The inflation process and expectations in Singapore

Choy Keen Meng[1]

Abstract

This country note discusses measures of inflation used in monetary policy formulation in Singapore, and assesses the relative influence of global and regional factors in determining domestic inflation dynamics. It is found that the regional factor has grown in importance as a source of external inflationary pressures, although domestic cost pressures and inflation expectations have continued to play significant roles. Indeed, the central bank's gauge of inflation expectations extracted from survey data provides the best forecasts of near-term inflation outcomes.

Keywords: Inflation, factor analysis, Phillips curve, forecasting, Singapore

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[1] Executive Director, Economic Analysis Department, Monetary Authority of Singapore. I am grateful to Grace Lim, Jasmine Koh and Desmond Zheng for help in preparing this note.

1. Introduction

This country note addresses selective aspects of the inflation process and inflation expectations in Singapore – a small open economy that is also a major international financial centre. As such, factors related to increased global economic integration have continuously shaped domestic inflation dynamics and affected the formation of expectations. In addition, Singapore has maintained the same monetary regime for the last 35 years, based on an exchange rate-centred policy framework aimed at achieving price stability.[2] The note begins with a description of policy-relevant inflation measures in Singapore, followed by approaches to modelling inflation outcomes. It concludes by discussing a useful gauge of inflation expectations extracted from survey data.

2. Inflation measures

Although Singapore does not operate a formal inflation targeting regime, the Monetary Authority of Singapore (MAS) in its conduct of policy takes reference from two measures of inflation: the headline consumer price index (CPI-All Items inflation) and core inflation (MAS Core Inflation). In many countries, core inflation serves as a more reliable indicator of underlying price pressures in the economy, and is typically derived by excluding food and energy prices from the CPI. However, this would not be appropriate for Singapore given its heavy reliance on imported food and energy products, as well as the relative importance of these items in the consumption basket (with a collective weight of 27%).

Instead, MAS Core Inflation is derived from CPI-All Items inflation by excluding the costs of accommodation and private road transport, as these two components are highly volatile and significantly influenced by administrative policies.[3] The cost of private road transport is largely policy-driven, being jointly determined by the supply of, and demand for, new vehicle licences.[4] Similarly, government rebates such as those for Service & Conservancy Charges generate fluctuations in the cost of accommodation, depending on when they are disbursed.

A significant share of housing outlays in Singapore comprises imputed "owner-occupied accommodation" (OOA) cost, which is calculated based on the rental equivalence method, ie the expected rental the owner would have to pay if he or she

[2] For an exposition of the characteristics of, and rationale behind, Singapore's exchange rate-centred monetary policy framework, which incorporates key features of the basket, band and crawl system, refer to Khor et al (2007).

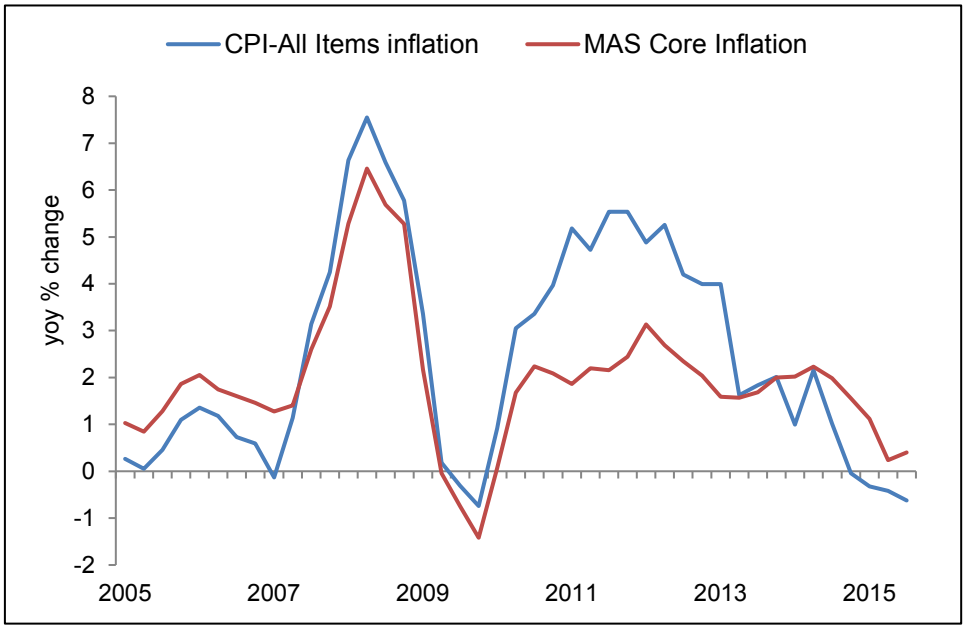
[3] There are other items in the CPI basket the prices of which can be considered as government-administered, for example public school fees and government levies on foreign domestic maids. However, as these account for a very small proportion of the basket, there is no need to exclude them.

