Causality between consumer price and producer price: Evidence from Mexico

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We examine the relationship between two inflation indices, consumer price index (CPI) and producer price index (PPI) for Mexico, a case study country which has successfully implemented inflation targeting after the economic crisis and high inflationary situation in 1995. Since the causality running from PPI to CPI exemplifies the cost push nature of inflation and the opposite is the indicator of demand pull inflation, this analysis could provide significant policy implications. We contribute to the literature by decomposing the time-frequency relationship between CPI and PPI through continuous wavelet approach. Our results indicate a bidirectional relationship between CPI and PPI. In short periods (1 to 7 months scale) CPI is leading PPI, while for longer periods (8 to 32 months scale) PPI is the leading variable. © 2013 Elsevier B.V. All rights reserved.

1. Introduction

The Mexican economic crisis of 1993–94 started mainly due to speculative capital flows and large current account deficit. Fixed exchange rate system, weak banking system and the overspending of the economy were among the main factors that have caused the crisis. The Mexican government negotiated a $50 billion dollar financial package with international financial agencies to cope up with the situation. It implemented a flexible exchange rate system followed by a monetary policy strategy of inflation targeting. The Mexican central bank, Banco de México, started the disinflationary move just after the 1993–94 crisis. Inflation was brought down from 52% in 1995 to near 4% in recent years, barring the recent spurt due to drought situation. Thus, Mexico is a proven example of the capability of a central bank to target inflation of an economy after achieving the fiscal prudence (Ramos-Francia and Torres, 2005).

In this paper, we study the relationships between the consumer price index (hereafter CPI) and the producer price index (hereafter PPI) in Mexico using the Wavelet Transform Method (WTM). We chose Mexico because, as we explained above, this country constitutes an excellent case study as it successfully targeted inflation after the crisis in the mid-1990s. Further, the relationship between CPI and PPI has not been discussed much in the Mexican context, with the exception of the study by Sidaoui et al. (2009) which has numerous methodological limitations. Investigating the causality between producer price and consumer price indices is an important issue since it helps to formulate concrete implications for central banks to target inflation. Theoretically, causality can run from PPI to CPI as well as from CPI to PPI. Causality running from PPI to CPI illustrates the cost push inflation. The cost push nature of inflation reflects the fact that changes in producers’ price in the initial stage of the supply chain will be transmitted to the later stage and subsequently to the consumer price. Clark (1995) provides a theoretical point of view about price transmission mechanism running from PPI to CPI. The author points out that the price pass-through mechanism may be distorted by the possible offsetting of changes in PPI by opposite changes in the price of imported goods, which is a part of CPI. Further, Clark (1995) mentions firm pricing strategies and possible productivity gains as plausible distorting factors from PPI to CPI price pass-through mechanism. However, there is an alternative view of demand pull nature of inflation according to which the causality is rather running from CPI to PPI (Colclough and Lange, 1982). This is based on the argument that change in consumer price leads to spurts in input prices and that would affect the producer price as well. Jones (1986) argues that both demand pull and cost push natures are possible and expects bidirectional causality between PPI and CPI.

Even though the theoretical literature points out both the causal links running from PPI to CPI and from CPI to PPI, many central banks...
still use exclusively CPI for inflation targeting. Sidaoui et al. (2009) note that only 6 out of 24 central banks studied mentioned PPI as an indicator of inflation during the period 2007–2009. However, if causality is running from PPI to CPI, central banks need to target the PPI to control the CPI. The empirical literature in this area is still inconclusive about the nature of the link between PPI and CPI for developed and developing countries.

Methodologically, we contribute to this debate by using the continuous wavelet approach which is superior in several aspects to conventional causality tests used in most previous studies. First, conventional Granger-causality tests are just one shot measure i.e., these tests do not indicate if any causal relationships exist between frequency components of variables unlike the wavelet approach. In other words, the conventional Granger-causality tests ignore the possibility that the direction of the Granger-causality – if any – could vary over different frequencies, whereas the wavelet based approach does. Second, conventional Granger-causality tests ignores the possibility that the strength of the Granger-causality – if any – could vary over different frequencies, whereas the wavelet based approach does. Third, the conventional approach does not indicate the cyclical and anti-cyclical relation that may be present, but wavelet transformation can clearly show that. And last but not least, the wavelet approach we use helps in detecting the structural breaks and jumps, steps and volatility clusters. Therefore, the wavelet approach we develop in this paper has advantages over the conventional causality analysis in the aforementioned areas.

