exchange rate will adjust such that the return of an investment of one euro is equal between the two countries. The equilibrium given by the uncovered interest parity is

$$i_t - i_t^* = E_t s_{t+1} - s_t \qquad (3)$$

where $E_t s_{t+1} \equiv E(s_{t+1}|I_t)$ is the expected value of the exchange rate in period t+1 given all information in present time t. Economic agents embody all the available information in present time when pricing the currency, i.e. if the expectations of the future exchange rate is $E_t s_{t+1} - s_t > 0$ the home currency is expected to depreciate (Olsson, 2010).

The relation between the price level and the exchange rate is determined by purchasing-power parity, and shows the difference in relative prices of products in different currencies (Rogoff, 1996). The relation is given by

$$s_t = p_t - p_t^* \qquad (4)$$

Now we insert equation (1), (2) and (3) into (4) and solve for s_t

$$s_t = \frac{1}{1+\lambda}[(m_t - m_t^*) - (y_t - y_t^*)] + \frac{\lambda}{1+\lambda} E_t s_{t+1} \qquad (5)$$

[3] The setup of equation (1) is obtained by taking the logarithmic form of the money market equilibrium condition $\frac{M}{P} = Y^{\phi} e^{-\lambda i}$, see Dornbusch, (1976).

To simplify further calculations we henceforth use

$f_t = (m_t - m_t^*) - (y_t - y_t^*)$,

we can thereby rewrite equation (5) as

$$s_t = \gamma f_t + \psi E_t s_{t+1} \quad (6)$$

where, $\gamma = 1/(1+\lambda)$ and $\psi = \lambda\gamma = \lambda/(1+\lambda)$.

Equation (6) states that the expected future values of the exchange rate are included in the present value of the exchange rate. As can be seen in the definition of f_t above, a relative growth in the stock of money will lead to a weakening of the home currency, while the opposite is true for a relative increase in the home country's income.

If we now study the model from the next period´s perspective and thereby extend equation (6) to $s_{t+1} = \gamma f_{t+1} + \psi E_{t+1} s_{t+2}$ we can from the information known in present time t, use the law of iterated expectations to get $E_t s_{t+1} = \gamma E_t f_{t+1} + \psi E_t s_{t+2}$. This is then substituted back into the equation (6), summarizing over all periods, s_{t+2},…, s_{t+k}, of the infinite horizon and we get

$$s_t = \gamma \sum_{j=0}^{k} \psi^j E_t f_{t+j} + \psi^{k+1} E_t s_{t+k+1} \quad (7)$$

A constant over or under valuation of a currency is not sustainable over time. As it is unlikely that foreign exchange markets are characterized as rational bubbles, which allow the exchange rate to deviate from its underlying economic fundamentals, we restrict the model by the *fundamentals (no-bubbles) solution* by imposing the so-called transversality condition (Mark, 2001)

$$\lim_{k\to\infty} (\psi)^k E_t s_{t+k} = 0 \quad (8)$$

If this condition holds, as $\psi < 1$, (8) will approach zero when $k \to \infty$ and equation (7) become

$$s_t = \gamma \sum_{j=0}^{\infty} (\psi)^j E_t f_{t+j} \tag{9}$$

Equation (9) says that the exchange rate is the discounted value of present expected future values of its fundamentals, which is the reason why the exchange rate can be argued to behave like an "asset". This implies that short-term predictions of the exchange rate will not be possible, but the current exchange rate would possess information about future fundamentals. Which, if it is true, should be a good complement to the current estimates of future commodity prices.

Throughout this paper we use this net present value relation, where the nominal exchange rate s_t is linked to its fundamentals f_t and its expected future values $E_t s_{t+1}$. In Equation 10 we can see that the exchange rate is dependent on expected future values of its underlying fundamentals given the information in present time

$$s_t = \gamma \sum_{j=0}^{\infty} (\psi)^j E_t \left(f_{t+j} \middle| I_t \right) \tag{10}$$

where the expression $E_t\left(f_{t+j} \middle| I_t\right)$ is the expectation of the fundamentals f_t given the information I_t of the economic agents at present time, and the parameters γ and ψ, are determined by the model specified above. In this model it can be seen why we expect the forward-looking behavior of exchange rate s_t to predict its fundamentals, while the opposite should not be true.

In the long run exchange rates converge towards equilibrium as they are "pegged" against the *law of one price*, but in the short run we know that this is violated as the price of comparable goods can be different in two areas (Krugman, 1978). A floating exchange rate in an asset price environment converges such that the expected return of a comparable good is the same for domestic as foreign. The exchange rates will therefore react in response to foreseen future fluctuations in the market of the traded and non-traded goods. In our case, where we use primary commodities there are several explanations to why it can be assumed that nominal exchange rates react to fluctuations in primary commodity prices. These fluctuations will for large traders of primary commodities appear as shocks to their terms-of-trade through channels such as the Balassa-Samuelson effect[4] and thereby affect their total income. Hence, if the exchange rate reacts in response to these expected future fluctuations it can be assumed to contain information of future commodity prices. This theory does not imply that it would only be true for the economies of the commodity currencies, but also for the economies of the non-commodity currencies. All small economies open to the world trade and integrated in the international financial market would face these fluctuations in the commodity prices as shocks to their terms-of-trade.

As mentioned, this is only true if the exchange rate of the country is priced on the market, which is the main reason to why we only look at countries with floating exchange rates.[5] If interventions where made to stabilize the exchange rate, as in a managed floating exchange rate regime, this relation cannot be assumed to hold. This as the fluctuations in the underlying fundamentals would pass through and affect other domestic factors, such as employment and interest rates.

However, it is important to note why it can be assumed that economic agents are able to foresee fluctuations in the commodity market, which for econometricians is hard to observe in basic time series models. It can be explained through the theory of cobweb-cycles, where agents of the market need to make decisions of production levels before the price is set (Ezekil, 1938). Thus there is a time difference between the supply decision and when actual demand can be determined. This can be illustrated by looking at trade in agricultural commodities. If the season is unexpectedly dry and the harvest becomes smaller than expected, and this will change the price of the crop when demand is constant.

The producing countries that are not exposed to the drought and produce the expected outcome will face an increased demand to an increased price, which generates a higher income of their exports. For countries that do not produce the crop and thereby import it, will with the same reasoning, face the price change of the crops as an increased cost of imports. These changes would ex-ante be hard for an econometrician

[4] For the Balassa-Samuelson model see ch.4 in Obstfeld & Rogoff, (1996) and ch.7 in Mark, (2001)
[5] International Monetary Fund states the currencies used in this paper as floating under the same conditions (IMF).

to observe using standard time series models, but can be observed and exploited by market participants.

We use the present-value framework to investigate the relation between the two types of currencies and the commodity price. If the exchange rate of countries with a large share of primary commodity export were unique in possessing information about future values of its underlying fundamentals, the only relationship we would be able to find is the relationship between the commodity currencies and the commodity prices. This means that we should not be able to establish a relation between the non-commodity currencies and the commodity prices. For commodity currencies, the expectations of future incomes from commodity export will be embodied in the exchange rate of today. On the other hand, for the non-commodity currencies, this relation would not be due to their exports earnings, but could just as well be captured in the exchange rate through the present realization of the expectations of future cost of these countries' import.

3.2 CRITIQUE OF THE PRESENT-VALUE FRAMEWORK

The most fundamental critique against the present-value approach in the case of exchange rates and its fundamentals is the endogeneity problem, making it hard to determine which predicts which. Usually the fundamentals of the exchange rate are considered to be interest rate, money supply, output and inflation. Within these fundamentals this endogeneity problem is a fact.[6] Using the net present value approach to test if the exchange rate possesses information about fluctuations in the money supply, the endogenous relation between them might cause biased estimates. Such results induce that inference of the present-value approach is not feasible. Therefore, in the case of the exchange rates, the present-value model will only be interesting to use when we investigate the exchange rate's relation to an exogenous fundamental. Primary commodity prices are therefore a possible fundamental to use, given that the economy in question is a small actor on the global market and thereby take the prices of commodities as given. Primary commodity prices can therefore be considered as exogenous to the exchange rates of these economies (Chen & Rogoff., 2003; Cashin et al., 2004).

