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การศึกษาเงินเฟ้อของไทย:  
การตั้งราคาและแนวโน้มราคาตามหมวดสินค้าExploring Inflation in Thailand  
Through Sectoral Price Setting Behavior and Underlying Trend

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## บทสรุป

ข้อคิดเห็นที่ปรากฏในบทความนี้เป็นความเห็นของผู้เขียน ซึ่งไม่จำเป็นต้องสอดคล้องกับความเห็นของธนาคารแห่งประเทศไทย

บทความนี้ต้องการตอบสนองคำถามสำคัญคือ หนึ่ง ในปัจจุบันนี้มีแรงกดดันด้านราคาหรือไม่ภายใต้ภาวะที่แรงกดดันด้านราคาไม่ปรากฏเด่นชัดในดัชนีชี้วัดที่มีอยู่ ทั้งที่เศรษฐกิจมีการขยายตัวต่อเนื่อง และ สอง กระบวนการปรับตัวของเงินเฟ้อเปลี่ยนแปลงไปหรือไม่จากปัจจัยแวดล้อมทั้งภายนอกและภายในที่เปลี่ยนไป บทความนี้เสนอวิธีการบ่งชี้แรงกดดันต่อราคา 2 วิธีใหม่ คือ 1) Kalman's inflation trend ซึ่งใช้วิธีการคำนวณที่มีลักษณะเฉพาะโดยการให้น้ำหนักแก่แต่ละสินค้าแตกต่างกันในแต่ละช่วงเวลา และ 2) การเปรียบเทียบพฤติกรรมของดัชนีราคาผู้ผลิตกับราคาผู้บริโภครายหมวดสินค้า ในปัจจุบันเครื่องชี้ทั้งสองตัวบ่งชี้แรงกดดันราคาขาขึ้น การศึกษานี้พบว่าราคาสินค้าผู้บริโภคทุกหมวดมีการเปลี่ยนแปลงราคาลดลงในช่วงหลังวิกฤตเศรษฐกิจ ถึงแม้ว่าความบ่อยครั้งของการเปลี่ยนแปลงราคาสินค้าผู้ผลิตจะเท่ากับช่วงก่อนวิกฤตเศรษฐกิจ นอกจากนั้น การศึกษายังชี้ให้เห็นว่าเงินเฟ้อมีการปรับตัวกลับสู่ระดับเดิมอย่างรวดเร็วเมื่อมีปัจจัยภายนอกมากระทบ ซึ่งมีนัยว่านโยบายการเงินอาจไม่ต้องมีลักษณะ Proactive มากนัก

ผู้วิจัยขอขอบคุณ ดร.อัญญา ไวกาญจน์ คุณนิตยา พิบูลย์รัตนกิจ ดร.อมรา ศรีพยัคฆ์ ดร.ทิตนันทน์ มัลลิกะมาส สำหรับข้อคิดเห็นและคำแนะนำที่เป็นประโยชน์ต่อทวิจจัยนี้ และขอขอบคุณ คุณนิพนธ์ พงศพรช คุณรัฐธรรม สุวรรณภูฏ คุณอริยาณี เจตยานนท์ ที่ช่วยจัดทำข้อมูลในขณะฝึกงานที่ ธปท. นอกจากนี้ ผู้เขียนขอขอบคุณ คุณเรจินา สวัสดิ์รัตนภักดิ์ สำหรับคำแนะนำและความช่วยเหลือในการแก้ไขร่างทวิจจัย และขอขอบคุณพนักงานสายนโยบายการเงินท่านอื่นในความช่วยเหลืออย่างดีตลอดช่วงเวลางานทวิจจัยนี้

## บทสรุปผู้บริหาร

เงินเฟ้อในไทยอยู่ในระดับต่ำมากภายหลังวิกฤตการณ์ทางเศรษฐกิจการเงินและเมื่อเริ่มใช้นโยบายการเงินภายใต้กรอบเป้าหมายเงินเฟ้อ ภาวะการณ์ดังกล่าวเอื้อให้การดำเนินนโยบายการเงินมีลักษณะผ่อนคลายและสนับสนุนการขยายตัวทางเศรษฐกิจได้อย่างต่อเนื่อง อย่างไรก็ตาม ในช่วงปีที่ผ่านมาพบว่าเศรษฐกิจได้มีการขยายตัวในเกณฑ์ดีอย่างต่อเนื่องและอัตราเงินเฟ้อทั่วไปในช่วงหลายเดือนที่ผ่านมาปรับสูงขึ้นอย่างรวดเร็วตามราคาสินค้าขั้นปฐม และราคาน้ำมันในตลาดโลกที่ปรับสูงขึ้นในขณะที่อัตราเงินเฟ้อพื้นฐานเริ่มปรับตัวตาม ดังนั้น การมีความเข้าใจเกี่ยวกับกระบวนการปรับตัวของอัตราเงินเฟ้อและแรงกดดันอัตราเงินเฟ้อที่เปลี่ยนแปลงไปจึงเป็นสิ่งจำเป็นเพื่ออำนวยความสะดวกให้การดำเนินนโยบายการเงินเป็นไปอย่างเหมาะสม งานวิจัยนี้จึงมีวัตถุประสงค์ที่จะช่วยเสริมความเข้าใจในประเด็นสำคัญต่างๆ เกี่ยวกับกระบวนการปรับตัวของอัตราเงินเฟ้อในไทยผ่านการวิเคราะห์เงินเฟ้อรายหมวดสินค้า โดยผลการศึกษารูปสาระสำคัญได้ดังนี้

1) การศึกษานี้ได้นำเสนอดัชนีวัดแรงกดดันด้านราคาที่เรียกว่า Kalman's Inflation Indicator เพื่อใช้ประกอบการบ่งชี้ด้วยอัตราเงินเฟ้อพื้นฐานและอัตราเงินเฟ้อทั่วไปที่ใช้อยู่ในปัจจุบัน โดยการคำนวณหาแนวโน้มร่วมของราคาสินค้าตามหมวดสินค้าในตะกร้าดัชนีราคาผู้บริโภคด้วยเทคนิคทางเศรษฐมิติที่ให้น้ำหนักของสินค้าแต่ละหมวดเปลี่ยนแปลงได้ในแต่ละช่วงเวลา ตามความสอดคล้องของแนวโน้มราคาสินค้านั้นๆ กับแนวโน้มร่วมของราคาสินค้าตัวอื่น โดยแตกต่างจากวิธีการคำนวณอัตราเงินเฟ้อทั่วไปและอัตราเงินเฟ้อพื้นฐานที่ให้น้ำหนักที่คงที่ตามสัดส่วนรายจ่ายครัวเรือน

จากการวิเคราะห์พบว่า ในช่วงที่ผ่านมาดัชนีนี้โดยทั่วไปจะเคลื่อนไหวสอดคล้องและใกล้เคียงกับอัตราเงินเฟ้อทั่วไปและอัตราเงินเฟ้อพื้นฐาน และขณะนี้มีระดับอยู่ระหว่างอัตราเงินเฟ้อพื้นฐานและอัตราเงินเฟ้อทั่วไป ซึ่งสะท้อนว่าแรงกดดันด้านราคาที่เกิดขึ้นสูงกว่าการบ่งชี้ของอัตราเงินเฟ้อพื้นฐาน ถึงแม้ว่าดัชนีนี้มีวิธีการคำนวณที่ซับซ้อนยากต่อการสื่อสารกับสาธารณะชนอย่างไร่งใส การศึกษาพบว่าดัชนีนี้มีประโยชน์มากในการพิจารณาแรงกดดันต่อระดับราคาสินค้าโดยรวม เมื่อแนวโน้มราคาสินค้ารายหมวดมีความไม่สอดคล้องกัน

2) จากการศึกษาพฤติกรรมการกำหนดราคาขายปลีกจากแนวโน้มของการเปลี่ยนแปลงราคาสินค้าผู้บริโภคและราคาสินค้าผู้ผลิตพบว่า ในช่วงหลังวิกฤต ราคาของสินค้าอุปโภคบริโภคจำนวนมากในตะกร้าดัชนีราคาสินค้าผู้ผลิต (PPI) ปรับตัวสูงขึ้นเร็วกว่าการปรับสูงขึ้นของราคาสินค้าประเภทเดียวกันในตะกร้าสินค้านักค้าปลีก (CPI) บ่งชี้ว่าผู้ค้าปลีกมีการปรับราคาขายในสัดส่วนที่ต่ำกว่าการเพิ่มขึ้นของราคาสินค้าที่ซื้อมาจากผู้ผลิต ซึ่งเป็นผลสะท้อนมาจากการเปลี่ยนแปลงของปัจจัยหลายๆ ประการ เช่น ระดับการแข่งขันที่สูงขึ้น และผลผลิตการผลิตที่สูงขึ้นในตลาดขายปลีก เป็นต้น

3) การศึกษาพฤติกรรมการกำหนดราคา (ความบ่อยครั้งและขนาดของการปรับราคาสินค้านี้ จากข้อมูลรายหมวดสินค้าในระดักร้าดซ์นี้ราคาผู้บริโภค) พบว่าในภาวะอัตราเงินเฟ้อต่ำนี้โดยทั่วไปแล้ว การเปลี่ยนแปลงของราคาสินค้ารายหมวด จะมีไม่บ่อยครั้งเท่าในช่วงก่อนวิกฤต โดยในช่วงก่อนวิกฤตเศรษฐกิจการเปลี่ยนแปลงราคาแต่ละครั้งของสินค้าที่มีการเปลี่ยนแปลงราคาไม่บ่อยครั้ง จะมีขนาดการเปลี่ยนแปลงที่สูงกว่าสินค้าที่เปลี่ยนราคาบ่อย นอกจากนี้ ความบ่อยครั้งในการปรับราคาขึ้นอยู่กับลักษณะเฉพาะของสินค้าในหมวดนั้นๆ เช่น สินค้าในหมวดที่ได้รับผลกระทบจากความผันผวนของอัตราแลกเปลี่ยนมากจะมีการเปลี่ยนแปลงของราคาที่บ่อยกว่าหมวดอื่น เป็นต้น