[4] Singapore uses a quota system to regulate the supply of vehicle licences. Under this system, anyone purchasing a new vehicle must first obtain a Certificate of Entitlement (COE), which confers the ownership right for 10 years. The Land Transport Authority determines the number of COEs available based on a target growth rate of vehicles, while the market determines the prices of COEs in an open bidding process. Consequently, sharp fluctuations in COE premiums can lead to volatility in car prices.

were a tenant of the premises.[5] Due to the high home ownership rate, however, most households in Singapore do not actually incur rental expenditure and the corresponding fluctuations in imputed rentals should therefore not have any real impact on their cost of living. For this reason, the Department of Statistics compiles an alternative inflation indicator that excludes imputed rentals on OOA ("CPI-All Items inflation less imputed rentals on OOA").

As an exclusion-based measure, MAS Core Inflation abstracts from relative price movements that emanate from the housing and car markets. Therefore, it is meant to only capture generalised and more persistent price movements, making it less volatile than CPI-All Items inflation (Graph 1). For example, headline inflation rose to an average of 4.9% in 2011–12, largely on account of sharp increases in car and house prices amid scarce supply, before easing to 1.1% in 2013–15 following the policy of a modest and gradual appreciation of the Singapore dollar exchange rate, as well as measures to cool the vehicle and property markets. In comparison, MAS Core Inflation was relatively more stable, declining from 2.4% to 1.5% over these two periods as oil prices tumbled. Nevertheless, both measures of inflation track each other quite closely and tend to converge in the longer run.[6] Much as it does in many central banks around the world, the MAS Core Inflation measure plays a useful role in guiding the formulation of monetary policy in Singapore even as close attention is paid to the headline rate.

CPI-All Items and MAS Core Inflation, 2005–15 Graph 1



[5] Besides imputed rentals on OOA, actual rentals paid are included separately in CPI-All Items inflation. Monthly market rental data from tax returns are used as the pricing indicator for both types of rentals.

[6] See Ong et al (2011).

3. The inflation process

Over the last three decades, numerous efforts have been made at modelling the inflation process in Singapore by the MAS as well as academic economists. In the traditional approach, price formation is broken into two stages, whereby import prices are first determined by foreign prices and the exchange rate, incorporating the assumption of unitary pass-through elasticities given Singapore's price-taker status, and they in turn play a crucial role in determining consumer prices, in conjunction with domestic costs.[7] This intuitive procedure has been given formal expression in the so-called "Scandinavian model" of inflation and the closely related Balassa-Samuelson hypothesis. Functionally, the second step is effected by taking consumer prices to be a composite of the form $CPI = P_T^{\alpha} P_{NT}^{1-\alpha}$, where the subscripts denote the tradable and non-tradable sectors of the economy and α calibrates the relative importance of import prices in consumer price determination.[8] Essentially, studies in this mould find a substantial contribution from foreign prices, while the exchange rate acts as an efficacious filter for imported inflation.

The approach outlined above provides only a reduced-form explanation of the inflation process in Singapore. Nonetheless, a deeper understanding of the structural determinants of foreign and domestic sources of inflation can be obtained through the estimation of factor models and a New Keynesian Phillips curve, respectively, as discussed next.

