The Changing Relationship Between Commodity Prices and Equity Prices in Commodity Exporting Countries

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Abstract

We explore the linkage between equity and commodity markets, focusing in particular on its evolution over time. We document that a country's equity market value has significant out-of-sample predictive ability for the future global commodity price index for several primary commodity-exporting countries. The out-of-sample predictive ability of the equity market appears around 2000s. The results are robust to using several control variables as well as firm-level equity data. Finally, our results indicate that exchange rates are a better predictor of commodity prices than equity markets, especially at very short horizons.

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1 Introduction

This paper investigates the relationship between commodity prices and the prices of other assets, in particular equity market. Our objective is twofold: first, we document empirical stylized facts regarding commodity prices and equity market values; second, we study whether equity market values contain useful information for predicting future commodity prices. One reason why equity markets may predict future commodity prices in commodity-exporting countries is the following: countries' equity market values reflect the net present value of their future cash flows. For countries that are heavy producers of primary commodities and price takers in the commodity markets, expected future commodity price increases should increase their future expected cash flows, and therefore their current market value, everything else equal. Note that such countries need to satisfy two conditions: they need to be price takers (if they were monopolistic producers, they could affect the prices by controlling their supply) and they need to be heavy producers of commodities. We chose the countries in our paper accordingly, by focusing on small open economies with a large export share of primary commodities such as Australia, Canada, Chile, New Zealand, and South Africa.

Our main findings are as follows. First, regarding empirical stylized facts on global commodity prices and equity markets, we document that the former are positively correlated with lagged equity values; the time series properties of commodity prices have however drastically changed since the 2000s, and commodity prices have become more correlated with equity markets around the same time. Such changes have taken place at a time of exceptionally high global demand pressures. Second, regarding the predictability of equity market values for future global commodity price indices, we document that a country's equity market value has significant out-of-sample predictive ability for the future global commodity price index relative to the random walk for several of the countries we consider. We also find that it also has significant predictive ability relative to an autoregressive model at the two quarter-ahead forecasts, but not at the one quarter-ahead forecast. We find little evidence of in-sample predictive ability against the autoregressive benchmark at the one quarter-ahead horizon, but significant predictive ability at the two quarter-ahead horizon for all countries once we appropriately take into account the effects of instabilities in the data. Thus, the predictive ability seems to be stronger at the medium horizon than at the shorter horizon. The out-of-sample predictive ability of the equity market predictor appears towards the mid-2000s, at the time of the sharp increase in the cost of primary commodities, high demand pressures, and large increases in the flow of investments in commodity markets, possibly driven by speculation.

A word of caution. This paper does not study the structural links between commodity prices and equity markets. Such analysis would require the use of a structural model. In other words, our finding that equity markets can, in some cases, help predict commodity prices is silent about what generates such predictive ability. In fact, our analysis is based on evaluating the predictive ability of equity markets via Granger-causality and forecasting regressions, which are useful to assess whether a variable has predictive ability, not whether it "causes" other variables to change. The latter question can only be answered by using a structural model. However, we can study whether equity markets have predictive ability above and beyond that contained in other variables, such as global demand pressures and interest rates, used as proxy for the world business cycle, and we undertake such analysis. We find that global demand and interest rate proxies do not contain additional, significant predictive ability for commodity prices above that contained in stock markets. The latter result does not mean, however, that the correlation between equity markets and commodity prices was not caused by a soar in global demand: it may well be that stock markets correctly incorporated future expected increases in global demand pressures in the equity market values of countries that are heavy producers and exporters of primary commodities. In addition, to provide some preliminary (although not conclusive) guidance on the economic channels through which higher equity returns affect commodity prices, we investigate the sign of the regression coefficient of future commodity prices on lagged equity markets. Generally speaking, equity values reflect the net present value of their cash flows: whether high equity values should help forecast high or low commodity prices depends on whether prices are driven by cash flows or discount rates. If equity prices increase because of positive news on future cash flows, for example driven by expected global demand pressures, high equity returns should predict high commodity prices and the coefficient should be positive. On the other hand, if equity prices decrease because of an increase in the price of risk, for example due to an increase in risk-aversion, which at the same time increases future expected returns on financial assets, then the coefficient should be negative and the channel should be through the discount factor rather than through future cash flow values.[1] We find that the coefficient was mainly positive in the period around the early 2000s, thus possibly reflecting the high demand pressures; however, towards the end of the sample, around the start of the financial crisis, the coefficient becomes negative, thus possibly reflecting a higher price of risk. For

[1] I thank a referee for suggesting this interpretation.

the use of a structural model to study whether financial investors destabilize the oil price, see Lombardi and Robaysy (2012).

Importantly, in order to disentangle whether the source of the increased correlation is diversification (which would affect all countries equally) or speculation linked to a cash flow argument (which would affect mostly countries that are heavy exporters of commodities whose prices have soared), we study whether country-specific equity markets of countries that are not heavy exporters of commodities have predictive power for the world commodity price index; if that is the case, then the channel of transmission for equities is likely not related to the fact that such countries are heavy exporters of commodities and the net present value theory but, rather, to other factors, such as diversification. Our results support the net-present value explanation. We also compare the predictive ability of equity markets with that of exchange rates. Our results show that, in most cases, a model that includes exchange rates forecasts commodity prices better than a model that has only equity market values; on the other hand, adding equity market values to a model with exchange rate predictors does not improve forecasts of commodity prices at the one-quarter-ahead horizon, although it does for three countries at the 5% level at the two-quarter-ahead forecast horizon. We also perform a series of robustness checks and further analyses. We check the robustness of our results to country-specific commodity price indices and firm-level equity values. In particular, we find that country-specific equity markets do Granger-cause country-specific commodity price indices, especially after taking instabilities into account. We also find that they have some out-of-sample forecasting ability as well. Interestingly, the results are robust to using firm-level equity prices.

Our paper is related to several strands of the literature. There is an increasing literature on the linkages between commodity prices and other asset prices/ markets and the causes of such relationship. There are two opposite views on what caused the soar in the cost of primary commodities and their volatility: one the one hand, Hamilton (2009) and Kilian (2009) have argued that the increase in commodity prices in that period was the consequence of the rapid growth in emerging economies, whose demand soared, pushing commodity prices up. On the other hand, the increase in commodity prices might have been driven by speculation caused by large flows of investments in commodity indices, as in Tang and Xiong (2010). The latter argue that the main responsible was the increasing presence of investors in the commodity markets, who generated a spill-over of shocks from outside commodity markets into the commodity markets and created a higher correlation of oil returns with the returns of primary commodities. Buyuksahin, Haigh and Robe (2008) reach instead a very different conclusion: their correlation analysis shows a lack of greater return co-movement across equities and commodities, which suggests that commodity markets can still be used for portfolio diversification. This paper is also more generally related to the literature on structural changes in commodity prices.[2] In particular, there is a literature on the relationship between the prices of primary commodities and other macroeconomic variables and their instabilities: see Caballero, Farhi and Gourinchas (2008), Chen et al. (2010) and Alquist, Kilian and Vigfusson (2011), among others. In particular, Caballero, Farhi and Gourinchas (2008) study the interconnection between global imbalances, the subprime crisis and the volatility of oil and asset prices, and note that such relationships underwent several structural changes during the period that they consider. While our paper is also concerned about instabilities in the relationship between commodity and asset prices, we pay more attention to predictability and Granger-causality and less attention to a detailed structural model of the transmission mechanism. Chen et al. (2010) find that exchange rates of small open economies with a large export share of primary commodities may have predictive content for future commodity price indices. The rationale is that exchange rates, like any asset prices, should be determined as the net present value of fundamentals, such as commodity prices. While their paper establishes a structural link between exchange rates and future commodity prices through the terms of trade and income channel, in this paper we conjecture that equity markets in these countries also offer useful information for commodity market behavior. In fact, in an insightful discussion of Chen, Rogoff and Rossi (2010), Helene Rey (American Economic Association meetings, 2009) showed suggestive evidence that stock price indices of the countries we consider have predictive ability for commodity price indices, similar to that of the exchange rates. The results in our paper indicate that equity markets have significant predictive content for future commodity prices, and that exchange rates have additional significant predictive ability above and beyond that of equity markets. Alquist, Kilian and Vigfusson (2011) focus on whether oil prices are predictable based on macroeconomic aggregates, paying particular attention to instabilities. They emphasize the problems with combining oil price data from the pre-1973 and post-1973 period because of structural breaks. They also find that nominal oil prices are predictable in-sample using lagged inflation, money aggregates, global commodity prices, and exchange rates of commodity exporters whereas real oil prices are predictable in-sample using global real output. The main difference between Alquist et al. (2011) and this paper is that we focus on the

[2] See Amano and Van Norden (1995), Chen and Rogoff (2003) and Cashin et al. (2004), among others for classical studies on commodity prices.

predictive ability of commodity price indices, of which oil (and, more in general, energy) prices are only one component, and we consider equity market values as possible predictors, which are not considered by Alquist, Kilian and Vigfusson (2011).

The paper is organized as follows. Section 2 provides heuristic empirical evidence on the relationship between equity markets and global commodity price indices. Section 3 provides a more formal empirical analysis on the relationship between equity markets of the countries we consider and the global commodity price index, paying particular attention to in-sample Granger-causality, instabilities and out-of-sample forecasting. We also check the robustness of our results to country-specific commodity price indices, exchange rates, global demand, interest rate changes and firm-level data on the stock value of a prominent Canadian oil producing and exporting firm. Section 4 concludes.

2 Equity Markets and Global Commodity Prices: Heuristic Evidence

We collect quarterly data on equity indices for a variety of commodity currencies. We focus on small open economies that are price takers in commodity markets and are heavy producers and exporters of primary commodities, such as Australia (denoted "AU"), New Zealand (denoted "NZ"), Canada (denoted "CA"), Chile (denoted "CHI") and South Africa (denoted "SA"). We focus on quarterly data as the latter provide information on the medium-run relationship between these variables; also, forecast horizons of one to two quarters are relevant for macroeconomists interested in predicting the behavior of such variables in the medium-run without being obscured by higher frequency movements. Datastream provides price data on the market index for these countries. Table 1 provides details on mnemonics as well as starting date of the sample. We focus on data before the financial crisis since the global financial turmoil would obscure the relationships we are seeking to uncover. Thus, all the data end in 2008Q1.

In addition, we also collect data on commodity price indices ('CP'). In particular, we consider the IMF aggregate (global) commodity price index, which is a world export-earnings-weighted price index for more than 40 primary products.[3] For robustness, we also consider country-specific commodity price indices, labeled cp_t. The country-specific commodity price indices aggregate the relevant dollar spot prices of commodities using export-earnings weights

[3] Here we focus on the non-oil commodity price index due to its longer span of available data.

specific for each country. Country-specific commodity price indices data are from Chen et al. (2010); the country-specific weights used to aggregate individual world commodity prices into country-specific indices are reported in Appendix I in their paper. The weights are country-specific. For example, copper receives 100% of the weight for Chile and 2% for Canada. For Canada, the largest weights are crude oil (21.4%), lumber (13.6%), pulp (12.8%), natural gas (10.7%), beef (7.8%), newsprint (7.7%) as well as other agricultural and mineral products whose weights are not more than 5% (zinc, wheat, silver, potash, nikel, hogs, gold, fish, corn, copper, coal, canola, and aluminum). For Australia, the largest weights are coking coal (14.7%), steaming coal (9.7%), gold (9.4%), iron ore (9.3%), wheat (8.3%), aluminium (8.1%), beef (7.9%), alumina (7.4%) as well as several other agricultural products (such as wool, cotton, sugar, barley, canola, rice) and mineral products (such as copper, nickel, zinc and lead), each of which receive a weight no larger than 5%. For New Zealand, the major weights are on lamb (12.5%), wholemeal (10.6%), beef (9.4%) and cheese (8.3%). Finally, South Africa's weights are 22% on coal, 48% on gold and 30% on platinum. In order to verify that the main results hold for the commodity currencies that we consider, but do not hold for currencies of countries which are not heavy exporters of primary commodities, we also collect data on equity indices for other countries, in particular, Austria, Germany, Ireland and U.K.[4]

In this paper we let cp_t^W denote the log of the global commodity price index and m_t denote the log of the country-specific equity market index. The rates of growth of the variables will be denoted by Δ preceding the variable; for example, Δcp_t^W denotes the rate of growth of the global commodity price index. To measure the global business cycle, we utilize two measures. The first is a measure of global real economic activity proposed by Kilian (2009), denoted by y_t^W. Since world economic activity is by far the most important determinant of the demand for transport services, Kilian (2009) proposes to measure real economic activity with a global index of dry cargo single voyage freight. He uses the net increases in freight rates as an indicator of strong cumulative global demand pressures to identify periods of high and low real economic activity. An alternative measure of real economic activity would be industrial production. However, as discussed in Kilian (2009), the former may be preferable to the latter since it avoids exchange-rate weighting, it automatically aggregates real economic activity in all countries, and it incorporates shifting country weights, changes in the decomposition of real output, and changes in the propensity to import industrial commodities for a given unit

[4]We do not consider the US since commodity prices are typically quoted in US dollars.

of real output.[5] The second is a measure of nominal interest rates, which we denote by "r_t^W". We chose the Fed Funds rate as our measure of interest rates for two reasons: the first is the conjecture that the soar in commodity prices was fueled by cheap money by the Fed. The second is that interest rates are highly correlated across countries and since interest rates for some of the countries we consider are available for only very short samples, we use the Fed Funds rate as a proxy for global interest rates. In our forecasting performance analyses in Section 3.6, we also consider real interest rates, constructed as the difference between the Fed Funds rate and the US CPI inflation rate.[6]

2.1 Stylized Facts About Commodity Price Indices

Figure 1 plots the commodity price data that we use. The figure clearly shows the well-known and large surge in both the global commodity price index and the country specific indices around 2004, which has been carefully monitored by the IMF (see IMF, 2012).