[6] E.g. the endogenous relation between the exchange rate and income in a Mundell-Fleming framework under flexible exchange rates, see Mark (2001), pp183-184.

4. EMPIRICAL APPROACH

We test our model through two analyses: first we conduct an in-sample analysis, where we determine if past values of one variable can explain current value of the other variable. Second we use an out-of-sample analysis, where we determine if it is possible to forecast one variable by using the other variable. The in-sample analysis consists of Granger causality tests and the out-of-sample analysis consists of a rolling window forecast comparisons between our model and benchmark models.

4.1 WHY BOTH IN-SAMPLE AND OUT-OF-SAMPLE?

To verify the theoretical model derived above and thereby verify the relationship between the exchange rate and its fundamental, an in-sample causality test would suffice. We also perform an out-of-sample analysis, with the objective to show our models' ability to forecast future values of the commodity price. We see these methods as complements and using both increases the validity of the results because the findings of inconsistent results between these methods are not uncommon.[7] The main reasons for this inconsistency between in-sample and out-of-sample are: overfitting, power differences, data mining, and unstable models within the tests for significance (Hawkins., 2004; Inoue & Kilian., 2005; Clark & McCracken,. 2005). These can affect the in-sample analysis and the out-of-sample analysis in different ways. Including irrelevant parameters to a model, overfitting, will increase the models in-sample performance, but it will reduce the out-of-sample predictability, due to the increased errors in prediction (Inoue & Kilian; 2005). To address the potential overfitting problem, we use Bayesian Information Criterion (BIC)-analysis to determine the number of lags include in the model. For each additional term, the BIC increases the penalty and thereby reduces the risk of potential over-fitting.

Another model specification problem occurs in the event of data mining, having a large dataset and a large number of models to choose from, a general model can be rejected in favor of a model suited for that exact dataset. This is one potential reason for finding significant in-sample results but insignificant out-of-sample results.

[7] One of the most refereed article in this area is Meese & Rogoff (1983), their finding that exchange rate yielding robust in-sample results underperformed compared to a random walk model in an out-of-sample analysis. See Inoue & Kilian (2005) for a thorough analysis of the pros and cons of the different approaches.

Therefore we use the same model in both the in-sample and the out-of-sample analysis, overcoming the problem of data-mining in at least one of the analysis.

A further reason for inconsistent results and poor performance in both the in-sample and out-of-sample analysis is due to parameter instabilities (Hansen 2001, Rossi 2006, and Clark & McCracken 2005). Events that can cause these instabilities are e.g. changes in monetary policies during the nineties, financial crises such as the Asian crisis, the IT-bubble, the 9/11 act of terror and the subprime mortgage crisis of 2008 with the bankruptcy declaration of Lehman Brothers. We address this problem by testing for parameter instabilities.

4.2 IN-SAMPLE ANALYSIS

For the in-sample analysis we perform Granger causality tests on the first half of the sample, which test whether lagged values of the independent variable have explanatory power on the dependent variable, given lagged values of the dependent variable. The term *causality* might be a bit misleading as the test only reports if *past* values of the independent variable are significant in explaining the value of the dependent variable. Thereby the test does not state that the independent variable actually causes the dependent variable, only that it carry information about the other's movements. The Granger causality test can also be seen as a test of exogeneity. If the independent variable Granger cause the dependent variable, but the reverse is not true, we can say that the independent variable is strongly exogenous[8] in the equation of the dependent variable (Brooks, 2008).

For the analysis we follow Meese & Rogoff (1983) and use the logarithm of the variables. Since the series are non-stationary we perform our analysis using first-difference[9]. We denote the first difference in log commodity prices as $\Delta cp_{i,t}$ where subscript *i* represent the country and *t* the time period. Similar, we define $\Delta s_{i,t}$ as first difference of log exchange rate. The general VAR model is thus defined as

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[8] Strong exogeneity is required when performing forecasts, as feedback information would otherwise be significant in future forecast values, for further discussion see Engel et al. (1983).

[9] Performing unit-root tests (Dickey-Fuller, KPSS) we conclude that all series are non-stationary, these results are robust when testing for unit-roots controlling for a structural break using the method suggested by Andrews & Zivot (1992).

$$\begin{bmatrix}\Delta cp_{i,t}\\ \Delta s_{i,t}\end{bmatrix} = \begin{bmatrix}\alpha_{1i}\\ \alpha_{2i}\end{bmatrix} + \begin{bmatrix}\beta_{1i}^{1} & \beta_{2i}^{1}\\ \gamma_{1i}^{1} & \gamma_{2i}^{1}\end{bmatrix}\begin{bmatrix}\Delta cp_{i,t-1}\\ \Delta s_{i,t-1}\end{bmatrix} + \cdots + \begin{bmatrix}\beta_{1i}^{k} & \beta_{2i}^{k}\\ \gamma_{1i}^{k} & \gamma_{2i}^{k}\end{bmatrix}\begin{bmatrix}\Delta cp_{i,t-k}\\ \Delta s_{i,t-k}\end{bmatrix} + \begin{bmatrix}\varepsilon_{1i}\\ \varepsilon_{2i}\end{bmatrix} \qquad (11)$$

The number of lags (k) included is determined by BIC, which suggests using no more than 1 lag for any of the series, and we henceforth exclude additional lags in our notation.[10] The exact same approach is used to test the relationship between the individual exchange rates and the world commodity index.[11] As mentioned in the theoretical section the same link could apply to countries with a large import share of commodities. If this is true we assume that a more general commodity index have a stronger linkage to the exchange rate for non-commodity currencies than their own export indices.

4.2.1 Parameter instability and Granger causality

In the empirical model specifications (Equations 11) we assumed that the parameters are constant over time. The implication of parameter instabilities can be insignificant parameters in the Granger causality test due to the presence of a break, not due to lack of explanatory ability. Using the qLL-test proposed by Elliot & Müller (2006) based on a "quasi Local Level" model we test if the parameter of the independent variable in the regression suffers from instability. In the empirical models above we add the additional assumption that the parameters can be time varying. Hence

$$\begin{bmatrix}\Delta cp_{i,t}\\ \Delta s_{i,t}\end{bmatrix} = \begin{bmatrix}\alpha_{1i}\\ \mu_{1i}\end{bmatrix} + \begin{bmatrix}\beta_{1it}^{1} & \beta_{2it}^{1}\\ \gamma_{1it}^{1} & \gamma_{2it}^{1}\end{bmatrix}\begin{bmatrix}\Delta cp_{i,t-1}\\ \Delta s_{i,t-1}\end{bmatrix} + \begin{bmatrix}\varepsilon_{1i}\\ \varepsilon_{2i}\end{bmatrix} \qquad (12)$$

Under the null hypothesis we have constant parameters

$$H_0: \begin{bmatrix}\beta_{1it}^{1} & \beta_{2it}^{1}\\ \gamma_{1it}^{1} & \gamma_{2it}^{1}\end{bmatrix} = \begin{bmatrix}\bar{\beta}_{1it}^{1} & \bar{\beta}_{2it}^{1}\\ \bar{\gamma}_{1it}^{1} & \bar{\gamma}_{2it}^{1}\end{bmatrix}$$

Under the alternative hypotheses we have time-varying parameters, that is

$$H_1: \begin{bmatrix}\beta_{1it}^{1} & \beta_{2it}^{1}\\ \gamma_{1it}^{1} & \gamma_{2it}^{1}\end{bmatrix} \neq \begin{bmatrix}\bar{\beta}_{1it}^{1} & \bar{\beta}_{2it}^{1}\\ \bar{\gamma}_{1it}^{1} & \bar{\gamma}_{2it}^{1}\end{bmatrix}$$

[10] Results of the BIC-analysis are presented in appendix Table 3-7.