3.1 Factor models

In recent years, empirical research on inflation dynamics has turned to the issue of the shifting balance between domestic and foreign drivers of inflation, with the latter believed to have assumed greater importance as a result of globalisation. Proponents of this view argue that the integration of China and the eastern European economies into international markets and supply chains, coupled with increasing cross-border spillovers resulting from more extensive trade and financial linkages, have imparted disinflationary impulses to the world economy.[9]

Factor models have proven to be useful for shedding light on this question. For example, Ciccarelli and Mojon (2010) extract a common factor from the inflation rates of 22 OECD countries and show that it contains sufficient explanatory power to outperform forecasts from standard inflation models. Some results in the same vein are reported here for Singapore, allowing for a further separation of external inflation influences into global and regional components. A principal component analysis is used to obtain the global common factor as in Ciccarelli and Mojon (2010), and the

[7] See Chew et al (2009) for an econometric analysis of the exchange rate pass-through that incorporates asymmetric transmission over the business cycle.

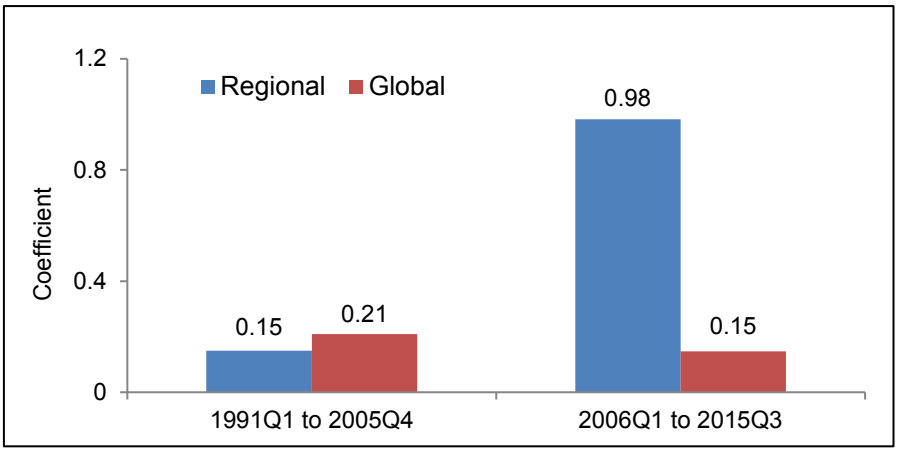
[8] Using import prices and unit labour cost as proxies for P_T and P_{NT} respectively, Low (1994) and Abeysinghe and Choy (2007) estimate α to be in the range of 0.45–0.7. The more recent work cited in footnote 7 puts the estimate of α at 0.42.

[9] See, for example, "The changing dynamics of inflation in EMEAP economies: the role of external shocks", background note for the 19th EMEAP Governors' Meeting, Bangkok, July 2014.

methodology is extended to 11 economies in Asia to derive a corresponding regional factor.[10]

When the global and regional factors are included in a regression equation for CPI-All Items inflation estimated over the period Q1 1991–Q3 2015, they are found to be jointly significant. Impact-wise, the global factor has a larger effect on CPI inflation. However, breaking the sample into earlier (Q1 1991–Q4 2005) and more recent (Q1 2006–Q3 2015) subperiods shows that the regional factor has grown in importance as a source of external inflationary pressures, with its estimated coefficient rising from 0.15 to 0.98 while that on the global factor declined (Graph 2). The proportion of domestic inflation variance accounted for by the foreign factors in the subsample regressions ranges from 54 to 74%, broadly in line with the reduced-form findings. The rising prominence of regional inflation drivers can be explained by several developments, including the greater synchronisation of business cycles within Asia, the prevalence of common commodity price shocks in the past decade, and the emergence of intraregional production networks.

Estimated coefficients on global and regional factors — Graph 2



3.2 New Keynesian Phillips curve

Alongside a larger role for global and regional factors in the determination of inflation at the national level, studies have found that the sensitivity of prices to domestic macroeconomic variables – in particular the output gap – has declined in many advanced economies. In noting this phenomenon of a "flattening" of the short-run Phillips curve since the 1980s, the BIS *84th Annual Report* attributed it to better anchored inflation expectations, the presence of global economic slack and swings in commodity prices driven by rising demand from emerging market economies.