The goal of this paper is to investigate the relationship between commodity prices and the prices of other assets, in particular equity markets, and their evolution over time. Figure 2 reports scatterplots of the global commodity price index against the equity market value for each country. The figure clearly shows that their relationship evolved over time: before 2004, there was little or no empirical evidence of a relationship, whereas a positive relationship became clearly visible after 2004.

2.2 Empirical Stylized Facts about Growth Rates of Commodity Prices

The empirical evidence so far is based on commodity price levels. However, Figure 1 clearly shows that both the global and the country-specific commodity price levels have a trend, and standard unit root tests do not reject the hypothesis that they are non-stationary. It is well-known that non-stationarity complicates inference; failing to impose non-stationarity may have problematic consequences on tests of predictive ability too.[7] Therefore, in the remainder of the paper we will focus on rates of growth of commodity prices. Figure 3 shows

[5] Note that the net increase in freight rates is already a first-differenced variable, therefore we will not take growth rates of this variable.

[6] Our meausure of CPI inflation is based on the all-consumers, all-goods, seasonally adjusted consumer price index.

[7] See Rossi (2005).

the growth rates of commodity prices. For each country, the continuous line depicts the rate of growth of its country-specific commodity price index, and the dotted line depicts the global commodity price index. The figure shows that the country-specific indices are quite correlated with the global index, although they also show some differences. For example, the country-specific index is less volatile than the global index for Australia and much more volatile for Chile and South Africa. This is due to different countries specializing in different export commodities, some of which may be more volatile than others. For example, copper price has been very volatile relative to other commodity prices in the period that we examine, and this is reflected in the Chilean commodity price index (which is composed 100% by copper) being more volatile than the global index.

It is evident from Figure 3 that the rate of growth of commodity prices changed dramatically since the beginning of 2000, when its average shifted from zero to a positive value, consistently with the evidence in Figure 1. In other words, growth rates of commodity prices experienced a structural break in the 2000s.

To explore more in details the time series properties of commodity prices in relation to those of the other variables used in this study Table 2 reports, for each country, cross-correlations at various leads and lags between the rate of growth of the two indices of commodity prices, the rate of growth of their equity market value, global demand and the US interest rate.

Table 2 shows that the rate of growth of global commodity price indices auto-correlation is the highest at one lag (row labeled "Δcp_t^W") and dies away quickly afterwards. In fact, unreported results show that the BIC criterion selects one lag in an autoregressive model for the growth rate of the global commodity price index. The table shows other interesting results. For example, the contemporaneous correlation between the global commodity price growth rate and the country specific growth rates (rows labeled "Δcp_t") is very high, ranging between .5, .6 for Australia, Chile and South Africa, to .38 for Canada and New Zealand; the cross-correlation decreases at further leads and lags. In addition, the global commodity price growth rate co-moves positively with rates of growth of their respective equity markets and the cross-correlation is the highest with two-quarters lagged equity market values. Commodity price growth is also pro-cyclical with the world business cycle proxied by the global demand index (row labeled "y_t^W") and leads the world business cycle; it is also negatively correlated with nominal interest rate changes. The table also confirms that the volatility of the country-specific commodity price indices (column labeled "Std.") is higher than that of the global index for Canada, Chile and South Africa, and smaller for Australia and New

Zealand.

Given the drastic structural change experienced by commodity prices, we investigate whether the change is related to equity markets. Figure 4 illustrates how the correlation between the growth rates of the global commodity price index and equity markets evolved over time. The bar separates two sub-samples: prior and after 2004Q1. A visual inspection of the figures suggests that the volatility of equity markets was lower in the latter part of the sample, and that the volatility of commodity prices was higher; it also suggests that the correlation between the two became stronger after 2004. Figures 2 and 4 suggest that before 2004 commodity prices were best described as a driftless random walk; after 2004, the growth rate of commodity prices became positive and more correlated with the positive growth rate of equity markets.

2.3 The Role of Global Demand And Interest Rates

One might worry that these correlations depend significantly on the state of the global business cycle, global demand or interest rates. Figures 5 and 6 investigate whether that this is the case. Figure 5 plots the correlations together with bars that denote either unusually very high or high global demand (labeled "Very High y_t^W" and "High y_t^W", respectively), defined as observations in the top 10% and top 20% quantiles of the distribution of the global demand index conditional on the sample available for the country we study.[8] Figure 6 plots the same except that the bars denote unusually high or low nominal interest rates (labeled "High r_t^W" and "Low r_t^W", respectively), defined as observations in the top 10% and lowest 10% quantiles of the distribution of interest rates. Clearly, the high correlation between equity markets and commodity prices that we observe after 2004 coincides with high global demand pressure, thus suggesting that global demand might be a potential cause of the increase in the correlation. On the other hand, there seems to be less evidence of a relationship between exceptionally high (or low) interest rates, and the high correlation between equity and commodity prices after 2004, at least over the sample that we consider, thus suggesting that interest rate surges do not seem related to the increase in the correlation.[9]

Figure 7 reports scatterplots of the relationship between (lagged) global demand and the global commodity price index. Figure 8 does the same for the relationship between

[8] Since the various countries have data whose samples differ, the quantiles of the distribution of the global demand index and the interest rate differ depending on the countries we consider.

[9] Unreported results show that our findings are robust to using real interest rates, that is the Fed Funds rate minus the CPI inflation rate.

(lagged) interest rates and commodity prices. The figures show that there does not seem to be a significant change between the relationship between these variables before and after 2004. In other words, while the correlation between commodity prices and equity markets clearly became positive after 2004, the correlation between commodity prices and demand or interest rates did not change.[10]

2.4 Several Stylized Facts

The analysis in this section suggests several interesting empirical stylized facts: first, over the sample that we consider, commodity prices are, on average, generally positively correlated with equity prices lagged one or two quarters; they are also correlated with global demand and interest rates. Second, the time series properties of commodity prices have drastically changed during the 2000s, when their rate of growth became positive. Third, commodity prices have become more correlated with equity markets around the same time; in particular, their correlation was inexistent before 2000s and became positive afterwards. Fourth, the change in the correlation between commodity price growth rates and equity market growth rates happened at a time of unusually high global demand pressures; there does not seem to be a drastic change in the relationship between global demand and commodity prices happening at the same time. Fifth, exceptionally high or low changes in interest rates do not seem to be related to the soar in commodity prices in 2000s, nor to the change in the relationship between equity prices and commodity prices.

While the second fact is well-known, the others will be the object of more careful investigation in the remainder of the paper. In particular, the rest of the paper investigates whether these correlations are statistically significant and stable over time, whether equity market values have predictive power for commodity prices, and whether the co-movements and the predictive ability findings are robust to the presence of third factors, such as interest rates or global demand.

3 Equity Markets and Commodity Prices

This section presents formal statistical tests of the predictive relationship between equity markets and commodity prices. We focus on the ability of country-specific equity market values to predict the future rate of growth of commodity prices. The intuition is that, all

[10] Again, unreported results show that our findings are robust to using real interest rates.

else equal, if markets are forward looking, the stock market value of a small open, price-taker economy that produces and exports heavily in commodities should increase when commodity prices are expected to increase, due to the future higher expected cash flows.

3.1 In-sample Predictive Content

We first consider whether equity market growth has in-sample predictive content for future values of the global commodity price index. We consider the following two regressions:

$$E_t \Delta cp_{t+h}^W = \beta_0 + \beta_1 \Delta m_t, \tag{1}$$

$$E_t \Delta cp_{t+h}^W = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta cp_t^W, \quad t = 1, 2, ..., T. \tag{2}$$

Regression (1) is most appropriate when growth in commodity prices is close to a random walk, such as before 2004; regression (2) is more appropriate when it is close to an autoregressive model, such as the period after 2004. We start by considering Granger-causality (GC) tests. In particular, we test whether equity markets Granger-cause future commodity prices in regression (2).[11] The p-values of traditional Granger-causality test are reported in Panel A in Table 3 for horizons "h" equal to one and two quarters. It is clear that there is little evidence of in-sample predictive ability one quarter ahead; however, there is strong evidence of predictive ability two quarters ahead for Australia, New Zealand and Canada. It is well-known that Granger-causality tests fail in the presence of instabilities (see Rossi, 2005). This might be problematic in our analysis since the previous section suggested that instabilities might be important. Therefore, we test whether the Granger-causality relationship is unstable over time using the QLR test (Andrews, 1993). Panel B in Table 3 reports p-values of the QLR test. In several cases, the p-values are close to or smaller than 5%, thus signaling the presence of instabilities.

Given the concerns about instabilities, we proceed to test for in-sample predictive ability using Rossi's (2005) Granger-causality test robust to instabilities.[12] Even after allowing for instabilities, there is little empirical evidence that equity market values Granger-causality the global commodity price index at the one quarter horizon (only Chile is marginally significant at the 10% level), although strong evidence for two-quarters ahead regressions for all countries – see Panel C in Table 3. Results are similar for eq. (1).

[11] All tests are implemented with a heteroskedasticity and autocorrelation robust variance estimation (Newey and West, 1987) using a bandwidth equal to $T^{1/3}$.

[12] We implement the test labeled Exp-W_T^* in Rossi (2005).

The presence of instabilities raises the question of how the marginal predictive ability of equity markets changed over time. Having noted the drastic changes occurring around 2004 in the previous section, we consider the following analysis. We estimate regression (1) over rolling windows of data, where $h = 1$ and the window size is equal to the sample of data we have available after 2004.[13] We report the value of the coefficient on equity in Figure 9. For example, the last point in Panel A corresponds to the value of the coefficient in the sub-sample 2004Q1-2008Q1; the second to last point corresponds to the value of the coefficient in the sub-sample 2003Q4-2007Q4, and so forth. The figure shows a dramatic increase and then decrease in the coefficient for all countries. Given that the sub-sample of data is very small, the decrease is not statistically significant (pointwise over time) at conventional values except in the case of Chile.

The sign of the coefficient on equity is interesting, as it may provide empirical evidence on the channels through which higher equity returns affect commodity prices.[14] Generally speaking, the value of equity depends on the net present value of its cash flows, and whether high equity values should help forecast high or low commodity prices depend on whether prices are driven by cash flows or discount rates. If equity prices increase because of positive news on future cash flows, for example driven by expected global demand pressures, high equity returns should predict high commodity prices and the coefficient should be positive. On the other hand, if equity prices decrease because of an increase in the price of risk, for example due to an increase in risk-aversion, which at the same time increases future expected returns on financial assets, then the coefficient should be negative. Figure 9 shows that the coefficient was mainly positive in the period around the early 2000s, thus possibly reflecting the high demand pressures discussed in Figure 5; however, towards the end of the sample, around the start of the financial crisis, the coefficient becomes negative, thus possibly reflecting a higher price of risk.

3.2 Out-of-sample Forecasting Ability

Granger-causality results are useful tools to analyze historical data; however, policy-makers would find useful to assess the existence of the predictive ability in real-time. In order to evaluate the real-time out-of-sample forecasting ability of the model, we produce a sequence

[13] The latter is only 17 observations, but in the presence of structural changes having a smaller window of data ensures a faster adjustment to changes in the environment, and results are robust to small changes in the window size.

[14] I thank a referee for suggesting this interpretation.

of rolling out-of-sample forecasts based on the model with equity market value, eq. (2), and compare it with forecasts based on two benchmark models: the random walk (RW) model:

$$E_t \Delta cp^W_{t+1} = 0, \tag{3}$$

and the autoregressive (AR(1)) model:

$$E_t \Delta cp^W_{t+1} = \gamma_{0t} + \gamma_{1t} \Delta cp^W_t, \tag{4}$$

The lag length of the autoregressive model has been selected by the BIC criterion, and it is consistent with the serial correlation properties of the data summarized in Table 2.

