ABSTRACT OF THE DISSERTATION

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Frequency Domain Causality Test and Its Applications

1 Introduction

Since the seminal work of Granger (1969), a lot of attention has been paid to the causal relationship among economic variables. A variety of testing procedures have been developed. Such tests include Sims (1972), Pierce and Haugh (1977), Geweke(1982), Boudjellaba, Dufour and Roy (1992), Gfillenzoni (1996) and Hidalgo (2005). However, these causality tests are mainly constructed in the time domain and only a few spectral approaches have been proposed.

Recently, Breitung and Candelon (2006) proposed a simple frequency domain causality test, which is based on the works of Geweke (1982) and Hosoya (1991). This procedure has steadily been gaining attention among macroeconometricians. This is partly because the procedure enables us to see how the causal relations between macroeconomic variables vary according to the frequency domain, and partly because, as in the case of the conventional Granger noncausality test, their test is based on a set of linear restrictions on the coefficients of the vector autoregressive (VAR) model.

This dissertation is based on several research papers concerning the frequency domain causality test of Breitung and Candelon (2006).

2 Chapter 1

Chapter 1 is based on

- Yamada, H. and Y. F. Wei, 2012, Some Theoretical and Simulation Results on the Frequency Domain Causality Test, forthcoming in *Econometric Reviews*.

Although, as I mentioned, the procedure of Breitung and Candelon (2006) has steadily been gaining attention among macroeconometricians, in their paper they reported that the frequency domain causality test severely suffers from quite low power at a frequency close to 0 or π. Does this result indicate that the test of Breitung and Candelon (2006) is useless when ω_0 is close to 0 or π? If it does, then the test procedure is less attractive for use

by macroeconometricians. Based on Yamada and Wei (2012), this chapter provides both theoretical and simulation evidence to answer the above question. It is found that the result stated above depends on the model treated and, with slightly different models, the test does not necessarily suffer from low power at such frequencies. In addition to the results given in Yamada and Wei (2012), this chapter provides some new results corresponding to the power of the frequency domain causality test. The conclusion of this chapter is that the test of Breitung and Candelon (2006) is still useful even at the frequencies close to 0 or π.

3 Chapter 2

Chapter 2 is based on

- Wei, Y. F., 2013, The Dynamic Relationships between Oil Prices and the Japanese Economy: A Frequency Domain Analysis, forthcoming in *Review of Economics & Finance*.

Oil is of particular importance to Japan's economy since it is one of the world's largest net oil importers. Accordingly, numerous articles have already addressed the oil price–macroeconomy relationship for Japan (Hutchison, 1993; Mork *et al.*, 1994; Lee *et al.*, 2001; Cunado and Gracia, 2005; Zhang, 2008). However, these papers are mainly concentrated on the time domain, and the conventional Granger causality tests based on vector autoregressive models (VARs) are often employed to investigate the causal relationships between oil prices and macroeconomic variables. Because the linkages between oil prices and macroeconomic variables may vary across the frequency bands, a time domain analysis may fail to fully capture such links. Moreover, researchers including Granger (1969), Geweke (1982), Hosoya (1991) and Granger and Lin (1995) argue that the extent and direction of causality can differ across the frequency domain. Consequently, unlike the previous research, this chapter adopts some frequency domain statistical methods to study the dynamic linkages between oil prices and the Japanese economy. Specifically, both the frequency domain causality test of Breitung and Candelon (2006) and the frequency dependent regression method developed by Ashley and Verbrugge (2009) are deployed in this research. The frequency dependent regression analysis indicates that nonlinear relationships exist between oil prices and the variables such as

industrial production and consumer price index at the low frequencies, while the nonlinear associations at the high frequencies are merely detected between oil prices and unemployment rates. The results of the frequency domain causality tests suggest that oil prices have significant predictive power for industrial production, consumer price index and unemployment rates at the low frequencies. In addition, oil prices can predict industrial production and unemployment rates at some high frequencies.