[10] The Asian economies included are China, Chinese Taipei, Hong Kong SAR, India, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam (Japan and Korea are excluded as they are part of the OECD). The results are based on the first principal component, which by construction explains the largest proportion of variance in the data.

In Singapore's case, however, there is no evidence to suggest that the link between aggregate real activity and inflation has weakened. Indeed, MAS's research using a New Keynesian approach indicates that the empirical Phillips curve is alive and well. The theoretical model on which this conclusion rests is an open economy version of the formulation introduced by Galí and Gertler (1999), which augments the traditional specification with rational inflation expectations and replaces the output gap measure of slack with marginal cost.[11] In the open economy setting, marginal cost is decomposed into four terms: the relative wage (domestic wages relative to import prices, w_t), the terms-of-trade (domestic prices relative to import prices, tot_t), the labour share in GDP (s_t) and aggregate output (y_t). The additional relative wage and terms-of-trade variables are implied by a model of price-setting behaviour that allows firms to substitute intermediate imported inputs for labour in production.

Estimating the model over the sample period Q1 1994–Q1 2013 by employing the generalised method of moments (GMM) produces the following estimates (standard errors in parentheses):

$$\pi_t = \underset{(0.21)}{0.65}\, E_t \pi_{t+1} + \underset{(0.14)}{0.33}\, \pi_{t-1} + \underset{(0.06)}{0.18}\, s_t + \underset{(0.14)}{0.18}\, tot_t + \underset{(0.08)}{0.18}\, y_t - \underset{(0.11)}{0.18}\, w_t,$$

$$\bar{R}^2 = 0.91$$

where π_t is annual CPI-All Items inflation. The results show that both forward- and backward-looking inflation expectations have statistically discernible roles in driving Singapore's inflation outcomes. The size of the estimated coefficient on future inflation expectations is in line with the literature and is twice that for the lagged inflation term – a proxy for inflation inertia. Further, the relative wage and terms-of-trade coefficients possess the right signs and are economically meaningful, even though they are not statistically significant at the conventional levels.

4. Inflation expectations and forecasting

The relevance of inflation expectations in determining actual inflation leads naturally to the issue of how they can be measured, as well as their potential use in forecasting. In practice, inflation expectations can be backed out from the forecasts of professional economists, surveys of households or the information embedded in financial markets, such as the market for inflation-indexed debt.[12] Only the first two of these sources can be availed of in Singapore, and the discussion that follows will focus on the *MAS Survey of Professional Forecasters* (SPF) conducted by the central bank.[13]

[11] Under the assumption of a Cobb-Douglas or CES production technology, it can be shown that the marginal cost is proportional to the output gap.

[12] Information on longer-term inflation expectations can also be gleaned from MAS Core Inflation, which is a good predictor of trend inflation.

[13] An online survey of 400 random households jointly administered by Singapore Management University and MasterCard, called SInDEx, was started in September 2011. It polls consumers on their perceived values of economic variables, including inflation, over the next one to five years.

The SPF was launched in the fourth quarter of 1999, with the aim of establishing a consistent benchmark for private sector forecasts of key economic variables. Around the middle of every quarter, the views of close to 30 respondents are collated on a host of indicators, the most important of which are real GDP growth, CPI-All Items inflation and the unemployment rate. The survey questionnaires are only sent to participants after official economic data are released to the public, so that forecasters are equipped with the requisite information set when making their projections. The survey confines the rolling forecasting horizon to one quarter, although it also asks forecasters for their evolving views on current full-year and one-year-ahead outturns.

Previous analyses of the SPF results suggest that survey participants appear, on the whole, to be rational, as their predictions were generally unbiased and efficient with regard to incorporating the latest information.[14] Moreover, shifts in forecasters' expectations of inflation have a bearing on the actual outcomes, consistent with the New Keynesian findings and further hinting that the information content of the survey may be superior to other inflation forecasts.[15]

Accordingly, a simple forecast competition is carried out to compare the accuracy of the SPF vis-à-vis the structural models discussed above as well as statistical benchmarks.[16] Initial experimentation suggests that Phillips curve models based on a single measure of economic slack – either the unemployment rate or its deviation from a long-term trend as captured by the Hodrick-Prescott filter – predicted inflation better, and so the results for these specifications are reported instead. All comparisons are performed using a pseudo out-of-sample forecasting methodology; that is, the models are estimated with data dated prior to the projection period of Q4 2009–Q3 2015. The two measures used for judging forecast accuracy are the root mean square forecast error (RMSE) and the mean absolute error (MAE).