To evaluate the out-of-sample forecasting ability of the models, we choose an estimation window size of 17 observations: a small estimation window is very important for capturing instabilities. In particular, in our sample, the results in the previous section suggest that the change in the relationship between equity markets and commodity prices happened around 2004; since the sample ends in 2008Q1, the small window of 17 observations (basically equal to the four years of data since the change) adapts more quickly to structural changes in the relationship, and allows us to capture more effectively the changes in the predictive ability. Table 4 reports the root mean squared forecast error (RMSFE, in percentage) of the competing models that we consider, as well as Clark and McCracken (2001) test statistic for equal predictive ability. Asterisks denote significance: at 1% (***), 5% (**), and 10% (*) respectively. When the Clark and McCracken's (2001) test rejects the null hypothesis, it is empirical evidence in favor of the model with the additional predictors – for example, in the case of Panel (a), equity. A note of caution: as explained in Clark and West (2006), in nested models (such as those considered here), the sample MSFE from the larger model is expected to be greater than that of the small model even when, in population, the two models have the same predictive ability, since the larger model introduces noise into its forecasts by estimating parameters that are useless in forecasting. Therefore, a finding that the small model has a smaller MSFE does not necessarily mean that the additional predictors present under the larger models are not useful for forecasting. The Clark and McCracken (2001) test takes this into account in evaluating the relative predictive ability of competing models.

Panel (a) in Table 4 compares the forecasting ability of model (1) and the random walk benchmark, eq. (3). The table shows that the model with equity forecasts better than the random walk in almost all countries and forecast horizons; only in the case of one-quarter ahead forecasts for Australia the model with equity does not forecast significantly better than the random walk. The empirical evidence in favor of predictive ability is very strong.

Figure 10 shows the forecast of the model with equity against the RW forecast, as well as the realized value of the commodity price growth rate, Δcp_{t+1}. From the figure, it appears that the predictive ability of the equity model improved after 2004. The next sub-section will consider a more detailed analysis of this conjecture as well as formal tests.

3.3 Equity Markets Forecasting Ability and Instabilities

It is important to note that the presence of instabilities might invalidate standard tests for forecast comparisons. Also, it is interesting to provide additional empirical evidence on the timing of the appearance of the predictive ability. We do so by reporting forecast comparisons of model (2) against the random walk benchmark over time using the Fluctuation test developed by Giacomini and Rossi (2010). The latter propose to measure of the local relative forecasting performance of the models, and test whether the competing models are equally good at forecasting the target variable at each point in time by plotting the (standardized) sample path of the relative measure of local performance together with critical values. The measure of local performance is obtained by the Clark and West (2007) test, which is appropriate for the nested models that we consider here. When the Fluctuation test is above the critical value, it signals that the model with equity information outperforms the benchmark at that point in time. The plot of the Fluctuation test thus provides some information on when the predictability appeared or disappeared over time.

Figure 11 shows that indeed that was the case in the data. For all countries, we note that equity market values became significant predictors sometime in the mid-2000s.

3.4 Equity Markets vs. the Autoregressive Model

Panel (b) in Table 4 compares the forecasting ability of model (2) and the random walk benchmark, eq. (4). It evaluates the predictive ability of equity above and beyond that of an autoregressive model. The table shows that the model with equity again forecasts better than the autoregressive benchmark in all countries at the two quarters ahead forecast horizon, and the significance is very strong; however, the model fails to beat the autoregressive model at the one quarter horizon, for all countries.

3.5 Equity Markets vs. Exchange Rates

We also compare the performance of equity markets as predictors for the global commodity price index with that of exchange rates. In a related paper, Chen et al. (2010) have found that exchange rates of small open economies with a large export share of primary commodities may have predictive content for future commodity price indices. The rationale is that exchange rates, like any asset prices, should be determined as the net present value of fundamentals, such as commodity prices. So the findings in the previous sub-sections beg the question whether there is significant predictive ability in exchange rates above and beyond that contained in equity markets.

We consider the following cases. The first case compares the predictive ability of a model with both equity and exchange rates with that of a model that includes only equity. More in detail, the first competing model includes lagged values of the growth of exchange rates (Δs_t, where s_t is the log of the exchange rate between the country and the US), equity market and commodity prices:

$$E_t \Delta cp^W_{t+h} = \beta_{0t} + \beta_{1t} \Delta m_t + \beta_{2t} \Delta s_t; \tag{5}$$

the second competing model does not include the exchange rate:

$$E_t \Delta cp^W_{t+h} = \beta_{0t} + \beta_{1t} \Delta m_t. \tag{6}$$

Results are reported in Panel (c) in Table 4. Clearly, in most cases exchange rates do have predictive ability above and beyond that of equity markets.

The second case compares the predictive ability of a model with both equity and exchange rates with that of a model that includes only exchange rates. More in detail, the first competing model is the same as eq. (5) and the second competing model does not include equity market values:

$$E_t \Delta cp^W_{t+h} = \beta_{0t} + \beta_{1t} \Delta s_t; \tag{7}$$

Results are also reported in Panel (c) in Table 4. The results show that, in most cases, a model with exchange rates only has the same predictive ability as a model that includes both exchange rates and equity market values. This is the case for all countries at the one-quarter-ahead horizon. Thus, equity market values do not have additional predictive ability above and beyond that of exchange rates at that horizon. The model with both exchange rates and equity market values predictors, however, has a significantly better forecasting performance for three countries at the 5% level at the two-quarter-ahead forecast horizon. Overall, these results reinforce the findings in Chen et al. (2010) and lend further support to the usefulness of exchange rates to forecast commodity prices especially at short horizons.

3.6 Equity Markets vs. Global Demand and Interest Rates

The findings that equity markets help forecast commodity prices lends support to the conjecture that equity markets have become more correlated with commodity markets. One explanation for this finding is that financial investors have started to heavily invest in commodities to diversify their portfolio risks (see Tang and Xiong, 2010). Thus, higher correlation in these markets is due to speculation and it is interpreted as less market segmentation. Under this scenario, shocks to equity markets spill-over to commodity markets, as investors change their positions across markets, and therefore affect countries whose production depends heavily on commodities, such as the countries considered in our study. An alternative explanation is that both equity and commodity markets have been similarly hit by common shocks in the 2000s, and this is why commodity prices can be predicted by equity markets.

To further investigate this issue, we consider the following two models. The first is a model that includes lagged values of the global demand index Δy_t^W (where the latter is the index constructed by Kilian, 2009), as well as the equity market rate of growth, Δm_t:

$$E_t \Delta cp_{t+h}^W = \beta_{0t} + \beta_{1t} \Delta m_t + \beta_{2t} \Delta y_t^W; \tag{8}$$

the second is a model that includes lagged values of the change in the nominal interest rate (Δr_t^W, where r_t^W is the proxied by the Fed Funds rate) and the equity market value:

$$E_t \Delta cp_{t+h}^W = \beta_{0t} + \beta_{1t} \Delta m_t + \beta_{2t} \Delta r_t^W; \tag{9}$$

The benchmark model is the model that does not include the global demand index nor the interest rate, eq. (6).

Note that interest rates are endogenous, and monetary policy may endogenously respond to commodity price changes, as discussed in e.g. De Gregorio (2012); in fact, Bodenstein, Guerrieri and Kilian (2012) show that the optimal response of monetary policy to, e.g., oil price changes depend on the reason why the oil price has changed and a response may, in some cases, be optimal.[15] Similarly for global demand.[16] In our exercise, which is based on

[15] See also Catao and Chang (2012) for an analysis of the relative advantages of PPI and CPI monetary policy targeting in open economies with different export-import structures and imported inputs in production, under alternative assumptions on international risk sharing.

[16] See e.g. Kose (2002) for an analysis of the role of world price shocks, such as fluctuations in the prices of primary goods and in the world real interest rate, in the generation and propagation of business cycles in small open developing countries, and Cespedes and Velasco (2012) for a theoretical analysis of output dynamics and the evolution of the real exchange rate in small open economy models during episodes of large commodity prices.

Granger-causality regressions and forecasting ability, we do not attempt to disentangle the structural shocks that cause the relationship between commodity prices and equity prices to change, as such analysis would require the use of a structural model, as in Bodenstein, Guerrieri and Kilian (2012) and Baskaya, Hulagu and Kucuk (2012). The goal of our analysis is instead to evaluate whether equity markets have additional marginal predictive content for future commodity price growth once we control for global demand and interest rate changes as extra predictors.

Panel (d) in Table 4 reports results for comparing forecasts of eq. (8) to those of eq. (6); panel (e) reports results for comparing forecasts of eq. (9) to those of eq. (6) using the Fed Funds rate as a measure of global nominal interest rates; panel (f) reports results for comparing forecasts of eq. (9) to those of eq. (6) but where the US real interest rate (measured by the difference between the Fed Funds rate and CPI inflation) is used as a proxy for global real interest rates. The panels show that neither global demand nor interest rate changes do have additional predictive content relative to equity.

Note that even if we find that global demand has no additional explanatory power above and beyond equity markets, that does not mean that the predictability we observe in our selected countries between commodity prices and equity markets in the 2000s is not caused by an expected soar in global demand: in fact, it might well be that future anticipated increases in global demand pressures were the source of the predictability, as stock markets efficiently incorporated its effects on equity values of countries producing and exporting primary commodities. In fact, the positive coefficients depicted in sub-section 3.1 seem to suggest that this might indeed be the explanation. What our empirical results imply, instead, is that future information regarding future global demand pressure or interest rate spikes for the purposes of predicting commodity prices is summarized by equity market values.

3.7 Robustness to Non-Commodity Currencies

We further analyze whether the fact that equity markets have become more correlated with commodity markets is due to a "financial diversification" argument (i.e. investors starting to heavily invest in commodities to diversify their portfolio risks) or to a net present value argument. One would expect that the "financial diversification" argument could apply to equity return even from non-commodity producers. On the other hand, according to the net present value theory, for countries that are heavy producers of primary commodities and price takers in the commodity markets, expected future commodity price increases should increase their future expected cash flows, and therefore their current market value, everything else equal. In the latter case, shocks to equity markets spill-over to commodity markets, as investors change their positions across markets, and therefore affect countries whose production depends heavily on commodities, such as the countries considered in our study. To disentangle whether the source of the increased correlation is diversification (which would affect all countries equally) or speculation linked to a cash flow argument (which would affect mostly countries that are heavy exporters of commodities whose prices have soared), we study whether country-specific equity markets of countries that are not heavy exporters of commodities have predictive power for the world commodity price index; if that is the case, then the channel of transmission for equities is likely not related to the fact that such countries are heavy exporters of commodities and the net present value theory but, rather, to other factors, such as diversification. We consider four such countries, two small and two big: Ireland (labeled "IR"), Austria ("OE"), UK and Germany ("Ger"), four countries for which data on equity markets are available since 1973Q1.

Results are reported in Table 5. The table shows that the evidence of predictive ability is now substantially smaller. In almost all cases (except Ireland at the 2 quarter-ahead horizon), the RMSFE of the model with equity is larger than the RMSFE of the random walk model; though it is still the case that the test statistic does find empirical evidence against the random walk, still the predictive ability is substantially smaller than that documented for commodity exporting countries. Furthermore, the model never outperforms an autoregressive model.

3.8 Equity Markets and Country-specific Commodity Price Indices

The analysis in the previous sub-section suggests that equity markets have some out-of-sample predictive ability for the global commodity price index, and that such predictive ability started to show up in the data around mid-2000s. One might argue that country-specific equity market values might have even more predictive ability for country-specific commodity price indices. We evaluate such conjecture in this section.

We first consider whether stock prices have in-sample predictive content for future country-specific commodity price indices. Let cp_t denote the country-specific commodity price index and m_t denote the country's equity market index. For each country, we estimate the following regression:

$$E_t \Delta cp_{t+1} = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta cp_t, t = 1, 2, ..., T. \tag{10}$$

We start by considering traditional Granger-causality tests in Panel A in Table 6.[17] The table shows that the rate of growth of equity markets significantly Granger-causes commodity prices at the 5% significance level in Australia and South Africa at the one quarter horizon, and for Australia, Canada and South Africa at the two-quarter horizon; however, results are not significant for the other countries/horizons.

We further test whether the Granger-causality relationship is unstable over time using the QLR test (Andrews, 1993). From Panel B, it is clear that the relationship between past equity market values and commodity prices has been subject to significant structural breaks for the majority of countries and forecast horizon combinations. Rossi's (2005) Granger-causality test robust to instabilities, reported in Panel C of Table 6, finds much stronger empirical evidence in favor of predictability of equity markets for commodity prices than the traditional Granger-causality test, and highlights predictive ability for Australia, Canada and South Africa at the one-quarter ahead horizon as well as for all countries except New Zealand for the two-quarter ahead horizon.