[11] In the part Empirical Results, subscript w is used where we refer to the world commodity index ($\Delta cp_{w,t}$).

4.3 OUT-OF-SAMPLE ANALYSIS

The out-of-sample analysis is conducted to study whether the addition of the exchange rate to the benchmark model make better forecasts of future commodity prices then the restricted benchmark model. We also test for reversed predictability, that commodity prices can forecast exchange rates. We apply a one-step ahead forecast scheme with a fixed window, half the sample in size. Using a fixed window generates parameters that are more sensitive to breaks in the series compared to recursive estimation. The left hand side is the expected change in commodity price index for country i in period t given the available information in period $t-1$.

$$E_{i,t}(\Delta cp_{i,t}) = \hat{\alpha}_{it}^{cp} + \hat{\beta}_{i1}^{cp}\Delta cp_{i,t-1} + \hat{\gamma}_{i1}^{cp}\Delta s_{i,t-1} \quad (13)$$

This procedure is repeated for all $t = r+1 \ldots T$, where r is equal to the window size. We compare the models forecasting ability to a benchmark model, an AR-model, with number of lags to include determined by using BIC. Comparing the forecasting ability for our extended model (15) with our benchmark model (16) we can determine whether the independent variable adds any additional information to the forecast.

$$E_{i,t}(\Delta cp_{i,t}) = \hat{\alpha}_{it}^{cp} + \sum_{j=1}^{J} \hat{\beta}_{ij,t-1}^{cp}\Delta cp_{i,t-1} \quad (14)$$

To compare the forecasting ability of the models we will use two methods; the OOS-F-test as defined in McCracken (2007) and the ENC-NEW-test as proposed by Clark & McCracken (2001). We report the OOS-F test statistics because this is based on the mean square forecast error differences (MSFE), thus we can see which models that have the smallest prediction error on average. What needs to be noted by this measure is that the estimates are biased when comparing nested models so we also report the results from the ENC-NEW test, correcting for this bias. We define the square forecast error for model j, country i and time period t as

$$\hat{u}_{ji,t}^2 = \Delta cp_t - \Delta\widehat{cp}_{ji,t} \quad (15)$$

We estimate the MSFE as

$$MSFE_{ji} = \frac{1}{p}\sum_{r+1}^{T} \hat{u}_{ji,t}^{2} \quad (16)$$

where p is the number of one step ahead forecasts and r is the number of observations used to estimate the parameter, i.e. the size of the fixed window. The OOS-F-test compares the MSFE between the models and is defined as follows

$$OOS - F = p\frac{MSFE_1 - MSFE_2}{MSFE_2} \quad (17)$$

where the $MSFE_1$ is the benchmark model, $MSFE_2$ is the extended model and p is the number of one step ahead forecasts. Since the models are nested the distribution of the test statistic is asymptotically nonstandard critical values are collected from McCracken (2007).

Under the null hypothesis of the ENC-NEW test, the restricted model embodies all information needed to predict the next value. In Equation 23 that means that the $\hat{u}_{1i,t+1}^{2}$ and $\hat{u}_{1i,t+1}\hat{u}_{2i,t+1}$ are equal thus the nominator will be zero.[12] The alternative hypothesis is that the augmented model contains additional information, that is $\hat{u}_{1i,t+1} > \hat{u}_{2i,t+1}$, so the nominator will be positive. Under the null hypothesis of equality, the augmented model has to estimate additional parameters compared to the restricted model, which by definition has set these parameters to zero. This will result in a larger MSFE for the augmented model because the sample variance is larger despite the fact that both models have the same population variance. A detailed explanation can be found in Clark & West (2006). Thus we use the ENC-NEW to correct for this bias, the test is defined as

$$ENC - NEW = p\frac{\sum_{r+1}^{T}(\hat{u}_{1i,t+1}^{2} - \hat{u}_{1i,t+1}\hat{u}_{2i,t+1})}{\sum_{r+1}^{T}\hat{u}_{2i,t+1}^{2}} \quad (18)$$

Since each estimate is compared one-by-one, in contrast to the OOS-F test where the MSFE was used, the ENC-NEW test might contradict the findings of the OOS-F test because of the bias.

[12]Under the null the models are equal, so $\hat{u}_{1i,t+1} = \hat{u}_{2i,t+1}$, thus $\hat{u}_{1i,t+1}^{2} = \hat{u}_{1i,t+1}\hat{u}_{2i,t+1}$

5. DATA

We collect monthly data of nominal exchange rates, export earnings per primary commodity and spot world commodity prices, which gives us 126 observations for the shortest of the time series. The sources of these data are[13] the International Monetary Fund databases International Financial Statistics (IFS) and Balance of payment Statistics (BOPS), Australian Bureau of Statistics, Statistics Canada, Korea International Trade Association, Philippines National Statistics Office, Statistics New Zealand and Statistics Turkey.

5.1 EXCHANGE RATES

We use end of period-nominal exchange rates of each country against the U.S. dollar. The nominal spot exchange rate is used, as exact values are given on a frequent basis, thus more correctly determined then the real exchange rate. This as the transformation from nominal exchange rate to real exchange rate will infer another step in the calculations, and by that another step of subjective decisions. All the exchange rates are collected from the same source (BOPS).

5.1.1 Commodity currencies

The commodity currencies are the Australian, Canadian and New Zealand dollar, which have had floating exchange rate regimes for a significant time period. The Australian dollar has been floating since 1983, so has the New Zealand dollar. The Canadian dollars has been floating since 1970 and the breakdown of the Bretton Woods agreement (Chen & Rogoff, 2003). The time spans of the samples are: Australia (Jan. 1984 – Dec. 2011), Canada (Jan. 1980 – Dec. 2011) and New Zealand (Jan. 1987 – Dec. 2011)[14]

5.1.2 Non-commodity currencies

The non-commodity currencies, the South Korean won, the Philippian peso and the Turkish lira, are all currencies of economies that have transformed from primary-commodity export – mostly based on agricultural – to exports consisting of manufactured goods. We use a sample where this transformation has occurred and

[13] For a detailed list of these sources see the part *electronic sources* in the references list in the end of the paper.

[14] For New Zealand we were only able to obtain quarterly data of the export earnings of their primary commodities, hence the test for causal effects between exchange rate and country specific commodity index will be performed using quarterly data. In case of a causal effect and further testing of global commodity prices we use monthly data.

this countries exports earnings from primary commodities are consistent. Both the South Korean won and the Philippian peso have been floating since January 1998, as a result of the Asian financial crisis. The Turkish lira has floating exchange rate regime since 2001 due to an IMF-program (Calvo & Mishkin; 2003, Yeldan; 2008). The time spans of the samples are: South Korea (Jan. 1998-Dec. 2011), Philippines (Apr. 1998 – Dec. 2011) and Turkey (Jul. 2001 – Dec. 2011).

5.2 COMMODITY PRICES

5.2.1 Country specific commodity price index

The country specific commodity price index is weighted averages of the earnings of exported commodities in relation to each countries total export earnings over the studied period *(1…T)*.[15]

$$\begin{bmatrix} index_1 \\ \vdots \\ index_T \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{I}\left(\frac{1}{T}\sum_{t=1}^{T}\frac{x_i}{\sum_{i=1}^{j}x_i}\right)_i \times p_{i1} \\ \vdots \\ \sum_{i=1}^{I}\left(\frac{1}{T}\sum_{t=1}^{T}\frac{x_i}{\sum_{i=1}^{j}x_i}\right)_i \times p_{iT} \end{bmatrix} \quad \begin{matrix} i = 1,\dots,I \\ t = 1,\dots,T \end{matrix} \tag{19}$$

Where x_i is total earnings for commodity i, t is the studied period and p_{it} is the price of commodity i at time t. p_{it} is set to 100 for $t = 1$ by dividing the spot price for period t with the spot price sp_{it} for period 1:

$$p_{im} = \frac{sp_{it}}{sp_{i1}} * 100 \tag{20}$$

The spot price of each commodity in each period t collected from International Financial Statistics (IFSa). This is the same price that IMF uses to calculate their country specific commodity price index (further explained below). We use these prices to be sure that the country specific indices are calculated in the same way and with the same values as the world index.