Forecast errors of inflation models

In percentage points — Table 1

	SPF	AR(2)	Random walk	Phillips curve (level)	Phillips curve (gap)	Global factor	Regional factor
RMSE	0.364	1.102	1.000	1.100	1.044	0.951	0.934
MAE	0.281	0.911	0.753	0.926	0.863	0.739	0.753

Table 1 reports the RMSE and MAE statistics for the out-of-sample forecasts generated from the alternative models. The SPF aside, there is little to choose between these, though the factor models come out quite well, followed by the random walk forecasts. Rather surprisingly, the autoregressive benchmark, known to produce accurate predictions in the short run, is beaten by all the models save for the

[14] See Special Feature A in MAS (2007).

[15] See Box A in MAS (2014).

[16] Only the one-quarter-ahead forecast horizon is considered here, as the year-ahead predictions are in the nature of a fixed event forecast, which leaves too few observations for a formal evaluation to be undertaken.

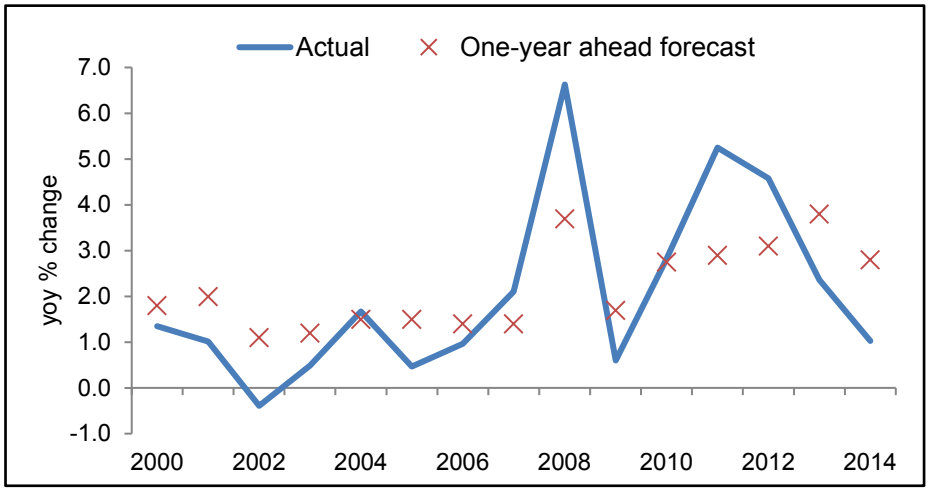
Phillips curve approach. The SPF clearly outperforms its rivals, with forecast errors that are about a third of the next best method.

To put this result in perspective, there is ample evidence that survey forecasts or market-based expectations are among the most accurate predictors of key macroeconomic variables in the short term, although they usually perform worse at long horizons (Giacomini (2015)). Some researchers have argued that survey participants do not necessarily possess deeper knowledge than a hypothetical econometrician of the dynamic forces driving the economy, but they are simply better at processing information in real time. More generally, the literature has shown that models which incorporate survey expectations can result in sizeable accuracy gains.

5. Implications for monetary policy

Two implications for monetary policy can be drawn from the foregoing short review of the inflation process and expectations in Singapore. First, the continuing importance of external factors in influencing inflation dynamics implies that policy should remain focused on managing a trade-weighted exchange rate basket. Indeed, the effectiveness of the exchange rate-centred framework in subduing inflation is demonstrated by the fact that domestic inflation has been relatively benign for the last 35 years, averaging 2% per annum from 1981 to 2015. Second, expectations of low inflation have also become more entrenched as a result of this good track record, as can be seen in the stability of the professional forecasts in Graph 3. This anchoring of expectations may explain why the short-term anticipations of survey respondents provide the best forecasts of near-term inflation outcomes.

Inflation expectations versus actual outcomes, 2000–14 Graph 3



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