We also evaluate the real-time out-of-sample forecasting ability of the model. We consider two models:

$$E_t \Delta cp_{t+h} = \beta_{0t} + \beta_{1t} \Delta m_t + \beta_{2t} \Delta s_t; \tag{11}$$

the second model is the model that does not include the exchange rate:

$$E_t \Delta cp_{t+h} = \beta_{0t} + \beta_{1t} \Delta m_t. \tag{12}$$

We find quite strong empirical evidence that the model with equity market forecasts better than the random walk benchmark, although the equity model never forecasts better than the autoregressive benchmark – see Table 7.

As previously discussed, the presence of instabilities might also invalidate standard tests of forecast comparisons. We thus provide additional empirical evidence on the robustness of the predictive ability to the presence of instability by comparing the forecasts of model (12) against the random walk benchmark over time using the Fluctuation test (Giacomini and Rossi, 2010). According to Figure 12, the predictive ability of the model with equity prices became much stronger towards the mid-2000s (only in the case of Chile, it became stronger

[17] All tests are implemented with a heteroskedasticity and autocorrelation robust variance estimation, see Newey and West (1987) using a bandwidth equal to $T^{1/3}$.

towards the end of the sample but then disappeared again). These results strengthen the results we found when using equity markets to predict the global commodity price index: the predictive ability follows a pattern that is very similar across countries. This is true notwithstanding the fact that the commodity price indices are different for each country, since they reflect the composition of their countries' exports. We interpret the evidence as pointing towards to the synchronization of co-movements across commodity prices, as well as the co-movements between commodity prices and equity market values.

3.9 Robustness to Firm-level Data

One might argue that our findings should be robust to using the equity market value of exporting firms. To verify whether the stock value of exporting firms has the same predictability properties, we collect data on firm level stock values. Unfortunately, several companies that export commodities are state-owned (e.g. the major industry in Chile producing copper) and several others are available only for a fraction of the sample we are considering. The results in this section use NASDAQ data from CRSP Monthly Stock database on the stock value of Imperial Oil Ltd., Canada's largest petroleum company. The company is engaged in the exploration, production and sale of crude oil and natural gas, and has been a leading member of the petroleum industry for more than a century, thus ensuring a long enough sample for empirical analysis.

Table 8 reports the results. Let f_t denote the firm's equity value at time t. We consider the following regression:

$$E_t \Delta cp_{t+1} = \beta_0 + \beta_1 (L) \Delta f_t + \beta_2 (L) \Delta cp_t. \tag{13}$$

Panel A shows that the stock market value of Imperial Oil Ltd. Granger causes the Canadian commodity price index at both horizons when using tests robust to instabilities (see Panel C), which are strongly present in the data (see Panel B). The results are robust in out-of-sample forecast comparisons (Panel D) against both the random walk and the autoregressive benchmarks. Overall, our results are validated by firm-level stock price data..

4 Conclusions

This paper explores the linkage between equity and commodity markets, focusing in particular on studying its evolution over time. Our main findings are as follows. We document that the global commodity price indices are positively correlated with lagged equity values: the time series properties of commodity prices have however drastically changed since the 2000s, and commodity prices have become more correlated with equity markets around the same time.

We also document that a country's equity market value has significant out-of-sample predictive ability for the future global commodity price index relative to the random walk for several of the countries we consider. It also has significant predictive ability relative to an autoregressive model at the two quarter-ahead forecasts, but not at the one quarter-ahead forecast. Similarly, we find little evidence of in-sample predictive ability against the autoregressive benchmark at the one quarter-ahead horizon, but significant predictive ability at the two quarter-ahead horizon for all countries once we appropriately take into account the effects of instabilities in the data. Thus, the predictive ability seems to be stronger at the two-quarter ahead horizon than at the one-quarter horizon.

The out-of-sample predictive ability of the equity market predictor appears towards the middle of the 2000s, at the time of exceptionally high global demand pressures; however, global demand does not seem to have additional explanatory power for future commodity prices beyond that in equity markets, and the same is true for interest rate changes; exchange rates, instead, do. The latter result does not mean, however, that the correlation between equity markets and commodity prices was not caused by a soar in global demand: it may well be that stock markets correctly incorporated future expected increases in global demand pressures in the equity market values of countries that are heavy producers and exporters of primary commodities.

An interesting avenue for future research would be to investigate whether it is possible to exploit parameter instabilities to improve models to forecast commodity prices, for example via time-varying parameter models. We leave this issue for future research.

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Tables

Table 1. Equity Market Data Description

Country	Mnemonics	Starting Date
Commodity Currencies:		
Australia	TOTMAU	Jan 1973
Canada	TOTMCN	Jan 1973
Chile	TOTMCL	July 1989
New Zealand	TOTMNZ	Jan 1988
South Africa	TOTMSA	Jan 1973
Other Currencies:		
Austria	TOTMKOE	Jan 1973
Germany	TOTMKBD	Jan 1973
Ireland	TOTMKIR	Jan 1973
UK	TOTMKUK	Jan 1973
Other Variables		
Global Demand	REA	Jan 1973
Interest Rates	FEDFUNDS	Jan 1973
CPI	CPIAUCSL	Jan 1973

Note. Data are from Datastream, Kilian (2009) and FRED.

Table 2. Cross-correlation of the Global Commodity Price Index Growth Rate (Δcp_t^W) and Other Macroeconomic Variables

	Std.	h:	-5	-4	-3	-2	-1	0	1	2	3	4	5
								Australia					
Δcp_t	0.04		0.16	0.15	0.15	0.29	0.31	0.63	0.27	0.26	0.24	0.12	0.18
Δm_t	0.08		0.08	0.12	-0.03	0.46	-0.05	0.12	-0.13	-0.02	-0.10	-0.10	0.10
								New Zealand					
Δcp_t	0.04		0.30	0.18	0.16	0.17	0.10	0.38	0.17	0.29	0.33	0.17	0.10
Δm_t	0.09		0.04	0.07	0.09	0.29	0.07	0.09	-0.07	-0.08	-0.01	0.07	0.02
								Canada					
Δcp_t	0.06		0.06	-0.03	0.12	0.10	0.11	0.38	0.03	0.27	0.11	0.01	0.08
m_t	0.08		-0.19	0.05	-0.09	0.28	0.01	0.19	0.05	-0.09	-0.01	0.03	0.06
								Chile					
Δcp_t	0.12		-0.13	0.20	0.03	0.23	0.28	0.51	0.23	0.10	0.02	0.08	0.13
Δm_t	0.12		-0.06	-0.01	0.01	0.13	0.07	0.04	-0.03	-0.06	0.02	-0.04	0.23
								South Africa					
Δcp_t	0.06		0.12	0.27	0.01	0.28	0.43	0.54	0.13	0.09	0.11	0.11	0.20
Δm_t	0.11		0.03	0.17	-0.12	0.05	0.09	0.33	0.15	-0.05	-0.09	0.05	0.19
								Global Macroeconomic Variables					
Δcp_t^W	0.05		0.06	0.11	0.08	0.09	0.19	1.00	0.19	0.09	0.08	0.11	0.06
y_t^W	22.01		0.05	0.08	0.03	0.02	0.13	0.21	0.21	0.19	0.33	0.41	0.39
Δr_t^W	3.69		-0.18	-0.22	-0.27	-0.28	-0.25	-0.30	-0.22	-0.15	-0.13	-0.06	-0.05

Note. The table reports $corr(\Delta cp_{t-h}^W, x_t)$, where x_t is either Δcp_t^W, Δcp_t, m_t, y_t^W or r_t^W, and $h = \{-5, -4, ..., 5\}$. 'Std' denotes the standard deviation of the variables.

Table 3. Global Commodity Prices: Granger-causality

$h=1$					$h=2$				
AUS	NZ	CA	CHI	SA	AUS	NZ	CA	CHI	SA
Panel A. Granger-Causality Tests									
0.51	0.36	0.58	0.30	0.56	0	0	0	0.33	0.28
Panel B. Andrews' (1993) QLR Test for Instabilities									
0.04	0.06	0.05	0.01	0.07	0	0	0.02	0	0
Panel C. Granger-Causality Tests Robust to Instabilities, Rossi (2005b)									
0.36	0.22	0.29	0.10	0.48	0	0	0	0.01	0

Note. Panels A-C report p-values for tests for $\beta_0 = \beta_1 = 0$ based on the regression $\Delta cp_{t+h} = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta cp_t$.

Table 4. Out-of-Sample Forecasting Ability Tests: Predicting Global Commodity Prices

	$h=1$					$h=2$				
	AUS	NZ	CAN	CHI	SA	AU	NZ	CAN	CHI	SA
					Panel (a): Random Walk Benchmark					
RMSFE eq.(1)	5.14	4.39	4.89	4.62	4.82	4.29	4.35	4.44	4.34	4.59
RMSFE eq.(3)	4.68	4.53	4.68	4.70	4.68	4.68	4.57	4.68	4.66	4.68
Test Statistic	-1.41	6***	2.1**	5.2***	1.8*	23***	8.2***	14***	10.7***	10.0***
					Panel (b): Autoregressive Benchmark					
RMSFE eq.(2)	5.40	4.51	5.02	4.73	4.93	4.31	4.44	4.50	4.41	4.69
RMSFE eq.(4)	4.77	4.34	4.77	4.47	4.77	4.65	4.40	4.65	4.46	4.65
Test Statistic	-6.09	-1.81	-2.01	-1.77	-1.75	21***	2.2**	9.4***	3.7***	4.7***
					Panel (c): Exchange Rates					
RMSFE eq.(5)	5.01	4.43	4.94	4.31	5.26	4.48	4.40	4.71	4.39	4.82
RMSFE eq.(1)	5.14	4.39	4.89	4.62	4.82	4.29	4.35	4.44	4.34	4.59
Test Statistic	6.9***	5.5***	3.1**	10***	-1.62	-0.65	1.59*	2.6**	0.15	-1.55
RMSFE eq.(5)	5.01	4.43	4.94	4.31	5.26	4.48	4.40	4.71	4.39	4.82
RMSFE eq.(7)	4.68	4.27	4.77	4.24	4.95	4.78	4.33	4.98	4.40	4.75
Test Statistic	-4.12	-1.69	0.25	-0.07	-3.85	14.3***	0.68	11.5***	1.89*	3.72***
					Panel (d): Global Demand					
RMSFE eq.(8)	5.65	5.04	5.39	5.41	5.32	4.69	4.92	4.78	4.97	5.02
RMSFE eq.(6)	5.14	4.39	4.89	4.62	4.82	4.29	4.35	4.44	4.34	4.59
Test Statistic	-5.83	-5.51	-5.86	-6.16	-4.61	-5.22	-4.99	-3.22	-4.14	-5.14
					Panel (e): Nominal Interest Rates					
RMSFE eq.(9)	5.35	4.61	5.03	5.01	5.02	4.49	4.54	4.58	4.53	4.82
RMSFE eq.(6)	5.14	4.39	4.89	4.62	4.82	4.29	4.35	4.44	4.34	4.59
Test Statistic	-1.83	-0.74	-0.64	-2.46	-1.63	-2.53	-2.02	-1.00	-1.82	-3.18
					Panel (f): Real Interest Rates					
RMSFE eq.(9)	5.30	4.49	5.02	4.77	5.01	4.47	4.53	4.58	4.54	4.82
RMSFE eq.(6)	5.14	4.39	4.88	4.61	4.82	4.28	4.34	4.43	4.33	4.59
Test Statistic	-1.38	-0.05	-0.80	-0.47	-2.08	-1.60	-1.45	-0.75	-1.91	-2.74

Note. The table reports re-scaled MSFE differences between the model and the benchmark forecasts. Negative values imply that the model forecasts better than the benchmark. Asterisks denote rejections of the null hypothesis that the random walk is better in favor of the alternative hypothesis that the fundamental-based model is better at 1% (***), 5% (**), and 10% (*) significance levels, respectively, using Clark and McCracken's (2001) critical values.