4) การศึกษาแสดงให้เห็นว่า ที่ผ่านม้อัตราเงินเฟ้อโดยรวมและรายหมวดสินค้านี้มีการปรับตัวกลับสู่ระดับเดิมได้ค่อนข้างรวดเร็วเมื่อมีปัจจัยภายนอกมากระทบ

### **บทสรุปและนัยต่อนโยบาย**

โดยสรุป การศึกษานี้มีนัยต่อการดำเนินนโยบายการเงินดังนี้ (1) แม้ว่าอัตราเงินเฟ้อพื้นฐานเป็นเป้าหมายของนโยบายการเงิน แต่ก็ยังมีความจำเป็นต้องติดตามเครื่องชี้วัดแรงกดดันด้านราคาตัวอื่นประกอบด้วย เครื่องชี้ที่นำเสนอในการศึกษานี้บ่งชี้ว่ามีแรงกดดันราคาขาขึ้นในปัจจุบัน และ (2) ข้อค้นพบว่าอัตราเงินเฟ้อมีการปรับตัวกลับเข้าสู่ระดับเดิมค่อนข้างรวดเร็วเมื่อมีปัจจัยภายนอกมากระทบ มีนัยว่านโยบายการเงินอาจไม่ต้องมีลักษณะ Proactive มากนัก อย่างไรก็ตาม ช่วงเวลาของการศึกษาส่วนหนึ่งเป็นช่วงเวลาที่ใช้ระบบอัตราแลกเปลี่ยนแบบคงที่ โดยที่ความร้อนแรงของเศรษฐกิจส่วนใหญ่ถูกดูดซับด้วยการขาดดุลบัญชีเดินสะพัด และไม่ปรากฏเด่นชัดในเงินเฟ้อ ดังนั้น นัยต่อนโยบายการเงินนี้จึงยังต้องมีความระมัดระวัง โดยเฉพาะอย่างยิ่งในช่วงเศรษฐกิจขาขึ้นจากนี้ไปที่เงินเฟ้ออาจใช้เวลาในการปรับตัวต่างจากที่ค้นพบในการศึกษา

## **Introduction**

In Thailand over the past recent years, the placidly low inflation environment despite robust economic growth poses a review on the assessments of current price pressure as well as the structure of the inflation process. Meanwhile, the reinforcing global low inflation over the same period strongly insinuates a structural change in the development of the inflation process. The fairly inert official inflation indicator as well as policy target, core inflation, which gives possibly insufficient information about price pressures, suggests an alternative unexplored approach using more revealing information at the sectoral level. Due to several environmental changes since the crisis, such as the flexible exchange rate regime, low inflation environment, inflation targeting regime, and trade liberalization, prices in different sectors may respond differently to shocks, and their responses may differ from the pre-crisis period and contribute differently to the aggregate inflation. Therefore, it is crucial to explore the sectoral inflation processes and their responses to shocks in order to better understand price pressure going forward.

Volatility of inflation indicators, the fixed expenditure-weight used on consumer goods and services in the construction of the consumer price index, and non-transparency due to exclusion of varying items in the index construction are the major criticism on the existing inflation indicators in representing the underlying inflation trend. Those criticisms on their methodologies together with the aforementioned events trigger a search for a plausible better indicator. This paper therefore explores a new methodology using an advanced technique, namely the maximum likelihood estimation using Kalman's filter to extract the common underlying trend embedded in each sectoral inflation process to be used as an additional indicator and to improve upon such criticism.

Several possible developments: enhancing technology, increasing level of competition, and increasing monetary policy credibility in an increasing number of countries adopting the inflation targeting regime have been highlighted as drivers of current global low inflation. As these developments shall greatly influence the relative movements between the sale prices and costs of firms, one approach to gauge existing price pressures under the above developments is therefore to compare the consumer prices (perceived as selling prices of retailers in the retail market) with the corresponding producer prices (perceived as a significant fraction of production costs to retailers). These relative

movements between consumer and producer prices should also reflect potential momentum of these developments, hence, some indications of price pressure going forward.

In addition, to the above price pressure indicators, the study on the adjustment of prices and inflation in response to shocks at the sectoral level is needed for a more complete understanding of the inflation process. The methodology adopted to study the nature of price adjustment involves analyzing distributions of the price adjustment frequency by comparing them across time periods and across sectors. On the other hand, inflation persistence is tested econometrically based on autoregressive inflation processes in order to study the speed of inflation adjustments in response to shocks. The main focus is whether and how sectoral prices and inflation processes differ over time especially after post-crisis major environmental economic changes. The results indicate the time dimension of the inflation process' response to shocks and gives implications on an appropriate monetary policy action.

This paper is organized into 2 main parts in which relevant literature is reviewed: first is the study of price pressure indicators, and second is the study of the persistence of price and inflation processes. The first part entails the study of the underlying inflation trend and the analysis of the relative trends between consumer and producer prices to determine price pressure going forward. In order to better understand the persistence of the inflation process, the second part investigates both the stickiness of sectoral prices and the persistence of their corresponding inflation processes. Finally, the policy implications and conclusions are drawn.

## **1. Price Pressure Indication**

During the late 90's and present, global inflation has remained rather subdued and well below the rates forecast by models based on strengthening economic conditions. This implies that structural changes of the inflation process have been going on. Economists have pointed out that increasing competition, increasing productivity, and successful inflation anchoring monetary policy are possible factors playing a big role altogether in restraining inflation.

First, increasing competition in both domestic and international trade may have eroded firms' pricing power and led to stickier prices. This happens because pass-throughs

of cost increases into prices may have declined. Furthermore, when relative prices evolve more slowly, the firms' need to actively adjust their prices also fall.

Second, with increasing productivity growth, an economy may be able to attain a higher GDP growth rate without having to face rising inflationary pressures. This should be reflected in a decline of the sensitivity of inflation to output gap or, in other words, a flatter New Keynesian Phillip's curve. However, several forces may have reinforced each other and affected the inflation process at the same time because higher productivity growth may be endogenously caused by increasing competition.

Third, as inflation has always been within the low target range for some time, monetary authorities may have gained greater credibility and been able to firmly anchor inflation expectations. This is observed in many countries especially those with the inflation targeting monetary policy regime where price stability is the overriding monetary policy objective.

The scope of this paper, instead of trying to identify or quantify the forces causing low inflation, is limited to better understand the resulting effects of these forces on changes in price adjustment and inflation process in the retail market. The above forces have kept inflation at a low level while output has robustly risen, the question of whether there are any additional signs showing greater price pressure in the near or medium term is the main focus of this part of the paper. It will provide two new alternative ways to further understand and detect the possibly hidden price pressures by using sectoral price information: constructing a new dynamic common trend indicator for underlying inflation and analyzing the relative trends of the consumer and producer prices.

### **1.1 The Measurement of Underlying Inflation**

Over the recent years, one of the most interesting and often-asked phenomena among macroeconomists and monetary policy makers is the globally widespread low inflation. The Thai economy is no exception. In the particular case of Thailand, while inflation has been low, the economy has recovered to an extent reflected in rising capacity utilization, more active housing and real estate markets, and a more tightening labor market. Are these developments indicating rising economic pressure in the current economy, which normally would have been signaled by a rising inflation indicator for the relative state of current and potential economic output? This notion alludes to the second

observation that Thailand's core inflation, currently used as an underlying inflation indicator, has in the past couple of years shown its steadily low trend deviating from the rising headline inflation, albeit its significant long-run relationship in the past. The observation validates a review of the underlying price pressure in the economy by looking into how categorical inflation trends move overtime and how each contributes to the aggregate underlying price pressure.

Several inflation indicators commonly used to gauge price pressure are headline inflation and measures of core inflation employing various statistical methodologies, motivated by inappropriateness of headline inflation as an indicator. Headline inflation is generally an expenditure-based index of consumed good prices where the relative weight of each good depends on its importance in the expenditure basket. However, many found that headline inflation is not a good indicator due to several reasons. The most important one is that many components of headline inflation contain high transitory noises, which do not affect the underlying inflation trend. These transitory noises are idiosyncratic shocks and typically reflect seasonal movements, volatile supply shocks, or once-and-for-all relative price shocks that will eventually dissipate and do not affect the true underlying inflation trend. Hence, more appropriate indicators are needed especially as monetary policy is not required to respond to such noises.

Instead of headline inflation, a more commonly used indicator with an attempt to take care of these noises is core inflation. The most widely used method is an exclusion from the headline inflation of goods items with high transitory shocks such as energy and raw food as, for example, in the case of Thailand.

Another often mentioned methodology to correct this transitory noise, interpreted to be price changes at the tails of non-normal distribution of categorical price adjustment each period, is the trimmed means. This indicator allows different prices in different periods at both tails of cross-sectional price change distribution to be excluded.