5.2.2 World commodity price index

The world commodity price index – which we use to compare the results of the country specific commodity price indices with – is collected from International

[15] For the composition of the country specific commodity price indices see appendix Table (1).

Financial Statistics (IFSb) and is based on forty-nine primary commodities. This index is used to study differences between commodity currencies and non-commodity currencies with a common index. The time span of the world commodity price index sample is (Feb. 1980-Dec. 2011)

5.2.3 Why both country specific commodity price indices and the world commodity price index?

As the country specific index of the non-commodity currencies only contains a few percent of their total exports, these indexes do not show a country's total exposure to trade in commodities. It is then possible that the connection between the country's exchange rate and the commodity prices could not be established, even though there might be a relation. Therefore we estimate the same model – as we do with the country specific indices – but with the world commodity price index as the dependent variable.

5.3 GRAPHS

All the currencies are plotted together with their own country specific commodity price index and together with the world commodity price index over time. When the exchange rate is plotted together with its country specific index we can see that for the commodity currencies (Figures 1-3) the exchange rate and the index follow each other fairly well. For the non-commodity currencies (Figures 4-6) the graphical relation is not that convincing. When we continue and look at Figures 7-12, where the exchange rates are plotted together with the common world commodity price index, the graphical result is not exactly the same. For the commodity currencies (Figure 7-9), it can be seen that for the Canadian and Australian dollar (Figure 7&8) the relation is fairly the same as in the country specific indices. Regarding the non-commodity currencies (Figure 10-12), it can be seen that the South Korean won and the Turkish lira (Figure 10 & 12), follow the index in a better way then for their own country specific indices. The relation for the Philippian peso seems to be fairly the same for the world index (Figure 11) as for the own country specific index (Figure 5).

In the graphs we have the first difference of the logarithm of each countries' exchange rate and country specific commodity price index. The commodity currencies are presented in figure1-3 and the non-commodity currencies in the figure 4-6.

Commodity currencies

Figure 1:
The Australian dollar and its own index

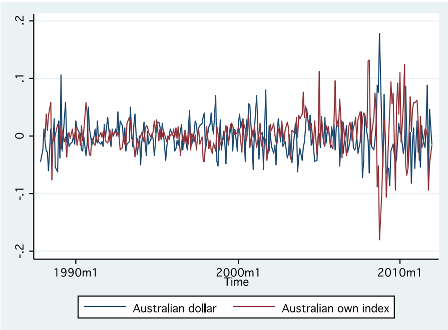


Figure 2:
Canadian dollar and its own index

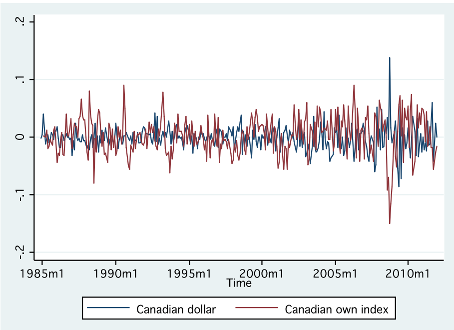
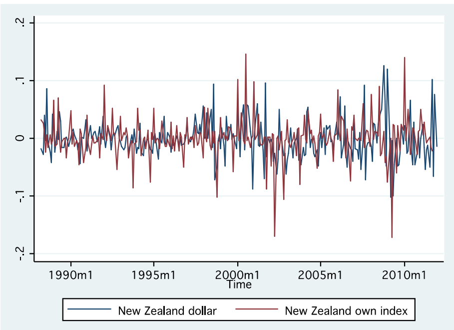


Figure 3:
New Zealand dollar and its own index



Non-commodity currencies

Figure 4:
South Korean won and its own index

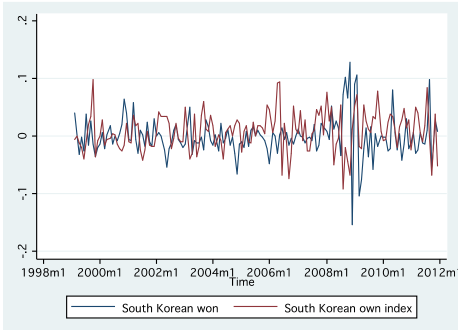


Figure 5:
Philippian peso and its own index

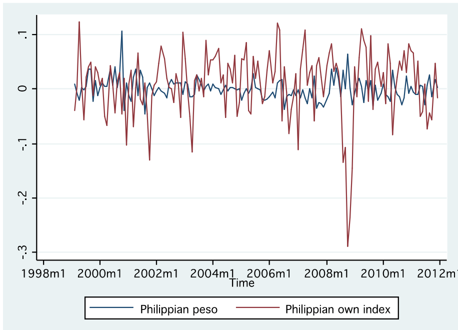
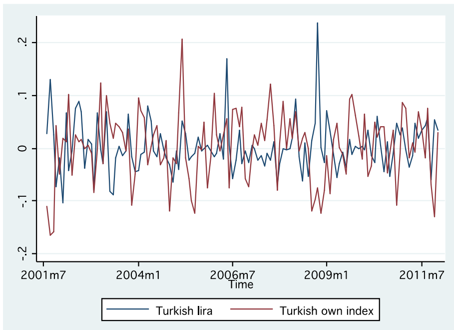


Figure 6:
Turkish lira and its own index



In the graphs we have the first difference of the logarithm of each countries' exchange rate and the world commodity price index. The commodity currencies are presented in figure 7-9 and the non-commodity currencies in the figure 10-12.