Table 5. Robustness to Non-Commodity Currencies

	$h=1$				$h=2$			
	IR	OE	UK	GER	IR	OE	UK	GER
				Panel (a): Random Walk Benchmark				
RMSFE eq.(1)	5.01	5.11	4.78	4.95	4.55	4.95	4.86	4.91
RMSFE eq.(3)	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68
Test Statistic	0.41	2.36**	3.00**	3.50**	10.43***	2.33**	3.83***	2.51**
				Panel (b): Autoregressive Benchmark				
RMSFE eq.(2)	5.13	5.25	4.93	5.18	4.81	5.05	5.16	4.91
RMSFE eq.(4)	4.77	4.77	4.77	4.77	4.65	4.65	4.65	4.65
Test Statistic	-3.59	-2.22	-0.93	-0.43	0.64	-1.43	-3.05	-1.42

Note. The table reports percent root mean squared forecast errors (labeled 'RMSFE', that is the square root of the mean forecast error multiplied by 100) of forecasts made with the equation specified in the table. The forecast horizon is denoted by h. The table also reports the Clark and McCracken's (2001) test statistics for comparing the out-of-sample predictive ability of the two competing models' forecasts. Asterisks denote rejections of the null hypothesis that benchmark model (the random walk in Panel (a) and the autoregressive model in Panel (b)) is better in favor of the alternative hypothesis that the model with equity is better at 1% (***), 5% (**), and 10% (*) significance levels, respectively.

Table 6. Country-Specific Commodity Prices: Granger-causality

$h=1$					$h=2$				
AUS	NZ	CA	CHI	SA	AUS	NZ	CA	CHI	SA
Panel A. Granger-Causality Tests									
0.03	0.38	0.11	0.43	0.03	0.01	0.50	0.06	0.12	0.05
Panel B. Andrews' (1993) QLR Test for Instabilities									
0.00	0.05	0.00	0.16	0.00	0.00	0.29	0.06	0.00	0.00
Panel C. Granger-Causality Tests Robust to Instabilities, Rossi (2005b)									
0.00	0.30	0.00	0.19	0.00	0.00	0.59	0.05	0.00	0.00

Note. Panels A-C report p-values for tests for $\beta_0 = \beta_1 = 0$ based on the regression $\Delta cp_{t+h} = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta cp_t$.

Table 7. Out-of-Sample Forecasting Ability Tests: Predicting Country-specific CP

	$h=1$					$h=2$				
	AUS	NZ	CAN	CHI	SA	AUS	NZ	CAN	CHI	SA
	Panel (a): Random Walk Benchmark									
RMSFE eq.(12)	3.35	3.85	6.05	13.49	6.33	3.27	3.94	6.12	12.92	6.33
RMSFE eq.(3)	3.63	4.01	6.01	12.97	7.18	3.63	4.04	6.03	12.75	7.28
Test Statistic	22.1***	6.3***	8.4***	1.8*	10.1***	24.6***	5.6***	6.3***	3.1**	10.7***
	Panel (b): Autoregressive Benchmark									
RMSFE eq.(11)	3.38	3.69	6.32	13.75	6.81	3.33	4.05	6.37	13.24	6.59
RMSFE eq.(4)	3.22	3.62	6.23	13.05	6.73	3.20	3.90	6.30	13.15	6.54
Test Statistic	-1.59	-0.38	1.91*	-1.42	0.30	-0.21	-1.09	1.68*	0.58	0.13

Note. The table reports percent root mean squared forecast errors (labeled 'RMSFE', that is the square root of the mean forecast error multiplied by 100) of forecasts made with the equation specified in the table. The forecast horizon is denoted by h. The table also reports the Clark and McCracken's (2001) test statistics for comparing the out-of-sample predictive ability of the two competing models' forecasts. Asterisks denote rejections of the null hypothesis that benchmark model (the random walk in Panel (a) and the autoregressive model in Panel (b)) is better in favor of the alternative hypothesis that the model with equity is better at 1% (***), 5% (**), and 10% (*) significance levels, respectively.

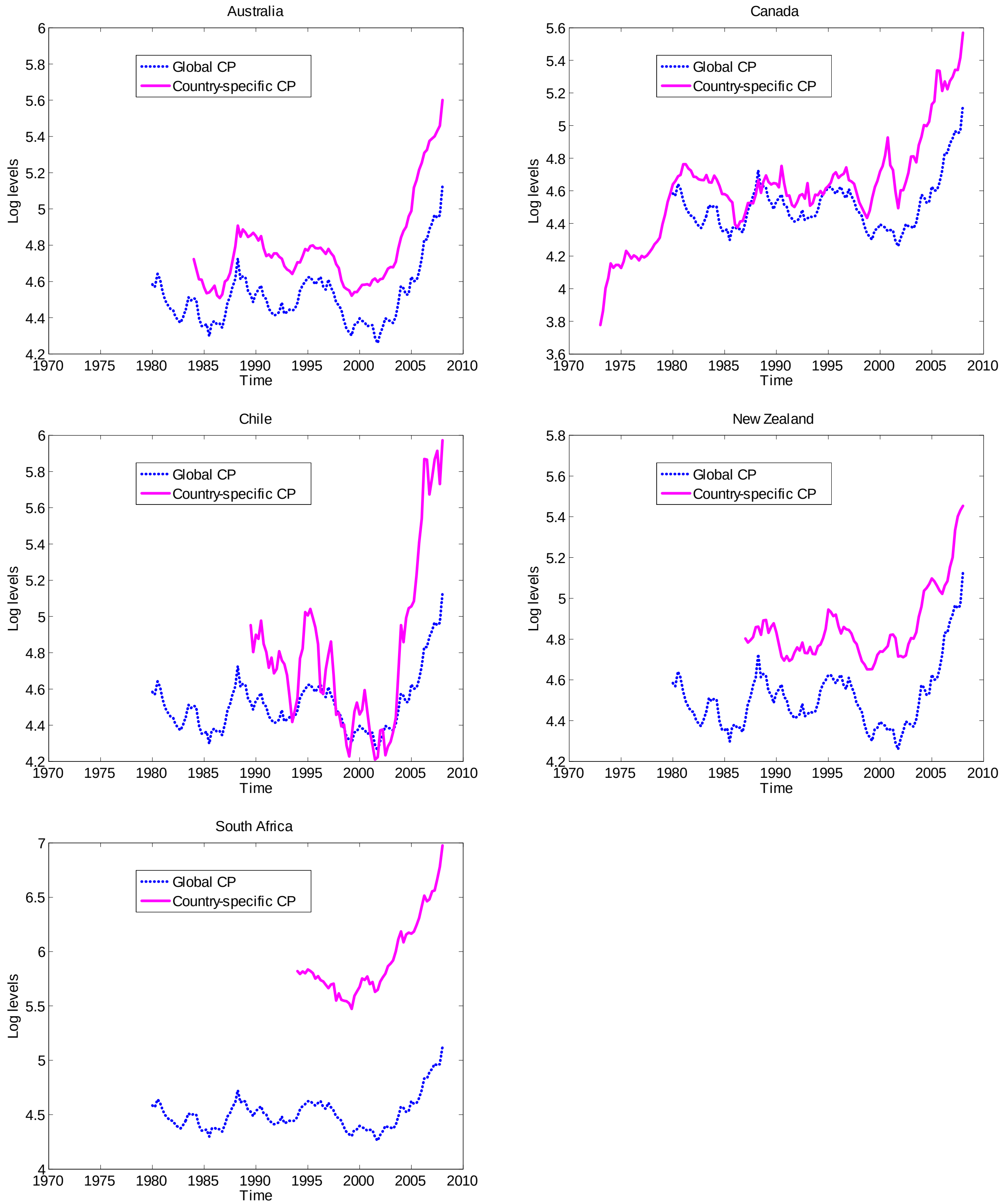
Table 8. Canadian Commodity Price Index and Firm-level data

	$h = 1$		$h = 2$	
	Panel A. Granger-Causality Tests			
	.00**		.34	
	Panel B. Andrews' (1993) QLR Test for Instabilities			
	0.60		.00	
	Panel C. GC Tests Robust to Instabilities, Rossi (2005b)			
	.00***		.00	
	Panel D. Out-of-Sample Forecasts			
	RW	AR	RW	AR
MSFE	7.75	7.75	7.01	7.01
MSFE	6.01	6.23	6.03	6.30
Test Stat.	8.12***	1.47*	3.31**	1.54*

Note. Panels A-C report p-values for tests for $\beta_0 = \beta_1 = 0$ based on the regression $\Delta cp_{t+h} = \beta_0 + \beta_1 \Delta m_t + \beta_2 \Delta cp$. Panel D reports percent root mean squared forecast errors (labeled 'RMSFE', that is the square root of the mean forecast error multiplied by 100) of forecasts made with the equation specified in the table. The forecast horizon is denoted by h. The table also reports the Clark and McCracken's (2001) test statistics for comparing the out-of-sample predictive ability of the two competing models' forecasts. Asterisks denote rejections of the null hypothesis that benchmark model (the random walk in Panel (a) and the autoregressive model in Panel (b)) is better in favor of the alternative hypothesis that the model with equity is better at 1% (***), 5% (**), and 10% (*) significance levels, respectively.