**Table 1.1.1: Comparing traditional measurements of underlying inflation**

<b>Traditional Indicators</b>	<b>Methodology</b>	<b>Advantage</b>	<b>Disadvantage</b>
Headline inflation	Fixed expenditure weight	Commonly used and easy to understand	Have strong seasonal and temporary effects
Core inflation	Exclude some volatile items	Less volatile than headline	May lose information about underlying inflation in the excluded components.
Trimmed means	Exclude some outlier items varying each period	Less volatile than headline	1. Not transparent due to varying excluded items. 2. May lose underlying inflation information

Of all indicators, the study of Griffiths and Poshyananda (2000) found core inflation to be the most appropriate inflation indicator for Thailand considering many advantageous qualifications including being a good match of current inflation trend and good forecast of future trend. But as of the recent declining forecasting ability of core inflation about future trend, some questions revisit.<sup>1</sup> Is it truly the case that the excluded price changes in core inflation never contain information about trend inflation? Griffiths and Poshyananda (2000) claimed that exclusion of raw food from core measure is likely to result in some loss of timely price signals. There are both gains and losses from the exclusion of raw food prices. The gain comes from removing “noises”, and it can be substantial. The loss, on the other hand, comes from the fact that transitory movements in the price of raw food can affect subsequent permanent changes in the price of goods using raw food as input. Moreover, another important problem of these indicators may arise when the price of a certain item with a high expenditure weight moves not in line with the common trend of other items. These indicators might move to the extent along the price movement of this high-weight item even though it does not reflect the real common underlying price trend. These two main problems lead us to consider how we might develop a supplementary indicator with a systematic statistical methodology for reducing the transitory noise in measured inflation indices without losing information on the underlying trend as well. In other words, this methodology should be a time-varying

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<sup>1</sup> For a new method to better forecast core inflation, see Sun (2004). That paper develops an approach where the projections of core inflation incorporate both a short-term element which attempts to exploit the forecasting power of various monthly indicators based on statistical criteria and a long-term element from an equilibrium-correction model that pinpoints the movement of core inflation toward its long-term path according to structural determinants.



mechanism to reduce the importance of prices that move differently from the common trend of the remaining prices.

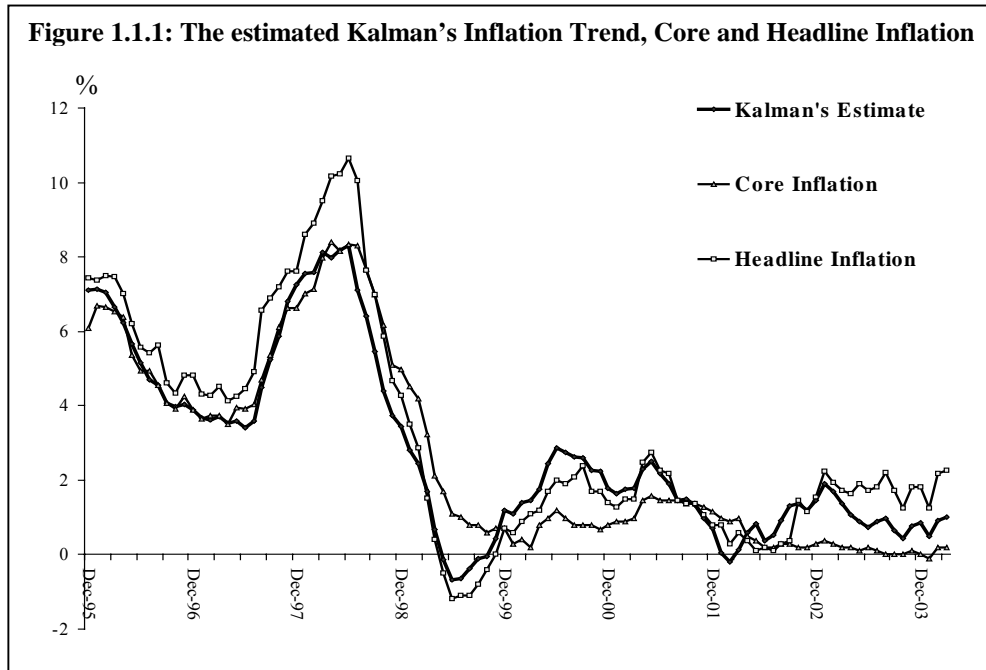
### **The Kalman's Filter Approach to Estimate Underlying Inflation**

Each price change of consumed goods can contribute to the change in the underlying inflation trend. Nevertheless, at the same time, each goods price movement is also subjected to its own specific determinants and shocks, which may not coincide with other goods'. Price movements due to these idiosyncratic shocks of each goods can significantly reduce its contribution to the underlying inflation trend. Hence, distinguishing the two components for each goods price movement as the movement of underlying inflation trend and the movement due to an idiosyncratic shock shall give a more complete picture of the underlying inflation process. As headline and core inflation is constructed from a fixed households' expenditure, it is implied that the idiosyncratic shock embedded in each price movement of each good is assigned the same weight as in the aggregate inflation construction. This can prevent headline and core inflation from demonstrating the real underlying inflation trend.

With the belief that the current headline inflation which is based on a fixed expenditure weight can be a bias inflation indicator, Bryan, Cecchetti and Sullivan (1993 and 2002), following the technique developed by Stock and Watson (1989) in their construction of a coincident index of real activity, has adopted a new method of maximum likelihood estimators using Kalman's filter to estimate the unbiased common underlying inflation, so called the "dynamic factor index". The concept of Kalman's filter is to extract the common trend among all price series out of the price shocks of each goods by assigning a weight to each good to minimize the sum of weighted idiosyncratic shocks in each period (detailed in appendix 1). The weight assigned to each price will vary over time depending on 2 factors: magnitudes of its correlation to others and variance of its idiosyncratic shock in each period. Thus, this dynamic factor index of consumer prices is constructed by essentially weighting commodities on each price's contribution to the common inflation signal.

In order to find the underlying price pressure suggested in categorical inflation trends, this part of the paper employs this method of maximum likelihood estimation by applying Kalman's filter to extract the common inflation trend among all good categories from the individual good shocks. The estimate is shown in figure 1.1.1. Compared with

headline and core inflation, this Kalman's inflation trend is less volatile than headline inflation and closer aligned with core inflation.<sup>2</sup>



**Table 1.1.2: Statistical comparisons between headline, core and Kalman's Inflation Trend**

Statistics	Core Inflation	Headline Inflation	Kalman's Inflation Trend
Mean	2.630	3.198	2.789
Median	1.225	1.971	1.898
Maximum	8.406	10.648	8.312
Minimum	-0.096	-1.190	-0.672
Variance	6.854	8.647	5.779
Std. Dev.	2.631	2.955	2.416
Skewness	0.765	0.817	0.794
Kurtosis	2.167	2.692	2.536

<sup>2</sup> Basic statistical comparisons of these indicators are in Table 1.1.2

Next, the paper looks closely into what contributes to the difference between core inflation and the Kalman's inflation indicator by comparing the correlations between each category and core inflation to the correlations between each category and the Kalman's inflation indicator. It was found that these two correlations to the same categories are mostly close and 5 out of 9 categorical prices correlate most with those two indicators within the same period. The major difference appears in the indicators' correlations to the energy category. The cross correlation between energy and the Kalman's inflation trend is higher than the one between energy and the core inflation. The cross correlation across time of the energy and Kalman's inflation trend is highest at 0.48 where the former leads the latter by three months. The cross correlation across time of core inflation and energy, on the other hand, is lower at 0.28 with core inflation lagging behind energy by five months as shown in Table 1.1.3. These statistical results suggest that energy, which is excluded in calculating core inflation, has led and contributed more to the common underlying inflation in the case of the Kalman's inflation trend. This notion is supported by the fact that energy is an input in most products in the CPI basket; therefore, energy price changes shall also contribute to other goods' price changes. Hence, changes in energy price should affect the common underlying inflation trend more than its existing contribution in the core inflation. In addition, with exclusion of energy from the composite inflation indicator, price pressure signaled by the indicator could be delayed.

On a minor note, the difference between the indicators' correlations to the housing category is worth mentioning. The higher correlation between core inflation and the housing sector than the one of the Kalman's inflation trend suggests that core inflation may have given too much weight, and hence, importance to housing's contribution to the underlying inflation as in the recent past when continuous decline in rent (accounted for a major weight in the housing category and accounts for 24 percent in core inflation) had anchored the core inflation to low levels.

**Table 1.1.3: Cross Correlation with Categorical Inflation Components of Core Inflation and Kalman's Inflation Trend**

	Core Inflation			Kalman's Inflation Trend		
	Lead (period)	Lagged by (period)	Correlation	Lead (period)	Lagged by (period)	Correlation
Alcohol			0.84			0.77
Clothing			0.96			0.94
Energy		5	0.28		3	0.45
Housing			0.96			0.88
Medication	2		0.80	3		0.75
Non-raw food			0.90			0.85
Raw food		1	0.70			0.73
Recreation			0.85			0.84
Transportation	4		0.57	6		0.63

\*Coincident relationships are left blank.

In reference to an assessment of the current price pressure, this Kalman's inflation trend in the recent past has lied between headline and core inflation, for example the estimate for March 2004 stood at 1.02 per cent compared with 0.19 per cent per annum of core inflation, suggesting higher price pressure than reflected from the present core inflation.

Additionally, one benefit of the Kalman's filter approach is that it may allow improvement by the inclusion of forward-looking inflation indicators such as assets price, which is being developed by the Bank of Thailand, to develop a leading inflation trend. This will reduce gaps and delays of indicators in indicating price pressures, caused by excluding information about inflation trends embedded in excluded key components. Once improvements are incorporated, the estimated underlying inflation, the Kalman's inflation trend, should better indicate price pressure.

However, limitations of the Kalman's inflation trend are also recognized. Firstly, is about the degree of disaggregation. Notably, the more disaggregated the price components are, the less biased the estimate is as prices of the more disaggregated levels are less affected by the fixed-weight problem. However, the increasing number of prices in the more disaggregated levels and, therefore, more variations of price movements render a less

efficient estimator.<sup>3</sup> Secondly, and more importantly, this method involves an advanced technique which makes communication to the public difficult and less transparent.

Despite its limitations, the Kalman's inflation trend has unique and important beneficial features not captured in other indicators. It should therefore be used as a complimentary indicator for monetary authorities to be monitored together with core inflation, which is the current policy target indicating the latent underlying inflation.