<u>Commodity currencies</u> **<u>Non-commodity currencies</u>**

Figure 7:
The Australian dollar and the world index

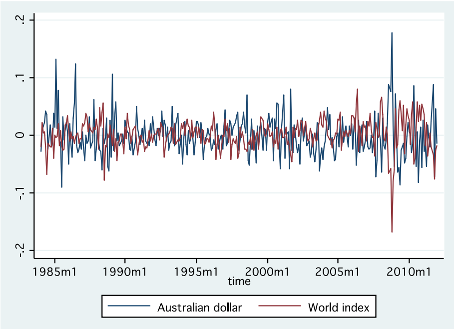


Figure 10:
The South Korean won and the world index

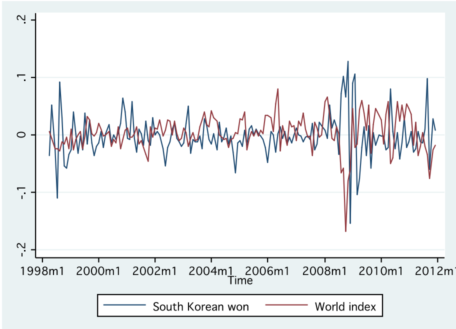


Figure 8:
The Canadian dollar and the world index

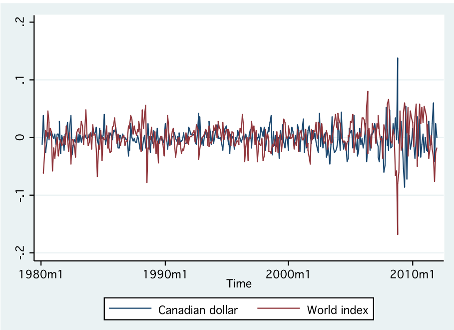


Figure 11:
The Philippian peso and the world index

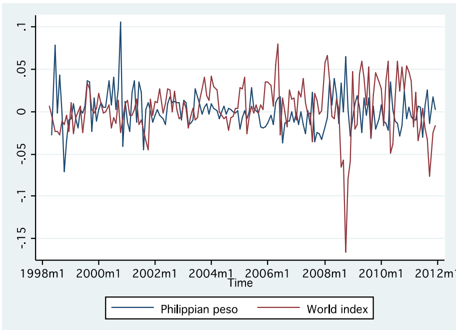


Figure 9:
The New Zealand dollar and the world index

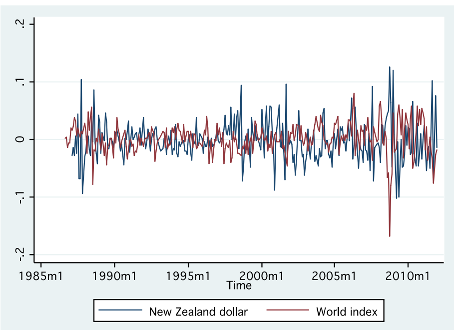
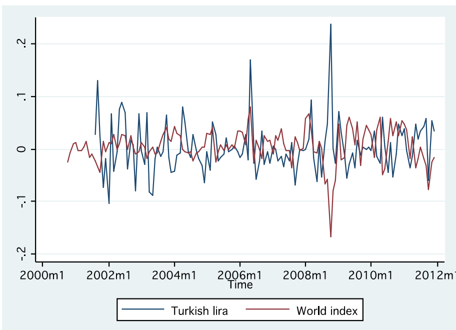


Figure 12:
The Turkish lira and the world index



6. EMPIRICAL RESULTS

In this section we present the results obtained from our analysis using the approach described in previous section. This section is divided into two subsections, first, we report the results based on the exchange rates relation to country specific commodity price indices while we in the second subsection report the results of the exchange rates relation to the world commodity price index. In each subsection we first report the results based on the in-sample analysis followed by the out-of-sample analysis.

6.1 EXCHANGE RATES' RELATION TO COUNTRY SPECIFIC COMMODITY PRICES

6.*1.1 Empirical in-sample analysis of exchange rates and the country specific commodity price indices*

In the in-sample Granger-causality analysis we find a significant relationship for exchange rates explaining commodity prices for the commodity currencies. For the Australian and New Zealand dollar this is significant on a 5% level while for the Canadian dollar the relationship is significant on a 10% level. For the non-commodity currencies, the South Korean won and the Turkish lira, we find the relationship significant on a 10% level. For the Philippian peso the relationship is not significant, which means that the Philippian peso cannot explain movements in its own country-specific commodity price index. The results are presented in Table 1.[16]

For the reversed causality we find that none of the indices can explain movements in its countries' exchange rate. This is in line with the vast literature within the exchange rate area, trying to find a causal link from fundamentals to exchange rates.

[16] Performing the same test on the whole sample yields stronger significant results indicating that the link is stronger towards the end of the sample for all currencies except for Philippines. This is supported by the findings in the out-of-sample analysis. Results of the whole sample analysis are available upon request.

TABLE 1

Granger causality test

	χ^2 test-statistic			
	Exchange rate causes commodity prices	Commodity prices causes exchange rate	Lags[†]	Sample period
Commodity currencies				
Australia	4.40**	0.60	1	1988m6 - 2000m1
Canada	3.22*	0.91	1	1985m2 - 1998m8
New Zealand°	8.63**	0.60	1	1988q2 - 1999q4
Non-commodity currencies				
Philippines	0.14	0.40	1	1998m9 - 2005m3
South Korea	2.80*	0.32	1	1998m7 - 2005m1
Turkey	3.10*	0.49	1	2001m12 - 2006m10

Notes: The table presents the χ^2 test statistics from the Granger-causality test.
Significance level: *10% **5% ***1%
[†] Lags determined by BIC, see table 3 in appendix
° Quarterly data

To verify that the insignificant and weak significant results found above is not due to parameter instabilities we perform a qLL test on the parameters from the regressions above. We see in Table 2 that we cannot reject the null hypothesis of stable parameters on the 5% significance level for any of the series. Hence the results in Table 1 are robust to this potential problem. Thus we conclude that we have at least a weak one-directional causal relationship for all currencies except for the Philippian peso and continue with the out-of-sample analysis.

TABLE 2

qLL-test for constant parameters

$\Delta cp_{i,t+1} = \alpha_i^{cp} + \beta_{\dagger it}^{cp} \Delta cp_{it} + \gamma_{it}^{cp} \Delta s_{it} + \varepsilon_{i,t}^{cp}$					
Australia	**Canada**	**New Zealand°**	**Philippines**	**South Korea**	**Turkey**
-11.11	-7.73	-13.08*	-6.60	-9.37	-7.93
$\Delta s_{i,t+1} = \alpha_i^{s} + \beta_{it}^{s} \Delta cp_{it} + \gamma_{it}^{s} \Delta s_{it} + \varepsilon_{i,t}^{s}$					
-8.49	-11.32	-13.49*	-9.45	-4.93	-10.07

Notes: The table report test statistics from the qLL test, testing for break in any of the parameters. Critical values are collected from Elliot & Müller (2006)
Significance level: *10% **5% ***1%
° Quarterly data

6.1.2 Empirical out-of-sample analysis of exchange rates and the country specific commodity price indices

We now continue with the out-of-sample analysis to see if there is a difference between the commodity currencies and the non-commodity currencies ability to forecast their own country specific commodity price indices.

In Table 3 below, the weighted value (OOS-F) of the difference between our extended model and the benchmark model is presented. These results are presented together with the results of the ENC-NEW test, which correct the bias present in the OOS-F test when comparing nested models. We base our conclusions on the ENC-NEW-test; the main function of the OOS-F results is to explicitly show on the differences between the forecasted value and the actual value of the commodity price index. For all countries but Philippines we find that including the exchange rate as an explanatory variable yields a significant improvement - on a 1% level- of the estimate compared to the benchmark model. We present the results in Table 3, we note that we do find stronger support for our hypothesis in the out-of-sample analysis than in the in-sample analysis. One potential reason for these findings is that the link between the variables is strengthened towards the end of the sample, thus the weaker findings in the in-sample analysis. We can see that for both Turkey and New Zealand the differences in MSFE is insignificant or weakly significant but once correcting for the bias the extended model including the exchange rate is better. For the Philippian peso we confirm the insignificant results found in the in-sample analysis, none of our tested models performs better than the benchmark models which indicates that the Philippines peso do not carry information about the future values of their exported primary commodities.

Based on these results it is possible that the factor determining the relationship is the countries characteristics of being large traders of primary commodities rather then large exporters. As both types of countries take the commodity prices as given, and is here shown to be able to forecast them. Our hypothesis that the commodity currencies do not have a unique ability to carry information about future primary commodity prices is thereby verified. The non-commodity currencies will be affected by the fluctuation in the commodity prices but not due to their large export earnings rather by their cost of import.

Later on we will test if these results are robust to a broader commodity price index, which is equal for all currencies.

TABLE 3

Out-of-sample results for exchange rates predicting country specific commodity price index

	OOS-F	ENC-NEW	Lags†	Sample period
Commodity Currencies				
Australia	10.65***	7.05***	0	2000m2-2011m12
Canada	14.26***	8.46***	1	1998m9-2011m12
New Zealand	1.30*	5.92***	1	2000q1-2011q3
Non- commodity currencies	OOS-F	ENC-NEW	Lags†	Sample period
Korea	4.49***	3.89***	0	2005m4-2011m12
Philippines	-6.94	0.29	0	2005m2-2011m12
Turkey	0.00	3.99***	0	2006m11-2011m12

Notes: In the table we present test statistics from the OOS-F-test and the ENC-NEW-test. Critical values for the OOS-F-test are collected from McCracken (2007), for the ENC-NEW test critical values are obtained from Clark & McCracken (2001)
Significance level: *10% **5% ***1%
† Lagged values of commodity prices determined by BIC, see Table 5 in appendix.
For exchange rates we have one lag for all series.