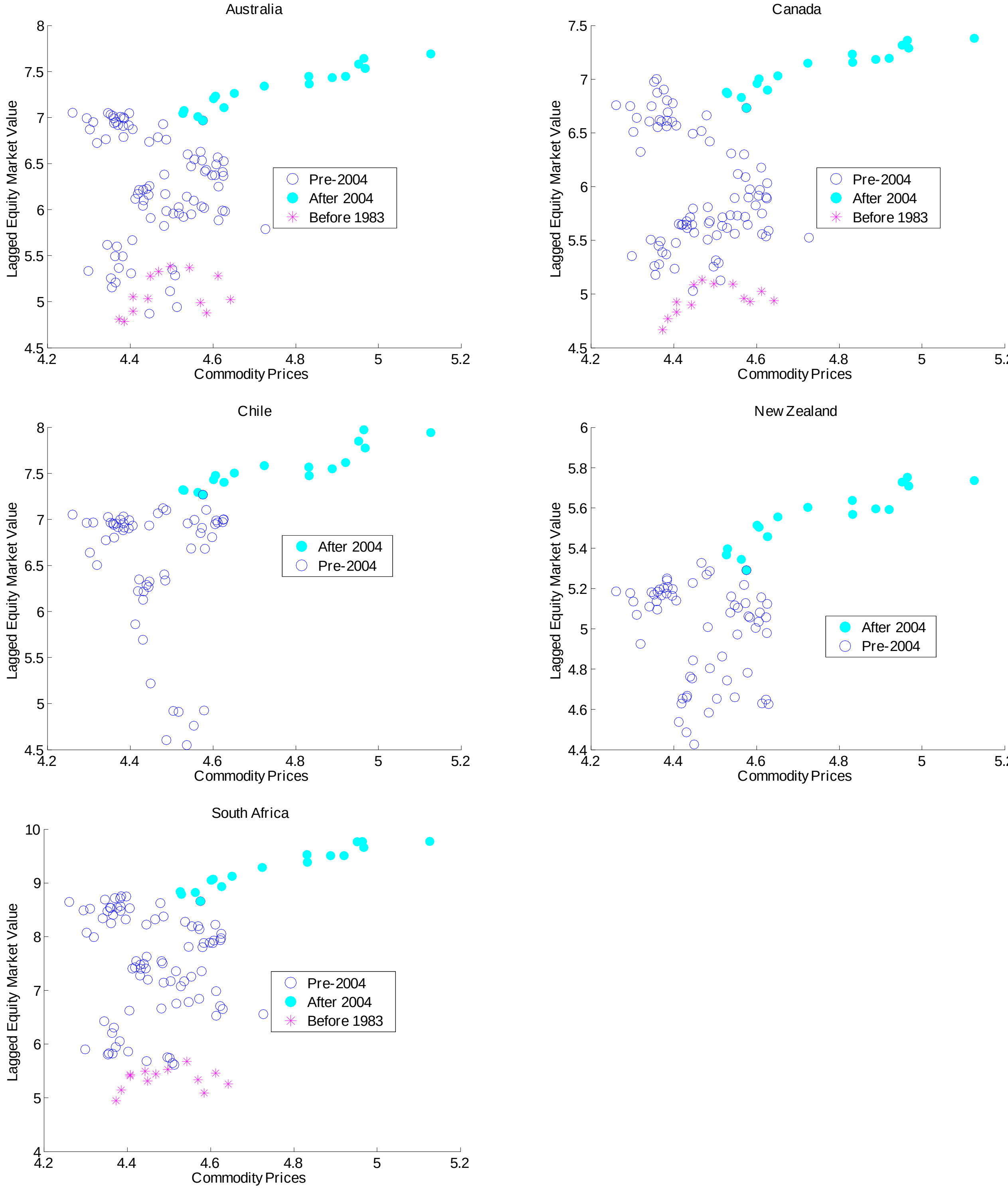
Figures

Figure 1. Commodity Prices Over Time



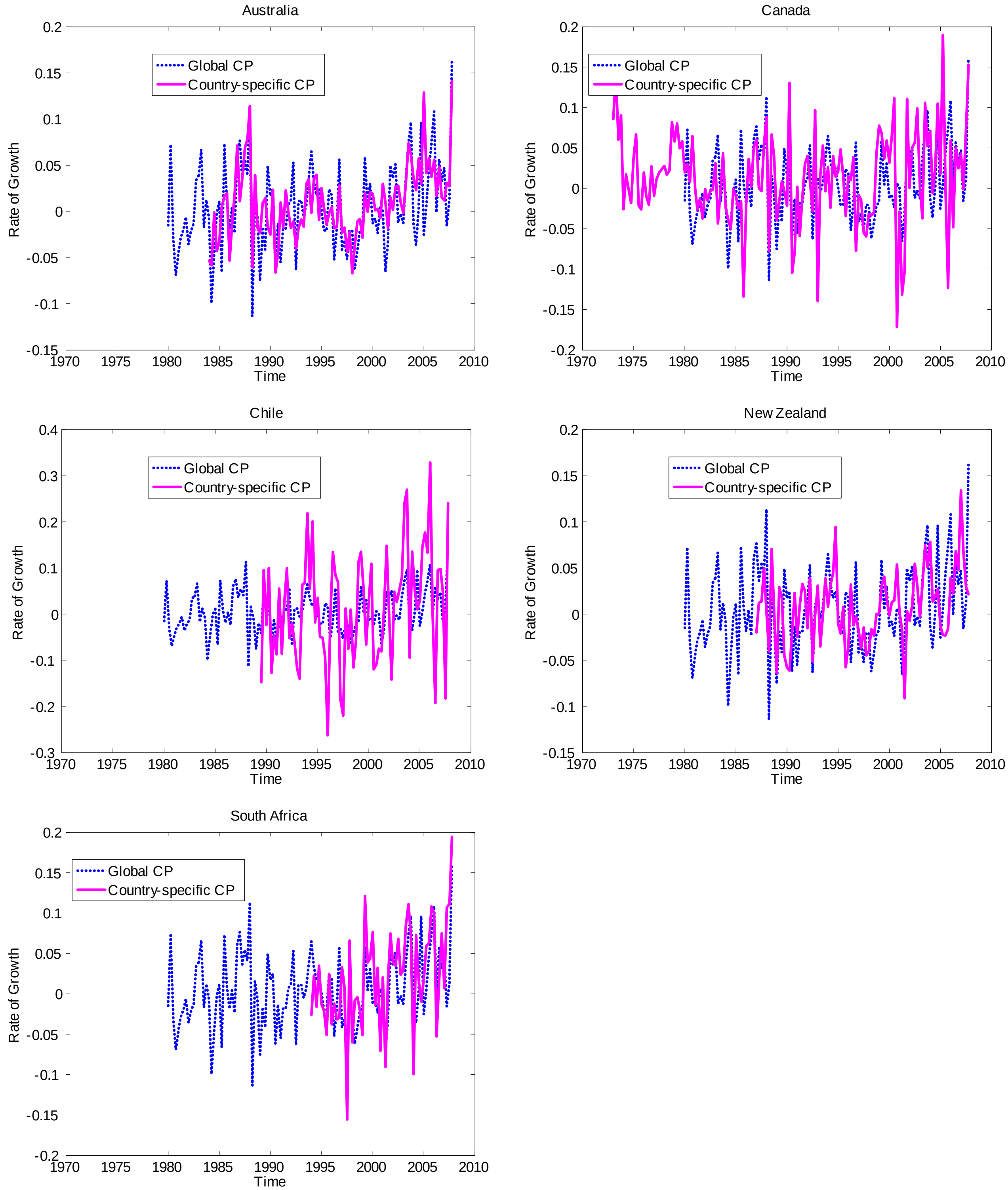
Note. The figure reports the (log of) the global commodity price index, cp_t^W (labeled 'Global CP'), and the country-specific commodity price index, cp_t (labeled 'Country-specific CP').

Fig. 2. Global Commodity Prices and Equity



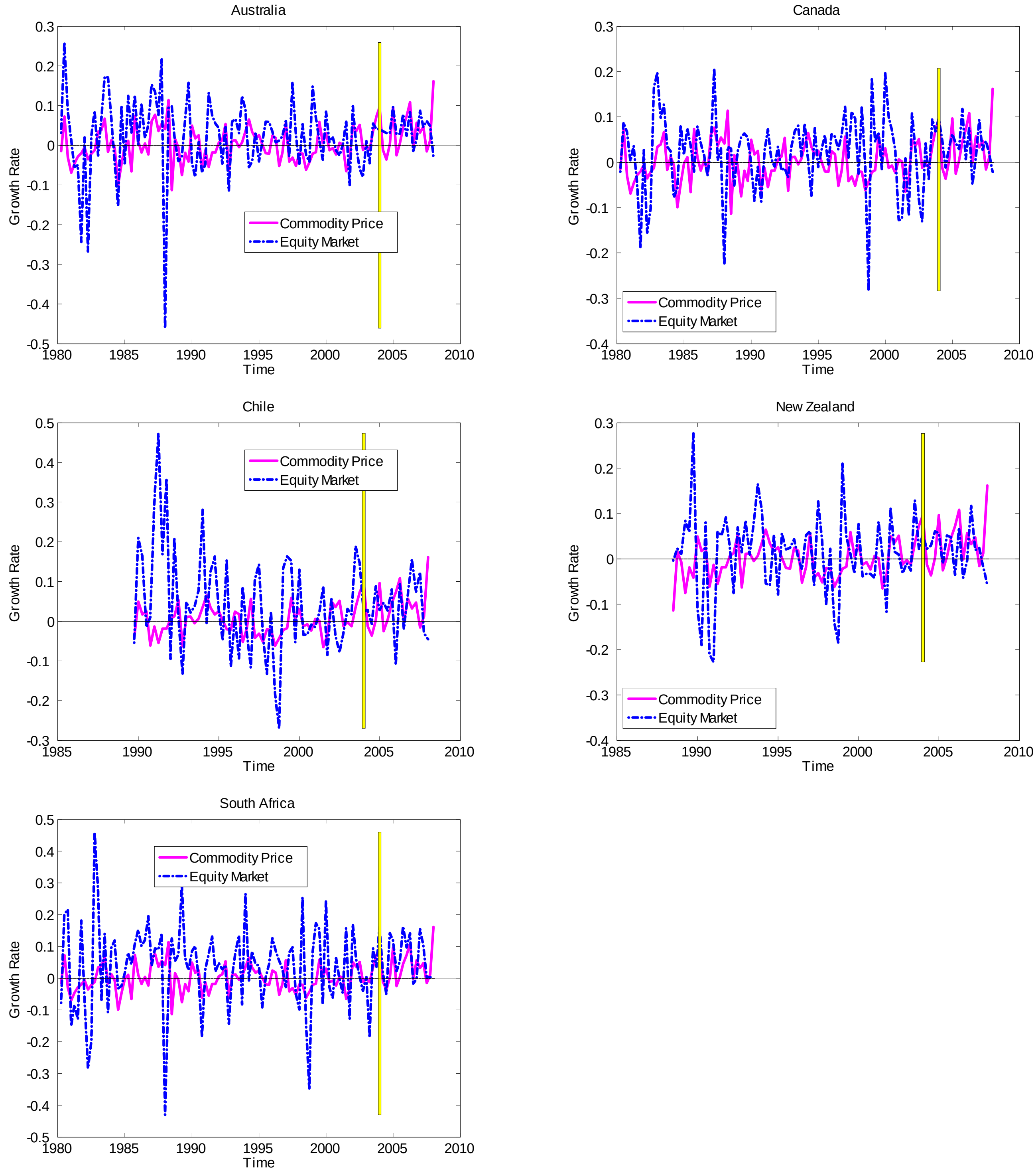
Note. The figure reports scatterplots of the global commodity price index, cp_t^W, and country-specific equity values, m_t (in log-levels).

Figure 3. Commodity Prices Over Time



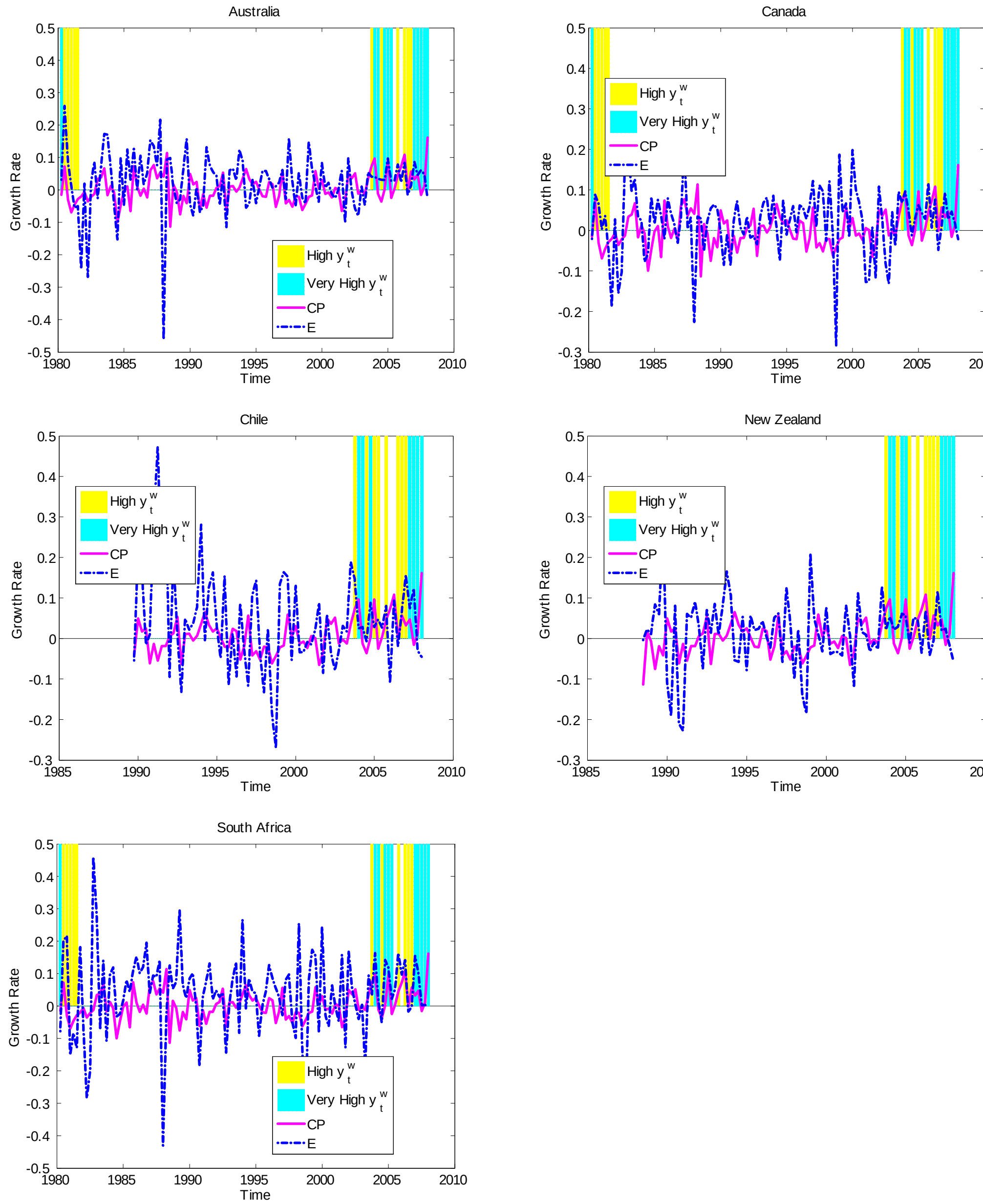
Note. The figure reports the time series of the global commodity price index growth rate, Δcp_t^W, and the country-specific commodity price growth rate, Δcp_t.