## **1.2 Trends of the CPI-PPI Ratios**

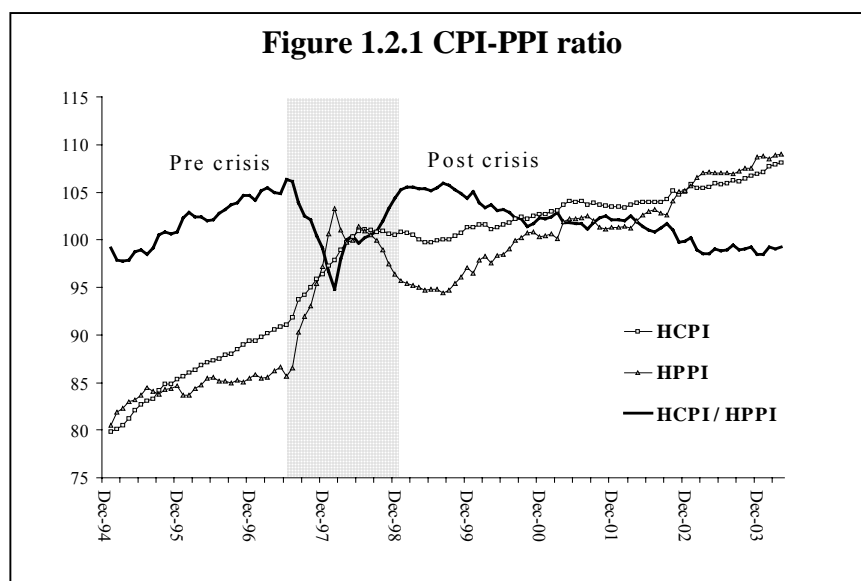
This part of the paper further explores another possible indication of price pressure in the retail sector by comparing retail sale prices demonstrated by prices of goods in consumer price index (CPI) basket with a considerable portion of retailer's cost represented by producer prices of goods in the producer price index (PPI) basket. Specifically, this section attempts to find evidence in the retail sector of increasing competition, improving productivity level, and increasing credibility of inflation targeting monetary framework. In doing so, the analysis of this part is performed to see how the relative movements of these two processes differ across sectors and across time periods by looking at the CPI-PPI ratio and what implications can be drawn going forward.

Comparing the trends of the CPI and PPI, it is clear that both the aggregate CPI and PPI have upward trends as shown in Figure 1.2.1. The CPI increased at a greater rate than the PPI in the pre-crisis period; however, the trend started to reverse in 1999. In other words, the CPI-PPI ratio, which is defined as the ratio of the CPI divided by the PPI, had an increasing trend in the pre-crisis period but began to have the opposite trend starting in the beginning of the post-crisis period.<sup>4</sup>

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<sup>3</sup> The common problem to all indicators also prevails that is the extent of the sample covered by the price data used might be incomplete. In addition, our calculations, similar to the calculations of headline and core inflation in this aspect, do not account for the potentially important measurement biases that arise when goods are systematically excluded or when there is a common measurement error, such as unmeasured aggregate quality changes.

<sup>4</sup> Along with the depreciation of the baht, the PPI increased much more sharply than the CPI during the crisis period (defined as being between July 1997 and December 1998) as the PPI basket has higher total import content than the CPI basket.



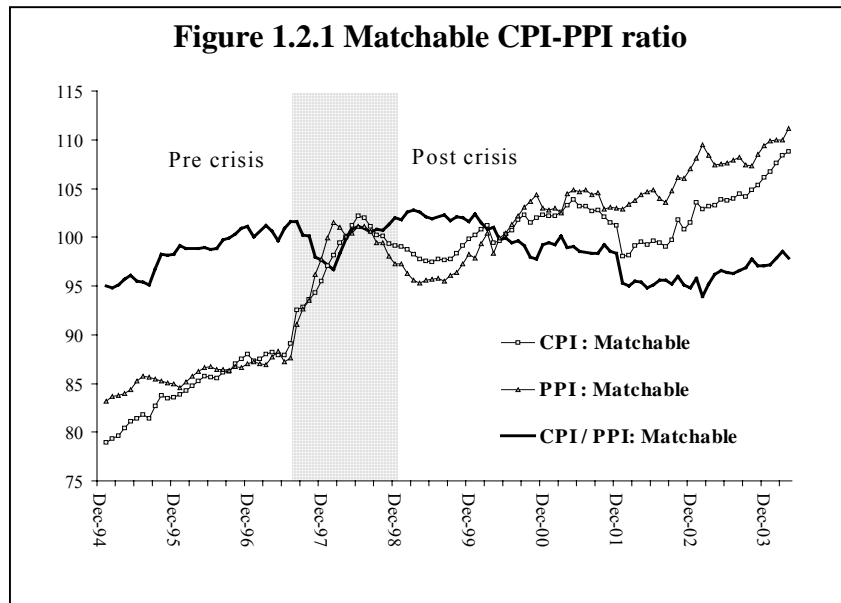
Nevertheless, not all items in the CPI basket are identical to items in the PPI basket. In particular, the PPI basket does not include any service items and the CPI basket does not contain capital goods and certain raw materials for production. To appropriately compare the aggregate as well as sectoral prices in the CPI and PPI baskets, these unmatched price items first need to be excluded. Furthermore, to additionally compare CPI and PPI prices by sector, it is necessary to match these items in both baskets product by product. The arduous matching scheme was initiated to allow for the analysis of different patterns of price adjustments in different sectors resulted in 40.4 percent of weighted items in the CPI basket being matched with 59.8 percent of weighted items in the PPI basket. In this study, the matchable items were grouped into 21 groups of consumer goods.<sup>5</sup>

The aggregate matchable CPI and PPI trends together with the ratio of their respective CPI-PPI ratios still demonstrate the same pre-crisis rising trend and post-crisis declining trend, similar to their respective aggregate trends.<sup>6</sup> The pre-crisis rise and the post-crisis decline of the CPI-PPI ratio imply that price setting behaviors of producers

<sup>5</sup> This was done by firstly assigning every item in the CPI and the PPI into the categories accordingly to the NESDB's 1998 version of the input-output table. So various categories of the I-O table would have potentially matchable CPI and PPI items. Secondly, in every category of the I-O table, CPI items that do not match with any PPI items of the very similar product characteristics were excluded and vice versa for the PPI items. Finally, the different I-O table categories are grouped into 37 groups of consumer products, only 21 groups out of which are groups of matchable CPI and PPI items. Please see appendix 2 and 3 for the details of the groupings.

<sup>6</sup> However, it should be noted that the CPI-PPI ratio in this case started to have a slight increase at the end of 2002

(wholesalers) and retailers might have changed under different environments. In the pre-crisis period, seeing increasing demand the retailers adjusted prices upwards while prices of the products bought from producers tended to increase much more slowly. Provided that the cost of retailers, other than the costs of goods purchased from producers, had not risen as fast as the increase in the sale prices (CPI), retailers might have enjoyed greater retail margins in that period.



The contrasting story is witnessed in the post-crisis period. The CPI-PPI gap has been on a declining trend since 1999 as the PPI has been rising at a faster rate than the CPI. Encountering growing competition in the retail landscape and increasing productivity in the retail sector propelled by both continuous rises in technology of product distribution and efficiency due to improved skills in retail marketing and management are the two main possible factors behind the declining trend but their implications on the future trend are poles apart. The former implies that profit margins of retailers might have been squeezed and this might lead to a faster increase of the CPI in the near or medium-term if the PPI still keeps on rising at a high rate. The latter, in contrast, will allow the CPI to increase gradually as long as the retailers can still maintain the same level of earning profits gained from increasing productivity despite increasing material costs.

Examining further into the sectoral comparison, the products were classified according to the trends of the CPI-PPI ratios into three groups: declining, constant and

increasing.<sup>7</sup> In the pre-crisis period, the three groups accounted for about the same proportion in the matchable CPI basket, having 32, 36, and 31 percent of the matchable products by weight in the declining, constant, and increasing trend groups respectively. These products are shown in groups in table 1.2.1

<b>Declining</b>	<b>Constant</b>	<b>Rising</b>
Dairy products	Rice and Flour	Petroleum
Vehicles	Alcohol	Non-durable households
Fishery	Furniture	Wearing apparels
Vegetables and fruits	Metal Products	Non-alcoholic beverage
Rubber products	Wooden products	Construction materials
	Meat	Cooking oil
	Processed food	
	Weaving and Spinning	
	Electrical appliances	
	Medicine	
<b>32% of Matchable CPI</b>	<b>36 % of Matchable CPI</b>	<b>31 % of Matchable CPI</b>

The overall pattern has strikingly changed for the post-crisis period. It was found that as high as 40 percent and 56 percent of the goods by weight were in the declining and constant CPI-PPI ratio groups, leaving only 4 percent in the increasing one. It is noticeable that a number of groups have shifted from the rising trend to the constant or declining trend and from the constant trend to the declining trend. Hence, the indicative overall pattern of declining aggregate matchable CPI-PPI ratio apparently has strong supporting evidence at the sectoral level.

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<sup>7</sup> See appendix 4 for CPI-PPI ratios of all sectors.



**Table 1.2.2 Trends of the Post-crisis Matchable CPI-PPI ratios**

<b>Declining</b>	<b>Constant</b>	<b>Rising</b>
Alcohol	Fishery	Electrical Appliances
Non-alcoholic Beverage	Dairy Products	Medicine
Cooking Oil	Processed food	Rubber Products
Vegetable and fruits	Non durable Households	
Meat	Weaving and Spinning	
Rice and Flour	Wearing Apparels	
Metal products	Vehicles	
Wooden products	Petroleum	
Furniture		
Construction material		
<b>40% of Matchable CPI</b>	<b>56 % of Matchable CPI</b>	<b>4 % of Matchable CPI</b>

This analysis implies that price pressures have been increasingly building up if productivity in the retail sector has not increased and matched up with the declining CPI-PPI ratios. Even though appropriate and reliable retail productivity data are not available, it is not arguable that productivity in the retail sector has increased since several major foreign retailers started their operations in Thailand a decade ago. They brought along management and distribution efficiency, and gained a great deal from the economy of scales. Nevertheless, if retail productivity starts to slowdown, efficiency improvements will start to be exhausted, or the economy of scale will start reaching its plateau while rising PPI remain strong, as much as 40 percent in the declining ratio group of consumer prices might start to rise and possibly at a high rate. This group is most likely to face increasing price pressure if gains from improving productivity recede.