As a robustness test we report the results for commodity prices predicting exchange rates in Table 4. The insignificant in-sample results are confirmed in the out-of-sample analysis. We see that the country specific index has no predictive ability for the associated exchange rate.

TABLE 4

Out-of-sample results for country specific commodity price index predicting exchange rates

	OOS-F	ENC-NEW	Lags[†]	Sample period
Commodity Currencies				
Australia	-0.91	0.13	0	2000m2-2011m12
Canada	0.45	0.27	0	1998m9-2011m12
New Zealand	-0.04	-0.88	0	2000q1-2011q3
Non- commodity currencies	OOS-F	ENC-NEW	Lags[†]	Sample period
Korea	-3.54	-0.89	0	2005m4-2011m12
Philippines	-3.50	-314.31	0	2005m2-2011m12
Turkey	-0.72	-0.35	0	2006m11-2011m12

Notes: See note in Table 3
Significance level: *10% **5% ***1%
[†] Lagged values of exchange rates determined by BIC, see Table 7 in appendix, for commodity prices we have one lag for all series

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6.2 EXCHANGE RATES' RELATION TO WORLD COMMODITY PRICE INDEX

In the country specific analysis, we investigated the relationship between the exchange rates and their own country specific commodity price indices. In this section we perform the same type of analysis but we use a broader index reflecting the most traded primary commodities worldwide, thus we capture the countries' exposure to the global market rather than their export. We argue that this could be the reason for the insignificant results for the Philippian peso. For the other non-commodity currencies – the South Korean won and the Turkish lira – we could not reject the hypothesis that these currencies can predict their own index, despite having only a small share of their export dedicated to these commodities. In this section we do the same analysis as in previous section but with a general commodity price index equal to all countries. Thus we will be able to make a more general comparison between the countries and their exposure to trade in primary commodities and not just their export.

6.2.1 Empirical in-sample analysis of exchange rates and the world commodity price index

As with the country specific index we first test for Granger causality to see if we have any significant in-sample causality. In Table 5 we confirm the findings of the country-specific analysis. For both the commodity and non-commodity currencies we find stronger significant results studying the world index. The insignificant result found for the Philippian peso persists. From Table 5 we can also infer that the world index does not carry information about changes in any of the exchange rates.

TABLE 5

Granger causality test for exchange rates and world commodity prices

	χ^2 test-statistic			
	Exchange rate causes commodity prices	Commodity prices causes exchange rate	Lags†	Sample period
Commodity currencies				
Australia	7.57***	0.69	1	1984m2 - 1998m4
Canada	4.10**	0.75	1	1980m7 - 1996m2
New Zealand	9.82***	0.88	1	1987m2 - 1999m8
Non-commodity currencies				
Philippines	1.73	0.26	1	1998m4 - 2005m3
South Korea	4.62**	2.64	1	1998m2 - 2005m1
Turkey	3.68*	0.21	1	2001m12 - 2006m10

Notes: The table presents the $\boldsymbol{\chi^2}$ test statistics from the Granger-causality test.
Significance level: *10% **5% ***1%
† Lags determined by BIC, see Table 4 in appendix

As can be seen in Table 6 parameter instabilities do not affect the findings in Table 5. Finding support for our hypothesis in the in-sample analysis we continue by performing an out-of-sample analysis with the world commodity index.

TABLE 6

qLL-test for constant parameters

$\Delta cp_{w,t+1} = \alpha_i^{cp} + \beta_{it}^{cp}\Delta cp_{wt} + \gamma_{it}^{cp}\Delta s_{it} + \varepsilon_{i,t}^{cp}$					
Australia	**Canada**	**New Zealand**	**Philippines**	**South Korea**	**Turkey**
-4.77	-5.26	-6.88	-9.69	-9.24	-9.60
$\Delta s_{i,t+1} = \alpha_i^{s} + \beta_{it}^{s}\Delta cp_{wt} + \gamma_{it}^{s}\Delta s_{it} + \varepsilon_{i,t}^{s}$					
-8.81	-8.38	-7.32	-5.92	-4.60	-6.42

Notes: The table report test statistics from the qLL test, testing for break in any of the parameters. Critical values are collected from Elliot & Müller (2006)
Significance level: *10% **5% ***1%

6.2.2 Empirical out-of-sample analysis of exchange rates and the world commodity price index

The results for the world commodity index are verified in the out-of-sample analysis. For all currencies except the Philippian peso, both the OOS-F and the ENC-NEW test indicates that the extended model yields better estimates, these results are significant on a 1% level, and can be seen in Table 7. This confirms that both commodity currencies and non-commodity currencies carry information about future world commodity price fluctuations, which indicates that large export is not by itself a determinant factor. The insignificant findings for the Philippian peso show that all currencies do not have this ability.

TABLE 7

Out-of-sample results for exchange rates predicting world commodity price index

	OOS-F	ENC-NEW	Lags	Sample period
Commodity Currencies				
Australia	26.87***	16.44***	1	2000m2-2011m12
Canada	7.50***	4.29***	1	1998m9-2011m12
New Zealand	16.93***	12.08***	1	2000q1-2011q3
Non- commodity currencies	OOS-F	ENC-NEW	Lags	Sample period
Korea	13.21***	7.53***	1	2005m4-2011m12
Philippines	0.69	0.86	1	2005m2-2011m12
Turkey	9.61***	6.44***	1	2006m11-2011m12

Notes In the table we present test statistics from the OOS-F-test and the ENC-NEW-test. Critical values for the OOS-F-test are collected from McCracken (2007), for the ENC-NEW test critical values are obtained from Clark & McCracken (2001).
Significance level: *10% **5% ***1%
† Lagged values of commodity prices determined by BIC, see Table 6 in appendix.
For exchange rates we have one lag for all series

As with the country-specific index the world index lack the ability to predict exchange rates, in Table 8 we see that no significant results for this can be found for any of the countries.

TABLE 8

Out-of-sample results for world commodity price index predicting exchange rates

	OOS-F	ENC-NEW	Lags†	Sample period
Commodity Currencies				
Australia	-2.50	-139.37	0	2000m2-2011m12
Canada	-0.68	-3.24	0	1998m9-2011m12
New Zealand	-1.00	-141.02	0	2000q1-2011q3
Non- commodity currencies	OOS-F	ENC-NEW	Lags†	Sample period
Korea	-6.14	-2.13	0	2005m4-2011m12
Philippines	-4.58	-387.81	0	2005m2-2011m12
Turkey	-14.86	-47.82	0	2006m11-2011m12

Note: See note in Table 7.
† Lagged values of exchange rates determined by BIC, see Table 7 in appendix. For commodity prices we have one lag for all series.
Significance level: *10% **5% ***1%

7. CONCLUDING REMARKS

In this paper we use a present value model to show that the exchange rate is dependent on expectations of future values of its underlying fundamentals. By doing so, the exchange rate is by definition able to predict changes in these fundamentals. The fundamental that we analyze in this paper is the primary commodity prices.

We investigate the relation by using two types of currencies based on their economies export composition. We define the currency of an economy that have a large share of their export earnings due to exports of primary commodities as a commodity currency, while a small exporter of primary commodities is defined as a non-commodity currency. We do this classification to investigate if the exchange rate of commodity currencies is unique in possessing information about expectations of future primary commodity prices, which is shown by Chen et. al. (2010) to be the case. The hypothesis in our study is that non-commodity currencies also carry information of future commodity prices, and we can in this paper verify this hypothesis.