Figure 4. The Changing Relationship Between Commodity Prices and Equity Markets



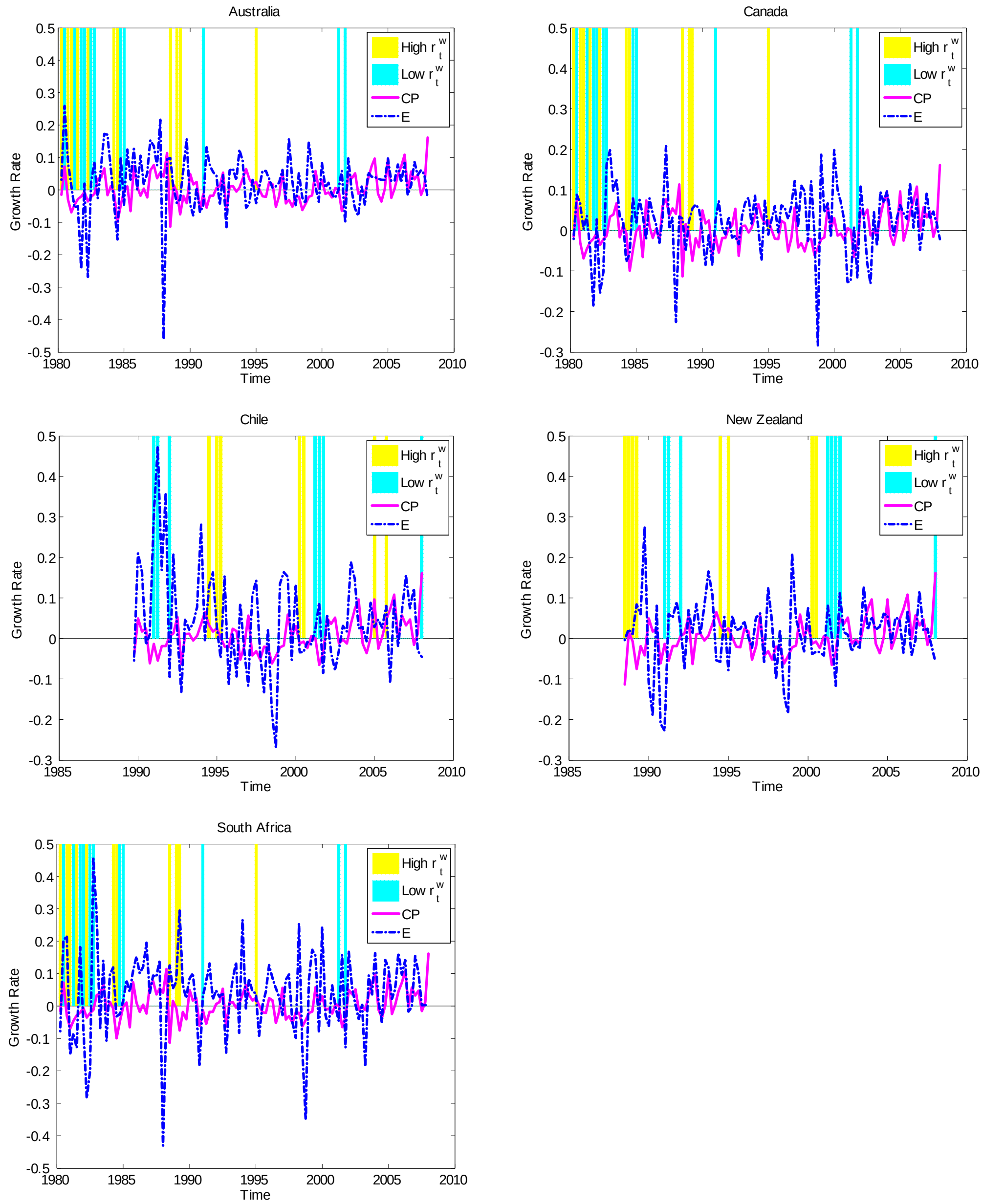
Note. The figure reports the time series of country-specific commodity price indices growth rates (Δcp_t) and country-specific equity growth rates, Δm_t.

Figure 5: Global Demand Pressure



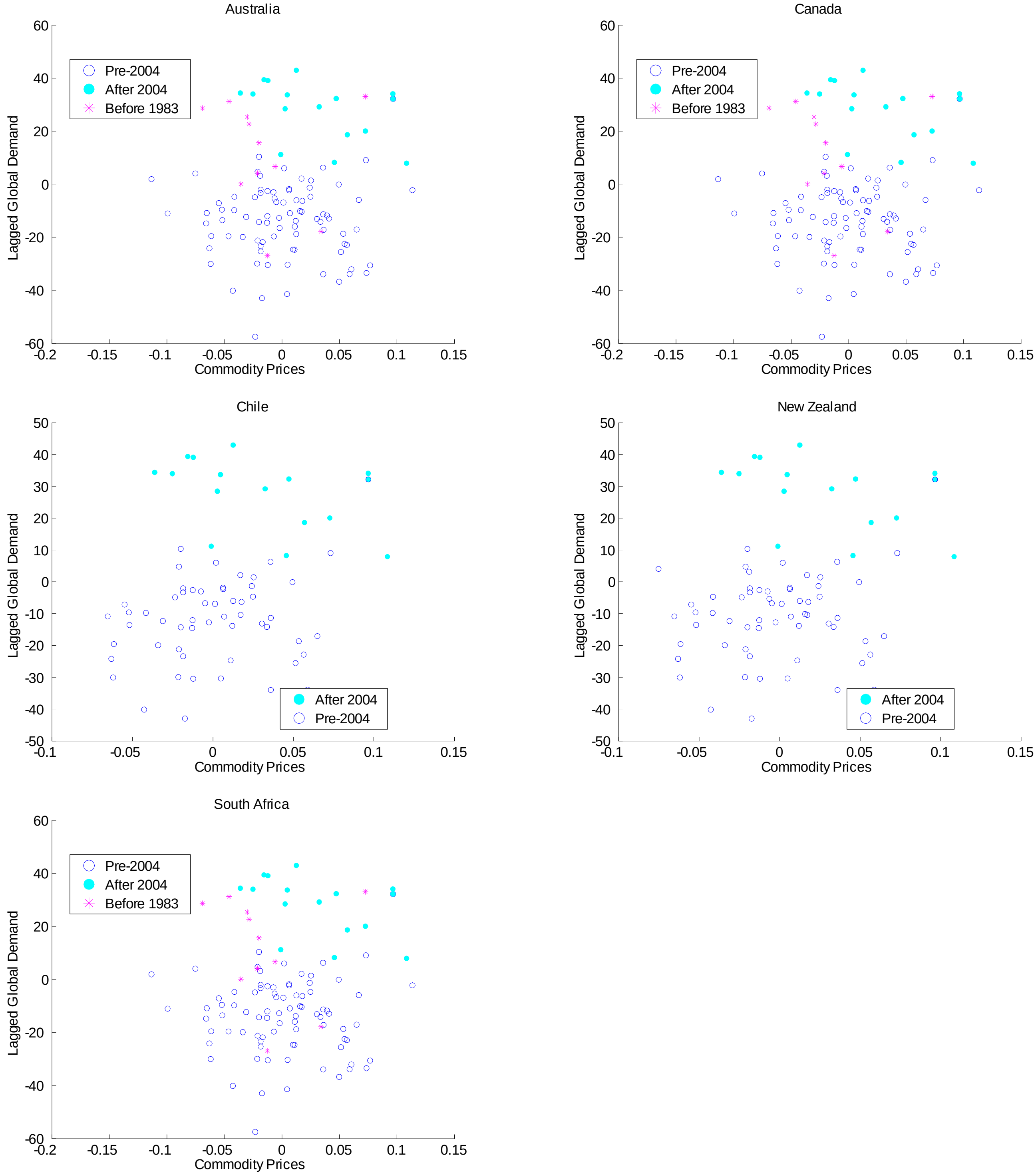
Note. The figure depicts country-specific commodity price growth rates as well as equity market growth rates. Bars that denote either unusually very high or high global demand, labeled "Very High y_t^W" and "High y_t^W", respectively).

Figure 6. Interest Rate Pressure



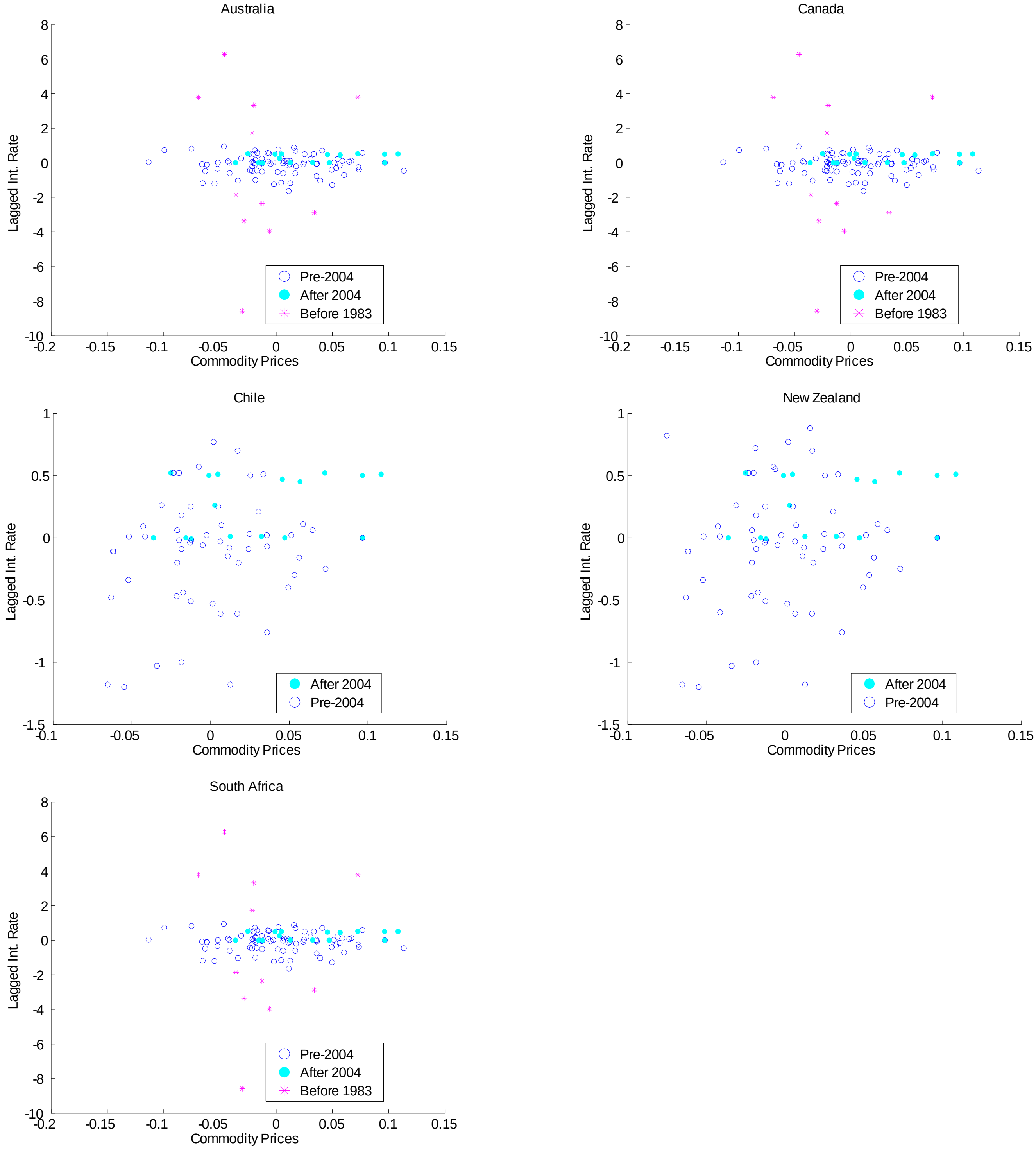
Note. The figure depicts country-specific commodity price growth rates as well as equity market growth rates. Bars that denote either unusually high or low interest rates, labeled "High r_t^W" and "Low r_t^W", respectively).

Figure 7. Commodity Prices and Global Demand



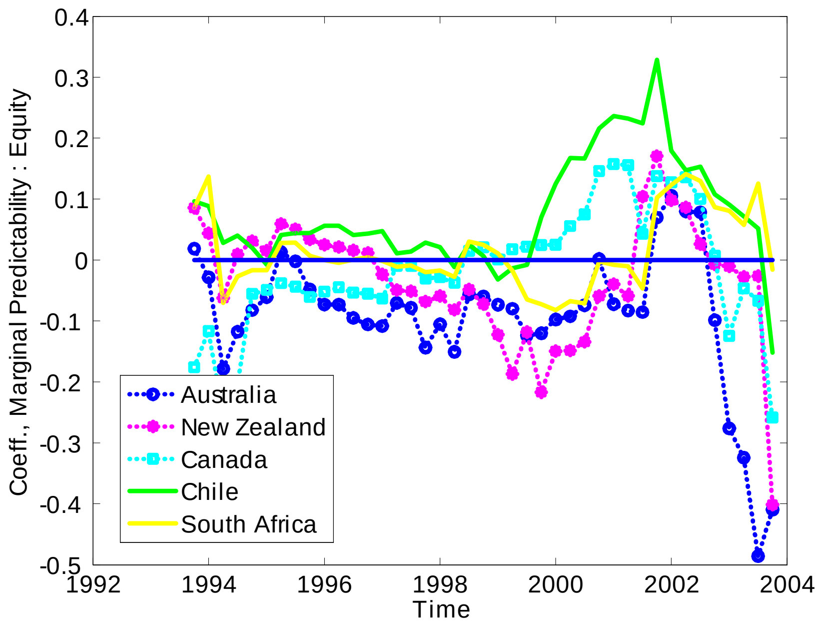
Note. The figure reports scatterplots of the global commodity price index, cp_t^W, and global demand, y_t^W.