In summary, the new underlying price pressure indicator is found to be particularly useful when prices of some sectors with high expenditure weights do not move in line with the common trend in most sectors. This new price pressure indicator mainly moves in the same direction as headline inflation and, for the past few years, has lied between headline and core inflation, suggesting higher price pressure than indicated by core inflation. In addition, the impending rising trends of the CPI-PPI ratios all have demonstrated that the upward risk of price pressure in the economy is likely to increase unless positive factors such as increase in productivity and elevated intensity of competition continues to outweigh the possibly hidden rising pressure.

## **2. Persistence Analysis**

As mentioned in part 1 that evolving global and domestic environments, namely the three major forces, have affected the inflation process development. This part of the paper will look into two of the most crucial aspects of the inflation process, which need better understandings: price stickiness and inflation persistence. Price stickiness has an important implication on the length of monetary policy effects on real variables. Here, the focused aspect of price stickiness is the frequency of price adjustment. On the other hand, inflation persistence provides information about, once hit by shocks, how quickly inflation returns to the pre-shock level. Hence, it will help provide the answer on how proactive the monetary authorities should be in responding to shocks in the present environment.

Using the aggregated price data consisting of asynchronous price adjustments of all goods will not depict an accurate picture of price stickiness. The firm level data although ideal for such study is not available, therefore, the next best thing is to analyze each product's price adjustment in the CPI and PPI baskets. This part of the paper therefore aims to study price and inflation persistence as well as their implicational relation by analyzing them at both the aggregate and sectoral levels.<sup>8</sup>

This part will start with a review of various theoretical models behind price stickiness and their different implications on inflation processes. Then empirical investigation is performed to analyze frequencies of price adjustments as well as inflation persistence at the aggregate and sectoral levels.

### **Theoretical models**

Theoretical models about aggregate inflation persistence are mostly based on microeconomic foundations of sticky prices and can be categorized into three major groups: time-dependent, limited information, menu cost or state-dependent models.<sup>9</sup>

In the time-dependent models, the number of firms that change prices in each period is determined exogenously. The classic models of this type were pioneered by Taylor (1980) and Calvo (1983) where the essential feature is that, with forward-looking

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<sup>8</sup> It will be best to analyze price data at the firm level as they will provide information about heterogeneity in price setting behavior of firms producing the same product. However, limited data availability has prevented us from performing the firm level analysis.

<sup>9</sup> See Taylor (1999) and Cecchetti and Debelle (2004) for an extensive literature review on price and wage stickiness.

expectation, firms will reoptimize prices at some regular intervals (their current prices reflect the firms' future expected real marginal costs and inflation).<sup>10</sup>

In the Taylor's model, a mark-up pricing over marginal cost is set based on a sequence of overlapping wage contracts where each contract lasts for a fixed number of periods,  $n$ . In this setting, shocks in the present period will affect not only the wage but also the price level for the next  $n-1$  periods until the current contract expires. The effect of shocks on wages and on the price *level* will be more persistent if the length of the contracts is long. As long as shocks are temporary, the Taylor model exhibits price level persistence rather than inflation rate persistence. This is because once a shock is realized as being temporary, only the wages and prices of those with expiring contract in that period change and stay at that new level for the whole period of the new contract, but it will not affect wages and the price levels of that cohort and the rest of goods and services into the next period. Therefore, prices are persistent for the contract period but inflation is not. That is because inflation only adjusts one time in that period of shock then returns to the same level as in the previous period.

Calvo (1983) provided a stochastic staggered contracts model where the contracts ended randomly. As only a subset of wages and therefore prices are reset in each period, prices are sticky. The random timing of price adjustment of different firms contributes to price persistence in response to shocks similarly to the overlapping wage contracts in Taylor's model. Like the Taylor's model, as the forward-looking price setters make their pricing decisions based on expectations of the future cost and inflation, this model does not generate inflation persistence.

On the contrary, limited information models, which follow the Lucas (1972) islands' model of price setting, generate persistence in the price level as well as inflation. When observing changing demand for their products, sellers are uncertain in the early periods whether it is the underlying general-price pressure, or an idiosyncratic or firm-specific shock. They will try to extract a signal to verify the degree to which the observed changes follows the economy-wide price pressure and gradually adjust their prices as the signal becomes clearer. The process of signal extraction induces persistence in both the

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<sup>10</sup> For modern variations of the Calvo-Taylor price-setting models, see for example, Chari, Kehoe and McGratten (2000), Christiano, Eichenbaum and Evans (2001), Rotemberg and Woodford (1997). And for an empirical assessment of the model, see Eichenbaum and Fisher (2003).

price level and inflation as it slows down the price adjustment process in response to shocks.

As for the menu-cost or state-dependent models such as Caplin and Spulber (1987), Dotsey, King and Wolman (1999), and Burstein (2002), firms have to pay a fixed cost of adjustments once they change their prices or pricing plans. The number of firms who set their new prices in any given period is determined endogenously subjected to the fixed cost, and the size and timings of shocks. The persistence of the price level generated by these models does not directly imply the extent to which inflation is persistent. The main property of these models is that shocks of different sizes and timings (even those of the same type) have different implications on persistence of price and inflation and different effects on the aggregate economic activities.

Other than the above models with built-in price stickiness, the monetary framework, especially inflation targeting, can also greatly influence the forward-looking behavior of price setters. The more credible the regime is, the less persistent inflation will be. This is because better information and understanding about the central bank's policy objectives provide the price setters a more tangible and clearer anchor for their expected future inflation. They also understand that a shock causing deviation of inflation from the target will be dissipated by some monetary policy actions, and hence do not adjust their prices in the same proportion as the size of shocks.

## **2.1 Price Persistence**

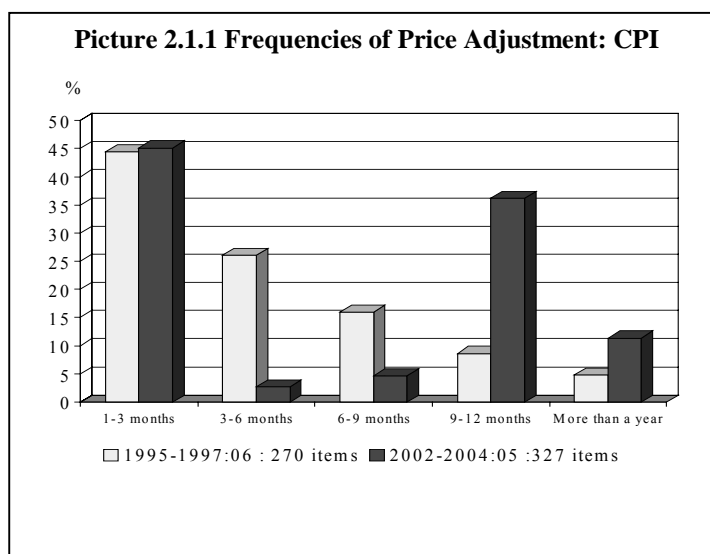
This section attempts to document some important stylized features of price stickiness through empirical analysis based on sectoral data used in the construction of the consumer and producer price indices by looking at how often prices of goods and services in the monthly CPI basket change. That is to see frequencies of price adjustment that consumers face. In particular, the paper tries to address whether the frequency of price adjustment differs in the post-crisis period (low inflation environment period) from the pre-crisis period.

Using the monthly data of all goods and services in the CPI baskets of the January 1995-June 1997 period (representing the pre-crisis period) compared with the January 2001-April 2004 period (representing the post-crisis period), calculations were performed

to answer how often in a year the price of each item was changed.<sup>11</sup> Then the distributions of price adjustment frequency of the above two periods were compared for different cases of aggregated CPI, durable versus non-durable, goods versus services traded versus non-traded, food versus non-food, and aggregate PPI.<sup>12</sup>

### Total CPI

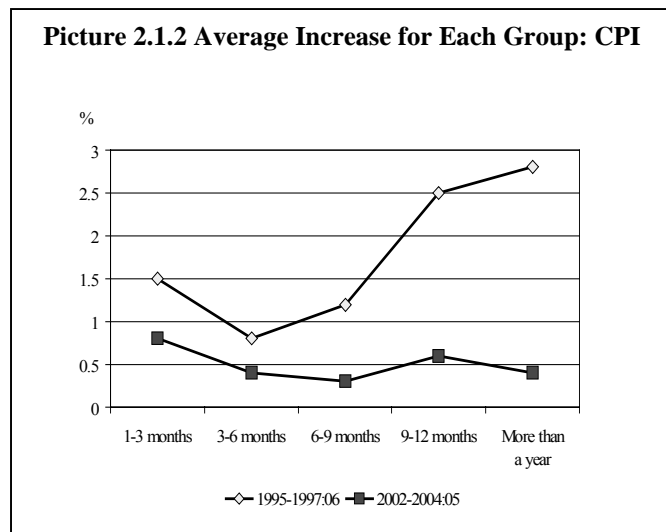
It was found that the overall prices were stickier in the post-crisis period. Monthly data show that prices were altered on average only 6.38 times a year in the post-crisis period as opposed to 8.64 times a year in the pre-crisis period. As shown in picture 2.1.1, for the pre-crisis period, it is apparent that most of the prices of goods and services in the CPI basket changed very frequently. The weight of goods and services in the CPI basket with average price adjustment frequency of every 1-3 months and 3-6 months together constitutes as high as 70.5 percent of all goods and services in the CPI basket. However, for the post-crisis period, the distribution has drastically changed from the pre-crisis period. Even though, the proportion of good and services with price adjustment frequency of every 1-3 month does not change much, the proportion of those with frequency of every 3-6 months drops sharply. However, that of the average price adjustment frequency of every 9-12 months rises sharply to 36 percent of the total CPI. This clearly indicates that on average prices change less frequently in the post-crisis period.