Caporale et al. (2002) analyze the CPI–PPI link in the context of G7 countries using the causality approach of Toda and Yamamoto (1995) and show unidirectional causality running from PPI to CPI. Akdi et al. (2006a) examine the relationship between CPI and PPI in three inflation targeting economies: Sweden, UK and Canada. The authors have not found evidence of causality in the long run, while in the short run causality is running from CPI to PPI. Akdi et al. (2006b) show that there is a short-run causal relationship running from CPI to PPI for Turkey. Ghazali et al. (2008) examine the same issue for Malaysia and show a unidirectional causality running from PPI to CPI. Fan et al. (2009) found that CPI is Granger causing PPI for China illustrating the demand side factors’ role in inflation. Shahbaz et al. (2009) found bidirectional causality between CPI and PPI for Pakistan using ARDL approach. Shahbaz et al. (2010) employ ARDL bound test and Johansen’s cointegration approach as well as Toda and Yamamoto (1995) causality approach for examining the link between CPI and PPI in Pakistan. This study found bidirectional causality between CPI and PPI, while the causality from PPI to CPI is stronger. More recently, Fan et al. (2009) found unidirectional causality running from CPI to PPI in China and the later reacts to changes in CPI with a lag of 1–3 months. Finally, Akçay (2011) examines the link between PPI and CPI in the context of European countries and shows unidirectional causality from PPI to CPI for Finland and France and bidirectional causality between the two indices in Germany.

As for Mexico, Sidaoui et al. (2009) addressed this issue and observed that causality is running from PPI to CPI; PPI is useful to improve the predictability of CPI for Mexico. These authors have used Vector Error Correction Model (VECM) to examine the causal links. The VECM overcomes the first or the second differenced Vector Autoregressive (VAR) model by including the error correction term in the specification and thus minimizing the omitted variable bias. However, VECM framework used by Sidaoui et al. (2009) is based on linear specification. Further, it is unable to provide the direction of causality, if any, which can vary over frequencies. Moreover, the VECM approach does not allow to assess the strength of causality between the studied variables (Tiwari, 2012a,b). To overcome these limitations, Tiwari (2012a) examined the causality between CPI and PPI for Australia using frequency domain approach and observed that the consumer price Granger causes the producer price at the intermediate level, providing evidence of medium-run cycles. In another study, using the same frequency domain approach, Tiwari (2012b) found that CPI Granger causes WPI (wholesale price index representing producers’ price index) for India at lower, intermediate and higher levels; WPI Granger causes CPI only at the intermediate level. Following the works by Tiwari (2012a,b), Shahbaz et al. (2012) applied frequency domain approach and showed unidirectional causal relationships from CPI to WPI at lower, intermediate and higher levels for Pakistan. In a recent work, Tiwari et al. (2013) extended the works by Tiwari (2012a,b) and Shahbaz et al. (2012) by integrating time concept with the frequency domain approach and studied the Granger-causality between variations in CPI and PPI for Romania. The authors decomposed the time-frequency relationship between CPI- and PPI-based inflation rates through a continuous wavelet approach. Their study provided strong evidence of cyclical effects in variables, while anti-cyclical effects are not observed.

Our study extends the existing literature by utilizing the continuous wavelet approach for Mexico to analyze the causal relationship between CPI and PPI. Previous studies such as Tiwari (2012a,b) and Shahbaz et al. (2012) utilize the frequency domain approach in which time concept was missing. Further, previous studies (Shahbaz et al., 2012; Tiwari, 2012a) have shown the existence of cyclical effects between variables but our study provides evidence of both cyclical and anti-cyclical effects. Our results show the evidence of volatility clustering and jumps in 1987 and thus the possibility of existence of structural breaks, corresponding to the high inflation era in Mexican economic history. Among the previous studies using frequency domain approach Shahbaz et al. (2012), and Tiwari (2012a) find unidirectional causality between CPI and PPI, whereas Tiwari (2012b) finds bidirectional causality between CPI and PPI. Using Wavelet transformation approach, Tiwari et al. (2013) provide evidence of bidirectional causal relationship between CPI and PPI. Our study also provides evidence of bidirectional causal relationship between CPI and PPI. The present study also extends Tiwari et al. (2013) by incorporating the rectified bias in the wavelet transform following Ng and Chan (2012).

The remainder of this paper is organized as follows. Section 2 introduces the methodology. Section 3 presents the data and empirical findings. Section 4 concludes with policy implications.

2. Methodology

2.1. The continuous wavelet transform (CWT)\(^3\)

A wavelet is a function with zero mean and that is localized in both frequency and time. We can characterize a wavelet by how it is localized in time (\(\Delta t\)) and in frequency (\(\Delta \omega\) or the bandwidth). The classical version of the Heisenberg uncertainty principle explains that there is always a trade-off between localizations in time and frequency. Without properly defining \(\Delta t\) and \(\Delta \omega\), we will note that there is a limit on how small the uncertainty product \(\Delta t \cdot \Delta \omega\) can be. One particular wavelet, the Morlet, is defined as

\[
\psi_\theta(t) = \frac{1}{\sqrt{\pi}} e^{i \omega_0 \pi} e^{-\frac{t^2}{2}},
\]

\(^3\) That is VECM or VAR models are unable to detect that either one variable positively Granger-causes or negatively Granger-causes the other variables unless lag one is used in the specification.

The description of CWT, XWT and WTC is extracted from Grinsted et al. (2004). We are grateful to Grinsted and co-authors for making codes available, which were utilized in the present study.