Both our in-sample and out-of-sample analysis confirms our hypothesis. Thus we argue that export is not by itself a prerequisite for this relationship and the link between the exchange rate and the commodity prices can be found among other currencies than just commodity currencies.

The findings of this study lead to at least three clear conclusions. The first is that the present value approach is also applicable to non-commodity currencies, as Chen et al. (2010) showed it to be for commodity currencies. We thereby show that commodity currencies do not have a unique capacity in carrying information about future commodity prices. Surprisingly we find that the exchange rates of non-commodity currencies carry information of both the country specific indices and the general world index, despite the fact that the country specific index only represents a small share of total trade of primary commodities for these countries. This result could be due to co-variation among different types of commodity prices, which can cause these findings of significant results in the analysis.

Our findings for the Philippian peso lead to the second conclusion; all currencies do not carry the information about future primary commodity prices. Despite that the Philippian peso represents an economy with larger total import/export size than the New Zealand dollar, the peso do not carry information about future commodity prices. It could be the case that the Philippine is not exposed to trade in primary commodities to the same extent as the other currencies, and is rather a large trader in semi-final and final goods. In such a case the import consists of intermediate goods, which later on is exported as final or semi-finished goods. Thus the price of primary commodities does not affect the economy in the same way as for economies with large share of import or export primary commodities.

It can also be the case that the composition of goods traded, both primary commodities and produced goods, change during the sample we analysis. Then the relation between the exchange rate and primary commodities is not consistent over time.

Since our findings point to the fact that the exchange rate possess information about future the primary commodity prices, the final conclusion suggests that it is reasonable to believe that economic agents embody expectations of future fluctuations in primary commodity prices when prizing the currencies. This as we argue that the

Philippines are not, after all, that integrated in the international financial market. The agents of the market do not trade the Philippian peso to the same extent as they trade the rest of the currencies analyzed in this study. This means that the economic agents do not embody the same information about future fluctuations of primary commodities, when they value the Philippian peso as they do when they value the other currencies.

We have in this study showed that when trying to find new ways in predicting future commodity prices using exchange rates, one should limit the currencies chosen to include only large exporters of primary commodities.

However, it is also found that whichever exchange rate is not possible to use. We therefore argue that the first question that needs to be solved before optimal forecasts of primary commodity prices are done is which currencies to use. The result of our paper is therefore crucial to e.g. investors trading in indices, as we argue that there is present information that can tell about the future, and knowing which currencies to use or not is a determine factor in their analysis.

Also worth noting is that the country specific commodity price index could not be used for predicting exchange rates, which is in line with earlier findings. It is therefore interesting to continue the research by investigate if a specific commodity price on its own posses information about specific exchange rates. Thereby investigate if high economic dependence of one certain good makes this good to posses information about the exchange rate, e.g. oil prices which is a primary commodity without substitutes, is it possible that it can predict the U.S. dollar which is both a producer of oil and a large consumer.

Further suggestions includes making the same type of analysis but extend it to include imports as well as exports and investigate if the results still are the same. Analyzing specific combinations of currencies of economies that have a large trade between each other, it might be possible to find a combination of currencies that possess even better information about future prices of specific primary commodities.

Finally, the findings of this study should not be unique to exchange rates and would just as well be able to find among other assets. Assets that also theoretically possess information of future commodity prices such as certain stock prices of primary commodity intense businesses or equity market indices.

REFERENCES

Brooks, C. (2008), *Introductory econometrics for finance*, Cambridge university press 2nd edition

Bernanke, B. (2008), Monetary Policy report to the Congress July 15 2008, Board of Governance of the Federal Reserve System

Carruth A. A., M. A. Hooker & A. J. Oswald, (1998), "Unemployment Equilibria and Input Prices: Theory and Evidence from the United States", *The Review of Economics and Statistics,* Vol. 80, No.4 pp.621-628

Calvo G. A. & F. Mishkin (2003), "The Mirage of Exchange Rate Regimes for Emerging Market Countries", *Journal of Economic Perspectives* Vol.17, Nr. 4 fall 2003 pp. 99-118

Cashin P., L. F. Céspedes & R. Sahay, (2004), "Commodity currencies and the real exchange rate", *Journal of Development Economics* 75, pp. 239.268

Chen, Y.-C. & K. Rogoff (2003), "Commodity Currencies", *Journal of International Economics* 60, pp.133-160

Chen, Y.-C., K. Rogoff & B. Rossi (2010), "Can Exchange Rates Forecast Commodity Prices?" *The Quarterly journal of Economics.* pp.1145-1194

Cheung. Y-W., Chinn. M.D., Pascual. A.G., (2002) "Empirical exchange rate models of the nineties. Are any fit to survive?" *NBER Working Paper* No. 9393

Clark, T. E., McCracken, M. W., (2001) "Tests of equal forecast accuracy and encompassing for nested models" *Journal of Econometrics* 105. pp. 85-110

Clark, T. E., McCracken, M. W., (2005) "The power of tests of predictive ability in the presence of structural breaks" *Journal of Econometrics*, Elsevier, vol. 124(1), pp. 1-31.

Clark. T.E., West. K.D., (2006) "Using out-of-sample- mean squared prediction errors to test the martingal difference hypothesis*", Journal of Econometrics* 135. pp. 155-186

Dornbusch, R. (1976), "Expectations and Exchange Rate Dynamics"*, Journal of Political Economics* 84, pp.1161-1176

Elliot, G., Müller. U.K,. (2006) "Efficient tests for general persistent time variation in regression coefficients*", Review of Economic Studies* 73. pp. 907-940

Engel, C. N., West K.D (2005). "Exchange rates and Fundamentals", *The Journal of Political Economy* 113(3). pp. 485-517

Engle R., D. Hendry & J.-F. Richard (1983) "Exogeneity" *Econometrica* Vol. 51

No. 2 pp. 277-304

Hansen. B. E. (2001) “The New Econometrics of Structural Change: Dating Breaks in U.S. Labor Productivity*”, The Journal of Economic Perspectives*, Vol. 15, No. 4, pp. 117-128

Hawkins. D. M., (2004). “The problem of overfitting”, *Journal of Chemical Information and Computer Science* 44. pp. 1-12

Inoue. A., Kilian. L., (2005) “In-Sample or Out-of-Sample Tests of Predictability: Which One Should We Use?”, *Econometric Reviews*, 23:4. pp. 371-402

Krugman. P, (1978) “Purchasing Power Parity and Exchange rates: another look at the evidence”, *Journal of International Economics* 8 pp. 397-407

Mark, N. (2001) *International Macroeconomics and Finance: Theory and Econometric Methods*, Oxford: Blackwell Publishing Ltd.

McCracken, M. W., (2007) *“*Asymptotics for out of sample tests of Granger causality”, *Journal of Econometrics,* Volume 140, Issue 2. pp 719-752

Meese, R. & K. Rogoff (1983) “Empirical exchange rate models of the seventies: do they fit out of sample*?”* Journal of International Economics 14 pp. 3-24

Obstfeld, M. & K. Rogoff (1996), *Foundations of international macroeconomics,* Cambridge, Massachusestts: The MIT Press

Olsson, O. (2012), *Essentials of advanced macroeconomic theory,* Taylor & Francis Ltd, United Kingdom

Rogoff, K. (1996), “The Purchasing Power Parity Puzzle”, *Journal of Economic Literature,* Vol. 34, No 2 pp. 647-668

Rossi, B. (2005) “Optimal test for nested model selection with underlying parameter instability”, *Econometric theory* 21(5), pp. 962-990

Rossi, B. (2006) “Are exchange rates really random walks, some evidence robust to parameter instabilities”, *Macroeconomic Dynamics* 10. pp. 20-38

Verbeek, M. *A guide to Modern Econometrics,* 3rd ed. West Sussex, John Wiley & Sons, Ltd