<sup>11</sup> Without the firm-level data, the analysis here can be biased towards the frequent side, if all the firms selling the same good alter their prices infrequently but do so at different periods. On the other hand, if some sellers often increase their prices but there always exist some sellers who lower their prices of the same item with the similar magnitude, the price of this item in the CPI will be biased towards the infrequent side as they canceled out although most sellers change their prices very often. However, as mentioned earlier, firm level data are not available for use.

<sup>12</sup> Detailed analysis on durable and non-durable, goods and services, food and non-food is in appendix 5.

Next we further investigated the magnitude of price increase for different frequency groups. We found that, during the pre-crisis period, the magnitude of average price increases was higher for those groups of infrequent price adjustments, particularly the groups with price adjustment frequency of every 9-12 months and of longer



than one year. Hence, the magnitude of average price increases rose as prices adjusted less frequently. This pattern was not witnessed post-crisis. However, for the post-crisis period, as considerably higher proportion of goods and services has infrequent price adjustments, if their magnitude of price increases eventually follows the same pattern of the pre-crisis one, the impact on overall inflation can be large as a result of greater proportions of items where increases in prices are expected to be quite significant.

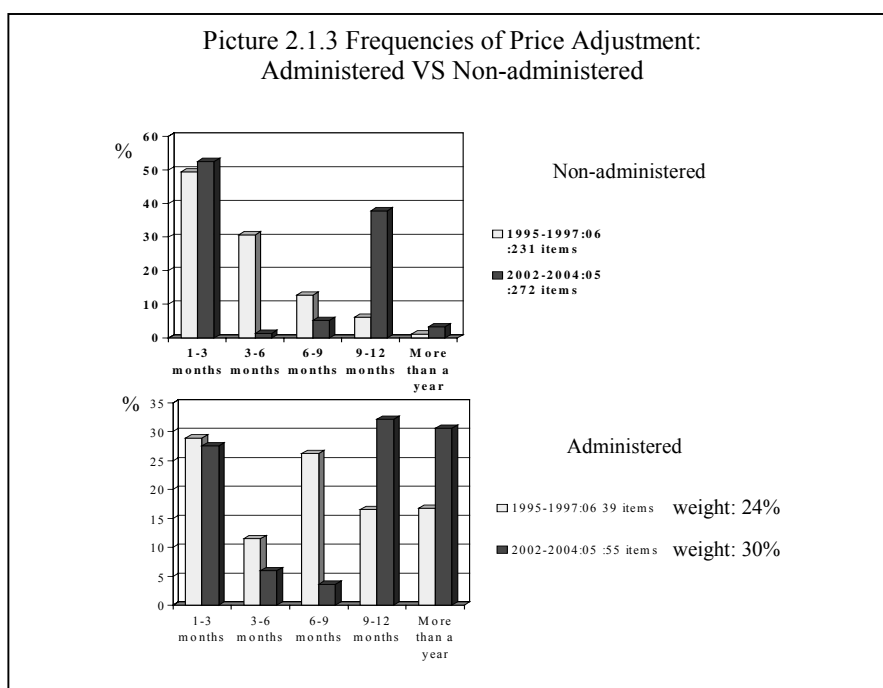
### **Administered VS Non-administered**

As a bias in the overall CPI towards lower frequencies of price adjustment might arise due to the stickiness in price of a large number of administered price components in the CPI basket, we classified the items in the CPI basket into administered and non-administered price groups and compared their relative frequencies of price adjustments. As high as 24 and 30 percent of the goods and services items in the CPI basket pre- and post-crisis, respectively are capped by the government ceilings. The distributions of administered prices in both periods are biased towards infrequent price changes. Among all the categories in the CPI basket, this group shows the least frequent price adjustment in both periods as the prices were adjusted only 5.92 and 4.38 times a year pre- and post-crisis, respectively.

The rest of the items in the CPI basket, as a result of excluding all administered prices, have the average frequencies of adjustment as high as 9.45 and 7.22 times per year. Therefore, in Thailand the government price ceilings are responsible for a sizable extent of the overall price stickiness in the economy. Both of the pre- and post-crisis distributions of non-administered price adjustment have similar shapes as the respective ones of total goods

and services price adjustment in the above case; however, the percentages of those with price changes within three months are somewhat greater than those in the case of total goods and services. This is because of the exclusion of the relatively stickier administered prices.

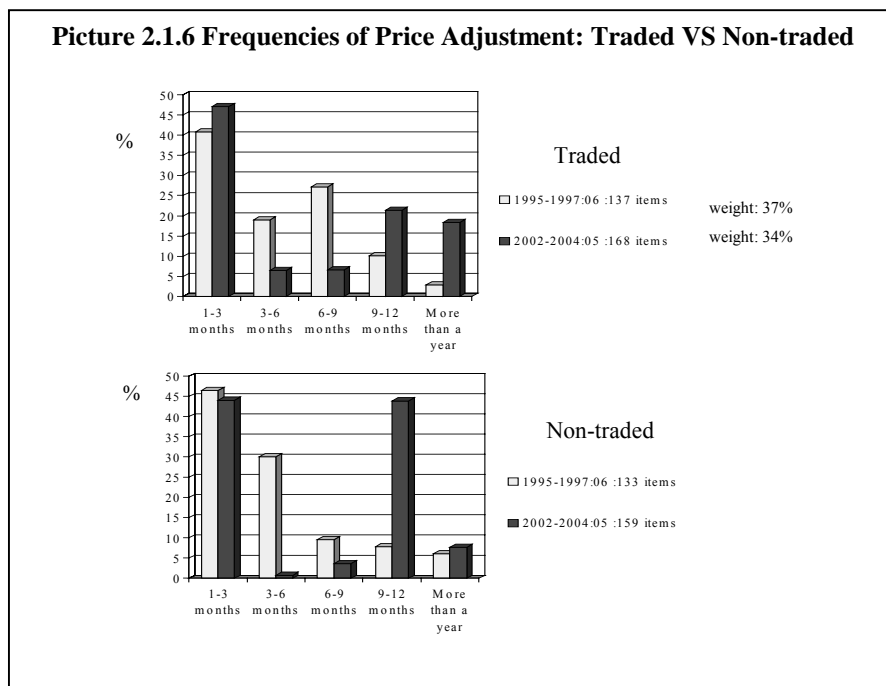
It is important to note that, as administered prices have been adjusted only 4 times a year for the post-crisis period, the prices in this group are likely to rise most significantly once they are allowed to be altered. The administered items without any price change in the past two years are taxi fares, air-conditioned bus fares, 1800 and lower cc. cars, telephone fees, private school books, and cigarettes.



### Traded VS Non-traded

Once the items are classified into traded and non-traded goods; the traded goods being goods that have entered the international trade arena and, therefore, are subject to movements of exchange rate, and non-traded goods being the rest of goods and services in the CPI basket, distinct patterns of the two groups are witnessed. For the pre-crisis sample, the distribution of the traded group demonstrates less frequent price adjustment compared to the nontraded goods and services distributions where most prices change within three months.

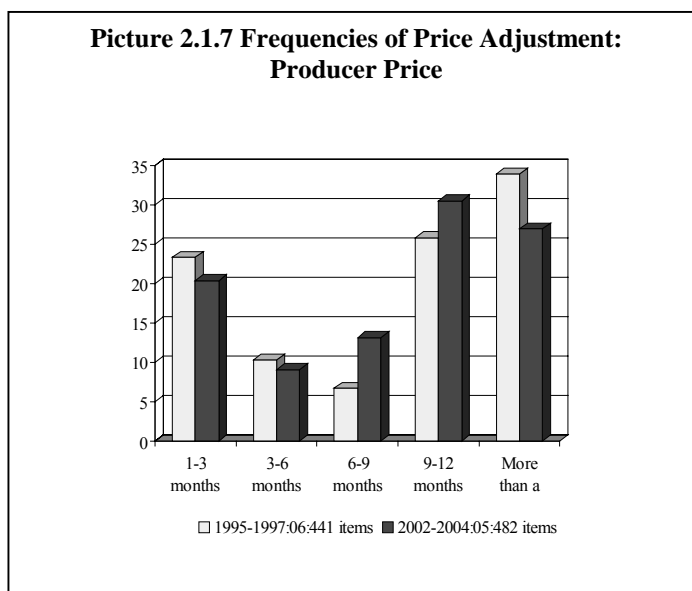
The two groups became significantly stickier in the post-crisis period. Nevertheless, the distribution of the non-traded group, which although closely resembles the total CPI group's distribution, showing relatively higher percentage of goods and services with no price change within 6 months, suggests a relatively higher degree of price stickiness. The non-traded group with the distribution that closely resembles the total group's distribution shows relatively greater percentage of goods and services with no price change within 6 months. The traded goods, on the other hand, show higher percentage of goods with price adjustments within three months particularly during the post-crisis period under the floating exchange rate regime. However, even with the impacts of the exchange rate factor for some proportion of traded goods, the overall distribution shows less frequent price adjustment.