Figure 8. Global Commodity Prices and Interest Rates



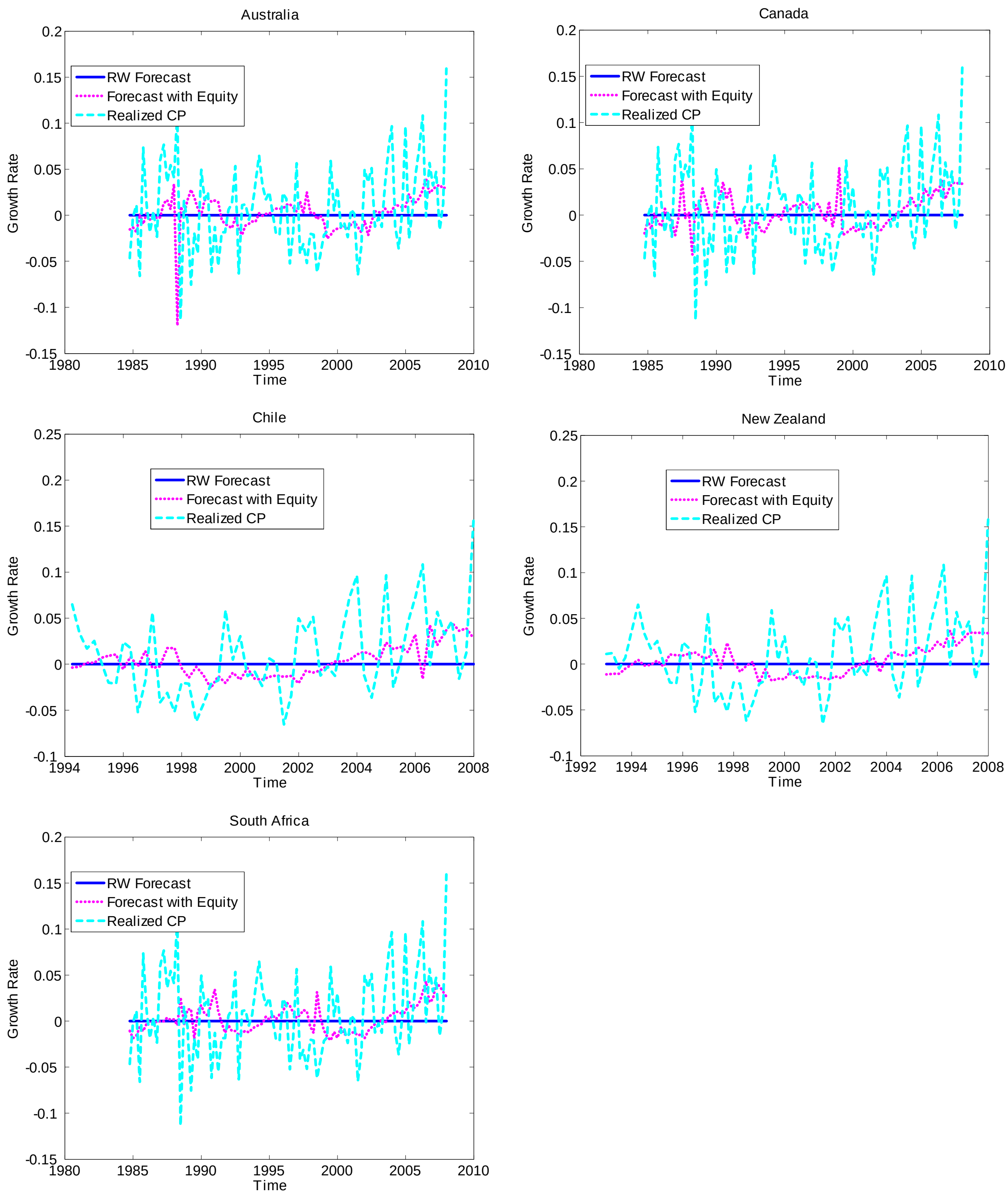
Note. The figure reports scatterplots of the global commodity price index, cp_t^W, and interest rate changes, Δr_t^W.

Figure 9. Marginal Predictive Ability of Equity over Time



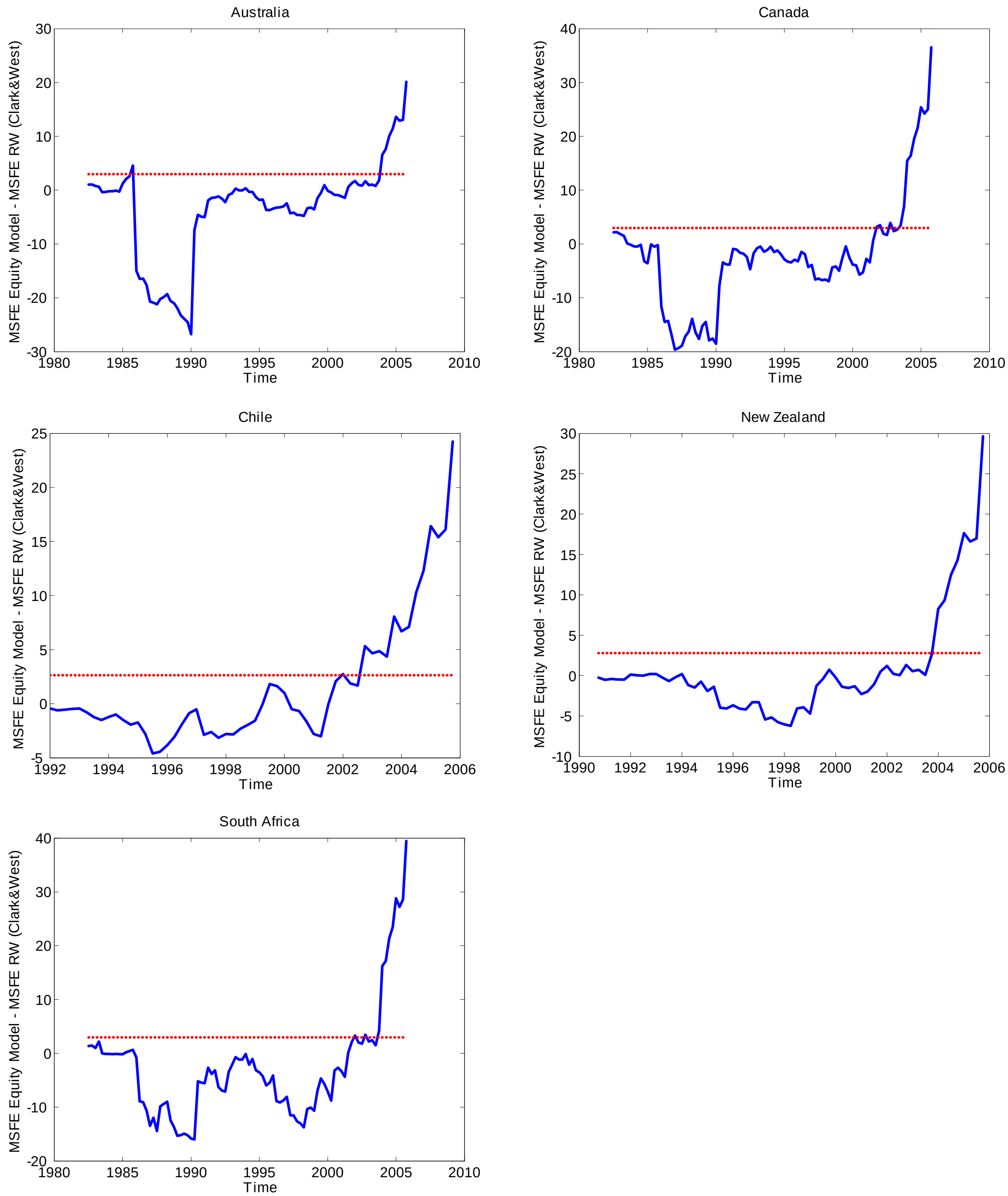
Note. The figure reports estimates of β_1 from regression (1) estimated in rolling windows over time.

Figure 10. Equity Market and Global CP Models' Forecasts



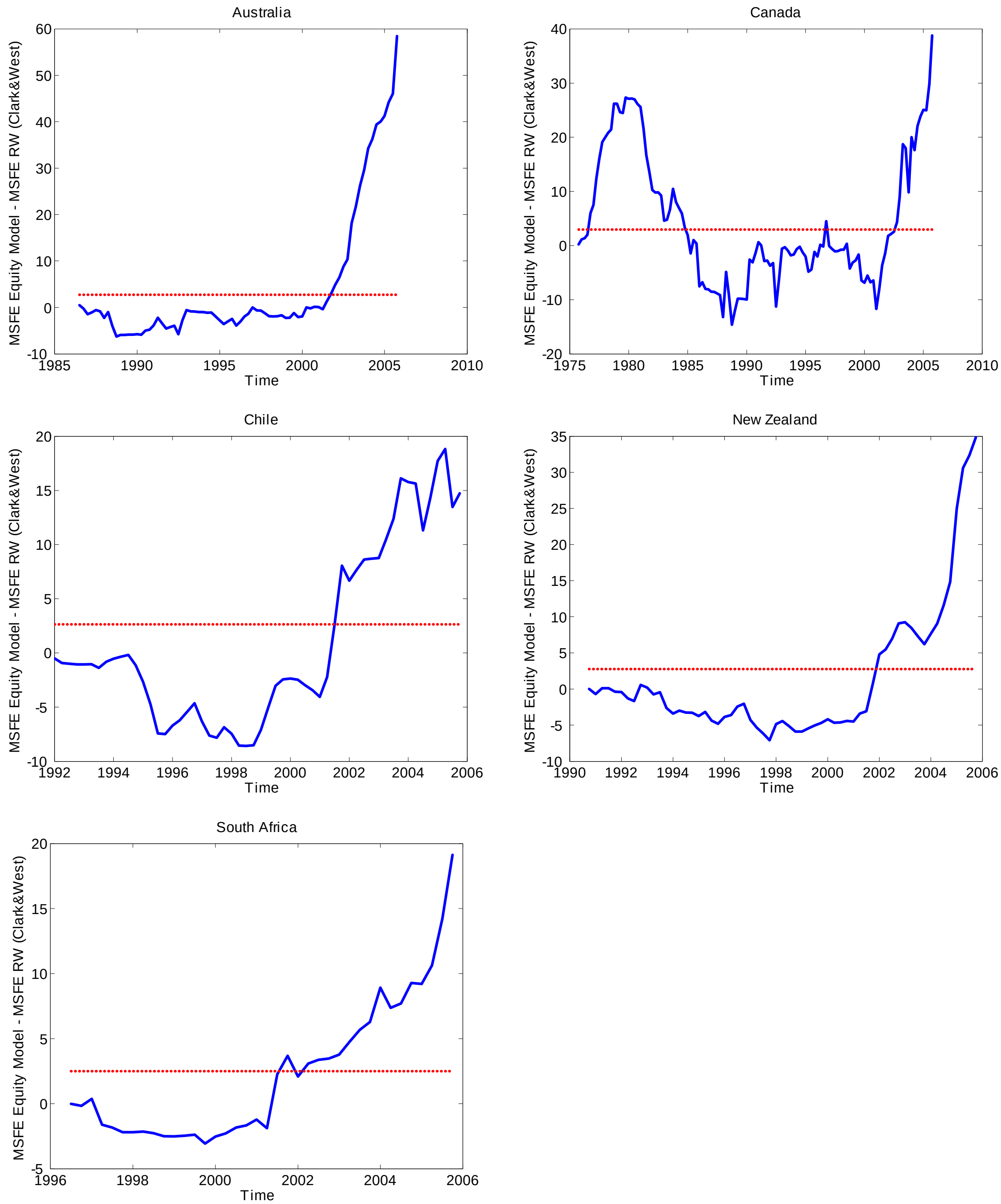
Note. The figure reports the forecasts of model (1), labeled 'Forecast with Equity', the forecast of model (3), labeled 'RW Forecast', as well as the time series of the realized one-quarter ahead commodity price growth rate, Δcp_{t+1}, labeled 'Realized CP'.

Figure 11. Fluctuation Test on Equity Market and Global CP Index



Note. The figure reports Giacomini and Rossi's (2010) Fluctuation test for comparing model (1) and the random walk model (solid line) as well as its critical value (dotted line). Values above the dotted line denote rejection of the random walk model.

Figure 12. Fluctuation Test: Equity Market Predictors vs. Random Walk



Note. The figure reports Giacomini and Rossi's (2010) Fluctuation test for comparing model (12) and the random walk model (solid line) as well as its critical value (dotted line). Values above the dotted line denote rejection of the random walk model.