Vercammen, J. (2011), *Agricultural marketing,* Hoboken, Taylor & Francis, 2011

Yeldan, E. A. (2008), “Turkey and the Long Decade with The IMF: 1998-2008”, *International Development Economic Association*, Jun 2008

Zhang Y.-J, Y. Fan., H.-T. Tsai & Y.-M. Wei, (2008), “Spillover effects of US dollar exchange rate on oil prices”, *Journal of Policy Modeling* 30 pp. 973-991

Zivot E. Andrews D.W.K., (1992). "Further evidence on the great crash, the oil price shock, and the unit-root hypothesis", *Journal of Business and Economic Statistics* vol.10 pp. 251-270

ELECTRONIC SOURCES

Australian Bureau of Statistics:
(http://www.abs.gov.au/) (28/2-12)

CIA factbook 2012, 9 January
https://www.cia.gov/library/publications/theworldfactbook/fields/2012.html) (19/3-12)

International Monetary Fund (IMF): "*Classification of Exchange Rate Arrangements and Monetary Policy Frameworks"*,
http://www.imf.org/external/np/mfd/er/2006/eng/0706.htm (22/3-12)

International Financial Statistics (IFSa)
- International Monetary Fund, World commodity prices:
(http://www.imf.org/external/np/res/commod/index.aspx) (1/3-12)

International Financial Statistics (IFSb)
- International Monetary Fund, World commodity index:
(http://elibrary-data.imf.org/QueryBuilder.aspx?s=322&key=1445284) (29/2-12)

Balance of Payment Statistics (BOPS)
- International Monetary Fund, monthly end of period exchange rates against U.S. dollar
(http://elibrary-data.imf.org/QueryBuilder.aspx?s=322&key=1445284) (6/3-12)

Korea International Trade Association
(http://www.kita.org) (5/3-12)

Philippines National Statistics Office
(http://www.census.gov.ph/data/sectordata/datafts.html) (6/3-12)

Statistics Canada:
(http://www.statcan.gc.ca/pub/65-209-x/2012000/parts-parties-eng.htm) (7/3-12)

Statistics New Zealand:
(http://www.stats.govt.nz/infoshare/ViewTable.aspx?pxID=bc0dd299-90e7-4a3d-825a-863b14ef0680) (8/3-12)

Statistics Turkey
(http://www.tuik.gov.tr/disticaretapp/disticaret_ing.zul?param1=0&param2=0&sitcrev=0&isicrev=0&sayac=5901) (3/3-12)

APPENDIX

TABLE 1:

Country-specific index composition

Commodity currencies						Non-commodity currencies					
Australia		**Canada**		**New Zealand**		**Philippines**		**South Korea**		**Turkey**	
Beef	6.5%	Fish	5.3%	Aluminum	7.8%	Bananas	16.3%	Cooper	10.0%	Citrus	31.5%
Crustaceans	1.6%	Barley	1.4%	Apples	2.8%	Coconut Oil	33.2%	Fish	6.3%	Copper	11.0%
Wheat	6.0%	Wheat	8.4%	Beef	11.7%	Copper	31.6%	Gold	17.7%	57.5%	57.5%
Barley	1.2%	Rapeseed	1.9%	Butter	7.8%	Fish	13.3%	Iron	58.8%		
Sugar	1.6%	Coal	3.1%	Casein	3.0%	Iron	5.6%	Skins	7.2%		
Hides & Skins	1.1%	Iron Ore	3.5%	Crustaceans	2.9%						
Wood	1.2%	Copper	4.9%	Fish	6.0%						
Wool	7.2%	Nickel	4.8%	Fruit, other	4.8%						
Iron ore	12.8%	Zinc	2.5%	Lamb	14.0%						
Uranium ore	0.7%	Aluminum	6.9%	Pulp	3.9%						
Copper	4.3%	Petro Crude	18.9%	Skim Milk	5.3%						
Lead	0.8%	Natural Gas	14.3%	Skins	5.0%						
Aluminum	13.1%	Lumber	13.3%	Whole MP	12.6%						
Zinc	1.1%	Pulp	10.8%	Wood	4.3%						
Gold	11.3%			Wool	8.1%						
Coal	22.8%										
Petro crude	6.7%										
Index share of total export	54.9%		28.4%		66.8%		5.2%		7.0%		2.9%

TABLE 2

World ranking in terms of export and import

Commodity Currencies	Export	Import
Australia	22	20
Canada	12	12
New Zealand	61	62
Non-Commodity Currencies		
South Korea	8	9
Philippines	58	47
Turkey	33	24

CIA workbook: https://www.cia.gov/library/publications/the-world-factbook/

In Table 3-7 we present the results from the BIC-analysis for determining the number of lags included. Table 3 and 4 is the lags used in the in-sample analysis for the Granger-causality test. For the out-of-sample analysis the number of lags of the dependent variable is based on the results presented in Table 5-7. * Denotes the number of lags that should be used according to this criterion.

Table 3

BIC-analysis for country specific index and exchange rate

Country	Lags			Sample period
	1	2	3	
Australia	-9.665*	-9.555	-9.479	1988m6 - 2000m1
Canada	-10.220*	-10.142	-10.052	1985m2 - 1998m8
New Zealand	-7.286*	-7.114	-6.962	1988q2 - 1999q4
Philippines	-8.467*	-8.371	-8.217	1998m9 - 2005m3
South Korea	7.790*	-7.586	-7.419	1998m7 - 2005m1
Turkey	5.616*	-5.385	-5.149	2001m12 - 2006m10

Table 4

BIC-analysis for world commodity index and exchange rate

Country	Lags			Sample period
	1	2	3	
Australia	-9.085*	-8.898	-8.818	1984m2 - 1998m4
Canada	-10.820*	-10.729	-10.626	1980m7 - 1996m2
New Zealand	-9.424*	-9.317	-9.210	1987m2 - 1999m8
Philippines	-9.978*	-9.784	-9.601	1998m5 - 2005m3
South Korea	-9.368*	-9.226	-9.033	1998m2 - 2005m1
Turkey	8.066*	-7.813	-7.655	2001m12 - 2006m10

Table 5

BIC-analysis for country specific index

Country	Lags			Sample period
	0	1	2	
Australia	-5.187*	-5.175	-5.148	1988m6 - 2000m1
Canada	-4.309	-4.383*	-4.355	1985m2 - 1998m8
New Zealand	-4.980	-4.991*	-4.977	1988q2 - 1999q4
Philippines	-3.148*	-3.109	-3.060	1998m9 - 2005m3
South Korea	-4.377	-4.435*	-4.356	1998m7 - 2005m1
Turkey	-2.598*	-2.539	-2.472	2001m12 - 2006m10

Table 6

BIC-analysis for world commodity index

Country	Lags			Sample period
	0	1	2	
Australia	-4.975	-4.998*	-4.983	1984m2 - 1998m4
Canada	-4.968	-5.000*	-4.982	1980m7 - 1996m2
New Zealand	-4.979	5.001*	-4.984	1987m2 - 1999m8
Philippines	-5.153	-5.310*	-5.269	1998m5 - 2005m3
South Korea	-5.221	-5.390*	-5.354	1998m2 - 2005m1
Turkey	-4.925	-4.991*	-4.948	2001m12 - 2006m10

Table 7

BIC-analysis for exchange rates

Country	Lags			Sample period
	0	1	2	
Australia	-4.138*	-4.111	-4.085	1984m2 - 1998m4
Canada	-5.872*	-5.848	-5.824	1980m7 - 1996m2
New Zealand	-4.345*	-4.330	-4.298	1987m2 - 1999m8
Philippines	-4.738*	-4.683	-4.631	1998m5 - 2005m3
South Korea	-4.179*	-4.125	-4.134	1998m2 - 2005m1
Turkey	-3.202*	-3.136	-3.071	2001m12 - 2006m10