## Producer Price

After discovering the overall tendency of increasing CPI price stickiness across sectors, we performed the same analysis to see if it coincides with price stickiness of goods and services in the producer price index (PPI) basket. In the pre-crisis period, prices of goods in the PPI basket were adjusted less frequently than prices of goods and services in the CPI basket. Only 23 percent of the items by weight had price adjustments within 3 months compared with 45 percent for the case of items by weight in the CPI basket. In the post-crisis period, the



distribution of frequencies of producer price adjustment appears to be very similar to that of the pre-crisis period as the average frequencies of price adjustment around the two periods were both around 4.7 times a year.

The distribution of PPI in the post-crisis period remains more or less the same as in the pre-crisis period while the distribution of CPI has changed over the periods.

This finding crucially demonstrates that the decline in frequencies of price adjustment observed in retail prices should not have been driven by the price setting behavior of producers.

In summary, for the post-crisis period, the overall and sectoral prices of consumer goods have been adjusted less frequently.<sup>13</sup> This varies from sector to sector as different sectors are affected differently by various environmental factors. The range of price adjustment frequency declined from 5.9-10.28 to only 4.38-7.22 times a year while highly

<sup>13</sup> Two plausible and reinforcing factors contributing to the observed declining number of price adjustment per year are related to the menu costs and increasing credibility of the inflation targeting regime. In the low inflation environment, the number of shocks with the size bigger than the menu cost might tend to be low, rendering a longer duration of prices fixed at a level after being set. In the view of price setters, increasing credibility, on the other hand, reduces the volatility of the general price movement as well as lowers the possibility of inflation slipping out of the target range. Hence, the need for firms to adjust their prices decline.

significant changes can be observed in the goods, non-traded, and foods sectors as shown in Table 2.1.1. It was also found that government price ceilings were an important factor reducing the overall frequencies of price adjustments in Thailand in both periods. On the other hand, producer price frequencies of adjustment did not change like those of the consumer price.

**Table 2.1.1 Average Frequency of Price Adjustment Per Year**

Category	Pre-crisis	Post-crisis
Total CPI	8.64	6.38
Administered	5.92	4.38
Non-administered	9.45	7.22
Durable	6.76	4.92
Non-durable	8.81	6.46
Goods	9.02	6.27
Services	7.66	6.60
Traded	7.94	6.75
Non-traded	9.03	6.19
Food	10.28	6.57
Non-food	7.41	6.27
PPI	4.70	4.66

## 2.2 Inflation Persistence

After it was discovered in the previous section that aggregate and broadly sectoral prices had been adjusted less frequently, what remains to be investigated further is whether inflation persistence has changed accordingly and in what ways. This study is essential for setting policy because, as suggested by theoretical models, price stickiness of various sources can imply different inflation processes including the speed of inflation adjustments in response to shocks.

Approaches in literature concerning inflation persistence investigation can be divided into two strands: univariate and multivariate approaches. The former assumes that shocks are represented by the white noise component of an autoregressive process and

evaluates the impact of the shocks on the on-going inflation in terms of size and duration. The larger the coefficient of the AR process of month-on-month inflation, the longer lasting the effects of shocks on inflation will be (the more persistent inflation will be). In contrast, the latter tries to assess the effects of shocks on inflation determinants such as output gap and wages on inflation. In this paper, we choose to concentrate on the inflation process and the price setting theories; therefore, the focus is on the univariate studies.

Concerning inflation persistence measurements, Clark (2003) shows that the three commonly used methods, the coefficient of the lagged dependent variable in the multivariate model, the sum of the lagged coefficients of an auto-regressive process with  $n$  lagged dependent variables (AR( $n$ )) model in the univariate model, and the half-life of a shock to the inflation process, give similar estimates of inflation persistence. In this paper, we follow Cecchetti and Debelle (2004) by using the simple AR(1) coefficient and the sum of the coefficients of an AR(12) process of month-on-month inflation.

Most past literatures such as Batani (2002), Batani and Neilson (2001), Levin and Piger (2003), O'Reily and Whelan (2004) find the inflation process to be highly persistent. That is the AR coefficient was close to one in most countries.

However, some recent papers (usually using data of the past twenty years) have tried to study if inflation persistence has changed over time by using rolling regressions to examine the changing coefficients of the AR( $n$ ). O'Reiley and Whelan find that inflation persistence did not significantly change in the Euro area. On the contrary, Debelle and Wilkinson (2002) show that the decline of inflation persistence can be observed in the UK, Canada, and New Zealand but not in the US. Although, the rolling regressions provide a better picture about the evolution of inflation persistence, Cecchetti and Debelle (2004) argue that estimates of the rolling regressions do not appropriately provide timings of structural changes in persistence.

More prominent among recent literature is that estimating persistence crucially depends on mean shifts.<sup>14</sup> Levin and Piger (2003) and Cecchetti and Debelle (2004) find evidence of low or no inflation persistence in industrialized countries when an explicit mean shift is introduced in the estimations. Marques (2004) demonstrates that the estimates of inflation persistence decline when time-varying means are allowed for.

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<sup>14</sup> It is shown in Perron (1989) that estimates of persistence can be misleading if a mean shift is not taken into account.

This study attempts to investigate how persistent inflation in Thailand is as well as whether the persistence has declined for the post-crisis low inflation environment period. Besides, the question of whether the means of aggregate and sectoral inflation have shifted down for the post-crisis period is also concurrently addressed. To be consistent with the above part about the frequency of price adjustment, this section looks at inflation of headline CPI, traded versus non-traded goods, food versus non-food, durable versus non-durable, good versus services as well as the aggregate PPI. The persistence tests employing the AR(1) and AR(12) of the following specifications were performed using the available data between January 1995 and June 2004:

For AR(1),

$$\Pi_t = \rho \Pi_{t-1} + \varepsilon_t \quad (1)$$

For AR(12),

$$\Pi_t = \rho_1 \Pi_{t-1} + \dots + \rho_{12} \Pi_{t-12} + \varepsilon_t \quad (2)$$

where  $\Pi_{t-i}$  is month-on-month inflation at time  $t-i$ ,  $\rho_i$  is the coefficient representing persistence, and  $\varepsilon_t$  is a white noise disturbance.

Unlike most earlier works, the AR(12) estimations were performed together with the AR(1) as our analysis about the frequency of price adjustment has suggested that for a large portion of goods and services, it has taken more than 6 months before their prices are readjusted each time in the post-crisis period.

Firstly, the AR(1) and AR(12) estimations were performed without any break points. Secondly, as the recent literature points out that mean shifts are crucial for the persistent test, we allow for mean shifts in the estimation by introducing dummy variables for the mean.<sup>15</sup> In the case of Thailand, all of the aggregate and sectoral inflation undeniably have mean shifts during the crisis period.<sup>16</sup> Hence, we introduced the intercept

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<sup>15</sup> We also attempt to employ rolling regressions. Nonetheless, they provide the estimates that were highly unstable because of the drastic inflation movements during the crisis even when crisis dummies were introduced.

<sup>16</sup> Cecchetti and Debelle (2004) and Marques (2004) conduct Quandt's test to identify possible break points. However, in the case of Thailand, the break clearly occurs during the crisis for the sample periods in the study. Furthermore, Perron (1989) concludes that allowing for many shifts tend to underestimate the degree of persistence and Cecchetti and Debelle (2004) find that introducing more than one mean shift

dummy for the crisis period between July 1997 and December 1998 (where there is a spike of inflation) in the estimation equations to control for this unusual event. More importantly, to test for the difference in inflation mean between the pre-crisis and the post-crisis period, the intercept dummy representing the post-crisis period was included. The next set of estimations was performed to see if the persistence would be different once the dummy representing the mean shift was included.

Lastly, to additionally test if the degree of persistence changed in the crisis and post-crisis period compared with the pre-crisis period, the slope dummies for those two periods were introduced in the estimation equations to check whether the persistence would differ from the pre-crisis period.

With the no-break-point specification, the AR(1) results of inflation persistence tests shown in table (2.2.1) of the headline and all sectoral categories indicate low persistence in all categorized sectors except in the services sector. The degree of persistence in the service sector is as high as 0.58 whereas the others' are below 0.5.

Consistent with Cecchetti and Debelle (2004), the results when allowing for crisis intercept and post-crisis intercept dummies (representing mean shifts in those two periods from the pre-crisis period) show low persistence in all categories. The degrees of persistence of Headline CPI and sectoral CPIs are considerably lower than in the case with no break-point dummies. In addition, they were found to have either a rising mean during the crisis period or a lower mean in the post-crisis period. The means of inflation were discovered to increase during the crisis period in the durable, and tradable sectors. On the contrary, headline CPI, non-durable, goods, services, non-tradable, food, and non-foods had lower means in the post-crisis period. As for the case of the PPI, its means did not significantly change in any of the two subsequent periods. As a result, allowing for these two mean breaks alters the degree of producer price inflation persistence very marginally.

Once the dummies representing persistence shifts were also introduced together with the intercept dummies, no persistence was discovered in any sectors as none of the persistence coefficients were statistically significant at even the 90% confidence interval. The exception is the services sector where the low degree of persistence is significant at the above confidence interval. A clear evidence of mean shifts during the crisis was observed in only two sectors whereas that of the post-crisis periods could be found in four sectors. It

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does not significantly alter the degree of inflation persistence. Therefore, applying Quandt's test in this study to look for other break points will be unnecessary.

is important to note that no evidence has pointed out to the difference in inflation persistence between the pre-crisis and post-crisis period.

Further investigation using the AR(12) specification shows different results in the case of no break point as shown in Table 2.2.2. It demonstrates that headline, services as well as producer price inflation are highly persistent. However, once the intercept dummies are introduced, the degrees of persistence decline quite significantly if the mean shift either during crisis or post crisis is evident. Headline and sectoral inflation was found to be inpersistent with the negative signs of the degree of persistence in as many as 6 sectors. On the other hand, although inflation persistence of the PPI declines when the intercept dummies are introduced, it still appears to be highly persistent.