4 Chapter 3

Chapter 3 is based on

- Wei, Y. F. and H. Yamada, 2012, An Evaluation of the CLI Component Series for Japan, presented at the 31th CIRET Conference–Vienna 2012, Austria.

The Organization for Economic Cooperation and Development (OECD) has developed a system of composite leading indicators (CLIs) for its member countries. On the other hand, the Japanese government has released another CLI for detecting the Japanese business cycle turning points. The OECD's CLI is composed of 8 component series, whereas the Japanese CLI is based on 12 component series. In this chapter, applying the frequency domain causality test of Breitung and Candelon (2006) and other statistical tools, the validity of such component series is evaluated. The frequency domain causality analyses indicate that four CLI component series (ratio of loans to deposits, construction: dwellings started, spread of interest rates and total floor area of new housing construction started) contain less useful information for predicting the industrial production. In addition, this chapter discovers that the component series, namely consumer confidence index and index of investment climate (manufacturing), perform fairly well. Because these two series are not currently included in the OECD CLI, they may be potential candidates as the component series of OECD CLI.

5 Chapter 4

Chapter 4 is based on

- Wei, Y. F., 2013, The Informational Role of Commodity Prices in Formulating Monetary Policy: A Reexamination under the Frequency Domain, submitted for publication in *Empirical Economics*.

The recent dramatic increases in commodity prices have stimulated the research on the relationship between commodity prices and the monetary policy. There is by now substantial evidence in the literature that commodity prices can signal the future movements in the economy and thus are useful in formulating monetary policy.[1] However, the literature does not clarify if this relationship is stable over time. In this chapter, based on the monthly U.S. data from January 1955 to December 2011, I attempt to analyze whether commodity prices contain useful information for managing monetary policy at various time periods. The frequency domain causality test proposed by Breitung and Candelon (2006) is employed in this chapter, and the Toda and Yamamoto's (1995) procedure is applied to establish standard inference for this test. I find the frequency domain causal relationship between commodity prices and economic activities (*e.g.*, consumer prices and industrial production) has changed dramatically over time. The results indicate that commodity prices are useful in setting monetary policy in the 1970s and the beginning of 1980s, but the usefulness has disappeared completely since the early 1980s.

6 Chapter 5

Chapter 5 is based on

- Wei, Y. F., 2013, Commodity Prices, Manufactured Goods Prices and Inflation: Evidence from Japan, *Economics Bulletin* 33, 986-992.

Some recent studies find that the predictive power of commodity prices for inflation has significantly decreased since the mid-1980s (Herrera and Pesavento, 2009; Verheyen, 2010). In this case, using the monthly Japanese data from January 1970 to De cember 2011, this chapter attempts to analyze the predictive power of commodity prices and manufactured goods prices for inflation. Like in Chapter 4, the frequency domain causality test proposed by

[1] See, for example, Cody and Mills (1991), Awokuse and Yang (2003) and Bhar and Hamori (2008).

Breitung and Candelon (2006) is employed, and the Toda and Yamamoto's (1995) procedure is applied to establish standard inference for this test. Because the Japanese economy suffers from structural changes in the early 1990s (Sato, 2002; Fang and Miller, 2009; Yamada and Jin, 2012), I split the full sample into the two sub-periods 1970M1-1990M12 and 1991M1-2011M12. Then I investigate the differences of the predictive power of commodity prices and manufactured goods prices for inflation in the two subperiods. In the first sub-period 1970M1-1990M12, I find commodity prices and manufactured goods prices Granger cause CPI in the frequency range $\omega \in (0, \pi)$. This indicates that commodity prices and manufactured goods prices can predict the short- and long-term fluctuations of inflation. In the second sub-period 1991M1-2011M12, however, the causality running from commodity prices and manufactured goods prices to CPI is merely detected at some small ranges of frequencies. In this sub-period, manufactured goods prices are still significant in forecasting inflation in both the short- and long-run periods, while commodity prices can only predict the long-run fluctuations of inflation. Thus, in recent years it is inappropriate to use the commodity prices to predict the short-term changes of inflation in Japan.

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