Furthermore, when the slope dummies are included in the estimations, inflation is still not found to be persistent in any categories except for the PPI. The mean of headline and some sectoral inflation declined with statistical significance in the post-crisis period. Nevertheless, in general the tests do not indicate that the degree of inflation persistence in the post-crisis period was different from the pre-crisis period.

In summary, firstly and most importantly, this study shows that, once allowing for break points, inflation is not persistent for the AR(1) as well as AR(12) specifications for the case of Thailand. Secondly, the downward mean shifts of inflation processes should come at no surprise for the economy has entered a low inflation environment during post-crisis. Thirdly, even though the previous section demonstrates that prices have adjusted less frequently in the post-crisis period, no clear evidence was observed that inflation has changed accordingly. Lastly, inflation persistence of the producer price, in contrast, appears to be relatively quite high for the AR(12) case, which implies that effects of shocks to the longer inflation process die down much slower for the producer price as compared to the consumer price.<sup>17</sup>

The analysis of price adjustment frequency in this part of the paper has demonstrated that consumer prices have adjusted less frequently for the post-crisis period across sectors. Moreover, the persistence tests have demonstrated that the response of consumer price inflation to shocks dissipates quite quickly through out the period of study. On the other hand, producer prices, which do not change over the two periods, have

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<sup>17</sup> This should be related to the nature of price stickiness of the PPI shown in the previous section. It takes more than 6 months for most of the prices in the PPI basket to be reset again.

displayed higher level of stickiness than consumer prices as well as slower adjustment of inflation in response to shocks.<sup>18</sup>

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<sup>18</sup> One likely explanation of the observed persistence of producer price inflation but in persistence of consumer price inflation is the lower menu cost for producers than for retailers. If both producers and retailers face the same common shocks in the economy, with the lower menu cost, the producers can adjust their prices in response to shocks more often.

**Table 2.2.1 Inflation Persistence Test for AR(1)**

	No Break Point Dummy	With Intercept Dummies			With Crisis and Post-crisis Dummies				
	Degree of Persistence ( $\beta$ )	Mean		Overall Degree of Persistence***	Mean		Persistence		
		During Crisis Period	Post-crisis compared to Pre-crisis		During Crisis Period	Post-crisis compared to Pre-crisis	Overall	During Crisis	Post-crisis compared to Pre-crisis
Headline CPI	0.39	Not change**	Decrease	0.20	Not change**	Decline**	0.08**	Increase**	Decrease**
Durable	0.2	Increase	Decrease**	0.12**	Increase	Not change**	0.09**	Decrease**	Increase**
Non-Durable	0.45	Increase**	Decrease	0.26	Increase**	Decline*	0.27**	Increase**	Decrease**
Goods	0.34	Increase**	Decrease	0.2	Decrease**	Decline*	0.39**	Increase**	Decrease**
Services	0.58	Increase**	Decrease	0.27	Not change**	Decline	0.27*	Not change**	Not change**
Traded	0.41	Increase	Decrease**	0.29	Increase**	Decline**	0.65**	Increase**	Increase**
Non-traded	0.26	Not change**	Decrease	0.08**	Not change**	Decline	0.00**	Decrease**	Decrease**
Food	0.35	Increase**	Decrease	0.23	Not change**	Decline	0.24**	Increase**	Not change**
Non-food	0.27	Not change**	Decrease	0.16	Decline	Decline	0.92**	Increase	Not change**
PPI	0.41	Increase**	Increase**	0.40	Increase**	Not change**	0.69**	Increase**	Not change**

\* Not significant at the 95 % confidence interval.

\*\* Not significant at the 90 % confidence interval.



**Table 2.2.2 Inflation Persistence Test for AR(12)**

	No Break Point Dummy	With Intercept Dummies			With Incept and Slope Dummies				
		Mean		Overall Degree of Persistence***	Mean		Persistence		
		During Crisis Period	Post-crisis compared to Pre-crisis		During Crisis Period	Post-crisis compared to Pre-crisis	Overall ***	During Crisis	Post-crisis compared to Pre-crisis
Headline CPI	0.85	Increase**	Decrease	-0.10	Increase**	Decrease	0.09	Decrease**	Increase*
Durable	0.15	Increase	Increase**	-0.25	Increase	Decrease**	0.02	Increase**	Not change
Non-Durable	0.50	Increase**	Decrease	-0.23	Increase**	Decrease*	-0.55	Increase**	Not change
Goods	0.44	Increase**	Decrease	-0.22	Increase**	Decrease*	-0.28	Increase**	Not change
Services	0.74	Not change**	Decrease	0.26	Decrease**	Increase	-0.36	Increase**	Not change
Traded	0.39	Increase	Decrease*	-0.31	Increase*	Decrease**	-0.38	Increase**	Not change
Non-traded	0.24	Increase*	Decrease*	-0.18	Increase**	Decrease**	-0.33	Increase**	Decrease
Food	0.29	Not change	Not change	0.27	Increase**	Decrease	0.26	Not change**	Not change*
Non-food	0.04	Increase	Decrease	-0.46	Not change**	Decrease	0.10	Increase	Increase
PPI	0.82	Increase	Increase**	0.68	Increase	Decrease**	0.56	Increase**	Increase

\* Not significant at the 95 % confidence interval.

\*\* Not significant at the 90 % confidence interval.

\*\*\* Sum of the  $\rho_t$ s, which are significant at the 90% confidence interval.

### **3. Conclusion and Policy Implications**

Using the formerly unexplored information available from sectoral price data, this paper has offered new methods to help demonstrate price pressures in the economy and has expanded the understandings on the changing process of price pressure in Thailand in particular on the speed of price and inflation adjustments.

The newly proposed alternative indicators, the Kalman's underlying price pressure indicator and the trends of CPI-PPI ratios, have demonstrated to be both beneficial to inflation forecasting. It is discovered that they provide important emerging signs of price pressure not captured by traditional indicators in the presently low inflation environment.

The new complimentary indicator is constructed to extract the common trend among all price series by assigning time-varying weights to each price to minimize the sum of idiosyncratic shocks in each period. It is found to be especially useful when prices of some sectors with high expenditure weights do not move in line with the common trend of the remaining sectors. However, its main drawback is the lack of transparency in communicating to the public as it involves econometric technicality. In this study, this indicator moves in line with headline and core inflation, and for the past few years, has lied between the two inflations, reflecting higher price pressure than that indicated by core inflation.

Furthermore, the study regarding relative CPI-PPI trends reveals that overall producer prices have risen more quickly than overall consumer prices for the past 5-6 years, implying that retailers have been adjusting their prices proportionally less than the price increase in their cost of products bought from producers. This reflects greater competition and increasing productivity in the retail business. However, it suggests that the upward risk of price pressure in the economy is likely to increase unless positive factors such as the increase in productivity or the elevated intensity of competition continues to outweigh the hidden rising pressure.

Other than the difference in magnitude of price increases, the study finds that producer and consumer prices are also different in terms of the frequency of adjustment. The investigation using price data in the CPI and PPI baskets shows that, in contrast to no change in frequency of producer price adjustments between the pre- and post-crisis periods, the overall and sectoral prices of consumer goods adjusted

less frequently in the post-crisis period. The changing frequencies of price adjustment vary from sector to sector as different sectors are affected differently by various environmental factors. For example, some prices in the sectors affected by exchange rate volatility such as the traded good sector have adjusted more frequently although the overall prices have been adjusted less frequently. Moreover, for those with infrequent price adjustments, once adjusted they tended to increase sharply pre-crisis.

More importantly, the findings from the econometric tests for inflation persistence showed that the overall and sectoral inflation are not persistent once dummies representing structural changes are introduced. Inpersistence of inflation found crucially implies that once affected by any one-time shock inflation tends to quickly return to the pre-shock period level. Hence, very active discretionary monetary policy is not needed for keeping on-going inflation within the target range. At the same time, increasing credibility of the inflation targeting monetary regime helps anchoring the inflation expectation to the target range. Hence, it helps quickening the adjustment process of inflation after shocks back to the expectation level. The two working forces, the low inflation persistence (the fast speed of inflation adjustment to shocks) and the increasing credibility of the inflation targeting monetary regime, therefore, have been mutually reinforcing each other.

Nevertheless, it should be noted here that the sample period used in the test partly covers the fixed exchange rate regime period where shocks to aggregate demand are largely absorbed by current account adjustments and, therefore, only partially affect inflation. In this regard, during the current up-turn of the economic cycle, monetary authorities should pay close attention to whether the discovered fast adjustment speed of inflation will still prevail going forward.

Further extensions of this study for a clearer big picture of the inflation process can be of many folds. Firstly, concerning the Kalman's inflation index, an improvement can be explored by including forward-looking inflation indicators such as asset prices in the development of a leading inflation trend. This will reduce gaps and delays of indicators in indicating price pressures, due to the exclusion of information about inflation trends embedded in excluded key components.

Secondly, to further explore the extent of the impacts of competition, productivity and new monetary policy regime of inflation targeting on price-setting

behaviors and the inflation process, a multivariate approach might help clarify their relative influences.

Thirdly, in order to obtain the appropriate policy response to a specific shock, it is necessary to distinguish shocks and understand their effects on inflation.<sup>19</sup> This task although difficult is certainly useful and therefore is worthwhile for further exploration. In addition, the nature of shocks should be explored and differentiated as their effects on the speed of inflation adjustment to shocks may differ, and therefore, have different policy implications.

Finally, how wage rigidity links to firms' price setting behavior and inflation process in Thailand is another subject worth a serious research effort. This is because wage rigidity is one of the major factors influencing the price adjustment process. Specifically relating to this study, further exploration on wage rigidity should help one understand the extent of its impact on the changing frequency of price adjustment in Thailand not covered here.

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<sup>19</sup> Our findings did not distinguish the differences of the speed of inflation to different kinds of shocks. Therefore, the implication on policy response is generalized for all kinds of shocks.

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